



UK Earth Observation Conference 2026

15–17 September, University of Warwick

ABSTRACTS

Presentation Abstracts

TUESDAY 15 SEPTEMBER

11:15-12:15

- 0.04 Climate Change & Global Cycles - Fire
- 1.01 AI & Digital Infrastructure
- 1.04 Space Innovation & Future EO Capabilities (Beyond Earth)
- 1.06 Carbon, Biomass & Natural Capital
- 1.09 Sustainable Development, Social Impact & Policy

14:15-15:15

- 0.04 Climate Change & Global Cycles
- 1.01 Biodiversity, Habitat & Ecosystems
- 1.06 Carbon, Biomass & Natural Capital
- 1.09 Sustainable Development, Social Impact & Policy
Disaster prediction & response

WEDNESDAY 16 SEPTEMBER

13:00-14:30

- 0.04 Climate Change & Global Cycles
- 1.01 Biodiversity, Habitat & Ecosystems
- 1.06 Carbon, Biomass & Natural Capital
- 1.09 Oceans, Coasts and Marine Systems
Sustainable Development, Social Impact & Policy

THURSDAY 17 SEPTEMBER

10:30-12:10

- 0.04 Biodiversity, Habitat & Ecosystems
- 1.01 AI & Digital Infrastructure
- 1.04 Meteorology & Atmospheric Chemistry
- 1.09 Inland Waters & Hydrology

12:30-13:30

- 0.04 Climate Change & Global Cycles
- 1.01 AI & Digital Infrastructure
- 1.04 Meteorology & Atmospheric Chemistry
- 1.09 Oceans, Coasts & Marine Systems



Tuesday 11:15

**Climate Change &
Global Cycles – Fire**

Room 0.04

Adam Povey

University of Leicester

Variability of Wildfire Smoke During the 2025 Canadian Wildfires

0.04 Tuesday 11:15-11:25

Wildfire seasons in Canada are becoming more intense, with more fires and more area burnt in recent years than almost all previously recorded. While not as intense as 2024, the 2025 season is one of the most severe on record with over 160 fires causing the evacuation of 85,000 people and several states declaring states of emergency. As boreal forests warm, the pattern of fire causes and their subsequent spread are evolving, particular due to the increased prevalence of "zombie fires" reignited by previous year's smouldering. This makes timely and continuous monitoring more important than ever. EarthCARE provides the MSI to monitor the spatial extent of smoke plumes (and some ability to detect active fires) while ATLID detects the vertical profile of smoke with unrivalled discrimination of particulate type. The active sensor also has the advantage of being able to monitor aerosols at night. The release of independent ESA and JAXA Level 2 products from these sensors provides further distinct views of this growing threat. This presentation will introduce the breadth of the 2025 Canadian wildfire season and discuss the extent to which EarthCARE captured the aerosols released, contrasting the ESA and JAXA datasets. An opportunistic flight campaign captured advected smoke in early June 2025, providing a time series of smoke evolution captured by EarthCARE with in-situ comparison. The study currently focuses on the L2a products but may extend to synergistic ones if time permits.

Maria Paula Velásquez García

University of Leeds / NCEO

Tracking Formic Acid in 2024 aging South American synoptic biomass burning plumes using IASI Observations

0.04 Tuesday 11:25-11:35

Richard J. Pope, Steven T. Turnock,
Steve R. Arnold, David P. Moore,
Ailish M. Graham, Ruth M. Doherty,
Martyn P. Chipperfield

Formic acid (HCOOH) is a prevalent organic acid that influences rain acidity and aerosol chemistry and hygroscopic properties. Its atmospheric loading is poorly constrained, given that known sinks surpass sources. Particularly within wildfire-induced plumes, enhancements in HCOOH persist, indicating additional HCOOH than is directly emitted. Current literature consistently indicates that heterogeneous reactions possibly explain the missing HCOOH. Satellite observations are powerful tools for assessing global models, but their ability to characterize HCOOH in aging fire plumes remains underexplored. Here, we combined IASI satellite retrievals with forward trajectory to determine the atmospheric loading of HCOOH through the long-range transport of South American synoptic fire plumes during the regional extreme fire season of 2024. The plumes evolution was characterised using forward trajectories and the total column HCOOH/CO ratio from IASI. We also examine how factors like humidity, aerosols, and isoprene impact HCOOH formation/loss. Overall, our results show HCOOH enhancement remains stable for three days, then declines by 8.7% until day seven, after which levels stabilize. When considering only continent plumes, HCOOH enhancement decays at a lower rate (-5.8%). Over the continent, HCOOH and aerosol enhancements show a strong correlation ($r \sim 0.7$), which might be explained by the reported contribution of aerosol oxidation to HCOOH formation. Using the UKCA box model, we assessed HCOOH production and loss terms, and plan sensitivity experiments to quantify the aerosol and humidity effects on HCOOH. Therefore, our findings highlight the value of fusing satellite-based multi-data approaches and process modelling to analyse biomass-burning plume chemistry.

fire, HCOOH, oxidation

David Moore

University of Leicester / NCEO

Hydrological drivers of hydrogen cyanide wildfire emissions from Indonesian peat fires during the 2015, 2019, and 2023 El Niño events

0.04 Tuesday 11:35-11:45

Antonio G. Bruno, Jeremy J. Harrison,
Ailish Graham, Martyn P. Chipperfield,
Corinne Vigouroux

Indonesian peatlands store vast amounts of carbon that are highly vulnerable to fire during El Niño-driven droughts. When ignited, peat releases large quantities of greenhouse gases and other species with significant environmental impacts, including hydrogen cyanide (HCN), a sensitive tracer of smouldering combustion. In this work, we use new satellite retrievals from the Infrared Atmospheric Sounding Interferometer (IASI) spectra using the University of Leicester IASI retrieval scheme (ULIRS), that we validate against ground-based FTIR measurements at Reunion Maïdo, TOMCAT atmospheric model simulations, hydrological information, and fire activity observations to evaluate the factors driving trace gas emissions during the 2015, 2019, and 2023 El Niño events. The 2015 El Niño produced large burdens of HCN and carbon monoxide (CO), unprecedented in the satellite observational era and driven by exceptionally low soil moisture, depressed groundwater levels, and deep burn depths. In contrast, the 2019 and 2023 events exhibited markedly weaker emissions despite similar Oceanic Niño Index (ONI) anomalies, reflecting more favourable hydrological conditions. Comparisons of the satellite trace gas observations with simulations of the TOMCAT model show that burned-area-based inventories such as the Global Fire Emissions Database (GFED) version 4 substantially overestimate emissions from peat fires in 2015, while a new peat-specific database, FINNpeatSM (Fire Inventory from NCAR (FINNv1.5) New peat with Soil Moisture), better represents fire season timing and burn depth by incorporating soil moisture constraints. From satellite-derived HCN:CO enhancement ratios, we provide new emission factors for HCN that offer benchmarks for new emission inventories. Our results show that peat fire intensity and emissions are driven not only by El Niño strength but also by local hydrological conditions such as soil water content and precipitation. Integrating hydrological indicators with satellite observations of atmospheric composition is therefore critical for improving fire emission inventories.

hydrogen cyanide (HCN), peatland hydrology, EL Niño

Ben Bradley

University of Leeds

Top-down carbon monoxide emissions reveal the role of global climate indices in shaping extreme fire in South America

0.04 Tuesday 11:45-11:55

Chris Wilson, Martyn Chipperfield,
Carly Reddington, Ailish Graham,
Fiona O'Connor

South America (SA) has suffered a multitude of extreme, drought-induced fires in recent years. Fire carbon emissions across SA during 2024 were more than 80% above average, threatening to push biomes past existential climate tipping points. Carbon monoxide (CO) is a major trace gas released from fires. Its emissions can be used to isolate wildfire contributions to ecosystem carbon budgets and investigate links between fire and climate. Despite this, there remains considerable disagreement between current fire inventory products, with annual CO emissions in SA regularly disagreeing by factors of 50% or more. Total column CO satellite observations, combined with inverse modelling techniques, provide a direct, top-down method to constrain emissions. Here, we perform 4D-Var atmospheric inversions for 2019—2024, using the inverse chemical transport model INVICAT. Satellite observations from the TROPospheric Monitoring Instrument (TROPOMI), onboard Sentinel-5P, are assimilated to constrain CO fire emissions. We additionally perform a suite of sensitivity tests on the 2024 model setup, which quantify the uncertainty of our inversion method. We then attribute total carbon emissions from fire across SA by prescribing emission ratios. Finally, we create a multilinear regression model to predict CO anomalies by correlating the inversion results to key global climate indices. During extreme fire events, our results show increases in CO fire emissions, for example by 4.3 Tg CO (+7.9%) over the Amazon basin and 2.7 Tg CO (+21%) over non-Amazonian Brazil during the 2020 Pantanal wetland wildfires. These results provide a crucial, observationally-constrained assessment of emissions across a fire-vulnerable continent.

wildfires, data assimilation, carbon

The background of the slide is a dark blue gradient. On the left side, there is a large, abstract graphic consisting of numerous thin, glowing blue lines that crisscross the space. Overlaid on these lines are several bright, white, particle-like trails that appear to be moving or flowing, creating a sense of dynamic energy and digital connectivity.

Tuesday 11:15

AI & Digital Infrastructure

Room 1.01

Alison Hopkin

CGI UK

When Truth Hurts - Criticality of Data Integrity

1.01 Tuesday 11:15-11:25

Jonathan Shears

As Earth Observation becomes increasingly AI-enabled, cloud-hosted and operationally embedded in critical decision-making, trust in the data supply chain is becoming as important as the imagery itself. This presentation explores how data integrity, provenance and authenticity can strengthen the digital infrastructure needed to advance scalable EO analysis and end-to-end workflows. Drawing on CGI's work on the TRUTHS mission, it examines how EO products can be made scientifically trustworthy across complex value chains, from sensor collection and onboard processing through ground dissemination, data processing, cloud storage, value-added analytics and final interpretation. The challenge is timely: AI and machine learning now depend on representative training datasets, while synthetic imagery, generative models and advanced manipulation techniques make it harder to assume that "the camera never lies." This creates both opportunity and risk for EO, where climate, environmental and policy decisions depend on reliable, traceable evidence. The proposed response is a robust authenticity framework for EO data platforms: STAC-based lineage, workflow versioning, environment pinning, cryptographic manifests, metadata checksums, schema validation, per-chunk hashing for cloud-optimised Zarr and subset delivery, digitally signed sidecars, trusted timestamps and long-lived mission trust services. Together, these capabilities enable users to verify not only what data they have retrieved, but where it came from, how it was generated, whether it has been altered, and whether results are reproducible. By embedding trust into digital EO infrastructure, the approach supports confident AI-driven exploitation, scalable cloud workflows and authoritative climate and environmental intelligence.

Loïc Houpert

Development Seed

Visualising Zarr-encoded Sentinel data in the browser with the EOPF Explorer

1.01 Tuesday 11:25-11:35

Loïc Houpert, Emmanuel Mathot,
Stephan Meißl, Ahmed Behairi,
Jonas Sølvsteen, Davis Bennett, Lubomír
Doležal, Max Jones, Silvester Pari,
Josef Prenner, Vincent Sarago, Ciaran Sweet

Earth Observation analysis usually begins by downloading entire Sentinel scenes locally, which does not scale and excludes users without dedicated infrastructure. ESA's Earth Observation Processor Framework (EOPF) now reprocesses Sentinel-1 and Sentinel-2 into Zarr, a cloud-native format designed for partial, remote reads. This created a new problem: tooling for browsing satellite imagery assumes GeoTIFF, leaving no straightforward way to explore Zarr-encoded Sentinel data in a browser. The EOPF Sentinel Zarr Explorer addresses this. Users discover Sentinel products through a STAC catalogue, stream only the parts of an array they are viewing, and screen scenes by changing band combinations and applying custom arithmetic. Sentinel-2 optical and Sentinel-1 radar imagery are tiled dynamically with adjustable contrast, and time series can be extracted through an OpenEO-compatible interface. None of this requires downloading a scene or installing specialised software. We will describe the engineering behind it: the GeoZarr and Web-Optimised Zarr conventions that make chunked arrays streamable in a browser, dynamic tiling with titiler, and STAC as the discovery layer. The Explorer is built from the same open-source components that run Microsoft Planetary Computer and NASA VEDA, making it the third operational instance of one approach rather than a one-off system. This open, standards-based foundation gives interoperability, reach beyond the EO community, and freedom from vendor lock-in. Because access goes through standard interfaces such as STAC and OpenEO, the platform is also ready for AI-driven use. For teams building national EO infrastructure, we offer concrete lessons on making multi-source platforms scalable and sustainable.

Sentinel, GeoZarr, web-optimised Zarr

Gemma Newbold

NCEO

Earth Observation Data Hub (EODH) is live

1.01 Tuesday 11:35-11:45

Dan Ormsby

The Earth Observation Data Hub (EODH) is live. The platform offers a broad Earth Observation (EO) data catalogue and processing capabilities. It provides a single-point of access to quality-assured commercial and open EO datasets. To bridge the gap between complex remote sensing data and diverse end-user needs, this platform introduces a tiered architecture that scales with user capability. It has a non-technical interface, facilitating EO data discovery for users that are new to EO data. It simplifies collective access, licensing and sharing of difficult-to-acquire EO data for teams and multi-organisation projects. The EODH supports all users across industry, public sector, and research to access datasets and processing via interfaces and integrations suitable for GIS analysts, data scientists and EO developers. The platform has enabled SMEs to migrate scripts and integrate their own datasets. It has provided a centralised platform for discovering and working with EO datasets, generating use cases, and moving to cloud-native processing for industry and public sector, while avoiding redundant data download and storage. For research, it provides a sandbox to test operational workflows. In this session you will learn how to access Analysis Ready Datasets (ARD) via the catalogue, plugins, and APIs; visualise imagery; launch your analysis; scale your processing; and assess fitness-for-purpose of EO datasets. We welcome innovative projects and proof-of-concepts to onboard, utilise, and demonstrate the capability of the platform. The EODH team will provide technical guidance and support, and the opportunity to share your work within the wider EO community.

**data access, cloud computing,
analysis ready data (ARD)**

Dan Clewley

**Plymouth Marine Laboratory /
NEODAAS**

**Living Wales - Improving the
Usability of EO Data for
Government**

1.01 Tuesday 11:45-11:55

Emmanuel Nwokocha, Ben Calton,
Oscar Hountondji, Hywel Williams,
Richard Lucas

Earth Observation (EO) data and derived products, such as land cover and habitat maps, play a key role in supporting policies in Wales such as the 30x30 target, which aims to be protecting and effectively managing at least 30% of land freshwater and sea for nature by 2030. As part of the Living Wales project, digital infrastructure has been built that provides easy access to large volumes of analysis ready data from satellites as well as derived products through Open Data Cube. A Jupyter Notebook interface allow access to data compute through a web browser. Example notebooks have been developed to demonstrate applications such as extracting habitat information, producing change maps and deriving new products such as flood maps. The use of Open Data Cube and Jupyter Notebooks solves many technical problems. However, the use of these tools is limited to those able to code with Python, restricting the use of EO data within government. Following engagement with users, we have developed easier ways of accessing these data utilising a) the 'Insights Tool', a simplified web front end that allows specific operations to be performed using a series of drop downs and b) the 'Living Wales Chatbot' a large-language model interface that provides a way to access EO data using natural language. The work highlights the importance of working with users to develop easier ways to access EO data and products to ensure they can be used to support policy.

datacube, government, enduser

Victoria Foing

GHGSat

Plume Origin Localisation with Computer Vision

1.01 Tuesday 11.55-12:05

Jake Wilson, Simon Andersson-Bastable,
Amanda Delgado-Recke, Jack Hayden,
Dylan Jervis, Krishna Moorooogen

Satellite remote sensing has become a critical tool for monitoring, measuring, and mitigating methane emissions globally. Reliable attribution of methane plumes to their source facility is needed to enable emission mitigation action, robust emissions accounting, and regulatory oversight. Although experts can manually attribute plumes to individual facilities, automated approaches are required for consistency, scalability, and transparency. Here, we provide a methodology to automatically estimate the source location of a plume as a spatial probability. Plume origin estimation is an essential component of attributing plumes to their source facility. We train a neural network to estimate a confidence region for the location of the plume source. The model achieves good accuracy, with 65.1% predicted origin points falling within 100m (4 pixels) of an expert-annotated point, and a median distance error of 64.2m (~3 pixels). We demonstrate that the predicted origin probability is well-calibrated by comparing the percentage of expert origins which fall into different confidence region bins. We apply this methodology to methane plumes in GHGSat satellite imagery, but the framework could be adapted to other sensors and types of plumes.

methane, AI, remote sensing



Tuesday 11:15

**Space Innovation & Future EO
Capabilities (Beyond Earth)**

Room 1.04

Sahar Ebrahimi

University of Isfahan

Quad-pol Data Reconstruction from Compact-pol Data Using Deep Learning Methods

1.04 Tuesday 11:15-11:25

Vahid Akbari, Armando Marino,
Mina Moradizadeh, Iman Khosravi

Quad-pol (QP) SAR systems acquire comprehensive polarimetric information by transmitting two and receiving four polarizations. However, they require higher pulse repetition rates (PRF) and more complex hardware, resulting in reduced swath width. Compact-pol (CP) systems, a specialized dual-pol mode, offer wider coverage with lower PRF requirements and have proven effective for land cover mapping, crop classification, soil moisture estimation, vegetation characterization, and ship detection. Two main approaches exist for utilizing CP SAR data: extracting polarimetric features through decompositions, and reconstructing the 3×3 QP covariance matrix from the 2×2 CP covariance matrix. This work focuses on the latter approach, enabling application of QP processing techniques to reconstructed data. Most reconstruction methods rely on Souyris' reflection symmetry assumption to relate CP and QP matrix elements, iteratively determining cross-polarization intensity. However, this assumption is valid primarily for volume-dominated scatterers and often fails for other scattering mechanisms. We propose a deep learning method that reconstructs QP data from CP data without assuming reflection symmetry. The network uses real and imaginary components of the complex covariance matrix to directly map CP to QP data. The model was trained and evaluated on multiple PolSAR datasets to demonstrate performance across diverse scenarios. Performance was assessed using Hotelling Lawley Trace (HLT), alongside Mean Square Error (MSE), Mean Absolute Error (MAE), and Coherence Index (COI) for quantitative analysis. Results were compared against Souyris' and Nord's classical reconstruction methods.

quad-pol, compact-pol, UNet

Ben Courtier

University of Leicester

The Land Surface Temperature Retrieval Algorithm for LSTM: An Overview and Results

1.04 Tuesday 11:25-11:35

Mike Perry, Darren Ghent

Wide scale observations of Land Surface Temperature (LST) are vital to improve our understanding of climate change, aid in the best use of agricultural land and has can help advise on the health implications of excessive heat. The Land Surface Temperature Monitoring (LSTM) mission will produce high resolution, highly accurate LST data. Here an overview of the operational retrieval algorithm for the LSTM mission is presented together with results from a test case. The LSTM retrieval algorithm is based on an Optimal Estimation (OE) framework. This framework retrieves the LST, the Land Surface Emissivity (LSE) and the absorption due to the atmospheric column (all gases absorptions are retrieved in a single catch all term); each of these variables are retrieved with an uncertainty term. The method propagates initial best estimates of the state vector (LST, LSE and the atmospheric column) to the observation space (i.e. Top of Atmosphere (ToA) radiances). Novelty, this algorithm is constructed over the tie-point grid (i.e. the grid that the atmosphere is specified on), rather than the usual observation grid. This allows a faster calculation of the jacobian matrix at each observation pixel and therefore faster retrieval of the optimal solution. The results of the Optimal Estimation are shown in a test scenarios: a scene generated using airborne observations of agricultural land in Grossetto, Italy. The real-world observations of the Grossetto scene allow for the direct comparison between the OE retrieval and measurements of ground truth over a number of different surface types.

LST, optimal estimation, LSTM

Niklas Duerr

know.space

The Value of the UK Earth Observation Industry

1.04 Tuesday 11:35-11:45

Alyssa Frayling, Greg Sadlier

Earth Observation (EO) is increasingly recognised as a strategic technology underpinning economic growth, environmental sustainability, national security, and scientific discovery. Conventional economic assessments typically attribute value to individual organisations or industrial segments, overlooking the interdependencies through which much of the sector's value is created. This paper suggests a novel framework for assessing value creation across the UK Earth Observation industry, developed as part of an independent study commissioned by the UK Space Agency. The analysis combines a conventional economic footprint assessment with an innovative application of Shapley value allocation to quantify how value is co-created across the Upstream, Midstream, Downstream and Ancillary Services segments of the UK EO value chain. While the sector generated £372 million in Gross Value Added (GVA) in 2023/24, the analysis demonstrates that this value is fundamentally collaborative. In isolation, the individual segments would generate only £158 million in cumulative GVA, implying that interaction across the value chain increases total industrial value by a factor of 2.4. Beyond measuring the industry's direct economic contribution, the study explores the wider societal benefits of EO through a series of end-user case studies spanning infrastructure, agriculture, healthcare, finance, climate resilience, and public services. Together, the findings highlight the importance of evaluating innovation ecosystems as interconnected networks rather than collections of independent firms. The study concludes by identifying four high-value global market opportunities where the UK is well placed to capitalise on its existing capabilities, spanning AI-enabled EO, carbon markets, satellite technologies, and climate risk services.

UK EO industry, Shapley value allocation, high-value global market opportunities

Joshua Vande Hey

University of Leicester

**A novel compact polarimeter for
airborne and ground-based
observations of atmospheric
aerosols**

1.04 Tuesday 11:45-11:55

Laura Horton, David Spilling, Harjinder
Sembhi, Adam Povey, Anna Gialitaki

Here we present the most recent updates in the development of the Compact Multi-Angle Polarimeter C-MAP, recently funded through CEOI as an adaptation of the CO2M MAP, for airborne and ground-based observations of aerosols. C-MAP aims to provide improved information on aerosol optical and microphysical properties as a standalone airborne or ground based instrument, as a validation for space borne polarimeters, and as a demonstrator for highly compact space deployments. In this talk, we present first observations and analysis from a 2024 flight over Manchester and surroundings and 2026 ground-based observations from Leicester, in comparison to ground based reference instruments. We evaluate instrument performance against specifications and sensitivity studies. We outline future development plans for compact polarimeters and highlight opportunities for synergistic applications with other airborne, ground based and space borne observations to improve understanding of aerosols and their impacts on air quality and climate.

aerosols, polarimetry, air pollution,

Charlie McKeown

isardSAT

Bringing Fully-Focused SAR Altimetry to the Cryosphere: Pre-Launch Validation of the CRISTAL Processor

1.04 Tuesday 11.55-12:05

Albert Garcia-Mondejar, Gorka Moyano
Stephanie Urien, Aida Ferro, Michel
Guerra (isardSAT); Alessio Izzo (Aresys);
Michele Scagliola (ESA - ESRIN);
Paolo Cipollini (ESA - ESTEC)

The Copernicus Polar Ice and Snow Topography Altimeter (CRISTAL) is an important upcoming ESA altimetry mission, planned for launch in 2027, that will build on the heritage of CryoSat-2 to continue the long-term monitoring of the cryosphere. CRISTAL's primary objectives are the measurement of sea ice thickness, snow depth over sea ice, and ice sheet elevation. Carrying a dual Ku/Ka-band interferometric altimeter and able to operate in both Closed-Burst and Open-Burst measurement modes, CRISTAL will be the first altimeter to combine cross-track interferometry with Open-Burst acquisition. ISARDSAT have been developing and validating the expected end-to-end performance under the CRISTAL System and Instrument Retrieval Simulator (SIRS) project. The SIRS project consists of the System and Instrument Simulator (SIS), generating various realistic test scenarios of point targets, land ice, sea ice, open ocean and inland waters; the Ground Processor Prototype (GPP), which processes the Level-0 ISPs from the SIS through to Level 2 geophysical retrievals; and the Performance Assessment Tool (PAT), evaluating the retrievals performance against the mission requirements. In this presentation, I will focus on CRISTAL's performance over sea ice and land ice scenarios. CRISTAL will be the first cryosphere-focused altimeter to acquire in Open-Burst mode, with Sentinel-6 being the only other operational European altimeter to do so, over the ocean. Open-Burst mode offers the benefit of operational Fully-Focused SAR altimetry, improving the along-track resolution compared with conventional unfocused Delay-Doppler processing, so CRISTAL's ability to apply it operationally over the cryosphere represents a significant step forward for cryosphere altimetry.



Tuesday 11:15

**Carbon, Biomass &
Natural Capital**

Room 1.06

Nathan Thomas

Edge Hill University

Mangrove forest extent is increasing. Is forest biomass following the same trend?

1.06 Tuesday 11:15–11:25

Pete Bunting, Maurizio Santoro,
Atticus Stovall, Charlotte Waite,
Lammert Hilarides, Lola Fatoyinbo,
Marc Simard, Tom Worthington

Mangrove forest extent is increasing globally, matching historical rates of human driven loss and exceeding any losses since 2010. While viewed as a positive step for mangrove preservation, this does not reflect the potential discrepancy in biomass between the loss of mature primary forest and gain in juvenile small-stature growth. We use 15 years of CCI Biomass, Global Mangrove Watch and Mangrove Typology data to calculate trends in mangrove forest biomass across the major mangrove typologies. Time-series CCI biomass data is calibrated with TanDEM-X derived 12m biomass estimates, revealing discrepancies between regional and typological trends in forest extent and biomass. Our findings demonstrate that new gains in mangrove forests extent cannot be interpreted as a like-for-like replacement of mature forest, with implications for ecosystem services and forest function. This work informs policy making around prioritisation of mangrove conservation and has important implications for blue carbon markets.

biomass, mangroves, blue carbon

Nikolaos Galiatsatos

RSPSoc

Robust Accuracy Assessment for national carbon finance in Guyana using an independent probability-based approach to estimate forest loss and gain

1.06 Tuesday 11:25-11:35

Daniel N.M. Donoghue

This presentation evaluates the 15-year evolution of Guyana's national Monitoring, Reporting, and Verification System (MRVS) under the REDD+ framework. In high-forest, low-deforestation (HFLD) regions like Guyana, deforestation events often occur as highly localized, small-scale disturbances (<1 hectare) underneath a persistent cloud cover. Global Earth observation products struggle to capture these events accurately in space and time and so the use of global products for estimating forest loss and gain can result in substantial bias and/or large standard errors. Here we show how a statistically robust framework can be developed independently of global products to validate the accuracy and precision of countrywide forest cover and forest degradation mapping. Tracking a 15-year continuous time series, the methodology illustrates a progressive transition from a model-assisted sampling framework to an independent, probability-based, two-stage stratified random change sample design. Built on a data-agnostic platform, the system maximizes satellite interoperability by integrating diverse Earth observation data (Landsat, RapidEye, Sentinel-2, and PlanetScope). These wall-to-wall mapping products are independently verified across expanding primary and secondary sampling units against very-high-resolution (25–60 cm) multispectral imagery, which evolved from airborne GeoVantage systems to Maxar and SkySat satellite acquisitions. Developing these rigorous, independent national frameworks is what shifts remote sensing from a purely academic exercise into a practical policy implementation tool. Validated measurements with low levels of uncertainty (low variance attached to change estimates) provide the level of statistical confidence required to activate performance-based international climate finance under national jurisdictional partnerships like the Guyana-Norway REDD+ agreement and the ART TREES framework. As of July 2026, only Guyana and Costa Rica have been awarded verified ART TREES carbon credits. Guyana is also the first country to issue credits for both voluntary carbon markets and the Carbon Offsetting and Reduction Scheme for International Aviation.

Mathias Disney

University College London / NCEO

New measurements to assess forest carbon credit schemes: integrating terrestrial lidar into forest carbon measurements at scale

1.06 Tuesday 11:35-11:45

Cecilia Chavana-Bryant, Wanxin Yang,
Joanne Nightingale, Matthew Scholes,
Leon Debell

The ESA-funded EU-FOCIS (EU Forest Observations for Carbon market Integrity using Sentinels) project is aimed at improving the integration of EO, ground-based data and inventory measurements to address the challenge of measuring the efficacy of carbon credit programmes in European forests, including the UK. In the UK, woodland creation is an important part of the government's plans for net zero, as well as delivering many other important benefits including biodiversity. Significant challenges remain as to how to monitor and verify these projects in transparent and traceable ways. We focus on an example application to the UK's Woodland Carbon Code (WCC), which administers the UK government's issuance of credits for woodland creation, according to a number of established protocols. The WCC currently has more than 900 projects with projected sequestration potential of 5.6 M tCO₂e. We present results of a pilot study using terrestrial lidar scanning (TLS) as a proxy for harvest measurements of forest carbon and as input to the WCC assessment protocol. We have developed an automated pipeline to convert TLS data into estimates of tree size and shape (height, trunk diameter and crown size) that are consistent with the WCC inputs and can also be used for biodiversity assessments. We show how TLS provides a significant improvement in the ability to deliver carbon assessments for WCC projects, can underpin EO-derived estimates, and may also be used to assess biodiversity-related metrics related to tree size and growth.

Ben Cutting

University of Surrey

Determination of Soil Organic Carbon via Hapke-Based Spectral Unmixing

1.06 Tuesday 11:45-11:55

Clement Atzberger, Belen Marti-Cardona

Determination of soil organic carbon (SOC) from optical remote sensing remains challenging due to complex interactions between soil composition and measured reflectance (Lehmann et al., 2020). While empirical and machine learning approaches have shown strong predictive performance, they typically require extensive calibration datasets and often lack transferability across soil types and environmental conditions. Physically based radiative transfer models provide an alternative by modelling soil reflectance spectra (Ben-Dor et al., 2009). Hapke's bidirectional reflectance theory underpins several soil reflectance models, including the SOILSPECT model, enabling retrieval of the single scattering albedo (SSA) from reflectance measurements (Hapke, 2012; Ding et al., 2022). This study develops a Hapke-based spectral unmixing framework for SOC estimation from hyperspectral bidirectional reflectance data. Soil is modelled as an intimate mixture of an SOC component and a background matrix, linking SSA directly to SOC abundance. The Hapke formulation is extended to account for SOC as both discrete particles and coatings on mineral grains. SOILSPECT inversion retrieves SSA for parent and background soils, after which the mixture model is calibrated to estimate SOC content. Results show clear SSA separation between parent and background soils, particularly in the near-infrared region. The model achieves SOC retrieval with an RMSE of 0.37% SOC and an R^2 of 0.56 using a physically constrained framework. These findings demonstrate that extending Hapke's intimate mixture theory enables physically interpretable SOC retrieval from hyperspectral data, with future work focusing on stability of the retrieved SOC optical properties over a broader range of soil types and conditions.

soil organic carbon, hyperspectral remote sensing, radiative transfer modelling



Tuesday 11:15

**Sustainable Development,
Social Impact & Policy**

Room 1.09

Erwan Rivault

BBC News

From Pixels to Stories: Using Satellite Data in a Newsroom

1.09 Tuesday 11:15-11:25

Earth Observation data has become an increasingly important tool in journalism, helping reporters verify claims, investigate events, and provide visual evidence from places that are difficult or impossible to access. This presentation explores how Earth Observation data is used within BBC News to support investigations, fact-checking, and storytelling. Using examples from conflict reporting, climate change coverage, and humanitarian crises, the presentation will show how satellite imagery and open-source techniques can reveal changes on the ground, verify online content, and add context to breaking news. It will also discuss the challenges of interpreting and communicating satellite data in a fast-paced newsroom, and how geospatial analysis is becoming an essential part of modern journalism.

Philip Eales

Planetary Visions Limited

Visualising EO Data for Non-Specialists

1.09 Tuesday 11:25-11:35

Andrew Wayne, David Jacobs, Freya Muir,
Sophie Hebden, Paul Fisher

As Earth observation technology has matured and applications proliferated, there has been an increasing need to communicate results and techniques to a range of audiences outside the “EO industry”. Creative data visualisation can be a powerful tool to help clearly and authentically present to the public, policymakers and target users the latest EO-derived science, data products, mapping tools and future capabilities. The lead authors have more than 20 years’ experience, working with print and digital publishers, museums, broadcasters, universities and research institutes, visualising a variety of Earth science data for non-expert audiences. We have found power in combining data visualisation with computer graphics, extremely high visual quality, and storytelling. We will demonstrate this approach with animated data visualisations developed from satellite observations for the European Space Agency. Even when following best practice for scientific data visualisation, unfamiliar data presented in isolation can appear abstract and distant. By presenting data in context and leveraging what the audience already knows about the world, we aim to increase viewer engagement. Satellite observations are supplemented by computer graphic representations of microscopic processes, such as aerosols seeding cloud formation, and of concepts and scale comparisons, such as the volume of ice lost each year. Background information shows how the data are relevant to daily life and newsworthy events, and to the challenges facing society due to climate change. These visualisations have been used on ESA’s website and social media channels, at conferences such as UN-COP, EGU and AGU, in the press, and by broadcasters.

**data visualisation, earth science,
climate change**

Kamran Ahmad

University of Punjab

Earth Observation-Based Assessment of Youth Psychosocial Vulnerability in Infrastructure-Induced Resettlement: The Diamer- Bhasha Dam, Pakistan

1.09 Tuesday 11:35-1:45

Dr Amer Masood Chishti (Assistant Professor,
University of Punjab), Rabia Bashir (MPhil
Student, University of Punjab), Rana
Muhammad Sohail (GIS Specialist, PULSE
Project)

Despite the importance of large-scale infrastructure projects for economic development, energy security, and Climate resilience and its social implications, including the psychosocial aspects of displacement, remain largely absent from planning and policy agendas. This study aims to develop a framework for Earth Observation (EO)-based geospatial analysis to evaluate the psychosocial vulnerability of young people in the Diamer-Bhasha Dam (DBD) resettlement in Gilgit-Baltistan, Pakistan. The research combines Sentinel-2 and Landsat imagery with Digital Elevation Models (DEM), population census data, and official resettlement records to explore connections between environmental changes, settlement processes, access to services, and psychosocial vulnerabilities. This methodology involves land use/land cover (LULC) change detection, mapping of settlement expansion, accessibility modelling, hotspot analysis, and construction of a Psychosocial Stress Index (PSI) based on secondary indicators like educational disruption, livelihood insecurity, social integration, housing stability, and access to support services. EO measurements of agricultural land loss, landscape fragmentation, and settlement transformation are combined with socio-economic data to understand spatial patterns of vulnerability and resilience. The results show that moderate-to-high psychosocial vulnerability is clustered in newly established resettlement areas, where land use is changing rapidly, access to educational and healthcare facilities is limited, and community networks are weak. The hotspots of vulnerability are mostly related to the environmental and livelihood transition zones. The geospatial vulnerability maps serve as an evidence-based decision support tool for targeted Mental Health and Psychosocial Support (MHPSS) interventions, inclusive resettlement planning, and sustainable governance for infrastructure. The proposed framework highlights the potential of Earth Observation and geospatial intelligence to aid human-centric infrastructure development and directly address SDGs 3, 4, 10, and 11.

social impact, earth observation, psychosocial vulnerability

Cristina Ruiz Villena

University of Leicester / NCEO

**IKIRERE capacity building:
inspiring the next generation of
African scientists**

1.09 Tuesday 11:45-11:55

Vicky Kondi Akara, Yaulande Alotse
Douanla, Catherine Fitzsimons, Charlie
Gamblin, Rose Meadows, Crispus
Muhire, Jeannette Mukangango, Ildephonse
Mungwarakarama, Rosebella Nsita,
Ankita Pant, Rob Parker, Mouhamadou
Bamba Sylla, Dative Tuyisenge

Many countries in Sub-Saharan Africa are amongst the most severely affected by the climate crisis, yet shortages of expertise and resources limit their ability to respond effectively. Here we present our experience designing and delivering events to inspire and train the next generation of African scientists: two full-day visits of school pupils aged 14–16 to research facilities (autumn 2025); a residential physics camp for older school students (July 2026); a three-day workshop for early-career researchers (July 2026); and a workshop dedicated to African women in STEM (scheduled for autumn 2026). We highlight co-creation with African partners, integration of EO resources, and early evidence of impact on participants' views, skills and confidence. For example, feedback from more than 170 students and 18 teachers who participated in visits in Rwanda and Tanzania showed that these events successfully raised aspirations of those involved as well as influencing the design of future events. These capacity-building activities, focused on climate physics, sit alongside research on drought and heatwaves in East Africa in the IKIRERE (Innovation and Knowledge Integration for Resilience in East Africa through Climate Research and Education) project. This is a collaboration between NCEO (University of Leicester) and the African Institute for Mathematical Sciences (AIMS) Research and Innovation Centre in Rwanda. IKIRERE is part of the STFC Africa-UK Physics Partnership programme, which aims to address a gap in physics research in Sub-Saharan Africa (where only 5% of research programmes involve physics) by helping develop highly skilled African physicists and supporting long-term Africa-UK partnerships.

Africa, capacity-building, climate



Tuesday 14:15

**Climate Change &
Global Cycles**

Room 0.04

Neil Humpage

NCEO / University of Leicester

Using the GEMINI-UK network of ground-based greenhouse gas observing spectrometers for regional scale validation of existing and future satellite missions

0.04 Tuesday 14:15-14:25

Paul Palmer, Jerome Woodwark,
Douglas Finch, Nikolai Ponomarev,
Lakshmi Bharathan, Bagirdan
Dharmalingam, Robert Parker

GEMINI-UK (Greenhouse gas Emissions Monitoring network to Inform Net-zero Initiatives for the UK) has been established as part of a wider national programme aiming to provide regular, timely, data-driven greenhouse gas (GHG) emissions estimates for the UK at a regional scale. It comprises ten Bruker EM27/SUN spectrometers, located across the UK in partnership with host institutions including universities, a research institute and a secondary school, that we operate in automated weatherproof enclosures designed by University of Edinburgh researchers. The enclosures allow for continuous daytime observations of the column concentrations of carbon dioxide and methane during cloud-free conditions, from locations in all four nations of the UK as well as the Channel Islands. Whilst the network has been designed to help improve top-down estimates of the UK's carbon emissions, the distribution and density of locations across a country the size of the UK means that GEMINI-UK will also prove to be a useful source of data for the validation of retrieval products derived from existing and future GHG observing satellites. In this presentation we show how GEMINI-UK data can be used to assess not only the performance of satellite greenhouse gas data products over specific locations, but also their ability to resolve spatial gradients in GHG column concentration fields over distances of tens of kilometres, through detailed comparison with data from existing missions including OCO-2 and Sentinel-5P. Through this work, we demonstrate that GEMINI-UK is well positioned as a network to support the validation of future GHG missions such as CO2M.

Alexander Arnstein

National Physical Laboratory

Satellite detection and multi-platform quantification of a major methane pipeline leak in Norfolk, UK

0.04 Tuesday 14:25-14:35

Alexander Arnstein, Paul Green, Neil Howes, Linh Nguyen, Fabrizio Innocenti, Rod Robinson, Tom Gardiner, Dafina Kikaj, Alex McColl (NPL); David Lowry, Victoria Rafflin (RHUL); Alistair Manning (Met Office); Grant Forster (UEA); Nathan Magnall (GHGSat); Dan Cusworth (CarbonMapper); Javier Gorroño (UPValencia)

Methane is a highly potent greenhouse gas, with a global warming potential far exceeding that of carbon dioxide over short timescales, making the detection and quantification of fugitive emissions critical for near-term climate mitigation. Large, unreported leaks from gas infrastructure can contribute significantly to national emissions but are often difficult to detect and quantify, many likely remaining undetected. In September 2025, the National Physical Laboratory (NPL) learnt of a potential leak from a damaged natural gas transmission pipeline in Diss, Norfolk, and rapidly confirmed and quantified the multiple tonnes per hour methane emission event using GHGSat satellite observations. This motivated a collaborative measurement campaign between UK and international partners, enabling instrument intercomparison, emission rate estimate refinement and a timeseries of measurements for total emissions estimation for the 6 weeks of atmospheric release. The teams and techniques involved were GHGSat, CarbonMapper and Sentinel-2 satellite observations, NPL's Differential Absorption lidar (DIAL) and Tracer Correlation (TC), Royal Holloway and East Anglia Universities' mobile vehicle surveys and atmospheric measurements from the UK tall tower network inverted with dispersion models (Met Office's NAME and FLEXPART). Here we present the results of this intercomparison, and lessons learnt for the incident. As with the highly publicised, smaller leak near Cheltenham in 2023 (Dowd. E, 2024), this event was discovered through chance, highlighting the importance of integrated monitoring systems to detect and characterise fugitive methane emissions to ensure their inclusion in national greenhouse gas inventories.

methane leak validation

Paul Palmer

NCEO / University of Edinburgh

Current and future emissions of methane from African wetlands: an integrated EO approach

0.04 Tuesday 14:35-14:45

Carole Helfter, Chris Taylor, Sport Beattie, Pascoal Chiambo, Doug Clark, Liz Cooper, Sonja Folwell, Angela Gallego Sala, Nic Gedney, France Gerard, Mangaliso Gondwe, Andy Hardy, Chris Huntingford, Frank Kansiime, Mike Murray-Hudson, Greg Oakes, Chloe Schooling, Noah Smith, Mouhamadou Bamba Sylla, Dai Yamazaki

Atmospheric methane has changed rapidly since 2020, but the drivers remain uncertain. Satellite observations identify eastern African wetlands as major and highly dynamic methane sources, but significant uncertainty persists over how hydrology and wetland vegetation regulate emissions. In this presentation, we introduce the NERC-funded CurFEW (Current and Future Emissions of African Wetland Methane) project, which aims to better predict tropical African wetland methane emissions and associated feedbacks in a rapidly changing climate. CurFEW is based on a coupled climate-hydrology-ecosystem-biogeochemistry framework linking large-scale climate variability to methane emissions from African wetlands. Positive phases of the Indian Ocean Dipole enhance rainfall over eastern Africa, driving changes in river discharge, flooding, and wetland inundation. These hydrological shifts alter vegetation structure, organic carbon inputs, and methane production and transport pathways, resulting in atmospheric methane emissions. CurFEW places EO data at the centre of efforts, supported by field and laboratory studies, to quantify methane emissions and their drivers. Satellite observations quantify variability in water flow and downstream wetland inundation, while AI-enhanced satellite products characterise wetland vegetation structure and extent. These EO data products will be integrated into statistical and process-based frameworks to derive spatially and temporally resolved hydrological flows, wetland inundation, vegetation changes, and methane fluxes. This integrated approach will improve attribution of methane emission variability to specific drivers and refine process-based models, leading to more confident projections of how African wetland methane sources may respond to future climate change.

methane, hydrology, wetlands

Jonathan Murray

Imperial College London

Exploring ground-based radiative signatures as part of the MAGIC-AVALON campaign

0.04 Tuesday 14:45-14:55

Michaela Flegrova, Hyoji Kang,
Sophie Mosselmans, Ben Pery, Helen
Brindley

The MAGIC (Monitoring Atmospheric composition and Greenhouse gases through multi-Instrument Campaigns) initiative is designed to better understand Greenhouse Gas concentrations and vertical distributions in several key regions and to prepare future space missions dedicated to their measurement. Taking place in France and Belgium between 1st-26th June 2026, MAGIC-AVALON (Aircraft VALidation Of New-generation satellites) was the latest instalment in the series, with the twin goals to validate instruments on MTG-S, MicroCarb and Metop-SG-A1 and to test new instrument concepts in support of future space missions such as ECO (Earth Climate Observatory). As an invited participant in the campaign, NCEO-Imperial College deployed their ground-based spectrometer FINESSE (Far-INfrarEd Spectrometer for Surface Emissivity) as a mobile unit, delivering measurements of the downwelling atmospheric infrared spectrum and of the surface emissivity, coordinated with aircraft and satellite overflights. Additional ground-based observations from lidar, sun-photometers, microwave radiometers and visible spectrometers provide the opportunity to fully characterise the atmosphere exploiting the strengths of each observing approach. Here we will provide an overview of MAGIC-AVALON, show some early examples of the observations that were collected during FINESSE's deployment, and illustrate how these can be exploited to help meet the goals of the campaign.

atmosphere, chemistry, calibration/validation

Will Maslanka

KCL

Satellite-based characterisation of Mediterranean Fire Emissions using the FIRE Approach.

0.04 Tuesday 14.55–15:05

Martin Wooster, Weidong Xu

Fire is an annual phenomenon across Mediterranean ecosystems and is particularly prevalent during the region's drier and warmer summer months. However, increasing temperatures and changing precipitation patterns are extending wildfire activity beyond the traditional fire season. Earth Observation remains a critical way to monitor wildfire activity across the region, with quantifying wildfire activity, emissions, and fuel consumption being essential for hazard monitoring and land surface modelling. We present progress in quantifying wildfire emissions and fuel consumption estimates for Mediterranean landscape fires using the Fire Radiative Energy Emission (FIRE) approach, a direct top-down methodology that links Fire Radiative Power (FRP) observations to trace gas emissions. Here, we use FRP observations from Meteosat Second Generation (MSG) and coincident CO observations from Sentinel-5P to estimate biome-specific emission coefficients for CO, used to estimate total CO emissions from wildfires across the MSG observation period. These coefficients, combined with established emission factor ratios, enable estimation of total carbon emissions and biomass burned. Fuel consumption per unit area is further estimated by applying the biome-specific CO emission coefficients to FRP observations for individual wildfires, whose perimeters have been mapped by the European Forest Fire Information System (EFFIS). Finally, we explore opportunities to enhance the FIRE approach through the incorporation of Fire Radiative Power observations from the newly operational Meteosat Third Generation (MTG) satellite, due to its higher spatiotemporal resolution.

fire radiative power, emissions, geostationary earth observation



Tuesday 14:15

**Biodiversity, Habitat
& Ecosystems**

Room 1.01

Pete Bunting

Aberystwyth University

Global Mangrove Watch Extent and Change 1985 - 2025

1.01 Tuesday 14:15-14:25

Pete Bunting, Lammert Hilarides, Ake Rosenqvist, Paula Castro Brandão Vaz dos Santos, Jessica Rosenqvist, Thomas Worthington, Catherine Waite

The Global Mangrove Watch (GMW) team has produced five mangrove extent products and three mangrove change products since the first release in 2018. Each version has produced significant improvements in the quality and accuracy of the mapping. The latest version (GMW v4.1) provides an annual timeseries from 1985 to 2025, significantly improving temporal coverage compared to GMW v3.0, which provided mapping from 1996 to 2020 but with gaps in the timeseries from 1997-2006 and 2011-2014 due to data availability. GMW v4.1 has used the full Landsat timeseries, alongside the Japan Aerospace Exploration Agency (JAXA) L-band radar timeseries with JERS-1 (1992-1998), ALOS PALSAR (2007-2010) and ALOS-2 PALSAR-2 (2015-2024) data. These have been classified with machine learning classifiers (Random Forests and XGBoost), fused with a probabilistic system based on likelihood ratios and temporally filtered using Bayesian Markov Chain. These results provide new and significant insights into the historical mangrove extent. The global trend identified no significant net change in mangrove extent from 1985 to 2025. Countries such as Indonesia, Malaysia and Myanmar have witnessed significant net losses in mangrove extent, primarily due to anthropogenic deforestation. However, the majority of countries have a net gain in mangrove extent, with India, China, Senegal, and most Middle Eastern countries (e.g., the United Arab Emirates) showing significant net gains. Mangrove gains across the tropics stem from sediment-driven mudflat colonisation in river mouths and deltas, likely driven by terrestrial land-use changes, as well as anthropogenic planting and hydrological restoration.

Rachel Gaulton

Fera Science Ltd

Mapping woodland Priority Habitat type across England using AlphaEarth satellite embeddings.

1.01 Tuesday 14:25-14:35

Rachel Gaulton (Fera Science), Quddus Busari (Fera Science), Clare Rowland (UKCEH), Andrew Crowe (Fera Science), Tamsyn Dawson (Fera Science), Paul Brown (Fera Science), Jonathan Brownnett (Natural England), Ray Kidd (Natural England), Dan Abrahams (Natural England).

The England Priority Habitat Inventory (PHI) provides key insights for conservation, policy and land management, but information on Priority Habitat types of deciduous woodland, specifically Lowland Beech and Yew, Lowland Mixed Deciduous, Upland Mixed Ashwood, Upland Oakwood, and Wet Woodland, is limited. This Natural England-funded project combines satellite embeddings with existing England-wide datasets to map these 5 habitat types. A rule-based classification of the Forestry Commission Subcompartment Database (SCDB), and ancillary environmental variables, to Priority Habitat type (and non-priority woodland) was used to derive training data. This, combined with additional data from the PHI, was used to train a Random Forest model, based on a subset of Google DeepMind AlphaEarth 2024 satellite embeddings. A further rule-based reclassification, based on soil and geology, and the native range of beech was applied, and classes mapped to Ordnance Survey polygons. The AlphaEarth classification, against a test data set of PHI and SCDB polygons, showed good accuracy (overall accuracy of 77% and balanced accuracy of 65%); however, the final classified polygon layer showed reduced accuracy against independent Sites of Special Scientific Interest data, with an overall accuracy of 64.9%, but mixed class-level accuracies. The largest errors were commission errors in the Lowland Beech and Yew class and omission errors from Wet Woodland. Results demonstrate the promise of new satellite embedding datasets for complex classification tasks, providing insights into the distribution of Priority Habitats. However, key to further development is the need for more extensive and suitable field data to allow better training and validation.

woodland, embeddings, habitat

Barbara Hofmann

HR Wallingford

EO4Biodiversity: Using Earth Observation to Support Early Planning Decisions

1.01 Tuesday 14:35-14:45

Barbara Hofmann, Sunshine Abbott, James Noble, Mike Panzeri, Quillon Harpham, Marta Roca

Biodiversity underpins healthy ecosystems, supporting both climate resilience and human wellbeing. In the UK, planning policy requires new developments to demonstrate a 10% biodiversity net gain. This is assessed using standardised biodiversity units, which are tied to habitat type and condition. Reliable habitat identification is therefore a key input to both planning and conservation. Practitioners can have a vast number of site development options to consider, balancing efficacy with potential for biodiversity gains. EO4Biodiversity supports screening of these options, making the task of narrowing down to a manageable set both efficient and effective. Our approach builds on the existing Natural England Living England broad habitat data and incrementally improves the classification of selected habitats using multispectral satellite data through GeoAI methods. The results are accessible through a web-based tool which allows users to upload proposed site boundaries, view mapped habitat evidence, adjust habitat attributes where survey data exists, and estimate biodiversity impacts using spatial analysis aligned with biodiversity metric rules. We show how GeoAI and Earth Observation can support improved habitat mapping and introduce the EO4Biodiversity prototype, which is being developed with support from the European Space Agency Incubed2 programme.

Henny Schulte To Bühne

Natural England

A mapping standard for conservation

1.01 Tuesday 14.45-14.55

Aidan Byrne, Jake Williams and Nathalie
Pettorelli (all Zoological Society of London)

Recent technological advances have made creating satellite-derived maps significantly easier, providing unprecedented opportunities for them to inform conservation research and practice. However, without a rigorous understanding of their quality, these maps risk being used in inappropriate ways that are unlikely to benefit nature or people. Current best practice guides for satellite-derived map quality assurance are typically aimed at technical experts and are often inaccessible for significant groups of end users, such as conservation scientists and decision-makers who do not have extensive Earth Observation experience. To close this gap, we propose a conservation map standard which enables map users with minimal Earth Observation knowledge to determine whether mapping errors are (i) low enough and (ii) known with sufficient precision to decide whether a given map can be used in conservation decision-making or further quantitative analysis. The standard consists of a series of checkpoints concerning three key themes: the quality of validation data; the accuracy of the map; and the accuracy of summary statistics derived from the map. We provide guidance on how to determine whether a map passes the checkpoints based on a review of best practice validation procedures and principles. We also highlight under which circumstances using maps that significantly deviate from the standard we propose may be acceptable. The proposed standard demonstrates that context- and domain-specific knowledge remains irreplaceable for ensuring high-quality satellite-derived maps for research and decision-making in ecology and conservation.



Tuesday 14:15

**Carbon, Biomass &
Natural Capital**

Room 1.06

Pedro Rodriguez-Veiga

Sylvera Ltd

Sylvera Biomass Atlas: A Globally Consistent Annual Time-Series of Woody Aboveground Biomass Density at 30-metre Resolution

1.06 Tuesday 14:15-14:25

Andrew Burt, Ezra Webb, Miro Demol, Oliver Levers, Freddie Ruxton, Henry Batten, Daniel Jahn, Marco Nasuto, Anastasia Bizyayeva, Beisit Luz Puma Vilca, Mikolaj Krzekotowski, Beatriz Fernandes, Luke Deigan, Sebastian Marcelo Frisancho Flores

Accurate, spatially explicit estimates of aboveground biomass density (AGBD) remain a critical challenge in remote sensing, with conventional EO-based approaches subject to systematic bias of 15–40% introduced by allometric assumptions and poorly characterised reference data. Here we present the Sylvera Biomass Atlas, an annual time-series of woody AGBD and canopy height (CH) at 30-metre resolution spanning 2000 to present, derived from multispectral Landsat imagery and digital elevation data, calibrated against a proprietary Multi-Scale lidar (MSL) reference dataset exceeding 250,000 hectares globally. The MSL framework integrates Terrestrial Laser Scanning (TLS), UAV-based Laser Scanning (UAV-LS), and Airborne Laser Scanning (ALS) across tropical, temperate, boreal, and dryland biomes. TLS-derived reference values carry errors of ~3% relative to destructive measurements, entirely bypassing allometric assumptions. Regional neural network models map CH from spectral and topographic predictors; AGBD is subsequently inferred via non-linear regression for each plant functional type. A pixel-level temporal profile correction fills gaps and suppresses noise from seasonality, cloud contamination, and Landsat 7 SLC failure, yielding a consistent annual time series. Validation against independent MSL sites in Central America, South America, Africa, and Australia — held out entirely from model training — demonstrates low systematic error (mean bias -0.5%) with pixel-level relative errors of 20–64%. Uncertainty declines markedly with spatial aggregation: <28% at 100 ha to below 10% beyond 100,000 ha. Ongoing field campaign over the UK in collaboration with the Woodland Carbon Code will allow to integrate MSL technology into the UK's standard for carbon-funded woodland.

Wanxin Yang

University College London

**Vertical woody volume profiles
from terrestrial laser scanning
for characterising tropical forest
biomass distribution and
supporting ESA BIOMASS cal/val**

1.06 Tuesday 14:25–14:35

Wanxin Yang, Mathias Disney, Phil Wilkes, Cecilia Chavana-Bryant, Casey Ryan, Kyle Dexter, Steven Hancock, John L. Godlee, José João Tchamba, Shaun Quegan

Tropical forests store a large fraction of terrestrial carbon, yet uncertainty remains high in aboveground biomass (AGB) estimates, particularly in structurally complex, high-biomass regions. Beyond quantifying total AGB, it is increasingly important to understand how biomass is distributed vertically within the canopy, because forests with similar biomass can differ substantially in the arrangement of woody material among stems, branches, height layers and tree size classes. This vertical organisation affects how spaceborne SAR and lidar signals interact with forest canopies. For example, recent studies using P-band TomoSAR suggest sensitivity not only to forest height and total AGB, but also to the vertical distribution of biomass within the canopy. However, calibration and interpretation of these observations remain limited by the scarcity of field measurements of vertical biomass profiles. Terrestrial laser scanning (TLS)-derived quantitative structure models (QSMs) provide a direct geometric description of woody material, including total woody volume, vertical volume allocation, stem–branch partitioning, and tree-level architectural traits. This makes it possible to move beyond plot-level total AGB and assess the vertical organisation of woody biomass. We have developed an automated pipeline to extract individual-tree and plot-level structural attributes from TLS point clouds. Here, we apply this approach to tropical forest TLS datasets from Gabon, French Guiana, and Angola, collected within the GEO-TREES reference-sites framework. We show how woody volume is distributed across forest sites, and how large-tree dominance shapes the vertical distribution of woody volume across forest height layers and discuss the implications for retrievals from RADAR EO more generally and ESA BIOMASS specifically.

biomass, lidar, calibration/validation

David T. Milodowski

University of Edinburgh

Exploring the impact of temporal error correlation on the information content of biomass timeseries from Earth Observation using a Bayesian carbon cycle modelling framework

1.06 Tuesday 14:35–14:45

Tim J. Green (lead author), Luke Smallman, Mathew Williams

Robust understanding of biomass stocks and their change over time is essential for developing effective land management, conservation and climate mitigation strategies. Earth Observation (EO) has transformed our capacity to monitor biomass from local to global scales. However, outside of areas with large losses (e.g., deforestation), uncertainties associated with biomass estimates are far larger than observed rates of change, limiting our ability to extract information on growth, mortality and degradation. These processes are critical in determining the strength and distribution of the terrestrial carbon sink. Uncertainty in biomass stocks is often assumed to be systematically correlated through time. If true, then correlation of errors implies higher confidence in estimates of biomass trends than if errors are independent. However, data producers rarely provide information on how uncertainty is temporally correlated. We use a Data Assimilation (DA) experiment to demonstrate how information content in timeseries observations of biomass is impacted by different assumptions on the temporal correlation of biomass uncertainties. We use the CARDAMOM DA framework to calibrate a terrestrial ecosystem model (DALEC) using EO-derived observations (including biomass) to generate data-informed, uncertainty bounded analyses of the Amazon and Congo forests. We demonstrate that if biomass uncertainties are assumed to be independent, little constraint on biomass trends or wider carbon cycling is provided. As temporal correlation increases, information content increases, dramatically impacting carbon cycle diagnostics. Results demonstrate a clear need for data producers to prioritise mapping algorithms that are temporally stable and to communicate uncertainties with sufficient information to better inform subsequent analyses.

biomass, uncertainty, data assimilation

Nezha Acil

NCEO / University of Leicester

Enhancing aboveground biomass mapping from Earth Observation with machine learning and multisensor data fusion

1.06 Tuesday 14:45–14:55

Nezha Acil, Pedro Rodriguez-Veiga, Shadi Ashgzaran, Akshatha Mandadi, Shaun Quegan, Casey Ryan, Penelope Mograbi, Steven Hancock, Mat Disney, Buster Mogonong, Collins Masinde, Duncan Chalo, Gregor Feig, Helga van der Merwe, Iain McNicol, John Godlee, Jonathan Muledi, Kyle Dexter, Lorena Benitez, Tatenda Gotore, Tshililo Ramaswiela and Heiko Balzter

Forests play a key role in the carbon cycle, capturing it through photosynthesis, storing it as biomass, and releasing it back to the atmosphere as carbon dioxide. Aboveground biomass (AGB) estimation from Synthetic Aperture Radar (SAR) measurements can be affected by radar backscatter saturation at high biomass, limited sensitivity at low biomass and anomalies due to moisture, topography etc. Added to other non-random error sources (model assumptions, calibration data etc.), these sensor-related issues may lead to substantial uncertainties. The recently launched BIOMASS and NISAR satellites offer new capabilities to better estimate AGB with a higher sensitivity to below-canopy woody volumes for the former and more frequent acquisitions at fine spatial resolution for the latter. Here, we leverage machine learning and multi-sensor data fusion to estimate AGB for selected sites across Africa. We first analyse the sensitivity of BIOMASS' P-band and NISAR's L-band to moisture, topography, tree height and biomass gradients, as opposed to existing SAR instruments. We then integrate the BIOMASS and NISAR data into our retrieval algorithm. The latter estimates AGB based on an empirical relationship with woody vegetation height, itself modelled based on a random forest algorithm, trained with space-based Light Detection and Ranging (lidar) observations (GEDI) and using SAR and optical data as predictors. Accuracy is then assessed with airborne lidar and plot measurements. Our preliminary results highlight the potential of BIOMASS and NISAR for reducing sensor-related uncertainties and provide insights into optimal data fusion for more accurate AGB quantifications to support carbon accounting and policy making.



Tuesday 14:15

**Sustainable Development,
Social Impact & Policy
Disaster Prediction &
Response**

Room 1.09

Mike Perry

University of Leicester

Thermal Downscaling: Advances in methods and User engagement

1.09 Tuesday 14:15-14:25

Ben Courtier, Charlotte Paton, Darren
Ghent, Jasdeep Anand, Karen Veal

Downscaling land surface temperature (LST) is becoming an increasingly important field of study due to the expanding data needs of many fields which focus on increasingly fine scale issues. This gap limits our ability to interact in meaningful ways with user groups and decision-making organisations in applications such as mitigating urban heat and health. Without long-term, high-resolution data, the development of targeted strategies for urban planning and climate adaptation remains challenging. Bridging this gap with comprehensive datasets is crucial for advancing our knowledge and creating more sustainable, climate-resilient cities. This talk not only addresses the technical advancements in the quality and coverage of downscaled data, but also the co-design process with key users to ensure that the data delivered matches the application needs of the users who need the data.

Rui Song

University of Oxford

Coal plants persist as a large barrier to the global solar energy transition

1.09 Tuesday 14:25- 14:35

Rui Song, Feng Yin, Jan-Peter Muller, Adam C. Povey, Basudev Swain, Chenchen Huang, Roy G. Grainger

The effectiveness of the global solar energy transition depends not only on photovoltaic (PV) deployment but also on the atmospheric conditions governing solar irradiance. Aerosol emissions from coal-fired power plants reduce surface radiation, degrading PV performance and potentially offsetting gains from renewable expansion. Here we present a global, facility-level assessment of this interaction by integrating satellite observations, atmospheric reanalysis, and machine learning to construct a database of 140,945 PV facilities with estimates of electricity generation and aerosol-induced losses. Our analysis shows that aerosols reduced global PV generation by 5.8% (111 TWh) in 2023. Between 2017 and 2023, annual aerosol-induced losses from existing PV systems were equivalent to approximately 30% of the electricity generated by newly installed capacity. China experienced the greatest impact, with 7.7% PV generation losses and a loss-to-growth ratio averaging 38%, whereas the USA exhibited substantially lower losses owing to limited spatial co-location of coal and solar infrastructure. The results demonstrate that persistent coal emissions remain a measurable physical constraint on solar performance, highlighting the importance of integrating atmospheric pollution, renewable deployment, and energy-system planning when evaluating pathways toward net-zero emissions.

solar photovoltaic, aerosols, coal plants

Agnieszka Soszynska

University of Leicester / NCEO

Mapping of Surface Indicators of Geothermal Activity in Preparation for the Future Sentinel Missions

1.09 Tuesday 14:35-14:45

Agnieszka Soszynska, Christoph Hecker, Rayco Marrero, Rocio Barrio Guillo, Michael Marshall, Harald van der Werff, Bruno Portela, Thomas Groen, Michael Perry, Ignacio Marzan, Darren Ghent

Geothermal energy is a reliable, low-carbon resource, particularly in high-enthalpy volcanic systems. Such systems produce surface manifestations of geothermal activity, including elevated surface temperatures, hydrothermal mineral alteration, soil discolouration, and vegetation stress, which can be treated as indicators detectable with state-of-the-art remote sensing methods. We propose the first product which incorporates complementary indicators of geothermal activity: surface thermal anomaly detection, detection of hydrothermal alterations of the surface including minerals associated with geothermal activity, and time-series analysis of vegetation stress indicating subsurface heat. The resulting products will be contextualised with high-resolution land cover information to reduce false detections and integrated using a random forest classification framework to support early-stage geothermal exploration. The output will support decision making in geothermal exploration, such as permit evaluation and planning detailed field exploration. The method is tested in two contrasting regions: the Canary Islands (Spain), an emerging volcanic system at the exploration stage, and the Greater Olkaria region (Kenya), an established geothermal field in a continental rift setting. Preliminary results from prior studies show moderate success, with thermal anomaly detection achieving 68% accuracy but facing challenges in complex terrain, while mineralogical mapping demonstrates strong potential. The upcoming Sentinel Expansion missions are expected to significantly enhance data quality and future operational capability. To provide an operational product meeting real-world need, we focus on close collaboration with stakeholders from the industry and local administration. The stakeholders influence the methodology design by providing requirements and iterative feedback to the products.

sustainable energy, remote sensing, data fusion

Sadiksha Chauhan

Northumbria University

Improved monitoring of water resource and hazard using small low-Earth-orbit satellites

1.09 Tuesday 14:45–14:55

Mel Sandells, Ben Brock (Northumbria University); Lora Koenig (Lockheed Martin Space USA)

Hydrological extremes such as floods and droughts significantly impact human activity, often resulting in considerable economic losses. Due to the complexity of hydrological systems, addressing these events requires interdisciplinary approaches and robust monitoring frameworks. Hydrological modelling is constrained by sparse, point-based monitoring networks and low-frequency satellite data, limiting our ability to understand and simulate rapidly changing and spatially diverse catchment conditions. Emerging remote sensing technologies such as CubeSats offer opportunities for high-frequency, spatially distributed data streams that may address these limitations. However, there is currently limited practical research on what data from emerging satellite technologies might be used for or how this might allow us to understand catchment processes differently. This project aims to explore how emerging satellite technologies might be used to drive regional hydrological modelling approaches to better understand and plan for hydrological extremes. Here, we discuss the three phases of the project and present the results of the first phase. Phase 1 identified key technologies and data sources and engaged with water management stakeholders to understand existing practices, data usage, limitations and future needs; Phase 2 will explore how simulated data from small satellites can be integrated into hydrological models, including the development of new data processing and assimilation methodologies; and Phase 3 will apply these methodologies in a detailed case study in the UK Tweed catchment, demonstrating their effectiveness in forecasting hydrological extremes like flood and drought. This work will drive innovation in satellite-based environmental monitoring and modelling and enhance regional capacity to anticipate and respond to hydrological challenges.

hydrological extremes, data assimilation, cubesats

Isabella Read

Ordinal Space Ltd

Global Disaster Response from Space: An Impact Assessment of the International Charter: Space and Major Disasters

1.09 Tuesday 14:55-15:05

David Hodgson, Thales Sehn Körting,
Laercio Massaru Namikawa,
Abhinav Shukla, KHV DurgaRao,
Emilie Bronner, Philippe Bally,
Zachary Foltz, Sally Wannop

The International Charter: Space and Major Disasters (“Charter”) delivers high quality, free Earth observation (EO) data to users, Value Added Products (VAPs), and analytical tools supporting disaster impact knowledge and enhance disaster response capabilities. This assessment provides a quantitative review of 380 activation reports (2018 2024), a general analysis (2000 2024), and case reports from interviews with five stakeholders to evaluate the Charter’s impact in emergency response. Since 2012 activations have grown at a compound annual rate of 6.5% with 100 countries able to directly activate the Charter, representing approximately 77% of the world's population. Between 2018 and 2024, over 104,000 satellite images were provided while the average delivery time of post-event images decreased annually to under 15 hours. VAPs were generated in 97% of activations. Analysis of user feedback reveals that 68% of activations cite planning benefits, 36% enhance operational decision making, and 61% improve general communications.

Short-term outcomes, including disaster impact knowledge and informed operations, are well evidenced. Medium-term outcomes such as event documentation and capability development are supported by evidence from multiple countries. Strong indications of long-term contributions to preparedness and resilience exist but remain difficult to quantify. Although complementary EO services are available and cooperation is common, the Charter is found to be unique in its global reach, breadth of satellite resources, and accessibility. These findings demonstrate the Charter’s importance in delivering high resolution remote sensing information that strengthens global disaster response and supports risk management efforts.



Wednesday 13:00

**Climate Change &
Global Cycles**

Room 0.04

Douanla Alotse Yaulande

AIMS RIC

Earth Observation-Based Causal Analysis of Soil Moisture Dynamics for Drought Monitoring in East Africa

0.04 Wednesday 13:00-13:10

Douanla Alotse Yaulande, Mouhamadou Bamba Sylla, Rob Parker, Cristina Ruiz Villena, Vicky Kondi Akara

Understanding land-atmosphere interactions is essential for improving drought monitoring and climate prediction across East Africa. This study investigates depth-dependent precipitation-to-soil-moisture coupling using multiple Earth Observation datasets, including CHIRPS precipitation, ERA5-Land soil moisture, ESA Climate Change Initiative Soil Moisture, and MODIS vegetation indices. We integrate complementary causal inference methods-Granger causality, Convergent Cross Mapping (CCM), and Transfer Entropy-to distinguish linear, nonlinear, and directional relationships between precipitation and soil moisture across multiple depths. Results reveal a clear depth-dependent transition in coupling behaviour. Linear causality strengthens with increasing soil depth, whereas nonlinear coupling weakens, indicating that shallow soils exhibit rapid state-dependent responses while deeper soils integrate precipitation over longer timescales. The strongest convergence of linear, nonlinear, and directional causal evidence occurs at approximately 100 cm depth, identifying the root zone as the dominant layer for precipitation-soil moisture feedbacks. Spatial analyses further show coherent coupling hotspots across semi-arid transition zones in East Africa. By combining multiple causal frameworks, this research demonstrates that reliance on a single statistical method can misrepresent hydroclimatic interactions. The proposed multi-method framework provides a more robust interpretation of land-atmosphere coupling while quantifying uncertainty through surrogate testing and spatial validation. These findings offer an observation-based benchmark for climate and hydrological models and support the development of improved drought monitoring and early warning systems across East Africa.

soil moisture, precipitation, causal inference

Richard Allan

University of Reading

Evaluating long-term decline in terrestrial water storage

0.04 Wednesday 13:10-13:20

F. Robertson, K. Wang

Water availability for societies and ecosystems depends upon Terrestrial Water Storage (TWS) yet climate change and altered land use are driving substantial regional changes that are not well understood. Combining Gravity Recovery and Climate Experiment (GRACE) gravimetric measurements since 2002 with observations-driven models, changes in the water cycle including TWS are evaluated since the 1980s to improve understanding of Earth-system processes and exchanges. GRACE-observed decreases in TWS 2002-2019 of -8.0 mm/decade) are underestimated by global hydrological models that include human water management. These models and reanalysis data indicate terrestrial drying extends back to the 1980s and are linked with regional precipitation decreases combined with intensive human water use over northern India, southwest U.S. and northeastern China; however, the magnitude of the drying is uncertain, ranging from little change up to -7 mm/decade during 1980-2019. Spurious changes in atmospheric moisture, precipitation and evaporation in the early 2000s are identified in one reanalysis that also impacts hydrological models through its use in providing driving meteorological data. Although, caution is therefore required in inferring changes in hydroclimate variables due to inhomogeneities in observations and reanalyses, robust regional terrestrial drying are identified across multiple datasets and these are underestimated over more arid regions by global climate models, with implications for future projections of water availability and policy decisions surrounding water resources.

Jawairia Ahmad

UKCEH

Impact of soil moisture on convective storm nowcasting

0.04 Wednesday 13:20-13:30

Christopher Taylor, Bethan L. Harris,
Dávid D.Kovács, Seonaid Anderson,
Adrià Amell, Colin Moldenhauer, Steven
Wells, and Wouter Dorigo

Soil moisture (SM) characterizes land surface conditions and impacts land-atmosphere interactions across different spatiotemporal scales. Here we explore the use of AI in modelling land-atmosphere interactions and the impact of this feedback on nowcasting skill. Medium resolution (0.1 degree) SM observations from ASCAT are added to a deep learning based nowcasting model (Network for Nowcasting Convective Cores, NetNCC). NetNCC used thermal imagery to operationally nowcast the location of convective storms at different lead times. Adding medium resolution ASCAT SM data to NetNCC improved the prediction accuracy of the nowcasts during the evening. The nowcast probability distributions show that adding SM to the baseline (thermal infrared based) model resulted in more frequent predicted event occurrence (high recall). The impact was higher across regions with spatial gradients in soil moisture climatology. The percentage of nowcast convective cores correctly predicted over drier soils increased from 57% (for the baseline model) to 59% for medium resolution SM after explicitly adding SM. This corroborates the results from previous studies that show higher core frequency over drier soils during the summer in western Africa. The results highlight the potential of more accurate nowcasting at longer lead times by using machine learning methods to represent the non-linear impact of land surface conditions on storm development.

nowcasting, convection, soil moisture

Christopher Taylor

UKCEH / NCEO

Signature of soil moisture-induced mesoscale circulations detectable from high resolution satellite total column water vapour data

0.04 Wednesday 13:30–13:40

Cintia Carabajal Henken, Guillaume Chagnaud, Jan El Kassar

Soil moisture is known to play an important role in the initiation of convective storms in many parts of the world. Contrasts in soil moisture on scales $\sim 10\text{--}40$ km create gradients in sensible heat flux which can induce daytime mesoscale circulations in the lower atmosphere. Though relatively weak, these circulations influence where thunderstorms develop, particularly in semi-arid regions. Up until now, observational evidence for this mechanism has relied on analysis of convective clouds. The Flexible Combined Imager (FCI) on the geostationary Meteosat Third Generation satellite includes channels in the near infrared which allow retrieval of total column water vapour. The high space (1km) and time (10 minutes) resolution of FCI over Africa for the first time provides an opportunity to routinely observe aspects of the mesoscale circulations underlying the soil moisture-convection feedback. We are able to detect a localised atmospheric drying signal during the afternoon associated with the subsiding branch of the circulation. This allows us to test our understanding of how background wind conditions influence the circulations and could provide a new approach to evaluating aspects of land-atmosphere interaction in weather and climate models.

land-atmosphere, water vapour

Claire Bulgin

NCEO

Using Earth observation data to evaluate climate models: fair comparisons, sampling, process representation, future projections and storylines

0.04 Wednesday 13:50-14:00

Long-term Earth observation datasets are typically developed as a means to monitor Earth's climate and understand changes in key physical variables over the course of the satellite era. As the Earth undergoes rapid warming, the need to understand how the Earth system will evolve over the coming decades is becoming more urgent. Climate models are frequently used to simulate future conditions and make projections of how these key physical variables will evolve into the future. In this context, Earth observation datasets can play an important role in climate model evaluation. In this presentation, we consider different ways in which Earth observational data can be used in comparison with climate models e.g. to evaluate the representation of a particular process or as an indication of the plausibility of future projections. We discuss why sampling in both the observation and model space is so important to making meaningful comparisons and identify some of the common pitfalls when comparing these data. We also present the international framework, obs4MIPs, which is designed to help facilitate the production of observational datasets in a format that is easily comparable with model data as part of various model intercomparison projects (MIPs).

Ranjini Swaminathan

University of Reading / NCEO

Rapid Evaluation Framework for the CMIP7 Assessment Fast Track

0.04 Wednesday 14:00–14:10

Birgit Hassler, Forrest Hoffman, Jared Lewis, Briony Turner and the REF delivery team

As Earth system models (ESMs) grow in complexity, there is an increasing need for rapid and comprehensive evaluation of their scientific performance. The upcoming Assessment Fast Track for the Seventh Phase of the Coupled Model Intercomparison Project (CMIP7) will require a fast response for model analyses designed to inform and drive integrated Earth system assessments. To meet this challenge, the Rapid Evaluation Framework (REF), a community-driven platform for evaluation, benchmarking and performance assessment of ESMs, was designed and developed. The initial implementation of the REF builds upon existing community evaluation and benchmarking tools and is aimed at generating and organizing diagnostics covering a variety of model variables. It runs within a containerized workflow for portability and reproducibility and to encourage widespread adoption in the community. The REF leverages best-available, CC-BY-4.0 or equivalent license, obs4MIPs ODS2.6 compliant, observational datasets available on the Earth System Grid Federation (ESGF), to provide assessments of model fidelity across a collection of diagnostics identified and selected with community involvement. Operational integration with the ESGF permits automated execution of the REF for specific diagnostics as soon as model data are published on ESGF by participating modeling centers. Key outcomes from the REF are direct benefits to national and international assessment endeavors such as the IPCC AR7, a shared platform for the climate modelling and observational science communities to engage around climate change, and improved access to climate analyses data (model and observations) for historically underserved communities especially from the global south.



Wednesday 13:00

**Biodiversity, Habitat
& Ecosystems**

Room 1.01

Jake Williams

Institute of Zoology

How can EO measure the condition of ecosystems?

1.01 Wednesday 13:00-13:10

Ecosystems represent the largest scales of biological organization and shape the ecology and evolution of genes, populations, species, and communities. Yet we lack an understanding of the key properties of ecosystems—the state variables—that must be tracked to predict changes in ecosystem condition through time, instead commonly relying on reference states. A recently published ecological equation of state demonstrated a strong relationship between biomass, species richness, organism abundance, and productivity, suggesting the previously untested possibility that this relationship may systematically vary under ecological disturbance (i.e., vary with ecosystem condition). This talk explores how EO data can test this idea, and how it might be deployed. I will talk through ongoing research to investigate how the performance of the ecological equation of state relates to expected ecosystem condition in multiple systems. Preliminary results show a systematic relationship between the performance of the ecological equation of state in predicting biomass and expected ecosystem condition in multiple systems. Moreover, differences in equation performance can be used to identify areas with different expected ecosystem condition. These findings suggest deeper underlying regularities linking ecosystem condition and EO-derivable state variables and the potential to break ecosystem science's dependence on reference states, which is vital to informing global biodiversity conservation efforts.

Nathalie Pettorelli

ecosystem condition, resilience, nature

Sophie Hebden

European Space Agency

Tipping points and abrupt change - emerging results from ESA CCI projects across domains

1.01 Wednesday 13:10-13:20

Susanne Mecklenburg, Clement Albergel,
Sarah Connors, Amy Campbell, Paul Fisher

There are elements of the Earth system, including ecosystems, that can undergo rapid transition and reorganisation in response to small changes in forcings. This process is commonly known as crossing a tipping point. Such transitions may be abrupt and irreversible, and many of them feedback to climate change, representing an additional uncertainty in projections of global warming. They therefore represent a challenge for informing decision making, in both climate mitigation and adaptation contexts, with research insights currently under review as part of the IPCC 7th assessment cycle. To better understand the risk posed by climate tipping points and improve understanding, ESA is supporting six projects applying satellite remote sensing across Earth system domains and biomes. Emerging methodologies for satellite-based fingerprinting and early warning indicators of tipping points are demonstrated in some highlight case studies, as well as novel methods for combining EO and models for improved process understanding.

tipping, warning, indicators

Pablo Tomás Paredes Berríos

University of Stirling

The Cascading Effects of an Unprecedented Drought in Mediterranean Chile: Linking Productivity Decline, Canopy Loss, and Tree Mortality

1.01 Wednesday 13:20–13:30

Prof Alistair Jump, Prof Thomas Kitzberger, Dr Sarah Greenwood, Prof Daniel Donoghue, Mr Diego Pillado, Dr Alejandro Venegas-González

Since 2010, the Mediterranean bioregion of central Chile has experienced unprecedented drought conditions, culminating in two extreme "Hyperdroughts" (Hd) in 2019 and 2021. These events caused widespread forest die-off, particularly within sclerophyllous forests dominated by *Cryptocarya alba*. To assess the consequences of such extreme conditions, this study integrates multi-scale remote sensing products and field-based mortality assessments across fifteen sites. Among 1,071 measured trees, *C. alba* populations dominated both abundance (48%) and basal area (59%), where 52% of the trees were classified as highly stressed or dead (<25% of alive canopy). Consistent with this, UAV canopy classification revealed defoliation rates ranging from 46.7% to 57.5%. Local NDVI timeseries showed that 80% of sampled sites experienced a persistent decline in 2019 or 2021, presumably linked to the Hd, and 53% showed no subsequent recovery. Regional productivity timeseries reveal significant declines in vegetation productivity following the 2019 Hd, showing a regional-level decline in forest health, strongly linked to the Hd at local ($r = 0.80$) and regional ($r = 0.75$) level. This study provides robust evidence of drought-induced forest mortality in a highly vulnerable Mediterranean ecosystem, which could work as a worst-case scenario due to the severe effects of this unprecedented drought conditions. Our findings underscore the urgent need for a deeper understanding of the ecological implications of prolonged and extreme droughts, raising concerns about the future of Mediterranean-type forests. By linking regional-scale remote sensing with field validation, this research offers critical insights into the cascading effects of climate change on forest health.

Luke Brown

King's College London

Towards improved EO-based leaf and canopy water content products via low-cost non-destructive in situ reference measurements

1.01 Wednesday 13:30–13:40

F. Mark Danson

Quantifying the water within plant leaves (i.e. leaf and canopy water content) is central to more efficiently managing agricultural production and the use of limited water resources, and is equally critical for wildfire risk assessment, forecasting, and early warning. Traditional gravimetric measurements are labour-intensive and time-consuming, limiting assessment of spatial variation, and are not appropriate for all environments due to their destructive nature. Earth observation (EO) retrievals have potential to overcome these challenges, but existing products and algorithms are poorly validated due to a severe lack of in situ reference data. To fill this gap, we investigate low-cost ($< \text{£}150$) transmittance meters, making use of radiative transfer simulations and dehydration experiments to test their theoretical and real-world sensitivity to leaf water content. Our results reveal strong relationships with equivalent water thickness (EWT) ($r^2 \geq 0.85$) and fuel moisture content (FMC) ($r^2 \geq 0.81$), indicating that a non-destructive in situ measurement instrument can be manufactured using inexpensive and readily available components. We discuss the potential of the measurement approach to provide in situ reference data for validation of EO-based retrievals, as well as progress towards fiducial reference measurement (FRM) status via metrological uncertainty characterisation. We then highlight a path towards improved EO-based leaf and canopy water content products, following data-driven and uncertainty-aware retrieval approaches established in the ESA GROUNDED EO project.

leaf water content, canopy water content, calibration/validation

Jack Samuel Marchant

Durham University

An improved canopy height model for the forest-tundra ecotone

1.01 Wednesday 13:40–14:00

Professor Daniel Donoghue, Professor Robert Baxter, Sophia Cunningham

The forest-tundra ecotone (FTE) represents the largest ecological boundary on Earth. Trees within this region take unusual growth forms, often presenting as short, stunted, and deformed, while exhibiting complex spatial patterns involving small, isolated individuals or patches. This complexity makes canopy height modelling difficult and likely means canopy height models (CHMs) trained on forests in lower latitudes and extrapolated into the FTE may not represent trees in this region accurately. Therefore, this study produced a CHM within the FTE through integration of regional ALS data and satellite imagery, with the aim of improving upon existing CHM products. Sentinel-1/2, PlanetScope, and Pleiades 1A/1B based models were produced using a range of machine learning algorithms. Predicting maximum canopy height using PlanetScope and an artificial neural network outperformed three globally extrapolated CHM products, with an RMSE half that of the next best model (RMSE = 2.13 m), and a data distribution indistinct from the field height values. Proportional biases in model predictions were corrected using orthogonal regression, but wall-to-wall mapping displayed substantial overprediction. Therefore, the predicted area was constrained using an attention augmented U-Net + ResNet-50 encoder backbone for binary semantic segmentation, capturing forest area well but with suboptimal precision. Overall, this study demonstrates that canopy height magnitude in the FTE is best predicted using PlanetScope predictor data, and that derivation of a regionally trained model leads to significant improvement upon other CHM products, although challenges remain in finding the balance between over and under prediction of forest area in the FTE.

canopy height, treeline, modelling

Ana Andries

Surrey University

Space4Nature

1.01 Wednesday 13:50-14:00

Space4Nature is a 3.5-year partnership between Surrey Wildlife Trust, University of Surrey, Buglife and Painshill Park Trust, that demonstrated how EO, AI, and citizen science can transform habitat monitoring and nature recovery. The project gained global attention, receiving Space for Climate Observatory accreditation, being showcased by the UK Government at COP as a national example of innovation for biodiversity recovery, and winning the OS Geovation Innovation Awards. At its core, Space4Nature addressed a major conservation challenge: the lack of fine-scale, up-to-date habitat evidence needed to restore fragmented priority habitats. More than 300 volunteers contributed collecting over 1,000 structured habitat surveys across Surrey, creating a rich ecological dataset for chalk grassland, heathland and acid grassland mapping (UK Hab Level 4). These surveys were combined with PlanetScope imagery, environmental datasets (e.g. topographic parameters and soil data) via machine learning to produce habitat maps that can support conservation planning and Local Nature Recovery Strategies. Model performance varied by habitat and internal and independent validation method: chalk grassland mapping achieved very high accuracies, while heathland mapping achieved strong model accuracy but lower ground-truth validation, highlighting both the promise and the challenges of mapping complex semi-natural habitats. Acid grassland modelling is currently under developing, extending this approach further. Overall, Space4Nature provides a scalable model for integrating citizen science, ecological expertise and satellite data into practical nature recovery. Likewise, the project also delivered direct on-the-ground impact. Through Buglife's B-Lines work, more than 62 hectares of habitat were created or improved across 22 sites and 13 landowners, with long-term management agreements in place to support pollinators and threatened species.



Wednesday 13:00

**Carbon, Biomass &
Natural Capital**

Room 1.06

Mathew Williams

University of Edinburgh

A model-data fusion diagnosis for spatial distribution of biomass carbon and net biome production across the world's largest savanna

1.06 Wednesday 13:00-13:10

Luke Smallman, Iain McNicol, Kyle Dexter, Casey Ryan, and David Milodowski

Southern African woodlands (SAW) are the world's largest savanna, covering ~3 M km², but their carbon balance and its spatial variability are poorly understood, challenging international reporting and action for climate. Here we quantify the dynamics of the regional carbon cycle, diagnosing stocks and fluxes and their interactions with climate and disturbance (largely fire) by combining earth observations of components of the C cycle with a process model. Using 1500 independent 0.5° pixel model calibrations, each constrained with local earth observation time series of woody carbon stocks (C_{wood}) and leaf area, and forced with climate, burned area and forest loss data, we produce a regional C analysis (2006-2017) with full uncertainty analysis. The regional net biome production is neutral, 0.0 Mg C ha⁻¹ yr⁻¹ (95% Confidence Interval -1.7 - 1.6), with fire emissions contributing ~1.0 Mg C ha⁻¹ yr⁻¹ (95% CI 0.4-2.5). The emergent spatial variation in biogenic fluxes and C pools is strongly correlated with mean annual precipitation and burned area. But there are multiple, potentially confounding, causal pathways through which variation in environmental drivers impacts spatial distribution of C stocks and fluxes, mediated by spatial variations in functional parameters like allocation, wood lifespan and fire resilience. The C budgets generated in this analysis can support more robust and observationally consistent national reporting in the SAW region for the Paris Agreement of the UNFCCC. The detailed resolution of the outputs, with locally valid functional characteristics, can enhance national CO₂ emission factors for fire disturbance, for instance.

Luke Smallman

University of Edinburgh

How have recent climate extremes impacted the UK's managed grasslands?

1.06 Wednesday 13:10-13:20

Vasilis Myrgiotis, Mathew Williams

Grasslands are an important ecosystem covering more than a third of the global land area (40 % in UK). They support livelihoods (e.g. through grazing and cutting activities), but their soil are also large carbon stores with the potential to be significant sinks making their sustainable management a priority for contributing to climate regulation as well as maintaining provisioning cycles. Despite their importance we still lack a robust means of quantifying their carbon cycling at national scales at policy relevant spatial resolution and including the impact of climate (e.g. drought) and management (grazing and cutting intensity). Here a model-data fusion framework (CARDAMOM) was used to combine the systemic representation of a process model, DALEC, with satellite-based Earth Observation (EO) information on land cover and leaf area (from which we can infer management activities) and soil carbon stocks. The result is a data-informed systemic, uncertainty bounded analysis for 'improved grassland' within each 1-km pixel across the UK (2019-2023). The analysis will be evaluated using UK national statistics on livestock density. We then quantify the impact of recent climate extremes (e.g. 2022 heatwave and drought) on net carbon exchange, on yield from grazing and cutting activities and their interactive impact on carbon cycling. This analysis will support the identification of where and under what conditions the UK's grasslands are vulnerable to a decline in functioning. Finally, we will identify the largest remaining uncertainties and what are the observational requirements needed to address these.

grasslands, carbon cycle, sustainability

Chris Wilson

NCEO / University of Leeds

Inversions of Novel IASI Carbonyl Sulfide (OCS) Observations Indicates that Global GPP is Underestimated

1.06 Wednesday 13:20-13:30

David Moore, Jeremy Harrison, Michael Cartwright, Martyn Chipperfield, Tristan Quaife, Mary Whelan

Carbonyl sulfide (OCS) is an atmospheric trace gas with various natural and anthropogenic sources and sinks. It is taken up by plants during photosynthesis, similarly to carbon dioxide (CO₂), but is not then re-released during respiration. It therefore has great potential for quantifying the biosphere's gross primary production (GPP), which is difficult to constrain using CO₂ observations alone. We use the TOMCAT atmospheric transport model to simulate atmospheric OCS mixing ratios, comparing to surface flask observations and column OCS retrievals from the IASI instrument onboard EUMETSAT's Met-Op B satellite. These IASI data are novel, based on the University of Leicester IASI Retrieval Scheme (ULIRS). Retrievals show evidence of significant biosphere-based OCS uptake in tropical regions not well-monitored by surface-based observations. Our previous versions of this work were based only on IASI retrievals over the oceans, but land-based retrievals have now also been produced for the first time, allowing for unprecedented analysis of biospheric OCS cycles. We assimilate the data into a global atmospheric inversion system, INVICAT, to optimally constrain OCS fluxes. Our results indicate that current state-of-the-art flux products underestimate vegetative uptake in many regions, particularly North America and the tropics, by over 50%. This further implies that current estimates of global GPP are also too low. This is the first time that OCS satellite retrievals sensitive in the troposphere were assimilated to estimate surface uptake. This work will allow NCEO to provide a vital assessment of the sensitivity of the biosphere to drought and heat stress into the future.

Liang Feng

University of Edinburgh

Role of Tropical Biosphere in Recent Fluctuations in the Global CO₂ Growth Rate

1.06 Wednesday 13:30-13:40

Liang Feng, Paul I. Palmer, Luke Smallman, Dongxu Yang, Jing Wang

Global atmospheric CO₂ growth rates (CGR) have shown strong fluctuations in recent years, with the largest increases typically occurring during El Niño events. In particular, the CGR reached a historical high of 3.71 ppm/yr in 2024, followed by a below average increase of 2.26 ppm/yr in 2025. Variations in the CGR are largely driven by interannual variability in terrestrial carbon fluxes, especially in the tropics, although the underlying mechanisms and relative contributions of key processes remain poorly constrained. Here, we use an ensemble Kalman filter to estimate CO₂ fluxes by assimilating in situ and satellite observations of atmospheric CO₂ concentrations over the 2015-2025 period. Our results show that tropical land regions dominate the observed variability in CGR. During the major El Niño events of 2015-2016 and 2023-2024, the net biosphere exchange (NBE) over tropical South America increased by approximately 0.8–1.5 PgC /yr relative to climatological conditions. Using a terrestrial biosphere model and an AI based model, we further investigate the relationship between NBE anomalies and key environmental drivers, including temperature, soil moisture, precipitation, and vapour pressure deficit. We find that the hot and drought conditions in 2023-2024 explain most of the unprecedented NBE increase over tropical South America. Finally, we assess the relative contributions of reduced gross primary productivity versus enhanced ecosystem respiration to these anomalies.

Tristan Quaife

NCEO

Evaluation of JULES-SIF against TROPOMI data

1.06 Wednesday 13:40-13:50

Natalie Douglas

The use of Solar Induced Fluorescence (SIF) to evaluate land surface models shows considerable promise in helping to elucidate the processes that control Gross Primary Productivity (GPP) on large spatial scales. This presentation describes the prediction of SIF from JULES, the Joint UK Land Environment Simulator, which is the land surface scheme of the Hadley Centre climate models and the UK Earth System Model (UKESM). We explain how we couple leaf-level SIF models to the biochemistry routines in JULES, and how we scale the emitted SIF to the canopy level using a vegetation radiative transfer scheme (L2SM) that is consistent with the physics inside JULES but also allows for radiative emissions within the canopy. The SIF scheme includes attenuation within the leaf, utilising either modelled or observed leaf reflectance and transmittance spectra and can make predictions of the canopy leaving SIF at arbitrary wavelengths. Downregulation of fluorescence by water stress is also included. We show results from JULES-SIF at regional and global scales and make comparisons against TROPOSIF data. The results show good agreement against forests globally but appear to underestimate SIF for grasslands and especially crops. We explore hypotheses that could explain this discrepancy, including whether JULES is simulating enough vegetation and the impact of water stress. A key result of this process is that our JULES-SIF predictions are sufficiently well aligned with the observations that they are able to highlight areas where JULES is not correctly modelling the relevant environmental processes.

Susie Sun

University of Edinburgh

Amazon forest structure mediates SIF and isoprene responses to drought

1.06 Wednesday 13:50-14:00

Paul Palmer, Brian Kerridge, Richard
Siddans

Tropical forests play a central role in regulating atmospheric composition through tightly coupled carbon uptake and biogenic volatile organic compound emissions, however their joint responses to drought remain poorly constrained at continental scales. Satellite observations of solar-induced chlorophyll fluorescence (SIF), a proxy for photosynthetic activity, and atmospheric isoprene columns provide complementary constraints on these processes. Here we show that SIF and isoprene increase with forest cover across the Amazon but diverge under drought stress. SIF responds rapidly to water limitation, declining as photosynthetic efficiency is impaired by rising vapour pressure deficit and thermal stress, whereas isoprene exhibits strong temperature sensitivity, and can increase under heat and moderate water stress, due to its protective role in leaf thermotolerance. This divergence can weaken or even reverse correlations between SIF and isoprene anomalies at large scales, reflecting contrasting metabolic and thermal controls. We find that forest structure critically mediates these responses: intact forests exhibit buffered SIF declines consistent with deep rooting, hydraulic redistribution, and access to stored soil moisture, while fragmented forests show amplified drought sensitivity. Spatial heterogeneity further reveals enhanced thermal sensitivity of SIF but reduced isoprene sensitivity in montane regions, with the inverse pattern in lowlands. Despite intensifying drought and warming, our results indicate substantial functional resilience in intact Amazon forests, while highlighting structural controls on biosphere-atmosphere feedbacks under climate change.



Wednesday 13:00

**Oceans, Coasts &
Marine Systems**

**Sustainable Development,
Social Impact & Policy**

Room 1.09

Alison Fowler

University of Reading

Flexible Estimation of Model and Observation Error for Shelf-Sea Biogeochemistry Forecasting

1.09 Wednesday 13:00-13:10

Yumeng Chen

Forecasts of marine biogeochemistry in the shelf seas surrounding northwest Europe are vital for marine conservation and monitoring ocean health. They are also important for supporting activities in the marine food sector and for providing visibility forecasts for defence operations. The accuracy of these forecasts relies on the assimilation of satellite ocean colour data. To ensure optimal use of this information, it is essential to correctly specify the error statistics of both the forecast model and the ocean colour observations. However, this is challenging due to multiple sources of error and the complex interaction between model and observational errors. We present a new software tool that is based on statistical analysis of model–observation differences. It enables flexible, accurate, and efficient estimation of error statistics and supports exploration of how best to parameterise them for inclusion within the forecasting system. Previous implementation of these new error statistics within the Met Office’s AMM7 northwest European shelf-sea forecasting system reduced significant biases in the magnitude of spring bloom chlorophyll a concentrations by up to 50%. This approach has since been implemented operationally. The new software tool allows the error statistics to be updated flexibly as the forecasting system evolves. We provide examples of how the error statistics change with model resolution, constrained variables, and the choice of observation dataset. This offers insight into the underlying sources of error and how to adapt the assimilation system to ensure optimal use of all available data and improved accuracy of marine biogeochemistry forecasts

marine biogeochemistry, ocean colour

Yumeng Chen

University of Reading

**Effects of assimilating
phytoplankton carbon in marine
ecosystem modelling in
NEMO4.0.4-MEDUSA2.0-PDAF2.0**

1.09 Wednesday 13:10-13:20

Dale Partridge, Lars nerger,
Alison Fowler

The state of the marine ecosystem can be estimated by a combination of numerical models and satellite observations through data assimilation (DA) methods. Satellite data representing phytoplankton chlorophyll are typically used in operational marine ecosystem prediction. These data are derived from ocean colour from optical satellite observations. Recently a novel phytoplankton carbon product, from the ESA funded BICEP project available from the UK CEDA Archive, has been derived through an alternate processing of ocean colour. With the novel carbon product, the phytoplankton biomass is represented more directly than relying on the chlorophyll. Here, we investigate the effects of assimilating the new carbon product on the modelling of the marine ecosystem. The investigation is carried out in a newly developed global ensemble DA system for the marine ecosystem using a coupled ocean-biogeochemistry model, NEMO-MEDUSA, and the Parallel Data Assimilation Framework. With the ensemble DA system, the evaluation can take the time-dependent uncertainty of the marine ecosystem and the reliability of the ensemble into account. We demonstrate that, compared with solely assimilating chlorophyll product, with the new carbon product the DA can provide different patterns of adjustments in the phytoplankton concentration and seasonal anomalies. Our findings reveal that simultaneously assimilating both phytoplankton chlorophyll and carbon products in a complex marine ecosystem yields more accurate and balanced estimates of phytoplankton biomass than assimilating a single phytoplankton product. Further, we use statistical consistency metrics to quantify the uncertainties and cross error correlations between the chlorophyll and carbon products.

marine biogeochemistry, data assimilation, carbon

Gavin Tilstone

Plymouth Marine Laboratory

**High performance of
phytoplankton pigment
estimation in the open ocean
from hyperspectral above-water
reflectance**

1.09 Wednesday 13:20-13:30

Thomas M. Jordan, Robert J. W. Brewin,
Giorgio Dall'Olmo

Estimation of phytoplankton pigments from ocean colour radiometry is a key step toward characterisation of phytoplankton functional groups at the global scale. The accuracy and number of pigments that can be retrieved from multispectral ocean colour satellites is limited. Hyperspectral remote sensing (e.g. from NASA PACE and future ESA CHIME) is expected to provide a step-change in the performance of pigment retrieval algorithms. Development and testing of these new algorithms ideally require co-located measurements of hyperspectral reflectance and phytoplankton pigment concentrations. To this end, we present an eight-cruise compilation of hyperspectral above-water reflectance from the UK Atlantic Meridional Transect (AMT) co-located with > 200 surface HPLC pigment samples. The near-continuous reflectance data from the AMT provides proof-of-concept for mapping pigments along cruise tracks and use of autonomous data for algorithm development. We use the AMT database to train, tune, and evaluate the performance of a hyperspectral algorithm that can potentially provide global pigment products from NASA PACE. The algorithm uses bio-optical modelling and spectral derivatives to isolate higher-frequency absorption features, which are used to construct a statistical model for pigment concentrations. We demonstrate high performance (absolute percentage error ~ 15-35%, log correlation coefficients > 0.75) for the estimation of > 15 pigments. We compare with Chlorophyll-a co-variation relationships, which illustrates the additional information that can be obtained from hyperspectral data. We conclude by describing how the AMT data are being combined with other high-quality measurements to produce an extensive hyperspectral algorithm development dataset across a range of water types.

Jozef Skakala

Plymouth Marine Laboratory

Deep learning model emulators for marine biogeochemistry forecasting from days to decades

1.09 Wednesday 13:30-13:40

Ieuan Higgs, David Moffat

Deep-learning emulators have emerged as a promising approach for reducing the computational cost of Earth System Models while potentially improving forecasting skill. Here, we demonstrate the successful emulation of a high-complexity marine biogeochemistry model within a simplified one-dimensional water-column framework. We explore two emulator architectures: Long Short-Term Memory (LSTM) neural networks that emulate a selected subset of variables at daily resolution, and physics-informed one-dimensional Convolutional Neural Networks (1D CNNs) that emulate the full pelagic system throughout the water column also at daily resolution. Using ocean physics simulator inputs, both emulators remain largely stable over multi-decadal timescales and accurately reproduce the parent model in both decadal climate projections and short-range (10-day) forecasting applications. The former includes the ability to predict the timing of phytoplankton Spring blooms several years in advance. When trained on reanalysis data, the emulators substantially outperform the parent model's forecast skill score for several key ecosystem variables, including phytoplankton and zooplankton. If similar performance can be achieved in three-dimensional regional applications, these emulators could provide substantially higher-quality predictions at a fraction of the computational cost. We further apply novel explainability techniques to identify key drivers of emulator behaviour and gain insights into emergent ecosystem dynamics. Performance is evaluated using a range of metrics, including the reproduction of daily variability and extreme events. These approaches have considerable potential for future applications in operational forecasting, climate-scale simulations, and marine autonomous systems.

Abdulazeez Tukur

University of Dundee

Integrating Remotely-sensed and Agronomic Information into Machine Learning Framework for Real-Time Nitrogen Diagnosis in Spring Malting Barley

1.09 Wednesday 13:40-13:50

Mark Cutler, Alexandra Morel, Debbie Sparkes, Katherine Smart, Matthew Crow, and Steve Hoad

Efficient and effective nitrogen (N) management is critical in spring malting barley production, where fertilizer decisions must simultaneously maintain strict grain quality specifications for the malting industry, maximize yield, and minimize environmental impacts. Real-time assessment of crop N status in-season can support sustainable crop production, whilst proximal hyperspectral sensing has shown promise for rapid, non-destructive monitoring of crop N dynamics and offers a pathway to account for temporal variability in crop growth and nutrient demand, supporting the development of precision fertilizer management strategies. This study developed and evaluated a machine learning (ML) framework for real-time estimation of canopy nitrogen content (CNC), nitrogen nutrition index (NNI), and nitrogen requirement (NR) of the crop using spectral and agronomic predictors. A three-year field experiment was conducted in Scotland, UK, between 2023 and 2025. Spectral reflectance measurements were acquired at key growth stages using field spectroradiometers and processed to derive various narrow-waveband indices. These indices were integrated with measurements of chlorophyll a concentration and total above-ground biomass within Support Vector Regression (SVR) models and achieved strong independent testing performance, with R^2 values of 0.90, 0.85, and 0.89 and RMSE of 5.32 kg N ha⁻¹, 0.11, and 2.94 kg N ha⁻¹ for CNC, NNI, and NR, respectively. Red-edge spectral information contributed 20%, 56%, and 22% to CNC, NNI, and NR prediction, respectively. These results demonstrate that the remotely-sensed driven models can reliably guide in-season N management decisions and that integrating red-edge spectral indicators with agronomic information enables operationally relevant N diagnostics for spring malting barley.

barley, nitrogen, requirement

Jonathan Shears

CGI UK

Climate Smart Farming - a novel approach to climate adaptation in farming

1.09 Wednesday 13:50-14:00

Prof Kevin Tansey, Simon Ighofose

The Climate Smart Agriculture project is a refreshingly innovative solution designed to accelerate sustainable agricultural development by combining Earth Observation, machine learning and clean agri-tech to deliver practical social impact for farmers. The new Cloud based service available via the UK's Earth Observation Data Hub (EODH) fuses Sentinel-2 satellite data with non-space datasets such as tracking of ploughing, harvesting and seeding activity data from a digital farming platform and using in-situ based bio-produced fuel and biochar from a novel clean-energy operations. The service provides business intelligence for mechanised farming, fertiliser optimisation and local bioenergy production. Its novelty lies in applying Long-Short Term Memory (LSTM) Deep Learning model techniques, including crop field delineation, mechanisation detection and yield-linked fertiliser ROI estimation, to turn EO time-series data into business-ready decisions for farmers. The approach is climate-friendly and circular by design. Agricultural residues are identified, harvested and converted locally through a containerised pyrolysis technology into biofuels, electricity and biochar, reducing waste while creating 100% biogenic products. The resulting biochar supports durable carbon removal, improves soil moisture retention and hence strengthens climate resilience, while renewable biofuels help displace fossil diesel in farming operations. This offers a pathway to reduce global fossil-fuel dependency and, by scaling residue-derived biofuels, support greater UK resilience against imported energy supply pressures. By bridging space and non-space technologies, this project aims to create a scalable model for EO-enabled climate action: improving farmer productivity, opening new rural revenue streams, supporting circular economy principles, and helping communities transition towards low-carbon, climate-smart agriculture.

carbon removal, machine learning, sustainability

Freya Muir

European Space Agency

Visualising global climate data - European Space Agency's Climate Change Initiative

1.09 Wednesday 14:00-14:10

Paul Fisher, Sophie Hebden, Freya Muir,
Philip Eales

Article 12 of the Paris Agreement highlights the importance of public understanding, education and participation in addressing climate change. The European Space Agency (ESA) has, in recent years, implemented a range of science communication activities to raise awareness of the critical role satellites - and their continuous, global observations - play in understanding and addressing climate change. These activities target scientists, policymakers, the public and students, with emphasis on data visualisation, storytelling and targeted multi-channel communication. At the core of this effort is ESA's Climate Change Initiative (CCI), a research and development programme developing high-quality global, satellite derived datasets for key aspects of the climate, known as Essential Climate Variables (ECVs). Spanning five decades, these records provide the empirical evidence needed to track change, identify trends, issue early warnings and improve projections of future climate change. They also support the work of the UNFCCC and contribute directly to IPCC climate assessments. To enhance dataset accessibility and engagement, ESA has developed intuitive data visualisations for print, broadcast, social media and exhibitions, including 2D maps, 3D graphics and animations. An interactive web application enables users to independently explore, compare and discover patterns in these time series via a virtual globe. These visualisations have also been showcased on interactive displays - such as touch tables, video walls and spherical screens - at ESA facilities, museums, science conferences and international events, including the annual UN climate summits.

visualisation, communication, climate



Thursday 10:30

**Biodiversity, Habitat
& Ecosystems**

Room 0.04

Md Saidur Rahman

Durham University

Monitoring coastal change and mangrove dynamics along the coasts of Guyana and Suriname

0.04 Thursday 10:30-10:40

**Daniel N. M. Donoghue, Isabella Bovolo,
Ruben Coppus, Sieuwnath Naipa, Zane
W, Havens, Ryan Pereira, Thomas
Wagner**

The coasts of Guyana and Suriname are highly dynamic and vulnerable, shaped by strong sediment transport from the Amazon basin, migrating mud banks, sea-level rise, and increasing anthropogenic pressures. In this coastal zone, these processes drive rapid shoreline shifts, coastal erosion, and flooding risks, while also affecting mangrove ecosystems that serve as critical natural coastal defences. Continuous and integrated monitoring is therefore essential to better understand these evolving conditions and to support effective coastal management and climate adaptation strategies. As part of the DEFRA funded ENHANCES project, we applied a multi-scale monitoring framework that combines satellite observations with high-frequency monthly UAV surveys to track shoreline changes and coastal morphology. At the same time, we investigated mangrove forest dynamics using advanced remote sensing techniques, including lidar, multispectral and hyperspectral imagery, to characterize forest structure, species composition, biomass and health. By linking geomorphological changes with ecosystem responses, this study improves our understanding of the interactions between sedimentary, physical, and ecological processes along this rapidly changing coastline. The expected outcomes include improved mapping and quantification of shoreline dynamics, enhanced classification of mangrove forest types and condition, and a better understanding of the role of mangroves in coastal protection. Ultimately, this work will support the development of more effective, evidence-based coastal management strategies and contribute to strengthening coastal resilience in the face of ongoing environmental change.

coastal dynamics, mangroves, remote sensing

Elizabeth Feakin

Natural England

The England Peat Map: EO and Machine Learning for Decision-Making

0.04 Thursday 10:40-10:50

Sam Dixon, Christoph Kratz

The England Peat Map (EPM) is a Natural Capital and Ecosystem Assessment-funded project delivered by Natural England to provide nationally consistent, high-resolution maps of peatland extent, depth and vegetation across England. EPM underpins a wide range of policy, reporting and project delivery needs across the Department for Environment, Food and Rural Affairs group. EPM represents the most comprehensive national evidence base for peaty soils in England and is published under an open licence. The maps are produced with an XGBoost and Deep Learning architecture using Sentinel-1, Sentinel-2, Environment Agency's lidar, geology and soils data. Extensive soil surveys and hundreds of thousands of records supplied by partner organisations trained the models. Following the initial publication of EPM in July 2025, the next phase of the project focuses on improving the quality of peatland mapping for environmental decision making through incorporating spectral indices, recent and historical climate data and scoping the application of L-band SAR. We are also carrying out strategic surveys; peaty soils surveys will target lowland environments, and vegetation surveys will improve spatial coverage and reduce class imbalance. Additionally, the project is exploring methodologies for monitoring peatland condition using vegetation change detection, InSAR to detect bog breathing, and a lidar-derived erosion and drainage features map as metrics. This presentation will provide an overview of EPM's vegetation and soil products and developments in condition monitoring. Attendees will gain insight into how cutting-edge data science is shaping peatland evidence for policy development, greenhouse gas emissions reporting, natural capital monitoring and nature recovery.

peatland, machine learning, condition monitoring

William Ray

Sinergise Solutions GmbH

Leveraging Copernicus Land Monitoring Service (CLMS) Datasets for UK Ecosystem management and conservation through Copernicus Data Space Ecosystem

0.04 Thursday 10:50-11:00

Andras Zlinszky

Amidst accelerating climate pressures and ambitious national statutory targets for nature recovery, robust, continuous, and high-resolution geospatial data has become the bedrock of effective environmental governance in the United Kingdom. This talk presents the Copernicus Land Monitoring Service (CLMS) dataset portfolio as a foundational—yet often underutilized—open-access asset for UK ecosystem management, conservation and research. Copernicus Data Space Ecosystem (CDSE) is the official data hub and cloud processing platform for Sentinel Data and CLMS data collections. CDSE integrates instant data availability with APIs, free virtual machine capacity (within a quota) and an open codebase. In addition, CDSE hosts EO-derived products such as CLMS providing geographical information on land cover and land use and their changes, ground motion, vegetation state, water cycle and Earth's surface energy variables for both Europe and the entire globe. For example, Soil Water Moisture available from 2015 across Europe, is an important parameter in monitoring drought severity on national and continental scales. Furthermore, the Urban Atlas is an important tool in monitoring urban change over time at high scale. These datasets can be combined with satellite imagery time series to create data products tailored to monitoring and decision support. CDSE makes all these datasets easy to search, download and visualise and even run detailed analysis through a single platform. Whether it is users exploring the data in Copernicus Browser or accessing the APIs directly to run complex workflows, CDSE is democratising EO data across Europe and the world.

Copernicus, cloud processing, big data

Beth Cole

Defra

Mapping England's Ecosystems: Earth Observation Applications in the Natural Capital and Ecosystem Assessment programme

0.04 Thursday 11:00-11:10

The Natural Capital and Ecosystem Assessment programme (NCEA) is transforming the way we make decisions and develop policy. NCEA is the Department for Environment, Food and Rural Affairs' (Defra) largest research and development programme, assessing England's land, freshwater, and coastal ecosystems to produce a baseline of our natural assets by 2029. The data the programme is producing is enabling a natural capital approach to policy and decision-making and helping to ensure we invest in environmental reforms that achieve maximum benefit. The NCEA programme portfolio includes a suite of mapping products that utilise and integrate Earth observation data and techniques, such as satellite imagery, airborne lidar, aerial photography, and machine learning. These products include the Living England habitat map, Trees Outside Woodland Map, Habitat Change Metrics and England Peat Map, each designed to show different aspects of England's natural capital. Together, they provide a joined-up picture of habitats, vegetation structure, and species, supporting both national reporting and local analysis. This session will provide an overview of these innovative products and showcase how they are being applied across government, industry, NGOs, and local authorities to support decision-making, environmental monitoring, and policy delivery.

Joseph Jones

Natural England

Living England: A ‘Guided Spectral Unmixing’ Approach for Detecting Habitat Change with EO

0.04 Thursday 11:10-11:20

Becky Trippier, Kieran McCloskey, Jade Bowling, Beth Hadfield, Elliot Petkovic, Rebecca Mein, Miles Smith, Lavanya Rajan, Amy Woodget, Sophie Potter, Nick Tomline.

In response to increasing anthropogenic pressures and climatic variability, ecological systems are predicted to become more dynamic, due to factors such as wildfires, invasive species, ecological niche shifts and unknown sources of environmental uncertainty. Accurately monitoring the resulting changes in broad-scale habitat extent is vital for nature conservation and restoration, planning and monitoring land management actions, and meeting environmental policy goals. As demonstrated by Living England’s habitat mapping programme (LE), the use of EO data within supervised classification workflows offers a rapid, repeatable and consistent method for mapping habitats at scale. Whilst such approaches provide valuable baseline assessments, they often struggle to distinguish true ecological change from subtle variations in the input data and small-scale differences in probabilistic outputs when applied across multiple time points. To address these concerns, LE is developing novel approach, by converting singular “hard” classification into continuous abundance estimations, allowing model runs to be compared across multiple timescales, termed “guided spectral unmixing”. This approach allows us to differentiate between areas of stable and mixed habitats and those undergoing seasonal variation, compositional change and/or disturbance events. Some early examples demonstrate the detection of post-burn recovery, clear-felling of woodland and land management actions. This novel method provides a repeatable, flexible framework for targeting and assessing nature recovery efforts and conducting natural capital assessments over an adaptable time frame. The LE team are now working to validate this workflow, demonstrate its capabilities and explore how it might shape future ecosystem monitoring for better informing policy and land-use decision making.

The background of the slide is a dark blue gradient. On the left side, there is a large, abstract graphic consisting of numerous thin, glowing blue lines that crisscross the space. Overlaid on these lines are several bright, white, particle-like trails that appear to be moving or expanding from a central point, creating a sense of dynamic energy and digital connectivity.

Thursday 10:30

AI & Digital Infrastructure

Room 1.01

Amos Lawless

NCEO / University of Reading

Machine learning of forecast
error covariances

1.01 Thursday 10:30–10:40

Ravi Shankar Nemani, Ross Bannister,
Hong Wei, Christopher Thomas

By quantifying uncertainty in numerical forecasts, error covariances play a central role in Earth observation. They are widely used both to characterize model prediction errors and to determine the relative weight given to the model forecast in data assimilation. Often the forecast error covariances are estimated from an ensemble of model simulations starting from slightly different initial conditions or parameters. However, this can be computationally challenging when the numerical model is expensive to run. In this work we develop a machine-learning method to estimate error covariances from a single forecast. The method is tested in a hectometric weather forecasting scenario using the Met Office's 300m-resolution Wessex model. An 18-member lagged ensemble was run over a domain in south-west England during the summer of 2023. Using this ensemble we calculate the structure of the vertical error correlations in convective and non-convective situations. These ensemble covariances are then used to train a machine-learning model to predict the vertical error covariance matrix from only the background forecast. We show how the machine-learning model can successfully reproduce realistic covariance structures from a single forecast. However, care must be taken to ensure that the resulting matrices are symmetric and positive definite.

data assimilation, machine learning, uncertainty quantification

Khunsa Fatima

University of Leicester

Developing a Multimodal AI Framework for Wetlands Mapping with Multi-Sensor Earth Observation Data

1.01 Thursday 10:40-10:50

Robert Parker, David Moffat,
Chandanca Pantula, Cristina Ruiz
Villena, Jeremy Emmett

Wetlands, though covering only about 6% of Earth's land surface, are among the largest natural sources of methane; a greenhouse gas with a global warming potential over 25 times that of CO₂ over a century. Accurate and up-to-date wetland extent data are essential to quantify tropical wetland methane emissions and improve climate change predictions. This study presents a multimodal deep learning framework that integrates Earth Observation (EO) datasets including MODIS, Sentinel-1/2, PlanetScope, and DEM for wetlands mapping across the tropics and subtropics. The framework is structured into three phases. In Phases I and II, MODIS imagery along with Copernicus GLO-30 DEM were used. Four band MODIS composites were used to compute NDVI and NDWI, and histogram thresholding of these indices produced three classes: water, vegetation, and other. DEM derived aspect refined classification, especially for narrow channels and small water bodies. The DEM was resampled to 500 m to match MODIS. MODIS 4 bands, DEM, and classified images were used to train six CNN models namely UNet, UNet++, DeepLabV3+, SegNet, PSPNet, and FPN for semantic segmentation of images. UNet exhibited highest prediction performance with overall accuracy of 94% and F1 scores of 0.93 and 0.87 for water and vegetation, respectively. Trained UNet was used to create seasonal, annual, and permanent water maps, along with water–vegetation interaction maps. In the phase III, the capabilities of the AI- framework will be expanded by incorporating additional EO datasets to enable detailed classification of diverse wetland types e.g. mangroves, peatlands, marshes, and bogs. The final outputs will include high-resolution wetland maps, validated against existing datasets, providing a scalable and transferable tool to support accurate methane emission estimates, enhance climate change predictions, and serve as a critical input to emerging digital twin frameworks for Earth system monitoring.

Aleksei Unagaev

Deep Planet Ltd

Earth Observation and Deep Learning for the Beauty Industry in Europe: Lavender Crop Monitoring in Bulgaria and France

1.01 Thursday 10:50-11:00

Yunxin Wu

Lavender (*Lavandula angustifolia*) is an important industrial crop and a critical raw material for the global beauty, fragrance and cosmetics industry, although its cultivation remains poorly represented in conventional agricultural monitoring frameworks. Currently, existing crop mapping approaches predominantly developed for traditional crops, rely mostly on quantitative approaches – vegetation indices time series analysis – an approach that struggles when target crops share spectral signatures or growing seasons with surrounding crops. This work presents a deep learning-based framework for lavender field detection and trend monitoring across Bulgaria – the world's largest lavender oil producer – and France, the historical centre of the fragrance industry. The system is built on a ResUnet segmentation architecture trained on multi-temporal Sentinel-2 imagery, reflecting lavender's distinctive flowering period spectral signature in combination with traditional and custom-developed vegetation index time series to capture phenological dynamics across seasons. The key methodological contribution is the introduction and integration of advanced satellite image interpretation techniques – utilising colour, texture, shape, and field structure as interpretation signs – combined with public and online-user datasets, cartographic, statistical, and phenological data to enable reliable crop identification, including regions where ground truth data is scarce. The pipeline supports year-on-year trend analysis of lavender distribution, detecting cultivation expansion and geographic shifts. Outputs directly serve beauty industry resource transparency, providing an independent, satellite-derived analysis of production trends across European regions.

deep learning, image interpretation, crop monitoring

Sandip Dhomse

University of Leeds

TCOM V2.0: A Gap-Free, Observationally Constrained Global Dataset of Stratospheric Trace Gas Profiles Using Machine Learning

1.01 Thursday 11:00-11:10

Prof Martyn Chipperfield

Accurate quantification of long-term stratospheric trends is essential for evaluating the effectiveness of the Montreal Protocol and understanding the evolution of the Brewer–Dobson circulation. However, trend analysis is often hampered by the inherent spatial and temporal sparsity of high-quality satellite observations. To address this, we present the TCOM (TOMCAT CTM and Occultation Measurement-based) version 2.0 datasets, which provide continuous, gap-free, global daily vertical profiles for a wide range of essential trace gases from 2000 to 2025. The TCOM framework utilise a synergistic approach, integrating sparse observations from the Atmospheric Chemistry Experiment (ACE-FTS) with the continuous background fields of the TOMCAT Chemical Transport Model (CTM). Using an XGBoost regression algorithm, the model is trained to identify and rectify systematic biases in the CTM simulations. Evaluation against independent benchmarks, such as the SPARC v2 compilation, confirms that TCOM successfully removes prominent model offsets—particularly the systematic low bias in the middle stratosphere—aligning the dataset closely with rigorous observational constraints. Interpretable machine learning analysis via SHAP values reveals that the XGBoost model primarily functions as a "transport corrector," using dynamical features like Age-of-Air, temperature, and potential vorticity to compensate for deficiencies in simulated stratospheric circulation. While primarily focused on CFC-11 and CFC-12, the V2.0 release has been expanded to include gap-free records for O₃, H₂O, CH₄, N₂O, HCl, HF, HNO₃, COF₂. For details see <https://tomcat.leeds.ac.uk/tomcat/tcom/>. These datasets are publicly available on Zenodo and serve as a valuable benchmark for refining chemical transport and climate models, helping to reduce uncertainties in long-term atmospheric trend analyses.

stratosphere, Montreal Protocol, machine learning

Enes Hisam

GMV-UK

Fusing Foundation-Model Land-Cover Change and Ground Deformation for Railway Vulnerability Mapping within the UK EO DataHub

1.01 Thursday 11:10-11:20

Enes Hisam, Dhritiraj Sengupta

Railway infrastructure is exposed to gradual risks such as ground subsidence and nearby development, which can be difficult to identify through routine inspections alone. This study presents a satellite-based workflow for mapping railway vulnerability by combining land-cover change and ground deformation information within the UK Earth Observation DataHub (EODH). The analysis covered a 10 km railway corridor near Winchester, Hampshire, with a 500 m buffer on either side of the track. Two Airbus Pléiades Neo images (0.3 m resolution) acquired in June 2022 and March 2025 were analysed alongside European Ground Motion Service (EGMS) deformation data derived from Sentinel-1. Processing was undertaken in the EODH JupyterHub environment using DASK. Land-cover classification and change detection were performed using ChangeStar, pre-trained on synthetic datasets generated by the Changen2 foundation model, while SamGeo was used to delineate detailed features within change hotspots. A vulnerability index combining hazard, sensitivity, and land-cover transition factors was then calculated and grouped into five classes. Results showed clear spatial variation along the corridor. Urban sections were generally characterised by stable ground conditions, with vulnerability largely driven by land-use sensitivity. In contrast, the northern section in the vicinity of recent development expansion exhibited elevated ground-movement risk. These areas highlight locations where new construction may increase pressure on railway assets and where targeted monitoring could help identify emerging issues at an earlier stage. The study demonstrates how EODH can support scalable and repeatable railway monitoring by providing access to commercial EO data and cloud-based processing resources for advanced geospatial analytics.

railway vulnerability mapping, geospatial foundation models, UK EO data hub



Thursday 10:30

**Meteorology &
Atmospheric Chemistry**

Room 1.04

Andrew Matheson

University of Edinburgh

SNEEZI (Sensing NO₂ Emissions to Evaluate net-Zero Initiatives)

1.04 Thursday 10:30-10:40

Health officials, policymakers and the public are becoming increasingly aware of the dangers of long-term exposure to air pollutants such as nitrogen dioxide (NO₂). NO₂ is strongly linked with respiratory diseases and plays a key role in the production of other air pollutants such as surface ozone and particulate matter. NO₂ is also a greenhouse gas, and its short atmospheric lifetime and low ambient levels, means that atmospheric plumes of NO₂ from combustion sources are more easily detected than CO₂ plumes – this makes NO₂ a useful proxy for CO₂, which is co-emitted during combustion. Increased spatial and temporal resolution of satellite observations of NO₂, could thus improve the ability to identify, quantify, and attribute emissions. This offers significant potential benefits for governments, regulators, industry, public health bodies, as well as the general population. SNEEZI (Sensing NO₂ Emissions to Evaluate net-Zero Initiatives) is a project to develop a high resolution NO₂ remote sensing system which is lightweight, low complexity, and capable of being carried on a Cube Sat - opening the possibility of a constellation of small satellites offering unprecedented spatio-temporal coverage. To achieve this, we propose a multispectral system with high throughput at key wavelengths in the NO₂ absorption spectrum. We will outline the concept and design of the system, and present results taken using a lab demonstrator system, as well as outline upcoming plans for an updated system which will be used for a field campaign in 2026/27.

Chloe Schooling, Josh Vande Hey, Paul Palmer, Jerome Woodwark

NO₂ multispectral cubesat

Chloe Schooling

University of Edinburgh

SNEEZI - Advancing Satellite NO₂ Monitoring through Algorithm Development, Simulation, and Sensitivity Analysis

1.04 Thursday 10:40-10:50

A. Jerome P. Woodward, Andrew B. Matheson, Paul I. Palmer

Nitrogen dioxide (NO₂) is a key atmospheric pollutant and an important tracer of anthropogenic emissions, making its accurate monitoring critical for assessing progress towards net-zero initiatives. The Sensing NO₂ Emissions to Evaluate net-Zero Initiatives (SNEEZI) project is developing a novel CubeSat-scale mission concept capable of delivering NO₂ observations at 200 m spatial resolution using a compact instrument with 10 spectral bands. This work focuses on the development and assessment of the retrieval and data processing framework underpinning the SNEEZI mission. A Differential Optical Absorption Spectroscopy (DOAS) retrieval algorithm has been refined and adapted to the constraints of a multispectral system. An end-to-end simulation environment has been developed to model the full observation chain, from atmospheric radiative transfer through instrument characteristics, to retrieved NO₂ columns. Using this framework, we evaluate retrieval performance across a range of realistic surface albedo environments, derived from AVIRIS hyperspectral data. Sensitivity studies are conducted to assess the impact of atmospheric constituents and conditions, including aerosols, thin cloud, water vapour, ozone, and glyoxal. In addition, we examine the influence of the number and selection of spectral bands on retrieval accuracy, providing guidance on instrument design trade-offs. These analyses enable a comprehensive assessment of retrieval uncertainties and highlight dominant error sources. The results demonstrate the feasibility of achieving robust high-resolution NO₂ retrievals from a small satellite platform, while emphasising the importance of integrated instrument–algorithm co-design. This work supports the development of cost-effective Earth Observation capabilities for air quality monitoring and emissions tracking.

NO₂, retrieval, multispectral

Ka Lok Chan

RAL Space / STFC

An Attention-Enhanced Two-Stage Deep Learning Framework for Spatial Infilling of Cloud-Obscured TROPOMI NO₂ Columns and Seamless Estimation of Surface Concentration over Europe

1.04 Thursday 10:50-11:00

Ka Lok Chan, Ioana Circu, Barry Latter, Richard Siddans, and Brian Kerridge

In this study, we introduce an agile, observation-driven, two-stage deep learning framework to tackle the persistent problem of cloud obscuration and an over-reliance on static land-use proxies in satellite air quality monitoring. Continuous daily surface NO₂ mapping is highly necessary for accurate regional exposure assessments, yet conventional methods often bypass cloudy scenes or rely on heavily on rigid proxies like static emissions inventories, population density, and road network maps. To overcome these limitations, our proposed approach relies strictly on atmospheric dynamics and clear-sky observations. We solve the cloud-contamination problem by first utilizing an attention-enhanced U-Net with a Convolutional Block Attention Module (CBAM) to reconstruct missing TROPOMI columns using surrounding spatial context and additional meteorological data. A secondary Patch-to-Point U-Net-MLP architecture then maps these gap-filled columns into surface concentrations by integrating EU-DEM topography and ERA5 meteorology to capture localized boundary layer physics. Trained and validated via cross-validation against over 4 million unique observations from the ground monitoring network (2018–2025) across Europe, our approach achieved exceptional precision ($R = 0.950$, $RMSE = 3.79\mu\text{g}/\text{m}^3$) and a 46.3% error reduction over conventional chemical transport model "ghost column" methods under clouds. It also demonstrated robust spatial transferability ($R = 0.901$) and successfully tracked emission drops during the 2020 lockdowns ($R = 0.940$) and the 2022 energy crisis. These results indicate that our cloud-tolerant technique has significant potential for operational application in the air quality sector, particularly in regions currently underserved by surface monitoring networks alone.

Richard Pope

University of Leeds / NCEO

Satellite-driven insights of atmospheric reactive nitrogen and emission season cycles over Southern Asia in UKESM

1.04 Thursday 11:00-11:10

Dan Grosvenor (Met Office), Steve Turnock (Met Office), Catherine Hardacre (University of Canterbury - NZ), Brian Kerridge (RAL Space), Richard Siddans (RAL Space), Lucy Ventress (RAL Space), Amy Peace (Met Office) and Jane Mulcahy (Met Office)

Understanding the role of atmospheric reactive nitrogen in Earth system processes requires accurate representation of ammonia (NH_3) and nitrate aerosols in global models. In this work, we evaluate the nitrate scheme implemented in the UK Earth System Model (UKESM) using novel satellite retrievals of total column ammonia (TCNH3) from the RAL Space Infrared-Microwave-Sounding (IMS) scheme. Initial comparisons reveal that UKESM substantially overestimates TCNH3 over Southern Asia, with the largest biases during the pre monsoon and monsoon seasons. Analysis of the underlying drivers shows that the Coupled Model Intercomparison Project Phase 6 (CMIP6) emissions inventory imposes a seasonal cycle with pronounced spring and autumn peaks. This pattern is inconsistent with satellite derived NH_3 seasonality, which instead indicates a late spring-summer time maxima. This likely contributes to the model–observation discrepancies in TCNH3. To diagnose these issues, we conducted a suite of targeted sensitivity experiment on the emissions. First, we replaced NH_3 and NO_x emissions (i.e. nitrogen sources) with the updated CMIP7 inventory while retaining all other species from CMIP6. Second, we imposed the satellite derived NH_3 seasonal cycle directly onto the CMIP6 emissions. These experiments aim to isolate the key processes driving the model-satellite mismatch. We will present results demonstrating how improved emissions seasonality and updated inventories impact simulated TCNH3 and regional air quality. Our findings highlight the critical need for observationally constrained emissions to advance Earth system modelling of reactive nitrogen. Future surface observations would be beneficial to help constrain the spatiotemporal evolution of nitrogen species in the region.

Martyn Chipperfield

University of Leeds / NCEO

Recent Trends and Variability in Polar Ozone

1.04 Thursday 11:10-11:20

Sandip Dhomse, Yajuan Li, Wuhu Feng,
Saffron Heddell, Mark Weber and
Lavinia Toso

The springtime Antarctic ozone hole, which forms every year in the cold lower stratosphere, is the most dramatic manifestation of human-caused depletion of the ozone layer. Satellite observations have played a central role in revealing the extent of this ozone depletion and in determining its cause from by chlorine and bromine compounds derived from emissions of long-lived compounds such as chlorofluorocarbons (CFCs). Depletion in the Arctic, which is warmer and more dynamically variable, is on average smaller but with large interannual variability. Controls of CFCs and other gases under the Montreal Protocol are now causing stratospheric chlorine and bromine to slowly decrease, which should lead to the gradual recovery of the ozone layer. However, this recovery is not smooth. Other perturbations, such as from volcanic eruptions, injections of wildfire smoke or climate-change-induced dynamical variability can cause conditions for much larger or smaller ozone depletion. It is important to observe and understand these variations so that long-lived recovery trends can be determined. We will present satellite observations (e.g. TROPOMI) and 3-D model simulations of recent polar winter/spring periods. We will focus in particular on the Arctic where 2024 and 2026 together saw record and near-record observed amounts of ozone (i.e. since 1960). In contrast, the Antarctic experienced a run of deep ozone holes from 2020-2023 despite the expectation of decreasing size due to the Montreal Protocol. These observations will be summarised and explained, as a prelude to the imminent publication of the latest 4-yearly 2026 WMO/UNEP Ozone Assessment.

ozone, polar, halocarbons



Thursday 10:30

Inland Waters & Hydrology

Room 1.09

Martin Unwin

SSTL

Early Results from ESA HydroGNSS Scout

1.09 Thursday 10:30-10:40

Ben Stern, Nazzareno Pierdicca, Estel
Cardellach, Jean-Pascal Lejault,
Massimiliano Pastena

A new UK-designed pair of satellites has been launched to take measurements of the globe's water, as a natural resource vital to climate, weather, and life on Earth. HydroGNSS is the first mission to reach orbit from the ESA EO directorate's new Scout programme. It comprises two 70 kg satellites launched on 28th November 2025 into a sun-synchronous 530 km altitude orbit. GNSS reflectometry (GNSS R) exploits opportunistic forward-scattered L-band GNSS signal reflections enabling radar-level remote sensing performance from small satellites. HydroGNSS determines reflectivity which can be inverted into measurements of soil moisture, freeze-thaw state, inundation, wetlands, above ground biomass, ocean wind speed and sea ice extent, through use of both established incoherent Delay Doppler Maps (DDMs) and signal types not previously available from spaceborne GNSS R missions. Early orbital results confirm successful acquisition of signals from Galileo as well as GPS and first data collections from the wideband second frequency (L5 and E5a), and they exhibit stronger than predicted performance and offer much potential for improving climate relevant parameters. Signals have also been collected in the opposite polarisation from both frequencies, and the new coherent channel is showing promise for high resolution inundation sensing and expected to enable new scientific and climate applications. SSTL is working closely with science partners from across Europe on the preliminary calibration and validation of results and to prepare for preparation and distribution of data to users on behalf of ESA. This presentation will summarise the mission architecture, instrument innovations and first results from early operations.

GNSS reflectometry hydrology

Athira Anandakumar Nair

University of Surrey

Multi-Frequency SAR-Based Reconstruction of Vertical Soil Moisture Profiles with In-Situ Validation in Agroforestry Systems

1.09 Thursday 10:40–10:50

This work was conducted as part of My MSc dissertation in Space Engineering under the supervision of Dr Raffaella Guida at the Surrey Space Centre, University of Surrey.

Soil moisture is a key variable for hydrology, agriculture, climate studies, and ecosystem processes, yet most spaceborne soil moisture products remain primarily sensitive to near-surface conditions. This study investigates the reconstruction of vertical soil moisture profiles using multi-frequency Synthetic Aperture Radar observations, developed as part of an MSc dissertation in Space Engineering. The methodology exploits the complementary penetration depths and subsurface sensitivities of C-band and S-band SAR data to infer depth-relevant soil moisture variability beyond the surface layer. C-band data from Sentinel-1 and S-band data from NovaSAR-1 were processed using the ESA SNAP platform following radiometric calibration, speckle filtering, terrain correction, and backscatter normalisation. Access to NovaSAR-1 datasets was supported through research collaboration with the Surrey Space Centre and data access coordination with SSTL and Airbus. Soil moisture retrieval was performed using physically based scattering models, including the Integral Equation Model (IEM) and I2EM. Field campaigns conducted within an agroforestry site in Suffolk incorporated depth-resolved in-situ soil moisture measurements using soil moisture probes connected to a GP2 data logger for continuous monitoring. Satellite acquisitions were temporally collocated with near-simultaneous SAR overpasses to enable time-matched comparison between EO-derived estimates and ground observations. Surface roughness parameters measured using a laser profilometer were integrated within the inversion framework to improve retrieval robustness. The results demonstrate that multi-frequency SAR observations combined with physically based inversion models and field validation can improve sensitivity to subsurface soil moisture variability compared with conventional single-frequency approaches. Improved characterisation of subsurface soil moisture also has relevance for future ecosystem, biomass, and carbon sequestration modelling applications.

multi-frequency SAR, vertical soil moisture retrieval, calibration/validation

Ollie Holmes

isardSAT

Performance comparison of Sentinel-6 and SWOT over terrestrial water targets, and a new SWOT framework to improve their analysis

1.09 Thursday 10:50–11:00

Adrià Gómez Olivé, Ferran Gibert,
Maria José Escorihuela

Freshwater is critical to all aspects of life, from agriculture to industry to sustaining life. Accurately understanding how climate change affects this resource across a region helps authorities manage it more efficiently and provides stronger scientific backing for environmental policy change initiatives. Increasing regional environmental stability and security. SWOT aims to address this problem by providing estimates of both water level and surface areas of all terrestrial water targets globally, via its LakeSP product. This study investigated the relative performance between SWOT and altimeters by comparing the results of LakeSP and Sentinel-6 (S6, water level), with ground-truth estimates from in situ gauges (water level) and optical data (surface area), for two targets in Catalonia. Observed discrepancies also led the study to investigate a new analysis approach using a customised processing of the SWOT PIXC product (water level and surface area). Water levels from in-situ gauges showed good agreement with S6, PIXC, and LakeSP, but with decreasing performance across the three. Surface area estimates from optical data showed good agreement with the PIXC approach, with biases on the order of thousands of square meters. In contrast, the LakeSP product showed poor agreement, with biases on the order of millions of square meters. These findings highlight the local effectiveness of this new PIXC approach and thus offer a new avenue of exploration for improvements to the LakeSP product.

lakes, data processing, radar

Chandana Pantula

University of Leicester / NCEO

Characterising Tropical Wetland Extent and Seasonality Using JULES Land Surface Model and Earth Observation

1.09 Thursday 11:00-11:10

R J Parker, T R Marthews, C Ruiz Villena,
K Fatima, J Emmett

Tropical wetlands play a crucial role in regulating global water and carbon cycles, supporting biodiversity, and reducing the impacts of extreme weather. However, their seasonal dynamics and responses to climate change remain poorly understood, limiting climate adaptation and carbon cycle assessments. This study aims to develop an integrated framework combining Earth Observation (EO), land surface modelling, and machine learning to improve monitoring and prediction of tropical wetland inundation. The framework is demonstrated over the Sudd wetland in South Sudan. Multiple EO datasets are evaluated, including static products (GlobCover, GLWDv3) for long term wetland extent and dynamic products (WAD2M, JRC Global Surface Water, and CYGNSS water mask) for seasonal inundation. Comparing these datasets provides insight into both seasonal variability and long-term wetland change. The JULES land surface model is configured using two hydrological routing schemes: the standard River Flow Model (RFM) and the CaMa Flood routing model. Simulated wetland extent and hydrological dynamics from both configurations are compared to assess their ability to represent floodplain inundation and seasonal wetland variability. Model outputs are evaluated against WAD2M observations to identify differences in performance, sensitivities, and biases. This integrated framework aims to improve representation of tropical wetland dynamics, support more reliable climate predictions, and provide evidence for climate adaptation and mitigation planning.

tropical wetland inundation, EO, JULES

Laura Boyall

Bangor University

Detecting emerging regime shifts in lakes using satellite observations and global lake models

1.09 Thursday 11:10-11:20

Iestyn Woolway, Ann Scheliga, Luiz Oliveira, Caren Binding, Christiane Zarfl, Daniel Odermatt

Freshwater lakes are experiencing substantial changes in their physical functioning under climate change, including alterations to ice cover, thermal structure, mixing regimes, and hydrological balance. These changes can have significant consequences for ecosystem functioning, water resources, and the services lakes provide to society. Understanding how lakes respond to ongoing environmental change, and whether they exhibit signs of declining resilience prior to persistent shifts in state, is therefore increasingly important. However, long-term observational records remain sparse and unevenly distributed, particularly in regions where lakes may be most vulnerable to future change. To address this limitation, this study combines satellite observations from the European Space Agency Lake Climate Change Initiative (Lake CCI) with global lake simulations from the ISIMIP3b framework to investigate the emergence of regime shifts across lake systems. Multiple indicators, including surface water temperature, ice cover, mixing regime, and hydrological balance, are examined across historical and future climate scenarios. Early warning indicators, including autocorrelation and variance, are used to assess whether lakes show evidence of resilience loss prior to persistent changes in physical state. Results reveal substantial spatial variability in the timing and nature of lake responses to climate forcing. Comparisons between observational and modelled datasets highlight both the opportunities and challenges of detecting large-scale lake-system change. These findings demonstrate the value of integrating satellite observations with process-based lake models to identify emerging risks and improve assessments of future freshwater vulnerability under climate change.

tipping points, data-model comparisons

James Noble

RSPSoc

Untangling Pollution Sources in UK Rivers: A Catchment-Scale Approach to Water Quality Apportionment

1.09 Thursday 11:20-11:30

James Noble, Felix Green, Lucas Terlinden-Ruhl, Ye Liu, Barbara Hofmann, Quillon Harpham, Angela Esposito, Richard Body, Emma Brown

Water quality in UK rivers continues to receive significant media attention, with ongoing concern around the impacts of both diffuse agricultural pollution and point-source discharges from wastewater infrastructure. Distinguishing between these sources remains challenging, despite continued monitoring and regulation. Sapphire Agriculture is a UK Space Agency (UKSA) funded project under the National Space Innovation Programme (NSIP). The project explores approaches to water quality apportionment at the catchment scale. The project aims to improve understanding of the relative influence of agricultural activities and wastewater infrastructure on observed water quality patterns. The intention is to support water companies in identifying where improvements to wastewater infrastructure may have a greater influence, helping to inform the prioritisation of investment. The work draws on a range of complementary datasets, including earth observation and in situ data, to provide an understanding of catchment conditions and pressures. These inputs are combined and used to develop machine learning approaches that are being investigated for their ability to support backwards-looking apportionment of historical water quality events. The project also considers the potential for short-term forecasting, incorporating weather information to provide insight into near-future water quality.

Maria Valasia Peppa

Newcastle University

Combining UAV Multispectral and Thermal Modalities to Determine Trends in Algae Content

1.09 Thursday 11:30-11:40

Joe Haines, Francisco Castillo,
Maria V. Peppa, Sabrina Su,
Abhinav Galodha, Sam Wilson,
Deepayan Bhowmik

Uncrewed aerial vehicle (UAV) remote sensing enables high-resolution monitoring of water quality of inland and coastal systems. Most studies use multispectral UAV sensors with empirical band ratios, linear regression, or machine learning to estimate water quality, while thermal UAV research primarily focuses on surface water temperature and thermal stratification. However, these sensing modalities are rarely integrated within a single monitoring framework. This research investigates the relationship between water quality and combined thermal and multispectral UAV modalities over the algal bloom-prone Lough Neagh, Northern Ireland. Monitoring the lake is critical due to severe harmful algal blooms, yet no published study at Lough Neagh has examined the combined use of thermal and multispectral UAV imagery for algal monitoring. By integrating both modalities with machine learning techniques, this study aims to advance UAV-based monitoring of algal dynamics in eutrophic lake systems. Multispectral and thermal UAV imagery was acquired at Rea's Wood and Battery Harbour, while water quality was measured using an uncrewed surface vehicle. Imagery was radiometrically and geometrically corrected to produce multispectral and thermal orthomosaics, which were combined into a multi-modal dataset for comparison with field observations. At Battery Harbour, elevated algal content produced strong linear relationships between pH, dissolved oxygen, chlorophyll-a, and the green, red-edge, and near-infrared bands. Lower algae concentrations at Rea's Wood resulted in weaker relationships. Including UAV-derived surface water temperature improved model performance, particularly at Rea's Wood. Machine learning models XGBoost showed multispectral data provided strong predictive capability, while thermal integration produced comparable or improved results, especially for dissolved oxygen. By monitoring algal growth using multiple UAV modalities, authorities can make informed decisions to protect both industry and the public, using relatively low-cost equipment.

machine learning, UAV, algae bloom



Thursday 12:30

**Climate Change &
Global Cycles**

Room 0.04

Darren Ghent

NCEO / University of Leicester

Algorithm selection for the future high resolution ESA satellite mission LSTM

0.04 Thursday 12:30-12:40

Mike Perry, Agnieszka Soszynska,
Ben Courtier

The Copernicus Land Surface Temperature Monitoring (LSTM) is built primarily to deliver operational agricultural and urban services, by monitoring evapotranspiration, irrigation, and urban heat islands for instance. To achieve this the LSTM instrument will achieve 50m resolution across a ~670 km swath. It will deliver a 2-day global revisit time, with daily coverage times at European latitudes by deploying two satellites. The mission will support the Copernicus new services, in line with the EU Common Agriculture Policy (CAP) and global sustainable agriculture policies. The LSTM mission will provide the following Level-2 observations: i) land surface temperature (LST); ii) land surface emissivity (LSE) per TIR spectral band; iii) bottom of atmosphere (BOA) surface reflectance per VNIR spectral band; iv) total column water vapour (TCWV) and aerosol optical depth; and v) a cloud mask. The Optimal Estimation (OE) algorithm was selected from the comprehensive algorithm intercomparison study carried out for LSTM. OE can use the a-priori knowledge of the surface and atmospheric parameters to create a simulated brightness temperature for the observed radiance, which can then be mathematically compared to the actual observed brightness temperatures. The offset between the simulated and observed brightness temperatures can then be used to provide an improved estimate of the true parameters. The retrieved parameters are LST, LSE and TCWV. Here we describe both the selection process and the functional form of the algorithm being operationally implemented.

Agnieszka Soszynska

University of Leicester

Intercomparison of Land Surface Temperature retrievals using Optimal Estimation and Temperature Emissivity Separation with high-resolution data from the ECOSTRESS sensor

0.04 Thursday 12:40-12:50

Michael Perry, Darren Ghent, Ben Courtier,
Rocio Barrio Guillo, Charlotte Paton

Optimal Estimation (OE) for Land Surface Temperature (LST) retrieval proved to be the most universal and unbiased algorithm, chosen as the operational algorithm for the upcoming ESA mission Land Surface Temperature Monitoring (LSTM). Thus, implementation of LST OE for other sensor data is an important step to provide additional verification and validation with existing data. The ECOSystem Spaceborne Thermal Radiometer Experiment on Space Station (ECOSTRESS) sensor bridges the gap in high-resolution thermal remote sensing until the launch of upcoming missions such as LSTM. The operational algorithm used for LST retrieval is the Temperature Emissivity Separation (TES), which has been widely used in multiple sensors operated by NASA. At the same time, the algorithm seems to underperform in several critical areas, such as vegetation, by underestimating emissivity, leading to errors in LST calculation. In this study, we compare the LST and emissivity data derived from ECOSTRESS L1B top-of-atmosphere radiance data using OE and operational products using TES. The results are compared statistically with emphasis on accuracy within specific biomes, to understand the performance of both algorithms in critical applications of remote sensing, such as agriculture and urban heat. Next, in-situ validation is conducted using data from radiometer validation stations, located in different biomes and climate zones. The results have high impact for important applications of high-resolution thermal data: agriculture optimisation and monitoring, urban heat island, critical raw materials mapping and more.

land surface temperature, algorithms, validation

Ritika Shukla

NCEO / University of Leicester

Calibration of in situ thermal radiometers for robust validation of satellite land surface temperature

0.04 Thursday 12:50-13:00

Jasdeep Singh Anand, Agnieszka Soszynska, Rocio Barrio Guillo, Darren Ghent

Accurate validation of satellite-derived land surface temperature (LST) relies on well-characterised in situ measurements. This work presents an overview of thermal radiometers used for LST observations, highlighting the importance of repeatable and traceable calibration to ensure measurement reliability and comparability. Key laboratory-based calibration methodologies are outlined, which employ well-characterised blackbody reference sources under controlled laboratory conditions, ensuring traceability to recognised radiometric standards while accounting for instrument-target geometry. Such calibrated configurations enable consistent characterisation of instrument response across varying environmental and observational conditions. Particular attention is given to factors influencing measurement uncertainty such as size of source, instrument field of view, and ambient temperature effects. These factors are incorporated into structured uncertainty budgets, allowing quantification of environmental contributions to measurement error. The propagation of these uncertainties into LST validation exercises is considered, including their influence on satellite product accuracy and inter-sensor comparability, emphasising the need for rigorous instrument characterisation to support high-quality reference data. Calibrated radiometers are applied in satellite LST validation activities, demonstrated through coordinated global field deployments across a range of surface types, climates, and observing conditions. These deployments provide critical datasets for evaluating satellite product performance and inter-comparison between sensors. Collectively, these efforts enhance confidence in satellite-derived LST products, support comparison activities across missions, and contribute to the development of best practices for in situ measurement and validation. This work underpins ongoing advances in environmental monitoring, climate research, and Earth observation applications.

calibration/validation, LST

Riccardo William Monfardini

University of Reading

Data assimilation of SEVIRI LST in the offline ecLand model

0.04 Thursday 13:00-13:10

Claire E. Bulgin, Sarah L. Dance,
Patricia de Rosnay, David Fairbairn,
Zdenko Heyvaert

Land Surface Temperature (LST) is an Essential Climate Variable with several high-quality, long-term datasets retrieved from both polar and geostationary satellites. These datasets have the potential to improve the numerical weather prediction representation of surface energy fluxes and land variables. Many weather centres, including the European Centre for Medium-Range Weather Forecasts (ECMWF), do not routinely assimilate LST data. Model surface skin temperature (SKT) exhibits biases with respect to satellite LST, with strong diurnal, seasonal and regional variations. We investigate the impact of assimilating satellite LST on SKT, soil temperature and moisture in ECMWF's ecLand offline land surface model. We use 2019 LST retrievals from the Spinning Enhanced Visible & InfraRed Imager (SEVIRI) aboard Meteosat Second Generation (MSG). Our land data assimilation experiments employ a Simplified Extended Kalman Filter to optimally assimilate the new, spatially aggregated, quality-controlled observations, analysing both domain-wide and biome-specific results. We evaluate assimilation results using observation-minus-background departures against a baseline control experiment, focusing on diurnal cycle and RMSE differences. Further work will use these results to improve the momentum and energy flux exchanges between land and atmosphere in coupled land-atmosphere models and assimilation systems.

land surface temperature, data assimilation, ecLand

The background of the slide is a dark blue gradient. On the left side, there is a large, abstract graphic consisting of numerous thin, glowing blue and white lines that crisscross the space. These lines are interspersed with clusters of small, bright white dots, some of which form larger, more defined shapes. The overall effect is one of dynamic energy and digital connectivity.

Thursday 12:30

AI & Digital Infrastructure

Room 1.01

Thomas Moncrief

University of Bristol

Satellite Foundation Embeddings for Above-Ground Biomass Estimation: Transferability, Limitations, and Potential Applications in Tropical Landscapes

1.01 Thursday 12:30-12:40

Dr Ce Zhang

Accurate estimation of above-ground biomass (AGBD) is essential for monitoring forest carbon stocks, assessing ecosystem degradation, and supporting climate mitigation efforts. Recent satellite foundation embeddings, such as AlphaEarth, provide compact representations of multi-modal Earth observation data and potentially offer a scalable alternative to conventional remote-sensing features. However, their effectiveness for biomass regression, and their ability to generalise across tropical regions and years, remains poorly understood. Here, we evaluate AlphaEarth embeddings for predicting aboveground biomass density (AGBD) across four major tropical rainforest regions: the Amazon, Congo Basin, Southeast Asia, and New Guinea, using GEDI-derived biomass reference data. We compare a range of tabular, deep learning, and graph-based models, and assess their performance under within-region, cross-region, and cross-year transfer settings. Our results show that AlphaEarth embeddings contain substantial biomass-relevant information, with gradient boosted trees achieving the strongest overall predictive performance. Spatial deep learning models generally performed less well quantitatively, although graph neural networks achieved the best performance among the deep learning approaches and produced more spatially coherent biomass predictions. Transferability was stronger across years than across geographically distinct rainforest regions, indicating that regional ecological and structural differences remain a key limitation for large-scale deployment. Overall, our findings demonstrate the potential of satellite foundation embeddings for biomass estimation, while highlighting the need to better understand and improve their spatial generalisation.

Reza M. Asiyabi

The University of Edinburgh / NCEO

Towards Trustworthy Forest Carbon Maps: Interpretable and Bias-Aware Deep Learning from Multimodal EO Data

1.01 Thursday 12:40-12:50

Reza M. Asiyabi, The SEOSAW Partnership, Mathias Disney, Shaun Quegan, Casey M. Ryan, Steven Hancock

Accurate, large-scale estimation of aboveground biomass (AGB) and related structural attributes is fundamental to carbon accounting, ecosystem monitoring, and climate policy. Earth observation provides the only practical route to continental-scale mapping, yet translating satellite signals into reliable biomass estimates remains challenging: label data are sparse and heterogeneous, field measurements are spatially biased, and most machine learning models offer little transparency into how their predictions relate to the underlying forest processes. This talk presents two deep learning frameworks for multi-attribute forest mapping from multimodal satellite data. Forest biomass is not directly observable from space; instead, EO data carry information about structural attributes such as canopy height, cover, and stem density, which are ecologically linked to AGB through known allometric relationships. Exploiting this structure, PG-CBM (Process-Guided Concept Bottleneck Model) constrains intermediate model representations to correspond to physically meaningful attributes (e.g., canopy height, cover, and stem density) before aggregating them into AGB, improving both accuracy and interpretability while reducing the structure-dependent bias that conventional black-box models exhibit. Two main label sources, spaceborne lidar and plots are incompatible and observe different variables at different locations with no overlap; StruMPL addresses this through joint multi-task learning with propensity-based correction for spatially biased field sampling and a learnable allometric constraint that links the two sources at every pixel. Together, these frameworks demonstrate that incorporating domain knowledge into the learning process, whether through architectural constraints or explicit physical relationships, improves not only predictive accuracy but also the scientific credibility and practical utility of satellite-derived forest carbon maps.

William Ray

Planet Labs PBC

How Agentic AI Transforms Earth Observation Into Actionable Intelligence

1.01 Thursday 12:50-13:00

Ash Hoover, Luke Davis, Shreelekha
Revankar, Megan Van Welie, Leela
Prabhu, Mikhail Klassen, Creon Levit

The unprecedented abundance of modern Earth Observation (EO) data has fundamentally shifted the primary geospatial bottleneck from data availability to time-to-insight. Traditional analysis pipelines require intensive manual processing, localized downloads, and geospatial expertise, often delaying critical operational decisions by days or weeks and failing to scale geographically across extensive regions. To overcome these limitations, this presentation introduces a paradigm shift toward "Planetary Intelligence"—an advanced digital infrastructure that integrates AI across the entire EO value chain, from edge compute onboard satellite constellations to cloud-hosted Large Earth Models (LEMs). A breakthrough in this architectural evolution is the deployment of agentic geospatial AI. Unlike traditional machine learning models restricted to rigid, predefined outputs, agentic systems utilize foundation models to orchestrate complex, multi-step data workflows via intuitive natural language interfaces. By unifying high-frequency data streams with agentic reasoning, this digital infrastructure reduces the complexities of traditional geospatial data processing. The pairing of Planet data with agentic AI now makes it possible to discover insights about the planet through a "Queryable Earth" interface. This new tool makes Planet insights accessible and enables the rapid discovery of change across the globe. Previously, extracting these insights demanded heavy compute, deep expertise in analysis algorithms, and bespoke processing pipelines, beyond most users' capabilities. The natural language interface removes those barriers by collapsing foundation models, analysis pipelines, and global embedding search into a single query. Users can now explore Planet's deep multitemporal imagery archive and in seconds surface important insights such as monitoring construction, deforestation and disasters.

AI agents, earth observation, time-series



Thursday 12:30

**Meteorology &
Atmospheric Chemistry**

Room 1.04

Jeremy Harrison

NCEO / University of Leicester

Spectroscopic uncertainty as a systemic risk in Earth Observation

1.04 Thursday 12:30-12:40

Earth Observation has become indispensable to climate policy, emissions monitoring, and weather forecasting. However, the quantitative spectroscopic databases underpinning every retrieval algorithm remain chronically underfunded, poorly understood by scientists in the field, and largely absent from formal uncertainty budgets. This talk argues that spectroscopic uncertainty represents one of the most significant and least acknowledged systematic risks to the scientific integrity of modern EO. Unlike instrument noise, spectroscopic uncertainties are systematic, global, and correlated across all missions sharing the same underlying databases. They do not average down with more observations and are not reduced by more precise instruments. A further problem lies in the radiative transfer models themselves, which were predominantly written by scientists with expertise in atmospheric physics and radiative transfer, not molecular spectroscopy. As a result, these models are frequently ill-equipped to exploit the most accurate line parameters. Improved spectroscopic data can therefore be undermined not only by its absence from retrieval uncertainty budgets, but by forward models structurally incapable of using it correctly. Meanwhile, empirical bias corrections are routinely applied to retrieved data to better agree with validation datasets. Many EO scientists see these corrections as solutions, but they simply conceal spectroscopic errors and represent a growing liability in our efforts to produce ever more accurate measurements of trace gases such as methane or carbon dioxide. The problem is compounded by a cultural one. Quantitative spectroscopy has been characterised as Cinderella science, i.e. supporting science rather than being science, a status judgement that underlies chronic underinvestment disproportionate to its importance. This talk argues that the community can no longer afford the consequences of this judgement.

Daniel Coxon

University of Leicester / NCEO

New spectroscopic line parameters of H₂O and CO₂ in the far-infrared region for ESA's FORUM mission

1.04 Thursday 12:40–12:50

Jeremy Harrison, Chris Benner,
Malathy Devi, Brant Billingham,
Jianbao Zhao, Dominique Appadoo,
Alexandre Voute, Alain Campargue

The upcoming ESA FORUM (Far-infrared Outgoing Radiation Understanding and Monitoring) mission will be the first to measure the Earth's spectrally resolved outgoing longwave radiation (OLR) in the far-infrared (FIR) at high spectral resolution. The FIR region is crucially important because it is responsible for over half of the Earth's emission to space. FORUM will capture the spectral window 100-1600 cm⁻¹, with water vapour (H₂O, 100-700 cm⁻¹) and carbon dioxide (CO₂, 500-850 cm⁻¹) being the principal atmospheric absorbers in the FIR. FORUM will evaluate the role of the FIR in shaping the current climate, thereby reducing uncertainty in predictions of future climate change. This will prove crucial in future mitigation efforts. The interpretation of measurements from FORUM is highly reliant on the ability to perform accurate radiative transfer calculations in the FIR. Recent high-resolution FIR measurements have shown deficiencies in the current HITRAN linelist. We report a new suite of high-resolution measurements of FIR spectra for pure and air-broadened H₂O and CO₂, at temperatures in the range 200-296 K. These were measured at synchrotron light source facilities, which provide a more intense source of FIR electromagnetic radiation than a conventional laboratory. We analyse spectra using the Labfit multispectrum fitting program, which has an extensive history in deriving non-Voigt line parameters for remote sensing. Through our analysis, we have derived new line parameters, including line positions, intensities, self- and air-broadened halfwidths, self- and air-pressure-induced shifts, along with temperature and speed dependence parameters. We compare our results to those from HITRAN database.

FORUM, water vapour, carbon dioxide

Nedim Sladić

University of Leicester / NCEO

**Energy balance climate models
as a tool for investigating the
linkage between the energy
imbalance and the
hydrological cycle**

1.04 Thursday 12:50-13:00

Tim Trent, Adam C. Povey, Richard P.
Allan, Kate Willett

The planetary energy imbalance depends on the amount of solar energy entering and leaving the system, as well as changes in greenhouse gas concentrations. Since the start of the 21st century, the Earth's energy imbalance (EEI) is assumed to have doubled, linked to the reduction of solar radiation reflected back to space, due to atmospheric dimming. Rapid and responsive feedback mechanisms have contributed to the accumulation of excess heat within the global oceans. The ocean warming drives the positive change in EEI and impacts the hydrological cycle, becoming more intense. Such linkage disturbs well-established weather patterns and cause their alternation. To understand these phenomena, traditionally complex state-of-the-art coupled climate models would be used. However, the strength of simpler, energy balance climate models capturing large-scale features has shown to be an alternative approach in understanding the general state of climate. In this study we utilise the ocean component of the newly developed novel Energy Balance climate Model (nEBM) to examine the relationship between EEI and ocean warming to perturbations in key hydrological cycle components (e.g. precipitation, runoff, evaporation, etc). This approach will show how each component modulates the EEI by driving the model with an ensemble observational datasets. The uncertainty relationship between the model and observational datasets is characterised in relation to the changes in EEI. The obtained modelled results are compared to CMIP6, observations and relevant literature. Finally, we discuss the ability of simpler climate models (e.g. nEBM) in quantifying sensitivity for climate studies.

climate sensitivity, ECS, EEI

Michaela Flegrová

Imperial College London

Evaluation of the Meteosat Third Generation FCI Outgoing Longwave Radiation Product

1.04 Thursday 13:00-3:10

Jacqui Russell, Helen Brindley

Outgoing longwave radiation (OLR) at the top of the atmosphere is a fundamental component of the Earth's radiation budget and a key observable for monitoring climate variability and change. The Meteosat Third Generation (MTG) Flexible Combined Imager (FCI) introduces a new geostationary OLR product derived from narrowband thermal infrared radiances using scene-dependent regressions. Ensuring the continuity, stability and scientific usability of this product relative to heritage datasets is therefore essential. Here we present an evaluation of the MTG FCI OLR product through comparisons with Geostationary Earth Radiation Budget (GERB) thermal fluxes on Meteosat Second Generation (MSG) and CERES OLR products. The comparisons against GERB exploit the co-location of MSG and MTG to enable a detailed intercomparison over several months spanning different seasons. BROADSCALE and regional differences are analysed as a function of viewing geometry, time of day, surface type and cloud cover, and interpreted in the context of known limitations in the GERB radiance-to-flux conversion and the MTG OLR retrieval methodology, including the use of scene-dependent regressions and plane-parallel assumptions. Further comparisons against the CERES OLR fluxes, together with associated cloud information, provide an independent benchmark and allow investigation of cloud-dependent and diurnal characteristics of the MTG OLR product. Together, these results provide a comprehensive assessment of the performance, stability and limitations of the MTG FCI OLR product, and offer guidance for its application in studies of the Earth's radiation budget and climate variability, as well as a roadmap for future product improvements.

outgoing longwave radiation (OLR), MTG FCI, validation



Thursday 12:30

**Oceans, Coasts &
Marine Systems**

Room 1.09

Jozef Skakala

Plymouth Marine Laboratory

Estimating seasonally varying marine ecosystem parameters from observations: results from Climate and Marine Production (CAMP)

1.09 Thursday 12:30-12:40

Deep S. Banerjee, Gennadi Lessin,
Shubha Sathyendranath

Despite the strong evidence that key ecosystem rates vary across regions and seasons, biogeochemical (BGC) models typically rely on fixed parameter values. This limits model forecast skill, contributes to divergence among primary production estimates and lowers confidence in regional and climate-scale projections. We present a new observation-constrained framework developed within the European Space Agency-Climate and Marine Production (ESA-CAMP) project to estimate seasonally varying ecosystem model parameters using one-dimensional (1D) water-column simulations along long-term stations and BGC-Argo trajectories. Our approach uses a 1D hydrodynamic model coupled with biogeochemical models, together with data assimilation, to estimate model parameters from observations. In other words, we use the observations to identify the parameter values that allow the model to reproduce the observed biogeochemical behaviour more realistically. We focus on parameters controlling phytoplankton light-limited growth, photoinhibition, maximum growth, respiration, and zooplankton grazing and assimilation. Initial applications span contrasting oceanographic regimes, including the English Channel, the North-West European Shelf, the Mediterranean Sea, the North Atlantic and the North Pacific ocean based on selected BGC-Argo trajectories and ocean observing stations. Preliminary results show coherent seasonal structure and site-to-site variability in both phytoplankton and zooplankton parameters, indicating that fixed parameterisations are unlikely to be adequate across diverse marine environments. These emerging parameter climatologies provide the basis for mapping parameter fields in space using machine-learning approaches with the objective of improving primary production estimates, biogeochemical forecasts, and regional-to-climate-scale ecosystem projections under changing environmental conditions.

Mark Warren

Plymouth Marine Laboratory

Tipping points and abrupt changes in marine ecosystems (TIME)

1.09 Thursday 12:40-12:50

Shubha Sathyendranath, Angus Atkinson, Robert JW Brewin, Yanna Fidai, John A Gittings, Bror Jönsson, Žarko Kovač, Gemma Kulk, Elin Meek, Nandini Menon, Peter Miller, Salem Ibrahim Salem, David Moffat, Dionysios E Raitsos, Eleni Livanou, Ranith Raj, Tim Smyth, Martí Galí, Victor Martinez Vicente, Johannes J. Viljoen, María-Andrea Orihuela-García, Sarah Connors

Tipping points and abrupt changes In the Marine Ecosystem (TIME) is a European Space Agency (ESA) funded project that focuses on eight tipping elements in the marine ecosystem: phytoplankton and primary production; phytoplankton phenology; plankton size structure; Noctiluca; coccolithophores; Antarctic phytoplankton; North Atlantic Subpolar Gyre; and coral reefs. The region of interest for each of the tipping elements is selected according to prior, initial evidence of change. The work will exploit the almost three-decade-long global time series of satellite-based products generated through the Ocean Colour Climate Change Initiative (OC-CCI) of ESA, and other relevant Essential Climate Variables (ECVs), such as Sea Surface Temperature. The work has a focus on satellite-derived data, but it will also make use of complementary in situ data and ecosystem models. The long time series data are being analysed using multiple statistical tools to identify abrupt changes and approaching tipping points. Where changes are identified, the potential drivers of change will be investigated. Furthermore, the project uses theoretical analyses and simulation models to investigate feedbacks, resilience, and fragility in the marine ecosystem, under a warming climate. The role of noise (variability) in the ecosystem in determining the threshold where rapid changes might occur, will be investigated. The challenges to be addressed include missing data in the satellite coverage, which is particularly acute in high latitudes.

tipping points, marine ecosystems, abrupt changes

Christopher Merchant

NCEO / University of Reading

Time and tide: exploiting thermal observations to identify resilient coral reef systems now and in the future

1.09 Thursday 12:50-13:00

Thermal stress is the greatest global risk factor facing corals and the reefs they build. Temperatures across reefs are variable, creating patches with high and low stress levels, and bleaching damage can be spatially heterogeneous even within single reefs. Thermal stress is generally quantified for corals (and for other photosynthetic ecosystems) via time-integrated temperature metrics, such as the degree heating week (DHW) that accumulates temperature above an ecologically relevant sea surface temperature threshold. Resolved, calibrated thermal-stress information is not currently available at scales relevant to the majority of reefs, but this may improve with coming ~60 m scale thermal missions (TRISHNA, LSTM, EAGLE), increasing the utility of Earth observation for heat-stress information and reef management responses. A case study of the applicability of ~1 km thermal observations to understanding the spatial variability in resilience across a very large reef system (in the Great Barrier Reef) will be presented to illustrate the methodology of integrating ecological and oceanographic understanding to assess comparative coral reef exposure to heat stresses, prototyping approaches that will be applicable at smaller and more impactful scales with the future ~60 m thermal missions.

Jiamin Pan

University of Reading

Satellite-derived Gulf Stream variability and its links to North Atlantic atmospheric circulation

1.09 Thursday 13:00-13:10

Jiamin Pan, Claire Bulgin,
Christopher O'Reilly, Ben Harvey

The Gulf Stream plays an important role in North Atlantic climate variability, air-sea heat exchange, and downstream weather over the UK and Europe. Its variability can be characterised using different indicators, including satellite-altimetry-based sea surface height (SSH) proxies, traditional North Wall indices based on subsurface temperature, and sea surface temperature (SST) front metrics derived from thermal gradients. However, these metrics may represent different physical aspects of the Gulf Stream and are not necessarily interchangeable. In this study, we develop a thermal-gradient-based metric to identify Gulf Stream path and intensity from satellite-derived SST gradients. We compare this metric with an SSH-based proxy and established North Wall indices to examine how different diagnostics represent Gulf Stream position, variability and intensity. Results suggest that the SST-gradient-based path is related to both SSH-based and North Wall metrics, but the strength and timing of these relationships vary, indicating that the indicators capture overlapping but distinct aspects of Gulf Stream variability. We further investigate how these diagnostics relate to North Atlantic and UK-relevant atmospheric variability using reanalysis fields, including lower-tropospheric temperature gradients, turbulent heat fluxes, low-level winds, storm-track activity and blocking. Preliminary results suggest that SST-gradient-based path and intensity are more closely associated with local thermal structure near the Gulf Stream, while the SSH-based proxy shows stronger links with large-scale atmospheric circulation. We also examine the role of the North Atlantic Oscillation to help distinguish local air-sea interaction from shared large-scale atmospheric forcing. Ongoing work uses CANARI large-ensemble simulations to assess model representation and future changes.

Gulf stream, satellite observations, air-sea interaction

Therese Marie Anais kimberley

University of Mauritius

Development of an Enhanced Weighted Shoreline Extraction Index for Reef Fringed Tropical Coastlines using Sentinel 2 Imagery

1.09 Thursday 13:10–13:20

Dr Manta Nowbuth

Accurate shoreline extraction is critical for coastal monitoring, shoreline change analysis, and coastal vulnerability assessment. However, standardised water indices such as the Normalised Difference Water Index (NDWI) and Modified Normalised Difference Water Index (MNDWI) often experience limitations in tropical reef-fringed environments due to spectral confusion between shallow water, submerged reefs, wet sand, and coastal sediments. These challenges are particularly significant in Small Island Developing States (SIDS), where complex coastal systems influence shoreline extraction and long-term monitoring. This study aims to develop an Enhanced Weighted Shoreline Extraction Index (EWSEI) for improved Shoreline extraction in Small Island Developing States (SIDS). The methodology uses Sentinel-2 multi spectral imagery and analyses the spectral signatures of key coastal features, including deep water, shallow water, wet sand, and dry sand. Based on the spectral behaviour of these classes, a weighted combination of selected spectral bands was developed to improve shoreline discrimination and reduce incorrect classification in complex reef-lagoon environments. The proposed approach was applied along the south coast of Mauritius, characterised by reef flats, shallow lagoons, and dynamic shoreline conditions. The results indicated an improved shoreline discrimination compared with conventional water indices. The study demonstrates the potential of Earth Observation and geospatial technologies to enhance shoreline mapping and coastal monitoring. The findings contribute to improved coastal management, climate adaptation planning and vulnerability assessment within tropical reef fringed SIDS environments.

geospatial sciences, coastal management, climate resilience

Poster Abstracts

Room 0.01

AI & Digital Infrastructure
Biodiversity, Habitat & Ecosystems
Carbon, Biomass and Natural Capital
Geosciences
Inland Waters & Hydrology
UKSA Skills for Space Internships

Room 0.02

Climate Change & Global Cycles
Disaster Prediction & Response
Meteorology & Atmospheric Chemistry
Oceans, Coasts and Marine Systems
Resilience, National Security & Dual Use
Space Innovation & Future EO Capabilities (Beyond Earth)
Sustainable Development, Social Impact & Policy
UKSA Skills for Space Internships

The background of the slide is a dark blue gradient. On the left side, there is a large, abstract graphic composed of numerous thin, glowing blue and white lines that crisscross the space. Interspersed among these lines are clusters of small, bright white dots, resembling data points or a network map. Some of the lines form curved, orbital paths. The overall effect is one of high-tech, digital connectivity and data flow.

AI & Digital Infrastructure

Room 0.01

This poster outlines our learnings from building two production grade agentic systems for data discovery, retrieval and analysis. For both, trustworthiness, reliability and reproducibility were key criteria from the start. Repeatability and transparency are not a nice-to-have when dealing with authoritative scientific information; they are indispensable for adoption. Even if the answer from a chatbot is scientifically correct, users will only rely on the outputs for decision making if they trust the system. Users now know that LLMs tend to exaggerate and hallucinate, which has created a healthy scepticism about agentic systems. In scientific and operational domains, it is not sufficient to guarantee a correct result; it also has to be transparent and reproducible. We used several techniques. The main principle is that we rely on the LLM mainly for orchestration of well-known tools, rather than on the generative capabilities of the models. For analysis, the systems are built so that transformations on the original data are reproducible: we use the LLM to write code that can be stored and re-run, allowing tracing of where the data comes from and how it was transformed. Two systems illustrate this. The Destination Earth Digital Assistant, built with the European Centre for Medium-Range Weather Forecast (ECMWF), helps users discover and retrieve data from the DestinE Digital Twins. Global Nature Watch, built with the World Resources Institute (WRI) and the Land and Carbon Lab, provides trusted, open data on land conditions and land-use change for evidence-based decisions on nature protection. For groups building national EO infrastructure, these learnings show how AI can be added to authoritative data without compromising trust.

agentic systems, earth data

Loïc Houpert

Development Seed

Trustworthy and reproducible AI
for Earth data, learnings from two
production agentic systems

0.01 Poster 001

Daniel Wiesmann, Jonas Sølvsteen,
Ciaran Sweet, Ricardo Mestre,
Daniel da Silva, Firza Riany, Fausto Pérez,
Marc Farra, Sanjay Bhangar, Sajjad
Anwar, Loïc Houpert

Snow- and ice-covered surfaces present a persistent challenge for satellite-based cloud-phase detection because their visible reflectances closely resemble those of clouds. Although infrared observations provide additional constraints, they are often insufficient for unambiguous phase discrimination. As an active sensor, the ATmospheric lidar (ATLID) on the EarthCARE satellite mitigates this limitation by reducing the impact of surface reflectance, thus improving aerosol and cloud retrievals. However, many satellite platforms lack active sensors such as lidar and instead rely solely on a multi-spectral imager (MSI). This project applies machine learning to train EarthCARE's MSI radiances to emulate ATLID-informed cloud-phase classifications over snow and ice surfaces. ATLID products are used as a high-confidence reference to supervise model training. The resulting framework aims to enhance cloud-phase detection using only MSI observations and may be modified for use with data from other satellites that lack associated active lidar measurements. If so, the cloud-phase data record in polar regions could be extended and the relationship between cloud phase and climate change better understood.

machine learning, cloud phase, EarthCARE

Colin Andres

University of Oxford

Improving Cloud-Phase Detection over Snow and Ice using EarthCARE and Machine Learning

0.01 Poster 003

Don Grainger, Rui Song

Small surface water bodies (sub-hectare ponds, ditches, and narrow channels) are ecologically important yet fall below Sentinel-2's 10 m detection limit, where mixed pixels suppress the water signal. While deep-learning super-resolution (SR) could bridge this gap, conflicting evaluation reports leave its sub-pixel benefit unresolved. This study assesses Sentinel-2 Deep Resolution 3.0 (S2DR3), a pre-trained service enhancing Sentinel-2 from 10 m to 1 m, for small surface water detection across lowland England. A residual attention U-Net trained on an 11-channel stack of super-resolved optical bands, spectral indices, and lidar-derived terrain (slope and topographic wetness index) was compared against an identical native model using four random seeds, Stochastic Weight Averaging, and a geographically held-out test set. On the test set, super-resolution yielded a small but consistent improvement over native imagery (Water IoU: 0.948 vs 0.943; Dice: 0.973 vs 0.971; recall: 0.969 vs 0.964), stable across all seeds. A size-stratified, object-level analysis showed that detectability was chiefly governed by feature size, declining near the native resolution limit. The improvement from super-resolution was modest and most apparent for small and intermediate bodies near this limit, rather than large bodies already mapped reliably. These patterns held across multiple object-matching criteria and false-detection assessments. We conclude that super-resolution offers a small but consistent improvement near the resolution limit, which is often masked by aggregate pixel metrics. Consequently, size-stratified, object-level evaluation is essential for assessing super-resolution in fine-scale Earth observation.

deep learning model, small water bodies mapping, super resolution

Sahar Sharifi

University of Surrey

Evaluating the Impact of S2DR3 Super-Resolution on Multi-Source Deep Learning Model for Small Water Body Mapping

0.01 Poster 005

Dr Ana Andries, Prof Stephen Morse,
Prof Emeritus Richard Murphy,
Ms Zoe Channon

Coastal monitoring is increasingly reliant on satellite image time series (SITS), yet segmentation outputs often exhibit temporal instability. In short time intervals, many land classes should remain relatively consistent, but segmentation outputs can still fluctuate due to model uncertainty. This is particularly problematic in coastal environments, where the dominance of the water class can inflate standard performance metrics, causing instability in smaller but important features in the output, such as linear coastal defence structures, which are harder to detect given their limited spatial extent. This study investigates whether the Segment Anything Model (SAM) and its variants could be adapted to improve the temporal coherence of coastal segmentation in SITS. Frame-by-frame outputs are evaluated on coastal imagery, and lightweight temporal mechanisms, including prompt propagation between adjacent dates and temporal-consistency regularisation, were tested to reduce unnecessary variation in predicted masks. Performance was assessed using standard segmentation metrics alongside class-aware and temporal-consistency measures, with particular attention to minority coastal classes and thin linear features. Improving the reliability of coastal segmentation is essential as temporal inconsistencies can reduce the utility of derived time series, weaken downstream analyses that depend on coherent spatial [PE1.1] patterns, and limit the detection of often small shoreline advance or retreat signals above observational uncertainty. By adapting SAM for temporally consistent coastal segmentation, this work aims to produce more stable land-cover products that are better suited to shoreline monitoring, coastal change assessment, and predictive modelling from satellite observations.

coastal change, semantic segmentation, temporal coherence

Silvia Alexandra da Silva Mourao

University of Glasgow

Towards Temporally Coherent Coastal Segmentation with Deep Learning

0.01 Poster 007

Dr Paul R. Eizenhöfer, Dr Tiffany Vlaar,
Prof Larissa Naylor, Dr Zhiwei Gao

CEDA provides the data archive component for NCEO and as such offers access to a large volume of EO and atmospheric science data and services. In 2021 CEDA partnered with ESA to deliver a Data Hub Relay (DHR) as part of the wider Collaborative Data Relay network using software developed and distributed by ESA and SERCO. In 2025 ESA replaced this DHuS software with a new software suite based around distinct components that are deployed in an up-to-date containerised deployment. This new Data Hub Software (DHS) suite now consists of several scalable Dockerised components for the identification and retrieval of Copernicus data (GSS – The GAEL Software Suite) as well as other components for tracking and visualization of the data. This new system allows greater interoperability with existing ESA systems such as the DIAS and PRIP and now provides conformant interfaces such as STAC that can handle the forthcoming transition to ESA's distribution of Copernicus data in cloud optimized formats - as well as the current focus on traditional formats as SAFE and NetCDF. As part of the DHS ESA has included a new component – the Transformation Framework (TF)¹. This allows bespoke processes to be incorporated within the DHS architecture, using the other GSS components such as the catalogue and shared incoming data to form the basis for processing chains. We describe here one such process: a regridding of Sentinel3 SLSTR data to aid the UK research community for processing and enhancing reflective and infrared channels. This process is referred to as the "SLSTR-lite" product.

Stephen Donegan

CEDA

Access to Copernicus Data and Services at CEDA

0.01 Poster 009

Continued expansion of solar energy infrastructure, driven by land-use incentives and a push for cleaner energy, is increasing the need for accurate and repeatable methods for monitoring solar farm extent and associated land-use changes. The Living England (LE) programme (Natural England) has provided mapping of solar farms, as part of LE's on-going provision of open-source data on the extent and distribution of England's broad habitats. This initial manual approach was necessitated by the classification uncertainties involved in mapping solar farms using LE's EO-based random forest method, due to the mixed spectral signals and frequent confusion with urban areas, some types of agriculture and wetlands. However, this approach remains time-consuming and labour-intensive. Consequently, new research by the LE project is now exploring deep learning for automated mapping of ground-mounted solar farms across the England using freely available EO data. A U-Net semantic segmentation framework has been developed using Sentinel-1 backscatter, Sentinel-2 optical imagery, and LE's national archive of manually digitised solar farms. Although Sentinel imagery is relatively coarse compared with commercial satellite or aerial datasets, its national coverage, open accessibility, and frequent revisit times make it well suited to large-area monitoring. This project demonstrates how deep learning can provide an accurate, scalable alternative to manual interpretation for delineating solar farms at regional and national scales. To our knowledge, this represents the first application of deep learning for national-scale solar farm mapping in the UK, demonstrating the potential of open EO to support habitat mapping, land-use monitoring, and renewable energy planning.

deep learning, solar

Jade Bowling

Natural England

Pixels, Panels & Predictions: Detecting England's solar farms using deep learning and Earth Observation

0.01 Poster 011

Matthew Cleave (University of Plymouth),
Jade Bowling, Joseph Jones, Becky
Trippier, Amy Woodget

Data-driven models for land surface CO₂ flux estimation are inherently observational, requiring real-time Earth Observation (EO) inputs that preclude application to hypothetical management scenarios or future climate projections. This study presents a methodological and infrastructural advance that extends a GeoML framework beyond observational constraints, enabling counterfactual inference at field scale across the agriculturally drained peatlands of East Anglia, England. The core innovation lies in decoupling phenological signals from real-time EO dependency: a Random Forest flux model is trained on field- and crop-stratified multi-year EO composites, explicit seasonality encoding, dynamic climate inputs, and static field characteristics (peat depth, elevation, etc.) , capturing crop-field interactions across rotation history while permitting crop identity to be substituted at inference time. Counterfactual capability is operationalised through a spatially and edaphically constrained phenology lookup: field-specific curves are prioritised where rotation history exists, falling back to analogous observations from physically similar neighbouring fields (within 1–2km), then to regional crop-type averages. A structured database of pre-computed field-crop phenological profiles underpins the lookup hierarchy, with a provenance flag propagating prediction confidence tier through to model outputs, ensuring operational inference speeds across historical, counterfactual, and future scenario requests. Validated against Eddy Covariance Net Ecosystem Exchange (NEE) data across seven sites and one withheld validation site, the model achieves average $R^2 = 0.71$ and NRMSE = 7.8% with best performance for managed grasslands and winter wheat. Deployed within an operational Digital Twin, the framework supports both near-real-time monitoring and forward-looking carbon accounting for net-zero land management.

Asima Khan

University of Leicester

Counterfactual-Ready GeoML for Field-Scale CO₂ Flux Scenario Analysis in Agricultural Peatlands

0.01 Poster 013

Earth Observation (EO) imagery is a critical data source for national mapping, supporting the creation and maintenance of up-to-date geospatial datasets. While aerial imagery provides high spatial resolution, its acquisition is limited by cost and revisit frequency. In contrast, satellite imagery offers more frequent coverage but often at coarser resolutions. This trade-off between spatial resolution and temporal currency presents a challenge for mapping applications. Recent advances in super-resolution (SR), particularly those driven by deep learning, offer a promising pathway to enhance the effective resolution of existing EO datasets and bridge this gap. This work presents an initial exploration of super-resolution applied to high-resolution Earth Observation imagery. The study focuses on visual enhancement experiments to better understand how these techniques influence image interpretability, highlighting both the potential benefits and challenges of applying super-resolution in a mapping context. Building on these early findings, we discuss the broader potential of super-resolution across a range of national mapping applications, including feature interpretation and change detection. We also consider the implications of using enhanced imagery in downstream processes, such as machine learning models, where improvements in apparent detail may enhance appearance while offering limited additional analytical value. Particular attention is given to key limitations, including artefact generation, impacts on geometric fidelity, and the risk of introducing misleading detail into authoritative datasets. These challenges raise important questions around data trust, validation, and fitness-for-purpose. This work aims to stimulate discussion within the EO community on the role of super-resolution in national mapping, outlining both its potential benefits and considerations for responsible adoption.

super-resolution, deep learning, image enhancement

Sławomir Bruszkowski

Ordnance Survey

Exploring the Potential of Super-Resolution for National Mapping Applications

0.01 Poster 015

EOEPCA (Earth Observation Exploitation Platform Common Architecture) is a European Space Agency (ESA) funded project led by Telespazio UK that defines a reusable exploitation platform architecture using open standard interfaces. Its goal is to encourage interoperation and federation between operational exploitation platforms, facilitating easier access and more efficient exploitation of the rapidly growing body of Earth Observation (EO) and other data. Users are beginning to appreciate the advantages of exploitation platforms. However, the market now offers a plethora of platforms with various added value services and data access capabilities. This ever-increasing offer is rather intimidating and confusing for most users. Users often face challenges such as inconsistent interfaces, proprietary software and limited interoperability. To fully exploit the potential of these complementary platform resources we anticipate the need to encourage interoperation amongst the platforms, such that users of one platform may consume the services of another directly platform-to-platform. The EOEPCA system architecture is designed to meet a set of defined use cases for various levels of user, from expert application developers to data analysts and end users. The architecture is defined as a set of Building Blocks (BBs), exposing well-defined open-standard interfaces. These include Identity and Access Management, Resource Discovery, Data Access, Processing Workflows, Datacube Access, Machine Learning Operations and more. Each of these BBs are containerised for Kubernetes deployment, which provides an infrastructure-agnostic deployment target.

platforms, kubernetes, deployments

James Hinton

Telespazio

EOEPCA+: Open-Source Building Blocks for EO Exploitation Platforms

0.01 Poster 017

Richard Conway

Reanalyses are fundamental for understanding weather and climate. They are products of combining numerical model forecasts with observations. In ocean reanalysis historical observations are often sparse and irregularly distributed, which makes the reconstruction of past ocean states particularly challenging. Many widely used ocean reanalysis systems are based on filtering approaches, such as 3DVar or ensemble Kalman filters, where observations are primarily used to update the model state at the analysis time. Smoother approaches like 4DVar can use observations from future times to improve estimates of earlier states, but implementing such systems usually requires substantial development effort and long production cycles. Here, we investigate a simple post-processing smoother that can be applied directly to existing filtering-based reanalyses. The method uses future analysis increments to retrospectively adjust earlier states, offering a practical way to improve reanalysis products without redesigning the underlying assimilation system. In an idealised experimental setup, we assess the smoother reanalyses using three metrics under various observation density and evolving configurations of observation networks. The latter configurations help us understand the impact of the post-process smoother in period of improved observation density. These metrics are used both to tune the smoother parameters and to diagnose how smoothing changes the accuracy and consistency with the model trajectory. The results show that tuning the post-processing smoother solely against root mean squared error can lead to dynamically inconsistent smoother reanalysis trajectories, whereas alternative parameter choices can improve consistency relative to the filtering reanalysis particularly for sparse observations.

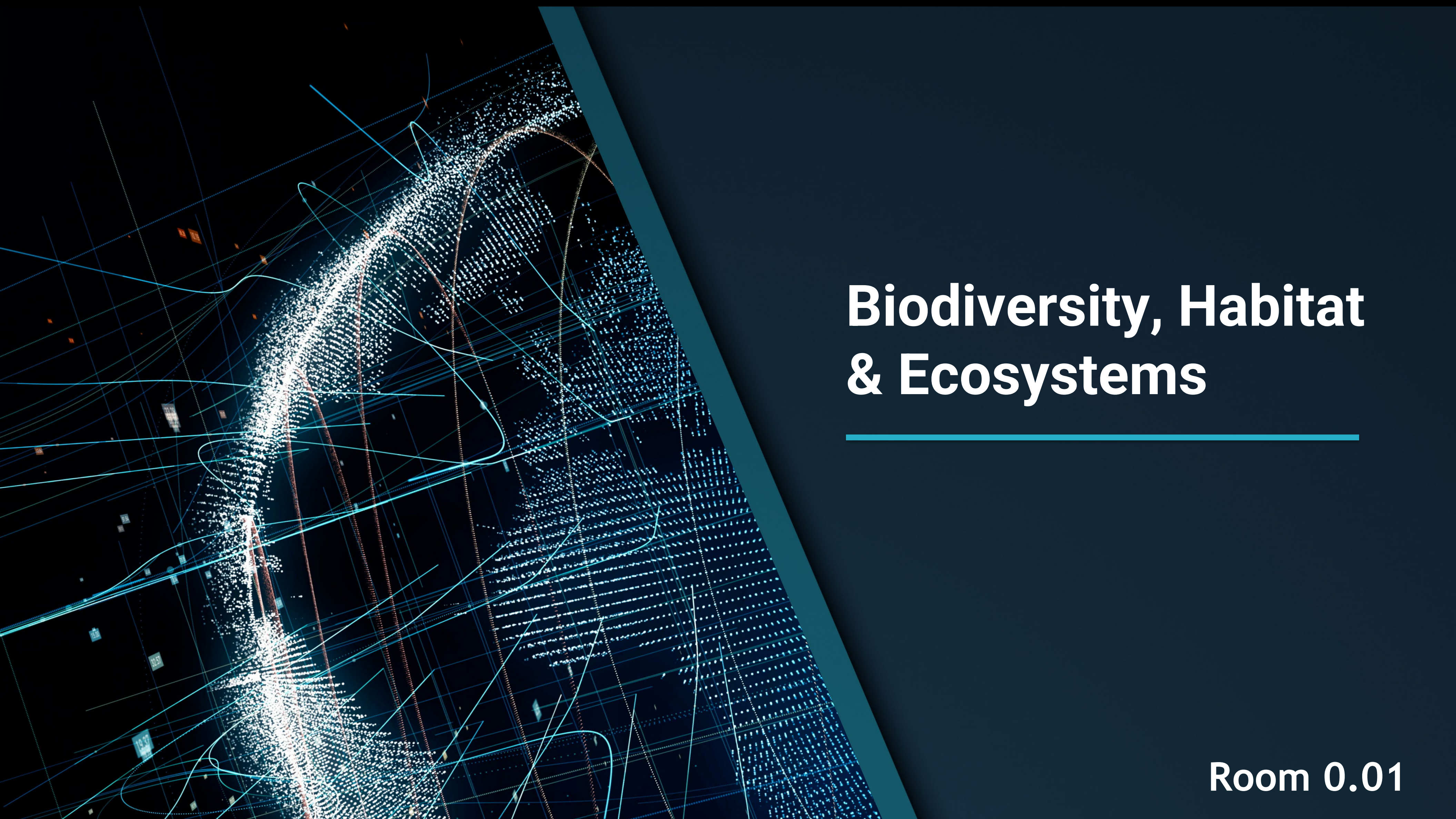
Yumeng Chen

University of Reading

A post-process smoother for improving the past reanalyses with sparse observations

0.01 Poster 019

Sukun Cheng, Keith Haines



Biodiversity, Habitat & Ecosystems

Room 0.01

Land surface phenology (LSP) characterises seasonal vegetation dynamics using long-term satellite observations and plays a critical role in monitoring terrestrial ecosystem responses to environmental change. These products support assessments of carbon cycling, water fluxes, and ecosystem interactions at global scales. A review of current validation approaches shows that LSP products have reached CEOS Land Product Validation (LPV) Stage 2, with accuracy assessed across multiple global sites and intercomparisons conducted between satellite datasets. However, a key limitation identified across the literature is the lack of robust uncertainty quantification in both satellite-derived products and ground-based reference measurements. Existing validation datasets, such as species-specific observations (e.g. Nature's Calendar) and near-surface imaging networks (e.g. PhenoCam), provide valuable temporal information but generally do not propagate measurement uncertainties into derived phenological metrics. Recent studies highlight the increasing use of automated ground-based systems, including wireless fAPAR networks and Digital Hemispherical Photography (DHP), which provide continuous, standardised measurements of vegetation structure and have been used for the validation of Level 2 satellite products. These systems offer a significant advancement by having an uncertainty budget at the measurement level. These measurement uncertainties can be propagated through smoothing processes and metric extraction (e.g. Start, End, and Length of Season) which remains an underdeveloped but critical requirement for LSP validation. This review demonstrates that integrating uncertainty-aware reference datasets with metrological frameworks provides a clear pathway toward higher validation stages. We present an approach for uncertainty propagation using the Community Metrology Toolkit (CoMet) and outline its application for improving the traceability and reliability of LSP product validation.

validation, phenology

Harry Morris

National Physical Laboratory

Advancing validation of land surface phenology through uncertainty-aware reference datasets

0.01 Poster 021

Joanne Nightingale, Luke A Brown, Jadu Dash

Accurate spatial information on vegetation composition and ecological conditions is essential for habitat monitoring and land-cover mapping. In particular, improved discrimination of grassland habitats, including neutral grassland, remains a key challenge for large-scale land cover map products. We are developing national-scale maps of Ellenberg Indicator Values (EIVs) for nitrogen (N), soil pH (R), and moisture (W) across Great Britain using Sentinel-2 satellite data and environmental covariates that capture key ecological gradients. Random Forest models were trained and validated using plot-level EIVs derived from plant species records collected as part of the Countryside Survey 2022. Preliminary results demonstrate the potential to predict spatial variation in EIVs at high resolution across Great Britain. These continuous ecological surfaces offer a novel means of characterising vegetation condition and function, and may provide valuable inputs for improving the classification of grassland habitats.

habitat condition, mapping

Merryn Hunt

UK Centre for Ecology & Hydrology

Improved Monitoring of Grasslands
- Mapping Ellenberg Indicator
Values Across Great Britain Using
Sentinel-2 and Environmental
Covariates

0.01 Poster 023

Lindsay Maskell, Simon Smart,
Chris Marston, Clare Rowland

When identifying conservation potential, it is important to set conservation goals that account for both area and ecological value. This global study uses systematic conservation prioritisation to identify optimal regions for protecting an additional 40% of global mangrove area and 30% of blue carbon, supporting the Global Mangrove Alliance goal of doubling mangrove protection to achieve 80% of mangrove area protected. By integrating EO and geospatial datasets with conservation targets, this approach aims to maximise climate mitigation benefits while identifying spatial priorities for mangrove conservation. We used Marxan, a decision-support software based on simulated annealing optimisation, to identify spatial networks that meet conservation targets at minimum area cost. The model identified priority areas that increased global mangrove protection from 43.2% to 80.6%, representing an additional 56,100 km² of protected mangrove area. Due to uneven baseline protection, new priority areas were concentrated in countries with extensive unprotected mangroves. Indonesia, Nigeria, Myanmar, Malaysia, and Papua New Guinea accounted for 60% of all newly selected areas. The model reveals that achieving the 80% target is dependent on focusing efforts in the five nations mentioned. This demonstrates that fragmented, local-scale protection schemes cannot meet global climate and area targets. Overall, these results provide a global framework for identifying where strategic conservation investment and policy attention may be most needed. However, global Marxan outputs should be interpreted as a prioritisation guidance rather than fixed conservation boundaries. Regional and national models are therefore necessary to refine these priorities and support effective implementation.

mangrove conservation, systematic conservation prioritisation, blue carbon

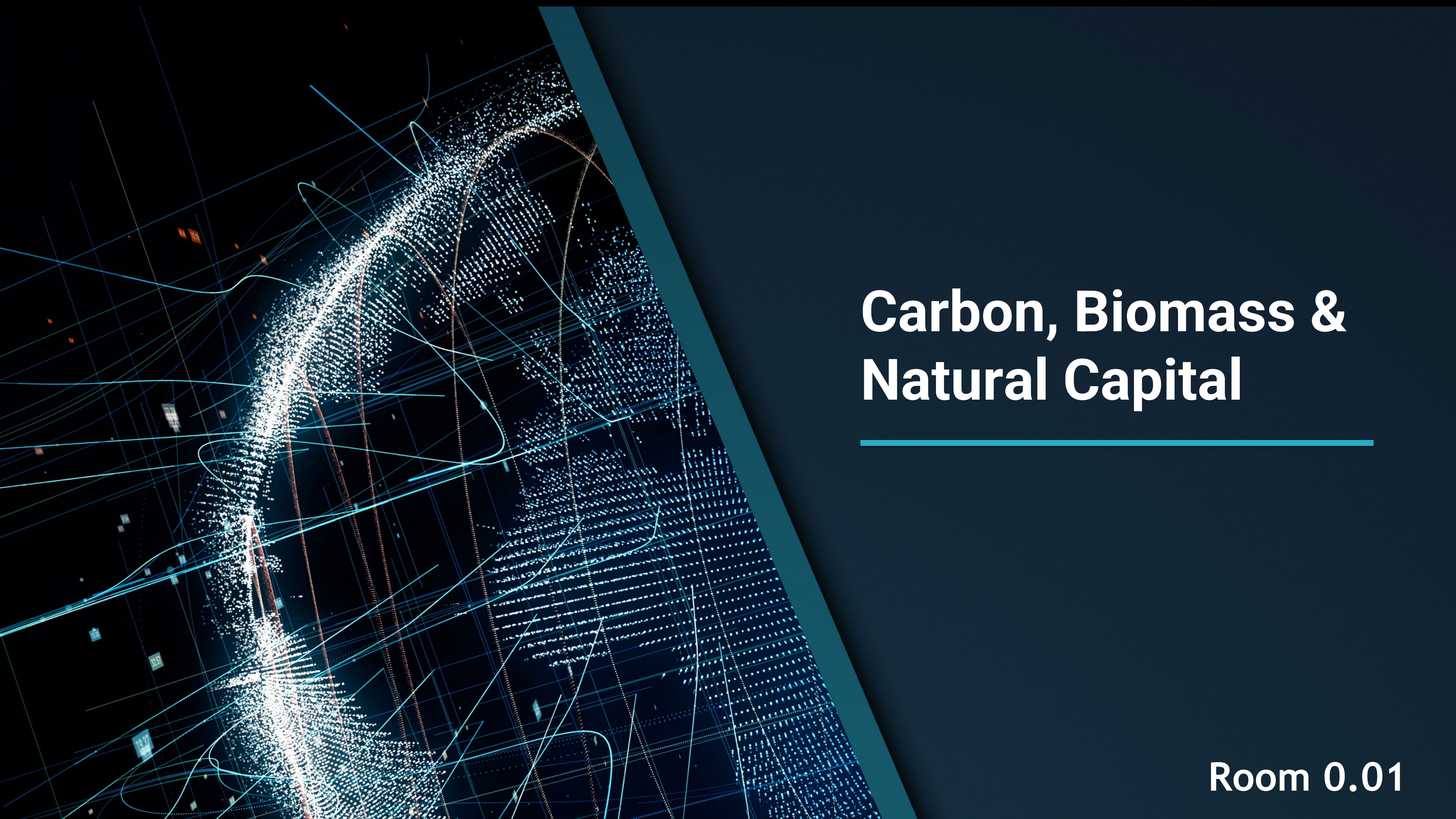
Paula Castro Brandao Vaz dos Santos

Aberystwyth University

Identifying Optimal Regions for
Mangrove Conservation Worldwide
to Reach the Global Mangrove
Alliance Goals

0.01 Poster 025

Pete Bunting, Andy Hardy,
Lammert Hilarides, Kate Longley-Wood,
Thomas Worthington



Carbon, Biomass & Natural Capital

Room 0.01

African savanna grasslands, mixed woodlands, and seasonally dry forests are major carbon sinks, yet estimates of how aboveground biomass density (AGBD) changes through time remain highly uncertain. Earth observation (EO) is the only feasible way to monitor biomass change at continental scales, and many EO AGBD change products now exist. However, these products disagree and demonstrate systematic spatial biases, limiting their value for detecting trends, attributing drivers, and evaluating mitigation or restoration outcomes. Validation is constrained by the scarcity of spatially representative, repeatedly measured in-situ AGBD data. As a result, EO change products are commonly assessed indirectly using space-for-time substitution, where temporally matched EO stock estimates are compared with single-time in-situ stocks across a biomass gradient, assuming that performance across space reflects performance over time. Here, we use repeated measurements from SEOSAW permanent sample plots (PSPs) across vegetation types to test this assumption and evaluate EO AGBD change performance via two complementary approaches: (1) indirect validation via temporally matched stocks and (2) direct validation using observed in-situ AGBD changes. Comparing these pathways provides the first multi-ecosystem, in-situ assessment of EO biomass change estimates across African savannas. We hypothesise that EO AGBD change products perform poorly because space-for-time validation seldom accommodates variation in vegetation structure beyond biomass, while key EO inputs used for change retrieval (e.g., radar backscatter) are strongly governed by structural components of vegetation. Improving the reliability of EO AGBD change estimates is critical for effectively monitoring and projecting ecosystem resilience and adaptation under future global change scenarios.

Oliver McFarlane

University of Edinburgh

In-Situ Validation of Biomass Change Estimates in African Woodlands and Savannas

0.01 Poster 027

Dr Steve Hancock, Prof Casey Ryan,
Dr Pedro Rodriguez-Veiga, Dr Melody
Sandells

The Beyond Biomass project will showcase how multisource Earth Observation (EO) can be combined with existing data and ecological knowledge to calibrate robust, spatially explicit simulation models for Scottish forests, supporting evidence-based policy making and sustainable and resilient land management. We will use a state-of-the-art Bayesian Model-Data Fusion (MDF) framework (CARDAMOM) to combine repeat maps of aboveground biomass, satellite EO and meteorological data with dynamic ecosystem models to produce spatially explicit carbon budgets for Scottish forests and woodlands at landscape and national scales. Exploiting EO data within the MDF framework allows these models to be calibrated to account for spatial variability, and dynamically updated to reflect ongoing processes of growth and disturbance. The ecosystem models are linked to local meteorological data. Therefore, these models account for variations in carbon cycling associated with variability in meteorological forcing, and provide the foundation for location-specific forecasts of climate change impacts on woodlands and forests into the future. MDF provides the mechanism to convert EO data into ecosystem information. A connected challenge is to make this ecosystem information useful for policy makers and land managers. This challenge will be addressed through deep engagement with Scottish Governing agencies (Scottish Forestry, Forest Land Scotland, Forest Research) and other forestry stakeholders to understand user needs and to co-create frameworks that translate the complex, systemic information in MDF analyses into consolidated insights that meet the requirements of decision makers.

carbon, forests, data assimilation

David T. Milodowski

University of Edinburgh

Beyond Biomass: using model-data fusion to transform multisource Earth Observation into systemic understanding of carbon cycling in Scottish Forests and Woodlands

0.01 Poster 029

Juan Suarez, T. Luke Smallman,
Tim J. Green, Mathew Williams

Terrestrial lidar (TLS) has emerged as a promising tool for quickly and non-destructively obtaining volumetric data in forest stands. In this context, the present study aimed to compare volumetric estimates obtained using destructive and non-destructive measurement techniques on a set of 18 trees belonging to the *Eucalyptus* sp. and *Corymbia* sp., located in the municipality of Itatinga, São Paulo, Brazil. Initially, the trees were scanned using a HoverMap STX mobile lidar system, generating three-dimensional point clouds. Subsequently, the trees were felled and subjected to rigorous volume measurement using the Smalian method, with measurements taken at 1-meter intervals along the stem, excluding the volume of branches. The trunks present in the individual point clouds were isolated in CloudCompare software and processed in TreeQSM to reconstruct the tree architecture and estimate volumes. The results demonstrated high agreement between the methods, with a coefficient of determination (R^2) of 0.906 and a root mean square error (RMSE) of 13.88%. The analyses indicate that the combination of lidar-TLS data and TreeQSM modeling constitutes an efficient alternative for the non-destructive estimation of stem volume in *Eucalyptus* sp. and *Corymbia* sp. trees, reducing costs, operational difficulties, and impacts associated with conventional measurement methods.

lidar, validation, volume

Otávio Magalhães Silva Souza

University of São Paulo

Comparative Analysis of
Destructive and Non-Destructive
Measurements of *Eucalyptus* sp.
and *Corymbia* sp. Trees Using
lidar-TLS Data

0.01 Poster 031

Matheus Pinheiro Ferreira

Measurements of solar-induced fluorescence (SIF) from space are emerging as a powerful method for estimating photosynthetic activity on a global scale. SIF has valuable applications in fields such as crop monitoring and drought prediction, as well as in reducing key uncertainties in the global carbon cycle. As a very-high-spectral resolution instrument with a long time series, GOSAT has provided an important benchmark for SIF measurements. GOSAT-2, the successor mission to GOSAT, can complement and expand these measurements, and extend the measurement record into the future. This study presents the development and results of retrievals of SIF from GOSAT-2. Two products have been developed in parallel; one using the University of Leicester's well-established retrieval algorithm, and the other using an algorithm implemented within a new next-generation framework which we expect to further develop in the future. This allows us to maintain consistency while expanding our capabilities in retrieval algorithm development. Retrievals are performed in two microwindows within the O2 A-band, located around 755 nm and 772 nm, with two linear polarisation states treated separately. A zero-level offset is retrieved, to represent the in-filling of solar Fraunhofer lines. SIF is a relatively small signal which must be disentangled from signals arising from instrument errors and the contribution of rotational Raman scattering. A bias-correction scheme is implemented to separate these signals, providing novel insights into instrument performance. Results are compared to those from GOSAT, taking advantage of similarities in instrument design, viewing geometry and overpass time.

SIF, retrieval, photosynthesis

Dan Orr

NCEO / University of Leicester

**Retrievals of Solar-Induced
Fluorescence from GOSAT-2**

0.01 Poster 033

Michael Cartwright, Rob Parker,
Peter Somkuti, Hartmut Boesch,
Alex Webb, Antonio Di Noia

Wildfires are among the most significant natural hazards affecting terrestrial ecosystems, with major impacts on carbon cycles, biodiversity, and human livelihoods. Recent studies indicate a rising contribution of lightning-induced fires, particularly in extratropical regions under a changing climate. These fires are especially important in forested ecosystems, where they account for a substantial share of burned area and associated carbon emissions. Accurate modelling of ignition processes is essential for understanding wildfire behaviour and improving prediction. This study proposes a methodology to identify lightning-caused forest fires using satellite remote sensing time-series data combined with machine learning techniques. Multiple geospatial datasets are integrated to construct a consistent database of wildfire events and associated lightning activity. Forest extent is derived from the JRC Global Forest Cover dataset, wildfire occurrence from EFFIS, and lightning observations from EUMETSAT geostationary satellites, providing high-frequency measurements at $\sim 0.05^\circ$ resolution. Wildfires are labelled as lightning-caused if lightning is detected within a 10 km radius of the ignition point on the day of ignition or within the preceding seven days, accounting for holdover fires. For each event, multi-source satellite time-series data from Sentinel-1 and Sentinel-2 are extracted, including monthly averages over the previous 12 months and vegetation indices such as NDVI and EVI. These features are used to train a Random Forest classifier, with a 70/10/20 split for training, validation, and testing. A case study of fires in Spain during 2025 demonstrates the applicability of the approach. Results will support improved attribution of ignition sources for wildfire risk assessment and early warning systems.

forest fire, lightning, satellite time series

Benyamin Hosseiny

University of Exeter

Identifying Wildfire Causes and
Analysing Their Driving Factors
Using Multi-Source Remote
Sensing, Geospatial Data, and
Interpretable Machine Learning

0.01 Poster 035

Milto Miltiadou

Accurate EO maps of biomass change are needed to improve carbon cycle models and monitor and verification of natural capital. Great efforts have been put in to mapping biomass and change, however there are regional biases between the products. Direct validation of change is rare, but studies suggest that current maps have poor predictive power for the regrowth and mortality estimates needed to test carbon cycle models. Errors include: * Field biomass allometry * Field and EO data alignment * EO signal noise * Field to EO biomass model (possibly multi-stage) * Sampling error of EO data (space and time) Some technologies can make direct measurements of forest height, canopy cover and complexity. For these, the sampling error is the largest source of error, currently preventing change estimates (Patterson et al 2019). The conversion of these to biomass change introduces biases, most probably due to changes in regional allometry. Including structural variables in biomass models is showing promise. Biomass change estimates would benefit from direct measurements of structure change. This can be provided by swath lidar. The Global lidar Altimetry MISSION is developing the technologies needed to achieve global measurements of height and cover change. Recent developments include the addition of atmospheric radiative transfer modelling to the end-to-end simulator, a UAV mounted demonstrator and analysis of current and upcoming detector technologies. Asiyabi, 2026. StruMPL: Multi-task Dense Regression under Disjoint Partial Supervision and MNAR Labels. arXiv:2605.19931. Patterson, 2019. Statistical properties of hybrid estimators proposed for GEDI—NASA's global ecosystem dynamics investigation. ERL.

lidar, biomass, change

Steven Hancock

University of Edinburgh/Field Spectroscopy Facility

Mapping biomass change: Current limitations and the potential for direct measurements of global plant height change

0.01 Poster 037

Steven Hancock, Matthew Purslow, Reza Asiyabi, Juan Molina-Valero, Sam Harrison, Oliver McFarlane, Casey Ryan, Iain McNicol, Callum Norrie, Dmitry Permogorov, Mat Disney, Wanxin Yang, Shaun Quegan

Smouldering combustion is a slow, low-temperature process and a major source of air pollutants such as particulate matter, carbon monoxide, and volatile organic compounds. Because it emits less Fire Radiative Power (FRP) and is often obscured by smoke, soil, canopies, and clouds, smouldering combustion is more difficult for satellite sensors to detect compared to flaming combustion. Thermal infrared instruments like IASI allow us better estimate trace gas concentrations, while lidar instruments like ATLID provide insights into the aerosol composition of smouldering plumes. Models like GEOS-Chem enable comparisons with observations and provide frameworks for integrating multiple observational datasets.

Gabriel Maxemin

Oxford

Smouldering Combustion from
Biomass Burning in the Tropics

0.01 Poster 039



Climate Change & Global Cycles

Room 0.02

Accurate field-scale soil moisture (SM) information is essential for agricultural management, hydrological modelling and environmental monitoring. Sentinel-1 (S1) C-band Synthetic Aperture Radar (SAR) provides frequent observations of surface soil moisture (SSM) at spatial resolutions suitable for agricultural applications. Although numerous approaches relate SAR backscatter to SSM, the influence of soil texture and its associated hydraulic properties remains poorly understood. This study uses long-term observations from the UK Cosmic-ray Soil Moisture Observing System (COSMOS-UK) network to investigate how soil texture influences the relationship between Sentinel-1 VV backscatter and field-scale SSM. Orbit-corrected Sentinel-1 VV backscatter was averaged over field sectors representing the COSMOS sensor footprints, while Sentinel-2 vegetation indices identified low-vegetation periods when backscatter was predominantly controlled by soil moisture. These observations were compared with COSMOS volumetric water content (VWC) measurements. A consistent first-order direct relationship between Sentinel-1 VV backscatter and SSM was observed during low-vegetation periods. Regression gradients remained stable over time at individual sites but varied systematically with soil texture. At Bunny Park (sandy loam), a 1 dB change in VV backscatter corresponded to a 1.69% change in VWC, compared with 4.81% VWC per dB at Loddington (clay), demonstrating a 2.8-fold difference in sensitivity. These findings provide the foundation for retrieving field-scale soil hydraulic properties by combining Sentinel-1 backscatter, rainfall observations and soil moisture modelling. This framework could enable site-specific estimation of van Genuchten hydraulic parameters through optimisation of modelled and observed soil moisture dynamics, with the potential to improve root-zone soil moisture simulations from remotely sensed observations.

Sentinel-1 SAR, soil moisture, soil hydraulic properties

Claire Stanyer

University of Surrey

**Towards Retrieving Field-Scale
Soil Hydraulic Properties Using
Sentinel-1 Backscatter and Soil
Moisture Dynamics**

0.02 Poster 060

Belen Marti-Cardona, Irene Seco

Carbonyl sulfide (COS) is the most abundant sulfur-containing gas in the atmosphere, a dominant source of stratospheric aerosol and can also be used as a proxy for photosynthesis. In recent years there has been an improved understanding of the location and magnitude of COS fluxes, and progress has been made in incorporating satellite datasets to provide increased global coverage and aid efforts to reduce uncertainties in current budget estimates. The Infrared Atmospheric Sounding Interferometer (IASI) instruments onboard the MetOp series of satellites has provided a continuous data record of nadir-viewing radiance measurements since 2007. This high-spectral resolution dataset offers the potential to observe COS over almost 20 years. Previous work by the authors has demonstrated the quality of COS from IASI-A and IASI-B radiances for 2018 using an adapted version of the University of Leicester IASI retrieval scheme (ULIRS). In that work, retrievals were performed over the ocean. We extend that approach to land retrievals, with a particular focus on tropical regions. We have incorporated the v3 CAMEL emissivity database and included retrievals of emissivity alongside COS to improve the quality of the fit. The retrieval of COS is complicated by overlapping CO₂ spectral lines in the most suitable COS band: 2000 – 2100 cm⁻¹. We use new CO₂ spectroscopic line parameters to show the effect these have on the retrieval compared to the older spectroscopy. We investigate the seasonal cycle of COS over the tropics, with particular focus over the Amazon, and demonstrate the close consistency of IASI COS results with measurements from the Network for the Detection of Atmospheric Composition Change (NDACC) ground-based observation network.

OCS, land-ocean, IASI

David P. Moore

University of Leicester / NCEO

**Retrievals of Atmospheric
Carbonyl Sulfide over land and
ocean surfaces from IASI Satellite
Observations**

0.02 Poster 062

Chris Wilson, Jeremy J. Harrison,
Martyn P. Chipperfield, Michael P.
Cartwright, Daniel Coxon

As an Essential Climate Variable (ECV), Land Surface Temperature (LST) products derived from spaceborne thermal infrared instruments have been available for several decades, and have multiple uses, ranging from monitoring climate variability to analysis of the urban heat island effect. These datasets must be validated using independent in situ data to ensure high quality and consistency. Geostationary platforms in particular offer unique insights into diurnal LST variation, but their large (~5 km) spatial footprint means that validation efforts are limited by the need for in situ stations to measure spatially representative land cover. Existing products are inadequately validated using several stations that are surrounded by homogeneous land cover, which sample only a small fraction of biomes measured by these satellites. Here, we describe a novel point-to-pixel upscaling method for validation of LST products, which aims to allow the use of other in situ validation sites surrounded by inhomogeneous land cover. In this method, in situ LST is upscaled to the geostationary satellite footprint using spatial information from the medium-scale (~1 km) LST data from the extensively validated ESA-CCI datasets, and temporal information from the ERA5 reanalysis. The method is demonstrated by applying it to the validation of LST derived from several geostationary satellites forming the Copernicus Global Land Service (CGLS) LST Product.

validation, LST, upscaling

Jasdeep Singh Anand

NCEO / University of Leicester

A Novel Point-to-Pixel Upscaling
Method for Validation of Land
Surface Temperature Products
from Geostationary Satellites

0.02 Poster 064

Darren Ghent, Ritika Shukla

Climate change is altering temperature patterns worldwide, increasing the frequency, intensity and persistence of extreme heat events. Timely identification of emerging hotspots and unusual temperature behaviour is therefore essential for climate monitoring, impact assessment and decision-making. his work, undertaken in support of the Copernicus Climate Change Service (C3S) and European Centre for Medium-Range Weather Forecasts (ECMWF), demonstrates a climate intelligence framework that uses long-term satellite-derived land surface temperature observations to identify and analyse temperature hotspots and anomalies across the globe. The approach combines multi-year temperature records to establish climatological baselines against which current conditions can be assessed. Temperature anomalies are calculated by comparing observed values with long-term averages, allowing regions experiencing unusually warm or cool conditions to be identified. Hotspot analysis is then applied to highlight areas where persistent or extreme temperature anomalies occur, providing insight into spatial patterns of climate variability and change. Global maps and time-series analyses reveal significant regional differences in anomaly behaviour, reflecting the influence of land cover, climate zones, seasonal variability and large-scale climate drivers. The methodology enables rapid detection of areas experiencing exceptional temperature conditions and provides a consistent framework for monitoring changes over time. By transforming large volumes of satellite observations into accessible climate intelligence products, the system supports the identification of emerging climate risks and areas requiring further investigation. The results demonstrate the value of satellite-derived temperature datasets for global climate monitoring and highlight the potential of climate intelligence approaches to support environmental management, climate adaptation planning and resilience-building activities. Such information can help researchers, policymakers and stakeholders better understand evolving temperature patterns and their implications for ecosystems, infrastructure and society.

LST, climate, trends

Abigail Waring

University of Leicester / NCEO

Climate Intelligence: Detecting Temperature Hotspots and Anomalies from Satellite Observations

0.02 Poster 066

Darren Ghent, Karen Veal

Extreme wildfires are becoming increasingly frequent and severe, with far-reaching consequences for ecosystems, public health, economies, and critical infrastructure. The recent escalation of large wildfire events across multiple regions of both hemispheres underscores the need to better understand how anthropogenic climate change is influencing the meteorological conditions that favour fire occurrence and spread. Quantifying these relationships is essential for improving risk assessments, supporting adaptation strategies, and strengthening climate communication. This study contributes to the State of Wildfires 2025-2026 report through an attribution assessment of major wildfire events that occurred between March 2025 and February 2026. We assess changes in extreme fire weather using the Canadian Fire Weather Index (FWI), combining ERA5 reanalysis data with large-ensemble (>10) simulations from three CMIP6 models. A probabilistic event attribution framework, coupled with an empirical-statistical approach, is used to quantify the influence of increasing global temperatures on the likelihood of extreme fire weather across historical, present-day, and future climates under multiple global warming levels. Preliminary findings reveal substantial increases in the probability of extreme fire weather in several regions. Relative to past climate conditions, the likelihood of extreme FWI values is approximately doubled in the Midwestern Canadian Shield Forests under present-day conditions and at a global warming level of $+3^{\circ}\text{C}$. In Northwest Iberia, the probability increases by a factor of three, while the Chilean Temperate Forests and Matorral region experience an increase of around 50%. These results provide further evidence that ongoing climate warming is amplifying fire-conducive weather conditions across diverse fire-prone ecosystems.

wildfires, extreme event, climate change

Zhongwei Liu

NCEO / University of Leicester

**Climate Change and Extreme Fire
Weather: Event Attribution for
Major Wildfires in 2025-2026**

0.02 Poster 068

Douglas I. Kelley, Jonathan Eden,
Robert Parker

The Earth's reflected solar radiation spectrum contains valuable information concerning many variables relevant to climate, including cloud and aerosol properties, atmospheric composition, and surface conditions. The ability to identify and distinguish cloud, aerosol and cloud-aerosol mixes is an important step in delivering data that can further our understanding of the effect of cloud, aerosol and cloud aerosol interactions on climate. To address this challenge, a database of over 0.5 million simulated reflected solar radiance spectra has been generated using the libRadtran (v2.0.6) radiative transfer code library. The simulations include seasonal atmospheric variation based on ERA-5 reanalyses and spatial, temporal and spectral variations in the surface spectral albedo from the HAMSTER database. Cloud properties are simulated using Mie theory for water and the Baum v36 optical model for ice. Multiple aerosol types including urban, continental, maritime, desert and Antarctic are included for both clear sky and cloudy simulations. The simulations cover the 400 to 2400 nm spectral range at 1 nm spectral resolution for a variety of solar illumination conditions and nadir viewing geometry. A method employing singular value decomposition of the simulations is presented to identify the unique combinations of wavelengths to detect cloud and aerosol over a range of surface types and solar illumination conditions. The method has been tested on a sample of observations from the EMIT instrument to demonstrate its ability to successfully distinguish cloud, aerosol and cloud mixed with aerosol observations.

solar radiation, fingerprints

Richard Bantges

Imperial College London

A method for identifying cloud, aerosol and mixed cloud-aerosol scenes in reflected solar radiance spectra

0.02 Poster 070

Jacqueline E Russell, Jonathan E Murray,
Helen E Brindley

Daytime retrievals of Sea Surface Temperature (SST) are a critical contribution to oceanographic remote sensing. However, uncertainty in daytime retrievals is significantly greater than at nighttime for contemporary radiometers, due to the exclusion of the valuable $3.7\text{ }\mu\text{m}$ channel, due to highly variable solar contributions to observed radiances in that spectral band. This study utilises ERA5 atmospheric data and the RTTOV model to simulate daytime radiances from the SLSTR instrument with and without aerosol and solar irradiance. Consequently, Top of Atmosphere (TOA) radiance can be modelled as a linear sum of physical components. ($R_{\text{TOA}} = R_{\text{Thermal}} + R_{\text{Rayleigh}} + R_{\text{Surface}} + R_{\text{Aerosol}}$, approximated as independent contributions). An Optimal Estimation (OE) framework is then used across five nadir SLSTR channels (S5-S9) and a five-element state vector: scaling factors for the Rayleigh scattering, surface-reflected and aerosol-affected terms, as well as the surface temperature and total column water vapour. The surface reflection component depends strongly on the surface roughness and specular tilt angle (the angle at which the sea surface facet needs to be tilted in order for sun-sensor specular reflection to occur), and Cox and Munk surface slope-probability modelling is used to quantify the prior uncertainty. By rigorously defining all prior and measurement uncertainties, retrieval uncertainty is evaluated (in the absence of calibration and simulation errors). The results show a significant improvement in the posterior error covariance matrix, especially at higher tilt angles, suggesting that further development of use of the $3.7\text{ }\mu\text{m}$ channel in daytime OE may yield significant improvements in SST quantification.

uncertainty, daytime, SLSTR

Laura McNamara

University of Reading

Daytime Sea Surface Temperature Uncertainty Analysis using SLSTR $3.7\text{ }\mu\text{m}$ Channel and the Tilt Angle

0.02 Poster 072

Jonathan Mittaz, Christopher Merchant

We present over 15 years of atmospheric methane data from the GOSAT (2009-present) and GOSAT-2 (2019-present) missions using the University of Leicester Proxy Methane Retrieval Algorithm. We describe in detail the processing pipeline to generate the data, assessing the characteristics and data quality for both the GOSAT and GOSAT-2 datasets. We perform extensive validation of the data against the Total Carbon Column Observing Network (TCCON). This validation shows excellent performance of the retrievals across the entire time-period, making them highly valuable for assessing long-term trends to better understand how methane is responding to climate change as well as for monitoring mitigation efforts to meet commitments to the Global Methane Pledge. We identify the need for and subsequently implement a solar-zenith angle dependent bias correction for GOSAT-2. We highlight key studies that have successfully used the GOSAT data to infer information about methane sources, especially those related to the urgent question around tropical wetland emissions. Finally, we also test the consistency of the two datasets, allowing for the data to be combined to improve spatio-temporal coverage and ensure the continued legacy of the GOSAT mission in providing a crucial climate data record of atmospheric methane.

methane, retrieval, global

Rob Parker

University of Leicester

**15 Years of Atmospheric Methane
Data from the GOSAT Missions**

0.02 Poster 074

Lakshmi Bharathan, Hartmut Boesch,
Michael Cartwright, Antonio Di Noia, Neil
Humpage, Dan Orr, Peter Somkuti, Alex
Webb

Ozone trends in the middle latitudes of the Northern Hemisphere exhibit distinct seasonal and regional patterns, which reflect complex interactions between chemistry, climate dynamics, and anthropogenic influences. It is important to understand this variability so that the slow recovery of the ozone layer from past depletion can be accurately detected and quantified. As no single satellite mission is long enough to characterise multi-decadal changes, we use the merged C3S total column ozone (TCO) dataset (1979–present), which combines observations from 15 satellite sensors, and the SWOOSH ozone profile dataset (1984–present), derived from a series of limb-viewing satellite missions, together with simulations from the 3-D TOMCAT chemical transport model. A ridge regression-based multivariate linear regression (MLR) model was applied to disentangle long-term trends from natural variability. Results reveal pronounced seasonal and regional heterogeneity in ozone recovery across Northern midlatitudes, with the strongest recovery occurring during winter and spring. Over the Tibetan Plateau (TP), lower - stratospheric ozone exhibits a distinct wintertime increase. Ridge regression further shows that solar variability and ENSO make modest contributions to interannual ozone variability, whereas the QBO primarily modulates wintertime variability through large-scale atmospheric circulation. The TP's unique topography and thermal forcing create a regional hotspot for tropopause-driven ozone recovery, diverging from global patterns. These findings emphasise that robust assessments of ozone recovery must consider both global-scale forcing and regional dynamical variability, and highlight the importance of long-term homogenized satellite ozone records for reliably detecting and attributing ozone trends. These datasets should be continued with future missions.

satellite observations, ozone recovery, northern midlatitudes

Yajuan Li

University of Leeds

Seasonal and Regional Variability in Column Ozone Trends across Northern Midlatitudes

0.02 Poster 076

Martyn P. Chipperfield, Sandip S.
Dhomse, Wuhu Feng, Mark Weber,
Jianchun Bian

This study proposes a comprehensive framework to investigate the combined effects of observational reference datasets and statistical bias-correction methods on the performance of NEX-GDDP-CMIP6 projections for precipitation, air temperature, and solar radiation. The framework employs the Climate Hazards Group InfraRed Precipitation with Stations (CHIRPS), the European Centre for Medium-Range Weather Forecasts (ECMWF) ERA5 reanalysis, and TerraClimate as observational references for precipitation, temperature, and solar radiation, respectively. Four widely used bias-correction techniques—Linear Scaling (LS), Variance Scaling (VS), Empirical Quantile Mapping (EQM), and Quantile Delta Mapping (QDM)—are applied to multiple NEX-GDDP-CMIP6 models under historical and future climate scenarios. Model performance is assessed using statistical and hydrological metrics, including Root Mean Square Error (RMSE), Mean Absolute Error (MAE), Nash–Sutcliffe Efficiency (NSE), Kling–Gupta Efficiency (KGE), Percent Bias (PBIAS), coefficient of determination (R^2), and selected climate-extreme indices. To explicitly quantify uncertainty arising from observational dataset selection, the study introduces a Reference Dataset Sensitivity Framework (RDSF), including a novel Reference Dataset Sensitivity Index (RDSI) to measure the sensitivity of bias-correction performance to different observational references. A Multi-Criteria Decision Analysis (MCDA) framework is further employed to rank observational datasets, bias-correction methods, climate variables, and CMIP6 models according to their overall performance, robustness, and consistency. Rather than identifying a universally optimal bias-correction method, the proposed framework determines the most suitable dataset–method combinations for individual climate variables. By explicitly incorporating observational reference dataset uncertainty into bias-correction evaluation, this study addresses an important but often overlooked source of uncertainty in climate projection studies.

Zayyanu Usman Doma

Heriot Watt University

Quantifying the Influence of Observational Reference Datasets on Bias-Correction Performance of NEX-GDDP-CMIP6 Climate Projections

0.02 Poster 078

Patidar Sandhya, Kirsty Topp,
Baskar Sen Gupta, Hazrat Ali

NEX-GDDP-CMIP6, bias correction, CHIRPS, ERA5, TerraClimate

Solar-induced chlorophyll fluorescence (SIF) constitutes the emission of infrared radiation from vegetation, as a by-product of the photosynthesis process. It is important for three fundamental reasons. These include: 1) it can be used as a proxy for CO₂ uptake and therefore can help us better understand the carbon cycle. 2) it is an indicator of plant health and water stress. 3) the infrared signal overlaps regions in which retrievals of carbon dioxide are made, so quantifying it at the top-of-atmosphere is imperative. The University of Leicester Version 4 GOSAT SIF product, publicly available through the CEDA archive, now spans 2009–2025 and incorporates refinements throughout the retrieval and processing chain. This long, consistent record enables robust global analyses of interannual variability in photosynthetic activity and vegetation stress. We highlight recent applications of the dataset, including its use in diagnosing ecosystem water-storage dynamics and their relationship to atmospheric carbon growth rate. Comparisons with TROPOMI demonstrate strong consistency in large-scale SIF patterns while also revealing mission-specific sensitivities. Future work will focus on developing a robust GOSAT-2 SIF product and exploring approaches for harmonising GOSAT and GOSAT-2 observations in space and time to create a continuous long-term record. Additional applications include the improved quantification of terrestrial carbon uptake and its role in the global carbon cycle.

vegetation, carbon, retrieval

Michael Cartwright

University of Leicester

**Development and Application of
the University of Leicester GOSAT
Solar-induced Chlorophyll
Fluorescence (SIF) Product**

0.02 Poster 080

Robert Parker, Dan Orr, Alex Webb,
Peter Somkuti, Hartmut Boesch

Tropical peatlands constitute the largest and most uncertain natural source of methane. Methane is a highly potent greenhouse gas, with a 100-year global warming potential approximately 30 times that of carbon dioxide, and accounting for around one quarter of total anthropogenic radiative forcing. Natural wetlands contribute roughly one-third of global methane emissions, while tropical wetlands dominate this flux due to their high productivity, warm temperatures, and persistently waterlogged conditions. However, significant uncertainties remain in estimating current methane budgets and in understanding how environmental drivers, such as temperature, hydrology, and soil carbon availability, interact to regulate tropical wetland methane emissions. Robust digital twins of tropical methane regions are being developed with The Joint UK Land Environment Simulator (JULES) to address these gaps. A first step towards achieving this understanding is the evaluation of JULES wetland methane emissions across different model configurations, exploring dependencies related to forcing data, temperature sensitivity and wetland extent. The model will be tightly coupled with Earth observation data to develop a near-real-time framework that enhances process-level understanding of methane dynamics while reducing uncertainty in emission estimates. The resulting improved model representations will inform projections of future methane emission rates under a range of ISIMIP climate scenarios. These analyses will together deliver policy-relevant insights into the magnitude, variability, sensitivities, and temporal evolution of methane emissions across near- and long-term horizons, supporting climate assessments and informing mitigation and adaptation strategies.

methane, wetlands, climate

Jeremy Emmett

University of Leicester

JULES Modelling of Tropical Wetland Methane

0.02 Poster 082

Robert Parker, Nicola Gedney

The Northeast Greenland Ice Stream is investigated as a regional case study of the influence (physical forcing) of atmospheric and oceanic processes on patterns of variability in the speed of grounded ice and glacial mélange, focusing on two marine-terminating glaciers (Nioghalvfjerdsfjorden Glacier and Zachariæ Isstrøm) with distinct behaviour over the 2015-2025 period. Sentinel-1 Synthetic Radar Aperture (SAR) image pairs are processed using the intensity offset tracking method to produce an up-to-date ice speed dataset over this region, and ancillary model datasets provide a contemporaneous record of meltwater extent, calving front position and terminus retreat, ocean heat anomaly and surface air temperature anomaly.

Ellie Fisher

University of Leeds

Atmospheric and oceanic modulation of ice speed variability in the Northeast Greenland Ice Stream during 2015-2025

0.02 Poster 084



Disaster Prediction & Response

Room 0.02

Fires play a critical role in shaping ecosystems, driving biogeochemical cycles, and influencing atmospheric composition. The frequency, intensity, and size of fires have undergone rapid change in recent decades especially in the climate change environment. It is essential and urgent to accurately represent wildfire dynamics within Earth system models to quantify their influence on carbon–climate feedbacks and predict ecosystem responses, including potentially rapid and irreversible ones, to environmental change. However, modelling and understanding wildfires processes is a complex issue due to the interaction among climate, vegetation, human activity, and land-use change. The Joint UK Land Environment Simulator (JULES) was then developed to simulate the dynamics of terrestrial hydrology, vegetation, carbon storage, and the surface exchange of water, energy, and carbon. At the same time, Machine Learning (ML) techniques allow development of model emulators, enabling large-scale data processing and quantification of model uncertainty for a comprehensive analysis of potential wildfire driving factors. Here we will present an ML-based emulator for the JULES-INFERN0 model and use it to: 1) Analyse and understand the key climatic drivers for wildfire, characterising recent trends (such as the size, frequency and intensity of wildfires) across JULES model simulations; 2) Evaluate and identify the potential for monitoring early warning signals for tipping points by combining model simulations, remote sensing data and Artificial Intelligence.

wildfire, tipping points, machine learning

Limeng Zheng

University of Leicester

Understanding the drivers of wildfires using JULES model simulations and machine learning emulators

0.02 Poster 086

Limeng Zheng, Robert Parker,
Zhongwei Liu, Darren Ghent,
Douglas Kelly, Chantelle Burton



Geosciences

Room 0.01

The integration and deployment of imaging systems on uncrewed aerial vehicles (UAVs) is a maturing technique within Earth Observation. At the cutting edge of deployment, narrow band hyperspectral push broom imagers covering the 350 nm to 2500 nm range are being deployed from UAVs, allowing for high spatial and spectral resolution measurements. The provision of such data fills a key niche in ground to space calibration/validation activities. However, the uncertainties associated with these measurements remain a challenge to both identify and quantify, posing questions on data robustness for missions requiring precise uncertainty budgets. Previous work has focused on quantifying the uncertainties in field deployment (such as the SRIX4VEG: Surface Reflectance Intercomparison Exercise for Vegetation) or on the uncertainties in the calibration and characterisation of the imager itself (IEEE P4001 - Characterization and Calibration of Hyperspectral Imaging Devices), providing key baselines from which to build upon. The NERC Field Spectroscopy Facility has the unique capability in having both an optical calibration laboratory to quantify the uncertainty associated with radiance measurements made by hyperspectral push broom imagers, and the means to deploy this in field measurements with the collection of ancillary data (e.g. atmospheric parameters, ground target validation using field spectroscopy). In this presentation, we present a full uncertainty chain from calibration and characterisation of a hyperspectral imager for UAV measurements, to field deployment, to final atmospheric correction, providing a final relative percentage uncertainty in surface reflectance for a test site located in Edinburgh, UK. This test case provides a methodological framework for other research groups seeking clarity and standards for UAV hyperspectral measurements.

calibration/validation, UAV, metrology

Robbie Ramsay

NERC Field Spectroscopy Facility

A Framework for the Calculation of Uncertainty Budgets for Hyperspectral Imaging from UAVs

0.01 Poster 041

Alex Merrington, Zoe Halem,
Callum Middleton, Steven Hancock

LSTs derived from satellite measurements are highly affected by atmospheric effects as well as surface radiative and thermodynamic properties, of which, emissivity (defined as the ratio of the radiance emitted by a given object to that emitted by a black body at the same temperature) can be selected as a key factor. However, many operational satellites do not have enough TIR channels to simultaneously retrieve both LST & LSE parameters. Therefore, auxiliary datasets are frequently used to provide this information instead. Current methods to determine LSE values frequently possess limitations, especially over urban areas, as they frequently only partitioning land into vegetation and soils. Where urban landscapes are considered, they are often described by a single land-use classification which is insufficient to fully document their heterogenous nature. In order to address this we: 1) Generate a novel classification algorithm based on the thermal properties of surfaces 2) Utilise the classification algorithm for better representation of surface emissivities and, consequently, enhance estimation of LSTs

LST, emissivity, classification

Charlotte Paton

University of Leicester

Emissivity Inputs for High Resolution LST Retrievals and Downscaling

0.01 Poster 043

Darren Ghent, Mike Perry, John Remedios

Volcanic plumes can have significant climatic and environmental impacts and pose hazards to aviation and local communities. Accurate estimates of volcanic plume height are critical for determining mass eruption rates and forecasting ash dispersal, but plume rise remains difficult to model because of uncertainties in poorly constrained eruption source parameters and atmospheric influences. We present the Plume Overshooting Parcel (POP) model, a computationally efficient 1D time-dependent Lagrangian model of the buoyant phase of volcanic plume rise, capable of modelling unsteady plumes. A global sensitivity analysis shows that plume neutral buoyancy height is highly sensitive to atmospheric structure, particularly tropopause height and tropospheric lapse rate, indicating that atmospheric conditions can exert strong controls on plume rise. These results motivate investigation of a neutral buoyancy forcing metric relating mass eruption rate to plume height for plume-limited and atmosphere-limited rise regimes. The POP model is evaluated using Advanced Baseline Imager (ABI) and Spinning Enhanced Visible Infrared Imager (SEVIRI) observations of the 2021 eruption of La Soufrière, St Vincent. The effects of parallax and side-viewing on satellite plume top observations are quantified, and a multi-instrument method utilising parallax is developed to estimate plume height during the eruption. These results demonstrate the importance of accounting for viewing geometry when interpreting satellite observations of plumes and provide improved observational constraints for volcanic plume modelling and mass eruption rate estimation.

volcanoes, plumes, ABI

Rebecca Tichford

**University of Oxford, Earth Observation
Data Group**

**Volcanic Plume Rise: Combining
Models and Observations**

0.01 Poster 045

Don Grainger, Isabelle Taylor

Terrestrial and coastal mass movements offer ecological niches for specialist species and act as a natural laboratory for understanding mass movements. England in particular hosts some of the largest and most geomorphologically important mass movement examples in Britain. However, active geomorphological processes at these sites are sometimes constrained by human activities, or face pressures from changing climatic patterns. Monitoring how these nationally important mass movements deform over time is critical for understanding their responses to such pressures. Current field-based or drone-based monitoring approaches for assessing deformation changes at these sites are temporally infrequent (up to annual but often multi-annual) and/or spatially small-scale (up to tens of kilometres). Such surveys therefore cannot capture slope motion on the scale of a whole coastline or landslide complex, or at a temporal frequency which enables study of the whole landslide cycle. Instead, we use Interferometric Synthetic Aperture Radar (InSAR) time series analysis to support monitoring of nationally significant terrestrial and coastal mass movements. These workflows ingest Sentinel-1 and ALOS-2 SAR data to produce maps and time series of surface deformation, 2016-2026. We test these workflows on sites including Alport Castles and Axmouth to Lyme Regis Undercliffs. We identify which mass movements have been active and when; peak rates of motion at active these sites; and the aerial extent of such motion. We test the use of automated processes to identify changes in deformation rate. In future, we will scale up this pilot project to provide routine observations of key mass movement sites across England.

Jess Payne

Natural England

InSAR for evidence: Natural England's use of InSAR to support mass movement condition assessments in England's Special Sites of Scientific Interest

0.01 Poster 047

Jonathan Brownett, Henny Schulte To
Bühne, Alexandra Kilcoyne, Hannah
Townley, Nish Halwyn

The spectral emissivity of ice and snow surfaces in the far-infrared (FIR) is a critical parameter impacting the surface energy budget and Earth's longwave radiative cooling. Its importance is particularly pronounced at high latitudes, where clear-sky conditions and low atmospheric water vapour concentrations enable surface-emitted radiation to propagate through the atmosphere and escape directly to space. Despite its climatic significance, observational constraints on FIR surface emissivity remain severely limited relative to the mid-infrared, with only a limited number of in-situ or airborne retrievals reported in the literature to date. To address this observational gap, we present a spectral emissivity analysis of ice and snow surfaces in the wavenumber range 400-1600 cm^{-1} , derived from measurements acquired by the Far INfrarEd Spectrometer for Surface Emissivity (FINESSE) — a ground-based Fourier transform spectrometer developed at Imperial College London. Surface emissivity retrievals were performed using data collected during the WHAFFERS campaign, conducted at Gault, Canada, in January and February 2025. Accounting for the angular dependence of surface emissivity, upwelling radiance measurements were acquired at multiple viewing angles over the ice and snow surfaces, alongside incident downwelling sky radiance measurements. For ice surfaces, the retrieved spectral emissivity shows good overall agreement with Fresnel equation-based modelled emissivity, with remaining discrepancies examined across modelled emissivities derived from different refractive index datasets. For snow surfaces, preliminary emissivity retrievals are presented, representing some of the first ground-based FIR emissivity measurements of snow. Since snow surface emissivity is known to depend on microphysical properties such as grain size, future work will investigate these dependencies using collocated in-situ measurements of snow microphysical properties obtained during the campaign.

far-infrared, ice and snow surface emissivity

Hyoji Kang

University

Far-Infrared Spectral Emissivity of Ice and Snow Surfaces from FINESSE Ground-Based Measurements

0.01 Poster 049

Jonathan Murray, Sophie Mosselmans,
Sanjeevani Panditharatne, Laura
Warwick, Helen Brindley

Accurate representation of terrestrial carbon, water and energy exchanges is essential for improving predictions of ecosystem function and climate change. However, uncertainties in land surface model parameters remain a major source of error, limiting confidence in simulations across a range of environmental conditions. Robust and computationally efficient calibration methods are therefore needed to better constrain model behaviour and support the development of next-generation land surface models. Building on previous work, we present recent developments to the LAVENDAR calibration framework that improve the robustness and conditioning of the problem while retaining the practical advantages of ensemble variational methods, including the avoidance of tangent-linear and adjoint models. The enhanced framework is applied to estimate the parameters of alternative stomatal conductance formulations within the Joint UK Land Environment Simulator (JULES) using FluxNet observations of gross primary productivity and latent heat from multiple forest sites. By providing a more robust framework for calibrating JULES against observations, this work aims to better constrain key land surface processes and reduce uncertainty in simulations of terrestrial carbon, water and energy exchanges. These advances will help strengthen confidence in UK Earth system model predictions used to understand climate change, ecosystem resilience and future environmental change.

land surface model calibration, terrestrial vegetation, carbon & energy cycles

Natalie Douglas

University of Reading

Improving the calibration of JULES stomatal conductance schemes using an enhanced LAVENDAR framework

0.01 Poster 051

Tristan Quaife, Rebecca Oliver

As part of the ESA-funded Fiducial Reference Measurements for Vegetation (FRM4Veg) project, this study investigates the feasibility of deriving Bidirectional Reflectance Factor (BRF) surface reflectance from UAV-based measurements, with the aim of developing a methodology for producing FRM-compliant datasets. A UAV field campaign was conducted in June 2026 at the Centre wallon de Recherches agronomiques (CRA-W), Gembloux, Belgium. A DJI Matrice 350 RTK UAV equipped with a MicaSense RedEdge multispectral sensor captured reflectance data from multiple viewing geometries. A total of 73 angular configurations were acquired per flight, with view zenith angles ranging from 0° to 60° (10° increments) and azimuth angles from 0° to 330° (30° increments). The UAV-derived measurements, initially recorded as Hemispherical Conical Reflectance Factor (HCRF), are converted to BRF using the CISAR atmospheric correction algorithm. Radiative transfer simulations performed using the Eradiate model provide reference BRF datasets for comparison. This study presents a novel UAV-based multi-angular acquisition strategy to derive BRF under FRM guidelines. Initial results indicate consistent angular reflectance behaviour, demonstrating the potential of UAV systems for BRF retrieval under field conditions. The approach supports improved calibration and validation of satellite observations, contributing to more reliable vegetation monitoring.

Harry Morris

National Physical Laboratory

Deriving BRF Surface Reflectance from UAV-Based Observations

0.01 Poster 053

Yves Govaerts, Morven Sinclair,
Matthew Scholes, Misael González,
Vincent Leroy, Thibaut Lamon,
Joanne Nightingale, Valentina Boccia

The BAE Systems Space & Mission Systems, Space Compact Hyperspectral Prism Spectrometer (SpaceCHPS) enables advanced hyperspectral measurements that significantly enhance monitoring of land, coastal, ocean, and inland water environments. By acquiring hundreds of contiguous spectral channels from 400 nm to 2.500 μm , SpaceCHPS captures the fine spectral structure needed to retrieve detailed surface and aquatic properties beyond the capability of traditional multispectral systems. This continuous spectral sampling supports precise characterization of vegetation biochemical traits, canopy water content, soil minerals, and surface composition, providing new insight into biodiversity, ecosystem condition and land use change. In aquatic and coastal zones, high spectral resolution improves detection of chlorophyll, colored dissolved organic matter, suspended sediments, and shallow benthic features while strengthening atmospheric correction over dark or turbid waters. SpaceCHPS also resolves solar Fraunhofer lines and atmospheric absorption features within each scene, enhancing spectral calibration and supporting high radiometric accuracy—critical for long term climate and environmental data records. Together, these capabilities allow SpaceCHPS to generate both Landsat and Sentinel like data products and advanced new measurements from a single dataset, positioning hyperspectral imaging as a powerful, next generation solution for sustained Earth observation.

Jessica Missun

BAE

SpaceCHPS- Hyperspectral Measurements for Land, Coastal, and Water Monitoring

0.01 Poster 055



Inland Waters & Hydrology

Room 0.01

The Sahelian wetlands are vital ecosystems supporting biodiversity and critical water security, yet remain highly vulnerable to climatic shifts (Dieng, 2021a; Madgwick et al., 2017). Following severe late-20th-century droughts, recent northward shifts in the Intertropical Convergence Zone and the 2019 positive Indian Ocean Dipole have driven increased rainfall and severe flooding across the Sahel and East Africa (Zeng, 2003; Feng et al., 2023). However, a chronic lack of hydrometric data leaves these hydrological responses poorly understood. Existing datasets cannot adequately capture these dynamics. Global inventories are static (Lehner et al., 2024), and broader satellite observations lack the spatial resolution to resolve key hydrological features. While 30 m Landsat archives offer mapping potential, current classification systems primarily detect open water, significantly underestimating inundation hidden beneath emergent tropical vegetation (Pekel et al., 2016; Hardy et al., 2020). To address this, we adapted the TropWet classification system for the Sahel-East Africa domain. We improved spectral consistency using standardised regional endmembers (water, soil, vegetation, and burnt area) and utilised a fuzzy-logic membership approach, using a Bayesian optimisation of thresholds to accurately map ecological transition zones. Applying this methodology, we developed a novel 30 m inundation time-series (2014–2023). Our results reveal a profound 86% increase in regional wetland extent, transitioning vast areas from ephemeral to seasonal regimes. This exposes new zones of extreme flood vulnerability intersecting with major cities and refugee populations, demonstrating how recent climatic shocks abruptly reset regional hydrological baselines.

inundation dynamics, Sahel

Gregory Oakes

Aberystwyth University

Profound changes in wetland extent across the Sahel and East Africa (2014-2024) drive ecological shifts and human vulnerability

0.01 Poster 056

Andy Hardy, Peter Bunting, Mori Diallo, Lorentzo Gaffi, Lammert Hilarides, Edmund Kuto, Boubacar Youssouf

We present the development of a new dataset to support research into the impact of a changing climate on the lakes surrounding the Greenland ice sheet. The dataset is derived from data provided by the United States Geological Survey from the Landsat 7, 8 and 9 missions and covers the period 1999 to 2025. We will describe the software tools which were used to create the dataset and discuss some of the challenges faced.

Greenland, lake temperatures

Niall McCarroll

University of Reading

Development of a dataset of Earth
Observations of Greenlandic Ice-
Marginal Lakes

0.01 Poster 057

Chris Merchant, Laura Carrea

Satellite retrievals have revealed a rapid increase in atmospheric methane since 2020. A principal driver has been the rapid expansion of wetlands across East Africa following extreme seasonal rainfall in 2019 and 2023. However, significant uncertainties remain, as process-based models are unable to capture the strong interannual variability in the seasonally flooded grasslands. A key limitation in river models is that while they capture the redistribution of water within a convergent drainage network, they typically neglect divergent (bifurcating) pathways which enable water to spread out across the wetland and characteristic of large inland delta systems. This leads to an underestimation in the seasonal and interannual amplitude of inundation extents. Under the CurFEW project, we use the Cama-Flood hydrodynamic river model which explicitly represents the additional bifurcating flow pathways. At the scale of our process-based model (~25 km) the bifurcation parameters are not directly observable and require tuning. Additionally, in data scarce regions such as East Africa, we rely on EO datasets of inundation to constrain and optimise the bifurcation parameters for inland river deltas, employing an ensemble data assimilation approach. We will investigate the bifurcation parameter sensitivity to the operators used to map between the observation and model space. We aim to develop a data assimilation-based framework, recognising that each major wetland will require a tailored solution. This work contributes to improving the representation of major fluvially flooded wetlands across Africa, with the aim of reducing uncertainties in estimates of tropical methane emissions.

inudation. data assimilation, modelling

Sonja Folwell

UKCEH

Leveraging EO to improve
modelled inundation of seasonally
flooded wetlands

0.01 Poster 058

Sonja Folwell, Elizabeth Cooper,
Douglas Clark

Ocean and inland water colour remote sensing are well established fields that can inform on water quality (e.g., chlorophyll-a, turbidity, total suspended sediments) with nearly 30 years of continuous ocean colour monitoring from space. But what happens when we start looking at small waterbodies? Utilising the 10-60m Copernicus Sentinel-2 satellite, in operation for over 10 years, together with in situ measurements, we can re-evaluate and optimise existing inland water algorithms to work better with this land-optimised sensor. The next challenge comes when observing waterbodies with low surface areas compared to their perimeter, as the adjacency and mixed land / water pixels are more prevalent in these waterbodies, leading to erroneous water quality estimates. Possible solutions include the use of adjacency correction algorithms and rethinking how to report the observed variables, for example, using per-lake statistics rather than pixel-based observations, or reporting on optical water types as biogeochemical behaviours rather than constituent concentrations with large uncertainty. The future development of a robust uncertainty model for these observations should be the next stage to be deployed to aid characterisation of the data quality.

water, quality, Sentinel-2

Mark Warren

Plymouth Marine Laboratory

Challenges of monitoring small waterbodies with Sentinel-2

0.01 Poster 059

Stefan Simis, Nick Selmes, Steve Groom

An abstract visualization of atmospheric data, featuring a dense field of white and blue particles and trajectories. The background is dark blue, with a diagonal band of lighter blue and white particles. The trajectories are represented by thin, curved lines in various colors (blue, orange, red, green).

Meteorology & Atmospheric Chemistry

Room 0.02

When applying data assimilation (DA) to environmental problems, the assimilation window is usually chosen according to the error growth rate of the underlying physical system. For example, for atmospheric DA the window is usually 6-12 hours at synoptic scales, whereas for the ocean windows of a few days can be chosen, reflecting the slower timescales. When applying DA to a coupled dynamical system with different timescales, the time window must be chosen based on the fastest error growth. In the context of variational DA for coupled atmosphere-ocean prediction, operational centres such as the Met Office and ECMWF are developing weakly-coupled DA systems, in which a separate assimilation is performed for the atmosphere and ocean, with information between the two passed through cycling of the assimilation system. This requires that the same time-window be used for the atmosphere and ocean, leading to a sub-optimal use of the sparser and less frequent ocean observations. Here, a new method is proposed to address this issue. After running the standard weakly-coupled DA for several assimilation windows, a new 'smoother' procedure is performed to find an ocean trajectory that best fits all ocean observations over these windows. We illustrate the proposed scheme using a new idealised model with an appropriate separation of timescales. We show how our new method significantly improves the accuracy of the ocean analysis, which leads to improvements in the atmosphere when the scheme is cycled. Furthermore, we illustrate how the new scheme enables the effective assimilation of late-arriving ocean observations.

data assimilation, couple systems, atmosphere-ocean

Amos Lawless

NCEO / University of Reading

**Treating different timescales in
data assimilation for coupled
systems**

0.02 Poster 088

Nancy K. Nichols, Tsz Yan Leung,
Shaerdan Shataer

Atmospheric methane (CH_4) is the second most important anthropogenic greenhouse gas after carbon dioxide, contributing to global warming. Concentrations of CH_4 continue to increase, however we do not fully understand global trends due to uncertainties in the drivers of its sources and sinks. The main sink of CH_4 , the hydroxyl radical (OH), contributes to large uncertainties in the CH_4 budget. Due to short lifetime of OH in the atmosphere ($\sim 1\text{s}$), it is very challenging to measure. Global OH concentrations have previously been estimated using concentrations of methyl chloroform as a proxy, however its near-removal from the atmosphere means this method is no longer viable. In this study, we present a machine learning approach to estimate spatially and temporally varying OH concentrations. We are developing a random forest decision tree machine learning model trained on Earth observation data from the MetOp satellites and the chemical transport model TOMCAT. The OH fields produced by the machine learning model will be used to investigate recent trends of atmospheric CH_4 with the aim of improving constraints on the CH_4 budget.

OH , machine learning, methane

Emily Dowd

University of Leeds

Constraining the hydroxyl radical (OH) using satellite data and machine learning to investigate methane trends

0.02 Poster 090

Richard Siddans, Lucy Ventress,
Brian Kerridge, Scott Hosking, Wenjie
Yin, Dwayne Heard, Chris Wilson,
Martyn Chipperfield

The Total Carbon Column Observatory Network (TCCON) consists of high-resolution ground-based Fourier transform spectrometers, which provide accurate abundances of atmospheric greenhouse gases (GHG) by measuring high resolution transmittance spectra of the atmosphere. Owing to the strict requirements on the instrumentation, calibration, acquisition, and data processing, TCCON stations and their datasets enable the validation of GHG satellites, contribute to carbon cycle sciences, and form a key component of the regional and global GHG emission measurement network of networks. Such observatories are essential to make the most out of the space infrastructure measuring GHGs, and to make consistent the developing national GHG emission monitoring systems. The Harwell site serves as the UK contribution to this TCCON. Established in September 2020 and operating under formal accreditation from the TCCON community since September 2021, the Harwell station meets even the most stringent precision requirements and has been included in the list of scheduled targets for the NASA OCO-2 satellite mission since 2022, with prospects to serve the EUMETSAT CO2M mission validation as well. In addition, the observatory is ideal to anchor the national GEMMA system to TCCON, and therefore link the national network to other similar national networks, for increase consistency and transparency. The station has successfully tracked five full CO₂ annual cycles and has consistently detected plumes from the Canadian boreal fires for the past three years. It is also the first site to host a GEMINI-UK instrument, to tie the national emission monitoring effort to the international standards. Meanwhile, an independent optimal estimation retrieval algorithm is being developed in collaboration with the University of Oxford, suitable not only for TCCON measurements, but for any ground-based direct-solar instruments.

carbon, monitoring, pollution

Stamatia Doniki

RAL Space, STFC, UKRI

The Harwell UK TCCON observatory: A key infrastructure for greenhouse gas emission science

0.02 Poster 092

Stamatia Doniki, Richard Brownsword,
Kevin Smith, Damien Weidmann

As climate change progresses, shifts are being observed and predicted in the transport of the Earth's water. In some locations, these impacts are already being observed, ranging from more intense precipitation to severe droughts. These changes harm societies through flooding and instabilities in food and water supplies. Climate policies have been implemented to mitigate the harmful consequences of these changes, but their overall impacts remain unclear. Indonesia has experienced more flooding in recent times due to extreme precipitation events, as seen in September 2025 and November 2025, which had devastating impacts across Sumatra. These areas had been subject to fires in recent months, which caused a loss of vegetation, slowed the absorption of water into the soil and exacerbated flooding in the local communities. Therefore, changes to the atmospheric moisture transport can have a significant impact on these regions. The aim of this study is to utilise the new water tracer ability of the Met Office Unified Model to investigate how a steady increase of greenhouse gas emissions can modify atmospheric moisture transport in the South Pacific region. We will first introduce the model's updates and explain how transport metrics are derived. Results will be presented along with comparisons to observations. Uncertainties in atmospheric moisture transport will be discussed, along with the broader context for those who live in the region.

water tracers, water vapour, climate policy

Eleanor Matkin

University of Leicester / NCEO

**Investigating Long-Term Policy
Impacts on Atmospheric Moisture
Pathways and the Implications for
Monsoon Rainfall Over Indonesia**

0.02 Poster 094

Tim Trent, Adam Povey, Alison McLaren,
Louise Sime

Ammonia (NH_3), primarily from livestock emissions, significantly impacts air quality by contributing to the formation of secondary inorganic aerosols (SIAs), including ammonium nitrate and ammonium sulfate (key components of $\text{PM}_{2.5}$). NH_3 has a short atmospheric lifetime (~ 15 hours) and can react rapidly with gases like nitric and sulfuric acid. The short lifetime and consequent large spatiotemporal variability of NH_3 makes it difficult to validate emission inventories with solely ground-based observations due to the sparsely distributed measurement network. Satellites help overcome this limitation by providing consistent observations with extensive spatial and temporal coverage. When combined with modelled columns, these can be used to constrain emission estimates. This project uses observations from IASI (Infrared Atmospheric Sounding Interferometer) and CrIS (Cross-track Infrared Sounder) to assess total column NH_3 concentrations over the UK and Europe. Observations are interpreted using the TOMCAT global chemical transport model to evaluate the spatial and temporal variability of NH_3 and its contribution to $\text{PM}_{2.5}$. We aim to constrain bottom-up NH_3 inventories, such as the National Atmospheric Emissions Inventory (NAEI), using top-down satellite-derived estimates, assessing long-term trends and emission sources. Here, we show comparisons between CrIS and TOMCAT, and preliminary estimations of emissions using a mass-balance approach.

air quality, ammonia, satellite

Matthew Alexander

University of Leeds

Space-based constraints on UK ammonia emissions and air quality impacts

0.02 Poster 096

Wuhu Feng, Richard Pope,
Martyn Chipperfield

The EarthCARE satellite provides a unique perspective on clouds through observations with its lidar-radar-imager suite. ESA's ACM-CAP cloud property retrieval synergistically combines the three measurement sets, but radiative closure experiments suggest that the retrieval can fail to predict the observed radiative effect of ice clouds. By comparing different sensor combinations used in EarthCARE retrieval products, we systematically study the propagation of information from the three sensors through the retrievals. Furthermore, we perform closure tests to probe which retrievals best reproduce observed radiances. The results provide important guidance for efforts to improve consistency of ice property modelling across the ACM-CAP retrieval.

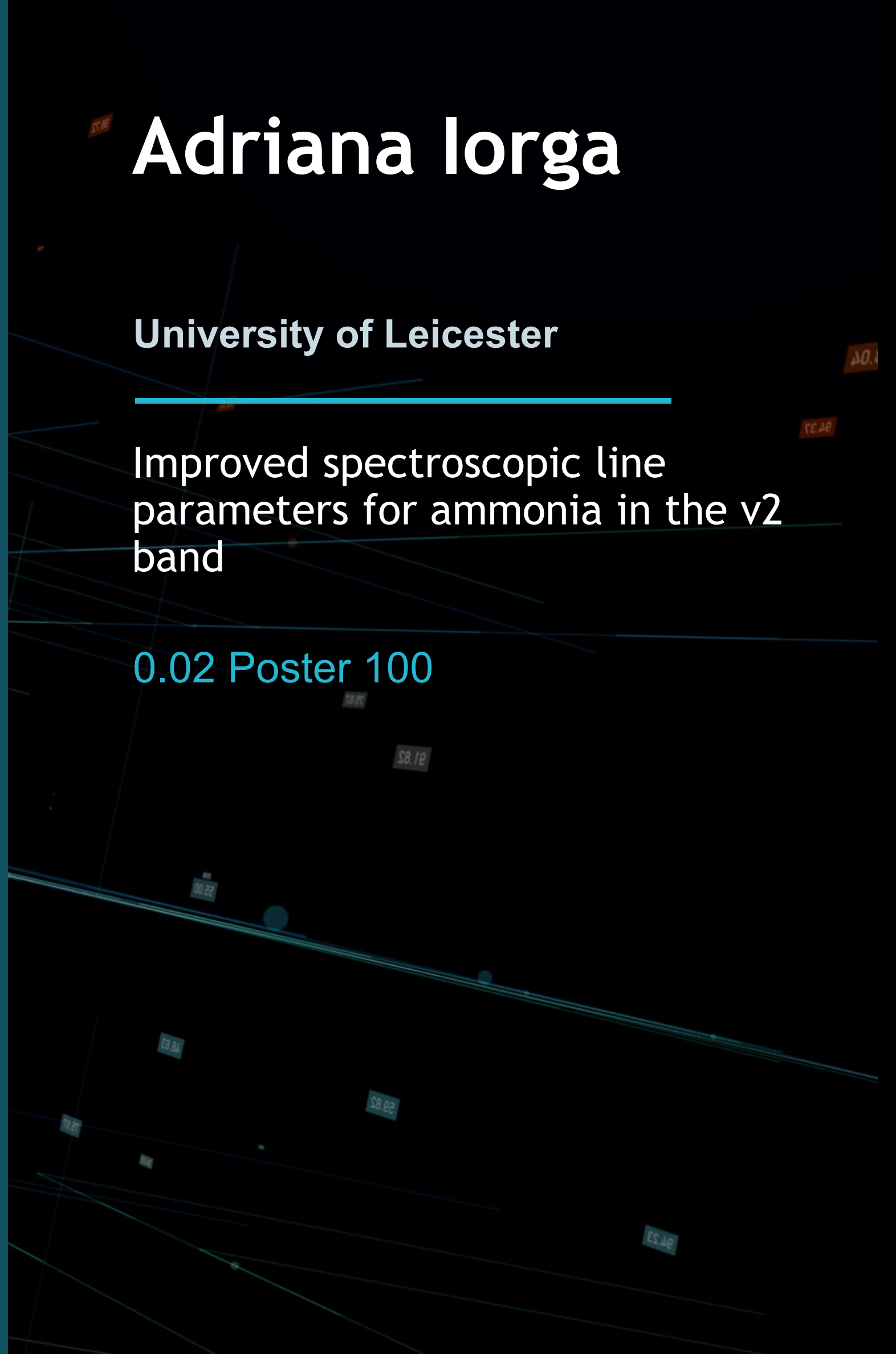
Ben Pery

Imperial College London

A multi-instrument exploration of
ice cloud retrievals with
EarthCARE

0.02 Poster 098

Accurate spectroscopic line parameters are crucial inputs for the radiative transfer calculations utilised by satellite retrievals of atmospheric composition. We extend the NH₃ spectroscopic work of Coxon et al. (2025) by adding 30 low temperature spectra over the same spectral range, with the aim of improving NH₃ retrievals. New temperature dependence coefficients of the air-broadened Lorentz halfwidths have been determined. These values are on average larger than their HITRAN equivalents and with lower uncertainties. The analysis has reduced the spectral residuals compared to HITRAN. The line parameters determined from the multispectrum fit reproduce the spectroscopic features to within 0.5%.



Adriana Iorga

University of Leicester

Improved spectroscopic line parameters for ammonia in the v₂ band

0.02 Poster 100

Aviation NO_x emissions represent a major uncertainty in climate impacts, making a complete understanding of these near-term climate forcers essential for achieving Net Zero. Meanwhile, NO_x is produced by space launches or their reentry though their effects on ozone is not well quantified due to the uncertainties in their emissions. With newly available in-situ observations of NO_x, we quantified their impact on atmospheric ozone using a well-developed coupled chemistry–climate model, the Whole Atmosphere Community Climate Model (WACCM), and CMIP7 emission inventories covering the COVID-19 pandemic period. Two simulations are conducted for 2015–2023 to investigate the impact of aviation NO_x emissions on ozone in the troposphere and stratosphere: The COVID simulation represents real-world anthropogenic emissions, with aircraft NO_x varying realistically and showing the sharp 2020–2021 pandemic-related reductions. The NOAVI simulation is identical except that aircraft NO_x emissions are set to zero throughout, allowing us to isolate aviation’s contribution to tropospheric and stratospheric ozone. Four modelling experiments were carried out to better understanding how different scenarios of rocket NO_x emission deplete mesosphere and stratosphere ozone. Aircraft and rocket NO_x strongly perturbs reactive nitrogen in the middle and upper atmosphere. The resulting total-column ozone response is a coherent large-scale decline, most pronounced over Northern Hemisphere mid- to high latitudes, where reductions reach several Dobson Units. The response to atmospheric ozone changes is quite different from aviation and rocket emissions.

Wuhu Feng

NCAS

Impact of NO_x emissions from aviation and space launches on atmospheric ozone based on Whole Atmosphere Community Climate Model studies

0.02 Poster 102



Oceans, Coasts & Marine Systems

Room 0.02

Five sediment cores from the North Sea (between Scotland and Norway) were analysed to determine concentrations of polycyclic aromatic hydrocarbons (PAHs) using gas chromatography–mass spectrometry (GC–MS). Pre-industrial baseline intervals were identified in each core based on the stabilisation of total PAH concentrations at lower levels with depth. Principal component analysis (PCA) was applied to the dataset and confirmed a clear separation between industrial and pre-industrial samples. Median concentrations for both parent and alkylated PAHs were calculated within the defined pre-industrial intervals for each core. These values were subsequently combined to derive an overall median baseline concentration for each compound across the study area. The resulting baseline levels were compared with existing background concentrations reported by OSPAR and those proposed in recent studies.

PAHs, background concentrations, sediment cores

Guillaume Hermann

Scottish government

Polycyclic aromatic hydrocarbons (PAHs) in deep core samples from the Northern North Sea

0.02 Poster 104

Angus Williams, Kyari Yates,
Lynda Webster

Algal blooms are increasingly recognized as indicators of declining coastal water quality and ecosystem health, posing significant ecological and socio-economic challenges for island nations such as Mauritius. Effective monitoring of bloom dynamics is therefore essential for supporting sustainable coastal management and early warning systems. This study investigates the temporal and spatial distribution of algal blooms across the northern, eastern, southern, and western lagoon systems of Mauritius using multi-temporal Sentinel-2 Surface Reflectance imagery spanning 2020 to 2025. The Normalized Difference Chlorophyll Index (NDCI) was used to estimate chlorophyll-related algal biomass, while the Normalized Difference Water Index (NDWI) was applied to isolate water bodies and reduce land contamination effects. Monthly and annual analyses were conducted to assess long-term trends and seasonal variability in algal bloom occurrence. Results show that annual mean NDCI values remain broadly consistent across all four lagoon systems, indicating relatively stable long-term algal biomass at the regional scale. However, monthly median spatial analyses reveal clear episodic increases in algal activity, particularly during May and June of 2022 and 2023. These short-term bloom events are not captured in annual averages, highlighting the importance of high-temporal-resolution monitoring. Spatial analysis further identifies localized bloom hotspots within lagoons, demonstrating strong spatial heterogeneity in bloom distribution. Comparison with sea surface temperature indicates no consistent relationship with elevated NDCI values, suggesting that temperature alone does not explain bloom dynamics. Instead, bloom events are likely driven by interacting factors such as nutrient enrichment, hydrodynamic variability, and reduced lagoon flushing. The study demonstrates the utility of Sentinel-2-derived NDCI for monitoring algal blooms in tropical lagoon systems and provides a baseline for operational monitoring and coastal ecosystem management in Mauritius.

algal blooms, Sentinel-2, eutrophication

Mohammad Shoaib Ibne Saleem Casseem

University of Mauritius

Satellite-Based Assessment of
Temporal and Spatial Dynamics
of Algal Blooms in the Coastal
Lagoons of Mauritius Using
Sentinel-2 NDCI

0.02 Poster 106

Dr Manta Nowbuth,
Dr Sameerchand Pudaruth

The present study was carried out in order to understand the morphological modifications recorded along the Ongole Coast, Andhra Pradesh, India. A study of Satellite Imageries was done using geospatial tools, February 9, 2010, March 18, 2012, May 27, 2014, and April 30, 2016. The study area lies in Survey of India (Sol) Toposheet No: 66/A2, 66A/3. 1, 2, 3, 4, 5, 6, and 7. Land Use Land Cover map of various classes were prepared using appropriate method. The Multitemporal satellite images of IRS P6 LISS-III and Landsat 8 OLI/TIRS data from 2010 to 2016 were used for this investigation. The subsequent short term river mouth dynamics, coastal accretion and erosion rates were examined. Low river inflow littoral, movement of the waves, tides, and wind currents play a key role in the dynamic activities of accretion and erosion. The erosion rate from 2010 to 2016 was slightly decreased from 5.71sq.km. The total net rate of accretion was estimated at 6.35 sq.km. During the study period (2010-2016) accretion is more than erosion. High fluctuation of erosion and accretion were considered to be key for the short-term scale at river mouth.

geomorphology, erosion & accretion, coastal environment, ecosystem

Jayaraju Nadimikeri

Yogi vema University

A study on morphodynamics of
Ongole coast, East coast of India:
A geospatial approach

0.02 Poster 108

B. Lakshman, G. Sreenivasulu,
T. Lakshmi Prasad, K. Nagalakshmi,
M. Pramod Kumar, M. Madakka

Understanding marine ecosystems and the global carbon cycle requires improved observation of phytoplankton diversity alongside coastal carbon pools and fluxes at high spatial and temporal resolution. Three European Space Agency (ESA) projects—Phytoplankton community diversity and Ecosystem function from Sentinels (Phytodiverse), Carbon from Earth Observation between Ocean and Land (COOL), and Sentinel User Preparation and organic Carbon from Earth Observation between Ocean and Land (SUPaCOOL)—collectively address these challenges through advances in Earth Observation (EO), algorithm development, and validation frameworks. Phytodiverse develops satellite-derived Essential Biodiversity Variables (EBVs) for phytoplankton, targeting community diversity and ecosystem function. Using hyperspectral data, the project derives trait-based indicators such as pigment composition, size structure, and phenology, supported by expanded in situ datasets for calibration, validation, and uncertainty characterisation. Applications span the NE Atlantic, Northern Adriatic, and Arctic to assess ecosystem variability and long-term change. COOL focuses on quantifying coastal carbon pools and fluxes using Sentinel-3 OLCI and Sentinel-2 MSI data. It produces consistent, high-resolution datasets for particulate organic carbon (POC), particulate inorganic carbon (PIC), dissolved organic carbon (DOC), and primary production (PP), validated against in situ observations and applied to regions including the Baltic Sea and the western Galician coast. SUPaCOOL addresses fine-scale carbon dynamics in river plumes and nearshore environments, leveraging upcoming Sentinel missions (CHIME and LSTM). It develops a reference open dataset supported by dedicated field campaigns, enabling next-generation algorithms for carbon variables and phytoplankton diversity. Together, these projects demonstrate the potential of synergistic EO approaches to link biodiversity and biogeochemistry and improve monitoring of marine ecosystem change.

coastal carbon, marine biodiversity, CHIME

Dan Clewley

Plymouth Marine Laboratory

An overview of ESA projects on coastal carbon and marine biodiversity research

0.02 Poster 110

Lianne Jackson, Victor Martinez-Vicente

Accurate and timely monitoring of shoreline dynamics is essential for coastal management and hazard assessment. We present an improved version of an existing SAR-based waterline extraction processor, originally designed for Sentinel-1 GRD imagery and extendable to other spaceborne SAR missions. The previous approach relied on a thresholding algorithm applied to VH-polarisation intensity, which proved prone to detecting the landward limit of vegetation rather than the true waterline, limiting its reliability for coastline change assessment. The new approach replaces this with a supervised Random Forest classifier trained on several land-cover classes, derived from manually and semi-automatically digitised polygons. Training polygons are delineated using "collocated" Sentinel-2 optical imagery acquired within a few days of the SAR overpass; to maximise model generalisation, SAR acquisitions under unfavourable weather conditions, for which no optical counterpart is available, are also included. Land class polygons are produced semi-automatically by applying the legacy threshold algorithm to VH backscatter to isolate bright pixels, while remaining classes are digitised manually. The classifier ingests a multi-dimensional feature stack including VV and VH backscatter intensities, GLCM texture descriptors, terrain elevation, incidence geometry, and co-located environmental variables from ERA5 and CMEMS. Following classification, post-processing outlier filtering steps are applied to refine the extracted shoreline vectors. The resulting multi-temporal shoreline positions are then analysed through Seasonal-Trend decomposition using Loess (STL) to characterise the long-term evolution and seasonal dynamics of the coastline from the full time series.

SAR, coastline, ML

Salvatore Savastano

isardSAT

Machine Learning-Based Shoreline Extraction from Sentinel-1 SAR Imagery: An Improved Waterline Detection Processor

0.02 Poster 112

Salvatore Savastano, Mark E. Pattle,
Albert Garcia-Mondéjar

GLORAN is a Copernicus CMEMS project contributing to the Ocean Decade, operating under the EU Horizon Europe–funded Marine Environment Reanalysis Evaluation Project (MER-EP). This study presents a multi-product evaluation of the Atlantic Meridional Overturning Circulation (AMOC) including: GLORYS4v2, CGLORS8, GLOSIA9v1, SODA3, and ECCOv4r4—over 1993 to 2023, mostly at $\frac{1}{4}^\circ$ resolution (ECCOv4r4 at $\sim 1^\circ$). The aim is to assess agreement with AMOC observations (RAPID, OSNAP, SAMBA) and across-product consistency. StraitFlux was employed—benchmarked against CDFTOOLS—to handle geometrically complex sections and the non-NEMO product SODA3. In contrast to the velocity-integration methods used by StraitFlux and CDFTOOLS, METRIC (RAPID-style boundary reconstruction) at RAPID gives larger AMOC strength and alters the seasonal cycle pattern, with larger discrepancies in summer, even with barotropic correction. The multiple source of uncertainty imply higher-resolution products are needed for such approach. The AMOC index (seasonal and Ekman removed) shows continuous weakening from 1993 to 2012, then slowing significantly thereafter. Ensemble spread was large before widespread Argo deployment and converged markedly afterwards. Although ECCOv4r4 is coarser ($\sim 1^\circ$), it captures the large-scale trend well owing to its advanced data assimilation. At OSNAP, the eastern arm dominates the AMOC signal, while the western arm shows mainly horizontal recirculation with flow cancellation, yielding weak net transport. Reanalyses show a systematic bias in near-boundary isopycnal bending against observations, with the magnitude of this disagreement varying across products. Reanalyses exhibit large AMOC divergence WITH poor correlation with observations at SAMBA, affected by high Eddy Kinetic Energy (EKE) and strong transient dynamics.

ocean, reanalysis, amoc

Sukun Cheng

University of Reading

Evaluation of AMOC Diagnostics in multiple Marine Environmental Reanalyses

0.02 Poster 114

Sukun Cheng, Keith Haines, Yumeng Chen



Resilience, National Security & Dual Use

Room 0.02

Ordnance Survey (OS) is the National Mapping Agency (NMA) for Great Britain providing geospatial data for a multitude of use cases, including national security and resilience. Advancements in technologies and data systems is transforming the Earth Observation (EO) industry, with data collected, fused, enhanced and interpreted across various sensors and intelligent systems. Data fusion could enhance multiple applications, strengthening insights to identify and mitigate any risks, supporting societal resilience. For example, data fusion could be used to monitor physical infrastructure, to assess degradation and potential impacts of specific structural collapse. However, differences in ways EO data is georeferenced means that different datasets can often be misaligned. Here, we present early work that explores whether well referenced aerial imagery data captured by OS can be used to improve the positional accuracy of EO imagery. We present a comparison of different workflows, using ENVI software, Esri software and different python libraries to identify the most suitable method to automate the process. Creating an automated workflow to enable data fusion provides the opportunity to deliver enhanced insights and information for OS customers.

EO, georeference, accuracy

Lizzie Dobromylska

Ordnance Survey

Positional Improvement of Earth Observation Imagery for Data Fusion

0.02 Poster 115

Jason Hopkins, Zen Goodwin, Thomas Bristow

Solar photovoltaic (PV) adaptation depends not only on the availability of PV infrastructure but also on the stability, seasonality, and long-term change and variability of downward solar (shortwave) radiation at surface. This study explores the spatial and temporal variability of PV power density across Nigeria using surface irradiance from SurfAve Radiation dAtaset Heliosat ed.3 (SARAH-3) for the 1983-2025 period. The analysis examines daily and monthly climatologies, regional contrasts between northern Nigeria and the national average, interannual variability, skewness, and excess kurtosis of PV power density. The results show a strong seasonal cycle in PV power density, with higher values during the dry and Harmattan months and a marked decline during the West African monsoon season. Northern Nigeria consistently records higher PV power density than the national spatial average, especially between February and April, reflecting clearer skies due to reduced cloud cover. Spatial distribution reveals persistent northern maxima, and the northward migration of the Intertropical Convergence Zone, a meridionally narrow region of the most intense tropical rainfall. Variability indicators show that PV power density is less stable during the monsoon and transition months, particularly across central and southern regions. Skewness and kurtosis patterns reveal the occurrence of asymmetric and extreme PV radiation conditions, especially in northern Nigeria during the dry season. Our findings show that long-term surface irradiance and related variables data are critical for assessing solar resources in Nigeria, where ground-based observations are scarce. The study provides evidence for operational PV site selection, grid integration, and climate-informed renewable energy policy.

solar potential assessment, climate change & variability, photovoltaic energy

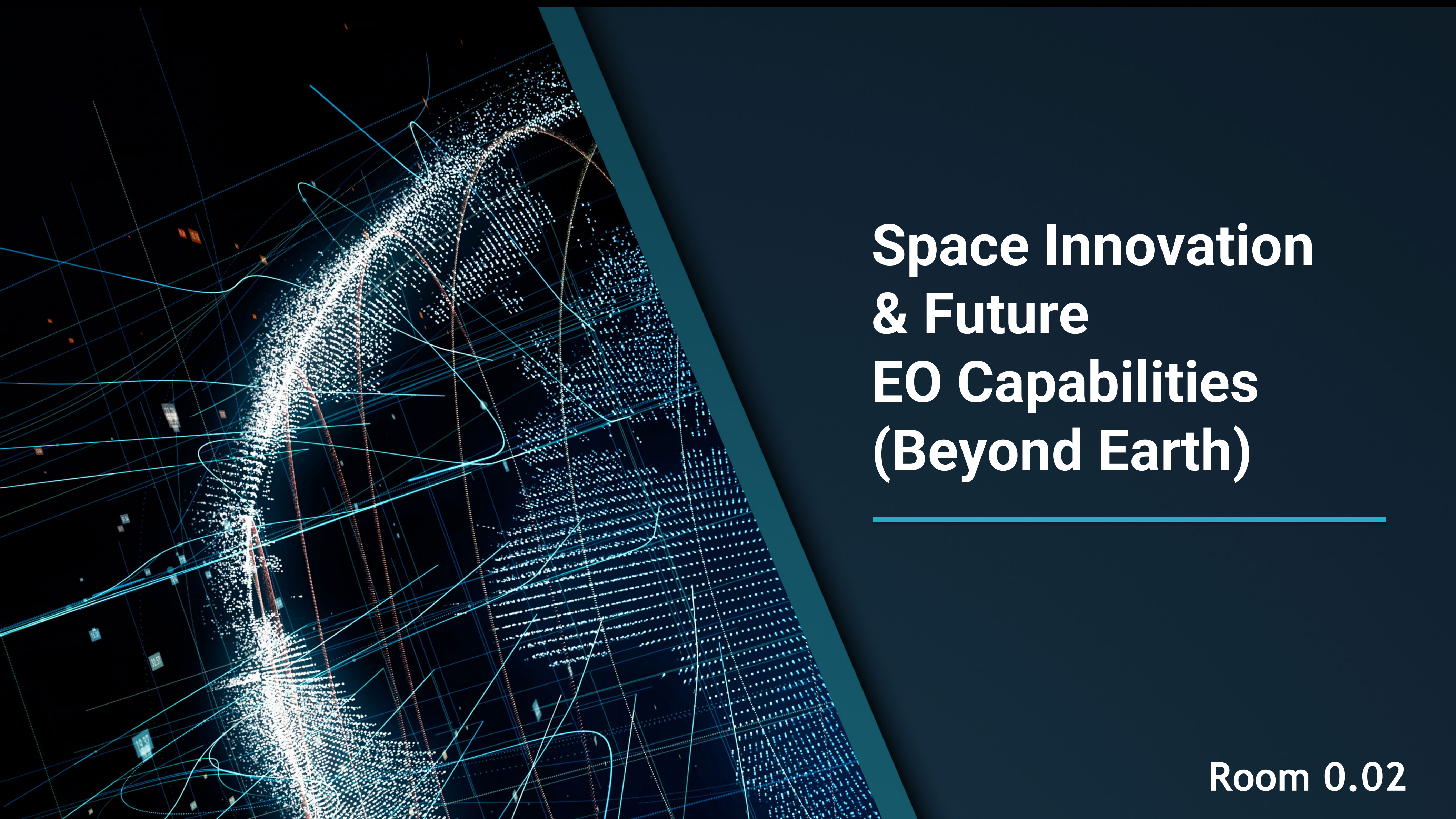
Muhammad Ibrahim Musa

University of Dundee

Analysis of SARAH-3 data for the assessment of PV potential in Nigeria

0.02 Poster 116

Muhammad Ibrahim Musa,
Paula Stella Teixeira



Space Innovation & Future EO Capabilities (Beyond Earth)

Room 0.02

A summary of phytoremediation techniques for perchlorate-contaminated martian regolith. Includes engineering considerations, as well as suggestions for a successive generation scheme with potential candidate species with recommended timelines and data on how utilising cyanobacteria could be more efficient and suggestions for how utilising environmental scientists' data on genetically modifying plants to make them more stress resistant in regards to environmental factors could be transferable to martian cultivation schemes. Cultivating crops in Martian regolith presents severe challenges, primarily due to the widespread presence of toxic perchlorate salts. This paper evaluates the viability of in-situ phytoremediation strategies to detoxify Martian soils, outlining the specific biochemical and engineering considerations required to sustain plant life in a closed-loop habitat. A multi-stage, successive generation cultivation scheme is proposed, identifying specific hyperaccumulating candidate species and establishing operational timelines for gradual soil detoxification. To optimize resource efficiency, this framework integrates cyanobacteria inoculation to accelerate perchlorate reduction and enhance initial nitrogen fixation within the regolith matrix. Furthermore, the paper proposes how terrestrial datasets regarding transgenic crop development—specifically modifications targeting extreme drought, salinity, and oxidative stress—can be directly transferred to Martian agricultural models. By synthesizing advanced ecological engineering, synthetic biology, and terraforming logistics, this model provides a scalable roadmap for transforming raw Martian regolith into a viable medium for long-duration human life support systems.

phytoremediation, candidates, perchlorates

Evie Wheeler

John Taylor High School 6th form

A comparative summary of phytoremediation strategies for perchlorate-contaminated martian regolith

0.02 Poster 117

The space radiation environment is a well-known hazard: dynamic, variable and still not fully understood, it poses a direct threat to the safe operation of satellites. Despite decades of measurement, research and modelling, most satellites still lack an effective capability to monitor their local in-situ radiation environment in real time. This gap reflects a practical trade-off: high-performance scientific instruments are often too expensive, complex and difficult to integrate, while simpler monitors lack the sensitivity, functionality and data quality required for wider operational use. The Umbrella Radiation Monitor, or URM, has been developed to address this gap. Supported through successive CEOI funding rounds, URM has progressed from concept to prototype and then to an engineering-qualified model. It is built on a novel digital platform supporting four scintillator+SiPM detector modules. A series of engineering innovations enable an intelligent, sensitive and reliable instrument tailored for medium-energy charged-particle monitoring. Our vision is to deploy URM widely across satellite platforms, creating a distributed global radiation dataset that can support spacecraft operations, anomaly investigation and future refinement of space environment models.

radiation, instrument, spaceweather

Hubert Hu

Umbrella Space Science Ltd

Umbrella Radiation Monitor -
satellite onboard intelligence of
space radiation environment

0.02 Poster 118

Development of spaceborne lidar technology in the UK has been supported through UKSA (including CEOI) and ESA funding. However, the projects have been sparse and disconnected. The purpose of the UK Spaceborne (and HAPS) lidar SIG is to connect people and businesses across the value chain, and pool their expertise to strengthen the UK position on this technology and stimulate the development of national capability.

Nicolas Leveque

UK Spaceborne lidar Special Interest Group

Launch of the UK Spaceborne lidar
Special Interest Group

0.02 Poster 119

lidar, technology, spaceborne



Sustainable Development, Social Impact & Policy

Room 0.02

Earth observation (including by drones and manned aircraft) increasingly provides the spatial underpinning for environmental decision making by national and local government and those associated agencies tasked with guiding landscape management. However, confidence in earth observation requires confidence in the data collected by the remote sensing instruments. Without this, the data are mere speculation and are open to challenge or misuse. Unfortunately, the characterisation and calibration of sensors is an often-neglected aspect of remote sensing; this is particularly true for passive optical sensors, and these are one of the main tools that is essential for the assessment and monitoring of biodiversity change as well as for ecosystem dynamics, especially where drones and manned aircraft carrying multispectral and hyperspectral instruments collect the fine detail and validate satellite observations! This poster announces an intercomparison exercise that seeks to compare the performance of different airborne and drone-borne hyperspectral and multi-spectral instruments and multiple models of the same instrument. The comparison is of (i) radiometric sensitivity, assessed against the large integrating sphere at NCEO's optical laboratory at Rothamsted Research, and (ii) the spectral profiles using a dual-beam monochromator at FSF's optical laboratory at the University of Edinburgh. This will provide the science community with the first independent comparison of instrument performance, spectral characteristics, noise metrics, model consistency, size, mass, power requirements, and relative cost. Instruments currently planned for inclusion in this comparison are: Specim Fenix1K, Specim IBIS, three NEO HySpex 1800 and three Headwall VNIR instruments, but more are planned!

intercomparison, calibration/validation, spectral

Gary Llewellyn

2Excel Aviation

Underpinning confidence in EO data; comparing the performance of different airborne and drone-borne spectral instruments

0.02 Poster 120

Callum Middleton, Robbie Ramsey,
Aser Mata, Melina Zempila

Upcoming thermal missions TRISHNA (ISRO/CNES) and LSTM (ESA) will facilitate the delivery of field-scale evapotranspiration (ET) with global coverage at two- to three-day temporal frequency. In agriculture, ET at this spatiotemporal resolution can be used to monitor crop stress, inform irrigation practices to maximise water use efficiency, and support water allocation in regions affected by drought. Partitioning of ET into soil evaporation and canopy transpiration is particularly useful for quantifying actual water uptake by crops. However, there are multiple operational models used to retrieve ET and ET partitioning from satellite data, with limited understanding of their relative performances for different crop types, growth stages, and climates. This poster will present first results of a comparison of models including the Two Source Energy Balance Priestly-Taylor (TSEB-PT) model implemented through pyTSEB and the Surface Temperature Initiated Closure (STIC) model in its STIC-JPL formulation. Generalizability will be assessed by in-situ validation of both models forced with the same data, including Landsat land surface temperature and leaf area index derived from Sentinel-2 reflectances in 8 spectral bands. The validation dataset will be eddy-covariance flux tower ET from Integrated Carbon Observing System (ICOS) and Associated European cropland sites. These results will further the understanding of systematic differences in ET retrieval model behaviors, contributing to a more detailed assessment of their strengths and limitations with respect to operational use in satellite remote sensing.

evapotranspiration, agriculture, intercomparison

Anna Kelly

University of Leicester / NCEO

A comparison of models for evapotranspiration (ET) and ET partitioning retrieval from satellite data

0.02 Poster 121

Darren Ghent, John Remedios,
Agnieszka Soszynska

Wheat is the UK's largest arable crop by area, yet timely, field-level yield information remains scarce and costly to collect. We present an approach for estimating winter wheat yield across the UK from Sentinel-2 imagery, validated against independent field level yield data over 5 growing seasons with relative RMSE < 15%. The resulting field-scale estimates span the UK's major wheat-producing regions and enable consistent analysis of yield variability from individual fields to national patterns, and across years. Building on these maps, we partition observed yield variation into environmental and management-related contributions. A substantial share is not explained by environmental conditions, indicating significant headroom for management-driven improvement. By tracking performance across seasons, we identify fields and regions that are persistently low-yielding or highly variable, providing an evidence base for targeted intervention by farmers, agronomists, and policymakers. More broadly, the results demonstrate how satellite-derived yield monitoring can deepen understanding of crop productivity, guide precision agriculture, and support more resilient and sustainable wheat production in the UK.

crop production

Feng Yin

UCL

Disentangling environment and management in UK winter wheat yields using Sentinel-2

0.02 Poster 122

The use of Earth Observation (EO) data is growing, with new capabilities, longer time series and novel analytical techniques offering opportunities for many areas of environmental research. As EO data becomes more widely used beyond specialist communities, effective uptake depends not only on data availability, but also on access to training, user support and enabling infrastructure. The NERC Earth Observation Data Analysis and AI Service (NEODAAS) and the NERC Field Spectroscopy Facility (FSF) provide complementary support to UK researchers using EO. NEODAAS provides airborne and satellite data processing and advice, an AI service and real-time data provision to support the use of EO data in research. FSF provides access to calibrated field spectroscopy instrumentation, technical support, and data analysis resources to support in situ data collection and EO validation. A key component of both services is support and training activities. In NEODAAS, this is delivered through a helpdesk, one-to-one training, workshops and training courses. FSF offers tailored training on instrumentation, methodological guidance and support throughout the data acquisition and analysis process. NEODAAS and FSF also collaborate to deliver an annual 4-day course covering EO fundamentals, field spectroscopy, data processing and analysis. Increasing demand for this course suggests a community need for practical application-focused training. These activities have highlighted common challenges faced by users engaging with EO and the importance of accessible support. This poster presents the NEODAAS and FSF service portfolios, focusing on the support and training activities and lessons learnt engaging beyond specialist EO communities.

training, capacity-building, user support

Emma Sullivan

Plymouth Marine Laboratory / NCEO

NEODAAS and FSF: Supporting the use of Earth Observation data in the UK research community

0.02 Poster 123

Zoe Halem, Dan Clewley, Dave Moffat, Pete Walker, Aser Mata, Andrey Kurekin, Meryl Hooper, Steve Groom, Alex Merrington, Robbie Ramsay, Steven Hancock



UKSA Skills for Space Internships

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Amolika Bansal

Satellite Applications Catapult

0.01 Poster 004

Daniel Milward

Satellite Applications Catapult

0.01 Poster 006

Jihyun Kim

Satellite Applications Catapult

0.01 Poster 008

Theo Fischer

Satellite Applications Catapult

0.01 Poster 010

Torin Wain

Satellite Applications Catapult

0.01 Poster 012

Rishon Thomas

Kavasam

0.01 Poster 014

Owen Hill

Protolaunch

0.01 Poster 016

Kamissa Stichter

OHB Space UK

0.01 Poster 018

Ty Fitzgerald

Omanos Analytics

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Eyja Alexandra Oskarsdottir

Aphelion Industries

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Sasirindu Bandara Hamangoda

Surrey Satellite Technology Ltd

0.01 Poster 024

Finlay Nunn

Geospatial Ventures (GVL)

0.01 Poster 026

Verity Broome Saunders

Satraka Ltd

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Gulam Samdani Piyas

GMV

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Tobias Andersen

The University of Birmingham

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Zachary Thorne

Gentian

0.01 Poster 034

Divyakshi Goyal

Paladin Space

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Joshua Gay

Astroscale

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Noah Casbourne

Civil Aviation Authority

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Natalie Segamwenge

Framatome

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Amir Mirhossaini

Farmer Charlie

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Jeroen Van Weelden

Craft Prospect

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Adam Jeffrey

Surrey Satellite Technology Ltd. (SSTL)

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Pablo Penedo Baragana

AstroAgency

0.01 Poster 050

Erik Croitoru

ClearSpace

0.01 Poster 052

Gabriella Gilliat

UKSA

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Matt Bull

UKSA

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Ben Ibbotson

Satellites Applications Catapult

0.02 Poster 063

Harrison Chivers

Satellites Applications Catapult

0.02 Poster 065

Petras Verseckas

Satellites Applications Catapult

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Théo Gallien-Currier

Satellites Applications Catapult

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Orli Meiksin

Craft Prospect

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Teoman Turgut

Space Park Leicester

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Sophie Oztoprak

ClearSpace

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Joseph Rivington Bidwell

Kavasam

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David Deng

Lumino Technologies

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Muntaha Sana Muneyb

Vestibular x Space Neuroscience Lab

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David Addison B. Calimlim

OHB Space UK

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Arthur Braga

Radtest

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Jamie Hopkin

Travel Radar Media

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Calum Ramsden

Eos Space Technology

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Tesni Pari-Jones

The Open University

0.02 Poster 091

Alex Paulson

VASTX Space

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Sara Miguel Winterburn

ClearSpace

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Ryan Watson

Civil Aviation Authority

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Ana Julia Garcia Colon Cornejo

URA Thrusters / AVS

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Chantelle Yeboah

Nascent Semiconductor

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Benjamin Bowman

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Arthur Penhaligan

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Micah Navaratnam

Magdrive

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Bernice Huntley

UKSA

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