JACIE 2026

PRESENTATION ABSTRACTS

ACTIVE SENSORS

Automating the Ground Control Process with AI-Generated Synthetic Imagery in the ESA EDAP+ Assessment

Mark Abrams, Exquisite Geolocation Systems

Historically, the exploitation of ground control points (GCPs) in geometric calibration and validation (Cal/Val) testing of remote sensing imagery has required a human to associate each GCP with the corresponding photo-recognizable feature. Additionally, the availability of free and open-source GCPs has been limited, except in cases such as Aeronautical Information Product (AIP) data shared internationally to facilitate global aviation (1). An alternative approach, Generative Control Point (GenCP) has been developed, which generates a high-resolution image chip database starting from vector data, such as OpenStreetMap, or nationally qualified vector databases. GenCP uses a Generative Adversarial Network (GAN) to generate synthetic imagery, which can be used to perform image-based calibration and validation testing and integrated into the existing EDAP+ workflow (2).

In the context of JACIE26, we propose a paper and hands-on tutorial following the initial trial at VH RODA 2025 (3). The software is available on GitHub, which includes data preparation guidelines and demonstration notebooks. The model weights and HR/VHR databases are also publicly available on Zenodo. The paper will illustrate how to develop cross-platform geometric calibration assessments using publicly available satellite collections of calibration sites, such as La Crau, France, and vicarious calibration sites, such as San Francisco, where very high-resolution ground control data exist, such as 50 ppm2 LIDAR data. In the case of San Francisco, we have high-resolution orthoimagery (RGB) and a digital surface model (DSM), permitting the comparison of geometric accuracy in 2D and 3D and validation against traditional GCP testing.

Coherent Change Detection for a Changing World

Vincent Hurley, ICEYE US

Coherent Change Detection, or CCD, is a technique that analyzes two time-separated satellite radar images to identify and quantify changes within a given area. CCD can reveal differences between the images by analyzing the millimeter-level variations between the images. To generate CCD, the imagery must be coherently collected, meaning there is little to no variation in the collection geometry. Since early 2025, ICEYE US has maintained two assets, soon to be joined by a third, within a ground track repeat (GTR) orbit that enables a 24-hour repeat cycle, allowing the satellite to revisit the same point on Earth every 24 hours with matching collection geometry. ICEYE US intends to achieve global GTR coverage in 2026. CCD supports the detection of environmental shifts, military activities, and even vehicle ground tracks. It can be applied to both Spot/Dwell and Stripmap imagery. ICEYE US has supported natural disaster events such as volcano eruptions in 2025, in which the data was used to determined when eruptions were likely to occur. ICEYE has forthcoming capability expansions, product releases, and scheduled satellite launches extending into 2026 and beyond.

Global elevation data from NASA's ICESat-2 mission

Denis Felikson, NASA Goddard Space Flight Center

Since October 2018, NASA's Ice, Cloud and Land Elevation Satellite-2 (ICESat-2) has delivered global laser altimetry at unprecedented accuracy. The elevation data has facilitated diverse Earth science research applications, including studies on ice sheets, glaciers, sea ice, oceans, the atmosphere, and terrestrial ecology. Recently, ICESat-2 measurements were used to produce a new global, near shore satellite-derived bathymetry dataset. Additionally, a new global, gridded terrain and vegetation height product is nearing completion and should be publicly available in early 2026. ICESat-2 data have been used for calibration and validation of other satellite-based data products, including ones derived from commercial sources. This presentation will provide an update on the current status of the mission, give an overview of science highlights, including examples of integration of ICESat-2 and commercial data, and discuss improvements to data processing that have been implemented in version 7 of the data products, released in Fall 2025.

Advantages of Third-Party Processing for High Resolution Commercial SAR CPHDs

Jeff Pennings, Wolverine Radar

The presentation will explain the Compensated Phase History Data (CPHD) output format sold by commercial SAR vendors and how customized processing workflows can be used to extract additional value from the collection that is not available in the standard deliverable SLC or GRD products. The presentation will show examples of how custom CPHD processing can provide sharpened pixel focus, enhanced azimuth resolution, improved ground calibration, and increased area coverage for downstream imagery users.

Developments in the Umbra SAR constellation

Paul Woodford, Umbra Space

Umbra is a 100% American-owned space technology company that is creating the US's highest-resolution shareable SAR constellation. In this presentation we will discuss future directions for the constellation, in particular scan mode and formation flying. Scan mode, which was previewed at JACIE last year, has now moved to general availability. We discuss the the unique flexibility of scan mode, highlight a few mission applications, and lay out a development roadmap. Formation flying, which was also introduced at JACIE last year, is available to research customers. We discuss the benefits of formation flying, such as high-resolution digital elevation models (DEMs), moving target indication (MTI), and tomography. Finally, we discuss Umbra's plans to leverage these capabilities in a next-generation formation of spacecraft to demonstrate the advantages of comprehensive, wide-area SAR coverage for search and find missions in open ocean and maritime applications.

AGENCY 1

CSPO-NRO Agency

Justin Langlois & Mark Bowman, CSPO-NRO

The National Reconnaissance Office's Commercial Systems Program Office (CSPO) will brief JACIE 2026 on its plan to expand and accelerate the government's use of commercial remote sensing data. The update will center on making acquisitions easier and faster, broadening access to capable providers, and ensuring timely delivery that supports mission needs across defense, intelligence, and civil partners.

CSPO will discuss steps to streamline how the government engages with industry—simpler processes, clearer communication, and quicker paths from interest to operational use. The session will describe how piloting, onboarding, and evaluation will be handled in a more efficient, repeatable manner so promising capabilities can move to production with less delay. CSPO will also touch on how continuous feedback will help providers refine offerings while meeting security and stewardship expectations.

Aligned with JACIE's focus, CSPO will reaffirm its commitment to dependable quality and transparent performance. Calibration, validation, and consistency remain key, and CSPO will continue to reflect these priorities in future acquisitions and assessments.

Community engagement is central to this effort. CSPO is enhancing opportunities for dialogue and demonstration through industry days, technical exchanges, and challenge activities that make it easier for companies of all sizes to understand needs and show what they can deliver.

Attendees will leave with a clear view of CSPO's priorities, the pace and approach for commercial data adoption, and practical ways to engage and align capabilities with government needs in 2026 and beyond.

AGENCY 2

EROS and NCAC Imagery Collection Support - 2025 Progress Report

Ross Rogers, U.S. Geological Survey National Civil Applications Center

The US Geological Survey's Earth Resources Observation Science Center (EROS) and the National Civil Applications Center (NCAC) continue to enhance the CRSSP Imagery-Derived Requirements (CIDR) tool, building on progress reported at previous JACIE meetings. This presentation will highlight key updates from the past year and outline planned improvements. We will also discuss the current status of commercial imagery contracts supported by the National Reconnaissance Office, which enable image collection and archive access through CIDR and other data portals. Additionally, we will describe collaborative efforts between NCAC, EROS, and NASA's Commercial Satellite Data Acquisition (CSDA) program to ensure the US Government receives optimal value in its procurement of commercial satellite data.

VH-RODA /JACIE Joint Update

Jim Vrabel, USGS Ctr

Representatives from VH-RODA and JACIE will make a joint presentation focused on collaboration between the organizations and their respective agencies. Included will be lessons learned from previous workshops, image quality coordination activities, joint meetings, and other information of interest to the JACIE Workshop audience.

National Land Imaging Update

Tim Newman, USGS National Land Imaging

This presentation will provide an update on the National Land Imaging program and its funded activities for 2026-2027. The discussion will center on the status of the Landsat sensors and the evolution of Landsat Next.

AI & AUTOMATION

CATALYST's Edge processing solution for band-aligned, geometrically calibrated, and Orthorectified, AI-ready images in near-real-time.

Joe Lovick, CATALYST (PCI Geomatics Inc)

CATALYST has developed an edge processing solution for satellite-based image processing. Our advanced technology takes raw sensor data and performs band-to-band alignment, geometric calibration and orthorectification on a commercial SoC(system on chip). CATALYST's advanced image matching algorithms, paired with an Nvidia Jetson Orin, process images to Level 1D in near-real-time, all the while leaving the GPU free for onboard AI Applications. With our GCP matching technology, we achieve fine location accuracy comparable to ground-based solutions at 60x the speed. We further show how an AI application can run in parallel with our processing chain.

The system addresses challenges associated with limited communications windows and bandwidth of data downlink infrastructure. By accurately georeferencing images in orbit, the system can down-sample or omit portions of the image that do not cover predetermined targets of interest. By performing analytics processing (AI) in orbit, the satellite can omit portions of the image that are occluded by cloud, or avoid the downlink of any imagery, and simply downlink the derived data products (ie locations of targets of interest in an area).

The system also enables the satellite to make tasking decisions autonomously based on analysis of the initial images. If a target is occluded by partial cloud cover, or other unanticipated obstructions, the satellite can recognize this and attempt to capture the target from a second vantage point along the same orbital path. It can also autonomously decide to not downlink the occluded image and re-task the capture for the next orbital pass.

BRDF: A Nuisance or an Additional Information Source for Quantitative Optical Image Analysis?

Wolfgang Lueck, EOIntelligence

Bidirectional Reflectance Distribution Function (BRDF) effects remain one of the most persistent and often underappreciated sources of radiometric variability in optical Earth observation. As commercial constellations expand and multi-sensor analysis becomes routine, differences in solar illumination and viewing geometry introduce scene-dependent reflectance inconsistencies that can obscure surface-change signals, degrade atmospheric correction, and reduce interoperability across sensors and acquisition dates.

This presentation reframes BRDF not simply as an error term to be minimized but as important, underutilized information source. The angular dependence of surface reflectance encodes meaningful attributes of land-surface structure and anisotropy. When systematically characterized at high spatial resolution and narrow spectral intervals, BRDF parameters enable a far more rigorous radiometric normalization than classical surface reflectance or NBAR products.

We argue that commercial EO data should be corrected to narrow-band albedo, a physically stable quantity that is independent of viewing geometry and consistent across sensors and seasons. High-resolution BRDF characterization enables this transformation, producing radiometrically harmonized datasets suitable for large-scale time-series analysis, multi-sensor fusion, and physics-guided AI applications.

As deep neural networks increasingly underpin operational EO workflows, the need for geometry-agnostic, radiometrically stable data becomes critical. Models trained on narrow-band albedo benefit from reduced angular variability, improved generalization, and a significant reduction in domain shift.

The presentation concludes with recommendations for evolving CEOS ARD standards to include a Narrow-Band Albedo Product as a core deliverable. Elevating BRDF characterization within ARD frameworks will strengthen the quantitative foundation of commercial EO and unlock more consistent and scientifically defensible analysis at global scale.

GAIA: A Cloud-Hosted Annotation System for Evaluating Commercial Satellite Imagery for Whale Detection

Lauren Connor, NOAA Northeast fisheries science center

The Geospatial Artificial Intelligence for Animals (GAIA) application is a cloud-based annotation and adjudication system developed by NOAA Fisheries to standardize the detection and labeling of marine mammals in commercial very high-resolution satellite imagery. Hosted in Microsoft Azure, GAIA ingests Maxar WorldView-3, WorldView-2, and GeoEye-1 imagery via USGS EarthExplorer and provides a web-based interface for viewing cloud-optimized GeoTIFFs, adjusting visualization settings, and assigning species identifications to points of interest. Each observation undergoes a structured workflow in which three reviewers independently label detections and assign confidence values, followed by automated duplicate reconciliation and export of adjudicated results. The initial implementation focuses on endangered North Atlantic right whales in Cape Cod Bay, where accurate detection of any whale is essential. The GAIA tool enables the systematic pre-processing of images such that quality (spatial resolution, radiometric depth, viewing geometry, and sea state) matches best practice for end goal data output. By centralizing imagery ingestion, reviewer attribution, and validation processes, GAIA offers a repeatable environment for assessing the suitability and limitations of commercial optical data for marine mammal detection. In doing so, the system highlights both the promise of these datasets and the environmental and technical constraints that influence target visibility in open-ocean conditions. GAIA establishes an operational framework that can be expanded to additional species and regions and provides structured outputs that support future development of automated detection approaches. This work demonstrates the value of tool-based evaluation for understanding the performance of commercial imagery in marine applications.

Scaling Expert Intuition: Automating Imagery Quality Control with Multimodal Large Language Models

Lucas Antonel, Satellogic

Ensuring the integrity of high-resolution satellite imagery at scale requires automated systems capable of nuanced visual analysis. This presentation introduces a Quality Control (QC) framework utilizing Multimodal Large Language Models (MLLMs) to detect and classify complex defects. We focus on automating tasks previously reliant on subjective human judgment, specifically targeting geometric and radiometric anomalies such as orthorectification errors induced by DEM inaccuracies, band-to-band misregistration, and transient sensor artifacts. We present a methodology for employing MLLMs to function as expert QC specialists for satellite data pipelines, outputting structured decisions that categorize defects by type and severity. The presentation will cover the technical implementation of this pipeline, including strategies for computational efficiency and validation of model outputs.

A Game-Theoretic and Model Predictive Control Framework for Fallback Autonomy in Satellite Mega-Constellations

Daniel Reynolds, United States Space Force

Large-scale satellite constellations provide unprecedented global coverage. While there is resilience in numbers, large constellations remain vulnerable to disruptions that sever centralized coordination. This work introduces a dual-stack fallback autonomy architecture for maintaining tasking and resilience in heterogeneous, multi-orbit constellations operating without persistent connectivity. The framework integrates Mean Field Game Theory (MFGT) and Model Predictive Control (MPC) as coupled decision layers: MFGT governs global coordination through broadcast incentive fields that inform satellites of evolving task priorities, while MPC refines each agent's best-response function to optimize short-horizon actions within operational constraints. Together, these layers enable distributed, scalable, and feasible optimization that preserves mission continuity under degraded conditions.

A notional mega-constellation spanning low, medium, and geostationary orbits is simulated through acute loss and task-surge scenarios involving 1,000 initial tasks distributed globally. When 90% of agents are lost mid-mission, the remaining 10% sustain a 45% task completion rate by autonomously redistributing workload. Following injection of 100 high-priority tasks, surviving agents collectively re-optimized within 30 minutes, completing one-third of the urgent workload despite degraded capacity. These results demonstrate continuity of mission functions under massive constellation failure and validate the feasibility of large-scale, game-theoretic autonomy as a replacement for centralized command-and-control strategies.

A framework is proposed for the next-generation command-and-control paradigm in the space domain, one built on resilient, self-healing autonomy rather than hierarchical oversight which is vulnerable to single points of failure. This dual-stack fallback architecture establishes a foundation for mega-constellation operations capable of sustaining coordinated performance in contested, degraded, and operationally limited environments.

ARD & INTEROPERABILITY

SWIRSAT: A New Era of High-Resolution Spaceborne SWIR for GHG Intelligence

Wolfgang Lueck, EOIntelligence

The LatConnect 60 SWIRSAT mission series introduces a new class of commercial satellites designed explicitly for high-resolution greenhouse gas (GHG) mapping and climate-analytics services. SWIRSAT-1, built by Gilmour Space Technologies, is a small satellite exceeding 100 kg and equipped with both SWIR and VNIR imaging systems, complemented by an onboard Laser Communications Terminal (LCT) for high-volume data downlink. Its payload includes 4-band SWIR at 8 m native (4 m Super-HD) and 8-band VNIR at 1.65 m native (80 cm Super-HD), providing spectral coverage optimized for CHâ‚„, COâ‚‚, moisture, and land-surface diagnostics.

SWIRSAT-2, built by NanoAvionics as a 6U CubeSat, hosts a single 4-band SWIR sensor identical in spectral design to SWIRSAT-1, enabling constellation-level revisits and expanded temporal density. Together, the missions achieve 4-7 day revisits at mid-latitudes.

A defining innovation of SWIRSAT-1 is the synergy between the Simera MultiScape-200 high-resolution VNIR instrument and the Dragonfly Chameleon SWIR sensor. Their overlapping fields of view allow advanced cross-sensor spatial sharpening, where VNIR structural detail enhances SWIR spatial resolution. In the central overlap region, combined radiometry improves SNR, spatial fidelity, and retrieval quality for GHG inversion algorithms.

The presentation outlines the calibration and commissioning strategy, including geometric modelling, radiometric cross-calibration, BRDF assessment, atmospheric correction, and multi-sensor fusion. All processing workflows are executed within EOIntelligence's IRMI ground segment, producing CEOS-ARD-compliant L2A Surface Reflectance, Super-HD imagery, and L3G GHG retrieval products with uncertainty layers.

Together, SWIRSAT-1 and SWIRSAT-2 establish a breakthrough capability for fine-scale GHG monitoring and climate-risk intelligence.

Multi-Modal Mapping Synergies: Integrating Satellite-Derived Bathymetry with Airborne Lidar for Enhanced Data Acquisition in Civilian and Military Maritime Applications

Michael Wernau, EOMAP

The comprehensive mapping of littoral regions, inland waterways, and critical infrastructure necessitates innovative, multi-sensor methodologies. EOMAP and Fugro developed a workflow synergistically combining Satellite-Derived Bathymetry (SDB) with Fugro's UAS-ready RAMMS lidar, enhancing operational efficiency and data fidelity. This presentation showcases this collaboration via three case studies, demonstrating the utility of integrating satellite intelligence with airborne surveys.

A proof-of-concept project in the Dominican Republic for a domestic intelligence agency illustrates these technologies' complementary nature for hazard assessment and risk mitigation from autonomous or piloted platforms. EOMAP's SDB technology was employed to extend nearshore coverage of the primary lidar survey. This integration produces a continuous, high-resolution bathymetric surface, achieving completeness over a single-sensor approach. This workflow is enhanced by solutions like WATCOR-X, which facilitates near real-time in-situ SDB data refinement for civilian and security operations.

For Italy's ISPRA, a USGS collaborative partner, this methodology supports the ambitious Marine Ecosystem Restoration (MER) project. In a Fugro-led multi-modal campaign to map seagrass along the Italian coast, EOMAP's SDB and Sea Floor Classification (SFC) provide foundational wide-area data on essential habitats like Posidonia oceanica. The project is a crucial component of Italy's National Recovery and Resilience Plan.

Finally, EOMAP's AQUA web application demonstrates proactive mission planning by delivering near-real-time and forecasting turbidity data for the Florida Seafloor Mapping Initiative. This enables strategic scheduling of lidar flights during optimal environmental windows, minimizing re-flights and maximizing acquisition success. Collectively, this integration yields more complete datasets, mitigates operational risk, and provides critical insights for resource and asset management.

Enabling Timely Water-Quality Monitoring Using High-Resolution Commercial Satellite Observations

Akash Ashapure, NASA GSFC / SSAI

Rapid changes in water quality following natural disasters, extreme weather events, and localized disturbances pose significant challenges for water resource management, ecosystem protection, and public health. Effective response and recovery require timely, spatially detailed observations that exceed the revisit frequency and resolution of traditional government satellite missions alone. Commercial satellite constellations offer high spatial and temporal resolution that can complement government missions for monitoring inland and nearshore aquatic systems. Planet's SuperDove sensors provide multispectral observations with near-daily revisit frequency, including visible and red-edge bands well suited for water-quality applications such as harmful algal bloom detection and post-disturbance monitoring.

In this study, we assess the suitability of SuperDove observations for aquatic science by evaluating sensor characteristics, cross-sensor consistency, and downstream water-quality products. Signal behavior is examined across visible and near-infrared bands, followed by cross-calibration against Sentinel-2 MultiSpectral Instrument observations using near-simultaneous acquisitions over diverse aquatic environments. Atmospheric correction is applied using established processing frameworks and resulting remote sensing reflectance products are compared to assess consistency and residual uncertainties. Derived water-quality indicators, including chlorophyll-a and water transparency, are evaluated qualitatively and through time-series analyses to examine their ability to capture expected spatial and temporal patterns.

Case studies of wildfire impacts and subsequent algal bloom development demonstrate the potential of high-resolution commercial imagery to resolve rapid aquatic changes often missed by lower-frequency satellite missions. This work highlights the growing role of commercial satellite data in operational water-quality monitoring, while remaining challenges in atmospheric correction and inter-sensor variability motivate continued methodological development.

From MODIS to VIIRS: Maintaining Continuity for Planet's Surface Reflectance Products

Alan Collison, Planet Labs PBC

Planet Labs has been producing surface reflectance (SR) products using data provided by multiple satellites for close to a decade. Except for Planet's Tanager hyperspectral mission, the spectral bands needed to accurately derive SR from radiance are not available, making it necessary to use third party atmospheric data to produce SR. For that purpose, we have used MODIS atmospheric data products, preferring those derived from Terra due to the similar crossing time compared to most of Planet's satellites. The MODIS data is critical for our ability to provide data services to our customers. With the end of MODIS operations planned for 2026/2027, we need to find suitable alternative sources of atmospheric data to support our global land coverage.

In this presentation, we will discuss how Planet currently ingests and uses MODIS data, the recent integration of VIIRS data ingestion into our processing pipeline, and how we can use VIIRS atmospheric data for generating Planet SR products for our SuperDove satellites. We also show how the VIIRS based products compare to those derived from Terra and Aqua data, as well as share some thoughts on extending our atmospheric data ingestion and use to other potential sources, providing the best option for any given image.

World Average Intercomparison Method: An approach to compare Landsat 8 OLI to Landsat 9 OLI

Mehran Yarahmadi, SSAI

Radiometric cross-calibration is essential for producing consistent long-term reflectance records across multi-sensor Earth observation missions. Traditional comparison methods typically rely on coincident acquisitions or designated calibration sites, which remain highly effective but are not always feasible for heterogeneous constellations. This study introduces a complementary global world-average approach that evaluates intersensor agreement using routine operational data without requiring simultaneous observations. Using more than three years of Landsat 8 and Landsat 9 Operational Land Imager (OLI) data, we applied a spatially balanced sampling framework in which each 18 Ã— 18 km surface region contributes a single representative reflectance value per 16-day cycle. Direct use of all observations demonstrated that oversampling of high-latitude cryospheric regions can introduce artificial seasonal differences when comparing global reflectance statistics. After normalizing spatial sampling, reflectance agreement between the two OLI sensors converged to within <1% across all reflective bands. Distribution-based comparisons further showed that full reflectance histograms remain consistent across seasons and during known acquisition anomalies. Agreement achieved using this world-average method is consistent with the radiometric similarity observed during the four-day 2021 Landsat underfly, demonstrating that global sampling offers a viable, complementary path to sensor cross-calibration. Because it leverages routine global imaging, the world-average framework provides a scalable option for maintaining radiometric interoperability across present and future satellite missions.

ATMOSPHERICS

Greenhouse Gas Emission Monitoring with the GHGSat Constellation: Progress and Performance

Jason McKeever, GHGSat

GHGSat offers services of detection, monitoring, and analysis of greenhouse gas emissions using satellites and airborne sensors. Its proprietary satellite constellation comprises 14 satellites specifically designed for methane sensing down to ~100 kg/hr source rates at high spatial resolution (~25m), enabling attribution to specific industrial sites, as well as a CO2 sensor based on the same technology.

This presentation provides an overview of the GHGSat technology, operating concept, and methods for performance validation. In particular, detection limit and quantification accuracy are key figures of merit of the observing system that can be assessed through controlled releases, where plumes are generated intentionally with a steady, metered flow rate. Over 5 years of its commercial constellation, GHGSat has built up a world leading sample size of 110 controlled release events, including self-organized and third-party single-blind studies, showing consistent detection performance ranging from 100 to 120 kg/hr at 50% probability under wind speeds of 3 m/s.

Additionally, we report on the latest efforts to characterize emissions from landfills and the energy sector, leading towards measurement-informed emissions inventories for sectors accounting for a significant part of global methane emissions.

Angstrom: An Imaging Star Photometer Camera Update: Calibration Processes and Applications

Robert Ryan, Innovative Imaging & Research

Innovative Imaging and Research is developing Angstrom, a simplified, easily deployable, multiband wide field-of-view imaging star photometer designed to measure aerosol optical depth and the Angstrom exponent across a patch of the night sky. Similar in purpose to Sun photometers, Angstrom performs analogous measurements at night using stars as the radiometric source. This presentation summarizes recent advancements in the instrument's design, calibration, and field deployment. Angstrom determines its orientation from the relative positions of stars and achieves high radiometric measurement performance through advanced image processing, high quantum efficiency/low-noise CMOS sensors, narrowband filters, and low-distortion, low f-number optics. This geometric self-calibration removes the need for precision moving mechanisms and significantly reduces installation and maintenance complexity. We describe the principles of operation and provide an overview of the laboratory and field calibration workflow, including intrinsic and extrinsic camera calibration for focal length, principal point, and distortion using known star catalogs. Additional instrument characterization topics include flat-fielding, detector linearity, and SNR assessment. Lastly, we discuss emerging applications such as atmospheric correction for nighttime satellite imaging, light-pollution assessment, and recent field results from a deployment at the Cooperative Institute for Research in the Atmosphere (CIRA) at Colorado State University.

The NOAA NESDIS Commercial GNSS-R Ocean Surface Winds Pilot Project

Gerard Peltzer, NOAA NESDIS Commercial Data Program, Science and Technology Corporation (STC)

The National Oceanic and Atmospheric Administration (NOAA) National Environmental Satellite, Data, and Information Services' (NESDIS) Commercial Data Program (CDP) is conducting a commercial pilot study on Global Navigation Satellite System Reflectometry (GNSS-R) data for determining ocean surface winds (OSW). Through this OSW pilot, NOAA is utilizing commercially provided GNSS-R data to investigate its effectiveness for characterizing and predicting tropical cyclones, improving numerical weather prediction, and conducting studies on improving the NOAA STAR GNSS-R ocean wind product previously developed by the NOAA Center for Satellite Applications and Research (STAR).

In this presentation, we will discuss the GNSS-R pilot including pilot rationale, data assessment and evaluation, key findings to-date and lessons learned. We will discuss future plans and the path toward commercial GNSS-R data purchases to support NOAA's current and anticipated operational mission needs.

Earthnet data assessment project (EDAP+) - Latest assessments using the Maturity Matrix and Guidelines tailored for the Atmospheric domain

Chloe Helena Martella Leo De Laurentiis, Serco for ESA, ESA

The Earthnet Data Assessment Project (EDAP) is an Esa project that is responsible for assessing the quality and suitability of commercial companies missions for the Earthnet Third Party Missions (TPM). ESA's TPM Programme plays a key role for integrating non-ESA missions into the overall ESA Earth Observation (EO) strategy. EDAP+ programme grants the access to a large portfolio of TPM data and information.

This work presents the most recent assessments of atmospheric missions performed under EDAP+ contract: GHGSat CO2 emissions rate, GRASP GAPMAP-0 air quality data and SPIRE GNSS-(P)RO atmospheric vertical profiles.

We will present the guidelines and maturity matrices tailored for the assessment of data in the atmospheric domain, challenges, main differences with other domains and the lessons learned during the work.

CALIBRATING SATELLITE CONSTELLATIONS

Update on calibration & validation of Newsat constellation

Emidio Bueno, Satellogic

As the Newsat constellation expands and matures, ensuring radiometric and geometric consistency across a diverse fleet of satellites becomes a critical operational challenge. This presentation provides a comprehensive update on the Calibration and Validation (Cal/Val) activities for the current operational generation of Newsat satellites. We will present the latest results from our continuous monitoring campaigns, focusing on long-term stability and inter-satellite consistency.

The discussion will cover three primary areas: (1) Geometric Performance: An update on band-to-band registration and absolute geolocation accuracy, including results from recent refinements in the processing pipeline; and (2) MTF and Spatial Quality: Characterization of on-orbit spatial performance and Modulation Transfer Function (MTF) stability over time. (3) Radiometric Stability: An analysis of cross-calibration results against industry "Gold Standard" missions (Sentinel-2) and vicarious calibration sites (e.g., RadCalNet)

WorldView Legion Geolocation Accuracy Calibration and Performance

Ryder Whitmire, Vantor

This presentation examines the geolocation accuracy performance of the Vantor, six WorldView Legion satellites throughout 2024-2025 from launch through achieving Full Operational Capability (FOC). The Vantor constellation, comprising four legacy operational satellites and the six WorldView Legion satellites, provides critical earth observation imagery and insight products for a variety of government and commercial customers.

During this two-year period, the constellation underwent significant expansion as the WorldView Legion satellites were launched in pairs of two and then progressed through commissioning, calibration, Initial Operational Capability (IOC), and ultimately FOC. This presentation analyzes the geolocation accuracy metrics achieved across the full constellation, with a particular focus on documenting the performance evolution of the WorldView Legion satellites at each major milestone alongside the continued operations of the established constellation assets.

Performance data is presented through statistical analysis of geolocation error distributions, temporal accuracy trends correlating with mission milestones, and comparative assessments between newly deployed and mature constellation assets. The presentation discusses challenges encountered during the WorldView Legion satellite calibration process and strategies employed to achieve target accuracy specifications at IOC and FOC. Additional analysis compares the performance and enhanced revisit capabilities of the four Mid-Inclination Orbit WorldView Legion satellites against the two Sun-Synchronous Orbit WorldView Legion vehicles.

These results provide comprehensive insights into constellation performance during operational expansion and offer lessons learned for future multi-satellite deployment activities.

WorldView Legion Constellation Instrument Geometric Calibration

Steven Hartung, Vantor

Vantor (previously Maxar Intelligence), Westminster, CO, USA, has now launched and commissioned all six of the WorldView Legion 30 cm-class electro-optical (EO) satellites. These instruments are used for both Earth observations, such as mapping and monitoring, and Non-Earth Imaging (NEI) in support of on-orbit asset inspection and space situational awareness. Like the legacy WorldView satellites, WorldView Legion is a push-broom sensor, where the image is obtained by scanning across the target area and acquiring the pixels one row at a time. While the push-broom design allows for more efficient area collections, it also introduces some different calibration needs as compared to more typical frame cameras.

We have adapted and enhanced our legacy process to support WorldView Legion. In this presentation we will show examples of our calibration for the WorldView Legion instruments. We rely on our proven high-density ground control ranges to match imagery with thousands of known points across the focal plane. The use of ground truth imaging allows for on-orbit calibration after space environment dry-out, zero-G, and temperature effects are realized in the instrument optical path. In hi-resolution cameras such as WorldView, each instrument is very slightly different. By utilizing a common ground truth with optimization methodologies, all WorldView Legion satellites can be brought to the same exacting standards of geometric telescope and focal plane precision.

Building a thermal digital twin - operational results from OroraTech's high revisit constellation

Ignacio Zuleta, OroraTech GmbH

Escalating wildfire activity and the increasing relevance of thermal monitoring highlight the need for rapid, reliable thermal Earth observation. Last year, we presented results from our first satellite, Forest-2. We now report on the performance of Pine Grove, OroraTech's first operational constellation of eight thermal satellites in a 4 a.m. and 4 p.m. orbit. The system provides global twice-daily coverage and delivers near–real-time information for wildfire

detection and land surface temperature monitoring (e.g. industrial activity). Operating in the mid-wave and long-wave infrared, the constellation executes onboard processing up to Level-2 Active Fire detections. Running the detection chain on orbit reduces the interval between overpass and alert dissemination from hours to minutes. Extensive validation studies show Level-1 radiometric accuracies <1.5 K in LWIR and < 3.2 K in MWIR.

The Near Real-Time Active Fire product reaches VIIRS performance, and land-surface-temperature retrievals achieve radiometric errors below 3 K compared to VIIRSand ECOSTRESS. Each confirmed fire event is paired with a spread forecast, providing early situational awareness beyond simple detection. With Pine Grove now fully operational, the constellation closes the long-standing afternoon observation gap during peak burn time. In this contribution, we will share results of pine grove, the next steps toward higher temporal density, contingency with existing missions and discuss how public–private collaboration can strengthen global thermal monitoring capabilities

CALIBRATION VALIDATION

Absolute Radiometric Calibration Sensitivity analysis of Vantor's surface reflectance product

Tina Ochoa, Vantor

This presentation evaluates the accuracy and sensitivity of Vantor's Atmospheric COMPensation (ACOMP) surface reflectance product, a key component in enabling consistent, analysis-ready Earth observation data. Vantor performs absolute radiometric calibration using the vicarious method at its site at Colorado Air and Space Port (CASP) in Watkins, CO over specialized reflectance targets. The radiometric performance of ACOMP-derived surface reflectance is assessed using in-situ reflectance measurements collected at a farmed vegetative field at CASP, along with RadCalNet (RadCalNet) observations of the stable natural target Railroad Valley (RVUS). The analysis quantifies how well these products reproduce ground-measured reflectance under varying atmospheric and viewing conditions.

A central focus of this work is the influence of absolute radiometric calibration coefficients on surface reflectance outputs. To characterize this relationship, a Monte Carlo sensitivity analysis was conducted that systematically perturbs calibration coefficients across a range of plausible uncertainty thresholds. This approach isolates the extent to which calibration uncertainty propagates into downstream reflectance products and identifies spectral regions and product types most affected by radiometric variability.

The results provide an empirical basis for understanding the robustness of ACOMP's atmospheric correction framework and highlight the critical role of accurate vicarious calibration in ensuring radiometric fidelity. These findings support ongoing efforts to refine calibration strategies and improve the consistency of Vantor's reflectance products across sensors and acquisition conditions.

EarthDaily Mission and Post-Launch Cal/Val Progress

Fraser Parlane, EarthDaily Analytics

The EarthDaily Analytics team is actively building a constellation of highly innovative satellites, capable of covering the earth's landmass every day with a novel set of spectral channels selected to serve a wide range of applications. This new data will flow through our EarthPipeline, a completely automated Ground Segment-as-a-Service offering, capable of processing, calibrating and validating not only the data from EarthDaily Analytics' constellation but data from multiple partners' constellations as well.

We know that nearly every application targeted by EarthDaily Analytics, agriculture, forestry, water and many more, will all benefit greatly from the science-grade imagery and analytics that the EarthPipeline will deliver. With novel spectral channels, ranging from visible through to thermal, combined with the objective to deliver high-value imagery and analytics, comes several calibration and validation challenges.

This presentation will focus on our thermal imaging capabilities as we discuss the EarthDaily constellation and the EarthPipeline, and will delve into our rigorous pre- and post-launch cal/val processes and present our progress to date, and discuss how we will ultimately address these various challenges in order to achieve the radiometric, geometric and retrieval accuracy requirements necessary to achieve the science-grade data products.

The Muon Space GNSS-Reflectometry Constellation

Clara Chew, Muon Space

Muon Space developed and launched its first GNSS-Reflectometry (GNSS-R) satellite, MuSat2, in the spring of 2024, which is similar to the satellites that comprise NASA's Cyclone Global Navigation Satellite System (CYGNSS) mission. Since then, Muon has launched an additional two GNSS-R satellites, with another three to be launched in 2026. Four of the six GNSS-R satellites that Muon will have on orbit by the end of 2026 will include the industry's first high gain antennas (19-20 dBi). We are aiming to demonstrate that high gain GNSS-R allows for new capabilities unattainable with lower gain GNSS-R antennas, such as soil moisture retrieval beneath dense forest canopies and ocean surface wind speed retrieval during hurricanes and tropical storms. Muon is working to improve latency for rapid assimilation of GNSS-R into numerical weather models from today's average of 2 hours to near-real time latency with state-of-the-art upgrades to the high gain Muon GNSS-R constellation.

This presentation will summarize the current and planned states of Muon's GNSS-R constellation and applications of the data for geophysical retrieval, including ocean surface wind speed, near-surface soil moisture, mapping inundation extent, and sea ice concentration. We will also describe our past, current, and future collaborations with partners including the US Air Force, NOAA, and the California Department of Forestry and Fire Protection (CAL FIRE).

Calibration and validation of SpaceEye-T1

Moongyu Kim, SI Imaging Services

The first satellite of SpaceEye-T constellation was launched on March 15, 2025. The SpaceEye-T delivers 25cm resolution optical images for various applications.

The calibration and validation has been conducted since its launch and the approached used and the characterization result will presented.

MTF tests for optical sensors before launch

Guoqing (Gary) Lin, NASA Goddard Space Flight Center

NASA has procured 5 Visible Infrared Imaging Radiometer Suite (VIIRS) instruments to collect radiance and reflectance measurements in support of rapid response, weather and climate applications. All 5 instruments have gone through pre-launch ground tests to calibrate and characterize spectral, radiometric and geometric performance, and 3 of them are currently in on-orbit operations. This talk focuses on the tests on sensor (detector) spatial responses. The responses are measured by line spread functions in the along-scan and along-track directions. They are parameterized and compared with the requirements using several sets of parameters: the dynamic field of view (DFOV) in the scan direction and instantaneous FOV (IFOV) in the track direction for all tested detectors, modulation transfer function (MTF) for 16 detectors in each of 17 moderate resolution bands (M-bands), horizontal spatial resolution (HSR) for 32 detectors in each of 5 imagery bands (I-bands), and HSR for 16 effective detectors in each of 3 selected aggregation modes in all 4 gain stages of the Day/Night band (DNB). MTF harmonization in nesting I-bands into M-bands will also be discussed. The presentation will highlight lessons learned from VIIRS pre-launch tests, including anomalies observed across optical, thermal, and electronic design/fabrication that varied from build to build, and the corresponding improvements implemented to mitigate these issues.

CHARACTERIZATION RESULTS

Cross-Calibration Challenges and Strategies for Multi-Spectral Constellations with 20+ Spectral Bands

Keith Beckett, EarthDaily Analytics

The emergence of hyperspectral and multi-spectral Earth observation constellations with a large number of spectral bands (20+) introduces new challenges for radiometric consistency and cross-sensor interoperability. Expanded spectral coverage increases the complexity of cross-calibration, particularly when maintaining stability across bands with differing signal-to-noise characteristics, atmospheric sensitivity, and calibration transfer mechanisms.

This presentation discusses cross-calibration strategies developed for the EarthDaily Constellation, a daily global imaging system with 22 spectral bands spanning the visible, near-infrared, shortwave infrared, and thermal domains. To support consistent analysis-ready data products, EarthDaily performs cross-calibration against seven independent reference science satellite missions, each presenting distinct challenges related to spectral response differences, temporal sampling, data formats, atmospheric effects, and calibration conventions.

Approaches for managing these complexities are described, including data pre-processing, spectral harmonization, and automated quality assessment to monitor inter-sensor consistency over time. Characterization results illustrate how calibration uncertainty propagates across spectral dimensions and impacts multi-band analytics and time-series stability. Underpinning in-orbit radiometric performance is rigorous pre-launch sensor calibration, including the use of tunable laser systems traceable to NIST standards, enabling the transition from laboratory calibration to sustained scientific-quality operations.

The work highlights the importance of rigorous pre-launch calibration and scalable, automated calibration frameworks with quality metrics suited to multi-spectral systems with high band counts. Practical experiences and lessons learned from calibration activities for the EarthDaily Constellation will be presented.

Early Radiometric Calibration Performance of Hydrosat's VNIR Instruments on VZ-1 and VZ-2: Pre-Launch Characterization and Initial On-Orbit Cross-Calibration

William Thomas, Hydrosat

Hydrosat's mission to deliver high-resolution, daily land surface temperature data began with the launch of its first pathfinder satellite, VanZyl-1, in August 2024, followed by a second mission, VanZyl-2, in July 2025. Both are ESPA-class small satellites and carry an identical dual-sensor payload, which includes a longwave infrared instrument and a multispectral visible-near-infrared (VNIR) instrument. This presentation focuses on Hydrosat's radiometric calibration performance for the VNIR instruments, which have a ground sampling distance of 30m and are designed for surface reflectance measurements, with emphasis on pre-launch characterization and the early on-orbit results that are available. We summarize our laboratory calibration approach to derive band-specific calibration coefficients and assess instrument linearity and stability. Relative spectral response (RSR) measurements are used to define band-effective quantities and support spectral harmonization. We present the initial on-orbit cross-calibration process and results for the instruments using near-coincident measurements with Sentinel-2 and our use of the instrumented Radiometric Calibration Network to quantify uncertainty.

High-Precision 3D Geometric Calibration and Validation Sites from Multi-Modal Satellite and Airborne Elevation Datasets

Shashank Bhushan, NASA Goddard Space Flight Center & University of Maryland

The NASA Surface Topography and Vegetation (STV) incubation team requires precise geometric characterization of lidar, radar, and stereo photogrammetry measurements across diverse surface conditions to support future satellite mission planning. Each measurement technique exhibits unique accuracy characteristics that vary significantly with landcover type and terrain complexity.

We established 13 precision geometric calibration sites covering approximately 2700 kmÂ^{2} across CONUS, spanning diverse landcover types (sparse vegetation, dense forests, agricultural areas) and terrain characteristics (flat coastal plains, mountainous regions, glaciated surfaces). Each site contains four-way data overlap: Maxar stereo, NASA ICESat-2 altimetry, NASA GEDI altimetry, and airborne lidar collections (3DEP, NEON, NCALM, NOAA).

Using airborne lidar as geodetic reference, we quantified systematic geolocation offsets across all satellite systems. ICESat-2 demonstrated the highest geometric accuracy with minimal geolocation errors (<2m horizontal), while WorldView stereo exhibited 5-8m systematic offsets that varied with terrain complexity. GEDI showed the largest geolocation uncertainties, with biases up to 30m that exhibited beam-dependent variations across different surface conditions.

The diverse landcover and terrain conditions across sites provided critical opportunities to test co-registration techniques and assess product geolocation accuracy under varying surface conditions. These precision-characterized sites establish accuracy benchmarks for current satellite systems and provide reference datasets for geometric calibration of future sensors. Our systematic approach to mining existing archives for coincident measurements demonstrates the potential to establish a distributed reference geodetic network supporting operational cal/val activities across diverse Earth surface conditions.

Consideration of Correlations in Radiometric Measurements of the Environment

Steven Brown, NIST

Optical measurements of the environment are used to characterize terrestrial, aquatic, and atmospheric processes across both spatial and temporal scales. Global observing systems and other measurement networks are crucial for tracking physical, chemical, and biological quantities that are related to phenomena of interest, e.g. absorption measurements used to assess atmospheric composition, or optical reflectance measurements that can be related to functional vegetation traits and primary productivity. The challenge for researchers lies in developing state algorithms that link optical properties of retrieval targets to biogeophysical data products. Uncertainties in environmental measurements propagate through state algorithms, retrieval targets, and data product generation. Minimizing uncertainties is particularly important when considering that environmental monitoring often involves quantifying small changes in a data record that may contain significant variability over longer timescales or large spatial domains.

In this presentation, we consider the impact of spatial and temporal correlations on the Type A uncertainties in ratios of two optical measurements and illustrate the potential for significant reduction in the Type A uncertainties in these measurements.

EROS Cal/Val Center of Excellence and Partners Level 2 Validation 2025 Annual Comparison

Garrison Gross, KBR-USGS

Abstract: Leveraging years of multi-scale optical system geometric and radiometric calibration and characterization experience, the EROS Cal/Val Center of Excellence (ECCOE) is a global leader in improving the accuracy, precision, and quality of remote sensing data. The Landsat Level 2 science product provides users with analysis-ready surface reflectance (SR) data. While this bottom of atmosphere (BOA) data is the gold standard in remote sensing, it can further be improved upon. The ECCOE field collection team conducts field campaigns throughout the year to support the improvement of the Landsat Level 2 Product. ECCOE implemented traditional vicarious calibration methods through regular field observations with portable spectroradiometers starting in 2021. These fieldwork collections are coincident with Landsat 8, Landsat 9, Sentinel 2, and EnMAP satellite overpasses and allow for direct comparison between satellite BOA products and the ground validation data. ECCOE also partners with several universities across the nation to aid in this endeavor, including South Dakota State University, University of Arizona, Rochester Institute of Technology and Jet Propulsion Laboratory, with the latter two partners providing surface temperature (ST) data. This compilation of data provides insight into the strengths and weaknesses of sensors over varying land cover types and across the electromagnetic spectrum. The data from 2025 saw uncertainties within 0.03 in SR and within 5 degrees Kelvin in ST.

HYPERSPECTRAL

Tanager-1: Calibration Improvements and On-Orbit Performance Monitoring

Norberto Hernandez, Planet Labs (Berlin)

In August 2024, Planet launched its hyperspectral imaging spectrometer, Tanager-1, the first satellite in a planned constellation. Its payload is a Dyson VSWIR spectrometer that collects data in the ~380 - 2500 nm range (at 5 nm band width) in >420 channels, with a target spatial resolution of 30 m. Pre-launch and on-orbit calibration, characterization and validation follow methods used by NASA JPL, specially the ones used for NASA's EMIT instrument.

To help ensure the delivery of consistently high-quality data, reliable calibration is essential. Planet has implemented significant improvements to both the calibration targets and algorithms utilized.

The spacecraft supports up to 30 degrees off-nadir imaging and advanced payload maneuvers to increase integration time and SNR. Due to the different acquisition modes the payload supports and the large amount of data generated, it is important to track and monitor the on-orbit performance of the instrument. Planet makes use of metrics and automation to monitor the instrument, detect trends and maintain high-quality data.

In this presentation, we will discuss some of the improvements done for on-orbit calibration as well as the different metrics and evaluation strategies to track the performance of the instrument.

Pixxel's Image Calibration Odyssey: From Raw Data to Decision-Ready Intelligence

Spencer Wahrman, Pixxel

Hyperspectral remote sensing from satellite platforms offers unprecedented capability for characterizing Earth's surface across hundreds of contiguous spectral bands. However, realizing the full scientific potential of these data requires a rigorous and well-understood image processing pipeline — from the moment the camera is turned on for capture to the delivery of analysis-ready surface reflectance products. This talk presents an overview of Pixxel's end-to-end image processing pipeline for the Firefly constellation, the calibration odyssey we've been on, and lessons learned since first light images were captured

The Application of Precisely Calibrated Hyperspectral Imagery to Real-World Problems

Josh Magarick, Orbital Sidekick, Inc.

The commercial hyperspectral imagery (HSI) data provider, Orbital Sidekick (OSK) has launched five visible near infrared through shortwave infrared (VNIR/SWIR) HSI satellites. The constellation, called the Global Hyperspectral Observation Satellites (GHOSt) launched throughout 2023 and 2024. Each satellite delivers 472 contiguous bands of hyperspectral information throughout the entire VNIR/SWIR spectrum at nearly 5 nanometer (nm) spectral resolution with an 8-meter (m) ground sampling distance (GSD). OSK's HSI technology has the unique ability to detect and identify solid and gaseous materials on the earth. Throughout late 2024 and 2025, OSK has been investigating a wide variety of sites worldwide to demonstrate the unique use cases of Visible to Near Infrared through Shortwave Infrared (VNIR/SWIR) commercial space-based HSI technology. Spectral signatures of materials of interest are required to perform detection analysis on HSI data, and as such, OSK has been able to obtain and measure a variety of its own relevant HSI signatures. Signatures include chemicals such as ammonium salts, sodium nitrate, potassium nitrate, urea, sulfur, and paints. OSK will demonstrate the detection of potassium nitrate and sodium nitrate at a port facility from space for the first time commercially. While showing this analysis, and in the spirit of the JACIE, OSK will highlight the importance that spectral calibration plays in the HSI community's ability to detect and distinguish one chemical from another, and in particular, those chemicals with absorption features in close proximity to one another.

Tanager-1 Surface Reflectance Validation

Dominic LeDuc, Planet Labs

Planet's first full VSWIR imaging spectrometer, Tanager-1, was launched in summer 2024 and commissioning completed in spring 2025. Operated from Planet's common smallsat bus, Tanager-1 collects >420 contiguous spectral bands from ~380-2500 nm at 5 nm sampling. Core data products include calibrated radiance and surface reflectance. Surface reflectance is retrieved using the open-source ISOFIT framework via optimal estimation. In this presentation, we describe the implementation of ISOFIT in a production setting and its use to estimate surface reflectance, aerosol optical depth, water vapor, and associated surface reflectance uncertainties. We share results from early data validation against ground measurements (e.g., RadCalNet, AERONET) and cross-sensor comparisons with airborne and satellite instruments like EMIT and AVIRIS-3. Preliminary results show that SR retrievals have an error typically below 5% reflectance across most wavelengths when compared to ground spectra over desert sites. When comparing time series over pseudoinvariant calibration sites, we find SR values vary by <4% for most wavelengths, with a mean standard deviation of ~2%. Additionally, we evaluate how our spectral and radiometric calibration performance, alongside Tanager-1's variable sensitivity modes and viewing geometries, influence SR retrieval quality. These analyses clarify the drivers of reflectance uncertainty and inform how customer-defined tasking parameters affect data utility.

Wyvern HSI Surface Reflectance Across the Dragonette Constellation

Anudeep Bildfell, Wyvern Inc.

Wyvern has been providing high-quality visible and near-infrared (VNIR) hyperspectral imagery for over two years, with data delivered as a standard Top-of-Atmosphere radiance (L1B) product. To address the needs of the community and enhance utility, Wyvern recently introduced a surface reflectance (L2A) product. This L2A product compensates for atmospheric effects (such as aerosols and water vapor), providing a substantially more robust measure of on-ground spectra that is suitable for time-series analysis, machine learning applications, and chemical composition analysis.

The L2A product is generated using the 6S radiative transfer model, which transforms L1B radiance to surface reflectance using specific inputs, including viewing/solar geometry, atmospheric profiles, and estimated aerosol optical thickness (AOT). Radiometric accuracy is established through primary validation using RadCalNet sites, ensuring the L2A product is traceable and accurate. Secondary validation includes near-simultaneous crossovers with established missions like Sentinel-2 and other Dragonette satellites to monitor consistency and confirm interoperability of the Dragonette constellation.

Wyvern is focused on two key technical advancements to enhance product quality. First, we are improving calibration techniques to accurately model and mitigate the effects of narrowband atmospheric absorption in the near-infrared (NIR). Second, we are addressing the challenge of MODIS data latency and replacement for AOT inputs by exploring on-orbit, image-based estimation methods, such as Dense Dark Vegetation), to ensure the long-term, independent stability of the L2A product.

Performance Assessment of Wyvern Dragonette Hyperspectral Constellation

Chad Bryant, Wyvern Inc.

Understanding the quality of Earth Observation satellite imagery is critical for scientific analysis, machine learning applications, and for promoting the creation of long-term, multi-sensor datasets. This presentation provides a technical overview and quantitative performance assessment of the four-satellite Wyvern Dragonette Hyperspectral Constellation, focusing on an evaluation of fundamental radiometric and spatial metrics.

Initial and current signal-to-noise ratio performance is presented using a spatial estimation methodology over Pseudo-Invariant Calibration Sites (PICS). The sharpness and ground resolved distance achieved by the system, as determined by Modulation Transfer Function (MTF) measurements over man-made sites, will be presented.

Absolute geometric accuracy is quantified using the circular error at 90% (CE90) across various scenes, ensuring good geospatial precision. Band-to-band co-registration is assessed to validate the spatial alignment of the hyperspectral channels. Finally, radiometric stability is evaluated by comparing the Top-of-Atmosphere radiance and surface reflectance products against established reference missions, such as Sentinel-2, over PICS.

These findings offer a clear understanding of the constellation's current capabilities and reinforce Wyvern's commitment to continuous processing refinement to enhance data quality.

Title: Impact of spectral and spatial uniformity on subpixel target detection performance when using imaging spectrometers that have spectral/spatial non-uniformities.

Tom Chrien, Matter Intelligence, Inc.

Matter Intelligence flew a VNIR/SWIR sensor integrated with a Lidar from a drone platform over a set of targets at the ROC-X 2025 campaign. We laid out large and small spectrally rich targets and used a match-filter algorithm to detect these targets in the image data. In this presentation, we describe the experiment plan and results that show the sub-pixel target detection under various conditions. The sensor used was thoroughly characterized to measure radiometric, spectral and spatial properties including signal to noise ratio and spectral/spatial non-uniformity that arise due to smile and keystone distortions, and variations is spatial resolution over spectra. We discuss how detector performance is related to sensor characteristics and the complexity of the backgrounds.

LIGHTNING TALK

Crop Water Productivity ("crop per drop") and Crop Water Savings of Cotton Crop in California's Central Valley using 3-30 m Remote Sensing Data

Daniel Foley, USGS

The overarching goal of this study is to model, and map irrigated cotton crop water productivity (CWP, "crop per dropâ€�) and assess crop water savings in California"s Central Valley (CCV) using 3-30 m resolution satellite sensor data. CWP provides a valuable ratio of crop output over water input. CCV was selected as study area since nearly 85% of California"s human water use goes towards growing irrigated crops in its about 5 million hectares. CCV has been under scrutiny for water use as many irrigated crops have been competing for limited water resources.

A methodology for a novel conjunction of multi-sensor remotely sensed data and onsite field measurements of cotton, was established. Methods explored correlating image data across satellite sensors including 3 m PlanetScope, 10 m Sentinel-2, and 30 m Landsat-9 at varying resolutions with field measurements to estimate cotton crop s productivity (CP; Kg/m2). Remote sensing based OpenET Evapotranspiration determined crop water use (CWU; m3/m2). Then CWP was determined by dividing CP by CWU (Kg/m3). This allowed assessment of crop water savings by increasing various proportions of CWP. The study has massive implications on where water can be saved in agricultural croplands and by how much. Given CWP has greatest potential for human water savings, and for creating water banks for alternative water uses (e.g., data centers), the study has major implications in providing technical knowledge for policy makers.

Microsoft"s Planetary Computer: Building a Planetary-Scale Data Platform

Taylor Corbett, Microsoft

Since its launch in 2020, Microsoft"s Planetary Computer has become a leading cloud-native platform for geospatial data, hosting over 70 PB of open-access Earth observation and environmental datasets. Accessed billions of times each month, the Planetary Computer enables researchers, policymakers, and businesses to integrate remote sensing data into applications and AI models.

In this session, we share how the Planetary Computer has transformed remote sensing workflows by focusing on three primary topics:

1. Current Capabilities - A brief tour of the Planetary Computer"s Data Catalog and APIs, along with case studies demonstrating how the platform has been leveraged for diverse use cases.

2. Building at Scale - Lessons learned in creating and maintaining a petabyte-scale platform, including strategies for performance, reliability, and interoperability. Discover why contributing to community standards such as the SpatioTemporal Asset Catalog (STAC) specification remains central to our approach.

3. What"s Next - Updates on new datasets, improved accessibility, and recent advances that enable tighter collaboration between geospatial data scientists, engineers, and business users. We also spotlight emerging standards and technologies that we"re actively evaluating to make our datasets even more analysis ready and interoperable.

Whether you are focused on algorithm development or operational applications, this session will offer practical insights into accelerating remote sensing workflows for science, policy, and business.

Multi-Domain Geospatial Fusion: Integrating LiDAR, 3D Analytics, and AI from Terrain to Orbit

Shawana Johnson, Global Marketing Insights, Inc.

This session introduces a next-generation multi-domain geospatial fusion framework developed by a collaborative team of aerial, analytic, and AI specialists. Engineered to meet the evolving demands of defense, intelligence, and critical infrastructure operations, this framework integrates high-resolution LiDAR, 3D spatial analytics, and AI-driven change intelligence into a unified operational environment spanning terrain, littoral, cyber, and orbital domains.

Airborne and terrestrial LiDAR data deliver highly precise 3D elevation and structural mapping across mission-critical environments such as coastal installations, port facilities, transportation corridors, and energy infrastructure. These datasets form the 3D spatial backbone for advanced analytics and simulations. Layered atop this foundation, 3D meshing and digital twin modeling enable real-time situational foresight, infrastructure impact assessment, and predictive risk analysis.

At the next tier, the AI reasoning engine fuses temporal aerial and satellite imagery to automate object recognition, change detection, and anomaly flagging—creating persistent awareness across spatial and temporal scales. This integration supports diverse mission sets, including maritime corridor surveillance, expeditionary logistics, cyber-physical infrastructure defense, and space asset tracking.

The resulting multi-domain operational picture provides commanders and analysts with rapid, fused situational awareness in both stable and contested environments. By uniting geospatial data from land, sea, cyberspace, and orbit, this fusion framework enhances mission assurance, operational readiness, and strategic resilience in an era of accelerating threats and complexity.

Assessment of Photosynthetic Function with ESA's FLEX and CHIME, and NASA's SBG and PACE products

Petya Campbell, NASA/GSFC and UMBC/GESTARII

Photosynthesis is of key importance for vegetation function and while canopy chlorophyll (Chl) informs on the potential for photosynthetic function, solar-induced Chl fluorescence (SIF) can offer a direct probe to assess chlorophyll fluorescence (ChlF) and actual photosynthetic activity at leaf, canopy, and regional scales. High spectral resolution data offers an efficient tool for evaluation of the ability of vegetation to sequester carbon due to changes in vegetation chemical and structural compounds. To address the need for continuous remote sensing monitoring photosynthesis, at select flux tower sites we collected high frequency leaf and canopy data for crops, prairies, tundra and boreal forests.

This study presents findings from the analysis of leaf-level active fluorescence metrics of photosynthetic efficiency (e.g., Electron Transport Rate, ETR; Yield to Photosystem II, Moni-PAM; Non-photochemical Quenching, NPQ), canopy eddy covariance measurements of gross primary productivity (GPP), reflectance and SIF and reflectance time series of images collected at different temporal, spectral and spatial resolutions. The Soil Canopy Observation of Photochemistry and Energy fluxes model (SCOPE) was used to integrate these measurements to link reflectance to plant photosynthesis and SIF. Using proximal reflectance and SIF we derived estimates of leaf and canopy photosynthetic pigments and efficiency (e.g., leaf electron transport rate, ETR) upscaling them across the seasons. The constellation of forthcoming spectroscopy missions, such as FLEX, SBG and CHIME offer potential for developing multi-sensor time-series capturing vegetation dynamics across multiple seasons and years.

Anchoring Reality: Strengthening Modern Remote Sensing Through Real-World GCPs and Geodetic Rigor

Philipp Hummel, CompassData

Advances in remote sensing-higher resolution, faster revisit rates, and improved geometric fidelity-are exposing geodetic inconsistencies that were previously unnoticed and operationally insignificant. Historically, most users worked without detailed understanding of tectonic motion, datum realizations, or crustal deformation. As modern sensors push toward sub-meter accuracy and cross-sensor interoperability, these geodetic simplifications now introduce visible gaps between a dataset's apparent positional accuracy and its true geodetic correctness.

This presentation examines the root causes of these issues, beginning with the distinction between Real-World Ground Control Points-surveyed physical features with rigorously validated coordinates-and more commonly used derived geo-references. Real-World GCPs function as the fiducial anchors necessary for reproducible accuracy and are fundamental to anchoring remotely sensed data within an authoritative terrestrial reference frame.

A second challenge involves the conversion and transformation of geodetic datums. While the International Terrestrial Reference Frame (ITRF) defines the global scientific standard, most operational workflows rely on regional datums such as NAD83 or ETRF, each differing by realization, datum definition, and epoch. Ongoing tectonic plate motion further complicates positional alignment over time, introducing drift that often exceeds the spatial accuracy of modern sensors.

Additional inconsistencies arise from selecting coordinate representations-Earth-Centered, Earth-Fixed (ECEF), Geographic Coordinates, or projected systems like Universal Transverse Mercator (UTM)-each introducing different forms of projection-based distortion.

Clarifying these geodetic factors provides a practical and urgently needed path toward improving the accuracy of remotely sensed datasets and achieving consistent, interoperable positioning across sensors, platforms, and time.

Dark Ship Identification with the Wyvern Dragonette Hyperspectral Constellation

Ellie Jones, Wyvern

Dark ship identification traditionally relies on assessing vessel similarity using very high-resolution optical satellite imagery; a modality constrained by limited spectral information and strong dependence on visual context. Wyvern is developing a complementary approach that leverages high-resolution hyperspectral imagery to compare the spectral signature of a ship across multiple captures. By exploiting narrowband spectral measurements, this method enables more discriminative characterization of vessel paint types and structural features, providing an additional, robust pathway for identifying ships operating without an active AIS transponder.

To operationalize this capability, Wyvern is constructing a comprehensive hyperspectral ship reference library. This library links hyperspectral observations with positively identified vessels derived from AIS data, thereby allowing the development of robust spectral fingerprints for a wide range of ship classes and hull configurations. These reference signatures form the foundation for spectral matching algorithms capable of identifying or ruling out vessels even under differing illumination or atmospheric conditions.

In parallel, Wyvern is developing automated detection and classification pipelines specifically tuned to hyperspectral datasets. These include algorithms for ship segmentation, anomalous target detection, and hyperspectral-based identification workflows designed to operate at scale. Together, these tools will enable customers to receive actionable insights on vessel presence, activity, and identity, significantly enhancing maritime domain awareness. The integration of hyperspectral data into dark ship analytics represents a significant advance in remote sensing-enabled maritime security by providing an additional modality for identifying vessels that attempt to evade traditional monitoring systems.

QUALITY & ACCURACY IMPACTS TO DATE FUSION

System Characterization and Evaluation of Remote Sensing Imagery- Lessons Learned from EDAP Evaluation

Aparajithan Sampath, KBR COntractor to US Geological Survey, EROS Data Center

The U.S. Geological Survey (USGS) Earth Resources Observation and Science (EROS) Center has developed a robust system characterization process to rigorously evaluate the quality of remote sensing imagery. This process encompasses a comprehensive assessment of geometric, radiometric, and spatial characteristics, ensuring the data's suitability for scientific applications. This research presents the lessons learned from adaptation of the process in the evaluation of Landsat OLI-1 and OLI-2 datasets using the ESA-NASA joint optical guidelines. This presentation summarizes lessons learned from an assessment of Landsat 8 and Landsat 9 Collection 2 data, focusing on documentation review and validation results across radiometry, geometry, and spatial characterization.

The assessment finds that both missions achieve Excellent grades for validation methods and results compliance, reflecting mature calibration practices, strong geometric accuracy, stable on-orbit performance, and comprehensive public documentation. Standardized metadata, globally indexed analysis-ready products, and well-established Level-1 and Level-2 processing workflows strongly support EDAP requirements. However, the absence of per-pixel uncertainty and covariance layers prevents an “Idealâ€� rating, underscoring the central role of uncertainty characterization in the framework.

Key lessons indicate that EDAP grading is threshold-based rather than incremental, with uncertainty influencing nearly all assessment categories. Achieving higher grades requires GUM-compliant uncertainty propagation, validated reference data, and global, multi-season validation campaigns-demands that carry significant resource and expertise requirements. While well suited to long-lived government missions, these requirements present feasibility challenges for commercial and startup Earth observation providers.

Uncertainty-Aware Modeling of Remote Sensing Data: From measurement uncertainty to Decision Analytics

Afreen Siddiqi, Massachusetts Institute of Technology

Remote sensing (RS) data of environmental conditions increasingly inform critical operational decisions related to flood-management, Harmful Algal Blooms (HAB) mapping etc. However, these data often carry inherent uncertainties due to sensor limitations, atmospheric conditions, and processing algorithms. Ignoring these uncertainties can lead to suboptimal or risky decisions. This work develops a quantitative framework that explicitly links RS data uncertainty to decision outcomes using probabilistic decision analysis and value-of-sample information concepts.

We focus on flood monitoring, where radiometric uncertainty in optical imagery affects water classification, and elevation uncertainty in digital elevation models affects derived water depth and volume. These uncertainties are analytically propagated using probabilistic models, from sensor measurements through water extent and volume estimation to false-positive and false-negative rates in flood prediction. A decision-tree formulation maps these error probabilities to expected socioeconomic outcomes, capturing the costs of missed floods versus false alarms, and can allow decision makers to make defensible decisions on the purchase or development of data or sensing systems of sufficient quality. These can also be linked back to system level decisions on uncertainty tolerability for system design.

The framework is demonstrated through a case study of wetland and reservoir monitoring. Results show strong agreement between RS-derived and in situ water levels, while revealing that epistemic uncertaintiesâ€•particularly DEM error and shoreline misclassificationâ€•dominate decision reliability. By translating RS data quality into decision-relevant metrics such as expected loss and return on investment, this work reframes accuracy assessment as a value-centric problem.

Satellite derived bathymetry vertical accuracy independence on satellite mission and processing method

Monica Palaseanu-Lovejoy, USGS / Geology, Minerals, Energy and Geophysics (GMEG) Science Center

The International Hydrographic Organization succinctly states: Our community continues to face a huge challenge in the available funding and resources to improve and maintain a detailed map of our seabed. SDB can make a valuable and cost-effective contribution.

This research focuses on three satellite derived bathymetry (SDB) methods applied to different optical satellite instruments: 1. A stereo-photogrammetry bathymetry module developed using the NASA Ames stereo pipeline open-source software with WorldView data; 2. A physics-based radiative transfer equation method using Landsat data; and 3. A modified composite band-ratio method for Sentinel-2 with an initial calibration using empirical coefficients followed by a rigorous linear regression against in-situ bathymetry data.

All methods were tested in three different areas with different geological and environmental conditions, Cabo Rojo, Puerto Rico; Key West, Florida; and Cocos Lagoon, Guam.

SDB vertical accuracy depends more on location such as site water clarity and property than the algorithmic method or optical satellite instrument used. The satellite instrument influences the SDB resolution, but not necessarily the bathymetric accuracy or the maximum bathymetric depths resolved. In other words, the SDB method itself has a weak influence on the overall SDB accuracy per site, irrespective of alignment to ICESat-2 ATL24 track bathymetry data.

SDB error distributions can be bimodal irrespective of method, satellite instrument, maximum bathymetric depth resolved or site, and consequently normal error metrics are not symptomatic. Alignment to ATL24 bathymetric track data does not completely eliminate error bimodality since SDB data have different biases for relatively shallow versus deeper waters.

RESOURCES FOR DATA QUALITY & CALIBRATION

Synthesizing Long-Range Sensor Models for 3-D Exploitation of Non-Earth Imagery

Brian J. Roberts, BAE Systems

Accurate 3-D measurement of orbiting objects from long-range imagery presents unique calibration and orientation challenges not addressed by traditional photogrammetry techniques. This work introduces a practical method for synthesizing sensor models for Non-Earth Imagery (NEI) that enables monoscopic and stereoscopic exploitation even when the observed object is moving or rotating between collections. Leveraging principles of projective geometry, the method re-establishes a consistent object-centric coordinate system by estimating the slopes of the target body's principal axes as they appear in long-range imagery, where parallelism replaces traditional vanishing-point cues. These observed slopes uniquely determine the camera's rotation matrix, while range and focal parameters are used to recover translation and scale.

Once a synthetic camera model is derived for one or more images, standard photogrammetric techniques can be applied to perform metric analysis, including feature mensuration, plane and axis-aligned measurements, and full 3-D reconstruction through stereo ray-intersection. This approach supports exploitation in tools such as SOCET GXP, enabling analysts to visualize NEI collections in stereo, scribe object sub-features, and perform quantitative assessment of satellites or other resident space objects.

The proposed framework provides a repeatable, sensor-agnostic methodology that expands the applicability of photogrammetric workflows to NEI and Space Domain Awareness contexts. It enables accurate characterization of rigid-body geometry from long-range collections without requiring on-board calibration data, ephemeris accuracy, or stable object pose-offering a new pathway for operational 3-D exploitation of spaceborne targets.

Spectroradiometric Evaluations of Commercial Data for NASA CSDA

Mohammad Tahersima, George Washington University

NASA's Earth Science Division's Commercial Satellite Data Acquisition (CSDA) Program was established to identify, evaluate, and acquire commercial data that supports NASA's Earth science research and application development for societal benefit. A growing number of commercial imaging spectrometers have been launched in recent years and CSDA has been tasked to evaluate various aspects of their spectroradiometric data quality for NASA data users. The spectral range and resolution of commercial imaging spectrometers are similar to federally funded sensors as well as to validation test sites, such as the Radiometric Calibration Network (RadCalNet). Therefore, the commercial sensor community has been leveraging these largely freely available data to facilitate their essential calibration and validation. All spectroscopic missions, regardless of fiscal constraints or flexibility, rely on trustworthy automated calibration sites to either establish or validate their absolute radiometric scale. Besides absolute radiometric accuracy, imaging spectroscopy missions also need to be cognizant of spectral accuracy and other radiometric characteristics. Here, we will show use cases of the only US based automated radiometric site of RadCalNet for spectroradiometric evaluation of commercial imaging spectroscopy missions. Also discussed here are the challenges CSDA often encounters in evaluating commercial sensors including limited global coverage compared to science missions and limited resources dedicated to calibration. A key conclusion is that commercial imaging spectrometry will rely on data from these test sites which will require continued support from government and commercial users to sustain our automated calibration/validation platforms.

Radiometric Calibration Round Robin for Earth's Reflective Spectral Range

Boryana Efremova, GeoThinkTankLLC (NASA contractor)

The long-established collaboration between the Radiometric Calibration Laboratory (RCL) at NASA Goddard Space Flight Center (GSFC) and the Airborne Sensor Facility (ASF) at NASA Ames Research Center has been instrumental in advancing the radiometric calibration at both facilities. The RCL and ASF provide well characterized integrating sphere radiance sources, calibrated using NIST-disseminated spectral irradiance standards (FEL lamps), for radiometric calibration in the 300 nm - 2400 nm spectral range. An annual calibration round robin, focused on transferring NIST irradiance standards to working FEL lamps and integrating sphere sources at RCL and ASF and calibrating the integrating spheres to radiance, aims at improving the calibration methodologies and uncertainty analysis by comparing current and historical radiance and stability measurements of the sphere sources performed independently by the two teams. The comparison of calibration results derived using independent testing equipment, personnel and measurement methodologies helps to better understand calibration uncertainties and any test setup-related biases, which otherwise may remain undetected.

In this presentation we report results of recent annual round robin calibrations performed at ASF by RCL and ASF personnel. The ASF working FEL lamps and integrating sphere sources were calibrated to irradiance and radiance respectively. The results are in family with historic measurements, showing that the agreement between the two labs stays within 1%.

Dense Time Series for Assessment of Photosynthetic Function and Productivity - Cal/Val and Algorithms for New Satellite Products

Petya Campbell, GSTAR II UMBC and NASA GSFC

Photosynthesis provides a sensitive indicator of vegetation function. While canopy chlorophyll (Chl) informs on the potential for photosynthetic function, solar-induced Chl fluorescence (SIF) can offer a direct probe to assess actual photosynthetic activity at leaf, canopy, and regional scales. Hyperspectral data offers an efficient tool for assessment of the ability of vegetation to sequester carbon due to changes in vegetation chemical and structural compounds.

At select flux tower sites we are collecting high frequency leaf and canopy Chl fluorescence (ChlF), reflectance and SIF data for crops, prairies, tundra and boreal forests, to address the need for continuous monitoring to detect changes in photosynthesis. Our analysis of the links between the leaf-level active ChlF metrics of photosynthetic efficiency (e.g., Electron Transport Rate, ETR; Yield to Photosystem II), canopy gross primary productivity (GPP), reflectance and SIF revealed strong correlations. Using proximal reflectance and SIF we derived estimates of leaf and canopy photosynthetic pigments and efficiency (e.g., leaf electron transport rate, ETR) upscaling them across the seasons and to regional level satelite HLS and PRISMA images. Partial Least Square Regressions (PLSR) were derived to estimate ETR and GPP from proximal and satellite data collected at different spectral, temporal and spatial resolutions. The constellation of forthcoming spectroscopy missions, such as FLEX, SBG and CHIME offer potential for developing multi-sensor time-series capturing vegetation dynamics across multiple seasons and years.

Development of a unified framework for quality control of imagery produced by a >20 satellite constellation

Jaume Gibert, Satellogic

Operating a constellation of over 20 high-resolution satellites introduces unique challenges in Quality Control (QC) that cannot be met with traditional, operator-centric workflows. As data volume scales, the heterogeneity of sensors launched across different batches requires a robust, unified framework to ensure a homogeneous product experience for the end-user. This presentation details the development and implementation of a scalable, automated QC framework designed to monitor the health and image quality of the entire constellation in near real-time.

We will present case studies illustrating how this unified framework drives operational feedback loops, allowing for rapid detection of sensor degradation and automated triggering of re-calibration tasks.

Streamlined Calibration for Small Satellite Optical Payloads

Deron Scott, Space Dynamics Laboratory

This paper presents the development of an efficient and cost-effective calibration method tailored for optical payloads. We emphasize streamlined setup, efficient measurement collection, and analysis to meet the constraints of small satellite missions. The approach identifies critical calibration parameters that fit into mission/science objectives. To the extent required, our calibration approach incorporates spatial, spectral, and radiometric methods and test-as-you-fly approach. Techniques, such as photon transfer, to achieve comprehensive characterization of sensors and sensor systems are also introduced. A proof-of-concept demonstration that was performed on multiple surrogate payloads, yielding large performance improvements, will be shown.

Products and Services Beyond RadCalNet: Custom RadCaTS Results and Emerging Upgrades

Jeff Czapla-Myers, University of Arizona

"The Radiometric Calibration Test Site (RadCaTS) was developed by the Remote Sensing Group at the University of Arizona (UArizona). RadCaTS, located in Nevada, USA, provides ground-based data for the radiometric calibration and surface reflectance validation of Earth-observation sensors that operate in the solar-reflective regime (350 nm to 2500 nm). RadCaTS has been in operation since 2012 and is currently used with a variety of spaceborne and airborne sensors.

The goal of RadCaTS is to provide accurate, timely, SI-traceable TOA and surface reflectance data. RadCaTS is one of the original automated test sites in the CEOS WGCV Radiometric Calibration Network (RadCalNet), which aims to harmonize ground-based calibration and validation measurements from international organizations. RadCalNet provides TOA reflectance (nadir view) and surface reflectance data in 30 minute intervals, 09:00–15:00 local time. The spectral range of the data is from 400 nm to 2500 nm, in 10 nm intervals.

In contrast, RadCaTS can produce temporal, spectral, and sensor view angle-specific data tailored to any sensor under test. TOA spectral radiance, TOA reflectance, and surface reflectance results are provided as either band-averaged or hyperspectral (1 nm) and use the exact time, viewing, and illumination geometry as the overpass of interest, thereby minimizing uncertainties due to temporal and spectral interpolation.

Work is underway at UArizona to improve RadCaTS data in the spectral and geometric domains. This includes developing a field radiometer in the SWIR spectral region (1000 nm to 2400 nm), hyperspectral VNIR measurement integration (400 nm to 800 nm), and directional reflectance measurements.

A DIRSIG-based CONUS model to support LandIS sensor trade-studies

Aaron Gerace, Rochester Institute of Technology

The DIRSIG model is an image-generation tool that can be used to assess the impact of a sensor's design on image quality. DIRSIG has been tailored over the past forty years to support sensor-trade studies for the Landsat program and other spaceborne assets. It utilizes MODTRAN to introduce atmospheric effects into the simulations and has the flexibility to ingest complicated sensor models to produce realistic raw image data. A major hurdle to remote sensing scientists seeking to perform sensor trade-studies with DIRSIG is properly defining the synthetic landscape to the model, i.e., describing a digitized scene to the model requires significant effort and a background in various image-processing techniques. As such, previous efforts focused on the development of large-scale synthetic landscapes that could be directly ingested into DIRSIG to seamlessly enable users to conduct sensor trade-studies. This presentation updates the results of an effort where a full continental United States (CONUS) scene was created. The resulting landscape has a 10m spatial resolution, has spectral material information to enable simulations with hyperspectral sensors, and has terrain relief to enable assessments of geometric correction algorithms, for example. An overview of the workflow used to create this CONUS scene will be presented as well as initial simulations that were conducted to identify potential issues with the model. The utility of a scene at this scale will be demonstrated with a cross-calibration study and future work discussed.

SPATIAL, GEOMETRY, & ELEVATION

Forensic Satellite Archeology of Historic Calibration Sites

Mark Abrams, Exquisite Geolocation Systems

In a simplistic sense, calibration targets and sites date back to the earliest years of the air and space era as engineering teams attempted to quantify the performance of satellite imaging systems. Two sites, the Fort Huachuca Spatial Reference Facility and the Tyuratam/Baikonur "Target Ground Complex' (TGC, or "Object 135 MK') span the 1960s into the 1980s and accomplish nearly identical functions. Remarkably, the Fort Huachuca site remains marginally usable, while the Baikonur site is just a field of large concrete pads. A remarkable array of resolution targets was built across Edwards Air Force Base, with 15 sites spanning 22 miles and a "high range' spanning 140 miles, with 9 targets in 4 groups, most of which are still usable to some degree. In contrast to the resolution targets, grids of targets were used for camera calibration and geodetic testing, including the Casa Grande Photogrammetric Range and the Dugway Mensuration Grid.

Most of these sites are surveyed in USGS 3DEP LIDAR data, providing a "second life' opportunity as geodetic grids for accuracy testing, even when the original targets may have significantly degraded. An incremental challenge is finding documentation on these sites and reconciling reported configurations with the current, modern configurations. Test records and test and evaluation training manuals are notable exceptions that contain remarkable insight into methods for quantifying satellite imaging performance in the film era. A concise summary of the sites and documentation will be provided, with a request for legacy data from any public source.

A Semi-Monte Carlo Technique for Evaluating True Image Spatial Resolution

Bin Tan, GSFC/SSAI

The true spatial resolution of an image is a key metric for evaluating the geometric performance of satellite imagery. Traditionally, satellite images acquired over calibration-validation (cal-val) sites containing test patterns-such as squares or circles-are used. The linear edges of black-white blocks enable construction of the line spread function, from which the full width at half maximum (FWHM), commonly taken as the true spatial resolution, is derived. Although accurate, this method has notable limitations: only scenes covering the cal-val site can be assessed, and the size of the ground patterns constrains the spatial resolutions that can be evaluated.

This study proposes an alternative approach for estimating true image spatial resolution without requiring cal-val site imagery, and it is capable of evaluating any image whose resolution is coarser than that of the higher-resolution reference image. The reference image is systematically aggregated to generate coarser-resolution versions, each of which is subsequently interpolated to the resolution of the image under evaluation. Cross-correlation is computed for each interpolated-target image pair, and a cubic polynomial is fitted to the relationship between coarse resolution and correlation. The peak of this fitted curve provides the estimated true spatial resolution. Preliminary results show that the uncertainty of the estimate is within 10%, and this uncertainty is expected to decrease as the aggregation and interpolation procedures are refined to more closely emulate satellite image acquisition and gridding. The influence of different resampling schemes on the estimated spatial resolution will also be examined.

Preliminary Geometric Performance of the Pelican Constellation

Saif Aati, Planet Labs

The Pelican constellation, first launched by Planet in 2025, represents the next-generation high-resolution imaging capability, transitioning from SkySat's frame-based sensors to pushbroom imaging. As with any new satellite system, understanding and characterizing geometric performance is essential for ensuring data quality and enabling downstream applications. Pushbroom sensors present distinct calibration challenges: they are sensitive to satellite attitude variations and platform dynamics during acquisition, which can introduce band misregistration and geolocation errors if not properly addressed.

In this presentation, we provide preliminary geometric performance results from the Pelican constellation, covering geolocation accuracy, band-to-band registration, and attitude characterization. We also outline the calibration and correction strategies developed to achieve consistent geometric quality across the constellation. To illustrate the potential enabled by this geometric performance, we will show early geoscience applications including earthquake surface displacement mapping and digital surface model generation. These examples demonstrate Pelican's readiness for precision applications with minimal post-processing.

Geometric Validation and Refinement of Landsat 8/9 Orthoimage Products

Jie Shan, Purdue University

Satellite orthoimage products are widely available, but their geometric accuracy is often limited by uncertainties in sensor calibration and topographic modeling. We study this problem by matching Landsat images with Sentinel-2 and National Agriculture Imagery Program (NAIP) imagery. Our experiments demonstrate an inconsistency of 3 to 10 m between Landsat images and other ones. To remove these offsets, we developed a multi-layer perception (MLP) based approach that can further reduce the inconsistency to 2-4 m. We will present our results from 26 Landsat 8/9 scenes in Indiana of USA and Berlin of Germinay.

Geolocation Accuracy Assessment of National Agriculture Imagery Program (NAIP) Orthoimages Across State Boundaries

Paul Bresnahan, USGS

Orthoimages are commonly used as a reference layer for calibration, validation, and geo-registration. The Landsat program has relied on Digital Ortho Quarter Quad (DOQQ) orthoimages generated predominately in the 1990's and early 2000's for calibration and validation over the United States. As previously reported in an assessment over Arizona, more recent US Department of Agriculture National Agriculture Imagery Program (NAIP) orthoimages have evolved to an impressive level of geolocation accuracy. Because NAIP orthoimages are collected and produced solely within the boundary of a US state, this assessment was performed over a Landsat Worldwide Reference System (WRS)-2 path/row that overlaps South Dakota, Minnesota, Iowa, and Nebraska. Besides being a NAIP performance evaluation over an additional Landsat path/row area, the impact to the absolute and relative geolocation accuracy of NAIP orthoimages that cross state boundaries was assessed. These evaluations demonstrate the potential use of NAIP imagery for the geometric calibration and validation of Landsat and the geo-registration and validation of other imagery sources.

Beyond Geometric Error: A Physics-Based Integrity and Accuracy Rating for Next-Generation Remote Sensing Data

Shawana Johnson, Global Marketing Insights, Inc

The remote sensing industry is at a pivotal moment with the deployment of commercial hyperspectral (HS) and Ultra-High Resolution satellite constellations, which are expanding into critical areas such as forensic analysis, national security, and digital modeling. This transition necessitates a fundamental evolution in calibration and validation (Cal/Val) protocols. Conventional approaches relying solely on statistical error metrics (e.g., CE95) are insufficient for meeting the demands of sub-pixel accuracy and source integrity, especially given HS data's spectral sensitivity and the need for forensic-level fidelity. To address these challenges, we propose developing a physics-based validation framework, a tool designed to evaluate data quality through multiple, internally consistent metrologies. The envisioned system will incorporate methods for: (1) assessing spectral/material fidelity against physics-based radiative transfer models and empirical benchmarks; (2) establishing geometric accuracy based on remote sensing principles for decimeter-level precision; and (3) verifying digital source provenance with multi-signature validation, including the detection of AI-generated artifacts. Moving beyond traditional external statistical comparisons, this internally consistent, physics-driven approach aims to produce a quantitative Data Quality Index that enhances trust, ensures high standards for critical applications, and significantly improves the reliability of downstream analysis methods. This methodology represents a step toward a new epoch of high-integrity hyperspectral data validation.

NOAA's SatBathy Desktop Tool

Gretchen Imahori, NOAA

NOAA has officially released the SatBathy software tool. This NOAA software tool automates the creation of Satellite-Derived Bathymetry (SDB), which consists of depth information retrieved from multispectral satellite imagery. SatBathy provides aGraphical User Interface (GUI), along with advanced processing capabilities to improve the speed, accessibility, and quality of SDB products. This tool is developed from open source programming languages and uses 10 meter resolution multispectral satellite imagery from the Copernicus Sentinel-2 mission and the ACOLITE atmospheric correction processor.

The methodological foundation of SatBathy involves a multi-temporal SDB approach. This includes an atmospheric correction process, a physically-based algorithm, and a multi-scene compositing method to address turbidity effects. A switching model is also utilized for improved mapping in shallow waters. The tool is designed to minimize manual input, requiring users only to define a time range for imagery and perform a simplified calibration process.

The SatBathy GUI enables users to generate Areas of Interest (AOIs) dynamically, query and preview imagery across various time frames, adjust for cloud coverage, and access image metadata. Moreover, SatBathy can convert “pseudoâ€� bathymetry (pSDB) outputs into actual bathymetric measurements (SDB in meters relative to a datum) through an automated vertical referencing step that correlates pSDB with reference data data.

This presentation will detail the functionalities of the SatBathy desktop tool and future endeavors. It will also highlight ongoing research activities that are contributing to the enhancement and evolution of the SatBathy framework.

Geometric Correction and Radiometric Validation of Landsat Lunar Images

Jie Shan, Purdue University

Lunar observations provide a highly stable reference for on-orbit radiometric monitoring of Earth-observation satellites. This study develops a rigorous geometric correction framework that reconstructs lunar imagery at the detector level by modeling each sensor's line-of-sight intersection with the lunar surface. The corrected images yield near-circular lunar disks with sub-pixel consistency across bands and SCAs. We then compute disk-integrated irradiance and compare it with the ROLO model to evaluate spectral, temporal, and inter-SCA radiometric behavior. The resulting irradiance ratios exhibit consistent spectral shapes with inter-band standard deviations of 0.03–0.04 and absolute deviations of approximately 4–16% from the ROLO predictions, in agreement with the expected band-dependent uncertainties. We will present our results using 4 days of Year 2024 of Landsat 8 and 9 lunar images.

TECHNIQUES & TOOLS

Effective spatial resolution of a satellite image with a few to tens of meter GSD using causeways

Minsu Kim, KBR

A satellite image has its nominal pixel size, which is ground sample distance (GSD). However, the effective pixel size can be quite different and it may be estimated by the point spread function (PSF) of the overall system (optical system, photo detector response, and electronic system response). For sensors with large GSD pixel (several to tens of meters), conventionally bridges are used. A generic algorithm to be applicable to any sensor was developed. An optimization method finds an optimal set of all physical bridge dimensions, orientations, and reflectances of bridge surface and background water. The subsequent characterization of line spread function (LSF) or modulation transfer function (MTF) are performed using the PSF. The main point of this presentation is to suggest several methods of quality assessment of the results. Once all physical parameters are provided, an optical PSF value that closely mimics the observed satellite image of the causeway will be estimated in most cases. However, it is known for an empirical fact that the physical parameters and the quality of the satellite image are so sensitive to the FWHM estimation that the quality of estimated FWHM is often not well controlled, thus the quality of the result is questionable in many cases. The evidence is a large dynamic range of estimated FWHM from many samples. Thus, we present several complementary methods in addition to the RMSD to guarantee the quality of the results. The spatial analysis results for Landsat OLI and Sentinel-2 MSI are to be presented.

NASA's CSDA Evaluations of True Spatial Resolution

Alana Semple, SSAI/NASA

Disaster tracking and science research are incorporating more commercially sourced satellite-based earth observations in their work. When deciding which sensor to use for their study, users often consider image spatial resolution a determining factor. Unfortunately, there is a misunderstanding for users about image spatial resolution, the fact that pixel size is not always equivalent to image resolution. In commercial imagery, the delivered image's true spatial resolution is often much coarser than the image pixel size.

As geometric quality assessors on NASA's Commercial Satellite Data Acquisition (CSDA) Program, we have evaluated many commercial images for their true sensor spatial resolution. Our evaluations of very high resolution (<5â€¯m pixels) images include spatial resolution assessments of BlackSky's Globals, Planet's SuperDoves, Vantor's WorldView-2 and -3, and most recently Satellogic's NewSat MarkIV and MarkV. We have expanded this evaluation to include the methane-detecting GHGSat (~30m pixels) images.

Results from our evaluations show that none of the commercial images have a pixel grid that matches the true sensor system spatial resolution, but some images are closer than others. The closest pixel grid to true image resolution (least oversampled) are Worldviews-2 and -3 as well as the RGB bands in Satellogic's MarkIV generation of NewSats. Following that is Satellogic's MarkIV NIR band, GHGSat, BlackSky, and Planet's Dove-R images that have a true resolution just over 2 pixels oversampled. Finally, Satellogic's MarkV generation of NewSats and Planet's Superdove images that have true resolution of 3 or more pixels oversampled.

JACIE Data Quality Assessment Interoperability with EDAP+ and Progress Toward a Landsat EDAP+ Evaluation

Jeffrey Clauson, U.S. Geological Survey (USGS)

The ESA-NASA "Earth Observation Mission Quality Assessment Framework - Optical Guidelines" establishes a standardized approach to evaluate the quality of commercial Earth Observation (EO) data. The framework consists of a two-part assessment: 1) Documentation Review: Examines mission documents to assess data quality. and 2) Detailed Validation: Quantitatively assesses data products against stated performance metrics. The results are compiled into a Quality Assessment Report and a color-coded Cal/Val maturity matrix, which visually summarizes the assessment results. The JACIE Data Quality Assessment process aligns with the ESA-NASA EDAP+ framework in several ways, especially in the areas of geometric, radiometric, and spatial validation. However, there are also differences. This talk provides an update to the steps being taken to align the JACIE Data Quality Assessment and EDAP+ processes to enable a Data Provider to use a JACIE Data Quality Assessment Report information in the fulfillment of the independent system evaluation requirement for the EDAP+ validation component. Also, to better understand the EDAP+ processes, the USGS ECCOE Project System Characterization Team and Landsat Cal/Val Team have been performing an EDAP+ evaluation for Landsat.

A laboratory-based spectrometer intercomparison for the measurement of snow spectra

Christopher Crawford, U.S. Geological Survey Earth Resources Observation and Science Center

Seasonal snow is an integral component of global hydrological systems, global energy budget and Earth's climate. As an important part of many Earth systems, seasonal snow is also a crucial source of water for many human populations and ecosystems around the world. As such, the measurement of seasonal snow and characterization of uncertainty in those measurements is crucial. To elucidate potential uncertainty attributable to commonly used field spectrometers (and to a lesser extent imaging spectrometers) and associated reference panels, this work presents results from an intercalibration experiment conducted synchronously with the NASA 2023 Snow Experiment (SnowEx) Albedo campaign near Fairbanks, Alaska USA. Three sets of experiments were carried out under controlled laboratory conditions to characterize the radiometric and spectral wavelength consistency of the instruments as well as the white reference panels used to calculate reflectance from field measurements. Although there was generally good agreement between the instruments, panels, and the references, there were also some notable differences. One instrument showed an average -74 percent change from the reference for radiance, and multiple instruments exceeded the suggested 0.5 nm threshold for spectral wavelength scale. This presentation will describe recent findings from Roberts-Pierel et al. (2026) published in Cold Regions Science and Technology to improve future field remote sensing campaigns and general use/maintenance of these high-precision scientific instruments.

An Overview of the RIT Open Community eXperiment (ROCX 2025)

Nina Raqueno, Rochester Institute of Technology

In an era of abundant Earth observation imagery, there remains the need for coincident ground-truthed datasets to validate algorithms and evaluate sensor performance. At the JACIE 2024 Workshop, RIT initiated a Call for Interest from the remote sensing community to participate in a field campaign to address this need. A working group was established for the RIT Open Community eXperiment (ROCX) 2025 which quickly grew to include over 100 individuals from more than 50 organizations. Participants proposed ground experiments and requirements were matched with potential data providers.

During September 4-18, 2025, 20 ground experiments and 15 data collection activities were conducted in Rochester, New York. Assets focused on this site to collect imagery from 6 satellite providers, 2 aerial platforms, 8 UAVs, and several ground-based instruments to capture a diverse set of modalities including multispectral, hyperspectral, thermal, polarized, and RGB basemap imagery, as well as lidar. Ground instrumentation included field spectrometers, all-sky imagers, a meteorological station, and a sun photometer to measure atmospheric transmittance. As part of the ground experiments several targets of various compositions and sizes were deployed throughout the site, and a centralized calibration row was established that contained several targets provided by Labsphere and the UAS teams.

Data acquired during ROCX 2025 are now being compiled with a plan for posting on an open access website. This will include compilations of the remote sensing and ground truth data sets provided by the data collection activities as well as data packages provided by the individual ground experiment PIs.

Expanding the SPARC/FLARE Methodology: Toward a Unified Point Source Irradiance-Based Calibration Metric for Earth Remote Sensing Systems

Stephen Schiller, Self/CalVal Research

Accurate radiometric calibration remains a central challenge for achieving quantitative consistency across Earth-observation systems spanning drones, UAVs, aircraft, and satellites. The Ground-to-Space Calibration Experiment (G-SCALE; Russell et al., 2023) demonstrated a unified cross-platform approach using specular mirror targets, including the SPecular Array Radiometric Calibration (SPARC) method and its commercial implementation, FLARE. Traditionally, sensors calibrated with mirror targets express pixel digital numbers in terms of equivalent radiance within their own operational domains, limiting cross-platform comparison and traceability. This work revisits and generalizes the calibration framework by defining calibration fundamentally in terms of irradiance at the sensor apertureâ€”the radiometric quantity that directly drives detector response. When SPARC/FLARE mirrors are treated as controlled irradiance sources, calibration becomes physically complete and naturally scalable to any geometry, altitude, or spatial resolution, enabling deployment through global or on-orbit networks (e.g., NIST CANDLE, NASA Landolt). Sensor-received irradiance is computed from the mirror intensity spectrum via the inverse-square law, including mirror configuration, reflectance, distance, and atmospheric transmittance. This maintains full SI-traceability through daily Top-of-Atmosphere solar irradiance from the NIST-calibrated TSIS-1 spectroradiometer aboard the ISS, establishing a consistent reference chain across all platforms. An irradiance-based form of the Zero Airmass Response Constant (ZARC) is introduced to normalize sensor response as if imaged under zero-airmass conditions, providing a common calibration metric from drones to satellites. This formulation extends G-SCALE toward a unified, SI-traceable calibration framework. Application of this inter-sensor calibration method (iSPARC) will be presented using data that includes the ROCX 2025 field campaign.

THERMAL

Geometric Calibration of Hydrosat Data Products

Ian McGreer, Hydrosat

Hydrosat collects thermal infrared, visual, and near-infrared imagery of the Earth's surface from a pair of satellites in low Earth orbit. The two satellite buses differ in their design and operation, but each hosts a dual-sensor payload consisting of a thermal infrared camera (2 bands in the range 10.6-12.5um) and a visual/near-infrared camera (7 bands in the range 450-900nm). We describe the geometric calibration procedure used to improve the geolocation accuracy of the images during processing. This procedure registers the red band visual image to the Sentinel Global Reference Image, then aligns the 11um thermal image to the visual image. Band-to-band registration additionally improves the relative alignment between the bands within each instrument. The geolocated image products include surface reflectances and brightness temperatures obtained from single bands, as well as derived products such as land surface temperature that combine bands. We demonstrate that the geolocation accuracy achieved in the final image products is sufficient to support Hydrosat's mission to provide high-resolution thermal infrared data for diverse use cases in agriculture, forestry, urban heat, energy, and defense.

Status and Progress in the Cal/Val activities and Data Quality of the thermal and VNIR Constellation HiVE

Andreas Brunn, constellr GmbH

constellr is a new space company at the forefront of delivering daily, global surface temperature (ST) data for agriculture, intelligence, defence, urban planning and other applications with the requirement for high spatial, temporal and spectral resolution data.

For this purpose constellr has launched 2 satellites of his HiVE (High-precision Versatile Ecosphere monitoring mission) constellation in January and June of 2025 with more satellites planned to be launched from 2026 onwards. Each of these cutting-edge 100kg class satellites is equipped with a cryocooled 4-band thermal camera and a visible/near-infrared COTS imager that replicates the Sentinel-2 bands below 1Âµm. While the VNIR images are mainly used to support atmospheric correction, on-the-fly emissivity estimation and precise geolocation, the main imager (TIR) data will be used to provide high accuracy (2K) surface temperature data. After the full deployment of the st gen constellation, it will be capable of accessing any place on earth on a daily basis.

The proposed presentation will, besides a brief introduction into the HiVE system, planned schedules and available products, present the procedures and results of the commissioning campaign of both satellites. Special emphasis will be laid on the initial and operational calibration activities and results as well as on the cross calibration between the 2 satellites already in orbit.

Radiometric Calibration and Validation of Hydrosat's Dual-Payload Thermal Missions for High-Resolution Land Surface Temperature Retrieval

Tania Kleynhans, Hydrosat

Hydrosat's mission to deliver high-resolution, daily land surface temperature (LST) data began with the launch of its first pathfinder satellite, VanZyl-1, in August 2024, followed by a second mission, VanZyl-2, in July 2025. Both ESPA-class SmallSats carry an identical dual-sensor payload, which includes a Longwave Infrared Imaging Radiometer (LIRI) and a multispectral VNIR sensor (VIRI). This presentation focuses on the radiometric calibration and validation of the LIRI thermal payload, which provides a native 70-meter ground sampling distance and is designed for precision thermal measurements.

Each LIRI instrument is equipped with an onboard blackbody, to support calibration for the Level-1 radiance product. Due to onboard data rate constraints, a two-point Non-Uniformity Correction (NUC) and time-delay integration (TDI) are applied in orbit prior to ground-based radiometric calibration. Validation of the LIRI data products leverages ocean buoy bulk temperature measurements, converted to skin temperature, and then modelled to band-effective at-sensor radiance using radiative transfer modeling. Land surface temperature validation is conducted using both ocean buoys and land calibration sites from the Surface Radiation Budget (SURFRAD) network. Near coincident Landsat collects additionally informs trends and large-scale analysis.

These efforts support Hydrosat's broader goal of deploying a satellite suite to provide daily thermal data. The calibration and validation framework presented here demonstrates Hydrosat's commitment to delivering reliable, high-resolution thermal data in support of precision agriculture, water resource management, weather resilience, global food security, and sustainable land management initiatives.

Landsat TIRS L1T Product Radiometric Pixel Uncertainty Update

Robert Ryan, Innovative Imaging & Research

Scientists from USGS, KBR, RIT, and I2R are developing algorithms to quantify Landsat Level 1 and Level 2 radiometric uncertainty on a per pixel basis, extending earlier work on OLI to now include TIRS. This paper emphasizes TIRS specific considerations and highlights key differences between OLI and TIRS that affect both radiometric uncertainty and downstream product quality. Per pixel uncertainty products enable end users to evaluate the radiometric accuracy of each pixel, and assess surface reflectance and surface temperature product quality. As part of this effort, we performed detailed L1R uncertainty analyses based on per detector radiometric calibration of TIRS Bands 10 and 11, including the impacts of NIST blackbody calibration mismatch. Additional TIRS specific contributors include linear interpolation in the radiance LUT, background variation, stray light correction, and noise equivalent radiance propagation through L1T interpolation. This work has been extended so that total L1R radiometric uncertainty is computed using a GUM compliant approach that combines Type A and Type B components, including bias terms that reveal potential opportunities for Collection 3 algorithmic refinement. The resulting framework is compatible with the existing OLI per-pixel uncertainty methodology and is structured to identify future Collection 3 enhancements, including the correction of known biases.

On-Orbit Radiometric Calibration and Validation of the FireSat0 Instrument

Stephen Maxwell, Muon Space

The FireSat mission, led by the Earth Fire Alliance and designed and operated by Muon Space, is a purpose-built satellite constellation for equipping first responders, incident commanders, fire modelers and scientists with next-generation wildfire awareness from low Earth orbit. The eventual constellation will offer global coverage on a 20-minute cadence over five bands spanning the red to the thermal infrared. In early 2025, the FireSat program launched the first satellite in this mission, FireSat0, to demonstrate the technology and develop the operational and scientific methodology to ensure that the constellation will produce data of the highest quality.

This presentation will detail the calibration and validation procedures established for FireSat0, which are based on an on-board calibrator, dark sky collects, vicarious calibration via RadCalNet, inter-satellite comparison using simultaneous nadir overpass, comparison with airborne platforms, as well as lunar calibration. We will present initial on-orbit performance results from FireSat0, demonstrating the radiometric accuracy and stability achieved through this framework. We will also discuss how these procedures are being automated and scaled to maintain calibration and interoperability across a multi-satellite constellation, ensuring the delivery of decision-quality data for fire management, scientific, and national security end-users.

Calibrating and Validating Satellite Datasets using the JPL Mid and Thermal Automated Radiometer Network aka Hooknet

Simon Hook, NASA/JPL

Post-launch calibration and validation of satellite instruments is needed to enable measurements from different satellites to be inter-compared and used seamlessly together. To help address this need we have established a set of automated validation sites where the necessary measurements for validating mid and thermal infrared data from spaceborne and airborne sensors are made every few minutes on a continuous basis.

We have established automated validation sites at several locations including Lake Tahoe CA/NV, Salton Sea CA, and Russell Ranch CA which have been operating for several decades. Recently we have started to expand the network by providing the same JPL developed radiometers to other operators of validation sites. The sites include La Crau, France, Venice Lagoon, Italy and Lake Constance, Switzerland, with several additional sites planned for the future. The Lake Tahoe site was established in 1999, the Salton Sea site was established in 2008 and the La Crau site was established in 2023. Each site has one or more JPL custom-built highly accurate (50mK) radiometers measuring the surface skin temperature. All the measurements are made every few minutes and downloaded hourly via the internet or a cellular modem.

Data from the sites have been used to validate numerous satellite instruments. In all cases the standard products have been validated including the standard radiance at sensor, radiance at surface, surface temperature and surface emissivity products.

We will present results from the validation of the mid and thermal infrared data using the automated validation sites.

Calibration and Performance of OroraTech's Level-1 Thermal Data Products

Andrea Spichtinger, OroraTech

Rapid, high-quality thermal Earth observation is increasingly vital as climate change intensifies wildfires, droughts, and land degradation. To provide persistent thermal monitoring, OroraTech is deploying a global constellation of 100 thermal payloads with a 30-minute revisit time. At its core is SAFIRE, a compact thermal imager based on uncooled microbolometers. Operating without internal blackbodies to minimise mass and power, SAFIRE requires a novel vicarious calibration strategy, further challenged by orbit configurations that lack high-resolution reference missions.

We present an integrated calibration and validation framework to ensure radiometric fidelity across the constellation. Low-temperature calibration is derived from deep-space acquisitions, enabling modelling of sensor self-emission. High-temperature calibration relies on Lunar observations and a thermo-physical Lunar model, achieving consistent performance across more than 50 observations per band with an RMSE of 2.3%. Detector nonuniformities are stabilised using flatfields generated from large ensembles of Earth-view acquisitions. Cross-calibration with VIIRS, ECOSTRESS, GOES-ABI, and MTG-FCI refines scene-dependent biases and constrains our straylight model. Resulting Level-1 products achieve radiometric accuracies better than 1.5 K in the LWIR and 3.2 K in the MWIR, with a geolocation accuracy of 350 m.

This framework enables scalable calibration of uncooled thermal imagers and advances persistent global thermal monitoring for climate-driven hazard response.

HotSat imagery and calval activities - ensuring product quality at SatVu

Joshua Chadney, SatVu

SatVu's planned constellation of mid-wave infrared imagers, the HotSats, will deliver the highest spatial resolution thermal infrared data available on the commercial Earth Observation market. Following the launch and acquisition of a data archive from HotSat1, future HotSat's commissioning and cal/val activities have been scoped such that onboarding them into the constellation will be seamless.

Within this presentation, first light results from HotSat2 and it's commissioning will be explored, as well as how lessons learned from HotSat1 have informed our decision making on ensuring our imagery is of the highest quality, and meets the specifications outlined in our documentation. These results and subsequent testing comprise the product quality assurance reports – the core of SatVu's cal/val planning – with this contribution covering deep dives on their results, with assessments on both geometric (using Sentinel2 as a primary reference) and radiometric (using VIIRS as a primary reference) characteristics of both HotSats 1 and 2. Regression cal/val testing throughout the lifetime of the HotSats will be explored in the context, with a view to detection of any change in behaviour.

Lastly, SatVu's ambition to become a Luno partner with other data providers from the industry will be presented, with key use cases being highlighted and the synergistic nature of the HotSat imagery shown.

FireSat: From Orbit to Action

Michael Falkowski, Earth Fire Alliance

Escalating wildfire activity demands faster, more transparent, and more collaborative access to actionable fire data. Earth Fire Alliance (EFA), a community-led nonprofit organization, is developing FireSat, a satellite network specifically for wildfires that will provide timely and trustworthy data directly to agencies around the world that protect their communities. With a strong emphasis on usability and open access, FireSatwill deliver high-cadence thermal and multispectral imagery to support early detection, active fire characterization, fire behavior modeling, and ecosystem and climate impact assessment on a global scale.

Following the successful launch of the FireSat0 protoflight satellite in March 2025, the system has begun capturing global wildfire imagery to validate sensor performance, data pipelines, and user workflows. Through EFA's Early Adopter Program, agencies and researchers worldwide are co-developing and testing FireSat data products in operational contexts. These collaborations are generating critical insights into usability, data accuracy, and the integration of satellite data into local, national, and regional decision-support frameworks.

This presentation will provide an overview of EFA and our FireSat Program, showcase FireSat0 imagery, and outline next steps and progress toward the launch of the first three operational FireSat satellites in mid-2026.

TRUST, TRACEABILITY, & STANDARDS

US Engagement with Technical Content for International Geospatial Standards

David Stolarz, GeoSDO

The Technical Committee (TC) 211 of the The International Organization for Standardization (ISO) is focused on geospatial standards for Geographic Information and Geomatics at the international level. The National Standards Body (NSB) that is tasked by the American National Standards Institute (ANSI) with representing US interests at those meetings and on the national level is the Geographic Information Systems (GIS) section of the InterNational Committee for Information Technology Standards (INCITS).

Do you want to learn more about how GIS, Remote Sensing, IoT, and other systems work together? Do you want to learn what it takes to write international standards while serving as a diplomat and ambassador based upon your professional body of knowledge? Then this session is for you!

At abstract submission time, 27 ISO standards are under development or revision, including projects on metadata, imagery and gridded data, registration and register governance, the Land Administration Domain Model (LADM), building information modelling (BIM) to geographic information systems conceptual mapping, UML modelling, imagery sensor models for geopositioning - Part 2: SAR, InSAR, lidar and sonar; and more.

In addition, INCITS members fulfill liaison roles with ICAO, UN-GGIM, CEOS/WGISS, FIG, IEEE, WMO, and internally to ISO on unmanned aircraft systems, smart cities, AI, space systems and operations, environmental management, sustainable communities, data-driven agrifood and smart farming, with a current vacancy in ISO/TC 172/SC 6 - geodetic and surveying instruments.Â

Innovators and implementers at all levels of professional expertise are greatly appreciated. Please attend this session to learn how to contribute.

Landsat Next Near-lossless Image Compression Strategy

Matthew Montanaro, NASA Goddard Space Flight Center

The upcoming NASA/USGS Landsat Next mission will provide a significant increase in the number of spectral bands and spatial resolution compared to previous Landsat missions. With a resulting data volume approximately six times greater than legacy missions, image compression will be necessary to efficiently store and downlink all science data to ground stations. Previous Landsat missions have incorporated lossless compression schemes. However, Landsat Next will require slightly lossy (i.e., near-lossless) compression to produce enough compression performance to compensate for downlink bandwidth restrictions. Although the Landsat user community is understandably cautious about lossy compression, it is possible to constrain the maximum loss, or error, introduced during compression, ensuring that any added error remains within the intrinsic noise level of the instrument. The Consultative Committee for Space Data Systems image compression standard, CCSDS 123.0-B-2, was chosen for the Landsat Next mission because it is an open-source, internationally supported standard suited for integration with space hardware, and it allows control over the magnitude and distribution of compression error. Using several surrogate Landsat Next image datasets, an investigation was performed to determine a preliminary set of parameter values that would keep the added compression error within acceptable limits. The results of these studies demonstrate that near-lossless image compression can be utilized by the Landsat Next instruments to store and downlink all science data without compromising image quality or mission requirements.

Advances in Commercial EO Imagery Product Standards

Monica Rios, NGA/ QS

For the last 1.5 years, NGA/QS, i.e., the Sensors and Ground Innovation Office in the National Geospatial-Intelligence Agency's (NGA) GEOINT Innovation & Research Directorate, has fast-tracked improving the requirements for electro-optical (EO) imagery delivered by commercial data providers (CDPs) to the National System for Geospatial Intelligence (NSG). Although the panchromatic (pan) and multispectral imagery (MSI) requirements for still imagery of the Earth remain essentially unchanged since about 2006, as documented in the NITF Commercial Dataset Requirements Document for Electro-Optical Imagery (NCDRDEO, STDI-0002 Vol. 2), the NGA has created requirements for non-Earth commercial still imagery, documented in the NCDRDNEI (Vol. 4) and for hyperspectral imagery (HSI) of the Earth, documented in the NCDRDHSI (Vol. 5). Both the NCDRDNEI and NCDRDHSI are based on functional requirements for the imagery products. As a result, the NCDRDHSI is based on the Spectral NITF Implementation Profile (SNIP, NGA.STND.0072), which is the DoD and Intelligence Community (IC) mandated standard for MSI and HSI products. Also, the NCDRDNEI includes the SNIP spectroradiometric requirements plus sensor geometry model information specific to observations of space objects. To facilitate implementation of these commercial imagery requirements, NGA has stood up the SNIP Implementation Working Group (SIWG), a (usually) monthly forum that provides guidance for implementing the SNIP as well as Q&A sessions with EO imagery stakeholders.

Towards a Scalable, Trust-Based Certification System for Earth Data

Zorana Jelenak, UCAR/UPC/CPAESS

The rapid growth and diversification of commercial and non-traditional Earth observation data has created a critical challenge: the absence of a trustworthy market signal for data quality. International Cal/Val standards exist, but there is a significant gap in procedural governance, specifically, a lack of systems to enforce and translate these standards into certified, verifiable processes. Without a neutral and trusted mechanism to signal quality, vendors struggle to differentiate their products, and government users face uncertainty and mistrust.

Current calibration and validation efforts are often mission-specific and focus on instrument capabilities rather than application-based fitness-for-purpose. The lack of open, standardized, and trusted procedures results in siloed and duplicative validation efforts, slowing the transition of data from research to operations. At the same time, existing pricing practices fail to reward investments in improved data quality and maturity, hindering the development of a robust Earth observation data ecosystem.

This paper proposes a Unified Cal/Val Framework to remove procedural friction and restore trust. The Framework is grounded in open standards that enable broad participation in Cal/Val, fostering both expertise and competition. A neutral implementation authority defines and publishes Application-Specific Performance Thresholds (ASPTs), concrete quality targets that establish fitness-for-purpose, and scores products based on measured performance against these ASPTs and adherence to standardized, independent Cal/Val procedures. By creating a certified maturity score that can be used by buyers and vendors to set prices, the Framework introduces a critical market mechanism, aligns incentives toward quality investment, and accelerates the delivery of trusted, application-ready data.