香港工程測量師學會
THE HONG KONG INSTITUTION OF ENGINEERING SURVEYORS

FIG WORKING WEEK 2025
Delegate Report
Summary and Learnings

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香港工程測量師學會
THE HONG KONG INSTITUTION OF ENGINEERING SURVEYORS

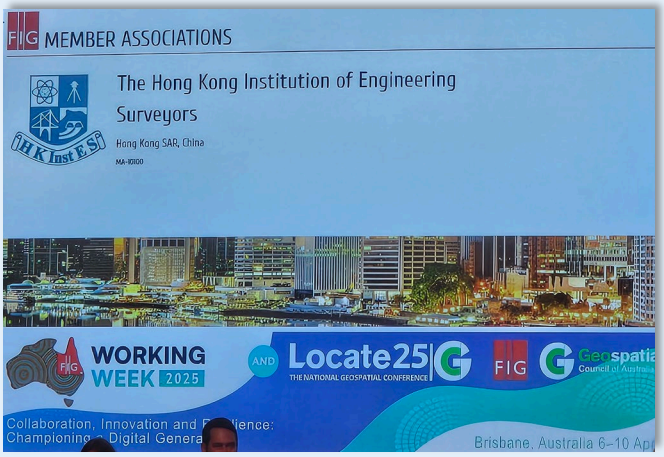
FIG Working Week 2025

(Left to Right) Kathy NGAN, Chris NG, Winnie SHIU, Freddy HO and Bernard LEE

The FIG Working Week 2025, themed "**Collaboration, Innovation and Resilience: Championing a Digital Generation**" emphasizes sustainability, digital transformation, and resilience in the surveying and geospatial profession.

FIG President Diane Dumashie (2023-2026) highlighted the need for collaborative, innovative, and sustainable actions to address global challenges like climate change, technological advancements, and inclusivity.

The conference focused on political, economic, social, and technological trends, emphasizing new technologies, professional competencies, and sustainable practices. By championing partnerships, particularly with indigenous communities, and leveraging geospatial data, **FIG (International Federation of Surveyors)** aims to enhance its relevance and impact in the digital age, aligning with the UN Sustainability Agenda.



We are one of the FIG Member Associations

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This year, the international FIG program was held in conjunction with the Geospatial Council of Australia's annual Locate conference, creating a truly remarkable and unified event.

The theme for this Working Week, "Collaboration, Innovation and Resilience: Championing a Digital Generation" reflects a forward-looking vision aimed at ensuring FIG remains relevant and impactful on the global stage. It emphasizes the need for collaboration, innovation, and sustainable action—not only for the benefit of FIG members but also in partnership with the wider international community, especially in the face of pressing climate challenges.

This theme also aligns closely with the Geospatial Council's top priorities, which include climate action, sustainability, the United Nations **Sustainable Development Goals (SDGs)**, the transformative power of geospatial technologies, and promoting diversity within the professional workforce. It highlights FIG's vital role in connecting surveyors across cultures and disciplines, fostering an inclusive and future-ready profession.

Sustainable Development Goals

Agenda

The 48th FIG General Assembly, convened on April 6 and 10, 2025, at the Brisbane Convention & Exhibition Centre, Australia, coincides with the FIG Working Week 2025, themed "Collaboration, Innovation and Resilience: Championing a Digital Generation.“

Chaired by FIG President Diane Dumashie, the assembly addresses critical governance and strategic priorities. Key activities include electing Chairs Elect for ten FIG Commissions (2025-2026), with a competitive election for Commission 3, and selecting the host for the 2029 Working Week, with bids from Halifax, Canada (Canadian Institute of Geomatics) and Kampala, Uganda (Institution of Surveyors of Uganda). Voting, conducted online via SimplyVoting, also covers proposed changes to FIG Internal Rules to adjust the timing of Commission Chair elections. The assembly reviewed membership issues, including admitting new members, expelling associations with arrears (e.g., Algeria, Bahamas, Sri Lanka), and suspending others (e.g., Palestine, Russia), financial reports, 2024 accounts, and budgets for 2025-2028, alongside setting 2027 subscription rates. Task forces on Sustainable Development Goals, climate action, diversity, and geospatial ecosystems presented updates, aligning with the UN Sustainability Agenda. Reports from commissions, networks, the FIG Foundation, and upcoming events (2026 Congress in Cape Town, 2027-2028 Working Weeks) underscore FIG’s commitment to advancing the global surveying profession.

Winnie SHIU (ACCO Chair (2025-2026) and FIG Vice President (2023-2026)

Report on Technical Sessions

AI and GIS Transforming the Geospatial Landscape

Introduction

AI and GIS Transforming the Geospatial Landscape," highlighted the transformative potential of artificial intelligence (AI) and geographic information systems (GIS) in the geospatial industry. Organized with contributions from Esri Australia, this session featured presentations and an expert panel discussing innovative applications of geospatial AI.

Overview of GeoAI and ArcGIS

GeoAI and ArcGIS work together to advance geospatial analysis by leveraging AI technologies. GeoAI combines artificial intelligence with geographic information systems (GIS) to process and interpret spatial data more effectively. ArcGIS, developed by Esri, is a leading GIS platform that integrates these AI capabilities to support various geospatial tasks.

GeoAI Applications in ArcGIS

ArcGIS uses GeoAI for both data extraction and analysis:

- **Data Extraction:** It employs computer vision to extract information from imagery, 3D data, and videos, such as identifying objects in satellite images. It also uses natural language processing (NLP) on unstructured text data to derive geospatial insights, like analyzing reports for location-based information.
- **Data Analysis:** Machine learning and deep learning are applied to vector data (e.g., maps with points, lines, polygons), tabular data (e.g., spreadsheets), and time series data (e.g., data over time) for tasks like classification and predictive modeling.

AI Assistants in ArcGIS

Beyond analysis, ArcGIS incorporates AI assistants to enhance user interaction. These assistants create more intuitive experiences, automate workflows, and boost productivity, with examples like ArcGIS Survey123, which helps collect and analyze geospatial data through surveys.

Broader Impact

This integration enables ArcGIS to address complex challenges, such as climate change and urbanization, by extracting data at scale and unlocking insights quickly. It advances the science of GIS, making it more accessible and efficient for users.

GeoAI and ArcGIS Integration

GeoAI, or Geospatial Artificial Intelligence, represents the fusion of artificial intelligence (AI) techniques with geographic information systems (GIS) to enhance the analysis, interpretation, and utilization of geospatial data. This integration is particularly significant in the context of ArcGIS, a leading GIS platform developed by Esri, which has increasingly incorporated AI capabilities to advance geospatial science.

Data Extraction

- **Computer Vision:** This technique is applied to imagery, 3D data, and video to extract meaningful information. For instance, computer vision can identify objects or features in satellite images, such as buildings, roads, or vegetation, which is crucial for urban planning and environmental monitoring.
- **Natural Language Processing (NLP):** NLP is used on unstructured text data to derive geospatial insights. This could involve analyzing reports, social media posts, or other textual data to extract location-based information, such as identifying disaster-affected areas from emergency reports. The slide highlights NLP's application to unstructured text, suggesting its utility in integrating textual data with geospatial analysis.

Data Analysis

- **Machine Learning and Deep Learning:** These AI techniques are employed on vector data (e.g., maps with points, lines, polygons), tabular data (e.g., spreadsheets or databases), and time series data (e.g., data collected over time). Machine learning can be used for classification tasks, such as land use categorization, while deep learning supports more complex tasks like predictive modeling for climate change impacts.

The presentation also included specific examples of GeoAI applications, such as cloud removal from satellite imagery, time-series analysis for tracking changes (e.g., deforestation rates), and segmentation for identifying specific features, all of which are facilitated by ArcGIS's integration with AI.

AI Assistants: Enhancing User Experience

Beyond data processing, ArcGIS incorporates AI assistants to create more natural and intuitive experiences for users. GeoAI and AI Assistants. Under AI Assistants, it was noted that these tools "create more natural and intuitive experiences of ArcGIS, using intelligent AI assistants and agents to empower GIS users and boost productivity." This includes automating workflows, providing intelligent suggestions, and enhancing usability.

A specific mention was made of ArcGIS Survey123, a form-centric solution for creating, sharing, and analyzing surveys, which integrates AI to streamline data collection and analysis. For example, AI assistants in Survey123 can help automate data entry, validate location data, and provide real-time insights, making it easier for users to collect geospatial data in the field.

Data Types Supported by GeoAI in ArcGIS

The presentation slides also outlined the variety of data types that GeoAI in ArcGIS can process, as shown in the following table:

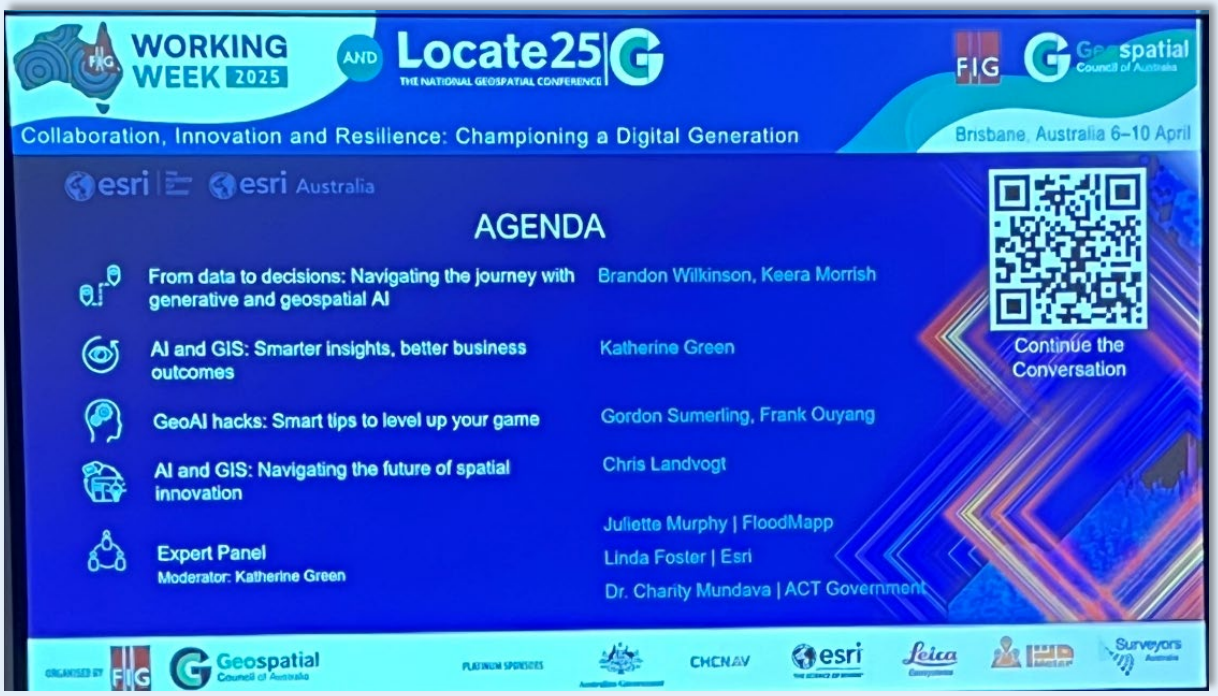
Data Type	Description	AI Technique
Imagery	Satellite or aerial images	Computer Vision
LiDAR / Point Cloud	3D laser scanning data	Computer Vision
Full-Motion Video	Video data with geospatial context	Computer Vision
3D	Three-dimensional models	Computer Vision
Tabular	Spreadsheet or database data with location info	Machine Learning
Vector	Maps with points, lines, polygons	Machine Learning, Deep Learning
Unstructured	Text data without fixed format	Natural Language Processing
Time Series	Data collected over time, e.g., climate data	Machine Learning, Deep Learning

This table illustrates the breadth of data types ArcGIS can handle, reinforcing its role as a comprehensive platform for GeoAI applications.

Broader Impact and Relevance

The integration of GeoAI in ArcGIS enables the platform to address complex global challenges, which listed areas like climate change, urbanization, natural disasters, and infrastructure. These challenges are tackled through GeoAI capabilities within the platform. For instance, GeoAI can support climate change analysis by processing time series data to predict future trends or assist in urban planning by analyzing 3D models and imagery for infrastructure development.

The session's emphasis on "advancing the science of GIS with AI, machine learning, and deep learning to enable data extraction at scale and unlock valuable insights faster than ever" underscores ArcGIS's role in making geospatial analysis more efficient and scalable. This is particularly relevant for professionals in fields like environmental science, urban planning, and public safety, where rapid insights can inform decision-making.



DigitalCities4Us and Leica Geosystems

The integration of digital twin technology in urban planning represents a transformative approach to creating inclusive and sustainable cities. The DigitalCities4Us project, spearheaded by Hexagon and the University of Applied Sciences and Arts Northwestern Switzerland (FHNW), exemplifies this innovation, with a focus on enhancing accessibility in urban environments like Basel. Leica Geosystems, a key player under Hexagon, provides critical technological support. Additionally, the FIG Working Week 2025 in Brisbane offered a platform to showcase such advancements in the geospatial industry. This report synthesizes information from project details, presentations, and event insights to address the role of digital twins, Leica's contributions, and the broader context of geospatial collaboration.

DigitalCities4Us Project Overview

The DigitalCities4Us project, active from 2023 to 2025, aims to leverage high-resolution 3D point cloud data to create digital twins for urban planning, with a particular emphasis on accessibility for individuals with mobility restrictions. The project encompasses multiple disciplines, including Building Information Modeling (BIM), Geovisualization, Infrastructure Management, Reality Capture, Mobility, and Smart City solutions. Partners include Hexagon and Leica Geosystems, with FHNW leading research efforts (DigitalCities4Us).

Applications in Basel

In Basel, the project has surveyed key areas such as Barfüsserplatz, as highlighted in a blog post dated February 27, 2024. These surveys generate detailed 3D geodata, enabling barrier-free route planning and inclusive urban design. The digital twin of Basel supports accessibility analyses with precision ranging from millimeters to centimeters, facilitating informed urban planning decisions.

Broader Applications

Beyond Basel, the project's scope includes other Swiss cities like St. Gallen, where digital twins aid urban planners in visualizing transformations and gaining public support for sustainable initiatives. For instance, St. Gallen's digital twin supports simulations for urban development, as presented in project-related materials. Similarly, Munich's digital twin enhances construction site coordination, climate simulations, and cycle path planning with 3D visualization, demonstrating the versatility of digital twin applications.

Leica Geosystems' Contributions

Leica Geosystems, a subsidiary of Hexagon, plays a pivotal role in DigitalCities4Us by providing advanced sensors, software, and services (Leica Geosystems). Their technologies, such as the Pegasus Mobile Mapping System (MMS), enable efficient data collection and processing for digital twin creation. The Pegasus MMS, noted for its flexibility and safety, requires only one operator and supports on-site data processing, as highlighted in project presentations. Leica's contributions align with Hexagon's mission to foster scalable and sustainable urban ecosystems, making them integral to the project's success.

Technology in Action

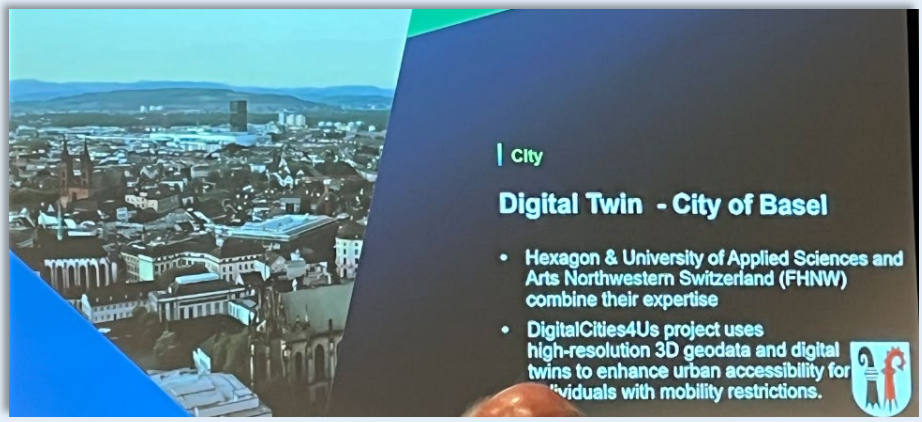
Presentations from the project showcase Leica's involvement through tools like Pegasus Two:Ultimate, Pegasus TRK, AutoTurn, and Cyclone 3DR, used for documenting road infrastructure and simulating heavy transport scenarios. These tools generate base maps for simulations, which are foundational to digital twin development. The presence of a Leica Systems banner in project events further underscores their active participation.

Digital Twins in Urban Planning

Digital twins are virtual replicas of physical environments, enabling real-time analysis and simulation. In DigitalCities4Us, digital twins facilitate:

- **Accessibility Planning**: Detailed 3D models support barrier-free route design, ensuring inclusivity for mobility-impaired individuals.
- **Urban Simulations**: Scenarios for urban transformations, such as sustainable infrastructure, are visualized to aid decision-making.
- **Infrastructure Management**: Tools like AutoTurn and 3D visualizations optimize heavy transport routes and construction coordination.

The project's use of high-resolution 3D point cloud data ensures precision, making digital twins a powerful tool for smart city development.



Resilient Champions of Surveying History

Richard Daintree: A Pioneering Surveyor

Richard Daintree (1831-1878), an English-Australian geologist, photographer, and surveyor, is a likely subject of this session. Born on December 13, 1831, in Hemingford Abbots, England, Daintree migrated to Australia in 1852 during the Victorian gold rush. He joined the Victorian Geological Survey in 1854 as an assistant geologist and, by 1859, served as a field surveyor. His routine duties included mapping and searching for gold seams, during which he pioneered the use of photography to enhance fieldwork documentation—a significant advancement in 19th-century surveying techniques.

In 1856, Daintree returned to England to study assaying and metallurgy at the Royal School of Mines Laboratory, further honing his skills. Back in Australia in 1857, he married Lettice Annes, daughter of surveyor Henry Foot, linking him to the surveying community. In 1864, he left the Geological Survey to manage pastoral properties in North Queensland, where he made several gold discoveries. By 1869, he was instrumental in establishing the Queensland government geological survey, becoming its first Government Geologist for North Queensland. His contributions are commemorated by the Daintree River and Daintree Rainforest.

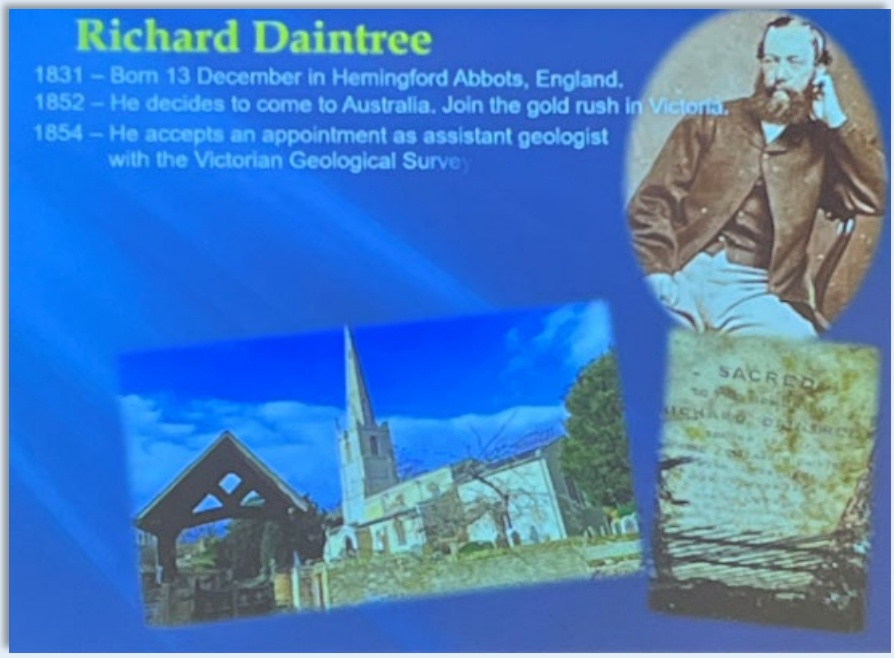
Presentation materials highlight Daintree's life through timelines, a portrait, field books from 1861-62 containing handwritten tables and maps, and his gravestone, inscribed with his name. These artifacts underscore his meticulous surveying practices and innovative use of photography, which improved the accuracy and documentation of geological and geographical data during a transformative period in Australian history.

History of Surveying: Military and Civilian Contributions

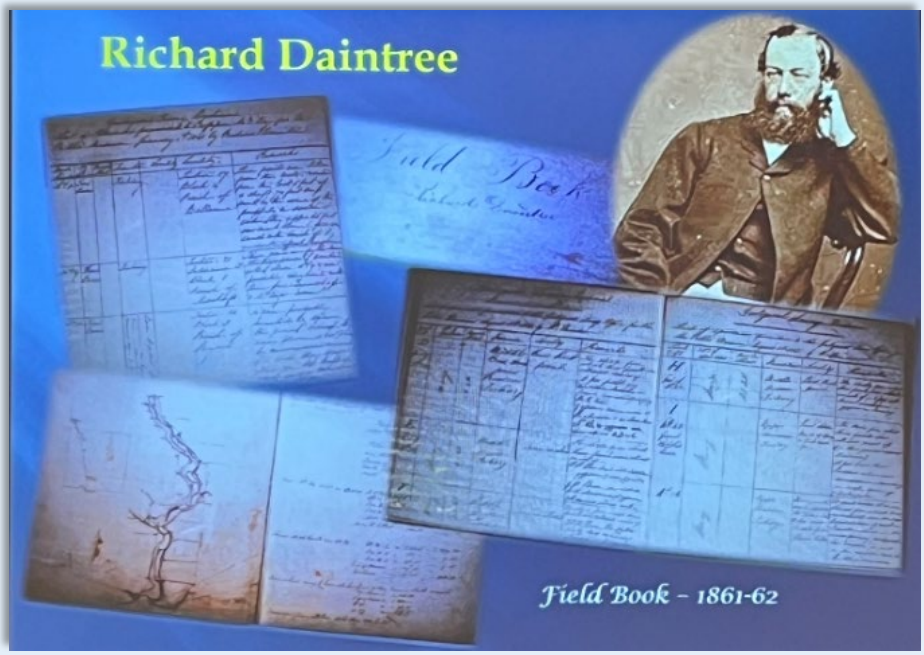
The history of surveying is deeply intertwined with both civilian and military applications, as evidenced by the session's focus. Daintree's work during the gold rush era exemplifies civilian surveying, where accurate mapping was critical for resource exploration and land development. His field books, containing detailed measurements and a hand-drawn map, reflect the labor-intensive methods of the time, relying on triangulation and manual record-keeping.

In contrast, military surveying, as hinted by McInnes's World War I connection and another slide mentioning the Survey Directorate at Victoria Barracks under Captain S.B. Ward, highlights the strategic importance of mapping during wartime. Instructions to map strategic areas of Australia underscore the role of surveyors in national defense, particularly during the early 20th century. The directorate's efforts likely involved producing maps for military planning, a critical task requiring precision and resilience under pressure.

The session likely draws on figures like Daintree, whose innovations in photography and geological surveying laid foundational work for modern practices, and possibly McInnes, whose wartime contributions reflect the adaptability required in surveying.



The theme of resilience resonates with these individuals' ability to navigate the technological and environmental challenges of their eras, from the rugged Australian outback to the demands of military strategy.



Standards in Surveying – FIG Standards Network

Introduction

"Standards in Surveying – FIG Standards Network,". This session focused on updates and discussions surrounding geospatial and surveying standards, emphasizing their role in fostering collaboration, innovation, and resilience in the global surveying community.

Session Overview

The FIG Standards Network session was designed to address critical advancements in standardization within the surveying and geospatial fields. The FIG Standards Network, established following a Task Force in 1998 and formalized in 2002, serves as a hub for FIG's standardization activities. It advises on priorities, maintains relationships with international standardization bodies, and ensures information dissemination to FIG members. The session aligned with the broader conference theme of "Collaboration, Innovation and Resilience: Championing a Digital Generation."

Agenda and Presentations

The session featured a comprehensive agenda with presentations by leading experts in the field. Below is a detailed breakdown of the topics and presenters, based on available information:

Topic	Presenter	Duration	Key Details
ISO/TC 211 Geographic Information/ Geomatics	Nic Donnelly	15 mins	Overview of ISO/TC 211, focusing on standardization of geographic information, including data management and integration with IT standards.
ISO/TC 211 Advisory Group 12: ISO Geodetic Registry (ISOGR)	Nic Donnelly	15 mins	Discussion on the ISO Geodetic Registry, a structured database for coordinate reference systems (CRS) and transformations, accessible online and conforming to ISO 19111, 19127, and 19135-1. Highlighted the 59th Plenary Meeting in Sydney (11-15 November 2024), marking ISO/TC211's 30th anniversary and a leadership transition from Peter Parslow (UK) to Sandra Branteback (Sweden).

Topic	Presenter	Duration	Key Details
ISO/TC211 19152 LADM Edition II	Peter van Oosterom	15 mins	Update on the near-complete Land Administration Domain Model (LADM) Edition II, with contributions from Christiaan Lemmen and Abdullah Kara. Noted its integration into educational curricula at TU Delft and the University of Twente, and its significance for global land administration. Referenced FIG Publication No. 84, "The Land Administration Domain Model: An Overview."
Hydrographic Surveying Standards	Geoff Ames	15 mins	Discussion on standards for hydrographic surveying, critical for marine and coastal applications.
International Property Measurement Standards (IPMS)	James Kavanagh	15 mins	Overview of IPMS, aimed at standardizing property measurement globally.
International Construction Measurement Standards (ICMS)	James Kavanagh	15 mins	Discussion on ICMS, focusing on standardized construction measurement practices.
ISO/TC 172 SC6 Survey Instrument Standards	David Martin	15 mins	Update on survey instrument standards, including ISO 12858, 16331, 17123, and 9849 series.
Standards for Survey by Drones	David Martin	15 mins	Follow-up on emerging standards for drone-based surveying, addressing technological advancements.
Any Other Business (AOB)	All	Variable	Open discussion to address additional topics or questions from participants.

ISO Geodetic Registry

Nic Donnelly's presentations provided significant insights into the ISO Geodetic Registry. The registry is a structured, online-accessible database for coordinate reference systems and transformations of international application. It conforms to ISO standards such as ISO 19111 (Spatial referencing by coordinates), ISO 19127 (Geodetic register), and ISO 19135-1 (Procedures for item registration). Donnelly showcased its functionality with examples like the New Zealand Geodetic Datum 2000 (NZGD2000), including deformation models and coordinate systems. He also discussed the 59th ISO/TC211 Plenary Meeting in Sydney, which celebrated 30 years since the committee's inception in Oslo, Norway (1994). The meeting marked a leadership transition, with Sandra Branteback succeeding Peter Parslow as chair.

Land Administration Domain Model (LADM)

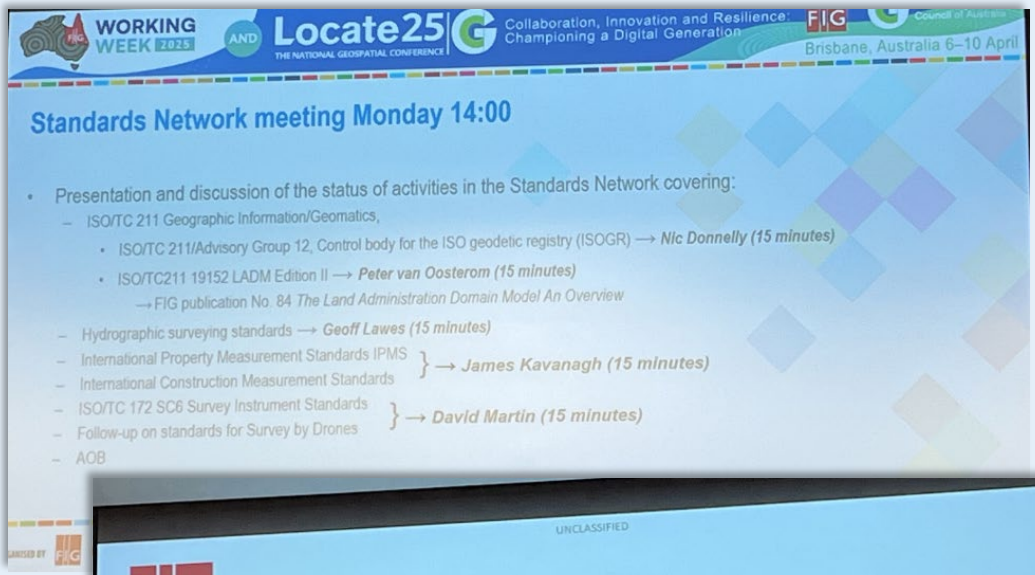
Peter van Oosterom's update on LADM Edition II was a focal point of the session. The new edition, nearing completion, builds on the ISO 19152:2012 standard and is poised to enhance global land administration practices. Collaborators Christiaan Lemmen and Abdullah Kara were acknowledged, and the involvement of organizations like kadaster and TU Delft was highlighted. LADM's integration into academic curricula at TU Delft and the University of Twente underscores its educational impact. The session referenced FIG Publication No. 84, which provides an overview of LADM's framework and applications.

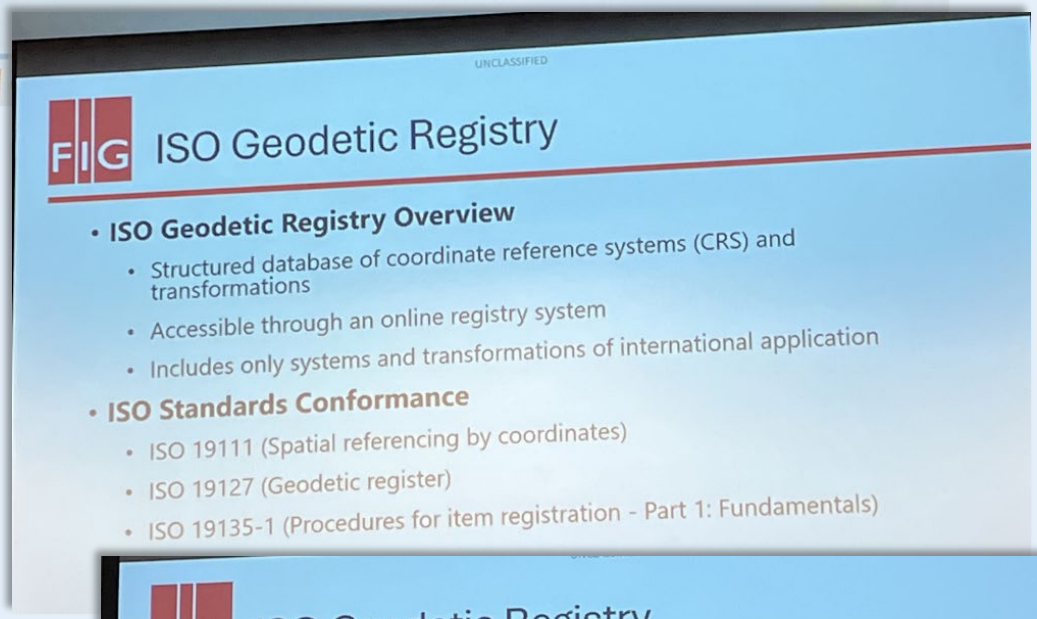
Other Standards

Geoff Ames addressed hydrographic surveying standards, essential for marine geospatial applications. James Kavanagh presented on IPMS and ICMS, which aim to standardize property and construction measurements, respectively, enhancing global consistency. David Martin covered survey instrument standards under ISO/TC 172 SC6 and discussed emerging standards for drone surveys, reflecting the integration of new technologies in surveying practices.

Context and Significance

The FIG Standards Network plays a pivotal role in advancing geospatial standardization, maintaining relationships with bodies like ISO, the Open Geospatial Consortium (OGC), and others. The session highlighted the network's efforts to ensure interoperability and consistency in geospatial data and surveying practices. The inclusion of diverse topics, from geodetic registries to drone surveys, reflects the broad scope of standardization efforts and their relevance to modern challenges in land administration, urban planning, and environmental management.


WORKING WEEK 2025
AND
Locate25
THE NATIONAL GEOSPATIAL CONFERENCE
Collaboration, Innovation and Resilience: Championing a Digital Generation
FIG
Brisbane, Australia 6–10 April
Standards Network meeting Monday 14:00
• Presentation and discussion of the status of activities in the Standards Network covering:
– ISO/TC 211 Geographic Information/Geomatics,
• ISO/TC 211/Advisory Group 12, Control body for the ISO geodetic registry (ISOGR) → Nic Donnelly (15 minutes)
• ISO/TC211 19152 LADM Edition II → Peter van Oosterom (15 minutes)
→ FIG publication No. 84 The Land Administration Domain Model An Overview
– Hydrographic surveying standards → Geoff Lawes (15 minutes)
– International Property Measurement Standards IPMS
– International Construction Measurement Standards
} → James Kavanagh (15 minutes)
– ISO/TC 172 SC6 Survey Instrument Standards
– Follow-up on standards for Survey by Drones
} → David Martin (15 minutes)
– AOB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ISO Geodetic Registry
• ISO Geodetic Registry Overview
• Structured database of coordinate reference systems (CRS) and transformations
• Accessible through an online registry system
• Includes only systems and transformations of international application
• ISO Standards Conformance
• ISO 19111 (Spatial referencing by coordinates)
• ISO 19127 (Geodetic register)
• ISO 19135-1 (Procedures for item registration - Part 1: Fundamentals)

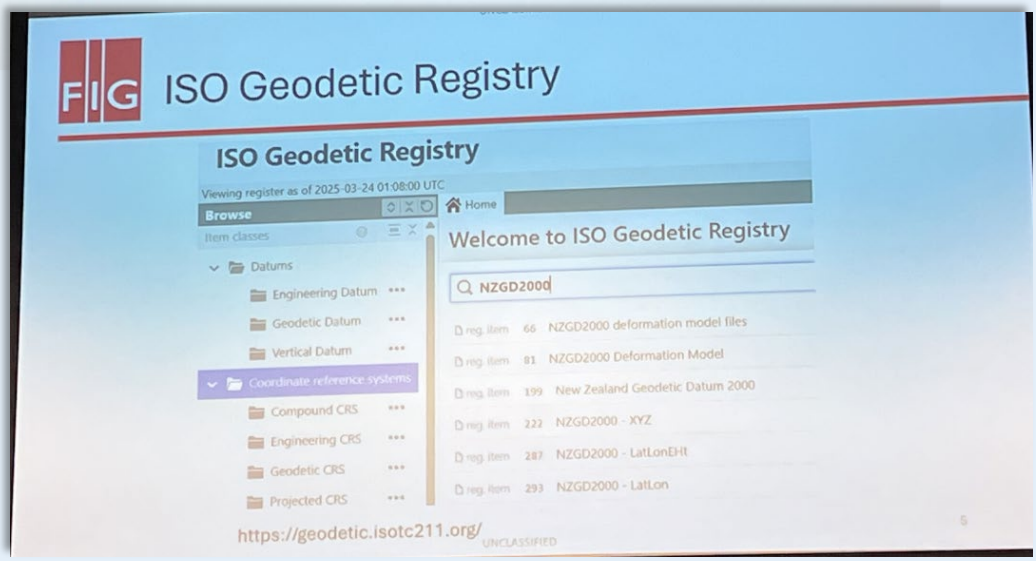
FIG
ISO Geodetic Registry
ISO Geodetic Registry
Viewing register as of 2025-03-24 01:08:00 UTC
Browse
Item classes
Datums
Engineering Datum
Geodetic Datum
Vertical Datum
Coordinate reference systems
Compound CRS
Engineering CRS
Geodetic CRS
Projected CRS
Home
Welcome to ISO Geodetic Registry
NZGD2000
66 NZGD2000 deformation model files
81 NZGD2000 Deformation Model
199 New Zealand Geodetic Datum 2000
222 NZGD2000 - XYZ
287 NZGD2000 - LatLonEHt
293 NZGD2000 - LatLon
https://geodetic.isotc211.org/
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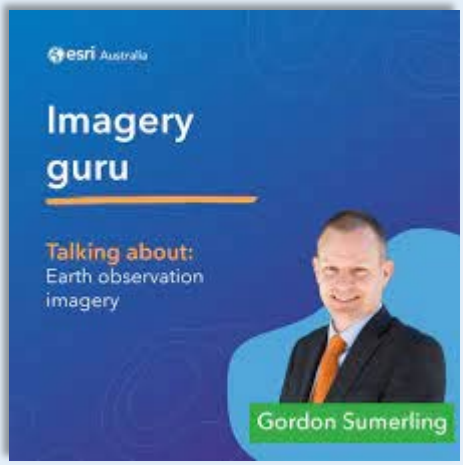
Dynamic, Open, and Accessible Earth Observation: Leveraging Imagery without the Need to Download



Gordon Sumerling, Principal Consultant at Esri Australia, presented on accessing Earth observation imagery without downloading large files. Historically, analyzing archives like Landsat (since the 1970s) required complex software and selective downloads, posing challenges in data management. Modern free, open services now enable global imagery access via web applications, allowing on-the-fly analysis directly in browsers, simplifying workflows and enhancing decision-making.

The session showcases a transformative shift from cumbersome data handling to user-friendly web platforms, democratizing access to decades of Earth observation data. It emphasizes practical tools that eliminate the need for specialized software, making geospatial analysis accessible to a broader audience.

This advancement addresses longstanding barriers in geospatial data use, particularly for non-experts. The browser-based approach is a game-changer, but the document's repetitive text obscures specific tool details, limiting clarity. Scalability for high-volume analyses or regions with poor internet access remains a concern.

Web-based Earth observation tools signal a future of inclusive geospatial analysis, but their success hinges on robust infrastructure and clear documentation. Integrating AI for automated insights could further enhance these platforms, especially for real-time applications like disaster response or urban planning.

Towards a Standard Bank of Spectral Signatures of Roof Construction Materials:

Innovation in Indirect Methods Applied to Multipurpose Cadastre from Field Spectroradiometry

Nelson Nieto, a researcher at the Geographic Institute Agustín Codazzi, presented on developing a spectral signature bank for roof construction materials to enhance cadastral updating in Colombia. Traditionally, cadastral data collection relies on field surveys, but the institute is exploring indirect methods using field spectroradiometry. The Earth Observation and Spectroradiometry Laboratory has created a database of over 200 spectral signatures from materials like ceramics, metals, plastics, and wood across five diverse Colombian regions. These signatures, integrated with satellite and aerial imagery, enable analysis of rooftop composition and property conditions, aiding radiometric correction, classification, and cadastral valuation, while supporting urban planning and climate adaptation.

The initiative's database, covering diverse materials and regions, showcases innovative use of hyperspectral data for cadastral purposes. Its integration with Earth observation imagery offers scalable solutions for property valuation and risk management.

This approach modernizes cadastral systems, but challenges like data standardization and accessibility in remote areas need addressing. The document lacks details on methodology validation, which could strengthen credibility.

Spectral signature banks could revolutionize cadastral management globally, especially for climate-resilient urban planning. Combining this with AI-driven image analysis could enhance automation and precision in property assessments.

Assessing Pixel versus Object-based Image Classification and Potential Use Cases'

Melinda Beadman and Chelsea Dawson (Umwelt Australia) compared pixel-based and object-based image classification. Pixel-based classification analyzes individual pixel values, while object-based examines pixel clusters' size, shape, and color. Using landscape rasters with vegetation, waterbodies, and infrastructure, they found object-based classification suits yearly change assessments, while pixel-based is better for diverse, isolated areas. Quality training samples are critical for both. Laura Brindle (CSIRO) discussed NovaSAR-1, a 2018-launched S-band SAR satellite. CSIRO's 10% share enables free data access via a portal. CEOS-ARD-compliant Normalized Radar Backscatter products, processed for all Australian data, enhance accessibility.

The classification study clarifies method selection, emphasizing task-specific applications. NovaSAR-1's open-access data and CEOS-ARD compliance democratize high-resolution SAR imagery for global research.

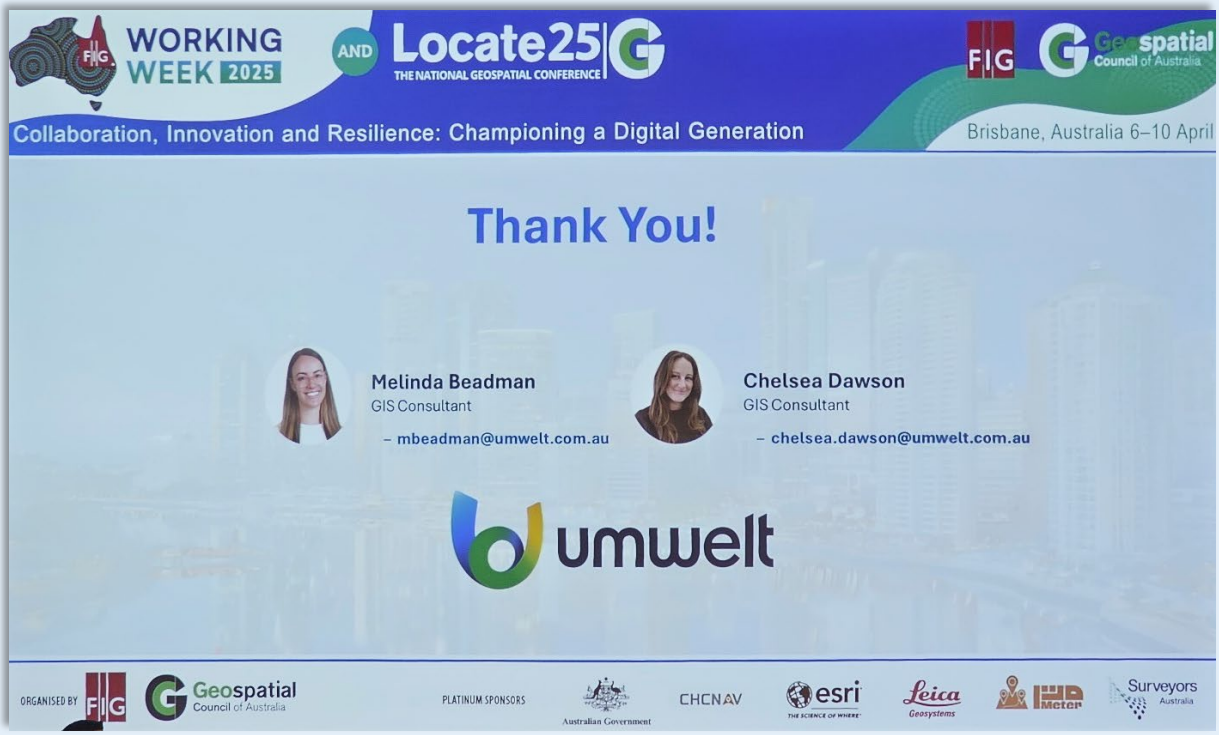
The classification findings are practical but limited by training data quality, raising scalability concerns for data-scarce regions. NovaSAR-1's advancements are impressive, though non-Australian coverage details are unclear.

Combining classification techniques with NovaSAR-1's SAR data could enhance environmental monitoring. AI-driven automation may address training data limitations, boosting applications in disaster management and land use planning.

Melinda Beadman's research at Umwelt (Australia) Pty Ltd compares pixel-based and object-based image classification for spatial and remote sensing applications. Pixel-based classification analyzes individual pixel values, while object-based classification evaluates pixel clusters based on size, shape, and color. The study used rasters of diverse landscapes, highlighting the critical role of training samples in both methods.

Object-based classification excels in yearly change assessments, focusing on object evolution. Pixel-based classification suits isolated areas, accommodating varied pixel ranges across regions. Both methods' efficacy depends on comprehensive training data.

The research underscores the importance of aligning classification methods with specific objectives. Object-based approaches are ideal for tracking dynamic changes in defined features, while pixel-based methods offer flexibility for diverse, scattered regions. The reliance on training data quality suggests that robust, representative datasets are crucial for reliable outcomes. This study provides a practical framework for choosing classification methods, emphasizing task-specific strategies and data preparation. Future exploration could assess hybrid approaches or automation to enhance training sample efficiency.



Latest Developments of the CSIRO NovaSAR-1 S-band SAR National Facility

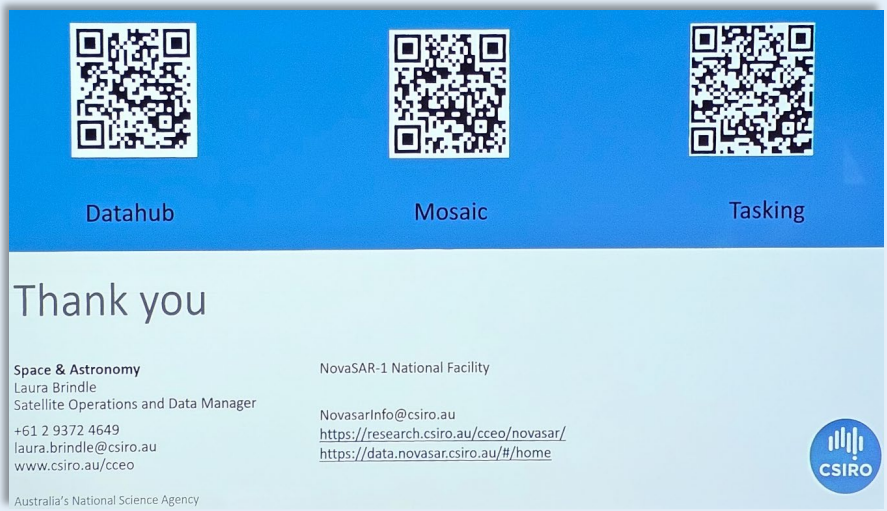
Laura Brindle, NovaSAR-1 Operations Manager at CSIRO, details advancements in the NovaSAR-1 S-band Synthetic Aperture Radar (SAR) satellite, launched in 2018 by Surrey Satellite Technology Ltd and Airbus.

As Australia's first sovereign civilian Earth observation capability, CSIRO's 10% mission share operates as a national research facility. NovaSAR-1 data, accessible globally via a CSIRO portal, supports diverse applications with medium and high-resolution imagery.

CSIRO has enhanced data accessibility by producing CEOS-ARD-compliant Normalised Radar Backscatter (NRB) products (v5.5, Threshold level, October 2023). All Australian archive and ongoing imagery are processed to this standard, available through the CSIRO NovaSAR-1 Datahub. Users can request new imaging tasks anytime.

The CEOS-ARD compliance marks a significant step in standardizing NovaSAR-1 data, broadening its usability for research and applications like environmental monitoring or disaster management. The open-access model fosters global collaboration, while Australia's sovereign capability strengthens national research autonomy.

Future efforts could focus on expanding application case studies or integrating NovaSAR-1 data with other remote sensing technologies for enhanced insights. The operational updates reflect a commitment to user-centric data delivery.



Estimation of High-resolution Digital Elevation Model (DEM) from SAR Data over the Confluence Region

Nadimah Abubakar, a student at Ahmadu Bello University, presented research on generating a high-resolution (5-meter) Digital Elevation Model (DEM) from Synthetic Aperture Radar (SAR) data for Nigeria's Confluence State. The study, focused on mapping hydrological components, produced a DEM with elevations from 79.59 to 529.27 meters, enabling precise identification of flood-prone areas, erosion zones, and drainage patterns. This supports flood mitigation, urban planning, and watershed management, addressing climate-driven flood risks through data-driven strategies.

The 5-meter DEM's precision is a standout, offering detailed topographic insights for flood modeling and early warning systems. The use of SAR data enhances applicability in regions with challenging weather conditions.

This research is timely, given rising flood risks, but the abstract's repetitive text obscures methodological details, limiting reproducibility. Validation processes and scalability to other regions need clarification to strengthen impact.

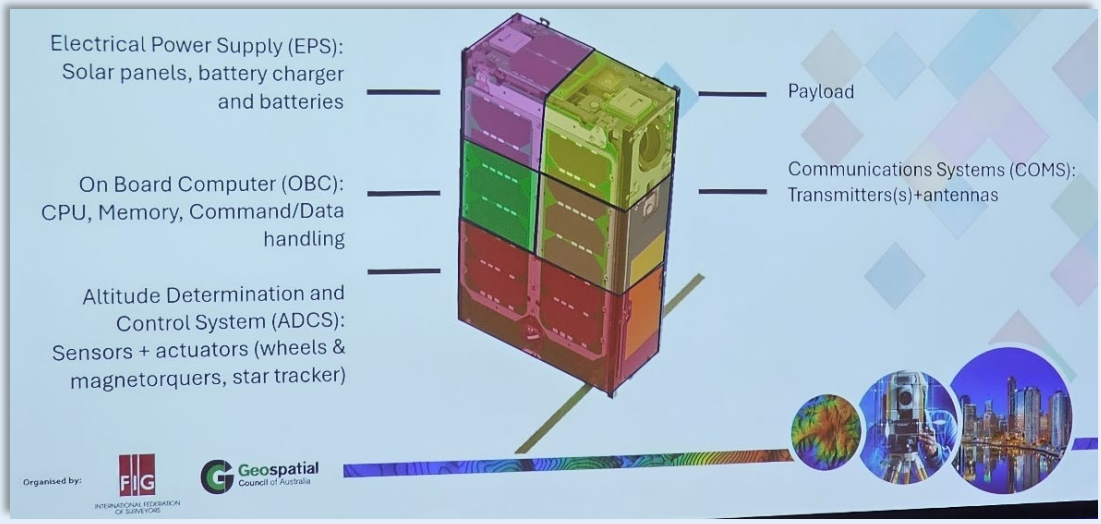
High-resolution DEMs from SAR are vital for climate-resilient planning in flood-prone areas. Integrating this approach with AI for real-time flood prediction could amplify its utility, fostering sustainable development in vulnerable regions.

Suitcase Satellites: The Rise of CubeSats and Their Impact on Environment and Climate Monitoring in Australia

Fabrice Marre and Andrew Barton explore the transformative role of CubeSats in Earth Observation (EO) for environmental and climate monitoring in Australia. These small, modular satellites offer cost-effective, rapid-deployment solutions, complementing traditional satellites.

CubeSats, leveraging Commercial-Off-The-Shelf components and piggyback launches, democratize space access. They address Australia's environmental challenges—bushfires, drought, Great Barrier Reef degradation, and biodiversity loss—using payloads like multispectral, hyperspectral, and thermal sensors.

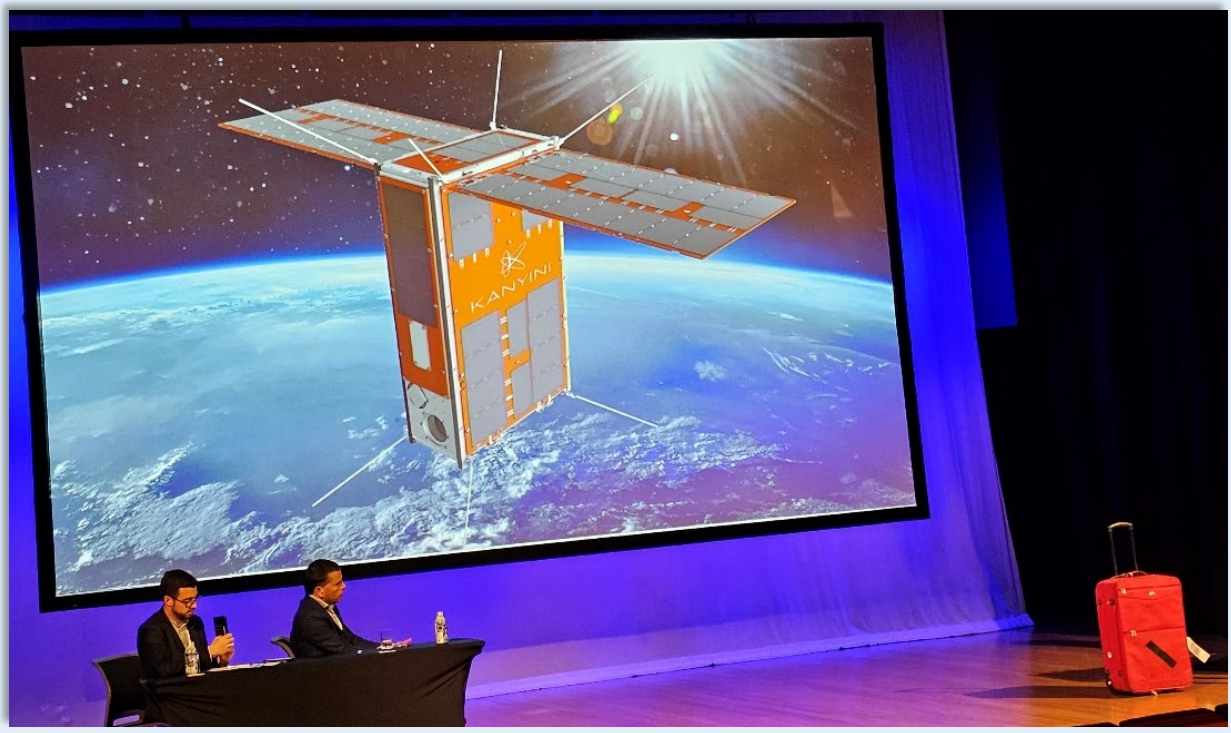
Constellations like Planet Labs and GHGsat enhance revisit frequency and coverage. The Kanyini mission, a South Australian 6U CubeSat, exemplifies regional innovation, integrating AI and hyperspectral imaging for local monitoring.



CubeSats' affordability and rapid development enable broad participation in EO. Their constellations improve temporal and spatial data, vital for monitoring dynamic events like bushfires. Kanyini's onboard AI and hyperspectral capabilities showcase Australia's growing space expertise, supporting applications like vegetation mapping and heatwave monitoring.

CubeSats are a game-changer, but sensor miniaturization trade-offs (e.g., lower resolution) and data downlink bottlenecks pose challenges. The Kanyini mission's success could inspire national EO strategies, though scalability to remote areas needs attention. The document's depth on technical and regional aspects is impressive but lacks specific performance metrics for Kanyini's payloads.

CubeSats are pivotal for climate-resilient monitoring, particularly in Australia's vast, diverse landscapes. Integrating AI and inter-satellite links will enhance data efficiency and autonomy, narrowing the gap with larger satellites. Kanyini's model of regional collaboration could drive global small-satellite initiatives, fostering sustainable environmental management and disaster response.

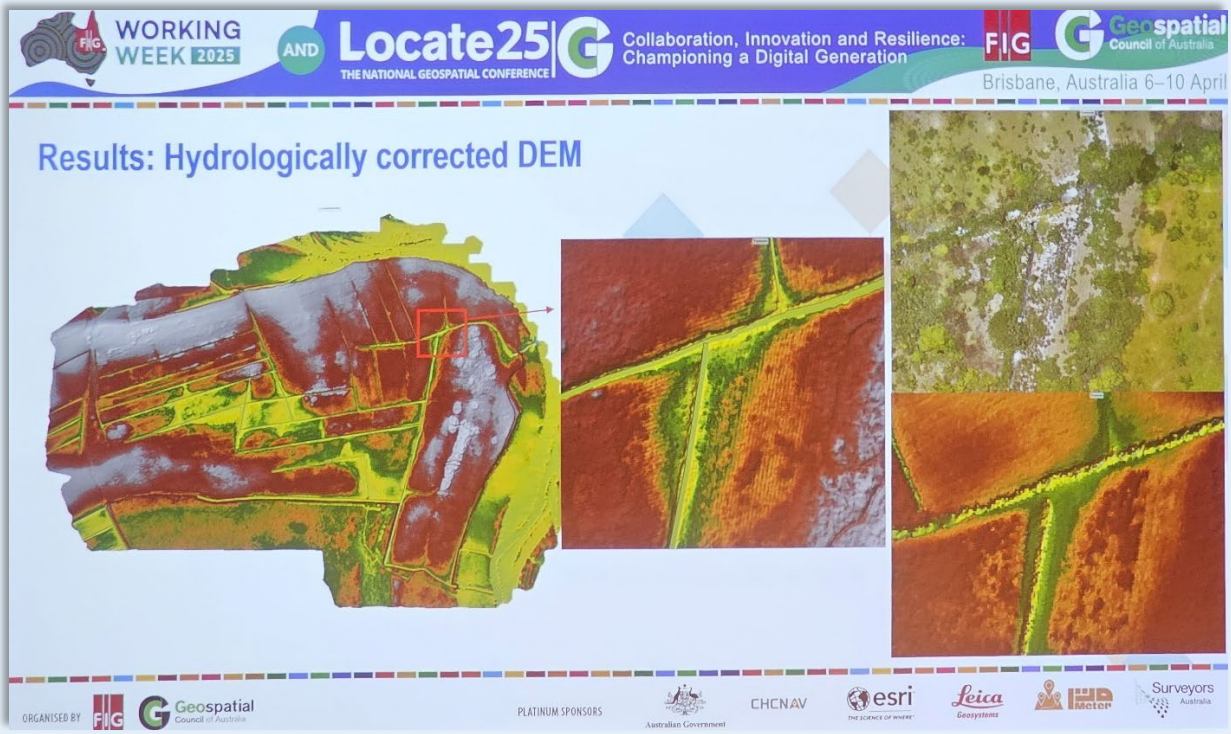


Overcoming Vegetation Challenges in Drone-Based Digital Terrain Modelling for Hydrodynamic Applications

Dr. Ben Jarihani, Senior Lecturer at James Cook University, presented a study on generating high-resolution Digital Terrain Models (DTMs) using drone-based technologies for hydrodynamic modelling in vegetated terrains. The research employed Structure from Motion (SfM) photogrammetry and LiDAR, supplemented by RTK GPS for ground validation. Dense vegetation, overhanging foliage, and standing water posed challenges, limiting automated vegetation filtering. LiDAR outperformed SfM in vegetated areas, but ground-based measurements and extensive data cleaning were critical for hydrologically accurate DTMs, essential for inundation modelling and Blue Carbon projects.

Drone-based LiDAR's superior performance in penetrating vegetation underscores its value for complex terrains. The necessity of ground-based validation highlights the limitations of automated algorithms, ensuring DTM reliability for applications like tidal inundation and water resource management.

The study effectively addresses real-world challenges in DTM generation, but the reliance on manual data cleaning raises scalability concerns for large areas. The abstract's lack of specific performance metrics (e.g., DTM resolution or error rates) limits comparative insights. Integration with satellite data could enhance coverage.



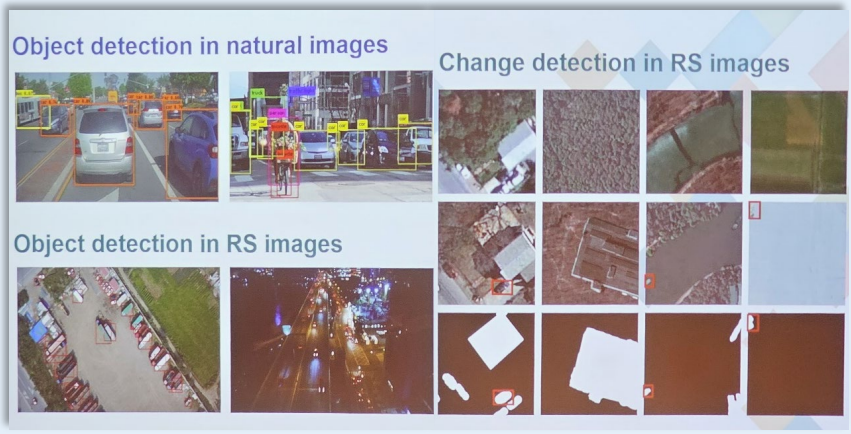
Drone-based DTMs are transformative for hydrodynamic modelling, particularly in vegetated coastal regions critical for Blue Carbon initiatives. Combining LiDAR with AI-driven vegetation filtering could streamline processing, improving efficiency. This approach has global potential for enhancing flood risk assessment and sustainable water management in challenging environments.

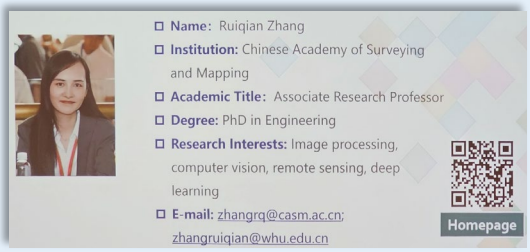
A Cascade Transformer-Based Multi-Scale Framework for Object Detection and Instance Segmentation in Remote Sensing Imagery

Dr. Ruiqian Zhang, a researcher at the Chinese Academy of Surveying and Mapping, presented a Cascade Transformer-Based Multi-Scale Framework for object detection and instance segmentation in remote sensing imagery. Addressing challenges like complex backgrounds and varying object scales, the framework uses a Swin Transformer backbone with a MaskDINO head and a lightweight Feature Pyramid Network. A semantic hybrid loss function balances localization, classification, and segmentation tasks. Validated on public datasets, it outperformed state-of-the-art methods and won first place in the ISPRS Individual Tree Crown Segmentation contest, enhancing applications in land-use surveys and environmental monitoring.

The framework's superior accuracy in complex scenarios and its top ranking in the ISPRS contest underscore its robustness. The hybrid loss function effectively tackles multi-task learning challenges, improving segmentation precision.

This framework is a significant advancement, but its computational complexity may limit scalability for real-time applications. The abstract lacks details on processing times or resource requirements, which are critical for practical deployment.

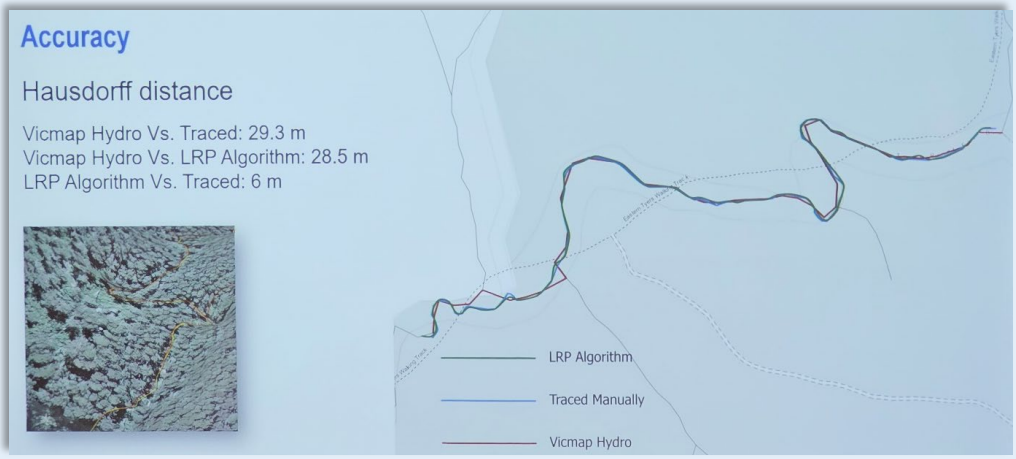




The approach sets a benchmark for remote sensing analysis, with potential to revolutionize urban planning and disaster assessment. Integrating edge computing could enable real-time processing, broadening its impact in dynamic environmental monitoring.

Geographic information system for spectral signatures

Fredy Montealegre, from Instituto Geográfico Agustín Codazzi (IGAC), presents two Geographic Information Systems (GIS): SIG_Firmas_Espectrales and SIG_SNRA. SIG_Firmas_Espectrales organizes, georeferences, and visualizes historical and future spectral signatures, capturing metadata on conditions and precise locations. It offers an intuitive interface for data entry, query, and download, enhancing spectral data management. SIG_SNRA supports Colombia's Agrarian Reform (Decree 1406 of 2023) by managing, analyzing, and publishing statistical and geographic data.



SIG_Firmas_Espectrales streamlines spectral signature handling with georeferenced metadata, improving data accessibility. SIG_SNRA ensures compliance with agrarian reform policies through robust data administration and visualization. Both systems emphasize user-friendly interfaces and comprehensive data management.

These GIS platforms demonstrate IGAC's commitment to leveraging geospatial technology for scientific and policy-driven outcomes. SIG_Firmas_Espectrales could revolutionize environmental and agricultural monitoring by standardizing spectral data, while SIG_SNRA supports equitable land reform, critical for Colombia's socio-economic development. Future enhancements might include integrating AI for predictive analytics or expanding public access to foster transparency. The dual focus on technical innovation and policy compliance highlights their potential for broad impact.

Advanced Extraction and Analysis of Topographic Features from High-Resolution DEMs

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Advanced Extraction and Analysis of Topographic Features from High-Resolution DEMs

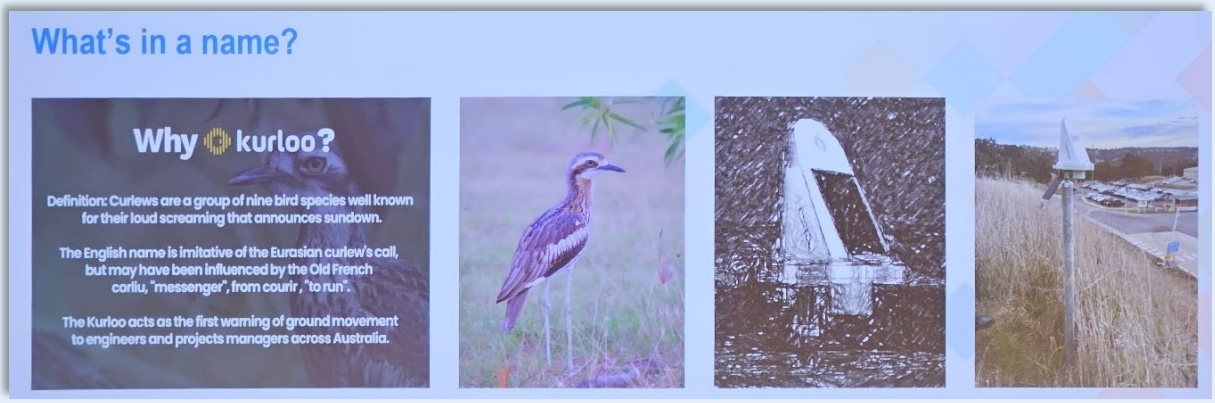
Kimia Amoozandeh, Senior GIS Officer at Victoria's Department of Transport and Planning, presents an advanced method for extracting topographic features like ridges and watercourses from high-resolution Digital Elevation Models (DEMs). The Surveyor-General Victoria's Land Reform Projects team uses these features to define cadastral boundaries for land reform. The method employs hydrological algorithms to detect flow patterns and elevations, enhanced by smoothing and simplification techniques to refine data accuracy. Similarity measures, like Fréchet distance, distinguish roads from topographic features, ensuring precise delineation.

The approach reduces reliance on time-consuming field surveys, offering a reliable alternative to low-resolution DEM datasets. Calibration against manually extracted features ensures accuracy, with results aligning well with high-resolution imagery.

This method streamlines cadastral boundary definition, critical for land reform, by leveraging high-resolution DEMs and advanced algorithms. Its ability to differentiate roads from topographic features addresses a key challenge, enhancing reliability. Future work could integrate machine learning to automate feature classification further or expand applications to environmental monitoring. The approach exemplifies how geospatial technology can improve efficiency and accuracy in land management, with potential for broader adoption in similar contexts.

Using Wi–Fi HaLow Technology for IoT GNSS Monitoring Systems

The Head of Research at Kurloo Technology presented a study integrating Wi-Fi HaLow into IoT-based GNSS monitoring systems for landslip applications. Wi-Fi HaLow's low power, extended range, and robust data throughput suit remote environments. Compared to LTE, it excels where connectivity is limited. Field tests in New South Wales, Australia, showed Wi-Fi HaLow's reliable data transmission over long distances using solar-powered devices, with a store-and-forward mechanism preventing data loss despite delays.



Wi-Fi HaLow's ability to maintain system autonomy in remote settings and its reliability in harsh conditions stand out. The store-and-forward mechanism ensures data integrity, critical for high-precision GNSS monitoring.

The study demonstrates Wi-Fi HaLow's potential, but the abstract's lack of specific performance metrics (e.g., range or delay times) limits evaluation. Scalability across varied terrains and integration with other IoT systems need further exploration.

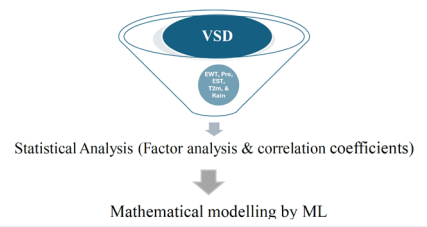
Wireless communication techniques comparison

	LTE/4G	Bluetooth	LoRa	Wi-Fi	Wi-Fi HaLow
Frequency	600-2600 MHz	2.4 GHz	868/900 MHz	5-60 GHz	Sub-1 GHz
Data rate	1 Mb/s	1-24 Mb/s	0.3-50 Kb/s	1-6.75 Gb/s	150k – 86.7Mb/s
Range	1 – 10 km	8-10 m	<30 km	20 -100 m	<1500m
Energy consumption	Medium	Medium	Very low	High	Low
OTA firmware updates	Supports	Supports	-	-	Supports
Pros	Coverage area, flexible, network density	Most popular peer-to-peer wireless technology	low-power wide area	Data transfer speed	Scalable, longer range, low power
Cons	Cost, rural area network	Short range	low data rates	Power consumption	Few suppliers

Wi-Fi HaLow could transform IoT-GNSS monitoring for geohazard applications, offering a cost-effective alternative in connectivity-scarce regions. Combining it with AI for predictive analytics could enhance real-time landslip monitoring, with global implications for disaster mitigation.

Exploring Factors Inducing Vertical Surface Deformation in Ifewara Zungeru Fault Zone, Southwest Nigeria Through Machine Learning Approach

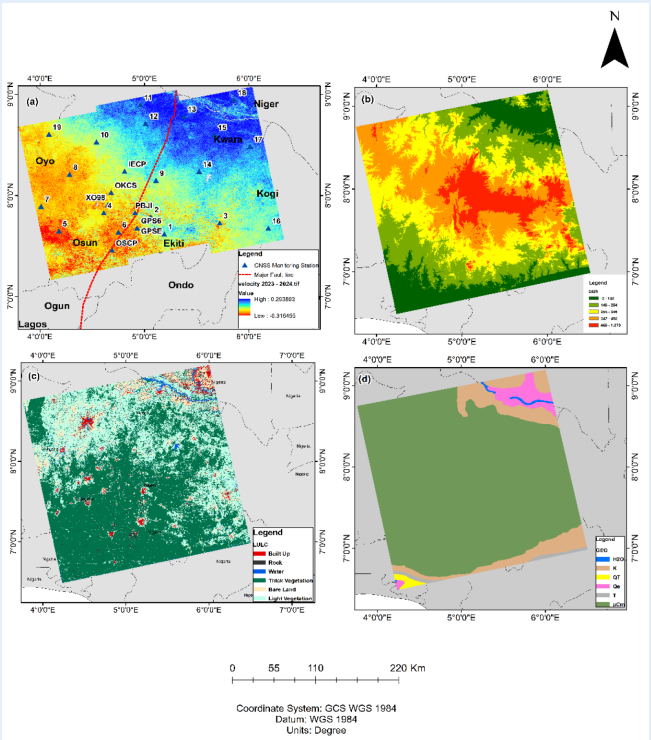
Ola Shittu and colleagues investigated vertical surface deformation (VSD) in Nigeria's Ifewara/Zungeru fault zone using machine learning (ML) techniques, focusing on hydrological and climatic influences. Employing Ridge Regression (RR) and Random Forest (RF) models, the study analyzed data from Gravity Recovery and Climate Change Experiment (GRACE) / GRACE Follow On (GRACE-FO), MERRA-2, and PERSIANN (2002–2023). Sentinel-1 InSAR data revealed deformation rates of ±30 mm/year, categorizing zones into subsiding and uplifting regions. ML models, trained on 80% of data (2002–2020) and validated for 2021–2023, showed strong predictive performance (RF: R^2=0.63, RMSE=0.019; RR: R^2=0.61, RMSE=0.05). Equivalent water thickness (ΔEWT) was the dominant VSD driver, contributing 90% in subsiding areas and 34% in uplift zones.



ΔEWT's overwhelming influence on VSD underscores hydrological impacts in tropical regions. Both ML models demonstrated robust predictions, with RF excelling in non-linear savanna dynamics and RR in linear rainforest patterns, offering versatile tools for geohazard assessment.

The study's integration of ML with diverse datasets is innovative, but the coarse 200–300 km GRACE resolution may limit local precision. The document's mathematical rigor is commendable, though validation details for InSAR data are sparse, potentially affecting credibility.

This research highlights ML's potential in unraveling complex VSD drivers, critical for infrastructure resilience and disaster mitigation in fault zones. Continuous hydrological monitoring, as suggested, could inform early-warning systems. Future studies integrating higher-resolution data and deep learning could enhance predictive accuracy, with global implications for tropical deformation management.



Possibilities and Challenges of Measuring Small Fibre Composite System Structures Using Terrestrial Laser Scanning

Laura Balangé from Universität Stuttgart explored terrestrial laser scanning for measuring coreless fibre composite structures, developed for lightweight, low-material construction within the IntCDC Cluster. These structures rely on precise fibre positioning for structural integrity, posing surveying challenges. The study compared Leica HDS7000, Riegl VZ2000, and Trimble X7 scanners, assessing scanning spray and angle of incidence impacts. Time-of-flight scanners outperformed phase-shift scanners, offering better detection of small fibres, with larger incidence angles and smaller spot sizes enhancing accuracy.

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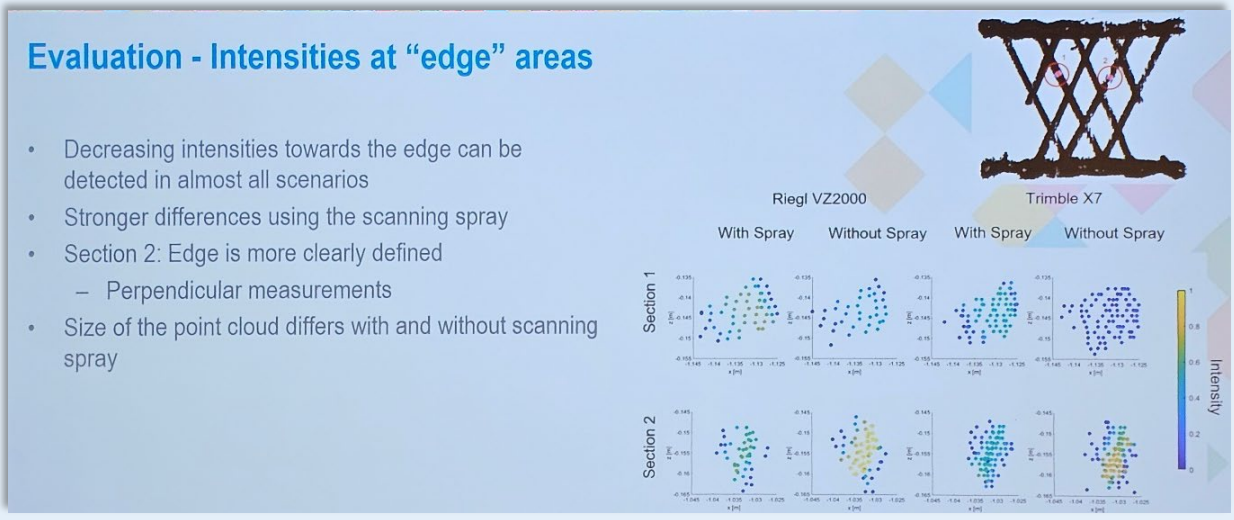
Time-of-flight scanners' superior performance in capturing small fibre structures and the influence of incidence angles and spot size on detection accuracy are key findings, critical for quality assurance in innovative construction.

The research addresses a niche but vital application, yet the abstract's repetitive text obscures specific performance metrics (e.g., resolution or error rates). Scalability to larger structures or varied materials remains unclear.

Terrestrial laser scanning could revolutionize quality control in fibre composite construction, supporting sustainable architecture. Integrating AI for automated fibre detection could enhance precision, with broader applications in lightweight material industries.



Real–Time Monitoring and Sensor Data Providing for the BIM–based Monitoring of Hydraulic Structures Using Sensor Things API and MQTT

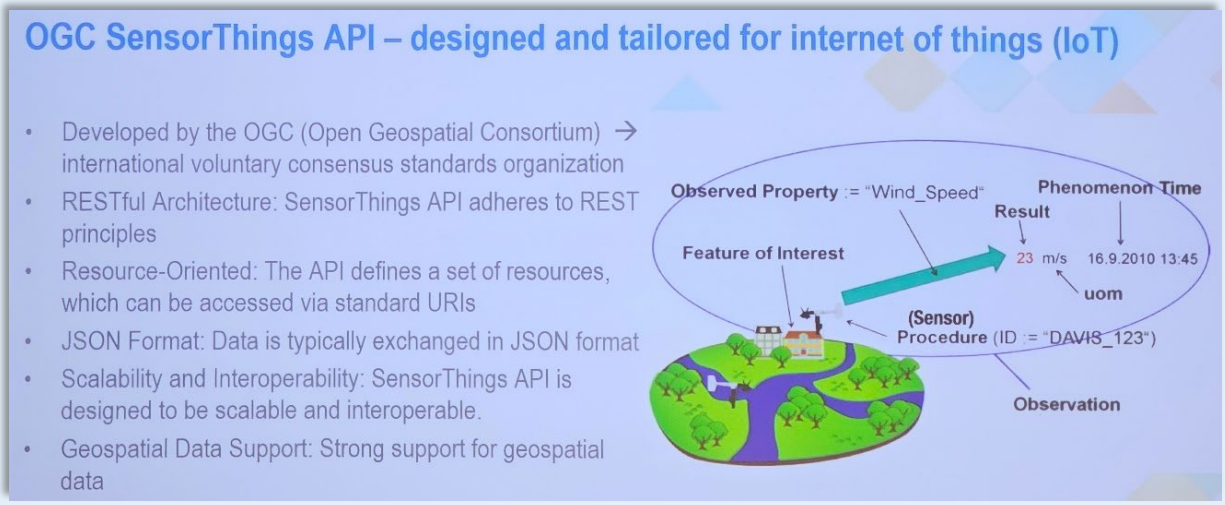
Baris Özcan from RWTH Aachen University presented a real-time monitoring framework for hydraulic structures using Building Information Modeling (BIM) integrated with the OGC SensorThings API and MQTT protocol. The system addresses aging infrastructure challenges by creating a digital twin for locks, weirs, and dams, enhancing maintenance and operational efficiency.

Edge computing preprocesses sensor data, reducing volume and enabling low-latency analysis. A linked data model connects sensor data to BIM components, improving decision-making. Initial tests show effective high-frequency data management, with plans for GeoMQTT and enhanced edge processing.

The framework's low-latency data streaming and semantic integration with BIM components enable proactive maintenance. The use of edge computing optimizes real-time analysis, critical for hydraulic structure monitoring.

This approach is innovative, but the abstract lacks specific performance metrics (e.g., latency or data volume reduction). Scalability across diverse structures and integration with existing systems need further exploration.

Real-time BIM monitoring could transform infrastructure management, particularly for critical hydraulic systems. Incorporating AI for predictive maintenance and GeoMQTT for geospatial precision could enhance scalability, with global potential for aging infrastructure resilience.



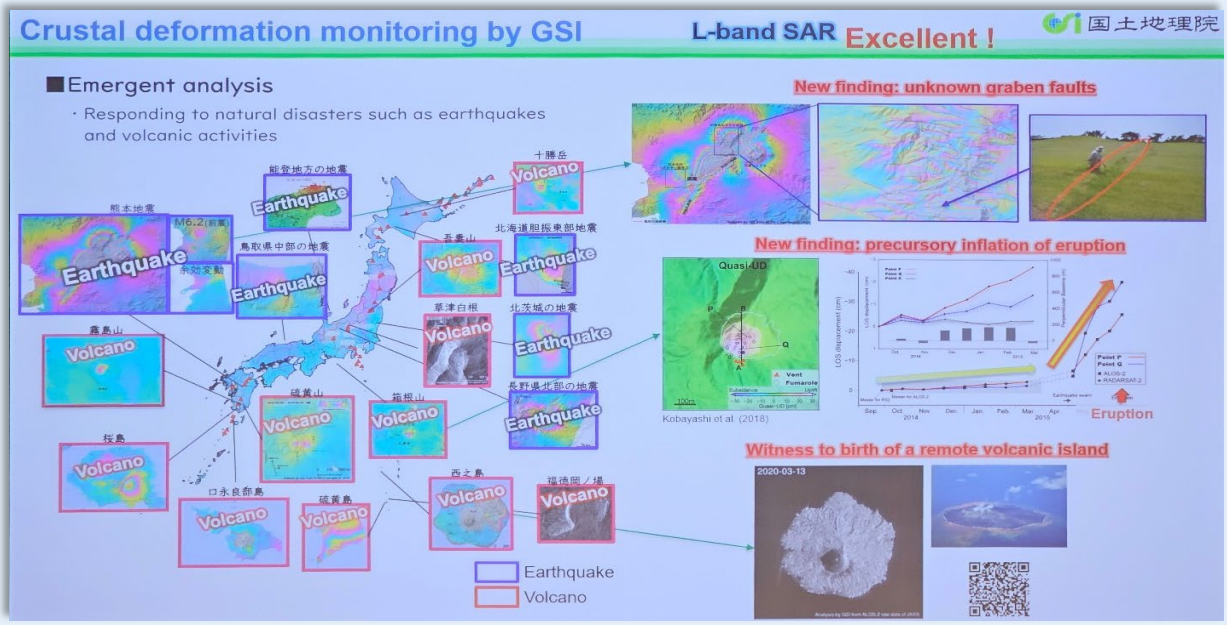
Nationwide Land Deformation Monitoring by InSAR Time Series Analysis of Japan

Basara Miyahara from Japan's Geospatial Information Authority presented a nationwide land deformation monitoring system using InSAR time series analysis with ALOS-2 satellite data (2014–2024). Enhanced by GNSS station data, the system mitigates long-wavelength noise, producing a comprehensive deformation map. This map detects subtle deformations (cm/mm per year) like volcanic activity, subsidence, landslides, and post-seismic shifts, accessible via the "GSI Maps" web-GIS interface. Discussions with public organizations explore its use for subsidence monitoring and coordinate updates, with ALOS-4 data expected to improve accuracy in 2025.

The integration of GNSS with InSAR enables precise detection of both tectonic and local deformations. The freely accessible web-GIS interface enhances public utility for disaster risk assessment.

The system's scalability is impressive, but the abstract lacks specific error metrics or validation details, limiting technical assessment. The transition to ALOS-4 raises questions about data continuity and processing challenges.

This InSAR-based approach sets a global benchmark for deformation monitoring, vital for disaster preparedness. Integrating AI for automated anomaly detection could further enhance real-time risk mitigation, with potential applications worldwide.



Improving Time-Series InSAR Velocity Along Kendeng Fault by Atmospheric Correction

Raudlah Hawin Ayani from National Cheng Kung University presented a study enhancing time-series InSAR velocity estimates along the Kendeng Fault System in Surabaya, Indonesia, using atmospheric correction.

Analyzing 235 Sentinel-1A images (2014–2020) with ISCE and GIAnT software, the study applied the Small BAseline Subset technique and corrected ionospheric/tropospheric delays. Corrected line-of-sight velocities ranged from -14.8 to 10.8 mm/yr, with reduced uncertainties (0–5 mm/yr). GNSS data validated uplift south of Surabaya/Waru faults and subsidence eastward, suggesting active fault coupling.

Atmospheric correction significantly improved InSAR accuracy, reducing velocity uncertainties by nearly half. Consistency with GNSS and ITRF14-validated 3D velocity inversion underscores the method's reliability for seismic risk assessment.

The study's robust methodology is commendable, but the abstract lacks details on correction techniques or computational costs, limiting reproducibility. Scalability to other fault systems remains unaddressed.

Enhanced InSAR velocity monitoring is critical for understanding fault dynamics and mitigating seismic risks. Integrating AI for automated atmospheric correction could streamline processing, offering global potential for real-time tectonic monitoring and disaster preparedness.

Unveiling Land Uplift in Ipswich Queensland Using InSAR

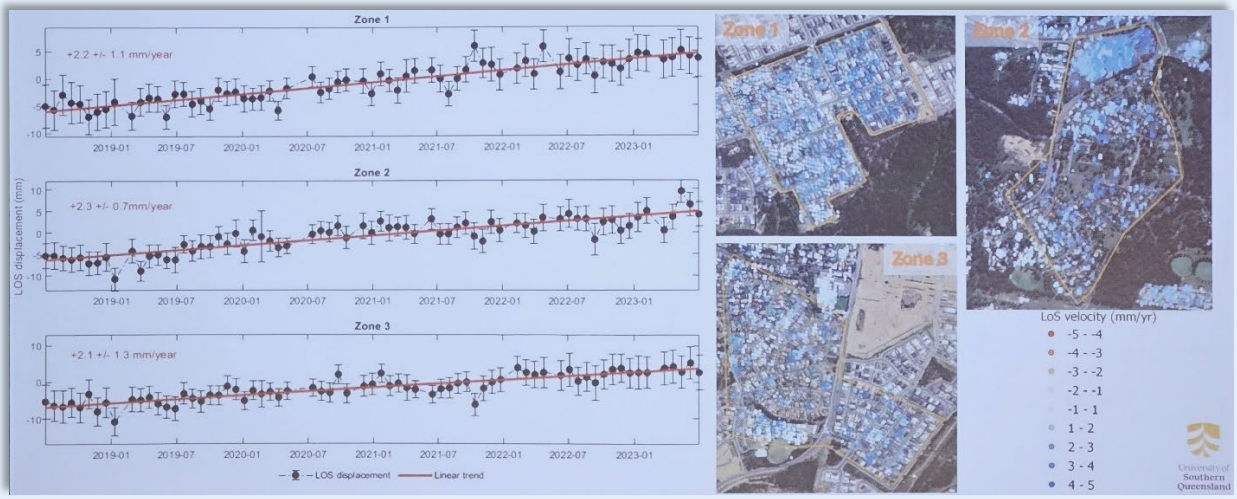
Dr. Armin Agha Karimi from the University of Southern Queensland utilized differential InSAR with Sentinel-2 data (2018–2023) to study land deformation in Ipswich, Queensland. Using the persistent scatter technique, the study identified localized uplifts in Collingwood Park, previously affected by subsidence due to historical mining and groundwater extraction (1998, 2008).

InSAR results correlated with a significant groundwater level rise (>12 meters) in uplift zones, contrasting minimal fluctuations (~1 meter) elsewhere, indicating a poroelastic effect driving uplift.

The detection of localized uplifts linked to groundwater recovery showcases InSAR's precision. The strong correlation between rising groundwater levels and uplift provides critical insights into poroelastic dynamics in urban settings.

The study effectively ties InSAR data to hydrological changes, but the abstract lacks specific uplift rates or error metrics, limiting quantitative assessment. Applicability to non-mining areas is unclear, warranting further exploration.

InSAR's ability to monitor subtle land uplift enhances urban planning and geohazard management. Integrating real-time groundwater data with AI-driven InSAR analysis could enable predictive models for deformation, with global relevance for post-mining landscapes.



The NSW Gravity Model: Australia's First State–Wide Airborne Gravity Model

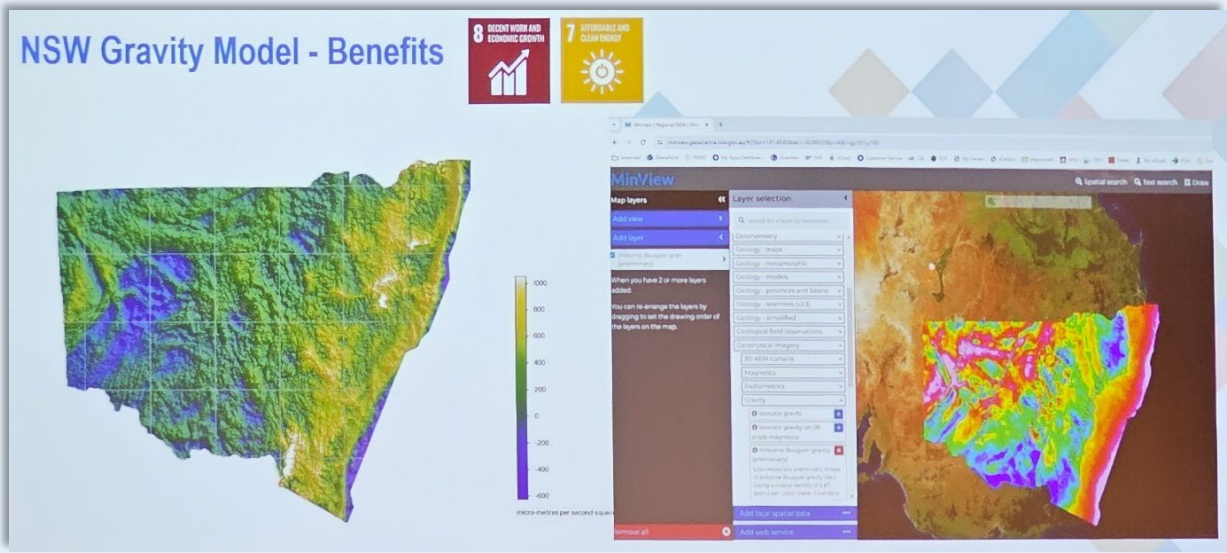
Thomas Grinter from DCS Spatial Services presented the NSW Gravity Model, Australia's first state-wide airborne gravity survey, conducted with the Geological Survey of NSW and Geoscience Australia. This high-density dataset enhances infrastructure planning, land management, natural hazard assessment, and resource development in New South Wales.

Delivered on time and within budget, it supports accurate height measurements, groundwater reserve analysis, and mineral exploration, with freely available data benefiting surveyors and the public.

The model's comprehensive coverage and high-quality data enable precise vertical datums, critical for surveying and hazard prediction. Its role in reducing financial risks for mineral exploration underscores its economic impact.

The project's success is notable, but the abstract lacks specific resolution or accuracy metrics, limiting technical evaluation. Integration with existing geodetic frameworks and scalability to other states warrant further discussion.

The NSW Gravity Model sets a precedent for state-wide geophysical surveys, enhancing geoscience applications. Incorporating AI for real-time data analysis could further optimize hazard detection and resource mapping, with potential for national and global replication in geospatial planning.



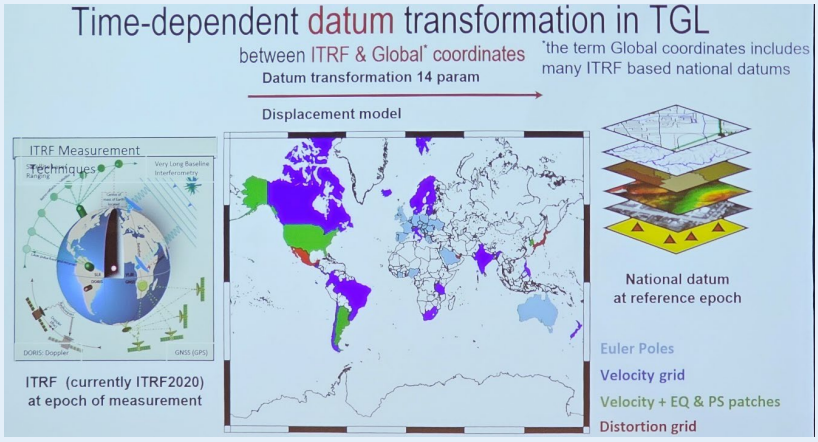
Initial implementation of Chile's REDGEOMIN Datum in Trimble Geodetic Library

Christopher Pearson and colleagues from Trimble detailed the integration of Chile's REDGEOMIN datum into the Trimble Geodetic Library (TGL) to address complex tectonic deformations. Chile's active plate boundary, marked by co-seismic and post-seismic deformations, challenges geodetic accuracy. The ADELA project at the University of Santiago Chile (USACH) developed REDGEOMIN using time-series analysis from over 250 GNSS stations. TGL, supporting 63 dynamic datums, adopted a hybrid approach, creating automated distortion grids from USACH's Bernese-processed GNSS data to model time-dependent motion. Tests showed residuals mostly in the millimeter range, with a maximum of 1.75 cm, ensuring high accuracy.

The automated distortion grid approach reduces latency and eliminates reliance on geophysical models, offering flexibility in modeling Chile's complex deformations. TGL's support for dynamic datums enhances coordinate transformations from ITRF to national datums, critical for precise point positioning.

The hybrid approach is innovative, but the paper's lack of detailed uncertainty estimates or grid resolution specifics limits full evaluation. Scalability to other tectonically active regions and integration with emerging standards like GGXF need further exploration.

REDGEOMIN's implementation showcases TGL's adaptability for complex geodetic environments, vital for mining and infrastructure in seismic zones. Automated grid generation could set a global standard for dynamic datum management. Future incorporation of AI-driven real-time deformation modeling and uncertainty estimates could enhance precision, benefiting geodetic applications in developing regions with active tectonics.



Strategy Adopted for the Transformation of National Horizontal Datum (NHD) to Modern National Spatial Reference Frame (NSRF)

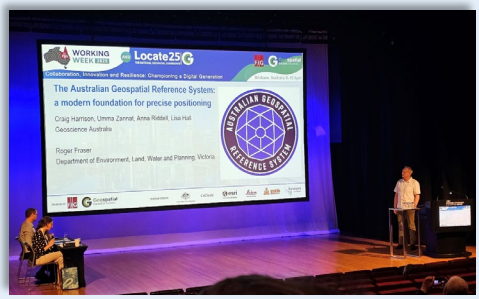
The Survey of India (SOI) is modernizing the National Horizontal Datum (NHD), based on ITRF 2008, to a dynamic National Spatial Reference Frame (NSRF) aligned with ITRF 2020. The NHD, outdated due to tectonic movements and global reference advancements, shows 20-30 cm deviations. The NSRF leverages GNSS, including IRNSS, and a nationwide CORS network for precise geodetic referencing. The methodology includes hierarchical CORS network adjustments, advanced GNSS data processing with GAMIT/GLOBK, and transformation parameter development for NHD-NSRF conversion. The NSRF supports applications like engineering surveys, geodynamic studies, and emerging technologies, with public access to datasets encouraged.

The CORS network, covering India, ensures high precision through primary, secondary, and tertiary tiers. SOI's SOIADJ software facilitates least-square adjustments, ensuring data consistency. Transformation parameters enable seamless data integration. The NSRF aligns with the National Geospatial Policy 2022, supporting UAVs, AR, and land management.

This initiative positions India as a leader in geospatial innovation, addressing NHD limitations through a robust, GNSS-based NSRF. The hierarchical CORS approach and automated data management enhance reliability, critical for multidisciplinary applications. Public dissemination fosters collaboration and scrutiny, ensuring transparency. Challenges include modeling complex tectonic zones, which future velocity models could address. Integrating AI for data validation or expanding CORS applications could further strengthen the NSRF. This modernization not only meets contemporary geospatial demands but also supports India's socio-economic goals through precise land and resource management.

The Australian Geospatial Reference System: a Modern Foundation for Precise Positioning

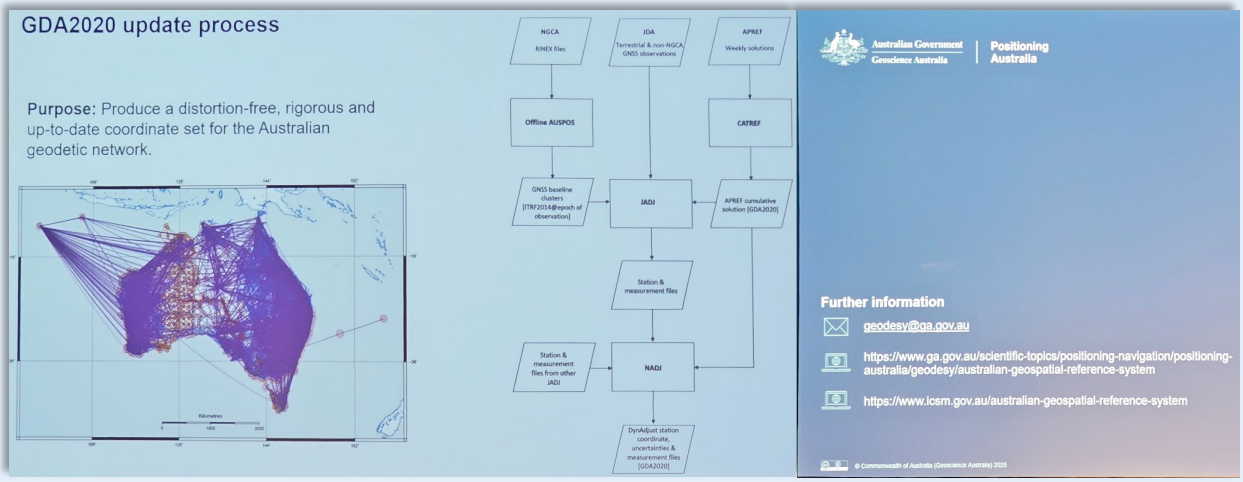
Dr. Craig Harrison from Geoscience Australia outlines the Australian Geospatial Reference System (AGRS), a comprehensive framework for precise positioning. The AGRS integrates datums, infrastructure, models, tools, and standards to support high-accuracy geospatial work. Recent enhancements include the bi-monthly GDA2020 update process, utilizing cloud-based least-squares adjustments (NADJ) and the National GNSS Campaign Archive (NGCA).



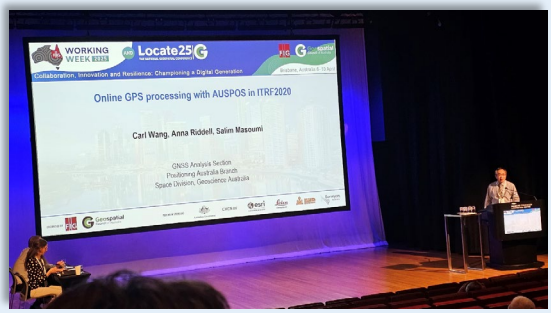
The NADJ adjusts 2.5 million measurements for 340,000 stations using DynAdjust software, while the NGCA's cloud-based portal allows jurisdictions to manage GNSS data efficiently.

The AGRS fosters collaboration across Australian governments, ensuring interoperability. The NADJ's cloud-based, phased adjustments and the NGCA's user portal streamline data processing, enhancing accessibility and workflow integration for jurisdictions.

The AGRS exemplifies innovative geospatial infrastructure, leveraging cloud computing and Agile methodologies for resilience and usability. Its collaborative approach ensures a unified, authoritative system, critical for applications like surveying and navigation. The NADJ and NGCA demonstrate scalable, modern solutions, though future expansions could integrate AI for predictive analytics or broaden data access. The AGRS sets a global benchmark for dynamic reference systems, supporting Australia's geospatial needs with precision and efficiency.



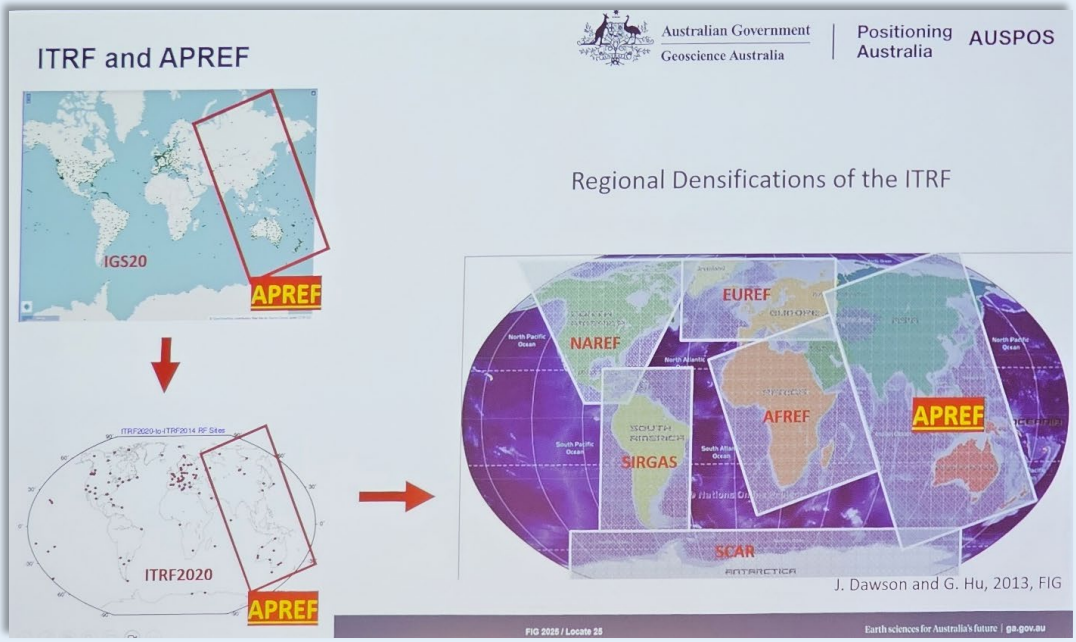
Online GPS Processing with AUSPOS in ITRF2020



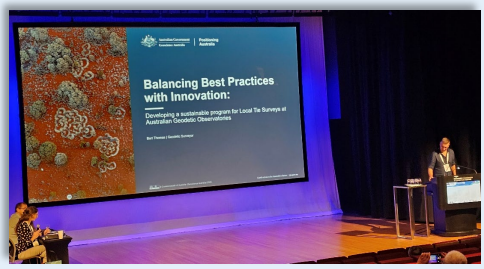
Dr. Anna Riddell, Director of GNSS Analysis at Geoscience Australia, discusses the upgrade of AUSPOS, an online GPS processing service, to align with ITRF2020. This enhancement, following ITRF2020's release in October 2022, improves coordinate accuracy and global dataset integration. AUSPOS, recommended by the ICSM for GNSS control surveys, adopts ITRF2020/IGS20 via a two-step transformation strategy to maintain compatibility with GDA2020, Australia's primary datum aligned with ITRF2014/IGb14. The upgrade involved rigorous calibration, software enhancements, and geophysical model integration.

The transition to ITRF2020 enhances AUSPOS's precision, supporting land surveying, mapping, and research. The two-step transformation ensures seamless GDA2020 access, while meticulous validation upholds geodetic standards.

The AUSPOS upgrade exemplifies Geoscience Australia's commitment to cutting-edge geospatial solutions. Aligning with ITRF2020 positions AUSPOS as a globally competitive tool, vital for precise positioning. The two-step transformation strategy smartly bridges legacy and modern datums, ensuring continuity. Future enhancements could explore AI-driven processing or broader geophysical model integration to further boost accuracy. This upgrade strengthens Australia's geospatial infrastructure, fostering reliable applications and international collaboration, with potential to influence global GNSS processing standards.



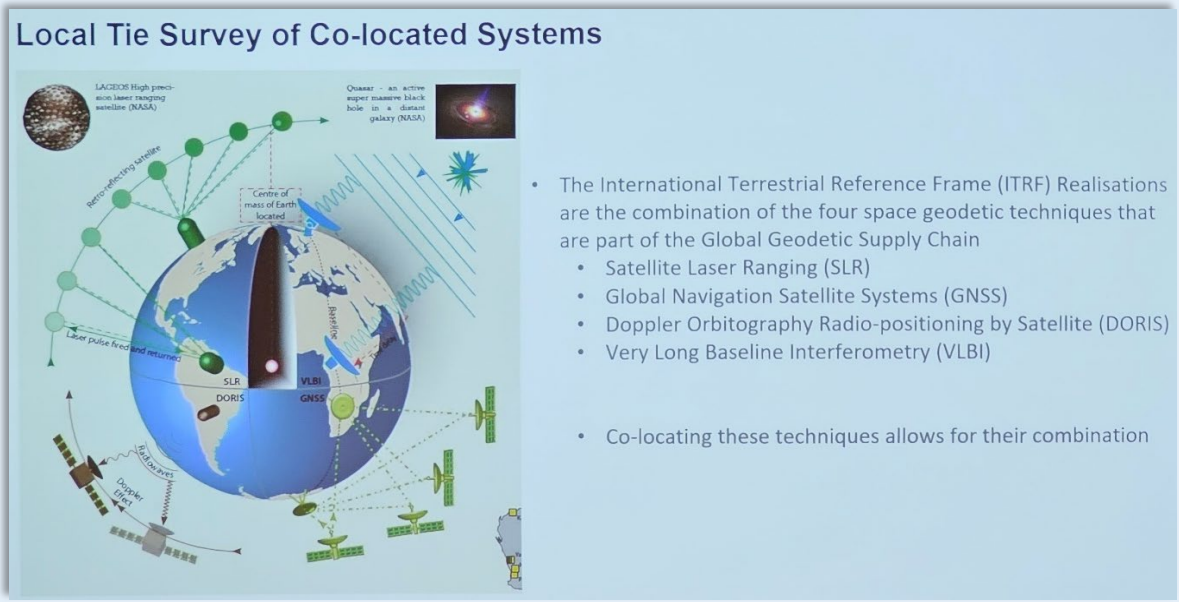
Balancing Best Practices with Innovation: Developing a sustainable program for Local Tie Surveys at Australian Geodetic Observatories



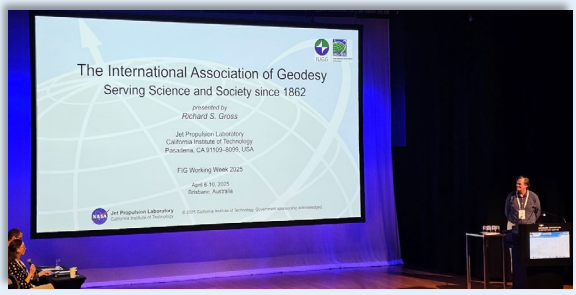
Bart Thomas, Geodetic Surveyor at Geoscience Australia, details a recent local tie survey campaign at four Australian observatories (Yarragadee, Mt Stromlo, Hobart, Katherine) to support the International Terrestrial Reference Frame (ITRF). Local tie surveys measure vectors between co-located space geodetic techniques (GNSS, VLBI, SLR, DORIS), ensuring accurate multi-technique reference frames and monitoring infrastructure stability. The campaign balanced best practices with innovations, improving safety, documentation, and resource efficiency, while exploring simplified observation techniques for future surveys.

The surveys updated local tie solutions, enhanced workplace safety, and introduced innovative validation methods. The program fosters collaboration for cost-effective, sustainable survey methodologies, supporting ITRF integrity.

This campaign exemplifies a strategic blend of tradition and innovation, strengthening Australia's contribution to global geodetic frameworks. Improved documentation and safety measures ensure long-term sustainability, while simplified techniques promise efficiency. Future collaborations could leverage automation or AI to further reduce costs and enhance precision. The focus on resilience and adaptability positions the program to meet evolving ITRF demands, reinforcing Australia's geospatial leadership and supporting applications like navigation and infrastructure monitoring.



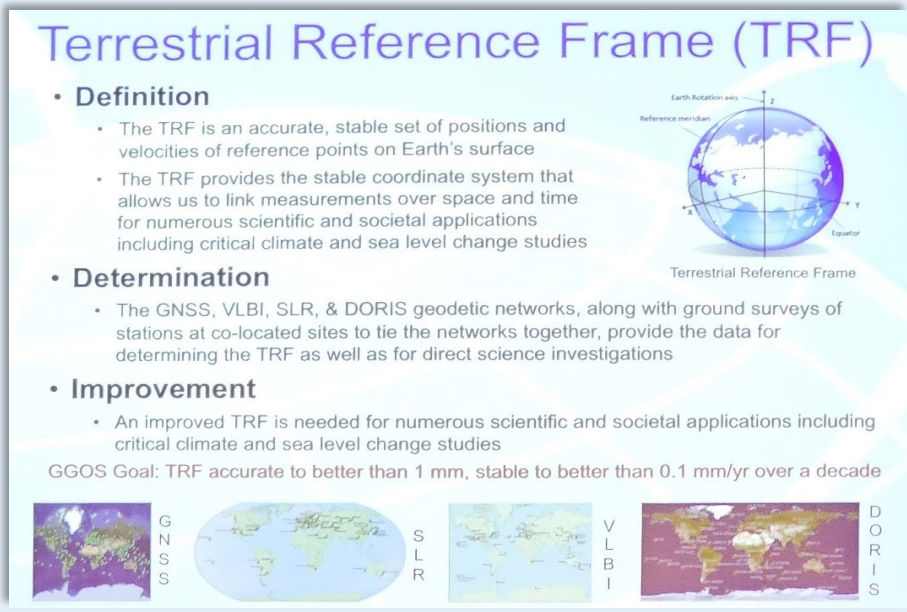
The International Association of Geodesy: Serving Science and Society Since 1862



Dr. Richard Gross, Senior Research Scientist at NASA JPL, highlights the 163-year legacy of the International Association of Geodesy (IAG), founded in 1862 for the Central European Arc Measurement project. The IAG advances geodetic observations and science, improving Earth's shape, reference frames, and geoid. Its structure includes Services for observations, Commissions for science, Projects for innovation, and GGOS for integrated Earth imaging, alongside outreach efforts. The IAG's interdisciplinary approach supports diverse Earth sciences and societal applications like navigation.

The IAG's dual focus on observations and science fosters global cooperation. The ITRF, provided by IAG's IERS, underpins location-based services. GGOS integrates geodetic data for comprehensive Earth monitoring.

The IAG's longevity reflects its adaptability and interdisciplinary strength, bridging science and societal needs. Its role in providing the ITRF is critical for modern technologies, from GPS to autonomous systems. Future efforts could enhance data integration through AI or expand public engagement to highlight geodesy's societal impact. The IAG's collaborative model sets a benchmark for global scientific organizations, ensuring relevance in addressing complex Earth processes and supporting emerging geospatial applications.

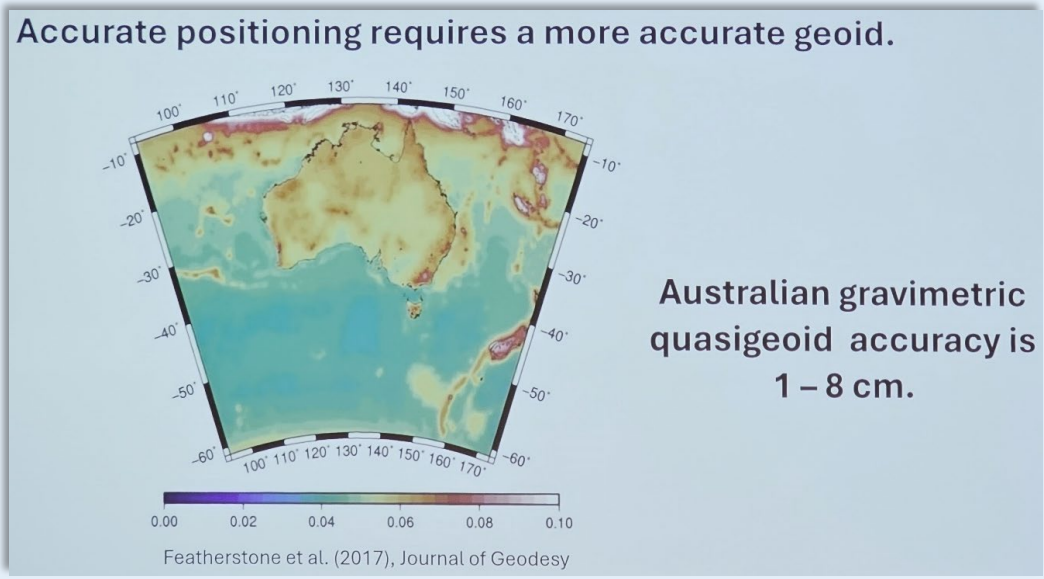


Modelling Australian Gravimetric Quasi-Geoid with Airborne Gravimetry Least Squares Collocation for Continental Scale Analysis Ready Gravity Data

Dr. Neda Darbeheshti, Geodetic Gravity Team Leader at Geoscience Australia, presents a methodology for computing the Australian gravimetric quasi-geoid using least squares collocation (LSC) within a remove-predict-restore framework. The approach integrates terrestrial, satellite altimetry, airborne gravimetry, and gradiometry data to generate gravity anomaly grids, which are then used to calculate geoid heights. The study focuses on New South Wales and Victoria, producing a precise quasi-geoid model for Australia's Vertical Working Surface.

The LSC method effectively combines diverse datasets, with airborne gravimetry and gradiometry enhancing model accuracy. The resulting quasi-geoid supports Australia's two-frame height approach, improving regional geodetic precision.

This work underscores the power of LSC in synthesizing varied gravity data, setting a standard for geoid modeling. The inclusion of airborne data significantly boosts resolution, critical for applications like surveying and resource management. Future advancements could incorporate machine learning to optimize data integration or expand coverage to other regions. This methodology strengthens Australia's geospatial infrastructure, offering a robust foundation for vertical datum modernization and potential global applicability in geoid computation.

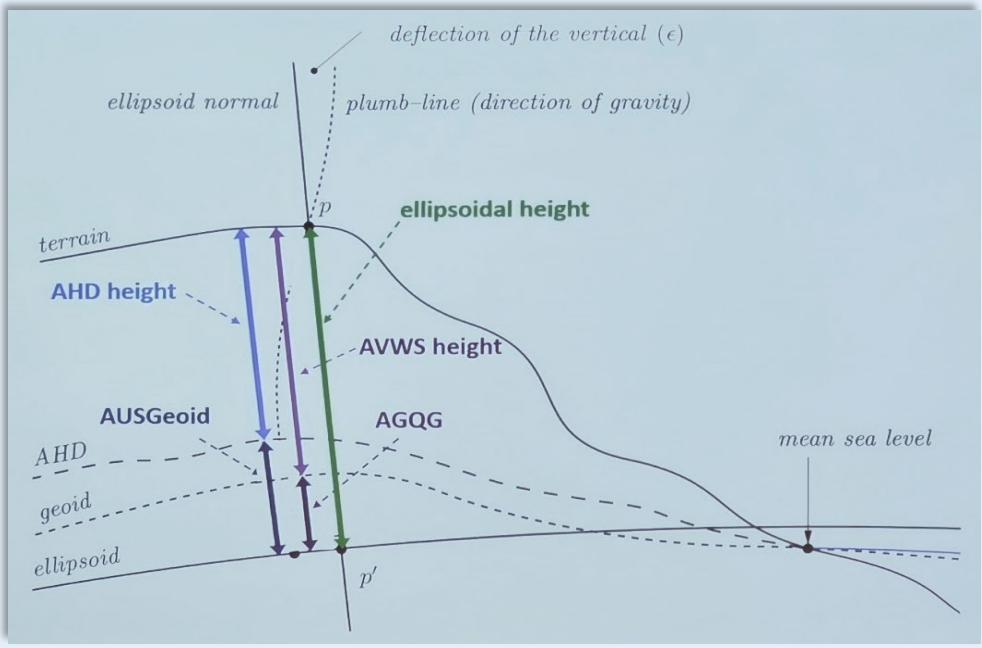


Two-frame Approach for Height in Australia

Dr. Craig Harrison, Geodetic Gravity Team Leader at Geoscience Australia, outlines Australia's two-frame height approach within the Australian Geospatial Reference System (AGRS). The Australian Height Datum (AHD), in use for over 50 years, remains the national standard, while the Australian Vertical Working Surface (AVWS), based on the Australian Gravimetric Quasi-Geoid (AGQG), offers a modern, GNSS-accessible alternative. The AVWS provides higher accuracy, free of AHD's biases, for applications requiring precision over large areas. Upgrades to AHD, AUSGeoid2020, and AGQG, alongside stakeholder engagement, support seamless transitions between systems.

The AVWS enhances accuracy for GNSS-based height determination, while AHD upgrades maintain its relevance. Stakeholder engagement ensures the dual approach meets diverse needs without disruption.

This two-frame strategy balances tradition with innovation, preserving AHD's widespread use while introducing AVWS's superior precision. The approach minimizes disruption, catering to varied applications like offshore surveying. Future efforts could focus on automating transitions or integrating AVWS with emerging technologies. The stakeholder program is key to driving AVWS adoption, positioning Australia as a leader in modern vertical datum systems with global relevance.



Precision Comparison and Analysis of Online GNSS Positioning Services in Static Mode

Sandesh Upadhyaya's study compares the precision and accuracy of three Precise Point Positioning (PPP) services—CSRS-PPP, RTX-PPP, and RTKLIB-PPP—against the differential GNSS service AUSPOS in static mode. Using 24-hour GNSS data from four CORS stations over 15 days, the analysis evaluates PPP's suitability for surveying, engineering, and reference frame densification. CSRS-PPP demonstrated high precision and accuracy, RTX-PPP showed high precision but lower accuracy, while RTKLIB-PPP achieved decimeter-level results, suitable for educational use.

CSRS-PPP and RTX-PPP meet precision needs for professional applications, potentially replacing differential GNSS in areas without RTK networks. RTKLIB-PPP is better for educational purposes. PPP offers cost-effective control point densification.

The study highlights PPP's potential to streamline geospatial tasks, particularly in regions lacking differential GNSS infrastructure. CSRS-PPP's superior performance positions it as a reliable, freely available tool for precise coordinate determination. Future research could explore real-time PPP applications or integration with emerging GNSS technologies to enhance accuracy. The findings underscore PPP's flexibility and economic benefits, paving the way for broader adoption in surveying and mapping, especially in resource-constrained environments.

Achieving Submillimeter Geospatial Position Precision Using Multiline Traversing®, a Hybrid of Triangulation, Trilateration and Traversing

Professor Akajiaku Chukwuocha introduces Multiline Traversing®, a hybrid method combining triangulation, trilateration, and traversing, achieving submillimeter geospatial position precision. Using total stations with 2” angular and 2 mm + 2 ppm distance accuracy, the method involves multiple back and forward sightings, forming triangle systems without trigonometric computations. In an 800 m traverse, triple-line traversing yielded 100% submillimeter precision (75% at 0.2–0.5 mm), while double-line traversing achieved 92% submillimeter precision (58% at 0.3–0.6 mm), improving traditional traversing by 64%.

Multiline Traversing® delivers unprecedented submillimeter precision, surpassing GNSS’s 10 cm accuracy for short-range surveys. It’s ideal for high-precision applications like shipbuilding, dam monitoring, and bridge construction.

This innovative method revolutionizes precision surveying, offering a practical alternative to GNSS for small-scale, high-accuracy tasks. Its simplicity and reliance on existing total stations enhance accessibility. Future adoption of 0.5 mm precision instruments could push precision to micrometer levels, meeting super-precision demands. Wider testing across diverse environments and integration with automated systems could further validate its potential, positioning Multiline Traversing® as a game-changer in geodetic applications globally.

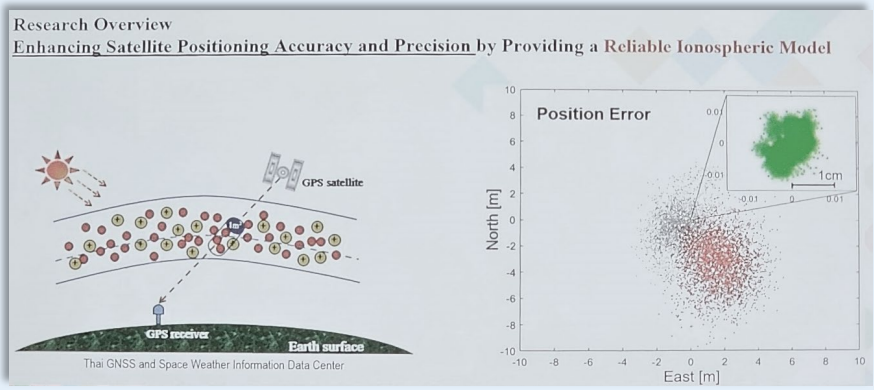
Forecasting Ionospheric Process Noise Using Long Short–Term Memory Network

Parvaneh Sadegh Nojehdeh and Kourosh Khoshelham from the University of Melbourne propose a Long Short-Term Memory (LSTM) neural network approach to forecast ionospheric process noise for Precise Point Positioning Real-Time Kinematic (PPP-RTK) applications. Accurate ionospheric corrections enhance GNSS positioning by improving Integer Ambiguity Resolution (IAR). Due to latency in correction delivery, dynamic models with precise process noise variance are critical.

The LSTM model leverages historical data from GNSS stations (SGOC, CUT0, PALM) to predict noise, incorporating solar flux, Kp index, and seasonal variations. Validated across diverse geographic locations, the model achieved RMSE values below 0.11 mm/√sec, ensuring high IAR success rates (>99.9%).

The LSTM model outperforms nominal noise values (1 mm/√sec), achieving RMSEs of 0.06–0.11 mm/√sec for CUT0 (2013–2023). An ablation study confirmed the importance of combining past noise data with solar and seasonal features. The model's generalizability was validated at equatorial and high-latitude stations, enhancing IAR performance during low solar activity.

This LSTM-based approach revolutionizes PPP-RTK by providing reliable ionospheric noise forecasts, reducing dependency on real-time data. Its adaptability to regional ionospheric variations makes it scalable globally. Future work could explore RMSE thresholds for consistent IAR success or integrate real-time solar data for enhanced predictions. The method's success in diverse conditions highlights its potential for surveying and navigation, particularly in areas with limited GNSS infrastructure, advancing precise positioning efficiency and accuracy.

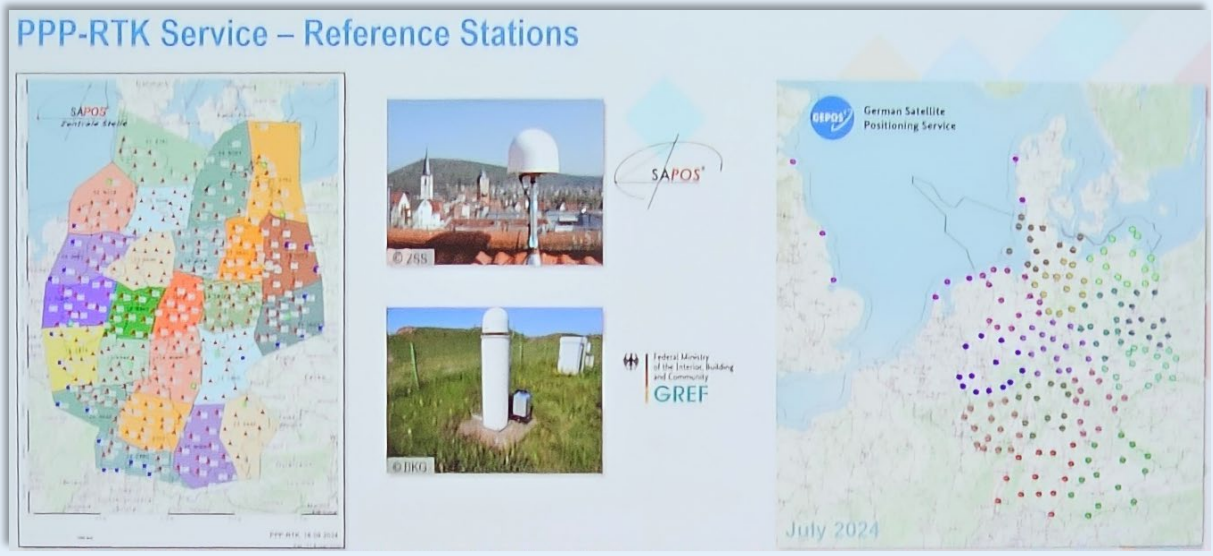


The New Open Data PPP-RTK Service in Germany as an Element of Digital Infrastructure

Dr. Axel Rülke, Head of Satellite Navigation at Germany's Federal Agency for Cartography and Geodesy (BKG), introduces GEPOS, a new open data PPP-RTK service developed with the Surveying Authorities of the German Laender (AdV). Broadcasting state space representation (SSR) corrections via internet nd digital audio, GEPOS delivers centimeter-accurate real-time positioning using the open SSRZ format. It supports applications like cadastral surveys, precise farming, seaborne positioning, and automotive navigation, aligning with growing global GNSS market demands (€580 billion by 2033).

GEPOS ensures precision, availability, and interoperability as a national digital infrastructure component. It addresses challenges like incomplete RTCM SSR messages while offering robust quality assurance and diverse use cases.

GEPOS exemplifies a forward-thinking approach to geospatial infrastructure, leveraging open data to democratize high-precision GNSS services. Its broad application range enhances efficiency in industries and mass markets. Future improvements could focus on completing RTCM SSR standards or integrating AI for enhanced correction accuracy. The collaboration between BKG and AdV sets a model for national geospatial initiatives, with potential to influence global standards and support emerging technologies in navigation and automation.



Assessment of the Accuracy and Precision of Deviations in Control Points Through the Three-Point Resection Method Which Established Using Reorientation Traversing on a Single-Unknown Station to Solve the Two-Point Resection

A BSc. Surveyor from Sabaragamuwa University of Sri Lanka evaluates the accuracy and precision of the three-point resection method (TPRM) using reorientation traversing to establish control points, addressing limitations of the two-point resection method. The two-point method requires intervisibility and fails with multiple unknown stations. Reorientation traversing overcomes these by enabling resection of multiple unknown stations through a twofold traverse computation. The study uses the Kaestner-Burkhardt method (KBM) for approximate coordinates and least squares for precise resected coordinates, validated via a MATLAB function.

Reorientation traversing resolves multiple unknown stations, unlike two-point resection. TPRM with KBM and least squares ensures high precision, validated computationally.

This study advances land surveying by introducing reorientation traversing, enhancing flexibility for complex networks. Its computational validation via MATLAB suggests scalability and reliability. Future research could explore automation or integration with GNSS for broader applications. The method's ability to handle multiple stations could streamline surveys in challenging terrains, offering significant potential for cadastral and engineering projects, and setting a foundation for modernizing traditional surveying techniques globally.

Accuracy Assessment of Two Empirical Tropospheric Models Over Short Baselines GNSS Survey: Case study of Jinja-Uganda

A part-time technician from Kyambogo University investigates the accuracy of two empirical tropospheric models—Saastamoinen and Improved Hopfield—for GNSS surveys over short baselines in Jinja, Uganda. With Uganda's infrastructure development driving demand for cost-effective GNSS solutions, tropospheric effects, unmitigated by multi-frequency receivers, require robust modeling. The study compares model performance across hill and valley terrains, using baseline datasets to assess height determination accuracy. Results indicate that the Improved Hopfield model outperforms Saastamoinen, delivering superior baseline height accuracies in Jinja.

Improved Hopfield provides more reliable height accuracies than Saastamoinen. The study's focus on local terrain variations (hill vs. valley) ensures context-specific findings for Uganda's GNSS applications.

This research highlights the importance of tailoring tropospheric models to local conditions, enhancing GNSS accuracy for infrastructure projects in developing regions. The Improved Hopfield's success suggests its potential as a standard for Uganda. Future studies could expand to longer baselines or integrate real-time weather data for model refinement. The findings support cost-effective, precise surveying, critical for Uganda's development, and could guide similar assessments in other tropical regions with comparable atmospheric challenges.

On the Interoperability of Open Satellite-based Precise Point Positioning Services

A student from The Hong Kong Polytechnic University investigates the interoperability of satellite-based Precise Point Positioning (PPP) services, focusing on BDS-3 PPP-B2b, Galileo HAS, and QZSS MADOCA. Using data from Hong Kong (DOY 153–336, 2024), the study evaluates correction availability, orbit, and clock quality via signal-in-space range errors (SISREs). Combining services improved accuracy by 50.2% for uncommon constellations. Two combination strategies were compared: switching to HAS during MADOCA outages (superior performance) versus full combination, which may reduce accuracy due to HAS's variability.

MADOCA outperforms other services, but switching to HAS during outages optimizes positioning. Combining services enhances satellite availability and reliability, with significant accuracy gains for uncommon constellations.

This study underscores the potential of satellite-based PPP to enhance global positioning resilience. The switching strategy's success highlights the need for dynamic service selection, though full combination may dominate as service variability decreases. Future work could explore automated bias correction or integration with emerging GNSS systems. The findings are crucial for applications like aeronautics and orbit determination, positioning satellite-based PPP as a cornerstone for robust, high-precision geospatial solutions.

Background: Era of Multiple Open PPP Services

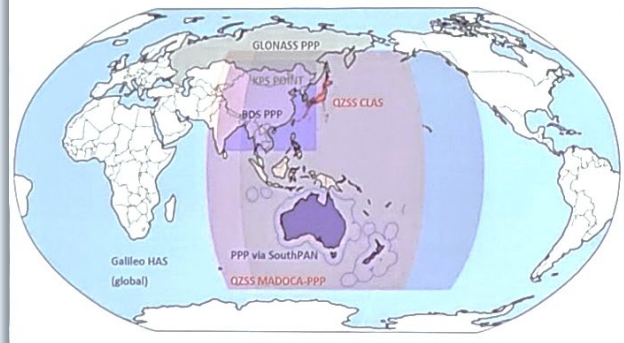


Fig.1 Service area of the PPP/PPP-RTK service

System	Service	Satellite	Status
QZSS CLAS	Nationwide PPP-RTK	IGSO/GEO	Operational (2018-)
QZSS MADOCA	Regional PPP	IGSO/GEO	Experimental (2017-)
Galileo HAS	Global PPP	MEO	Operational (2022-)
BeiDou PPP	Regional PPP	GEO	Operational (2020-)
SouthPAN PVS	Regional PPP	GEO	Early Open Services(2022-)
GLONASS PPP	Regional PPP	GEO	Concept (2030-)
KPS POINT	Regional PPP	IGSO/GEO	Development(2022-)

[1] PPP/PPP-RTK Service Providers Report

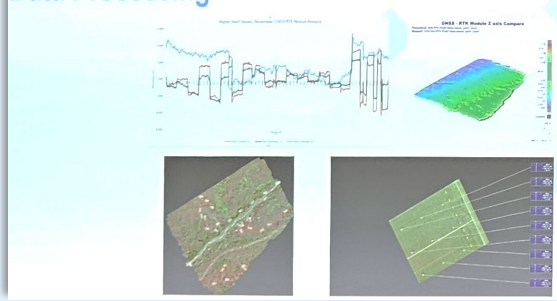
Comparative Accuracy of GNSS, NTRIP, and Base Station UAV Surveys

The study by Whomsley and Booth evaluates the accuracy of GNSS, NTRIP, and RTK base station methods for UAV surveys across rural, urban, and coastal UK sites using a DJI Mavic 3 Enterprise. Standard GNSS achieved 2-10m accuracy, while RTK-corrected methods (NTRIP and base station) reached sub-centimeter precision. Surveys at three sites with varied environmental challenges and a control site with GCPs were compared against total station data. Analysis involved EXIF data extraction, point cloud generation, and GCP distance measurements, revealing all methods achieved <25mm point-to-point accuracy, with the RTK base station consistently delivering <15mm.

The RTK base station outperformed others, achieving a mean accuracy of <10mm and <15mm upper bound, while NTRIP showed occasional <10mm precision but averaged <20mm due to connection variability. Standard GNSS struggled with altitude estimation (up to 4.8m range) in low satellite visibility conditions, like Higher Shelf Stones. Environmental factors, such as poor phone signals or coastal cliffs, impacted NTRIP and GNSS performance. Photogrammetry processing reduced deviations, with point cloud analysis showing 90% of distances within ±100mm compared to raw EXIF data.

The study underscores RTK base stations as the most reliable for high-precision UAV surveys, critical for applications like construction monitoring. NTRIP's potential is limited by connectivity issues, suggesting improvements in network infrastructure could enhance its viability. The correlation between UAV turning patterns and positional deviations highlights a need for refined flight planning. Future research should incorporate geodetic control networks and PPK to validate findings and address limitations, such as camera quality affecting GSD. These insights guide surveyors in selecting optimal positioning systems for specific environmental conditions.

Data Processing



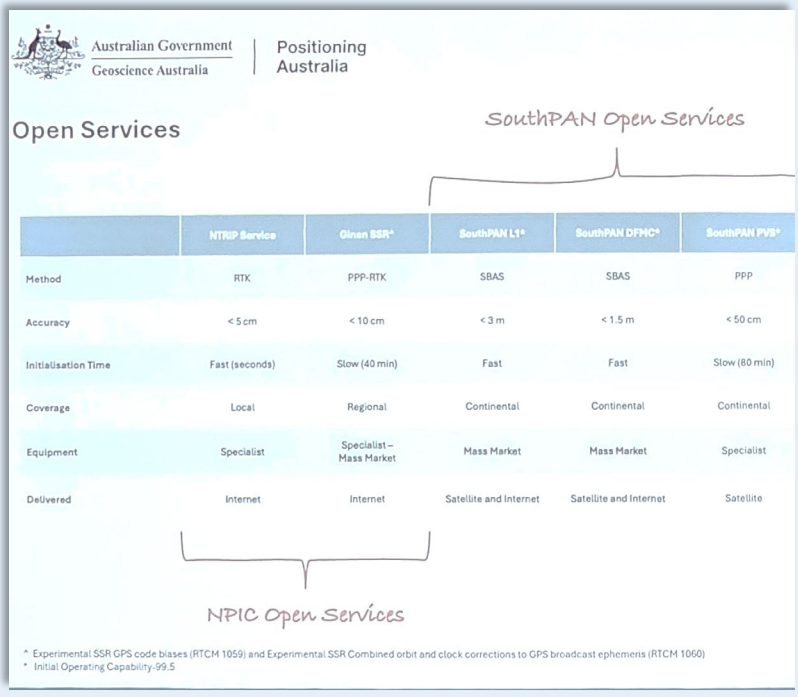
Analysis

Subject	Details
Altitude Estimation	When GNSS is corrected with RTK, the range in altitude estimation can be reduced by as high as 95% depending on the site conditions. In areas of poor GNSS coverage an onsite base station can significantly improve performance.
Poor turning circle	The raw data indicates that the turning circle of the drone is not consistent with each flight.
Processing interpolation	Cloud-cloud analysis displays significantly lower deviations than the raw data showing the level of photogrammetry interpolation. Could lead to errors.
GCP image overlap	GCP's not captured in the same image display higher point-point deviations, which increases at larger distances.
NTRIP inconsistency	The NTRIP system produced higher data ranges than the onsite base likely due to loss of connection or delays from the server.

A unified approach to Australia's positioning infrastructure

In 2018, Australia invested A$64 million in the National Positioning Infrastructure Capability (NPIC) to unify the management of positioning infrastructure. This initiative ensures consistent, high-accuracy positioning services for government, businesses, and academia. The NPIC provides open access to trusted reference station data, expands service coverage, and enables commercial providers to deliver cost-effective solutions across industries. An economic analysis projects A$545 million in economic benefits by 2038, with a A$2.58 return per dollar invested, impacting agriculture, mining, construction, and surveying. The unified approach enhances data quality and accessibility, fostering innovation and flexibility in service delivery.

The paper details practical applications and a future operating model to advance positioning technology. The NPIC's unified framework is a strategic leap, addressing fragmented infrastructure and boosting economic growth through precise positioning. Its open-access model democratizes high-quality data, benefiting diverse sectors. The projected economic returns highlight the value of investing in geospatial infrastructure. Future enhancements should prioritize scalability and integration with emerging technologies like GNSS and RTK to maintain global competitiveness. This model could inspire other nations to adopt similar unified approaches, though sustained funding and stakeholder collaboration will be critical for long-term success.

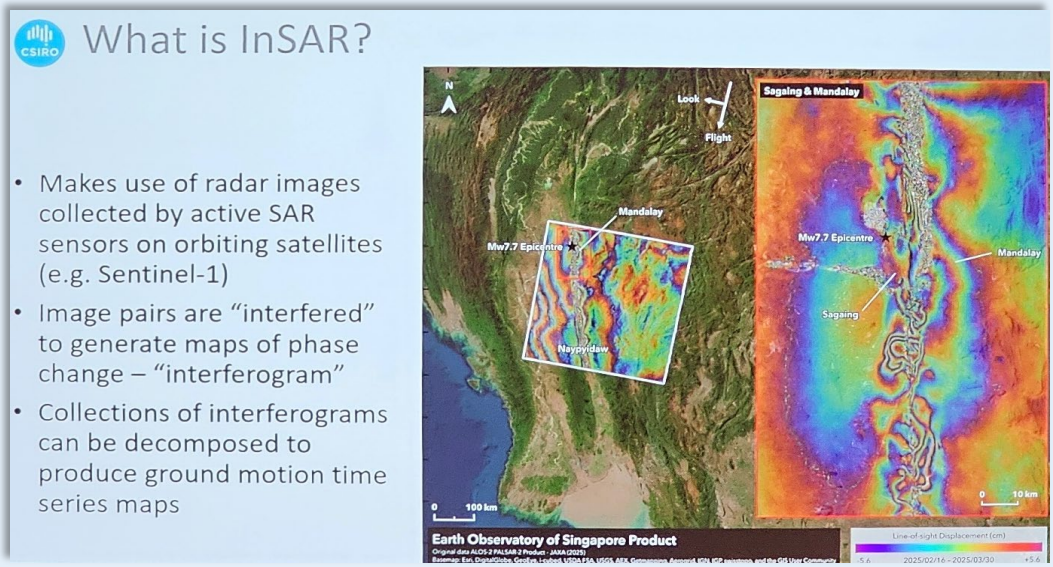


Opportunity for an Australian Ground Motion Data Infrastructure

Dr. Matt Garthwaite proposes a national-scale Australian ground motion data infrastructure using Interferometric Synthetic Aperture Radar (InSAR) from the Sentinel-1 constellation, which has collected radar images every 12 days since 2016. InSAR transforms these images Into millimeter-precise ground motion time series, enabling the mapping of subsidence and uplift. Demonstrated locally (e.g., 60 cm subsidence over two years at Tahmoor coal mine), this infrastructure is now feasible with advanced computational power.

The infrastructure would provide sub-kilometer spatial and bi-weekly temporal resolution data, revolutionizing research in coastal sea level rise, infrastructure monitoring, resource extraction, and urban planning. Europe's open-access InSAR service and New Zealand's partnership with a UK firm serve as models. It would stimulate industry growth by leveraging commercial satellite data at identified "hot spots."

This initiative could transform Australia's geospatial capabilities, offering precise data for critical applications. Its open-access model aligns with global trends, fostering collaboration across government, academia, and industry. Challenges include securing funding and computational resources. Integrating commercial data could enhance resolution at key sites, but scalability and data accessibility must be prioritized to maximize impact, potentially positioning Australia as a leader in InSAR applications.

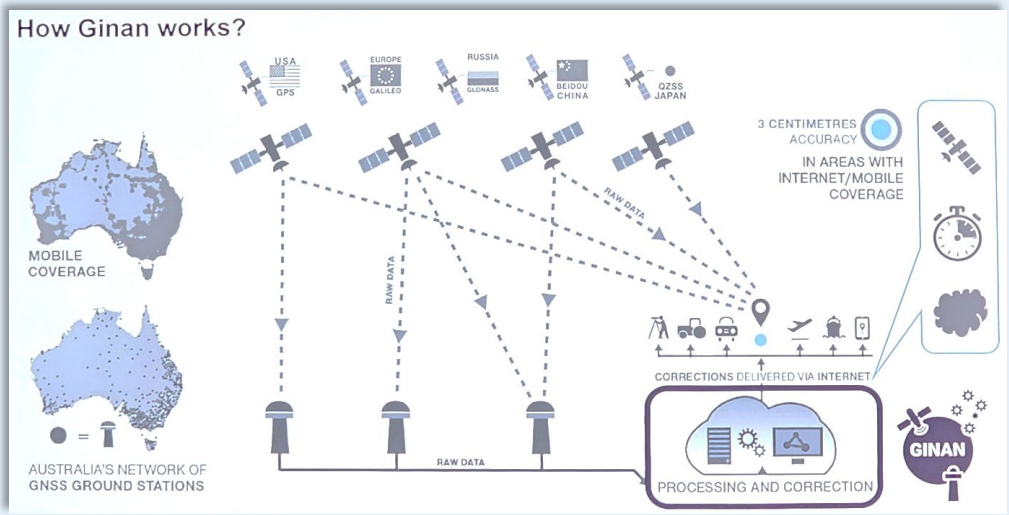


Ginan: Evaluating Multi-GNSS Precise Point Positioning for Surveying Applications

Dr. Eugene Du presents Ginan, an open-source multi-GNSS Analysis Centre Software developed by Geoscience Australia. Built on State Space Representation and Precise Point Positioning (PPP) models, Ginan supports real-time correction services and user-level PPP positioning. Written in multi-threaded C++ with YAML configuration, it uses a Kalman filter, data pre-processor, and orbit integrator for robust processing of RTCM3 and IGS data, enabling applications like kinematic tracking and atmospheric modeling.

Ginan's multi-GNSS PPP capabilities outperform single-constellation (e.g., GPS-only) solutions, leveraging GPS, Galileo, GLONASS, and BeiDou for enhanced precision. Evaluations show improved static positioning accuracy over 1–24-hour spans and faster convergence times with multi-GNSS. Kinematic PPP benchmarking against short-baseline RTK reveals Ginan's strengths and limitations in dynamic surveying, supporting geodetic and navigation tasks.

Ginan's open-source, flexible architecture positions it as a powerful tool for modern surveying, particularly with multi-GNSS integration enhancing accuracy. Its real-time and post-processing capabilities suit diverse applications, though kinematic PPP may lag RTK in some dynamic scenarios. Scalability and user adoption could be challenges, requiring robust training and support. Future enhancements should focus on optimizing convergence times and integrating emerging GNSS signals to maintain its edge in precision surveying.



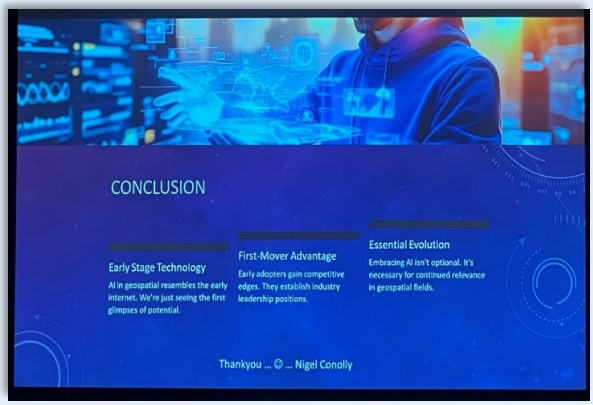
AI in Geospatial

The presentation on the transformative role of AI in the geospatial industry by Nigel Conolly is both insightful and compelling. It underscores the necessity for professionals in the geospatial field to embrace AI-driven workflows to remain relevant and competitive. The paper highlights the potential for a significant increase in productivity—up to 600%—through the integration of AI, which is a remarkable proposition.

The historical development of AI in geospatial science is meticulously traced, from early rule-based systems to the current era of real-time AI and big data analytics. This evolution showcases how advancements in computing, remote sensing, and machine learning have progressively enhanced geospatial applications. Notable milestones include the introduction of neural networks in the 1990s, the machine learning revolution in the 2000s, and the rise of deep learning and cloud computing in the 2010s.

Key applications of AI in geospatial fields are presented with practical examples, such as automated land cover classification, disaster response, and predictive modeling. These applications demonstrate AI's capability to handle and analyze vast spatial data efficiently, providing real-time insights and supporting decision-making processes. The paper also illustrates how AI can revolutionize industries like precision agriculture, insurance, and real estate by improving yields, enhancing risk assessments, and accelerating transactions.

The concept of leveraged growth is particularly compelling, suggesting that AI can drastically reduce the time required to develop geospatial applications. This is exemplified by the comparison between traditional methods and AI-assisted workflows, where tasks that once took months can now be completed in minutes.

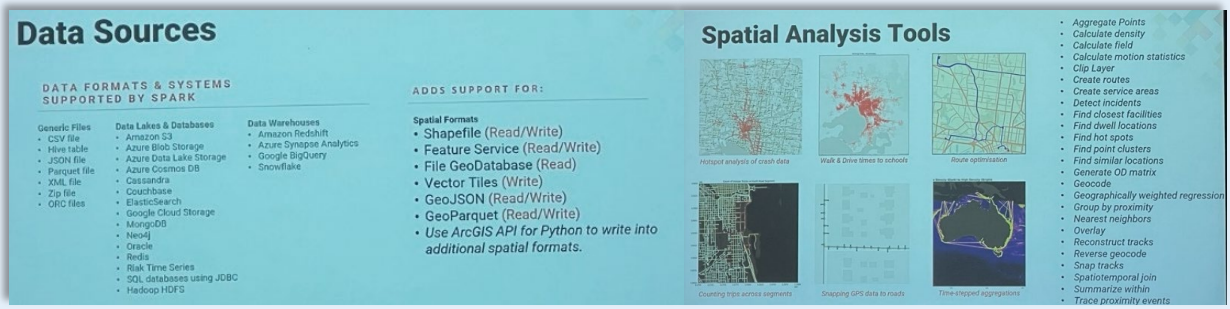


In conclusion, the presentation emphasizes that adopting AI in geospatial applications is essential for future career success. Professionals who fail to integrate AI risk falling behind in an increasingly AI-centric world. The paper effectively articulates the value of AI in geospatial, making a strong case for its adoption to unlock unprecedented opportunities and enhance professional impact.

The presentation on Esri's GeoAnalytics Engine, showcased within the Databricks environment, was a compelling exploration of how advanced geospatial analysis is revolutionizing big data workflows across industries. The integration of Esri's GeoAnalytics Engine with Databricks reflects a seamless blend of scalability and precision, enabling organizations to tackle complex spatial challenges with remarkable speed and efficiency.

One of the most impactful aspects of the presentation was the demonstration of the engine's 120+ spatial SQL functions and 15+ spatial analysis tools. These capabilities open doors for nuanced geospatial operations, including hotspot detection, spatial joins, and spatiotemporal analysis. By visualizing real-world use cases, the presentation provided a clear understanding of how these tools are enabling decision-making processes in fields like urban planning, resource management, and environmental monitoring. What stood out was the emphasis on interoperability—the integration of diverse geospatial data sources within Databricks and Esri's GIS suite ensures that organizations can derive actionable insights from vast datasets without compromising efficiency or accuracy. The fusion of data science workflows with spatial analytics promises a transformative approach to problem-solving.

The presentation was an insightful reminder of the pivotal role geospatial intelligence plays in driving innovation. By leveraging these advanced tools, industries can significantly enhance their ability to address critical issues with precision and foresight. The session not only highlighted the cutting-edge features of the GeoAnalytics Engine but also served as an inspiring vision for the future of data-driven spatial analysis. Its potential to reshape geospatial workflows is truly a game-changer.

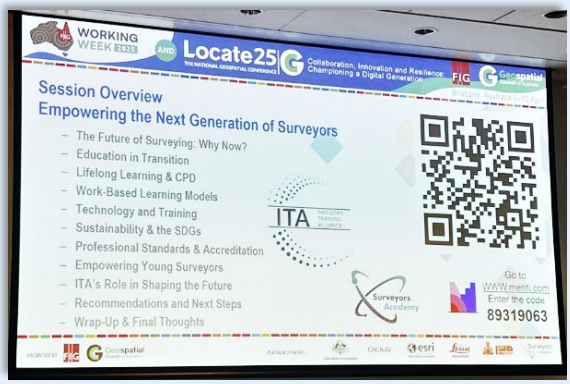


Diversity and Inclusion Task Force Sustaining Geospatial Innovation – The Hope of the Young Surveying Explorer

The presentation effectively underscores the pivotal role of education in advancing the surveying profession to meet global challenges. By integrating cutting-edge technologies like GeoAI and big data analytics, it highlights the necessity for surveyors to be equipped with modern skills to address issues such as climate change and infrastructure resilience.

A particularly insightful aspect is the emphasis on early exposure to surveying initiatives. This not only helps address the skills shortage in the field buconcepts through school-based t also inspires younger generations to consider surveying as a viable career path. The article's focus on participatory methodologies and blended learning further underscores the importance of an inclusive and adaptive educational approach.

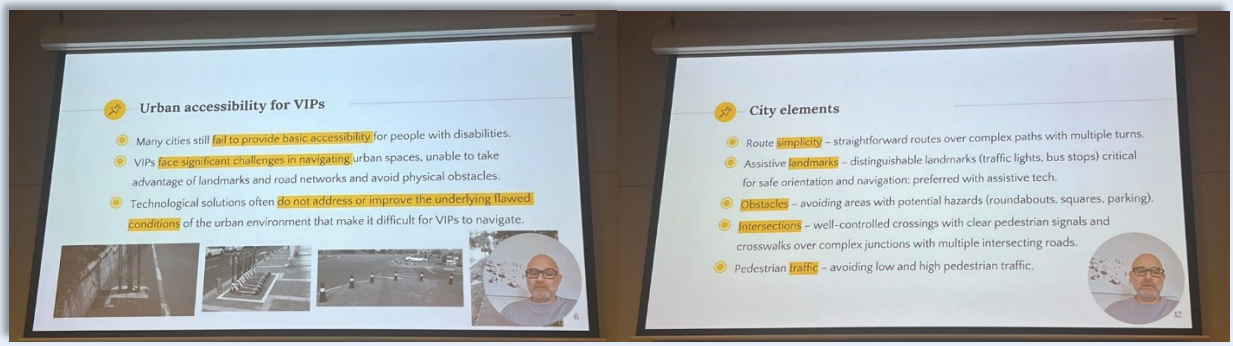
The transformative potential of blended learning and participatory methodologies is well-articulated, showcasing how these approaches can inspire a new generation of surveyors. The visit to the surveying museum further reinforces the importance of understanding historical advancements in the field and how they shape future innovations.



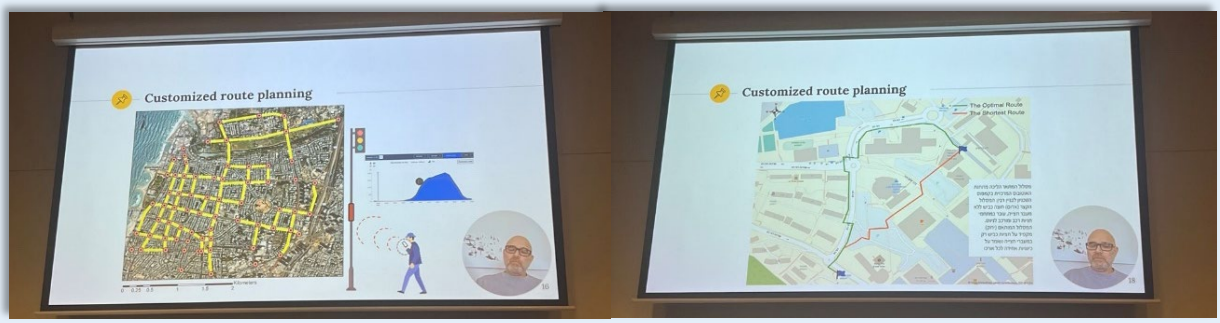
Overall, the presentation provides a comprehensive overview of how education can drive sustainable development, strengthen global partnerships, and prepare the surveying profession to thrive in an increasingly digital and interconnected world. By embracing new technologies and fostering inclusive learning methods, surveyors will be better prepared to contribute meaningfully to global sustainability efforts.

Mobile Technologies for Inclusive Sidewalk Mapping

This presentation provided an in-depth look into urban accessibility and walkability for visually impaired pedestrians (VIPs). The discussions revolved around customized route planning, geospatial intelligence, and assistive mapping technologies, all essential elements in shaping inclusive cities.



One of the core themes explored was the physical and temporal urban factors affecting VIPs' mobility. Elements like tactile paving, lighting conditions, pedestrian flow, and street obstacles significantly influence accessibility. VIPs often prefer longer but safer routes, avoiding areas with complex intersections or crowded walkways.

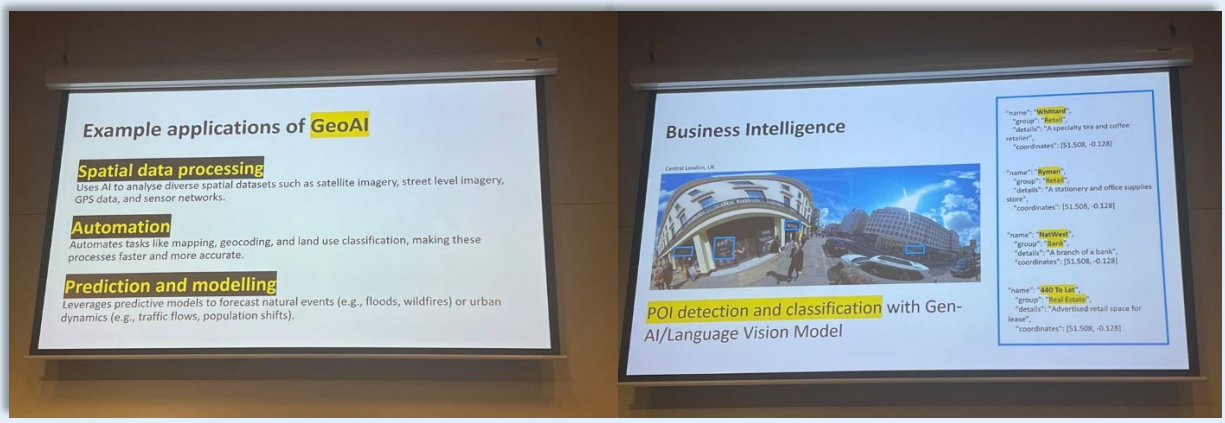


Another key topic was Mundi – Accessibility Mapping (Beta) and its contributions to OpenStreetMap (OSM). By integrating real-world accessibility tags, users can enhance route planning with precise data on crosswalks, landmarks, and assistive services. Similarly, web tools like TouchMapper allow for 3D-printed tactile maps, empowering VIPs to navigate independently.

The presentations also touched on assistive landmarks smart intersections, and how geospatial analytics support decision-making in urban planning. Mapping platforms play a transformative role, ensuring cities are not just efficient but also equitable for those with mobility challenges.

Ultimately, creating human-centered cities requires a combination of policy, technology, and community participation. By leveraging crowdsourced data, AI-powered route optimization, and smart city initiatives, urban spaces can become more inclusive for all individuals, regardless of ability.

This presentation highlights the significance of inclusive sidewalk mapping as a crucial element in urban mobility and accessibility. It acknowledges that sidewalks are often overlooked in broader infrastructure planning, yet they play an essential role in ensuring equitable movement for all pedestrians, particularly those with disabilities. The emphasis on mobile technologies and AI-driven mapping suggests a forward-thinking approach, where data collection, spatial analysis, and geospatial intelligence can reshape urban navigation. By leveraging innovative tools, cities can transition from traditional models to more dynamic, user-centered designs, ensuring that pedestrian environments are safe, navigable, and well-integrated into urban planning.



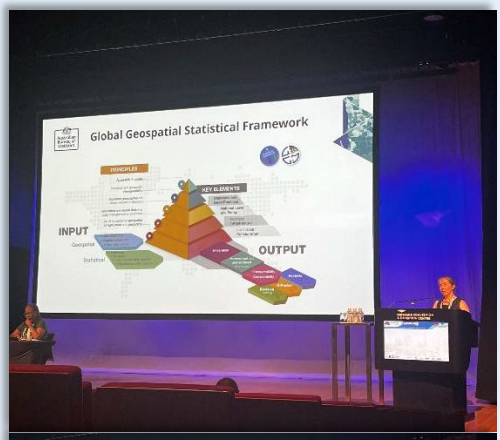
This initiative reflects a broader push toward inclusive urbanism, where accessibility is not just a secondary concern but a key driver in shaping the built environment. It's encouraging to see technology being applied in such impactful ways, directly improving the daily experiences of individuals who rely on pedestrian networks the most.

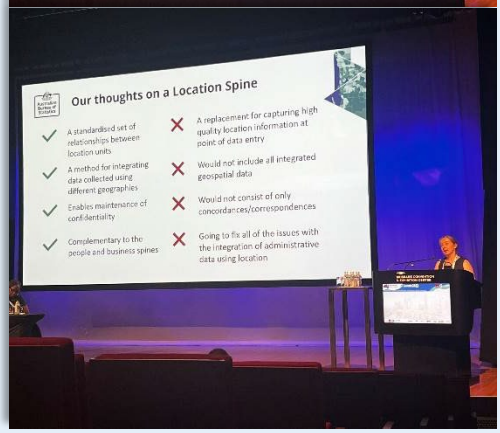
Platforms like footpath.ai employ street-level imagery and machine learning to create multimodal sidewalk maps, catering to both humans and autonomous systems. These efforts support pedestrian infrastructure projects, as seen in Sydney's extensive mapping of 750+ km of footpaths.

Another significant focus is crowdsourced geospatial data, with research evaluating the trustworthiness of OSM sidewalk data across cities such as Chicago, Seattle, and New York. Automated data enrichment improves accuracy and accessibility, bridging gaps in urban mobility.

The presentations also address urban heat mitigation, highlighting sidewalk canopy coverage for cooler pedestrian environments. AI-driven mapping solutions analyze shading levels and optimize city-wide infrastructure. Ultimately, these projects underscore the transformative potential of AI-powered geospatial analysis, fostering safer, more inclusive, and sustainable cities.

Spatial Planning and Disaster Risk Management



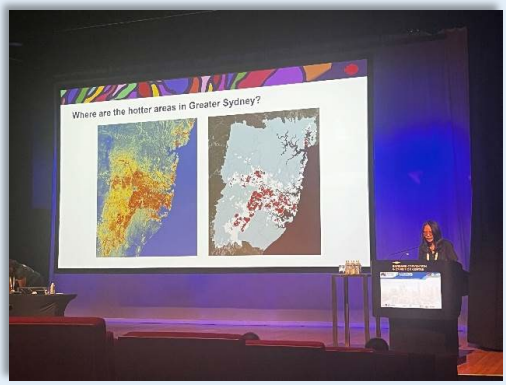


This presentation highlighted the increasing role of geospatially-enabled statistical infrastructure in supporting evidence-based decision-making for governments. Statistics coded to geography are essential in addressing policy challenges such as climate change, disaster management, social disadvantage, and economic development. By leveraging administrative data collected through various government programs, countries can enhance efficiency while reducing the cost of generating reliable statistics.

A key takeaway was the concept of a "location spine," which links different geographic units to maximize the utility of administrative data. The session underscored the growing complexity of geographic data management, particularly due to the lack of agreed international geocoding standards, which poses challenges in efficiently using administrative datasets for policy formulation.

The Australian Bureau of Statistics (ABS) showcased its progress in developing geospatially-enabled statistical systems, aiming to improve decision-making processes across various sectors. The presentation reinforced the importance of collaboration between policymakers, data providers, and statisticians to establish a standardized framework for spatially-coded statistics.

The development of the Heat Vulnerability Index (HVI) toolkit was a significant highlight, demonstrating how Earth observation data combined with socio-economic indicators can empower local governments to tackle urban heat risks. This approach underscores the importance of accessible tools for climate adaptation and informed decision-making.



The Akosombo Dam Spillage Event 2023 case study further emphasized the critical role of data-driven disaster management. The use of GIS and remote sensing for real-time monitoring demonstrated cross-sector collaboration's importance in mitigating flood impacts.

Overall, the presentations underscored the profound impact of geospatial intelligence, interdisciplinary collaboration, and innovative planning in shaping sustainable, disaster-resilient communities. These insights reaffirm the necessity of leveraging technology and collaboration for a more secure and sustainable future.

Hydrography for a Sustainable Future: Solutions for People, Planet, and Progress

Impact of Echo Sounders on Marine Mammals

Marine mammals such as whales, dolphins, and dugongs rely on sound for communication and echolocation, but anthropogenic noise can disrupt their signals, resulting in behavioral changes, hearing damage, and injuries. Evidence from studies highlights the impact of multibeam echo sounders (MBES). For example, acoustic signals from an MBES caused a mass stranding of 100 melon-headed whales in Madagascar's Loza Lagoon in 2008. Similarly, behavioral alterations were were observed in beaked whales exposed to single beam echo sounder signals.

Indo-Pacific humpback dolphins (top) and Irrawaddy dolphins (bottom) in the coastal waters of Matang, Perak, Malaysia

Photo: MareCet Research Organization

A dugong herd, including the presence of mother-calf pairs, sighted during aerial surveys around Sibu Island, Johor, Malaysia.

Photo: The MareCet Research Organization

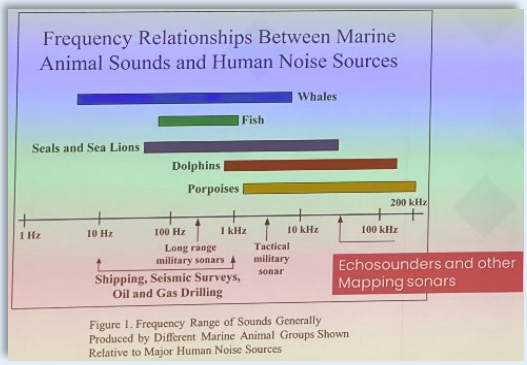
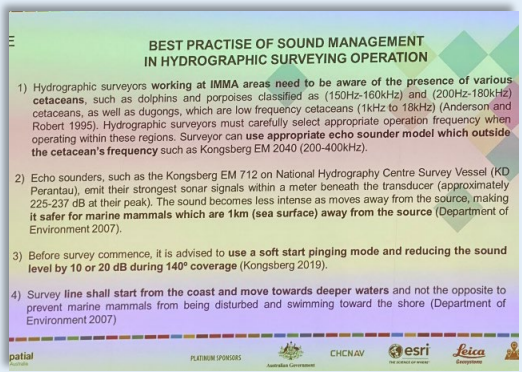


Figure 1. Frequency Range of Sounds Generally Produced by Different Marine Animal Groups Shown Relative to Major Human Noise Sources

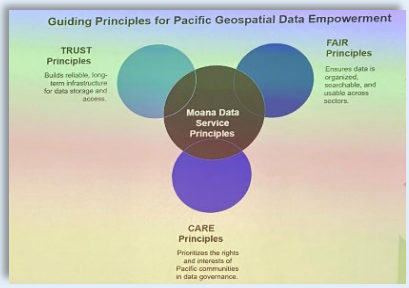
However, contrasting findings from 2020 suggest that Cuvier's beaked whales showed no changes in foraging behavior when exposed to MBES emissions. These results highlight the need for precautionary measures in hydrographic surveying, especially in Important Marine Mammal Areas (IMMA).

Best Practices in Survey Operations

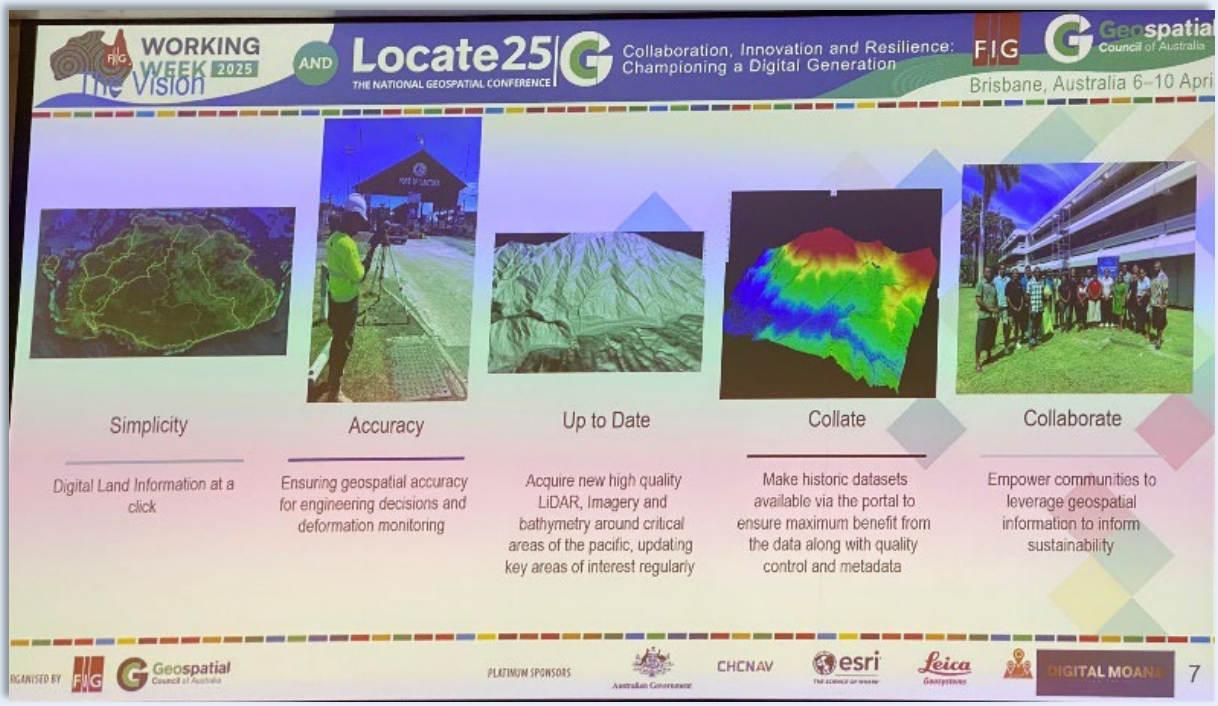
Surveyors should tailor echo sounder frequencies to avoid interference with cetacean communication. For instance, high-frequency devices like Kongsberg EM 2040 (200-400kHz) are preferred for minimizing impact. Additionally, adopting soft-start pinging modes and commencing surveys from coasts toward deeper waters reduce disturbance to marine mammals. Implementing sound management guidelines sets a new standard for hydrographic surveying, ensuring Malaysia's waters are charted responsibly while protecting vulnerable marine species.



Moana Data Service - Sustainable Geospatial Data



The Pacific Islands face challenges in geospatial data access, including limited local aerial survey companies, capacity shortages, high costs of LiDAR acquisition, and a lack of centralized repositories or standards. Reliance on development partners further complicates sustainable data management. The Moana Data Service, a Fijian-led initiative, aims to to provide accessible, high-resolution geospatial data, enabling informed policy decisions for community safety and prosperity. Rooted in principles like FAIR, CARE, and TRUST, Moana fosters regional collaboration, reduces costs, enhances climate resilience, and empowers governments to manage strategic datasets. By May 2025, Phase 2 plans include acquiring and integrating 800 km^2 of airborne data.



Innovations and AI in the Field of Property Values

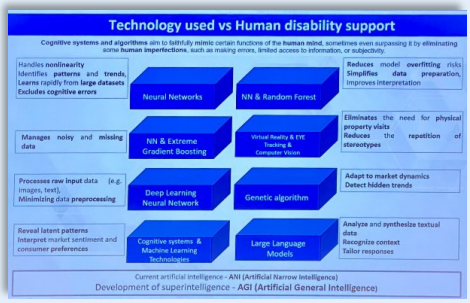
The application of Artificial Intelligence (AI) and Automated Valuation Models (AVMs) is transforming the property valuation industry, introducing enhanced efficiency, transparency, and accuracy. Experts examined the progress, challenges, and ethical considerations that come with AI adoption, highlighting its role in shaping a more data-driven and dynamic approach to valuation.

Standardization and Data Interoperability in Real Estate

A major focus of the session was the importance of standardization in real estate data management, using Taiwan as an example of real estate price registration. Standardization through the ISO 19100 series enables open data formats that support innovative applications, such as identifying transaction hotspots. Experts emphasized how structured data encoding strategies—whether using Geographic Markup Language (GML) or CSV-based distribution methods—ensure interoperability in real estate transactions. Such frameworks improve market transparency, helping government and private entities make informed decisions while mitigating inconsistencies in real estate records.

AI, AVMs, and Blockchain Integration

AI-powered AVMs are revolutionizing property valuation, integrating machine learning with traditional economic modeling. The session explored how leading valuation organizations such as RICS, TEGoVA, and IAAO perceive AVMs, balancing human oversight with automation. While AI enhances objectivity and enables rapid property assessments, professionals underscored the necessity of maintaining ethical valuation practices. Blockchain integration is seen as a solution for improving data accuracy and governance, creating more reliable valuation models. The use of neural networks, cognitive systems, and deep learning enables better pattern recognition, market trend analysis, and simulation testing.



Challenges and Ethical Considerations

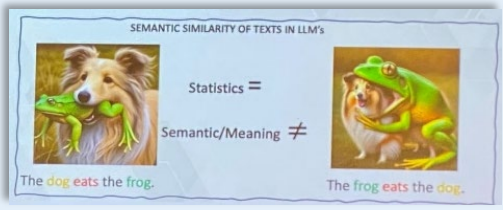
Despite AI's promise, the discussions acknowledged critical challenges, including data security, biases in valuation models, and the difficulty of applying AI in opaque property markets. The need for transparency in AI-driven valuations was underscored, reinforcing that human expertise remains essential in interpreting real estate trends, especially in complex scenarios.

Emotion Recognition and Property Attributes

An innovative part of the session examined how AI-driven emotion recognition could impact property valuations. By analyzing buyer responses to specific property attributes—such as location, window view, and technical condition—researchers can determine which factors evoke the most positive emotional responses. This process leverages facial emotion detection and eye-tracking technology to assess subconscious preferences, adding a new dimension to property valuation methodologies.

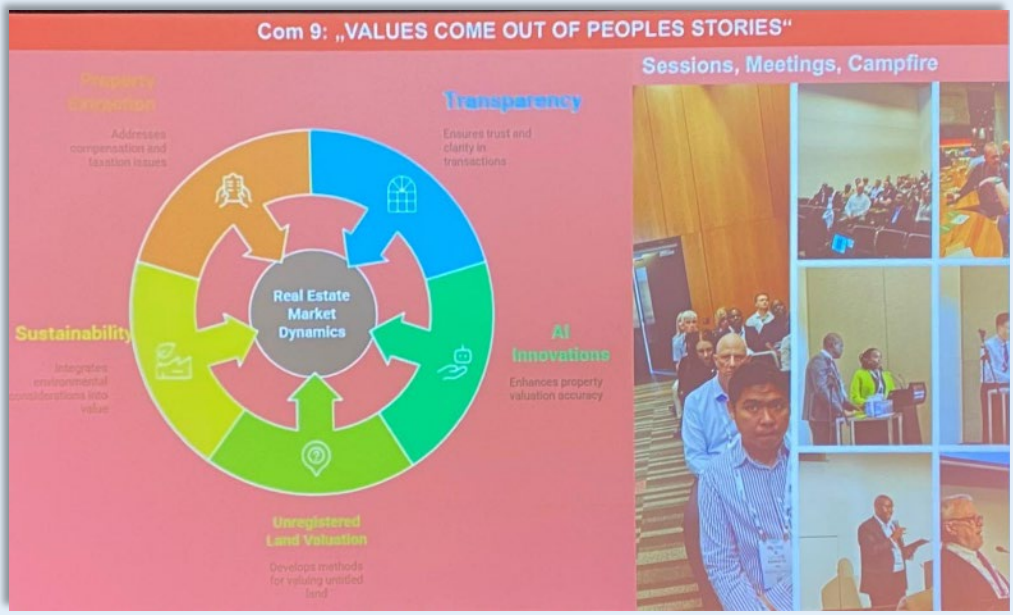
Future Directions and Recommendations

Experts laid out nine key recommendations to guide the future of AI-powered property valuation. These include fostering collaboration between valuers and technologists, advocating for clear regulatory frameworks, ensuring high-quality data standards, and investing in professional AI training. The adoption of blockchain, VR/AR technologies, and large language models was discussed as pivotal strategies for advancing valuation practices.



Conclusion

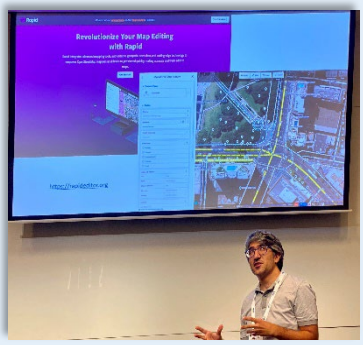
This session offered a fantastic exploration of AI innovations in property valuation, presenting a well-balanced discussion on both the advantages and challenges. The constructive debates highlighted the importance of ethical considerations, human oversight, and regulatory in shaping the future of property valuation. By acknowledging both the opportunities and risks, this discussion set the stage for informed AI adoption in the industry while championing best practices for sustainable and equitable real estate management.



Mobile Technologies for Inclusive Sidewalk Mapping : Outdoor Active Mapping

This engaging session offered us the opportunity to explore innovative tools for inclusive urban mapping through hands-on outdoor activities. It demonstrated cutting-edge technologies aimed at improving accessibility for individuals with mobility challenges.

The session focused on two key tools: an AI-powered computer vision system paired with a 360-degree camera and a smartphone app for direct community contributions to OpenStreetMap (OSM). Participants experienced these technologies in action by walking through Brisbane streets, mapping critical sidewalk features, and immediately observing updates on OSM. The highlight of the session was the integration of RapidEditor, an advanced OSM editing tool that leverages authoritative geospatial data for accurate and real-time map updates. This session also introduced apps like "My Walk" and "Vespucci," showcasing their features, such as user-friendly interfaces, automatic data uploads, and cross-platform compatibility. We had the chance to actively test these tools, gaining insights into how technology can bridge gaps in accessibility data.



The hardware demonstration included the use of a helmet-mounted 360 degree camera for real-time data capture and visualization. Within minutes, photos from the session were processed and integrated into OSM, demonstrating the efficiency of the workflow.

This hands-on session successfully illustrated how mobile technologies can empower communities to create more inclusive and accessible urban environments while actively engaging with mapping innovations.

Professional Education – Learning Methods and Syles in Surveying Education

Surveying education faces unique challenges, from staying current with rapidly evolving technology to preparing work-ready graduates who meet industry demands. Various innovative approaches have been explored to address these issues, emphasizing practical, engaging, and adaptable learning methods.

Project-Based Learning in Surveying Education

Project-based learning offers a compelling solution to bridge the gap between academic institutions' goals and industry expectations. This method allows students to lead large-scale, complex projects that involve research, fieldwork, data analysis, and reporting. A notable example is the capstone course for final-year surveying students at the UNSW, Australia. The course encouraging a collaborative, student-driven approach where the instructor assumes the role of a "client." Students take on leadership roles and develop soft skills. Assessment methods are holistic, combining literature reviews, presentations, final reports, and self-assessments, fostering both technical and professional maturity.

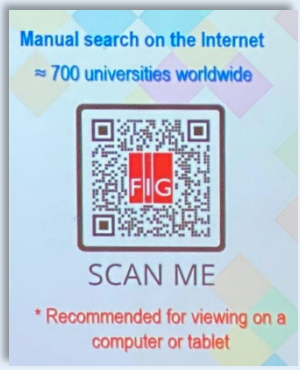
The flexibility of project-based learning allows educators to upskill alongside students, incorporate cutting-edge techniques, and engage with industry and community partners. Despite requiring significant effort and agility from educators, this approach enhances student engagement and empowers learners to tackle real-world challenges effectively.

Increasing the Pipeline of Surveying Graduates

A dedicated program, "Lifting the Veil," aims to attract and retain more students in surveying programs. With funding from industry, government, and professional organizations, the project focuses on raising awareness, fostering engagement, and encouraging application and enrollment in surveying degrees. It addresses barriers such as financial risks, limited geographic options for education, and identity struggles, particularly for first-generation university students.

The program adopts a multi-stage engagement strategy, starting with raising awareness about the profession through online platforms and career expos. Hands-on experiences, such as school holiday programs, work experience opportunities, and teacher professional development, help students interact with the field of surveying. These initiatives aim to create an emotional connection and align students' aspirations with the surveying profession, ultimately leading to increased enrollments.

Global Geomatics Education and Boundary Demarcation



A web-based initiative to map global geomatics education programs seeks to standardize and comprehensively document surveying studies across approximately 700 universities. It facilitates understanding of the diverse curriculums, professional requirements, and evolving trends in geomatics education worldwide.

In Spain, a proposed new paradigm for boundary demarcation emphasizes the need for professional qualifications and mandatory processes to resolve legal ambiguities in land ownership. By introducing rigorous standards, ethical codes, and CPD, this approach aims to enhance legal certainty, reduce disputes, and promote efficient land management practices.

Concluding Remarks

Surveying education is undergoing significant transformation, driven by innovative learning methods, targeted recruitment initiatives, and global collaboration. Overall, these initiatives represent a dynamic, forward-thinking approach to addressing challenges in surveying education while preparing students for meaningful careers.

This comprehensive exploration underscores that surveying education is evolving constructively, blending tradition with innovation to secure a robust future for the profession.

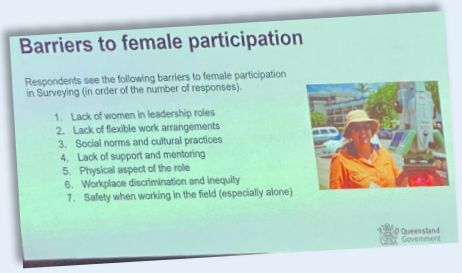
Women's Land Rights and Access to Land under Cadastre and Land Management

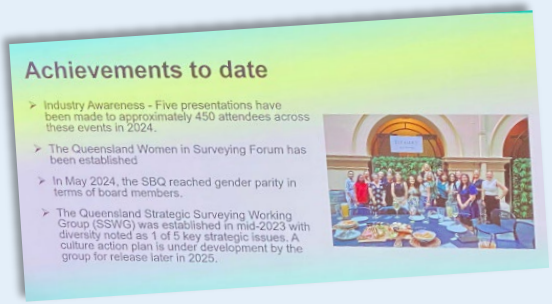
Women's Land Tenure Security (WOLTS) in Mongolia: Since 2015, the WOLTS project has worked with the National Land Agency (ALAMGAC) to develop gender-sensitive land governance tools addressing climate-related social and economic challenges facing Mongolian herders. A critical issue is pastureland degradation, reducing livestock productivity and affecting livelihoods. WOLTS promotes inclusive local land governance, ensuring women and men participate in land decision-making. A major achievement was the development of 'Gender Guidelines' integrated into national policies, aiding sustainable pastureland management.

Over 300 land officers received training on these guidelines in 2021-22. With increasing awareness, herders have gained confidence to defend their land rights against mining companies violating licensing and environmental standards. Successful protests highlight the importance of gender equity in land governance. The authors argue that formally adopting gender-inclusive policies at the national level will strengthen tenure security and land access.

Kiribati Women in Mapping (KWIM): Founded in 2020, KWIM empowers women in Geographic Information Systems (GIS), promoting gender equality and reducing poverty. The society consists of professionals including cartographers, land surveyors, and engineers. KWIM has undertaken projects such as mapping Betio and Buariki and well water salinity assessments, funded by regional organizations. Future plans include GIS training expansion, internships, scholarships, and employment opportunities for women. However, challenges such as funding shortages, lack of facilities, and limited government support hinder progress. Addressing these barriers would improve gender equality in GIS, allowing women to actively contribute to land governance.

Women in Surveying in Queensland: The surveying sector is vital to Queensland's economic growth but suffers from a severe shortage of surveyors, with female participation below five percent. A government-led research project investigated solutions to enhance female engagement. In response, the Department of Natural Resources and Mines launched the Women in Surveying program. Its four key initiatives include industry-wide awareness campaigns, a networking forum, female appointments to the Surveyors Board of Queensland (SBQ), and a strategic forum addressing diversity challenges. Since its inception, five industry presentations have raised awareness, and the Women in Surveying Forum has grown to 42 members.





In 2024, SBQ achieved gender parity. Although early in implementation, progress suggests that fostering an inclusive professional culture will attract and retain women in surveying, helping to meet future demand and sustaining land governance efforts.

Together, these initiatives highlight the importance of gender inclusion in land-related professions, strengthening women's access to land, securing tenure rights, and contributing to economic and environmental sustainability.

Exhibition

Visiting the exhibition booths at the FIG Working Week 2025 was one of the most engaging and informative aspects of the event. The exhibition hall was a vibrant hub filled with cutting-edge technology, innovative solutions, and industry leaders showcasing the future of surveying, mapping, and geospatial sciences.

As I walked through the booths, I had the opportunity to interact with representatives from global companies, government agencies, academic institutions, and professional organizations. Each booth offered unique insights into advancements in areas such as GNSS, LiDAR, UAVs, BIM, and smart land management systems. The hands-on demonstrations and live presentations allowed me to better understand how these technologies are transforming the way we collect, analyze, and apply spatial data.

In addition to exploring new tools and software, I also learned about ongoing research projects, educational programs, and sustainable development initiatives being supported by the geospatial community. Many exhibitors were eager to share knowledge, answer questions, and discuss potential collaborations.

The exhibition was also a great networking space, where I connected with professionals and experts from different parts of the world. Overall, the visit to the FIG 2025 exhibition booths was both educational and inspiring, highlighting the innovation and passion driving the future of the surveying profession.

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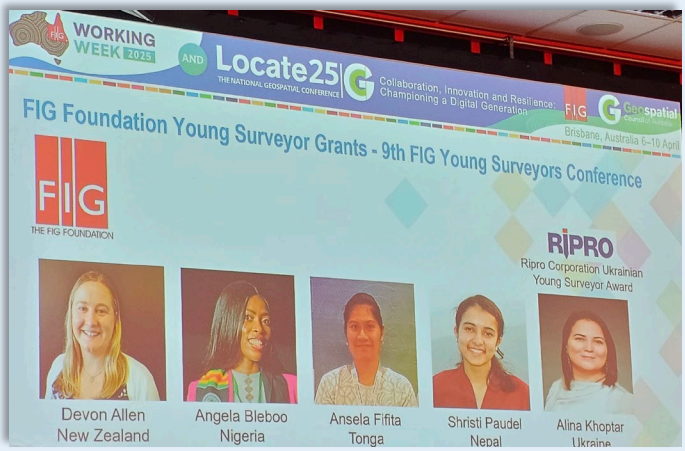
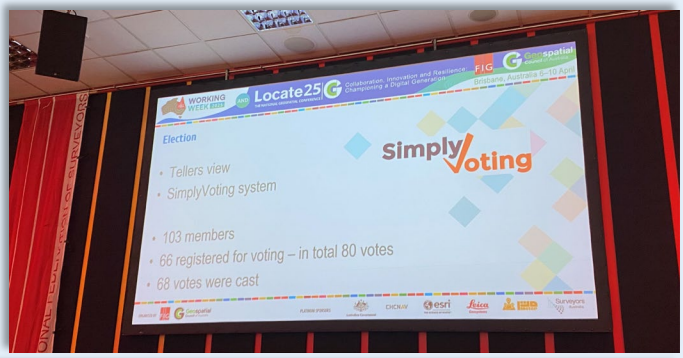
FIG Working Week 2025 Closing Assembly

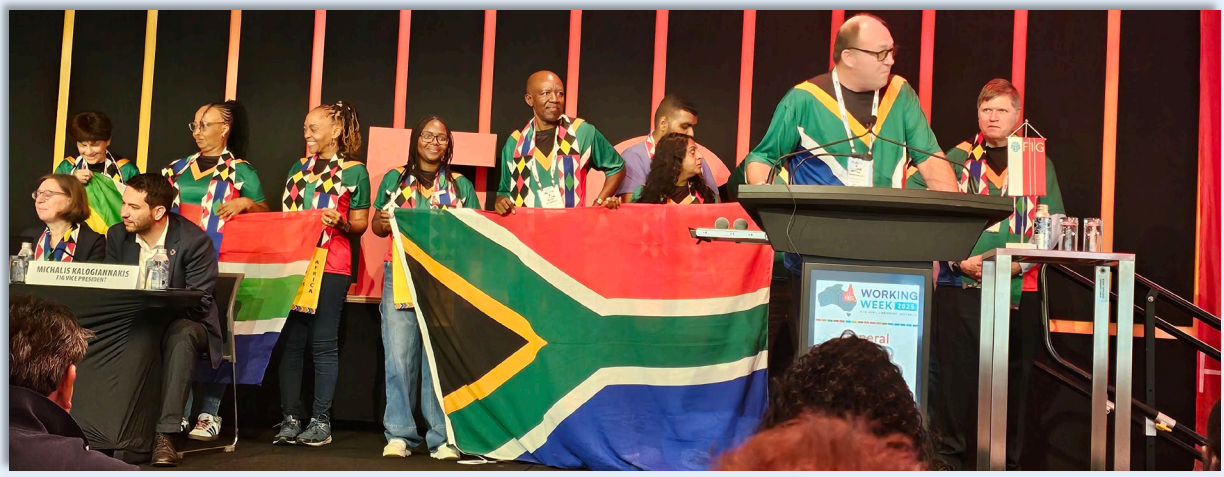
Participating in the closing assembly was a truly meaningful and memorable experience in my professional journey. As the final event of an inspiring and action-packed week, the closing assembly brought together delegates, speakers, and organizers from across the globe to reflect on the achievements, insights, and connections made during the conference.



The atmosphere at the closing assembly was celebratory and forward-looking. Highlights of the week were recapped, including keynote speeches, technical sessions, workshops, and networking events that fostered innovation and professional growth. The organizing committee expressed gratitude to the participants, sponsors, and volunteers whose efforts made the event a success.

One of the most inspiring moments was the symbolic handover to the next host city, which underscored the continuous and evolving nature of the FIG's mission. It was a reminder that while the Brisbane FIG Working Week 2025 had come to a close, the momentum and ideas generated would carry forward.





Overall, my participation in the closing assembly reminded me of the value of collaboration and lifelong learning. I left the event feeling energized and motivated to apply new insights and strengthen professional relationships developed throughout the week, with a renewed passion for contributing to the future of our profession.

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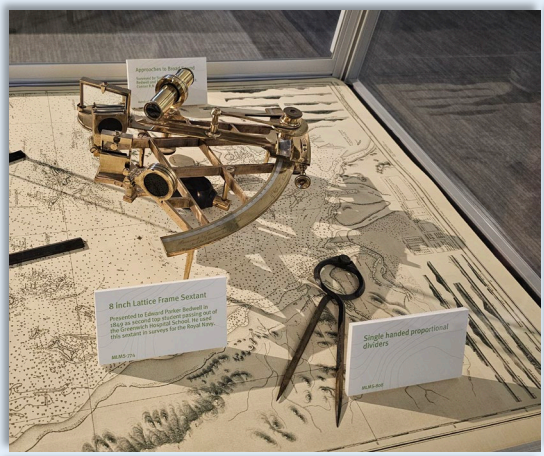
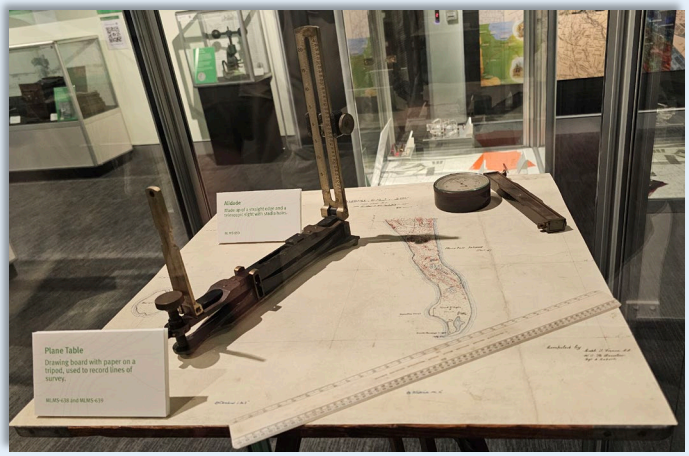
Technical Visit – Museum of Lands, Mapping and Surveying

The Visit

A visit to the Museum of Lands, Mapping and Surveying in Brisbane offers a fascinating journey through Queensland's geographical and cartographic history. Nestled in the heart of the city, the museum showcases the evolution of land exploration, mapping techniques, and surveying tools that have shaped the state since the early colonial period.



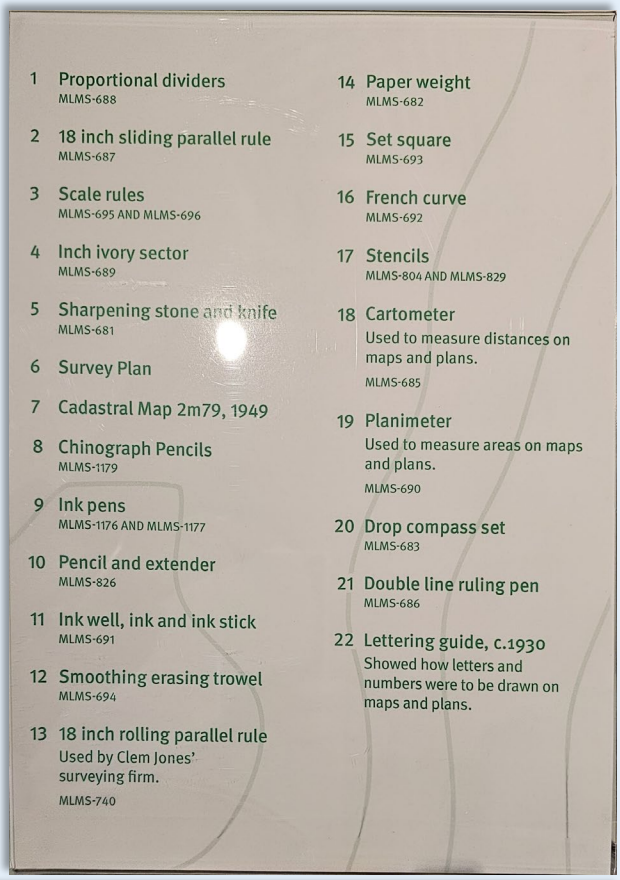


Upon entering, visitors are greeted with detailed maps from various eras, illustrating how perceptions and representations of the land have changed over time. The museum features historic surveying instruments, such as theodolites, compasses, and chains, highlighting the ingenuity and challenges faced by early surveyors navigating uncharted territory.

Digital archives provide insights into how land ownership and use have transformed through legislation and development. One of the highlights is the cadastral maps used for defining property boundaries, which reveal the historical layout of Queensland's towns and rural areas.

The museum also pays tribute to the significant role of Aboriginal land knowledge, acknowledging traditional custodianship and mapping practices. With a strong educational focus, the exhibits appeal to students, professionals, and anyone interested in geography, history, or urban planning.

Overall, the Museum of Lands, Mapping and Surveying offers an enriching experience, connecting visitors to the foundation of Queensland's modern landscape.



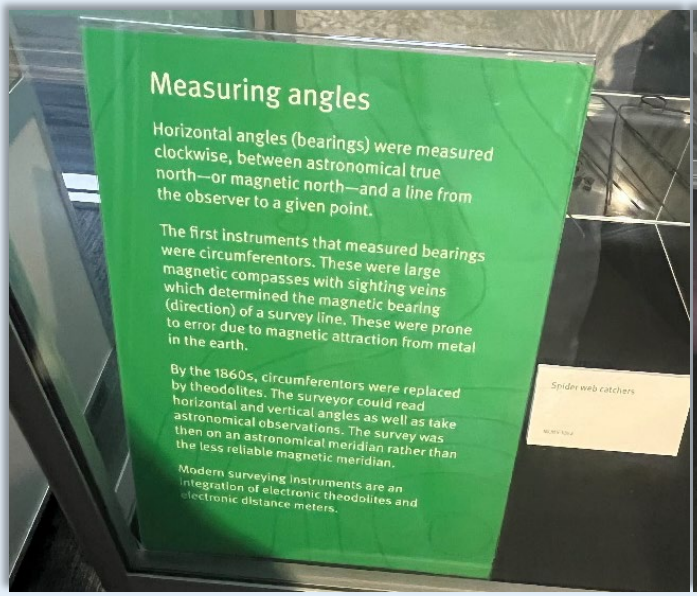
The Museum

The Lands Surveying and Mapping Museum, located at 317 Edward Street in Brisbane City, Queensland, Australia, stands as a specialized institution dedicated to preserving and showcasing the rich history of land surveying, mapping, and cartography in Queensland. As a sub-branch of the Queensland Museum, it offers a unique window into the state's land exploration and development, making it an invaluable resource for researchers, historians, and the general public. This report provides a comprehensive overview of the museum's exhibits, visitor information, and historical significance, based on detailed observations and analysis.

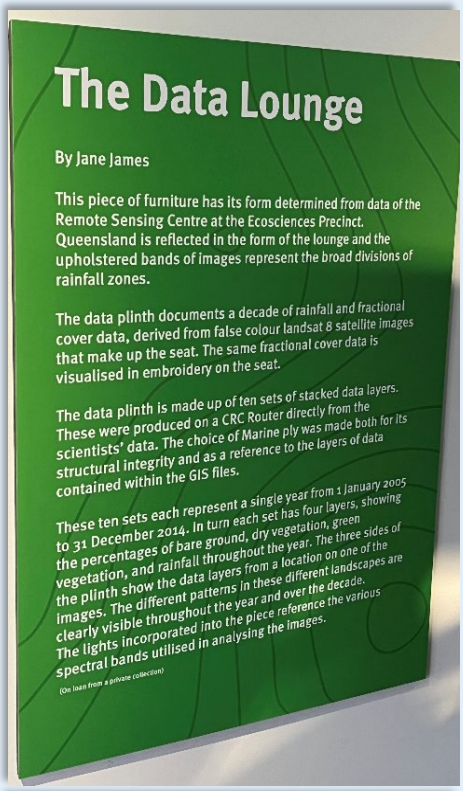
Exhibits and Collections

The museum's exhibits are meticulously curated to highlight the evolution of surveying techniques and their critical role in shaping Queensland's landscape. Below is a detailed breakdown of key displays:

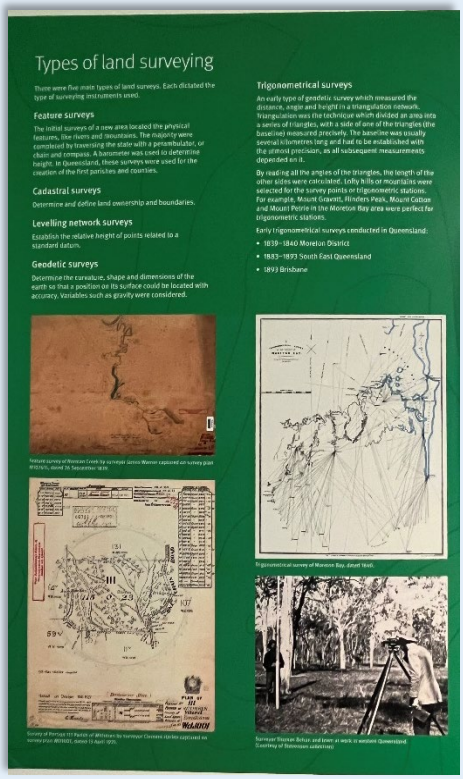
Measuring Angles: One exhibit features a display case with a placard titled "Measuring angles," mounted on a green background. This panel details the historical methods of measuring angles in surveying, explaining the transition from early circumferentors—large magnetic compasses with sighting veins prone to magnetic errors—to theodolites by the 1860s, which allowed for reading horizontal and vertical angles and taking astronomical observations. The display also mentions modern advancements, such as electronic theodolites and distance meters. A smaller label references "Spider web catchers" (MLMS 1082), hinting at precision tools used in early instruments, enhancing the exhibit's focus on historical accuracy.



The Data Lounge: Another innovative exhibit is "The Data Lounge," an artwork by Jane James, credited on a detailed plaque. The lounge's design is derived from data collected by the Remote Sensing Centre at the Ecosciences Precinct, reflecting Queensland's rainfall zones through upholstered bands and visualizing fractional cover data in embroidery on the seat. The accompanying data plinth, made from Marine ply for structural integrity and as a nod to data layers, documents a decade (2005–2014) of rainfall and fractional cover data from false color Landsat 8 satellite images. This exhibit, noted as on loan from a private collection, exemplifies the intersection of art, science, and technology.



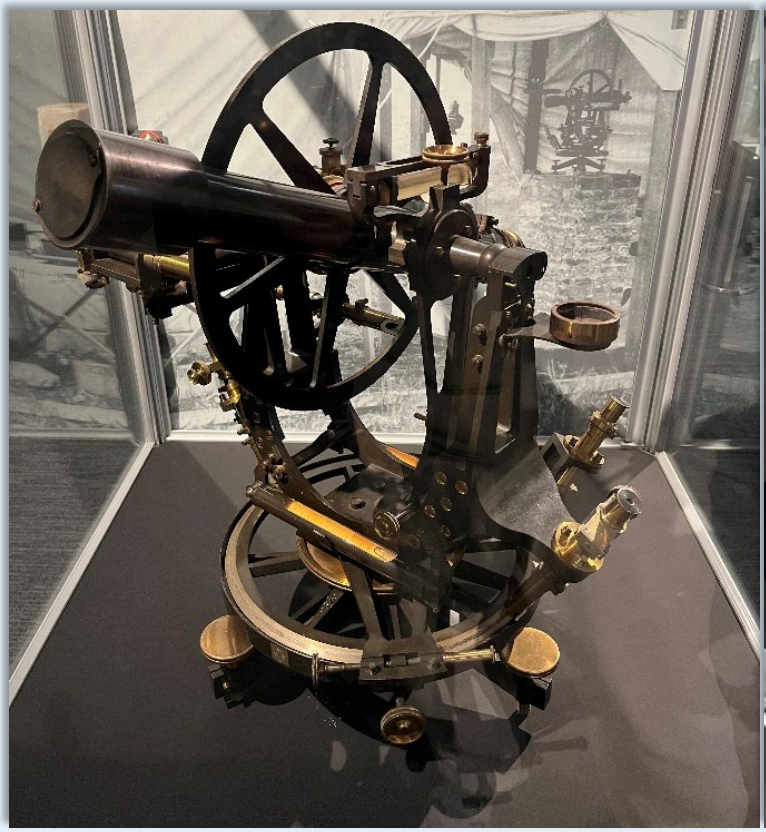
Museum Interior and Atmosphere: The museum's interior, as observed in photographs, features modern design elements, including glass display cases, informational panels, and a flat-screen monitor likely showing additional content. A large wall display showcases a black-and-white photograph of a surveyor using a tripod-mounted instrument on a rocky outcrop, with a vast landscape in the background, symbolizing the challenges of early fieldwork. The room is well-lit, with dark carpeting and black cushioned benches for visitor comfort, creating a professional and educational ambiance.

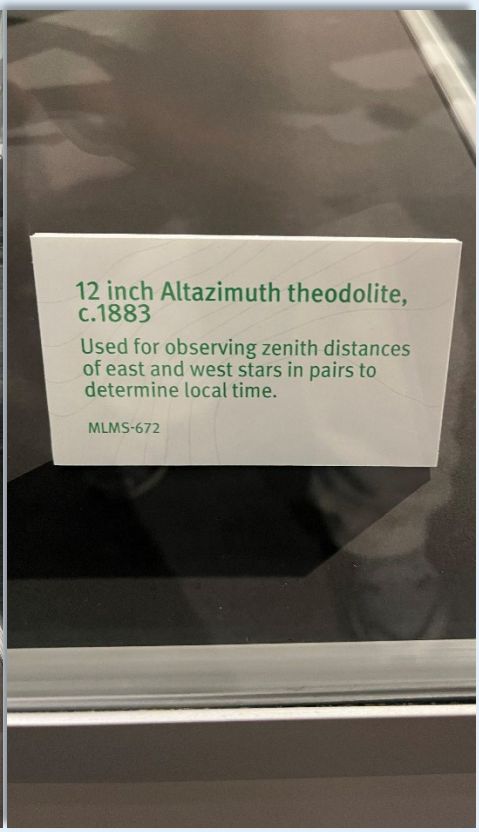


Types of Land Surveying: An informational panel titled "Types of land surveying" details five main types: feature surveys (initial surveys of new areas, e.g., Norman Creek, 1839, by James Warner, M1076), cadastral surveys (defining land ownership and boundaries), levelling network surveys (establishing relative heights), geodetic surveys (determining earth's curvature for accurate positioning), and trigonometrical surveys (early geodetic surveys using triangulation, e.g., Moreton Bay, 1840). The panel includes historical maps, such as the survey of Portion 111 Parish of Withers by Clemens Harlen (WD1001, 13 April 1871), and a photograph of surveyor Thomas Behan and team in western Queensland, illustrating practical applications.

Historical Surveying Instruments: A display label for a "12 inch Altazimuth Theodolite, c. 1883" (MLMS-672) explains its use for observing zenith distances of east and west stars in pairs to determine local time, encased on a dark, reflective surface for protection. This artifact underscores the precision instruments used in historical surveying, offering visitors a tangible connection to past practices.

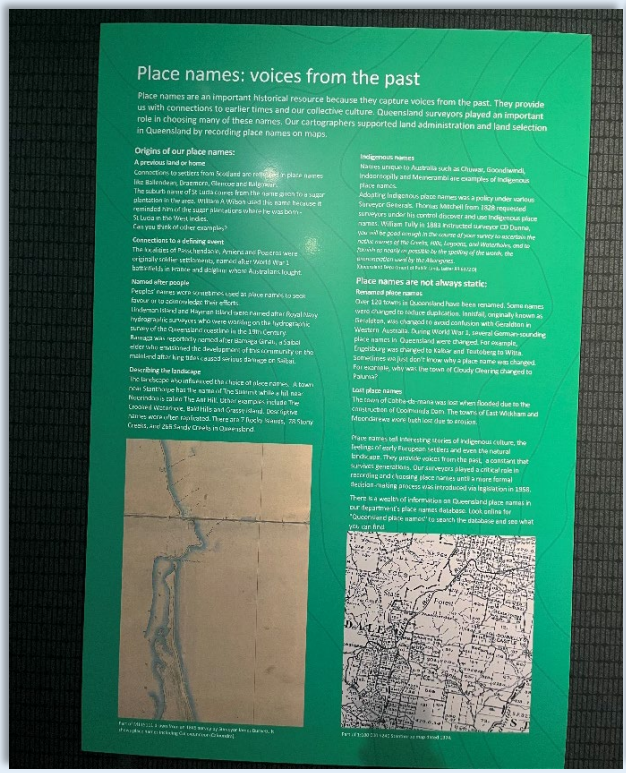
Historical Maps: Two significant maps are showcased: a 1839 plan of Moreton Bay and the Brisbane River by surveyor Robert Dixon (M1076, 26 July 1839), depicting coastal and riverine features with aged, hand-drawn details, and a 1874 survey of the Parish of Barambah by Joseph C. G. Cayne (F2/2/3), detailing inland land parcels and the Burnett River area. Both maps, mounted on a dark background with a green frame, reflect early colonial surveying efforts and are part of the museum's extensive archival collection.

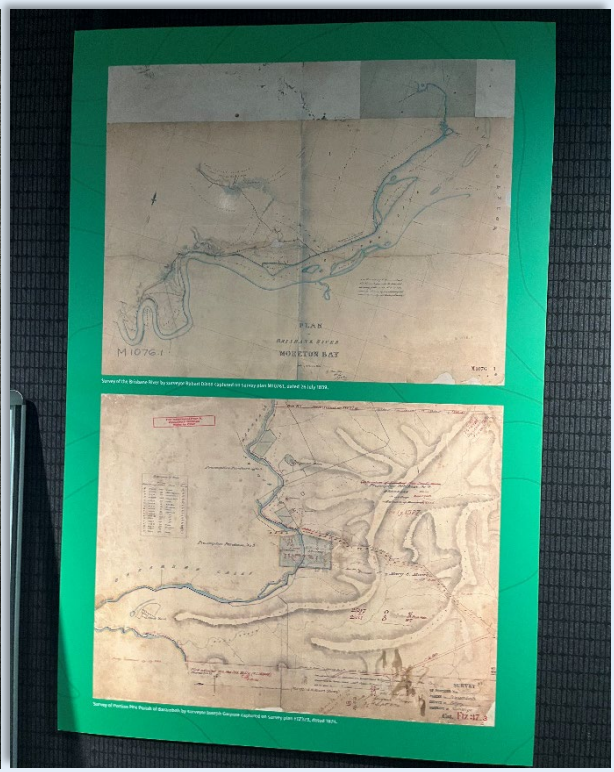




Notable Figures: A panel dedicated to Sir Augustus Charles Gregory (1819–1905) and Clem Jones (1918–2007) highlights their contributions. Gregory, Queensland's first Surveyor General from 1859 to 1875, influenced early land legislation and exploration, with a bust entrusted to surveying firm Brazier Motti in 2018 and honors like the Gregory River and Highway. Jones, starting as a surveyor in 1935, became Lord Mayor of Brisbane (1961–1975), advancing town planning and surveying, with a survey plan (RP57018) from his early career displayed. The panel includes photographs, such as Jones shaking hands, and a historical letter from Gregory's 1859 application for Surveyor General.

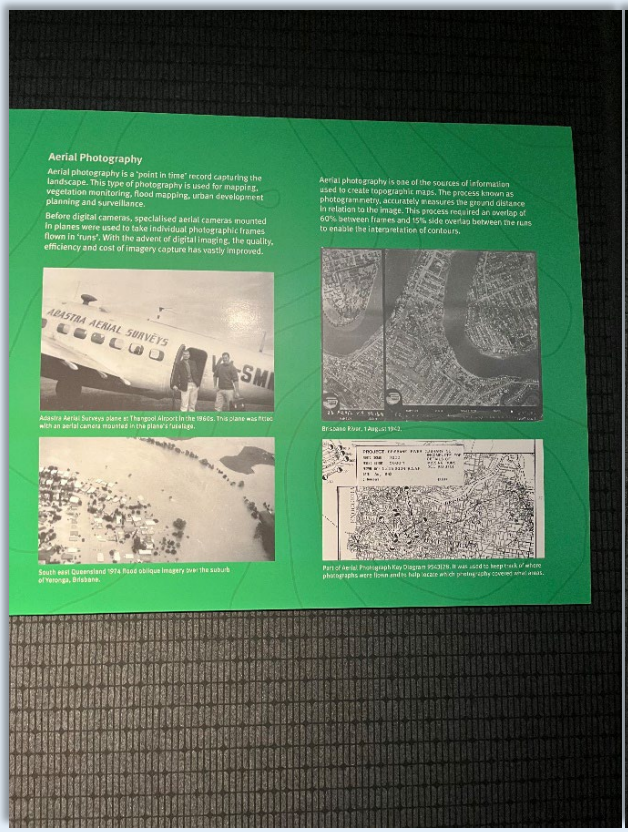
Place Names: A panel titled "Place names: voices from the past" explores the origins of Queensland place names, reflecting Scottish heritage (e.g., Ballendean), World War I connections (e.g., Passchendaele), individuals (e.g., Lindeman Island after Royal Navy surveyors), landscape descriptions (e.g., The Summit, Noorinoodoo), and Indigenous names (e.g., Chuwarr, Goondiwindi). It notes changes due to duplication (e.g., Innisfail, originally Geraldton) or cultural shifts (e.g., Nundah from Engelsburg to Kalbar). Two maps illustrate this: a 1865 survey by James Burnett (M15311, Cullin-la-ringo) and a 1974 Stanthorpe map, encouraging exploration of the Queensland place names database online.

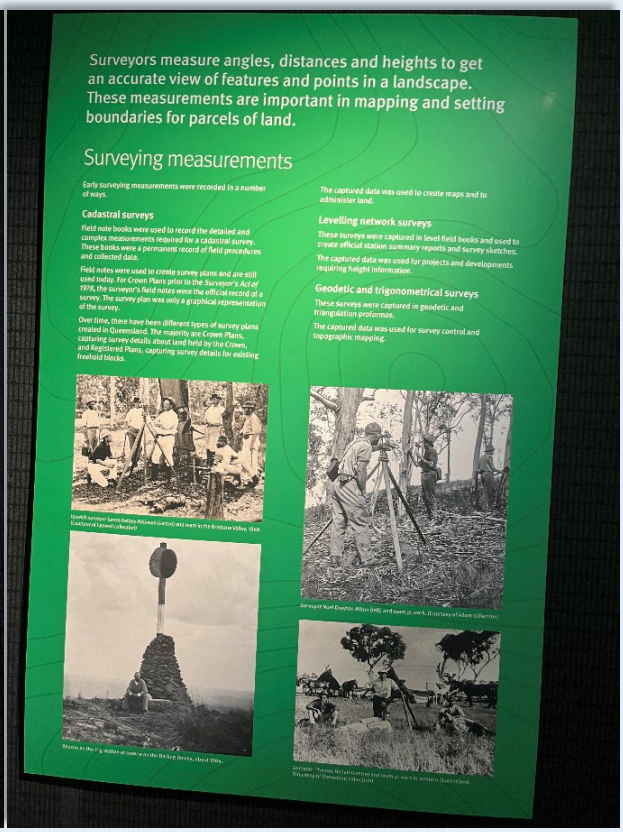




Aerial Photography: A panel on aerial photography explains its use for mapping, vegetation monitoring, flood mapping, and urban planning, historically using specialized cameras in planes for "flown runs" before digital advancements. It includes four images: an Adastra Aerial Surveys plane at Thangool Airport (1960s), Brisbane River (1 August 1942), a 1974 flood-affected Yeronga, Brisbane, and a 1942 Project Photograph Key Diagram (543/28), highlighting the methodology with 60% frame overlap and 15% side overlap for photogrammetry.

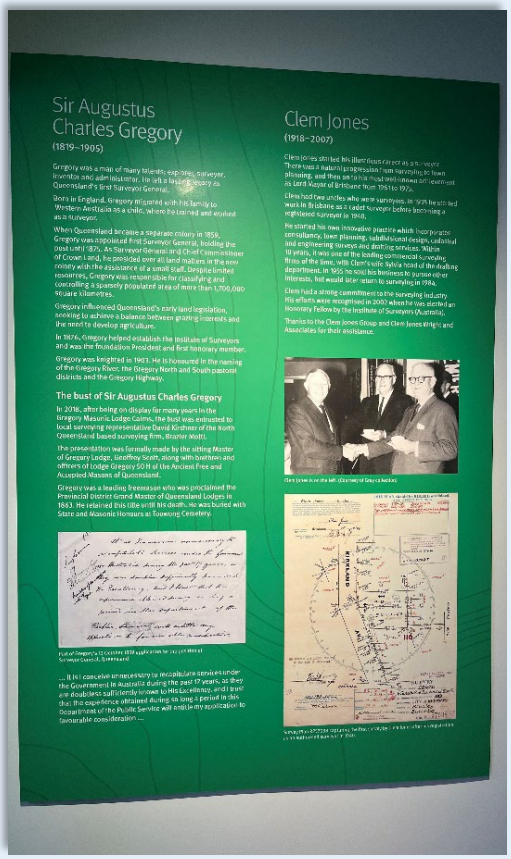
Surveying Measurements: A panel titled "Surveyors measure angles, distances and heights" explains the importance of these measurements for mapping and land boundaries. It details historical recording methods, such as field notebooks for cadastral surveys (official records pre-1978 Surveyor's Act), level field books for levelling network surveys, and geodetic/trigonometrical proformas for survey control. Four photographs depict historical teams: Ipswich surveyor James Robey Atkinson (1868, Brisbane Valley), Noel Drayton Allen, a beacon on Gowrie trig station (1884, Darling Downs), and Thomas Behan in western Queensland, illustrating fieldwork practices.





Historical and Cultural Significance

The museum underscores the critical role of surveying in shaping Queensland's 1,700,000 square kilometers, from establishing borders to facilitating infrastructure development. It honors figures like Gregory, knighted in 1903, and Jones, an Honorary Fellow of the Institute of Surveyors (Australia) in 2002, reflecting their legacies in land administration and urban planning. The digitization of collections, such as historical maps and aerial imagery under open licenses, enhances its value for research, while exhibits like "The Data Lounge" and place names panels highlight cultural and scientific intersections. The museum's commitment to education is evident in its interactive displays and free entry, fostering appreciation for Queensland's cartographic heritage.



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