CASE STUDY
FENGCHIA UNIVERSITY, TAICHUNG
NATIONAL CENTER FOR HIGH PERFORMANCE COMPUTING; HSINCHU
TAIWAN

Taiwan´s Journey Towards Integrated Disaster Management

In a region where typhoons, landslides, and floods hit densely populated terrain, Taiwan has elevated its disaster management strategy through a groundbreaking data integration initiative powered by rasdaman. By uniting siloed satellite imagery, UAV data, and environmental sensors across multiple government agencies into a single federated platform, Taiwan now leverages real-time AI, 3D simulations, and smart analytics to predict and respond to natural threats with unprecedented precision.

TWCC TAIWAN COMPUTING CLOUD

„rasdaman is a game changer for managing Earth Observation Data"

Chen-Yu Hao
Prof. of High Performance Computing,
Feng Chia University

It was a coincidence. During a 2017 OGC meeting, representatives from Taiwan including Prof. Jimmy Zhou and Prof. Chen-Yu Hao met for lunch with Prof. Peter Baumann. Both sides had a history in contributing to geo standardization, but in different corners. Occasionally, the datacube topic came up, and datacube pioneer Baumann introduced rasdaman, supported by live demos. Fengchia University had looked into datacubes before, but only now learnt about rasdaman. This lunch marked the beginning of a transformative journey.

Taiwan, a country perpetually under environmental threat due to its unique geography, was working intensively towards a robust and interoperable infrastructure for Big Earth Data, many of them with a temporal component.

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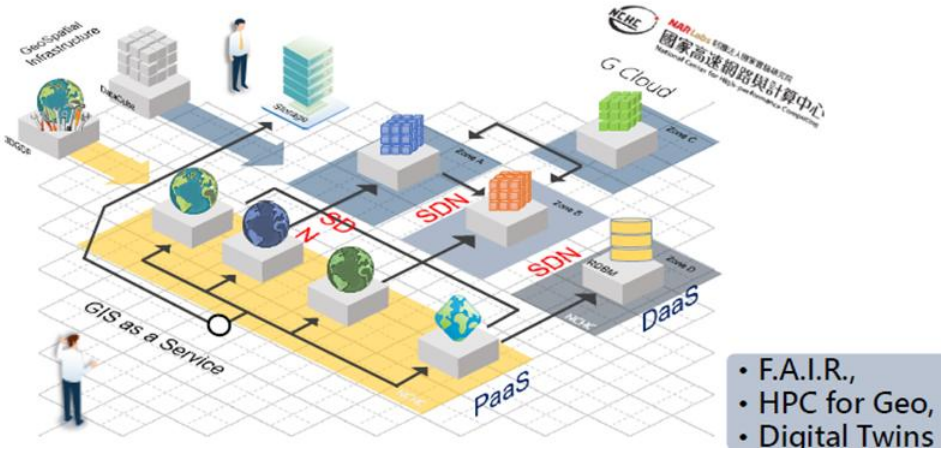
"The solution to our long-standing data problems suddenly appeared within reach", says Chen-Yu Hao, Professor of High-Performance Computing at Fengchia University in Taichung. "I was enthusiastic about the idea of bringing the National Center for High Performance Computing (NCHC) in Hsinchu on board and presenting them the concept of a datacube federation".



This interaction catalysed a multi-year collaboration among public institutions, academic partners, and technology providers, culminating in the development of a national federated data repository to manage environmental and geospatial data at scale.

Threats & Disasters

Nestled within the Pacific Ring of Fire and lashed by violent typhoons, landslides, earthquakes, and tsunamis, the island faces a relentless onslaught of natural threats. Taiwan's physical landscape is dominated by rugged mountain terrain, making up for 75% of its landmass. These topographical features make the country highly susceptible to natural disasters, and at the same time difficult to manage the risks. These events often occur simultaneously, ing their impact. During phoon seasons, for instance, heavy rainfall in mountainous regions frequently triggers landslides and debris flows, posing a threat to communities living in adjacent lowlands and cities. In such a complex and hazardous environment, governmental agencies rely heavily on earth observation data for disaster preparedness, response, and recovery.

For years, government agencies across Taiwan had to operate in silos. Each department, whether responsible for water, land, forest, or urban management, collected and stored its own Earth observation data. Various agencies, such as the Soil and Water Conservation Bureau, the Water Resources Agency, and the Central Weather Bureau, maintained separate datasets, generated through their own satellite programs (like Formosat-2 and Formosat-5), UAV flights, and aerial surveys. This siloed approach made it difficult for researchers and decision-makers to obtain accurate, consolidateed insights, especially during emergencies. The lack of interoperability slowed down collaboration, painful especially when disasters struck. Agencies relied on isolated systems, different formats, and incompatible software. Valuable data often went unused because they could not be accessed and shared in time.

„rasdaman´s technical team provided prompt and consistent support, several times a week."
Chen-Yu Hao

Taiwan´s Federation

Recognizing the limitations of the existing data landscape, NCHC Taiwan, being part of the National Applied Research Laboratories (NARLabs), initiated a strategic project to federate geospatial data.

This involved setting up a platform known as the Taiwan National Federated Research Data Repository.

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Built upon the infrastructure of NCHC, the platform allows the agencies to rent "units" that include access to datacubes managed by rasdaman as well as containerized backends. This architecture allows seamless ingestion, storage, and retrieval of massive raster datasets. Agencies no longer needed to procure expensive hardware or software individually; instead, they can use rasdaman as a service hosted on the NCHC high-performance infrastructure. Each app comes with a web-based image ingestion tool and administrative functions, making it user-friendly also for non-technical personnel.

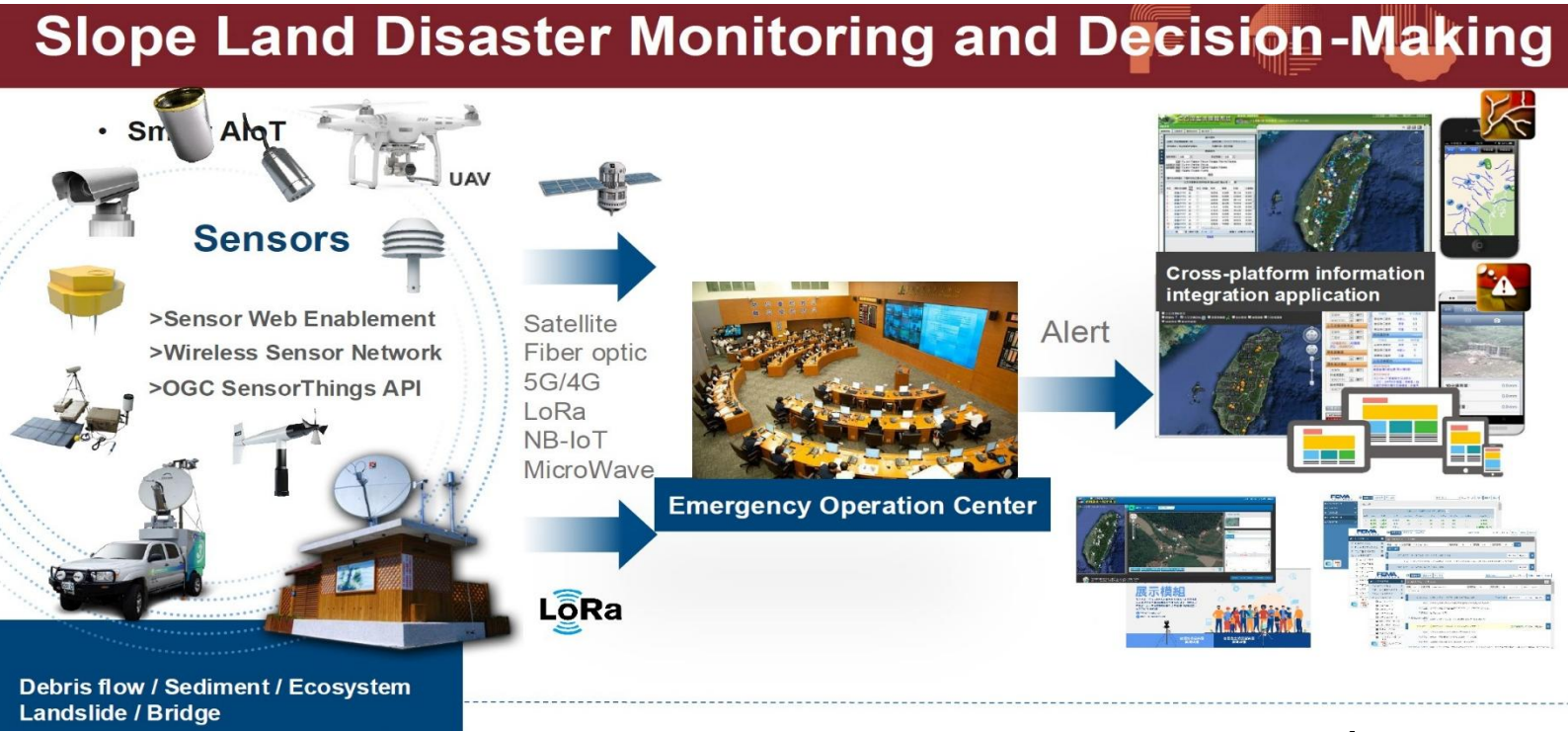
The goal was not only to reduce duplication and storage costs, but also to facilitate secure data sharing across departments.

AI Integration

With integrated access to Earth observation data, Taiwan's agencies began developing sophisticated applications for disaster monitoring and urban planning. One notable example was the use of AI models on real-time camera feeds to identify urban flood zones. By analysing water levels in streets using machine learning algorithms, local governments can monitor flood risks with the existing sensor network

Another compelling case is the use of UAVs equipped with thermal cameras to monitor cities at night. This data, along with historical flood maps, gets visualized on a 3D GIS platform, enabling authorities to simulate flood scenarios with high spatial

accuracy. Unlike traditional flood simulation models that consider only natural elevation, this new model incorporates building heights and underground pipelines to predict water flow more accurately. Moreover, the integration of IoT data with flood simulation engines allows real-time decision-making. Agents can adjust parameters like pump operations or water gate schedules in simulations, helping to prevent or mitigate flood impact.



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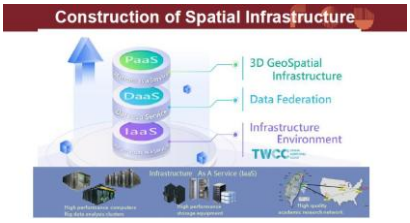
User Orientation

The federated repository employs precise access control. Data providers can choose to keep their datasets private, share them conditionally, or make them publicly accessible. Access is managed via token-based authentication and API proxies. This flexibility ensures that sensitive data remain protected while still fostering collaboration. To assist non-English-speaking staff, a Mandarin interface was added, ensuring accessibility and usability across different agencies. This commitment to localization and usability was critical for stakeholder acceptance.

„The platform today is not just a repository, but a dynamic ecosystem supporting AI-driven analytics, 3D visualization, simulation modeling, and real-time monitoring."

Chen-Yu Hao

The Web interface also enables public access to open datasets for research or educational purposes. Researchers can conduct complex analyses (such as image fusion, NDVI calculations, slope modelling, or change detection) directly from the browser using preconfectioned query templates. The underlying OGC WCPS (Web Coverage Processing Service) datacube query language allows "any question, anytime" in a compact, high-level manner.



More Use Cases

The system saw rapid adoption by central and local government entities. For example, the National Mining and Geological Management Center monitors mountainous mining regions. UAV images collected over a decade were ingested into the platform as timeseries datacubes; change detection models helped track expansion of mining boundaries. This assists regulatory compliance and environmental impact assessments.

Universities also became involved. Institutions in Taichung and Kaohsiung use the platform for academic research, further validating its versatility. Additionally, collaborations extended to Taiwan's Agricultural Council and the Ministry of the Interior, highlighting its applicability across domains like agriculture, urban development, and environmental conservation.

Overcoming Barriers

Rolling out such a transformative initiative was not without challenges. Initially, some agencies remained hesitant. Concerns ranged from data security to unfamiliarity with the underlying technology and the English-language interfaces.

Trust building took time, and only consistent demonstrations, user training and interface customizing made overall acceptance successful. Today, rasdaman datacubes form an integral component of Taiwan's world-class national spatial data infrastructure.

About rasdaman

The rasdaman pioneer datacube engine enables distributed management and analytics on spatio-temporal Big Earth Data, with unique flexibility, scalability and performance, security, seamless AI support, and interoperability, acknowledged by a series of innovation awards.

Learn more about rasdaman datacubes
Visit https://rasdaman.com
or contact the team: contact@rasdaman.com

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