



# OGC Innovations for NASA New Observing Strategy

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Comprehensive  
global community-  
driven forward-  
looking expertise in  
location

*Using location, we connect people, communities, technology and decision making to create a sustainable future for us, our kids and future generations*

- *By specializing in making location more Findable, Accessible, Interoperable and Reusable*
- *Via a proven collaborative and agile process combining standards, innovation and partnerships*



**Communities-  
Tech & Market  
Domains**



**Partnerships  
& Alliances**



**Process for  
Standards &  
Innovation**

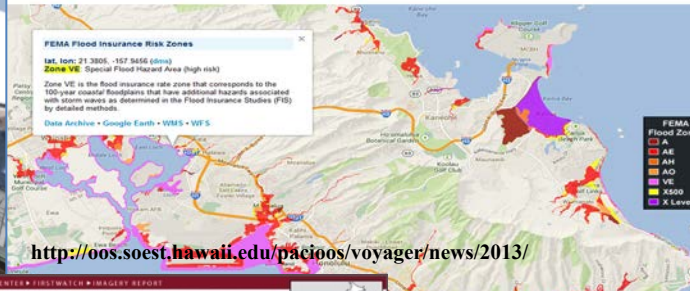
# Millions of Geospatial Datasets on >200K Servers



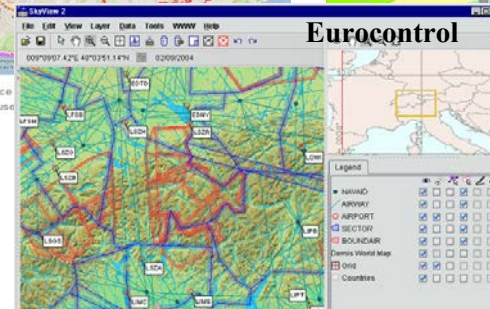
**Web Map Service (WMS)**  
**Web Map Tile Service (WMTS)**  
**Web Feature Service (WFS)**  
**Web Coverage Service (WCS)**  
KML, GML, GeoPackage  
GeoTIFF, NetCDF, HDF



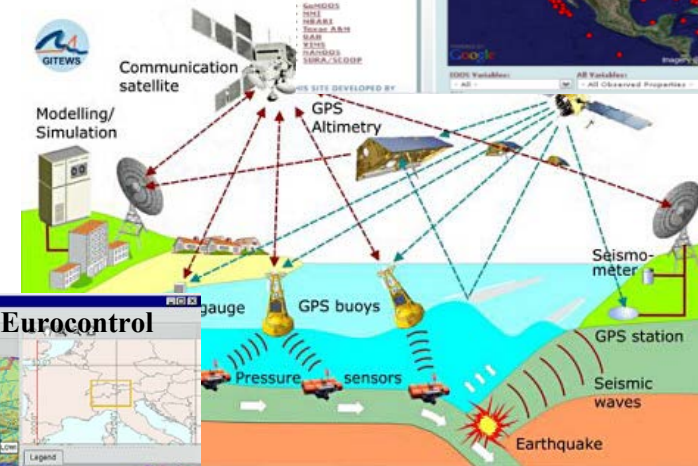
CityGML



Emergency /  
Disaster  
Management



Aviation Flight Information / Safety



Meteorology, Hydrology,  
Ocean Monitoring

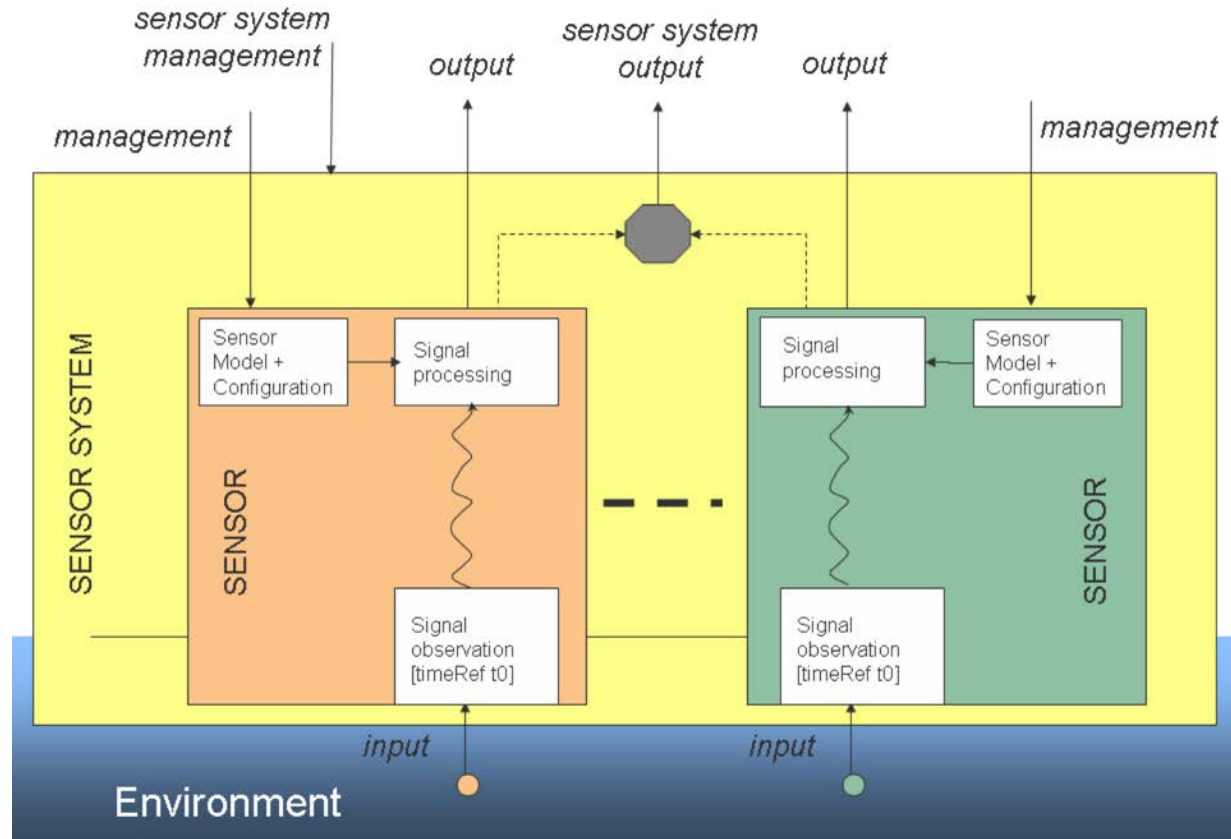
# SENSOR WEB ENABLEMENT

# Sensor Web Requirements



- Quickly **discover sensors and sensor data** (secure or public) that can meet my needs – location, observables, quality, ability to task
- **Obtain sensor information** in a standard encoding that is understandable by me and my software
- Readily **access sensor observations** in a common manner, and in a form specific to my needs
- **Task sensors**, when possible, to meet my specific needs
- Subscribe to and **receive alerts** when a sensor measures a particular phenomenon

# SWE Model of a Sensor System



Sensor Web Enablement Architecture, OGC document 06-021r4  
[http://portal.opengeospatial.org/files/?artifact\\_id=29405](http://portal.opengeospatial.org/files/?artifact_id=29405)



# Sensor Web Enablement

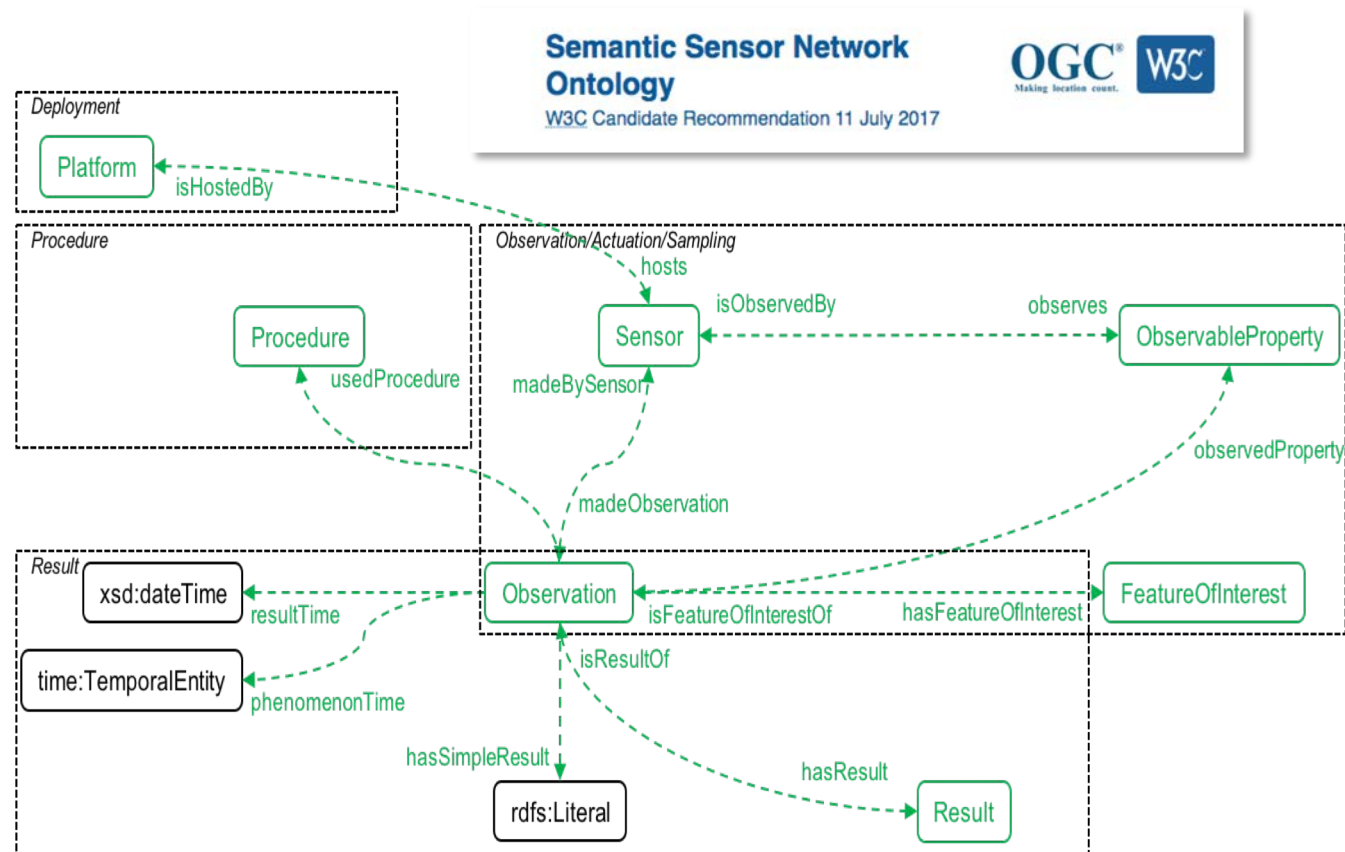
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- SWE Information Models and Encodings
  - Sensor Model Language (SensorML)
  - Observations and Measurements (O&M)
  - SWE Common
- SWE Web Services
  - Sensor Observation Service (SOS)
  - Sensor Planning Service (SPS)
  - Sensor Alert Service (SAS)

**SWE Standards are deployed in operational systems – TRL Level 9**

- An OWL-2 DL ontology
- Relationships between sensors/ actuators/ sampling and observations/ actuations/samplings
- Modular architecture that supports the judicious use of "just enough" semantics for diverse applications.
- Aligned with OGC/ISO Observations and Measurements



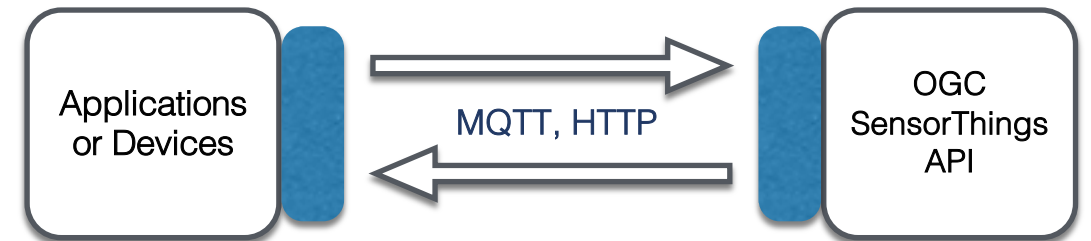
<https://www.w3.org/TR/vocab-ssn/>  
<https://portal.opengeospatial.org/files/74883>



# OGC SensorThings API



- Open, geospatial-enabled API to IoT devices, data, apps
  - Part of OGC Sensor Web Enablement Standards
  - OGC Standard
  - ITU Technical Specification D3.2
- Provides these functions
  - Sensor data management
  - Sensor data analytics
  - Command and Control
  - Event Detection and Notification



<https://www.opengeospatial.org/standards/sensorthings>

<https://www.itu.int/pub/T-FG-DPM-2019-3.2>

**FT HUACHUCA, AZ**

- CBRN Detection
- DES FIAF Scenario

- ▶ *Use Open Geospatial Consortium (OGC) Sensor Web (SWE) services and data formats to enable Tactical to Enterprise integration of sensors and observations*
- ▶ *Search DCGS for dynamic discovery of sensor data and sensor observation web services*
- ▶ *Apply network constraints to determine optimal configurations for Disconnected, Intermittent, Low-Bandwidth (DIL) environments*
- ▶ *Document the results in SIF Common Profile to facilitate Sensor System Acquisition*



*SIFWG is a subworking group of the GWG, co-chaired by NGA, AGC, and NMO.*

# IOOS



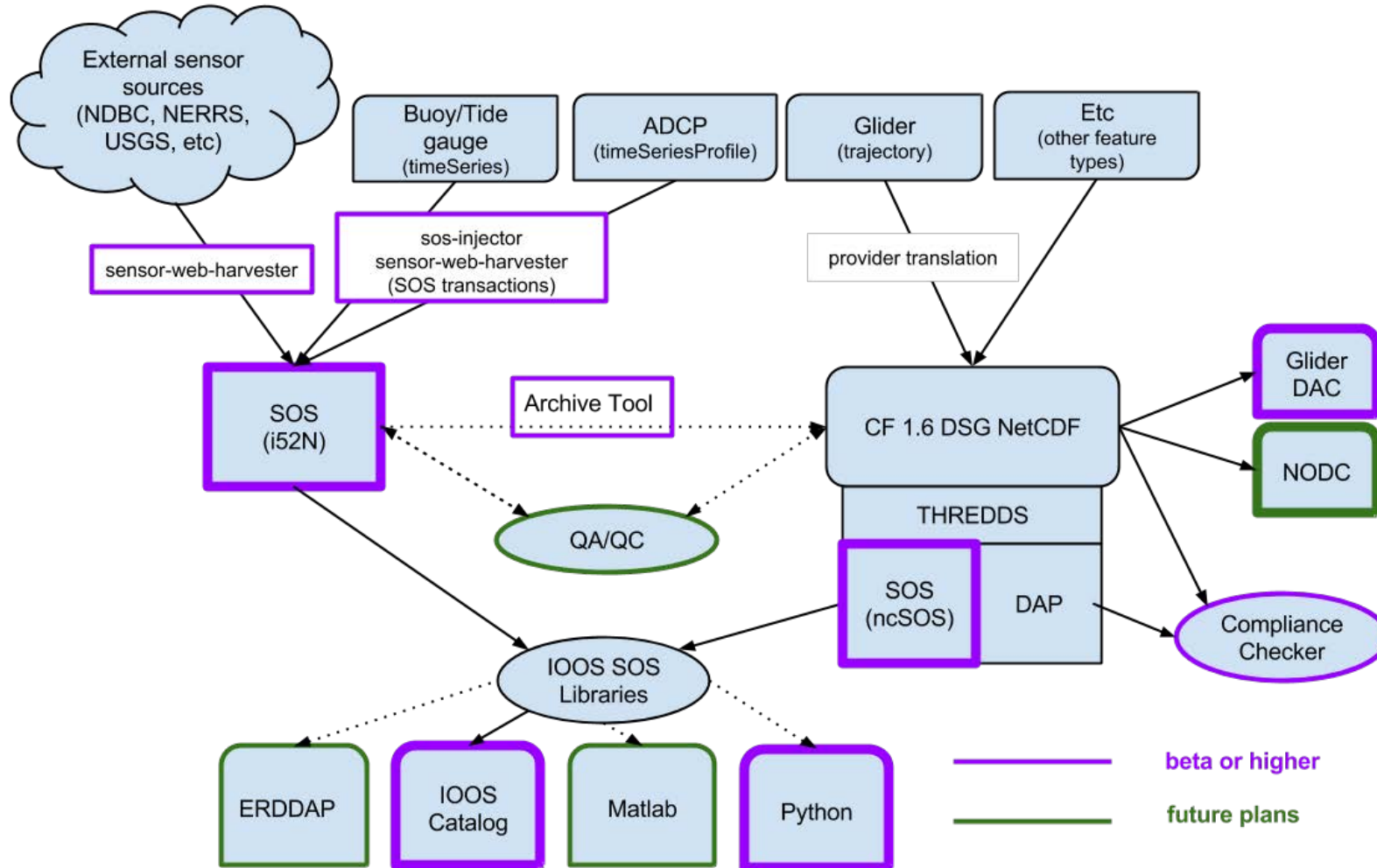
## Operated By: Federal Component:



## Regional Component:



# OGC standards in use by IOOS

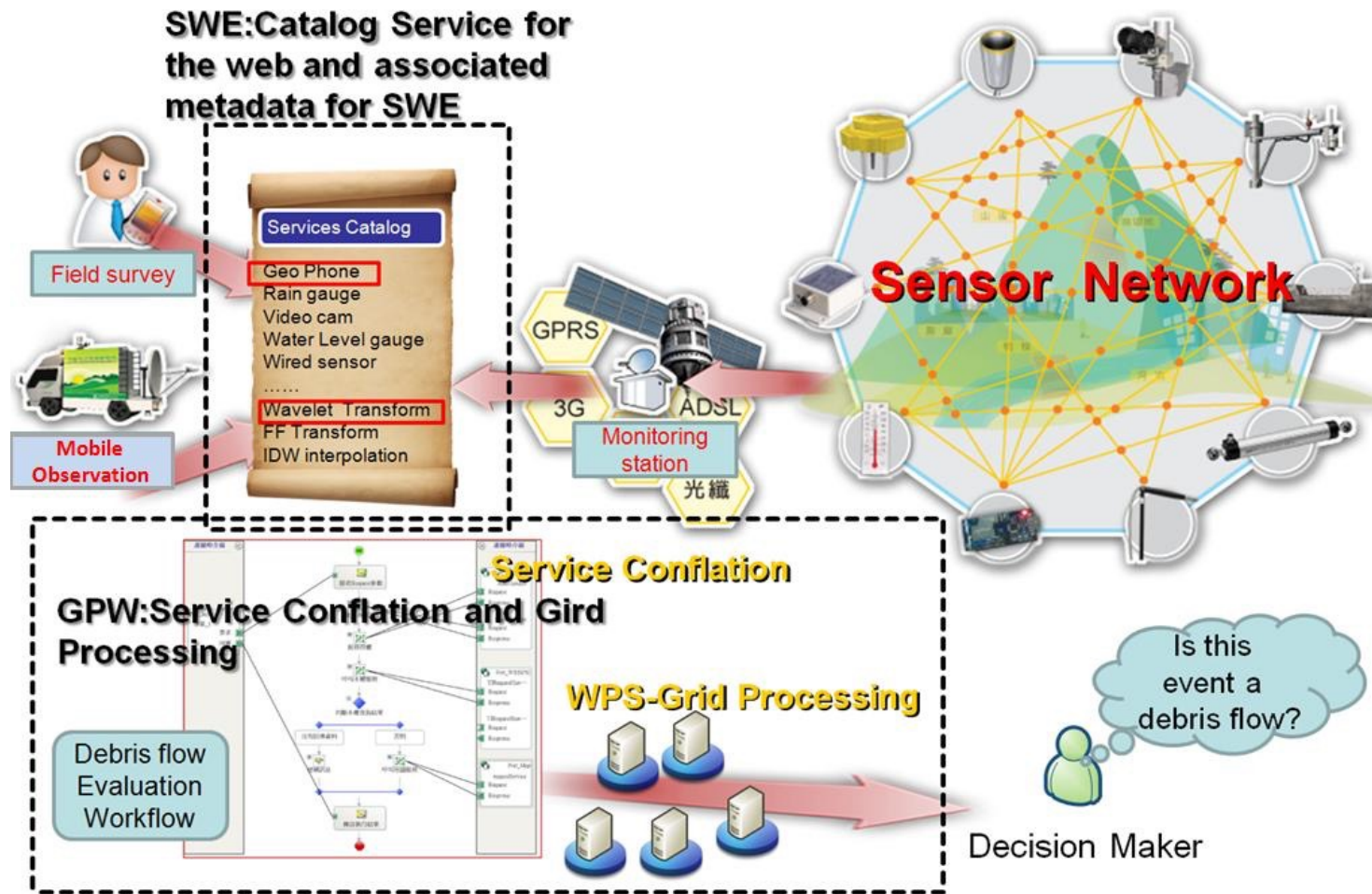


## OGC Standards in IOOS

- SOS
- O&M
- SensorML 1.0
- netCDF
- CS/W
- WMS



# Global use of SWE in Operational Systems



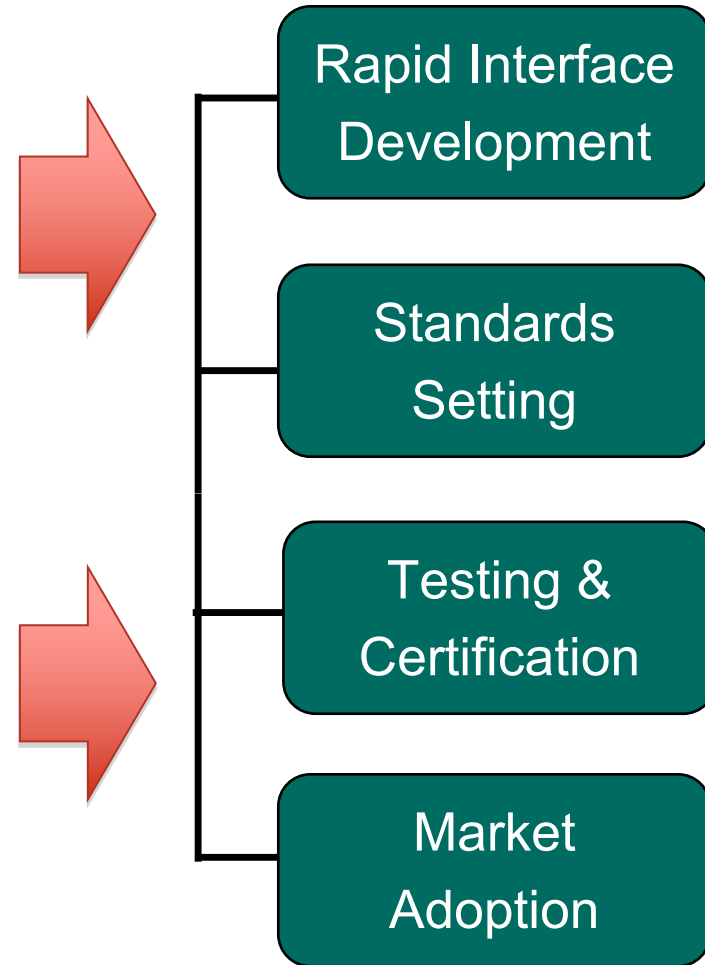
Taiwan Debris Flow Detection System <http://en.fcu.edu.tw/>

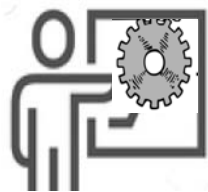
# OGC INNOVATION AND STANDARDS PROCESSES



# OGC's Approach for Advancing Innovation

- **Innovation Program** – a global, innovative, hands-on rapid prototyping and testing program designed to unite users and industry in accelerating interface development and validation, and the delivery of interoperability to the market
- **Standards Program** – Consensus standards process similar to other Industry consortia (World Wide Web Consortium, OMA etc.).
- **Compliance Program** – allows organizations that implement an OGC standard to test their implementations with the mandatory elements of that standard
- **Communications and Outreach Program** – education and training, encourage take up of OGC specifications, business development, communications programs





Sponsors

Bring  
Challenges



World  
experts

Agile  
Prototyping

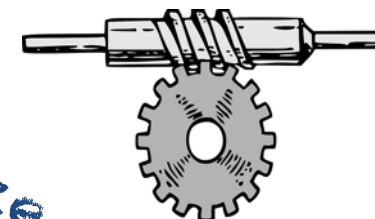
# INNOVATION PROGRAM



Open  
standards

Reduce  
technology  
risks

Help  
Mobilize



New  
technologies

# OGC Innovation Program

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- More than 100 initiatives in a collaborative agile process for solving geospatial challenges.
- OGC annual Testbed
  - research and development programs explore geospatial technology from various angles to establish open interoperability between independent implementation.
- OGC Sprints
  - Agile, developer focused events for API innovation

# OGC INNOVATIONS FOR NASA NEW OBSERVING STRATEGY

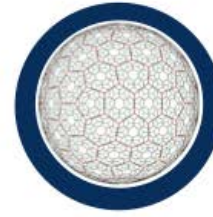
## EARTH OBSERVATION CLOUDS (EOC)



EO APPS  
W. JUPYTER



DATA ACCESS  
& PROCESSING



DISCRETE GLOBAL  
GRID SYSTEM



AVIATION



MACHINE  
LEARNING



FMV TO  
MOVING FEATURES



ANALYSIS  
READY DATA

**DATA INTEGRATION & ANALYTICS (DIA)**



DATA CENTRIC  
SECURITY



FEDERATED  
SECURITY



GEOPACKAGE



OPENAPI

**MODELING AND PACKAGING (MAP)**

# Earth Observation Cloud Architecture



- OGC EO Cloud Applications architecture defines interface specifications and data models working on the HTTP layer.
  - Architecture supports developers and consumers to interact with service endpoints abstracted from the complexity of data handling, scheduling, resource allocation, and infrastructure management
  - Applications are developed in local environment and made available as containers on a Docker Hub. API is in OpenAPI using the currently emerging OGC APIs.
  - Application Consumers discover available applications through the same endpoint. The containers offer a list of available OGC APIs to be invoked.



APP  
DEVELOPER



DOCKER  
HUB



DATA &  
PROCESSING



APP  
CONSUMER



EXPLOITATION  
PLATFORM



DATA &  
PROCESSING

Architecture developed in Testbeds (TRL 4) and now in Pilots (TRL 7)



# Containers and Jupyter Notebooks



- Applications are deployed next to physical location of the data to be processed using WPS interfaces to submit Docker containers.
- Testbed-16 interacts with applications using [Jupyter Notebooks](#) to improve workflow and efficiency of scientific computing.



# OGC API Standards Development



## **Modular API building blocks; spatially enable Web APIs in a consistent way**

- Spatial Data on the Web Best Practices
- Leverages OpenAPI
- Focus on developer experience and usability
- Modular building blocks for access to spatial data that can be used in data APIs,
- Open development; Public GitHub, Early implementations, In-depth validation

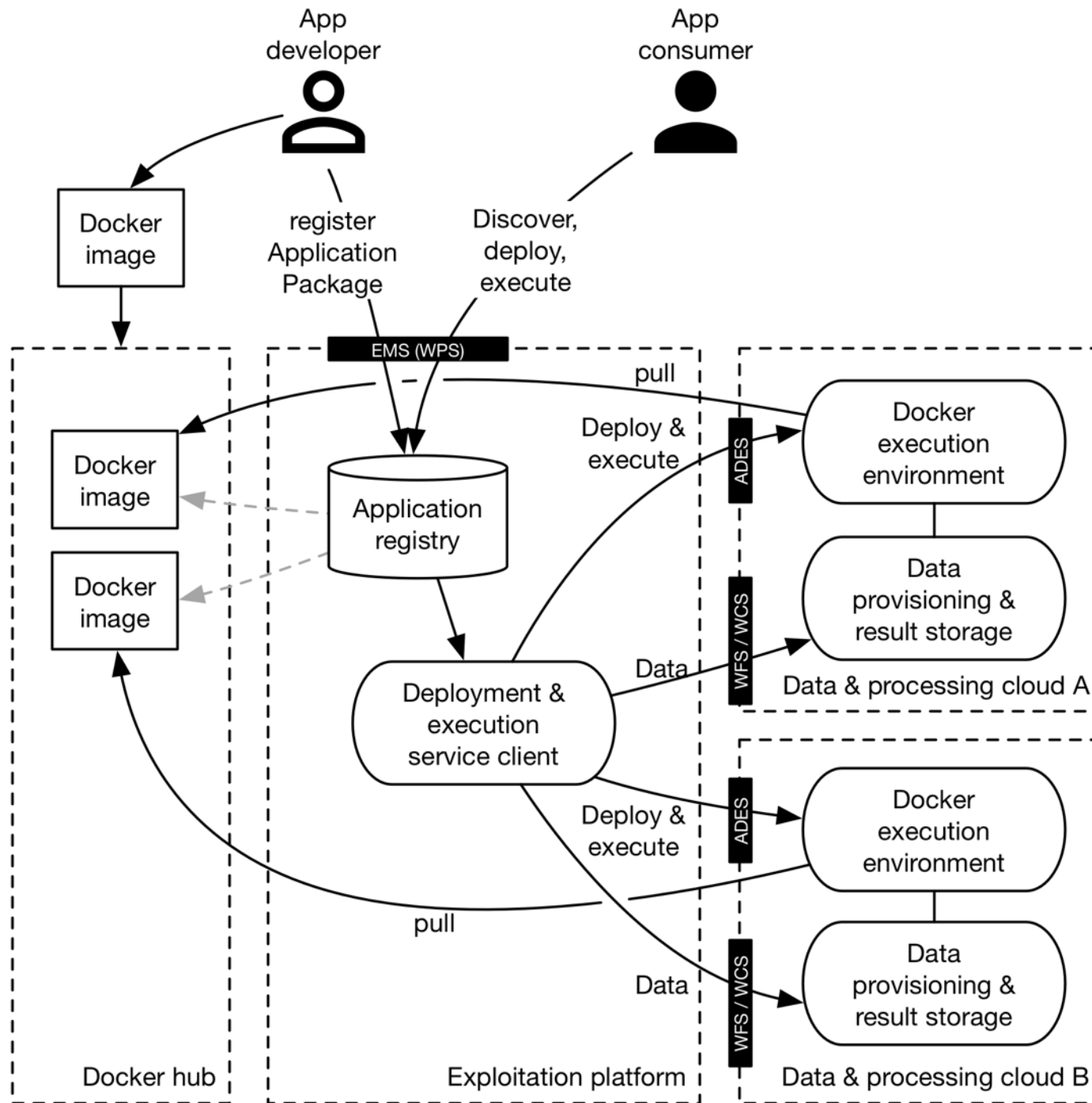


**OGC API - Features**

**OGC API - Coverages**

**OGC API - Map Tiles**

**OGC API - Processes**



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