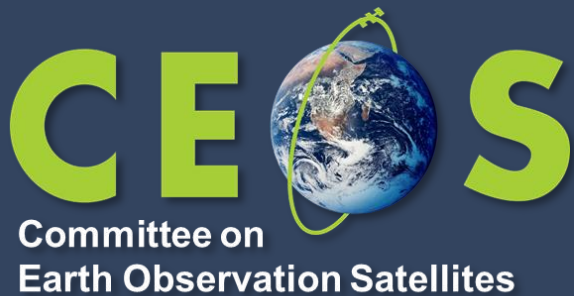


CEOS Analytics Lab & Commerical Interoperability Study



David Borges
Systems Engineering Office
Committee on Earth Observation Satellites
NASA Earth Science Division
LSI-VC-15 Agenda 3.1
05 April 2024



CEOS Earth Analytics Interoperability Lab

Working Group on Information Systems and Services and Systems Engineering Office

20 April 2020

Robert Woodcock, CSIRO, WGISS Chair

Brian Killough, NASA, SEO Director

Situation

A significant number of CEOS activities are now engaged in the CEOS ARD and FDA strategies and in Integrated Earth observation data analysis (COAST, SDG, WGClimate, LSI-VC, WGDisasters, GEO Aquawatch and GEOGLAM). There is strong collaboration between groups with both WGISS and SEO being sought for technical advice and coordination on issues related to interoperability of all kinds including data standards, formats, analytics and discovery services.

To date coordination has taken the form of project linkages, development of common terminology (e.g. CEOS Interoperability Terminology Report), and joint development and use of best practice approaches (e.g. The LSI-VC CARD4L specification and process is being used as a template for the for CARD4Water). This has worked well for more isolated outputs like data standards.

Current project activities are seeking to improve data discovery and analytics interoperability with often subtle impacts on CEOS services be they provided by WGISS, SEO or CEOS agencies. The CEOS community has reached a point where ARD and FDA activities need to become demonstrable and testable in a live service ecosystem in order to validate interoperability throughout the EO value chain from Discovery through to Analytics outcome.

ceos.org/cal



Analytics Lab

Empowering exploration and scalable analysis of Earth observation data

The CEOS Analytics Lab is a multiuser gateway for spatial data science made possible by the CEOS Systems Engineering Office and CSIRO. Every user is provided a customized JupyterLab environment to easily load EO data products and seamlessly scale to additional computational nodes through the Dask Gateway.

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- ❖ Analytics Lab is an implementation of CSIRO's Earth Analytics Science and Innovation platform (EASI)
- ❖ Combination on several open-source projects:
 - JupyterHub
 - Open Data Cube
 - AWS
 - Dask scaling
- ❖ Scales individual user environments on demand.
- ❖ Analysis can scale beyond the user environment using Dask workers that are used only when the analysis is run.

Commercial Interoperability Project



- CEOS New Space Task Team (NSTT) Deliverable

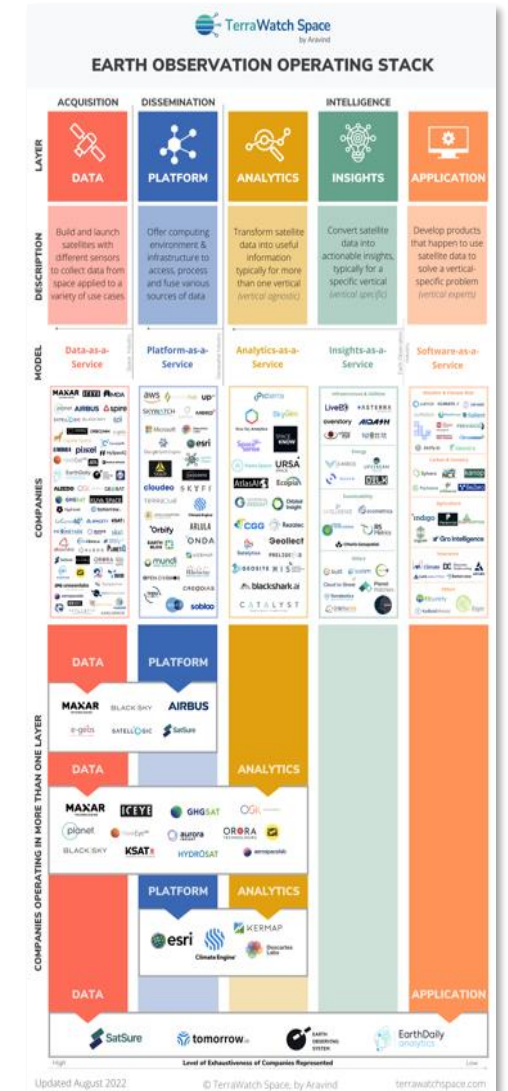
D5) SEO should demonstrate the integration of New Space data into CEOS Analytics Lab and evaluate its interoperability with common CEOS datasets.

- Optical

- Landsat 8, 9
- Sentinel-2
- Maxar
- Planet Planetscope
- DESIS

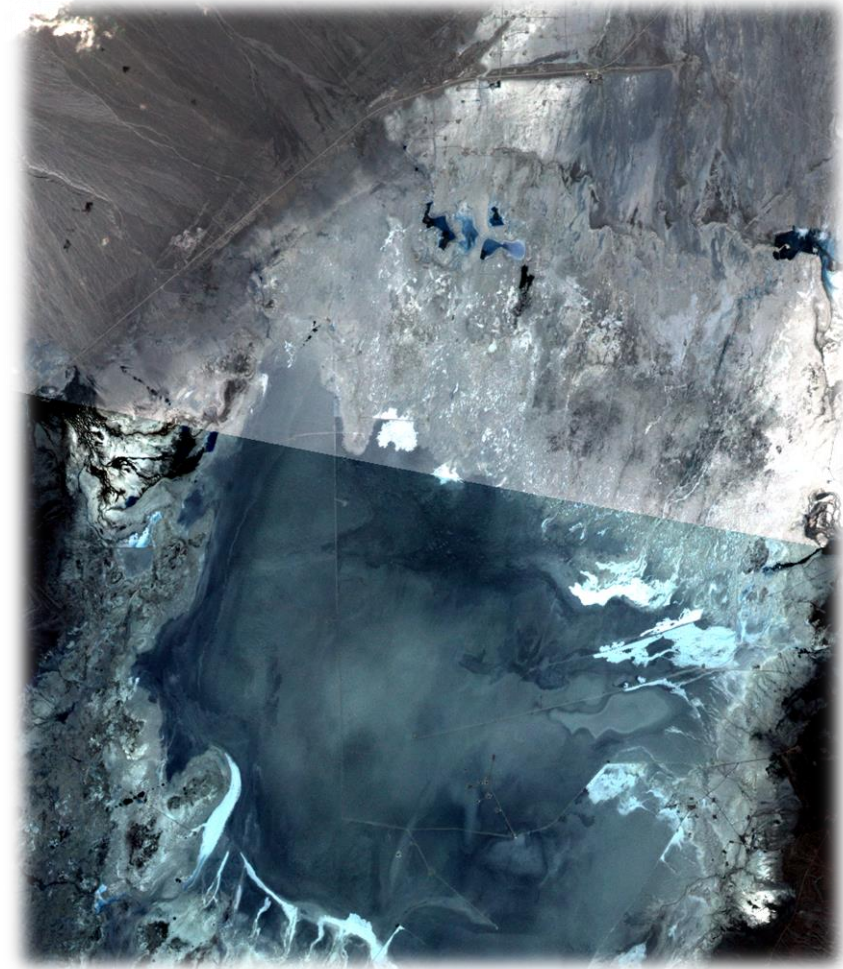
- SAR

- Sentinel-1
- ALOS
- Umbra
- ICEYE
- Capella



❖ Importance:

- Improve understanding of commercial image quality as compared to public imagery datasets
- Evaluate cross-platform interoperability and accessibility of commercial datasets
- Explore challenges of working with data from both commercial and public platforms
- Understand workflows necessary to incorporate multiple data sources
- Provide a foundation of knowledge to promote increased use of commercial data
- Formulate future recommendations for guiding CEOS policy regarding commercial data
- Test usage on the CEOS Analytics Lab (CAL) and the Open Data Cube
- Delineate Interoperability of Systems vs Data



❖ Level 2A Data (Monthly Comparisons, 2018-Present):

Commercial Platforms	Public Platforms
Planet Dove/SuperDove	Landsat 8/9
Maxar WorldView-02/03	Sentinel 2
Teledyne DESIS	HLS



Railroad Valley



Lake Pontchartrain Bridge

❖ Cal/Val Sites

Cal/Val Sites	Northern Hemisphere	Southern Hemisphere
Radiometric	Railroad Valley Playa (Nevada, USA)	Gobabeb (Namibia, Africa)
Spatial	Lake Ponchartrain Causeway (Louisiana, USA)	Suramadu Bridge (Indonesia, Asia)



Gobabeb



Suramadu Bridge

- Technical Approach
 - Data Access
 - Evaluate use of commercial providers APIs (not all include API access)
 - Implement APIs to access data
 - Data Loading
 - Generate ODC indexing scripts for each commercial provider
 - Create demo indexer notebooks
 - Analysis / Visualization
 - Build notebooks evaluating:
 - Pixel-by-pixel scatter plots comparing individual bands
 - Inherent harmonization evaluation
 - Resampling analysis
 - Band to band spectral comparison
- OUT-23-05/06: NASA/ESA Mission Quality Assessment Framework Guidelines (optical & SAR)

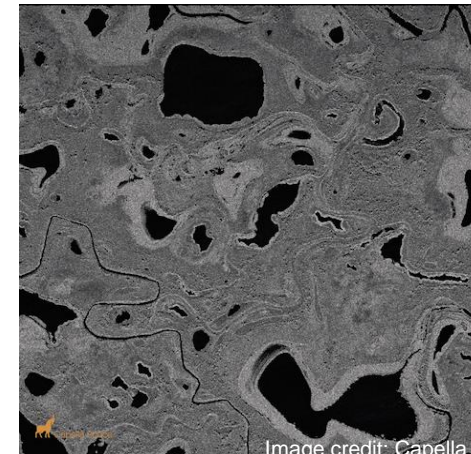
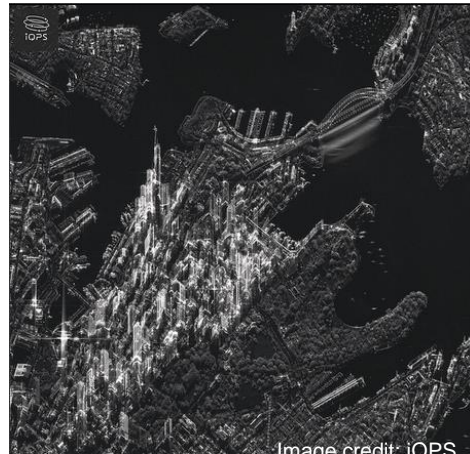
- Key Considerations and Challenges (Optical)
 - Sensor Variation
 - Impacts spectral band alignment, spatial detail, signal strength
 - Processing Biases
 - Differences in atmospheric correction and vendor-specific sharpening will influence direct comparisons
 - Situational Factors
 - Slight time offsets and viewing geometry differences create irreducible limitations
 - Commercial data compliance with CEOS-ARD PFS

Increase in small commercial “New Space” SAR companies

- ❖ X-band SAR systems
- ❖ Light-weight, low cost
- ❖ Large satellite constellations (10~50 satellites)
- ❖ Very high spatial resolution (0.2~2 m)
- ❖ Very high temporal revisit capacity (daily/sub-daily)
- ❖ Main market segment: defence, security
- ❖ Targeted observations per user requests
- ❖ Strategic background observation plans - probably not

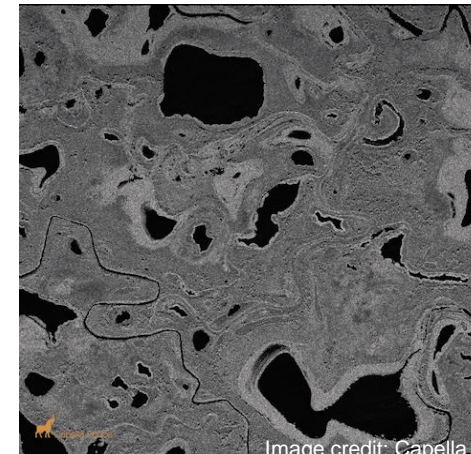
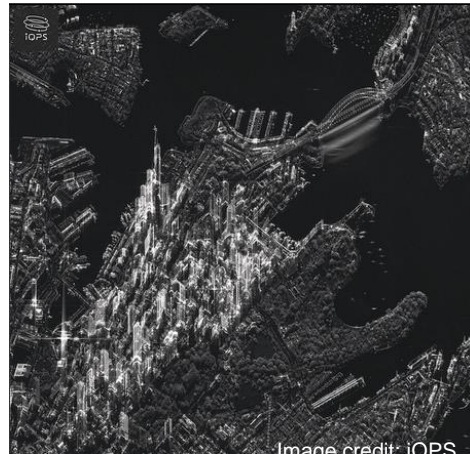
Current (SAR) actors:

- ❖ Capella Space (USA) [9]
- ❖ ICEYE (Finland) [32]
- ❖ iQPS (Japan) [3]
- ❖ Synspective (Japan) [2]
- ❖ Umbra (USA) [7]
- ❖ Others?...



SEO assessment (sample data)

- ❖ Data quality
 - Geometry, Radiometry
- ❖ User friendliness
 - Product levels
 - Documentation
- ❖ Data accessibility
 - Sample data
 - Data for purchase
- ❖ CEOS-ARD
 - Interest & relevance in providing CEOS-ARD product levels
 - Mock (self-)assessment of sample products
- ❖ CEOS Analytics Lab (CAL)
 - Feasibility for inclusion of sample data
 - Additional processing?





Preliminary Findings:

- ❖ Most commercial data doesn't meet threshold CEOS ARD requirements
- ❖ CEOS Cal/Val Portal
 - Some information is deprecated
 - Could use improved navigation clarity and page overviews
- ❖ RadCalNet only has manual data access
- ❖ Clarity on commonly accepted CEOS standards and practices for Calibration and Validation
- ❖ Only one high resolution spatial test target on ECCOE - Baotou test site

Cal/Val Opportunities:

- ❖ Addition of API access to RadCalNet
- ❖ Development of automated Cal/Val systems based on CEOS approved methods

Commercial Data Opportunities:

- ❖ Work with commercial providers to conform with CEOS ARD Standards
- ❖ Work with providers to better document their calibration and validation processes
- ❖ Continue developing tools to index commercial data on the ODC

CEOS Outreach Efforts



- SatSummit 2024
 - Washington, D.C.
 - 16-17 May
- IGARSS 2024: CEOS Booth
 - Athens Greece
 - 7-12 July

