



Committee on Earth Observation Satellites

CEOS Coastal Observations & Applications Study Team (COAST): Data Use & Interoperability Needs, Challenges and Opportunities

Paul M. DiGiacomo
NOAA/NESDIS
CEOS-COAST Chair

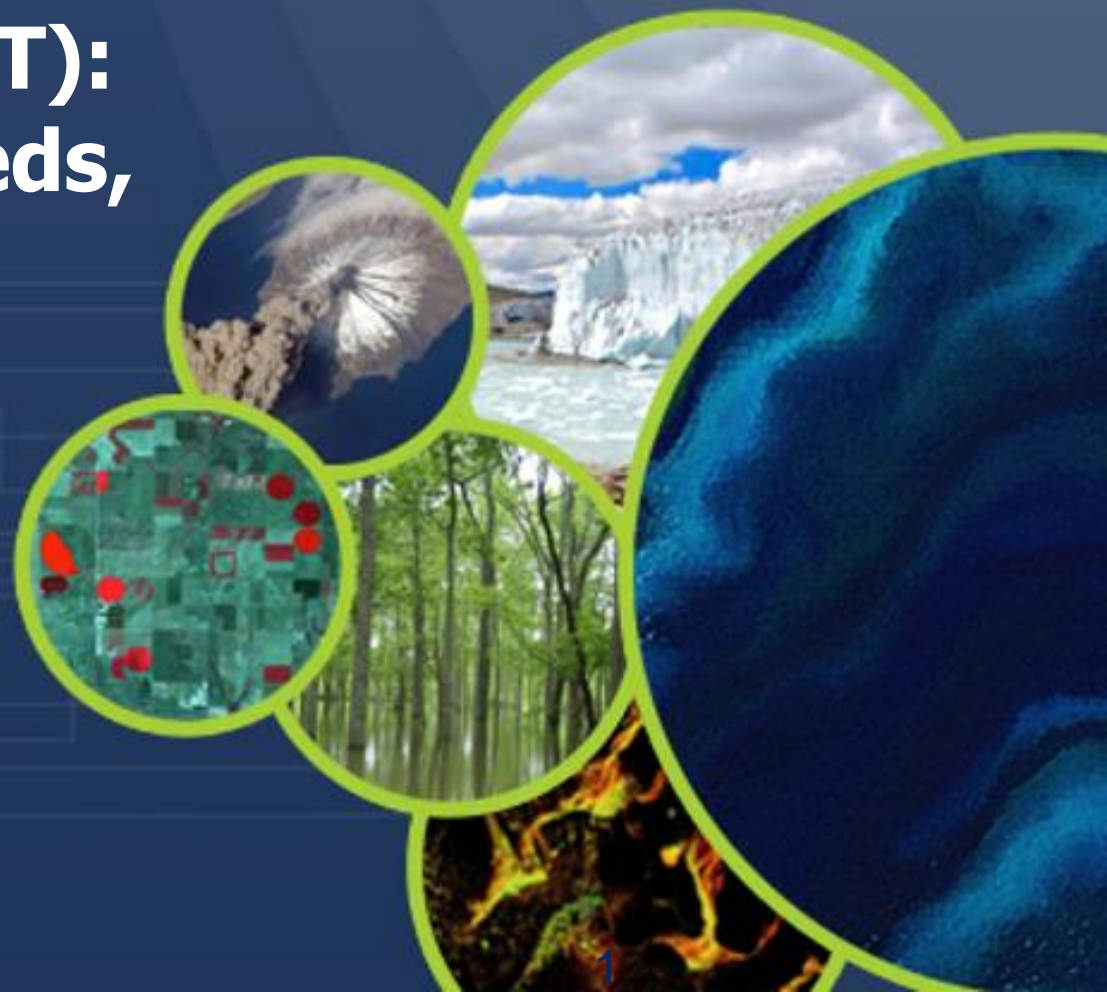
WGISS-50 Meeting (Virtual)

Session: Data INTEROPERABILITY and USE

23 September 2020

9/14/2020

CEOS WGISS-50 Meeting





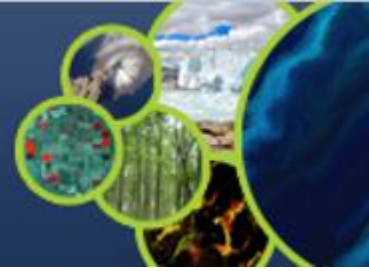
CEOS Coastal Observations & Applications Study Team: COAST



- **CEOS Coastal Observations and Applications Study Team (CEOS-COAST): Initiated at 33rd CEOS Plenary to define a CEOS Coastal Strategy and facilitate engagement with key international stakeholders**
 - Bridging land and aquatic observations within CEOS, helping to integrate across multiple CEOS entities and domains, both thematic and technical.
 - Leveraging CEOS Systems, services and interoperability approaches, including the **CEOS Analysis Ready Data (ARD) framework** already demonstrated for terrestrial and oceanic applications; **and the emerging CEOS Earth Analytics Interoperability Lab (EAIL)**
 - Facilitating the broader utilization of Earth observations for greater societal benefits within coastal zones and enhancing CEOS engagement with external stakeholders such as GEO, IOC/GOOS, UN Environment, WMO and the UN Decade of Ocean Science for Sustainable Development (2021-2030).
- **COAST Study Team Approach:**
 - Virtual monthly+ meetings
 - Collaborative offline document and project work via GoogleDocs
 - CEOS SIT Side Event and Technical Workshop Session
 - Briefings to partners and collaborators



CEOS Coastal Observations & Applications Study Team: COAST



COAST Team Members:

- CEOS COVERAGE: Jorge Vazquez (JPL), Vardis Tsontos (JPL)
- CEOS Executive Officer: Kerry Sawyer (NOAA)
- CEOS SEC Support: George Dyke, Matt Steventon (Symbios)
- **CEOS Systems Engineering Office (SEO): Brian Killough (NASA)**
- CEOS VCs: Ed Armstrong (JPL), SST-VC; Eric Leuliette (NOAA), OST-VC
- CEOS WGCapD: Nancy Searby, Lauren Childs-Gleason (NASA)
- CEOS WGClimate: Albrecht von Bargaen (DLR-DE), Joerg Schultz (EUMETSAT)
- CEOS WGCV: Philippe Goryl (ESA)
- **CEOS WGISS: Rob Woodcock (CSIRO)**
- CEOS WG Disasters: David Green (NASA), David Borges (NASA)
- CEOS SDG AHT: Flora Kerblat (CSIRO)
- CNES: Aurelien Carbonniere
- CSIRO: Janet Anstee
- ESA: Jérôme Benveniste
- EUMETSAT: Estelle Obligis
- European Commission: Astrid-Christina Koch, Fabienne Jacq
- GEO AquaWatch Initiative: Steve Greb (Univ of Wisconsin)
- GEO Blue Planet Initiative: Emily Smail (UMD), Leah Segui
- GEO Secretariat: Douglas Cripe
- Geoscience Australia: Stephen Sagar
- ISRO: Rashmi Sharma, Raj Kumar
- NASA: Laura Lorenzoni (OCR-VC)
- NOAA: Paul M. DiGiacomo (Chair); Merrie Beth Neely (Project Manager)
- USGS: Steve Labahn (LSI-VC)

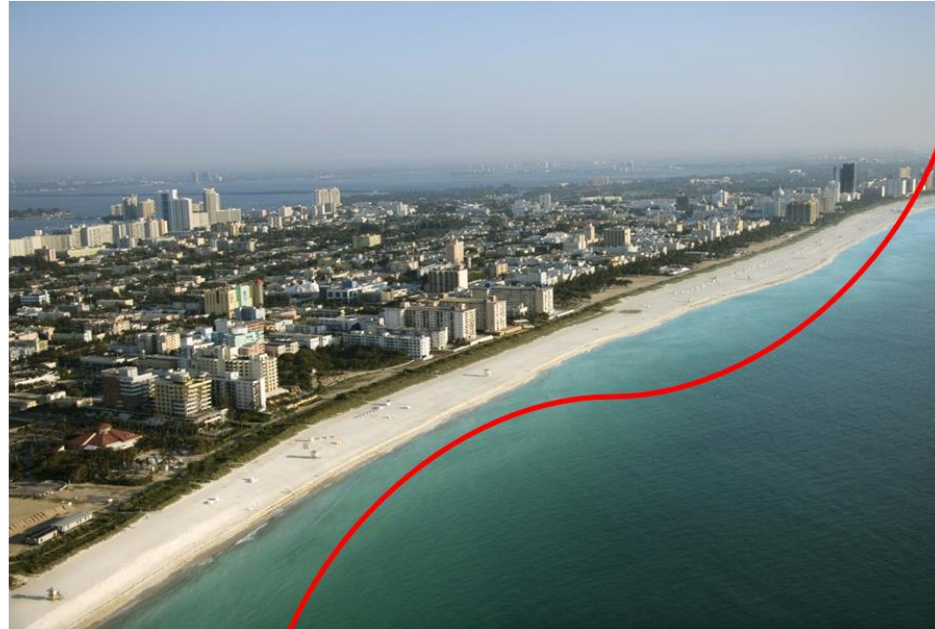


Cross-Cutting Needs:

- Analysis ready data
- Tools, products & services
- User-centric web portals

Products needed:

- Land cover/use (impervious surfaces)
- Shoreline mapping/elevation
- Precipitation and Discharge
- Sediment and Nutrient loadings
- Habitat/water quality maps
- et al.



Partners/Stakeholders

- Blue Planet
- AquaWatch
- UN Environment
- IOC/WMO

Products needed:

- Land cover/use
- Bathymetry/elevation
- Shoreline mapping
- Waves and Tides
- Flood Maps
- et al.

COAST Project Component
Land to Sea Impacts (~ biological/ecological)

COAST Project Component:
Sea to Land Impacts (~ physical forcing)

Ecosystems, Water Quality & Habitats

- Sediment loading - e.g., benthic habitat impacts
- Coastal eutrophication - e.g., SDG 14.1.1. et al.

Coastal Disasters/Hazards: Flooding & Inundation

- Large-scale coastlines - e.g., urbanized, developing regions
- Small-island states - e.g., coral-reef lined islands

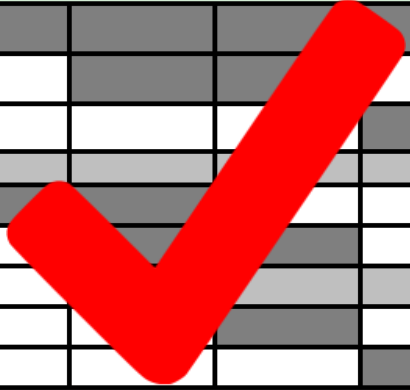


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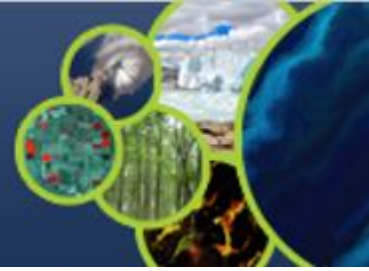
COAST Project: Phases, Milestones and Schedule

TASK	2020					2021				2022		
	Jan	Apr	July	Sept	Dec	Apr	July	Sept	Dec	Apr	July	Sept
Phase 1												
Annotated Bibliography												
GEO CEOS Joint Workshop Prospectus												
Initial User-driven Gap Assessment												
Pilot Project List (prioritized)												
Long list 7-10												
Short list 1-3												
Pilot Project Implementation Plan												
First draft												
Final draft												
Phase 2 - Internal Focus												
Detailed Assessment and Gaps												
CEOS Pilot Project 1												
CEOS Pilot Project 2												
GEO CEOS Joint Workshop (Sept 2021)												
Phase 3 - Broader Community Engagement and Partnership												
CEOS Co-led Community Coastal Projects												





CEOS Coastal Observations & Applications Study Team: COAST



Summary of COAST Phase 1 Deliverables (anticipated completion of all by ~30 September 2020)

- Established - CEOS-COAST website: <http://ceos.org/ourwork/ad-hoc-teams/ceos-coast/>
- Completed – Annotated COAST Bibliography; available soon at CEOS-COAST website
- Completed – Compilation of COAST-related projects/activities; available soon at CEOS-COAST website
- Pending – draft satellite data requirements inventory for SDG 14.1.1a (coastal eutrophication)
- Completed - Phase 2 Pilot project components, priorities and sites identified
- Delivered – Draft of CEOS-COAST Phase 1 White Paper #1: “Sea to Land Impacts: User Needs, Observations, and Services”
- Delivered – Draft of CEOS-COAST Phase 1 White Paper #2: “Land to Sea Impacts: User Needs, Observations, and Services”
- **Delivered - CEOS-COAST Phase 1 White Paper #3: “Cross-Cutting Tools, Systems and Services”**
- Pending – COAST Phase 2 Implementation Plan

NB: On hold due to COVID: Planning for *Joint GEO-CEOS COASTAL Workshop* (~Summer 2020; now TBD)



CEOS Coastal Observations & Applications Study Team: COAST



Anticipated COAST Pilot Locations

Continental:

Odisha/Bay of Bengal

Coastal Virginia/Chesapeake Bay

West Coast of Africa

Rio de la Plata region (Backup/TBD)

Small Island Nations:

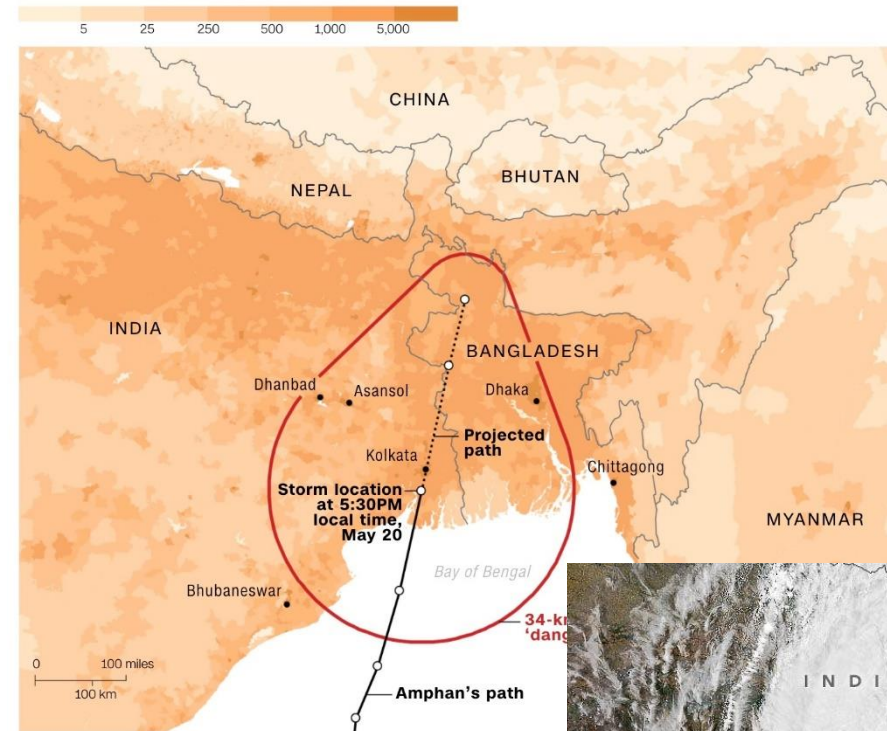
Caribbean: Bahamas

Pacific: Tahiti/Kiribati/New Caledonia

Other sites/TBD

Cyclone Amphan's path

Population density (people per square kilometer)



Note: Data as of 8:30 p.m. local time, May 20

Source: Joint Typhoon Warning Center (storm path, danger area); Center for International University (population density)
Graphic: Renée Rigdon, CNN



Mahanadi River Delta – Coastal Flooding Cyclone Amphan (2020) or Cyclone Fani (2019)



NASA MODIS via Worldview

- A large, relatively flat and expansive basin in eastern India, the Mahanadi experiences flooding from heavy monsoonal rains, typhoons, and related storm surge
- Recently impacted by Typhoon Amphan, in addition to past storm events

Expected Outcomes

- Improved capability to map flood extent from combined optical and SAR; continued development of algorithms to benefit during NISAR operations period
- Produce flood inundation maps, hazard maps, vulnerability maps, and combine with available flow data and other in situ observations

Status and Level of Effort

- Leads: ISRO, TBD
- Region of interest and potential events have been defined, need to bring together available data sets from free and open sources or those shared (Sentinel-1, geostationary/LEO, Landsat/Sentinel-2) and others

Data Needs, Challenges, and Risks

- In situ data needed for flood observations at any given time and to understand maximum extent or high water mark coverage
- Looking for additional data coverage from multiple sensors including ASTER, CARTOSAT-1, ALOS DEM, CARTOSAT-2 high resolution images, Radarsat-1, 2 and RISAT-1 images and Sentinel-1 A/1B datasets
- DigitalGlobe/Planet Labs mapping may be available through NASA Commercial Data Buy or other Charter assets



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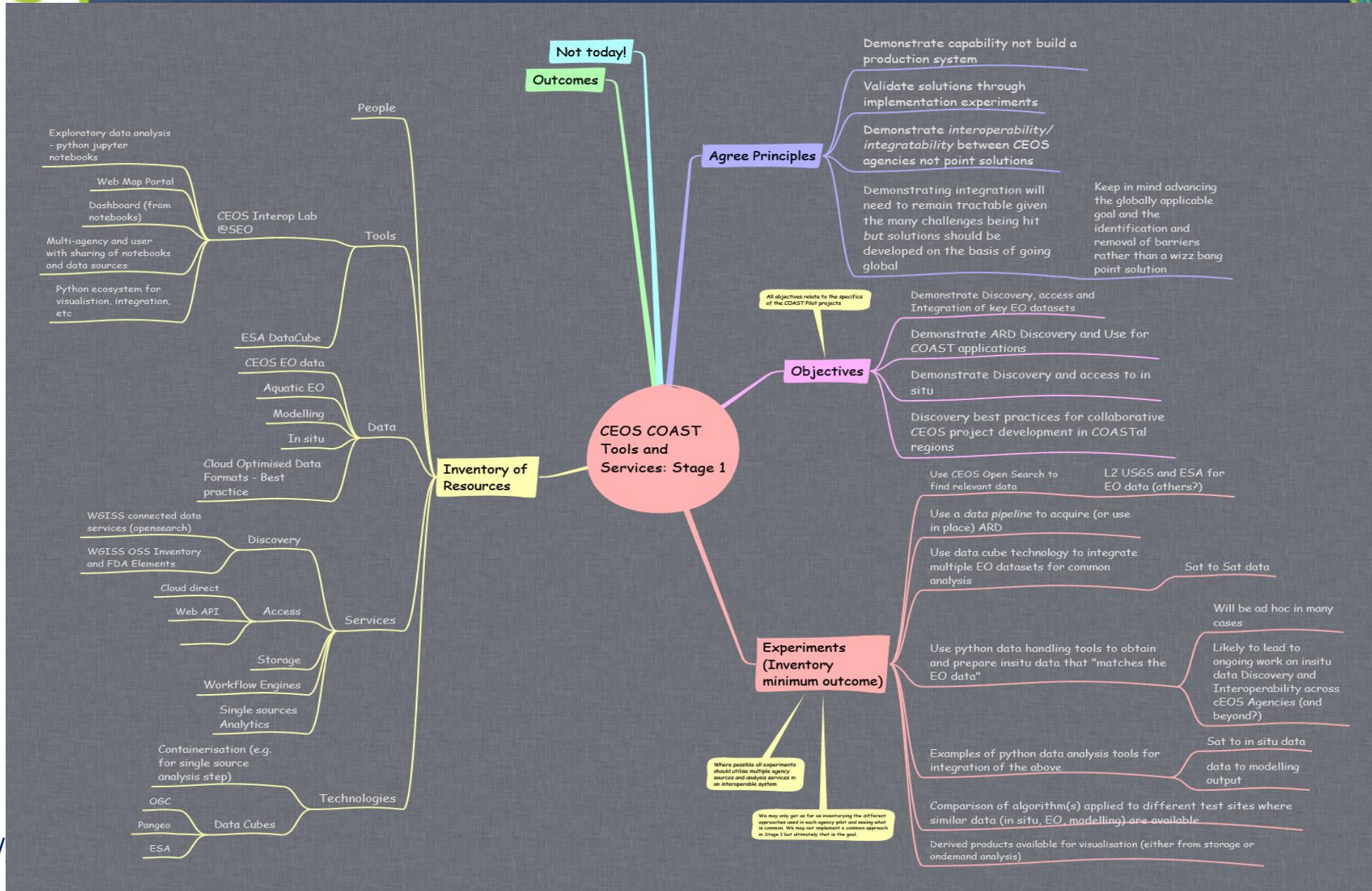
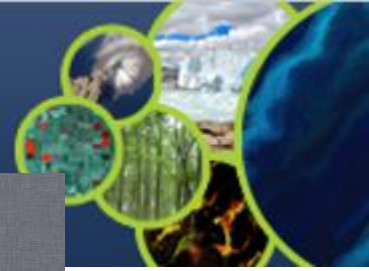
Forthcoming Request to CEOS Plenary to Continue COAST Through September 2021

- The COAST Team has made significant progress to date, including meeting and exceeding its initial deliverables as identified in its Phase 1 work plan for 2020.
- Furthermore, it has identified compelling user needs and opportunities that CEOS can readily address via COAST.
- As such, we will be requesting at CEOS Plenary continuation of COAST activities through Sept 2021 as a **CEOS Ad Hoc Team**, w/approval of impending Phase 2 Implementation Plan
- Likewise, we will be requesting therein pledges/contribution of resources as appropriate by CEOS Agencies.

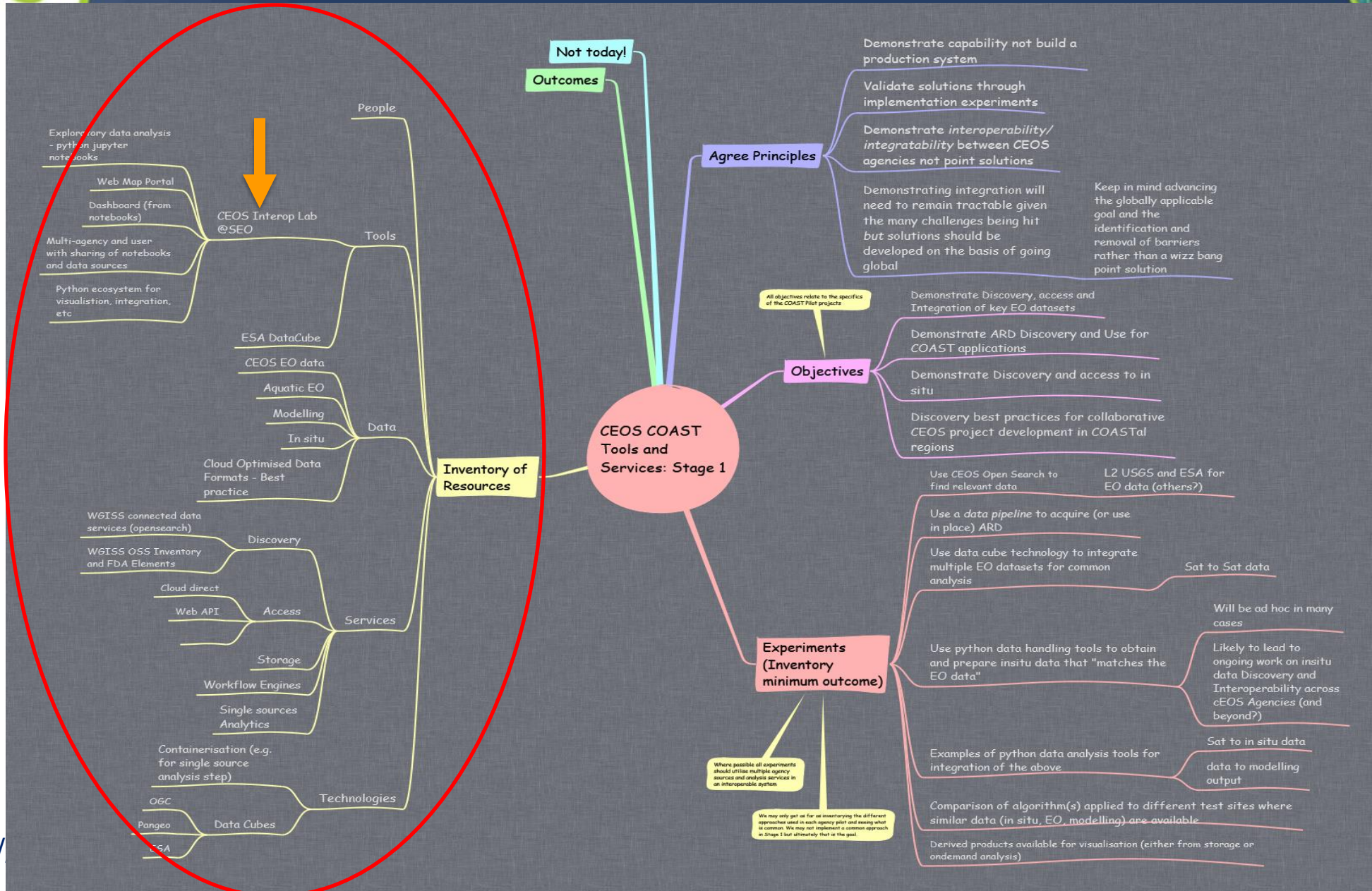


**Now to specific COAST
linkages/interfaces with WGISS,
especially for ARD and EAIL...**

CEOS COAST Architecture Mind Map



CEOS COAST Architecture Mind Map



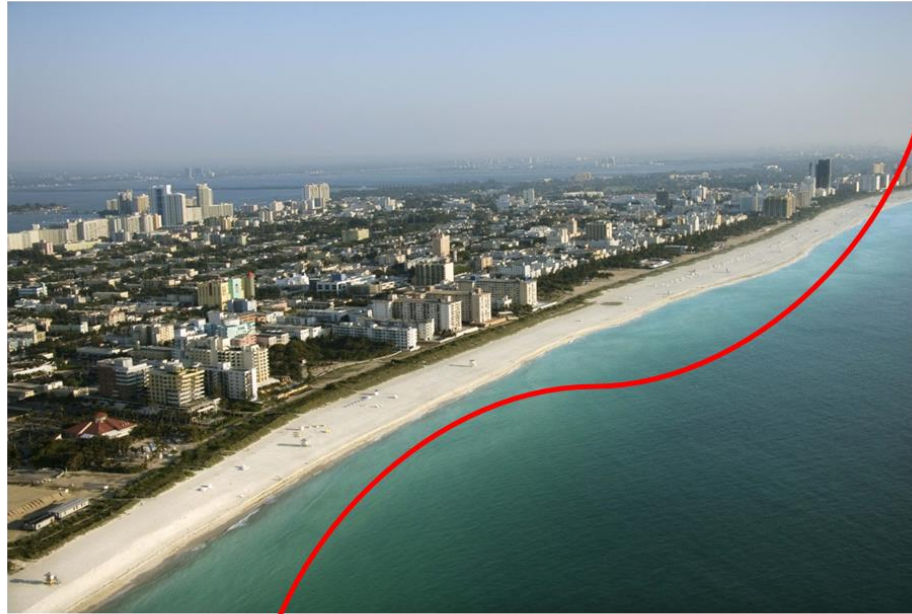


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COAST is Transboundary & more so Transdisciplinary! Coupling across Land & Sea, Sat & In Situ Data & Models, Physical & Bio Processes, Enviro & Social Sciences along w/other data linkages & interoperability is crucial – But how do we do this? And how do we transfer CEOS capabilities to other regions and partners, especially in developing regions?



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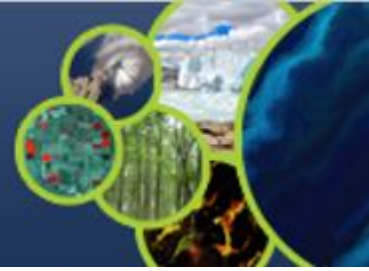
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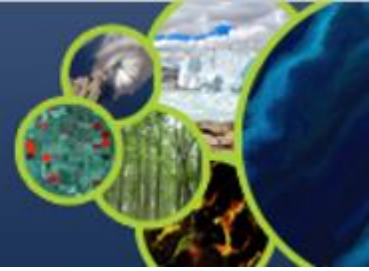
- Large-scale coastlines: urbanized, rural/agricultural, mixed use
- Small-island states: Coral-reef lined



- ***What:*** Successful realization and utilization of trans-boundary Analysis Ready Data (ARD) will be one of the unifying factors & primary engines that drives the COAST effort forward (NB: heritage/non-ARD data sets are of vital importance as well)
- ***Why:*** Because there have been significant challenges to date, and more so great opportunities looking ahead, in bridging and coordinating geophysical satellite data across the land-sea (~aquatic) interface, as well as *in situ* and diverse biological (and ultimately socio-economic) data sets – **ARD provides a common framework!**
- ***How:*** As COAST moves toward implementation, we will guide and leverage current and planned capabilities and approaches within CEOS for ARD, i.e., SST-VC, CARD4L/LSI-VC, USGS Aquatic Reflectance Demo, COVERAGE and **WGISS/SEO**



CEOS-COAST & Analysis Ready Data

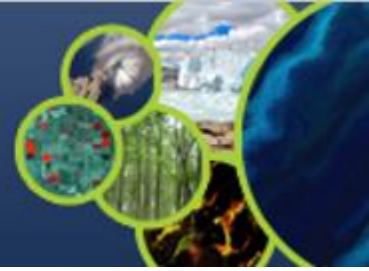


Key findings per **CEOS-COAST White Paper #3: Cross-Cutting Tools, Systems & Services:**

- COAST should leverage the CEOS Analysis Ready Data (ARD) framework, WGISS Interoperability Lab, Virtual Constellations, GHRSSST, COVERAGE et al. developed approaches, tools, and services as available/fit for purpose
- COAST should embrace.... the level of data that application developers desire, referred to as Analysis and Access of ARD in the CEOS Interoperability Terminology Report
- Many COAST relevant ARD discussions were initiated or continued within CEOS sub-communities (**CEOS/WGISS**, GEO AquaWatch, LSI-VC, SST-VC) with COAST a likely benefactor of streamlined, open source, formats trending toward achievement of FAIR data principles (Findable, Accessible, Interoperable, and Reusable/Reproducible)
- GEO AquaWatch, in association with COAST, is providing recommendations to CEOS for core ARD requirements to be adopted for the aquatic side - including addressing when available land requirements/approaches incompletely characterize or fulfill aquatic data product needs, or are not applicable, at least not w/o corollary modifications to suit the aquatic realm. This includes actively supporting the Aquatic Reflectance Product Family Specification Science Expert Review Panel led by N. Pahlevan, S. Labahn, A. Siqueira & C. Barnes.



CEOS-COAST & Earth Analytics Interoperability Lab

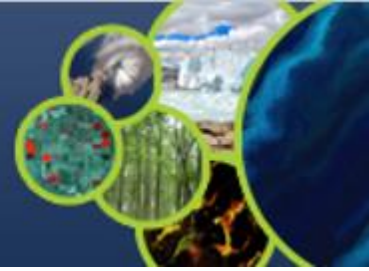


Key findings per **CEOS-COAST White Paper #3: Cross-Cutting Tools, Systems & Services:**

- COAST is extremely supportive of the nascent CEOS Earth Analytics Interoperability Lab (EAIL) as it will help us meet our requirements for interoperable data integration and analysis in a collaborative exploratory data analytics environment – much of our activity is innovative/transdisciplinary and not readily/directly supported by existing CEOS infrastructure
- The CEOS EAIL will assist in filling this gap by augmenting the existing CEOS agency capabilities in a collaborative way where all participants in COAST have access to the same capabilities. Specific capabilities identified by CEOS COAST that hopefully will be supported as part of the EAIL are:
 - Multi-sensor satellite data access and analysis via the CEOS Open Data Cube (including via WGISS CEOS Open Search and agency specific interfaces); In-situ data access and analysis via Python geospatial libraries; Shared Jupyter Labs Exploratory Analysis environment with notebook sharing and development; Scalable on-demand compute resources for data analysis
 - Ability to publish Web Dashboards directly from the Jupyter notebooks for “no source code visible” dashboard applications; Ability to host mid-scale data storage for data sources not readily available in interoperable, online forms but required by CEOS COAST Data pipeline and analysis automation tools



CEOS-COAST & Earth Analytics Interoperability Lab

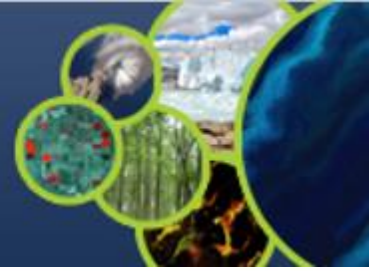


Key findings per **CEOS-COAST White Paper #3: Cross-Cutting Tools, Systems & Services:**

- Specific capabilities identified by CEOS COAST which hopefully will be supported as part of the EAIL are (continued):
 - Examples and shared library of visualization and analytics tools to assist Capability Development
 - Derived products can be shared using OGC Web Mapping Services Hosting for project web portals in a robust IT environment; Support from CEOS SEO and WGISS on identification and development of interoperability best practices; Potential for expansion of the EAIL to includes nodes and services from multiple CEOS agencies as interoperability is improved
- All this said, it is important to note that the EAIL is not intended as a long-term sustainable platform for CEOS COAST (or other projects for that matter). Nor would WGISS and CEOS SEO become responsible for COAST project outcomes.
- Instead, we envision they will provide the design blueprint and implementation which once understood can be more readily sustained through a more appropriate mechanism (TBD). It will also help inform development of WGISS Best Practices in interoperability and potential services improvements from CEOS SEO.



CEOS-COAST & Earth Analytics Interoperability Lab



Key findings per **CEOS-COAST White Paper #3: Cross-Cutting Tools, Systems & Services:**

- Finally, it is hoped additional CEOS Agencies might choose to host EAIL nodes using their particular technology choices to support multi-agency interoperability experiments with CEOS COAST and other projects. This would enable regional focus on dataset collection and leverage existing agency partnerships for data sharing and capacity building to deliver COAST data product solutions to users and train them.
- COAST looks forward to working with WGISS and SEO on this most important initiative

Thanks for the support!!