Web-based Tools and Services for Integrated Support of NASA Satellite Salinity and Field Campaigns

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COVERAGE
CEOS Ocean Variables Enabling Research & Applications for GEO

CEOS The Committee on Earth Observation Satellites

Abstract

There is a growing number of oceanographic field campaigns complementing NASA satellite missions that necessitate a more integrated approach to data access involving implementation of enhanced value-added data services to enable this. Here we report on open source software capabilities that leverage emerging cloud-computing technologies developed under NASA/AIST and ACCESS-funded projects at JPL to provide advanced Web-based data visualization and on-demand matchup and analytics services for salinity data of different types. These include SPURS and Saildrone in-situ datasets, satellite data from Aquarius and SMAP.. Capabilities of the JPL Common Mapping Client (CMC), and Science Data Analytics Platform (SDAP) are described and illustrated in the context of salinity. These services, applicable also to oceanographic data more generally, are being leveraged by the NASA-led COVERAGE project within the Committee on Earth Observation Satellites (CEOS), and once matured further have the potential to be infused operationally to usefully augment existing NASA data archive (DAAC) infrastructures.

Initiative

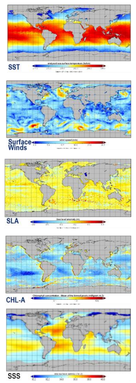
- Cross-cutting, collaborative initiative within CEOS and NASA project
- Address key constraints to access and synergistic use of multi-sensor/variate Earth Observations and ocean observing system data, particularly amongst currently underserved user communities with a need for such environmental information.
- Enable more widespread, integrated use of ocean satellite, in-situ & model data for interdisciplinary open science/applications to more fully realize their potential.
- Build upon an advanced technology platform being implemented providing access to complementary satellite & in-situ datasets via value-added data services
- Exercises emerging cloud technologies for Earth Observation applications across heterogeneous cloud environments (NASA-AWS, EUMETSAT WEkEO)
- Reusable data platform and software toolkit leveraging Hybrid-Cloud infrastructures

Approach

- User community driven, Stakeholder focused, Open Source, data FAIR
- Emphasis on data interoperability standards and thematically-based data access via distributed data architecture
- Phased Development: currently Phase C (18 months)

- Governance: Advisory Board (stakeholder agencies)
- Operationalization concept and Sustainability strategy development

Core EO Data



Coherent set of high value, interagency L4 NRT & Reanalysis Baseline Datasets included

SST
- METOFFICE-GLO-SST-L4-NRT-OBS-GMPE-V3 (GHRSST-CMEMS/UK Met.Office)
- MUR25-JPL-L4-GLOB-v4.2 (GHRSST- NASA/Measures)

Ocean Surface Topography
- SEALEVEL_GLO_PHY_L4_NRT_OBSERVATIONS_008_046 (AVISO/CLS - CMEMS)
- SEALEVEL_GLO_PHY_L4_MY_008_047 (AVISO/CLS - CMEMS)
- SEA_SURFACE_HEIGHT_ALT_GRIDS_L4_2SATS_5DAY_6THDEG... (NASA/Measures - JPL)
- NOAA_LSA_SLA_GLOB_L4_NRT and DT (NOAA/LSA)

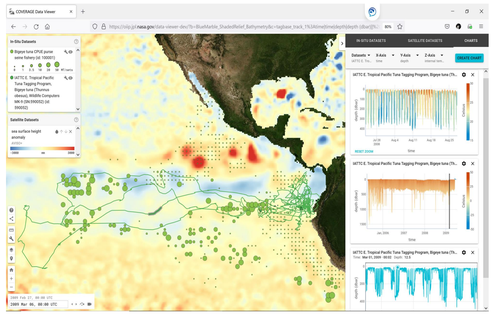
Ocean Color
- JPL-MRVA25-CHL-L4-GLOB-v3.0 (NASA/COVERAGE -JPL)
- OCEANCOLOUR_GLO_CHL_L4_REP_OBSERVATIONS_009_082 (Globcolour – CMEMS)
- OCEANCOLOUR_GLO_CHL_L4_NRT_OBSERVATIONS_009_033 (Globcolour – CMEMS)
- NOAA_MSL12-NRT-CHL-Daily-L4 and DT (NOAA/Coastwatch)

Winds
- WIND_GLO_WIND_L4_REP_OBSERVATIONS_012_006 (CERSAT/IFREMER - CMEMS)
- WIND_GLO_WIND_L4_NRT_OBSERVATIONS_012_004 (CERSAT/IFREMER - CMEMS)
- RSS_CCMP_WINDS_V2.1 (NASA/Measures – RSS)

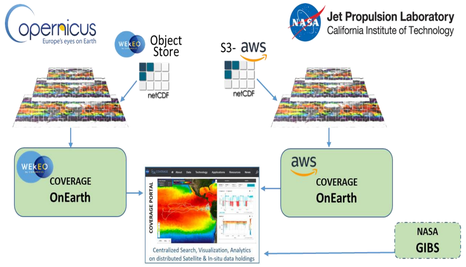
Sea Surface Salinity
- OISSS_L4_multimission_7day_v1 (NASA/SCP – IPRC-SOEST, RSS)
- OISSS_L4_multimission_Monthly_v1 (incl. SSS-anomaly field) (NASA/SCP – IPRC-SOEST, RSS)

Cloud-enabled Data Services

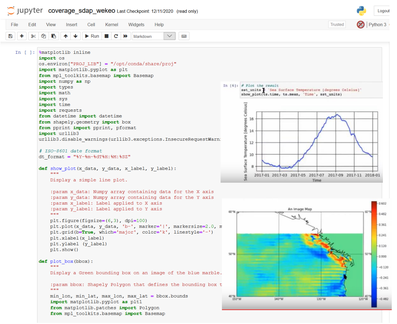
Click figures below to enlarge



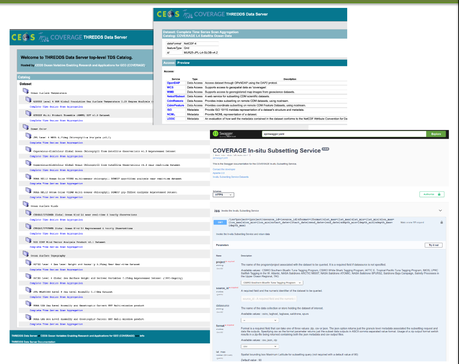
Web-based Data Visualization



WMTS Tiled Imagery Services

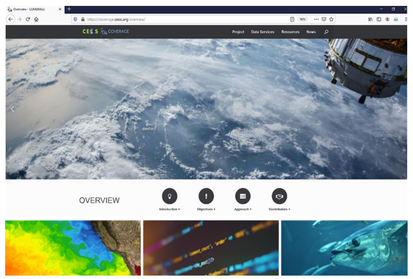


SDAP Analytics Services



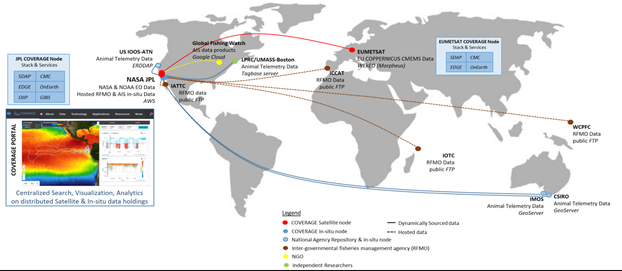
THREDDS OGC & ISS OpenAPI Services

Web Portal https://coverage.ceos.org



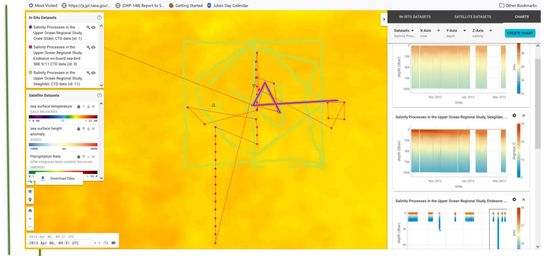
Distributed Data Architecture

JPL-AWS and EUMETSAT/CMEMS-WEkEO cloud nodes with connectivity to GOOS in-situ providers

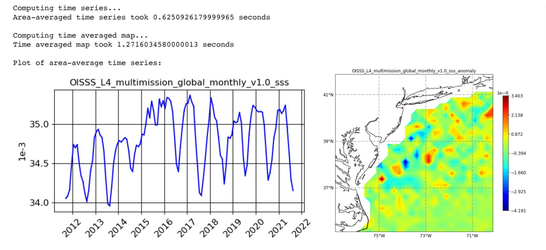


NASA Salinity Data Visualization & Analytics

Click figures below to enlarge



Integration of SPURS Field Campaign Data in the COVERAGE Viewer



OISSS regional time series & spatial anomaly analytics via COVERAGE SDAP API using Jupyter

What's next?

- Thematic NASA Salinity Application development
- Integrate full suite of SPURS 1 & 2 datasets
- Extend analytics capabilities to include matchup and couple to Viewer
- Demonstrate COVERAGE support for field campaigns

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URS CL# 21-6002

Prototype Data Services

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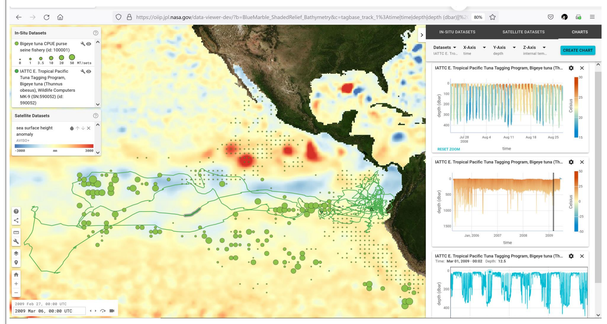
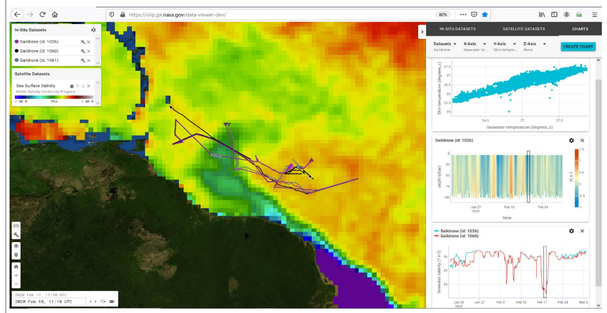
Web-based Data Visualization

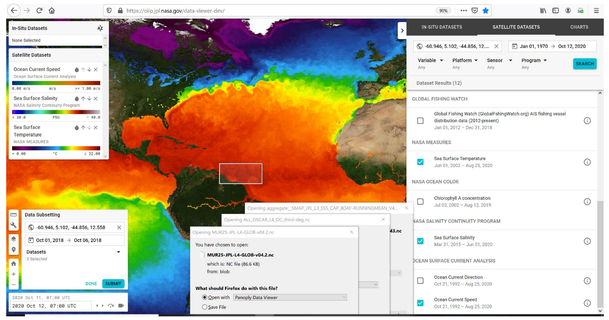


IATTC Bigeye Tuna archival tag & spatial catch distribution data relative to AVISO-SSHA and animal telemetry environmental measurements

- Integrated visualization of satellite & in-situ data - a generalized and reusable software capability
- Synchronized horizontal and vertical views of data and their evolution over time
- Integrated dataset Search
- "One-stop" Data Subsetting capability (both satellite & in-situ)
- Open Source: JPL Common Mapping Client
- What's Next: Analytics API integration



Saildrone ATOMIC cruise ADCP and CTD data overlaid on Sea Surface Salinity data from SMAP

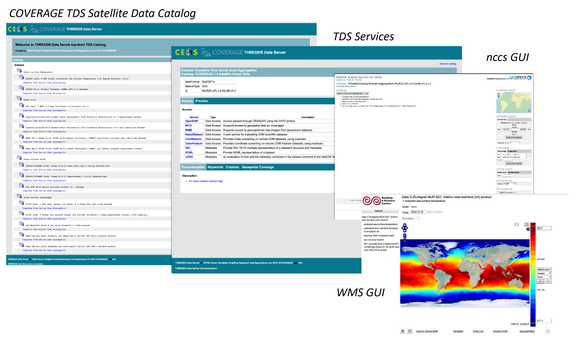


Integrated Data Search & Subsetting

TDS OGC Services

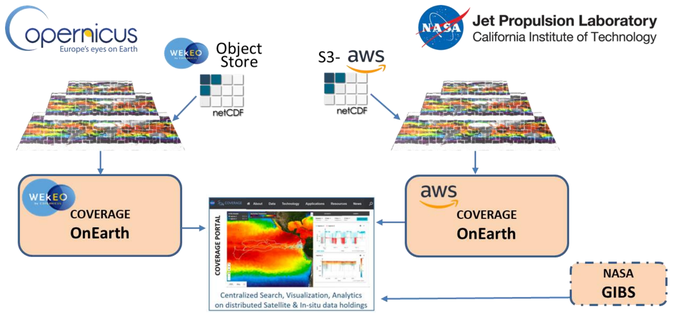
- Powered by THREDDS v5 in the Cloud
- Deployed on both COVERAGE AWS and WEkEO nodes
- TDS catalogs accessing COVERAGE dataset granule repositories natively in S3 object stores
- Integration of forward data file stream on ongoing basis via COVERAGE "Harvester software"
- Supported TDS services/APIs: nccs subsetting, opendap, WMS, WCS, ISO metadata, and CDM-remote
- TDS-5 also provides support for in-situ discrete spatial geometry type data in addition to gridded data

COVERAGE TDS Satellite Data Catalog

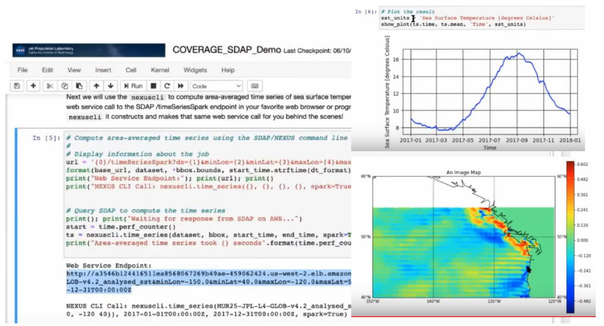


Tiled Imagery Services

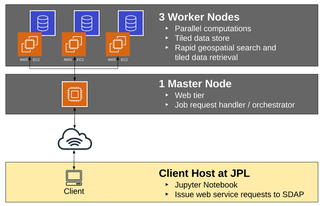
- COVERAGE deploys an OnEarth image tile server for rapid web-based visualization
- OnEarth is a high performance map tile server developed and led by JPL
  - It is also the backend for NASA GIBS and Worldview
  - Open source on GitHub: https://github.com/nasa-gibs/onearth
  - Primarily access using the Web Map Tile Service (WMTS) specification
- Deployed in two nodes: WEkEO and AWS
- Imagery from OnEarth and other sources such as GIBS are used in the viewer



Analytics Cloud Services



SDAP WEkEO Deployment Instance



- Science Data Analytics Platform (SDAP)
- Open Source : *http://sdap.apache.org*
- *"Enabling Big Data Science Without Download"*

- Cloud Deployments: AWS (JPL) & WEkEO (EUMETSAT)
- Interfaces: Jupyter notebooks & APIs

NASA Salinity Data Web-Visualization

Integrated Satellite and SPURS *in situ Data Visualization via the COVERAGE Viewer*

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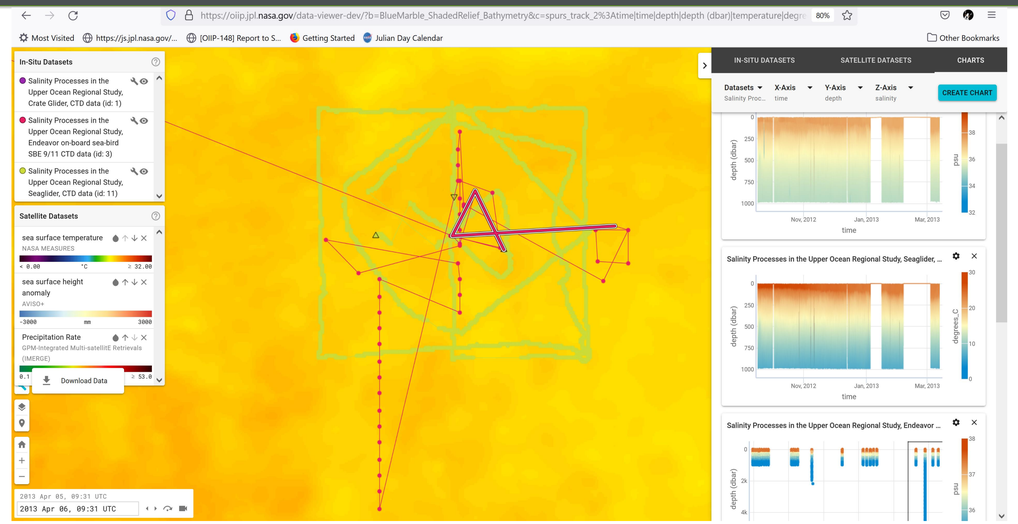
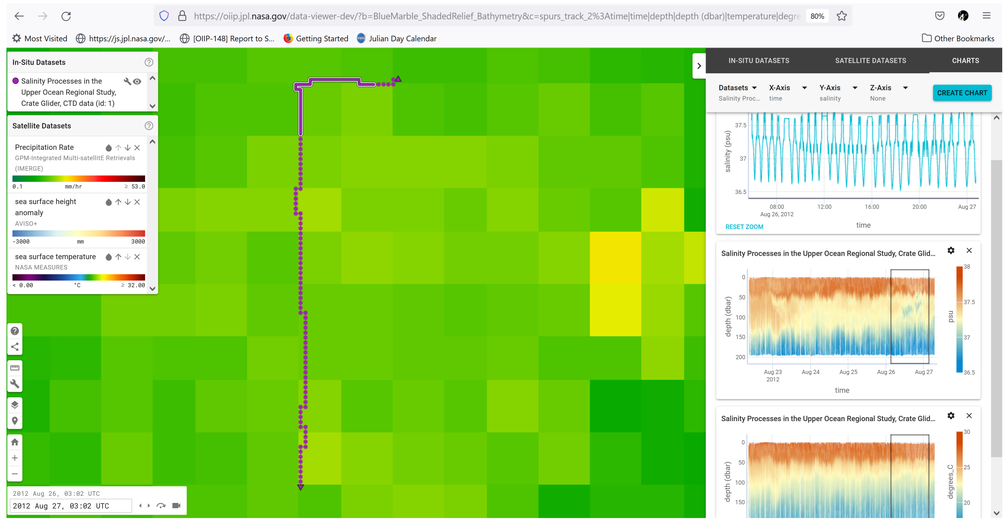
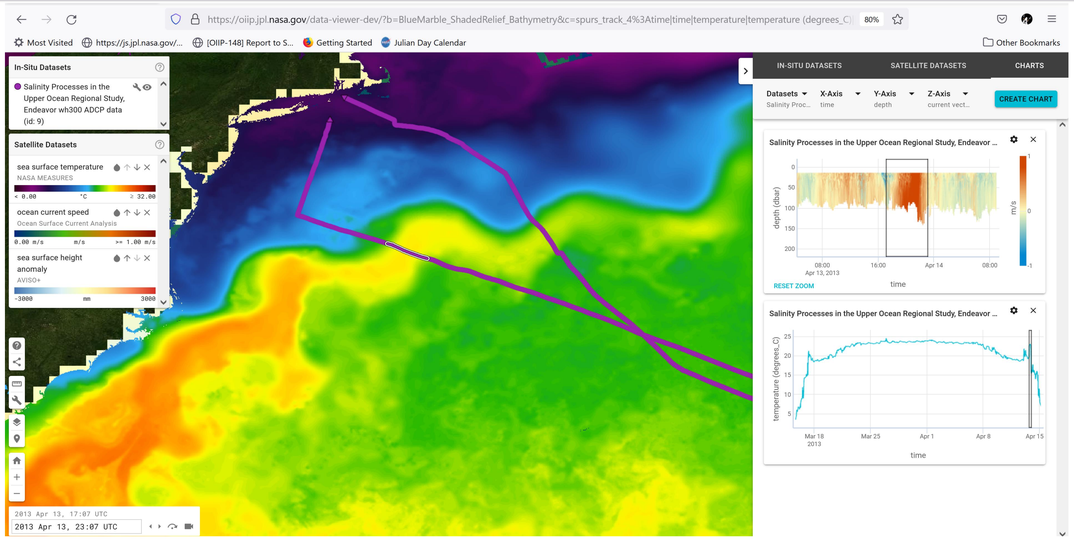
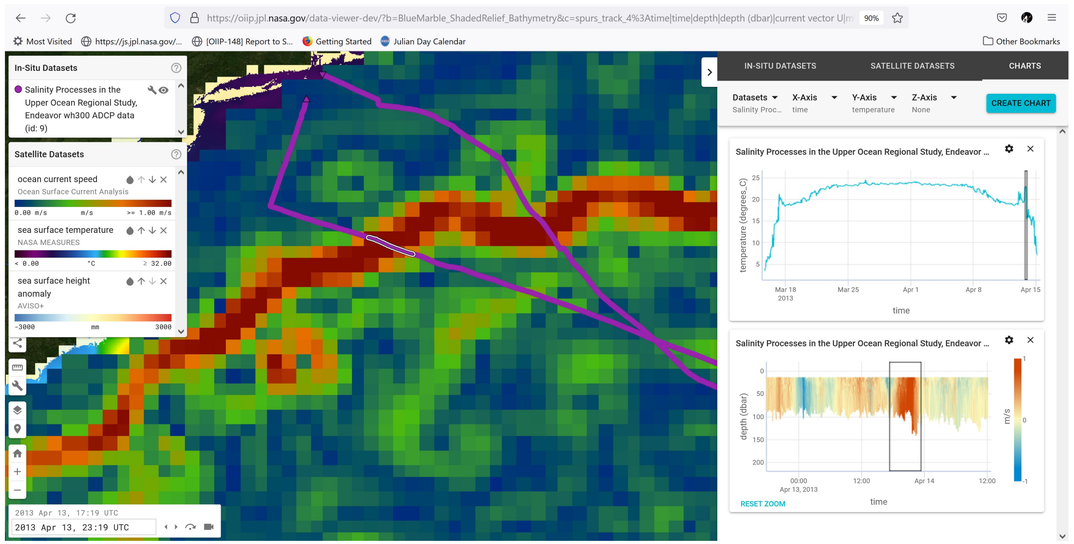


Interactive visualization of Seaglider, Crate Glider and RV Endeavor deployments and vertical profile data within the SPURS-1 sensor web domain, April 2013 in relation to contemporaneous satellite SST.



Detailed trajectory & vertical profiles of salinity, temperature measurements from a Crate Glider during SPURS1, Aug. 2012 overlaid on satellite precipitation data, illustrating the presence of subsurface patches of less saline water between 50-80m on the current Aug. 26-27 time step.





Coherence between remotely sensed SST and along track in-situ temperature data from the RV Endeavor thermosalinograph while traversing the extent of a Gulf stream frontal feature over a 6 hour period in April 2013 at the end of a SPURS 1 cruise (Top). Associated spatio-temporal coherence between satellite surface current fields from OSCAR and subsurface flow fields measurements from on-board vessel ADCP across the same frontal feature (Bottom).