

Integrating the Distributed Oceanographic Match-Up Service into OceanWorks



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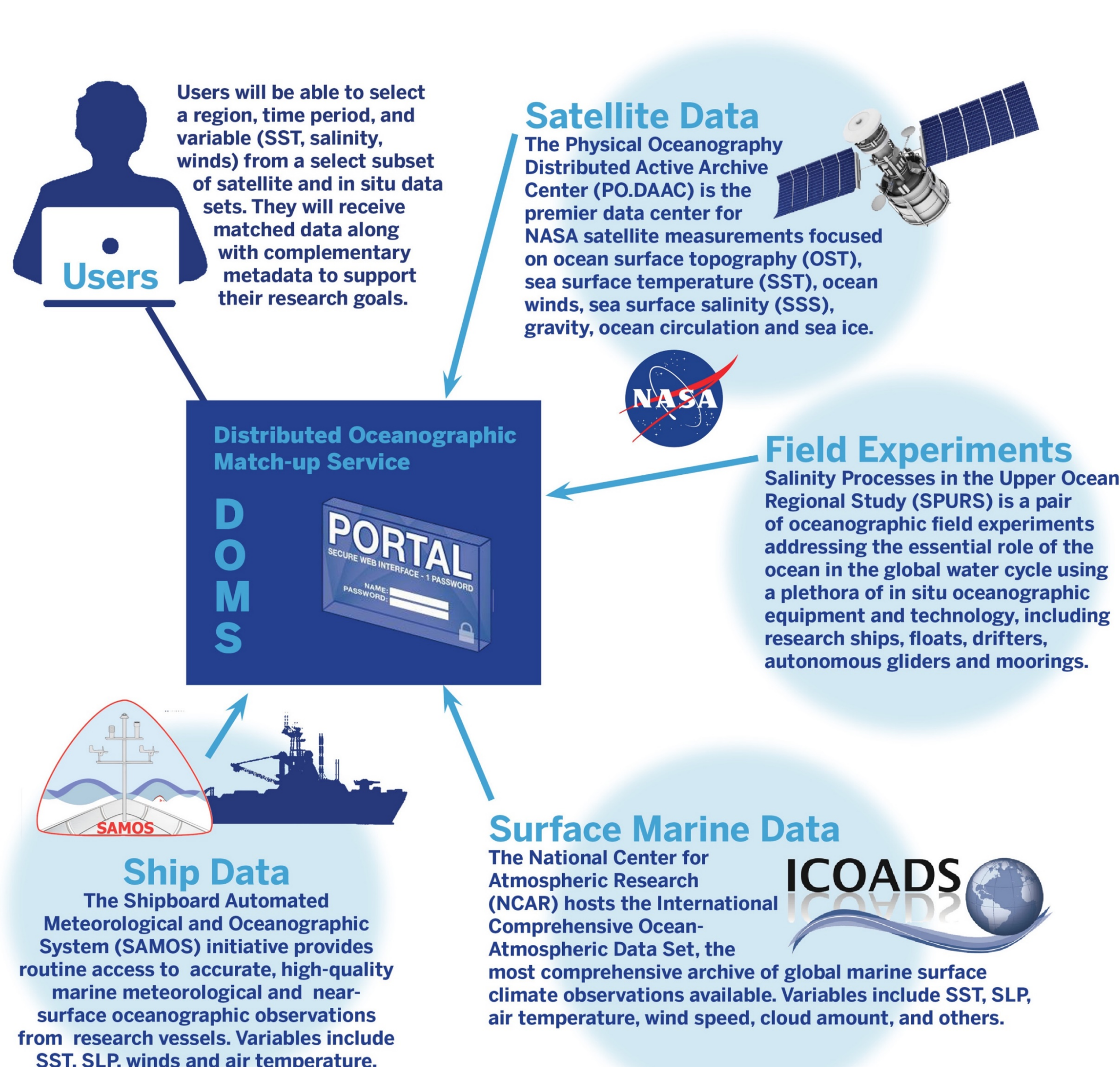
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Overview

The Distributed Oceanographic Match-Up Service (DOMS) is a collaborative effort between COAPS, NCAR, and NASA JPL. The service currently has prototype application program interface (API) and graphical user interface (GUI) services available. DOMS reconciles satellite and in situ datasets in support of NASA's Earth Science mission. The service provides a mechanism for users to input a series of geospatial references for satellite observations and receive the in situ observations that are matched to the satellite data within a selectable temporal and spatial search domain. DOMS includes several characteristic in situ and satellite observation datasets.

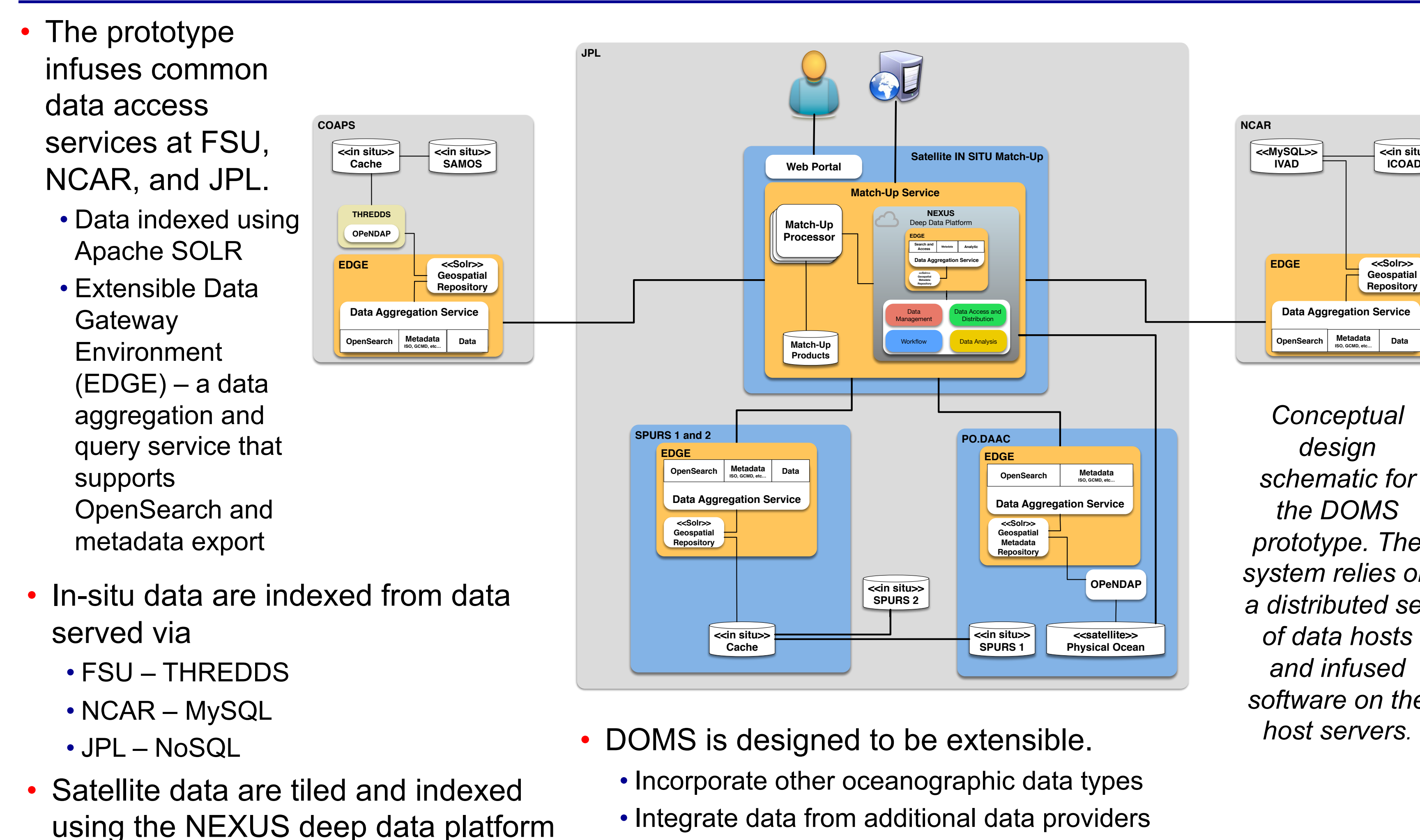
DOMS is designed to provide a community-accessible tool that dynamically delivers matched data and allows the scientists to only work with the subset of data where the matches exist. Building on the successful prototype, further development of DOMS is continuing as an integrated component of the OceanWorks data analysis platform.



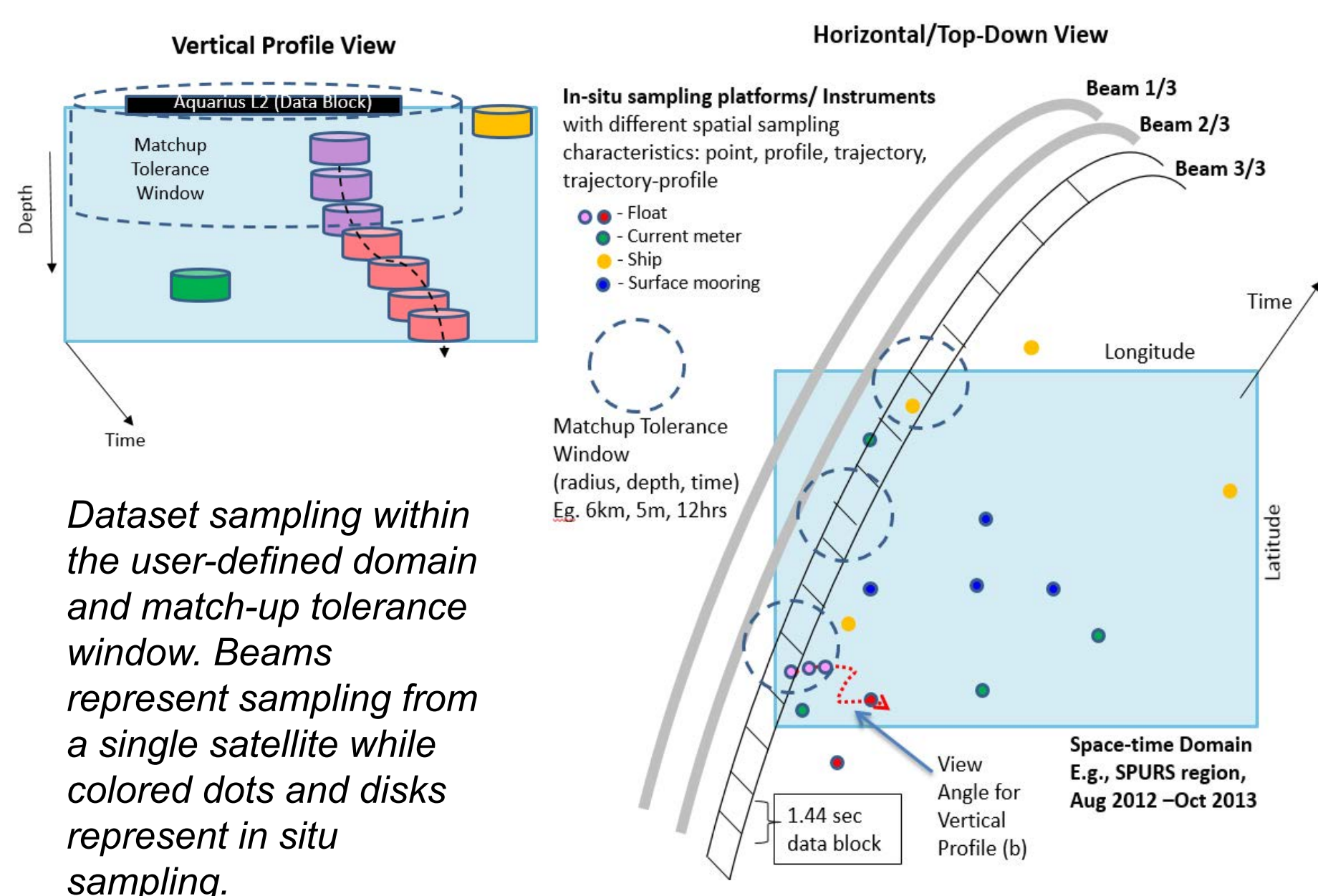
Why DOMS is Needed?

- A wide user community seeks to match satellite to in situ observations to meet goals that include:
 - Satellite algorithm calibration, validation, and/or development
 - Decision support for planning future field campaigns
 - Investigations to support process studies, data synthesis, etc.
- The DOMS prototype focuses on algorithm calibration/validation.
- DOMS eliminates the need for one-off match-up programs that require satellite and in situ data to be housed on one's local computer

Architecture of the DOMS Prototype



Search Domain, Match-Up Tolerances



- Queries use Solr index of the following
 - Parameter – salinity, sea temperature, winds
 - Temporal search domain – ISO 8601 UTC
 - Horizontal search domain – latitude & longitude
 - Vertical search domain above/below sea level
 - Data source
 - Satellite: JPL SMAP L2B v2.0 salinity; ASCAT-B L2 Coastal 12.5 km winds; AVHRR OI L4 GHRSSST 0.25° and MUR L4 1 km daily sea surface temperature
 - In situ: ICOADS Release 3.0, SAMOS, SPURS-1, 2
 - Platform type (ship, orbiting satellite, etc.)
 - Device type (CTD, glider, radiometer, etc.)
 - Mission (SMAP, ASCAT, MODIS, SAMOS, etc.)
 - Data quality flag (simplified mapping)
- Users can also specify spatial and temporal match-up tolerances for locating a match (e.g., within 1 hours and 30 km).

Prototype User Interface

- A GUI supports browsing and submitting match-up requests interactively
 - Allows users to “test/evaluate” searches by returning metadata only, creating visualizations, and then follow-up with a full matched dataset
 - Uses flexible filtering and query specification based on indexed search criteria
- The API supports machine-to-machine match-up operations to enable scalable data processing by external applications and services.

1st Prototype Steps

- Select Satellite Source
- Select Date Range
- Select Depth Range
- Select Match-Up Tolerances (Space + Time)
- Draw Bounding Box

Step 5 triggers search of in situ data in box and displays counts

Once in situ counts are displayed and mapped (as shown above) user triggers data matching algorithm with **Submit** button. Resulting matched data are provided in tabular and graphical displays (below). Data can be downloaded as CSV or netCDF-CF files.

Source	Time	Lat	Lon	Depth (m)	SST	SSS	Wind Speed	Wind Direction
SMAP_L2B_SSS	2015-07-04 08:04:51	28.220	-90.604	0.000	0.000	32.160	0.000	0.000
SMAP_L2B_SSS	2015-07-02 08:29:17	28.445	-92.090	0.000				
samos	2015-07-02 07:30:00	28.510	-92.010	0.000				
samos	2015-07-02 07:31:00	28.510	-92.010	0.000				
samos	2015-07-02 07:32:00	28.500	-92.010	0.000				
samos	2015-07-02 07:33:00	28.500	-92.010	0.000				
samos	2015-07-02 07:34:00	28.500	-92.010	0.000				
samos	2015-07-02 07:35:00	28.500	-92.010	0.000				

Satellite Measurements: -- In-Situ Measurements: --

Satellite Matches: 22 In-Situ Matches: 1656

Integrating DOMS into OceanWorks

- First development cycle for DOMS completed in spring 2017 with 2nd prototype at a technology readiness level (TRL) of 4.
- Through the OceanWorks project (started in September 2017), the team plans to achieve a TRL-6 by
 - Building new capability to support large-scale data queries (e.g., whole globe or entire satellite mission),
 - Developing delayed-mode data delivery protocols and file formats,
 - Enhancing the data match-up algorithm to improve performance,
 - Implementing filters using data quality information, and
 - Fully integrating DOMS into OceanWorks via deployment to the AIST Managed Cloud Environment.
- Ongoing architectural changes to DOMS include
 - Enhancements to the data match-up capability
 - Harvesting the SOLR-indexed in situ data from the remote data hosts using the OpenSearch interface.
- These changes should eliminate the on-the-fly data movement and network stall overheads.
- They also will make the code ready for implementation in a cloud environment.

Vision for the Future

- Under OceanWorks, DOMS can address big data approaches to finding (1) problems with data used in calibration (satellite-to-in situ and satellite-to-satellite), and (2) physical relationships in the observed variables. For example,
 - Algorithm development depends highly on using observations from moorings; however, in high winds moorings are riding very large waves and are suspected to report non-representative winds when the mooring is in the wave trough. Quantifying this problem requires collocating large numbers of satellite to in situ data.
 - Diurnal warming links SSTs, winds, and chlorophyll among other variables. To understand the physical relationships requires matching multiple data parameters across a range of observing platforms.
- Further DOMS enhancements being considered include the following:
 - Supporting satellite-to-satellite and in situ-to-in situ data matching,
 - Supporting satellite/in situ to numerical model matching, and
 - Including additional high-priority science datasets.

Acknowledgements

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