Building a Distributed Oceanography Match-Up Service (DOMS) To Pair Field Observation And Satellite Data

Zaihua Ji
Steven Worley
CISL/NCAR
and
DOMS Teams at JPL NASA and Florida State University

NCAR SEA, April 4th 2016

DOMS Distributed Oceanographic Match-Up Service

https://mdc.coaps.fsu.edu/doms

ESTO Earth Science Technology Office

DOMS Teams

FSU PI: Shawn Smith
FSU Co-I: Mark Bourassa
FSU Engineers: Jocelyn Elya and Adam Stallard

JPL Co-Is: Thomas Huang, Vardis Tsontos and Ben Holt
JPL Engineers: Kevin Gill, Frank Greguska, Nga Quach and Namrata Malarout

NCAR Co-I: Steve Worley
NCAR Engineer: Zaihua Ji

OUTLINE

- Introduction
- Distributed Data Sources
- Implementation
- Technical Activities at NCAR
- Summary
- Future Work
- Questions?

Introduction

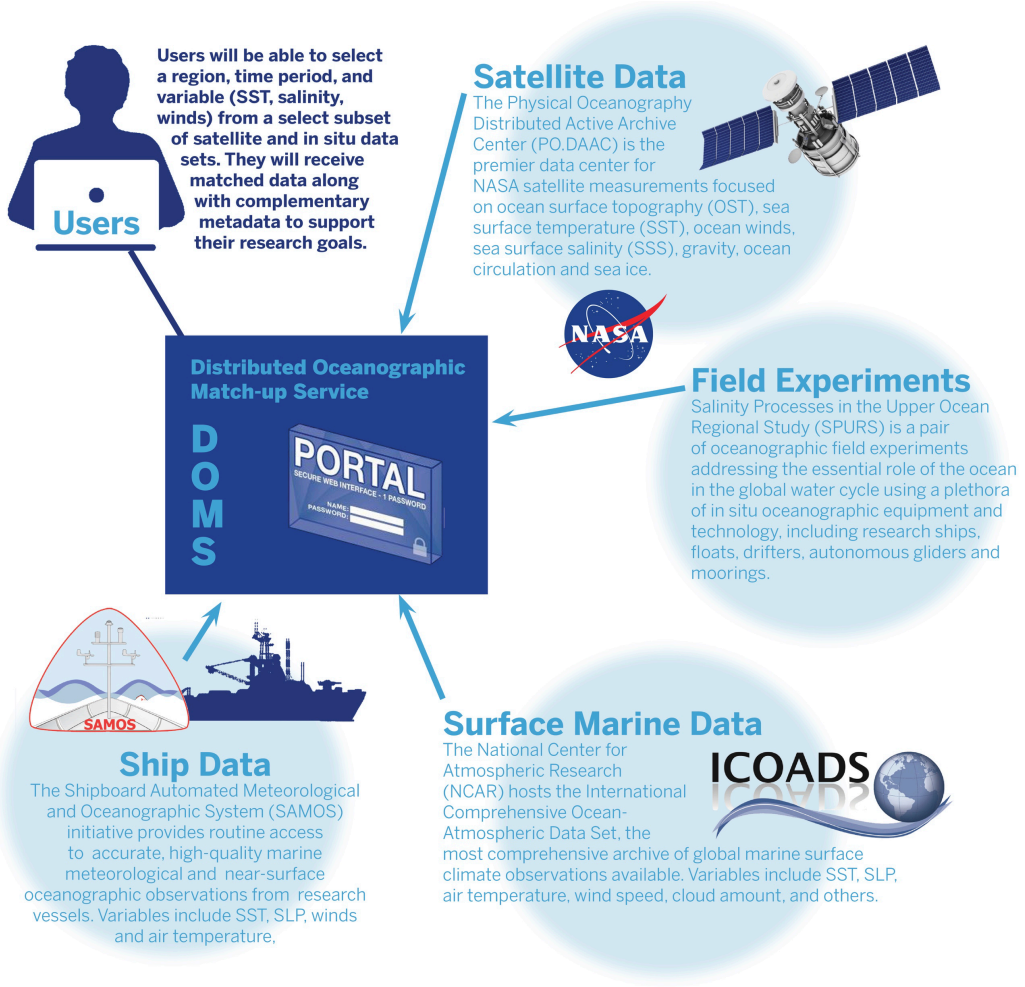
- DOMS – a Distributed Oceanographic Match-up Service
- Matches satellite and in situ marine observations to support platform comparisons, cross-calibration, validation, and quality control
- Supports human-initiated data requests and machine-to-machine queries
  - a series of geospatial references for satellite observations (e.g., footprint location, date, and time) and receive matched in-situ observations within a selectable temporal and spatial domain
  - in-situ geospatial data (e.g., positions of moorings, floats, or ships) and return corresponding satellite observations

Introduction

- Focus on select in situ marine datasets and satellite products on initial prototype
- The design will be flexible to allow expansion and portability for additional in situ, model and satellite data to be matched in future versions
- Distributed services reduce duplicate development and man hours required to match satellite/in situ data

Distributed Data Sources

- Surface observations from the International Comprehensive Ocean-Atmosphere Data Set (ICOADS) at NCAR
- The Shipboard Automated Meteorological and Oceanographic System Initiative (SAMOS) at FSU/COAPS
- The Salinity Processes in the Upper Ocean Regional Study (SPURS) at NASA/JPL
- Satellite data from NASA/JPL

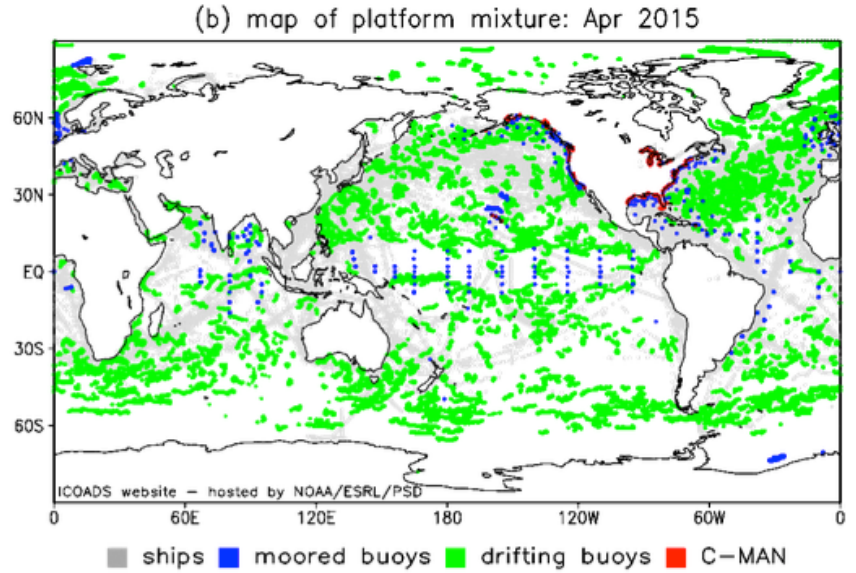


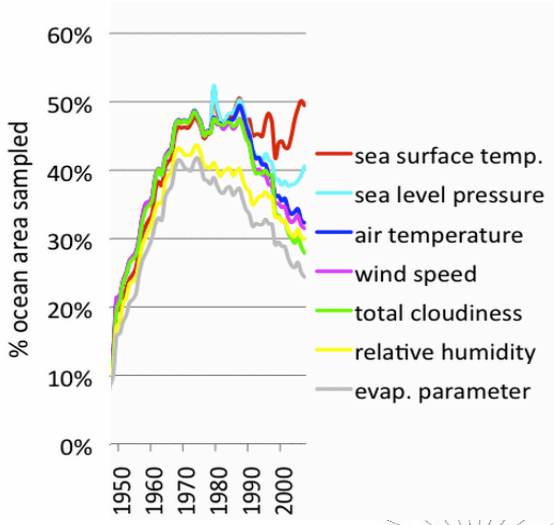
In situ data: ICOADS

ICOADS Release 3.0

- Availability April 2016
- Date range, 1662-2014
- Monthly updates lagging real-time by one month
  - Approximately 3M records per month
  - Using two GTS data streams (NCEP and NCEI-Asheville)
- Global coverage from ocean observing systems
  - SST
  - Sea Surface Wind
  - Salinity

Note: Illustrative figures are produced from Release 2.5, the current operational archive





DOMS Distributed Oceanographic Match-Up Service

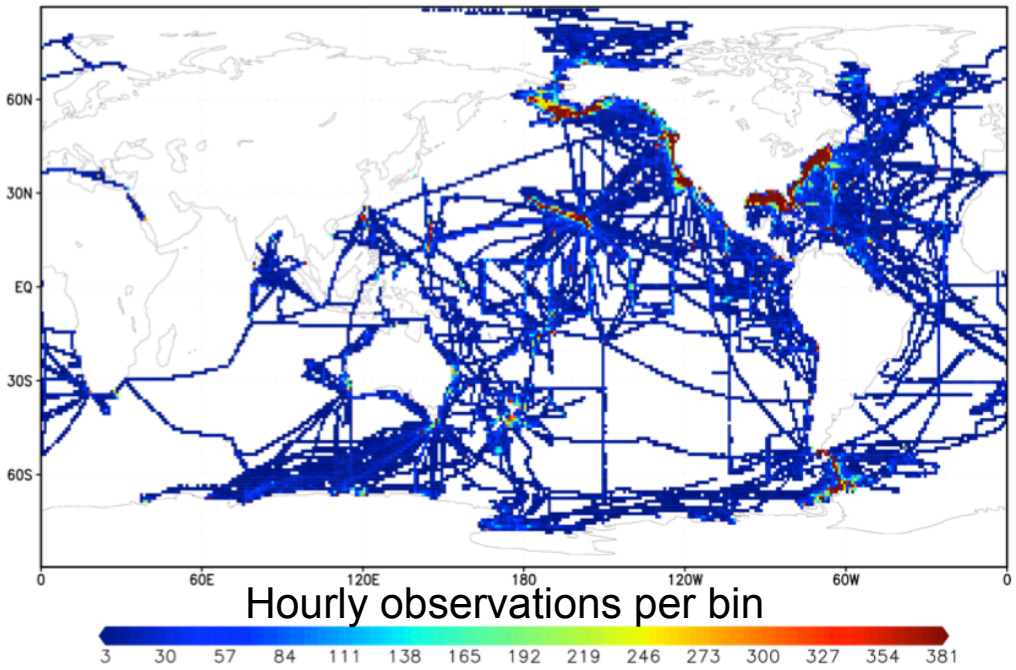
https://mdc.coaps.fsu.edu/doms

ESTO Earth Science Technology Office

In situ data: SAMOS

- Shipboard Automated Meteorological and Oceanographic System (SAMOS) initiative provides high-quality underway data from research vessels.
- Hosted at FSU/COAPS.
- ~30 vessels participating in FY2014
  - Vessels operated by WHOI, SIO, UH, UW, BIOS, NOAA, USCG, USAP, IMOS, SO, LUMCON
  - ~30-40K one-minute observations/month/vessel

SAMOS Data Density: 2005-2014



- Data include routine navigation (position, course, heading, speed), meteorology (wind, air temperature, humidity, pressure, rainfall, radiation), and oceanography (sea temperature and salinity).
- All data undergo scientific quality control.

DOMS Distributed Oceanographic Match-Up Service

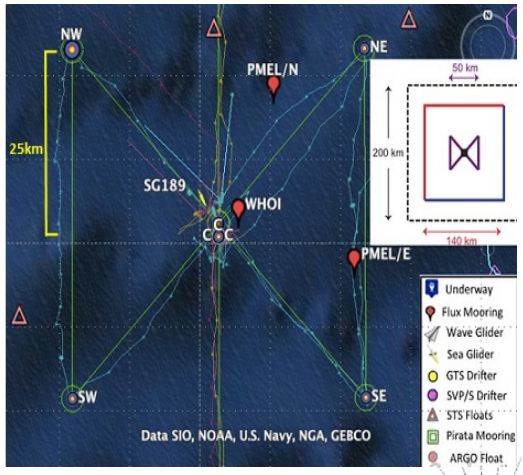
https://mdc.coaps.fsu.edu/doms

ESTO Earth Science Technology Office

In situ data: SPURS

- NASA-funded oceanographic field campaigns/Science salinity process studies:
  - SPURS-1: N. Atlantic (2012-13) : salinity max region
  - SPURS-2: Eastern Equatorial Pacific (16-17): high precipitation/low evaporation region
- SPURS-1 campaign
  - Series of 5 cruises
  - Advanced sampling technologies deployed in a nested design
    - 900 x 800-mile square study area centered at 25˚N, 38˚W.
  - Natively heterogeneous formats for 15 datasets converted to NODC NetCDF standard by SPURS-DMT
  - Archived at the PO.DAAC, Discoverable & Distributed publicly as of 5/11/2015
    - PO.DAAC SPURS Mission Page: http://podaac.jpl.nasa.gov/spurs

Ship (cruise #)	Dates	Country	Chief Scientist
Thalassa	16-Aug - 13-Sep-2012	France	Reverdin
Knorr (209)	6-Sep - 9-Oct-2012	US	Schmitt
Endeavor-1 (522)	15-Mar - 15-Apr-2013	US	Schmitt
Sarmiento	14-Mar - 10-Apr-2013	Spain	Font
Endeavor-2 (533)	19-Sep - 13-Oct-2013	US	Fratantoni



JPL Jet Propulsion Laboratory California Institute of Technology

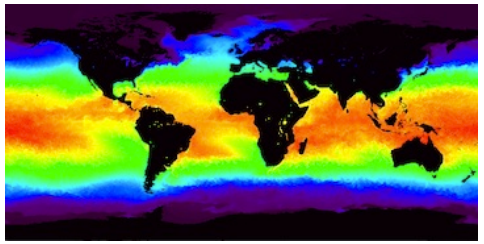
DOMS Distributed Oceanographic Match-Up Service

https://mdc.coaps.fsu.edu/doms

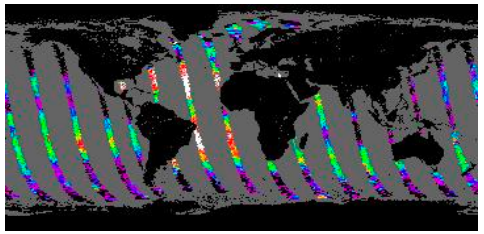
ESTO Earth Science Technology Office

Satellite Data: PO.DAAC

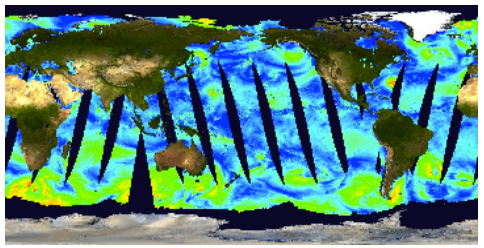
- SST: L2 GHRSST-MODIS-A L2P, GHRSST-MODIS-T L2P (1km grid, 2330km swath, 12hr repeat) L4 MUR-SST (1km, daily)



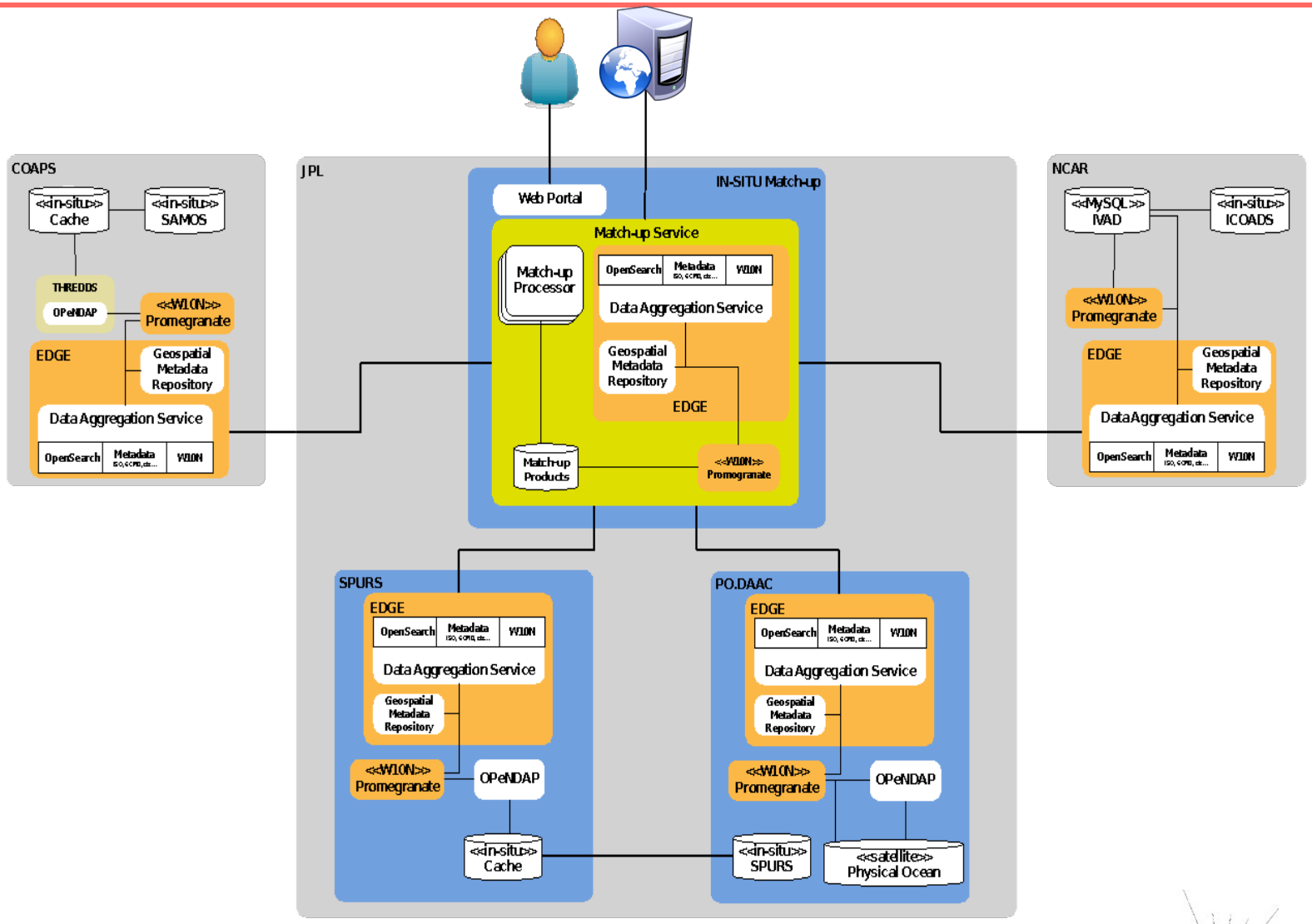
- SSS: L2 Aquarius L2 v3.0, CAP L2 v3.0 (100km grid, 390km swath; 7day repeat)



- Winds: L2 JPL Quikscat v3.0 (12.5km grid, 1800km swath; 12hrepeat)



Distributed Design



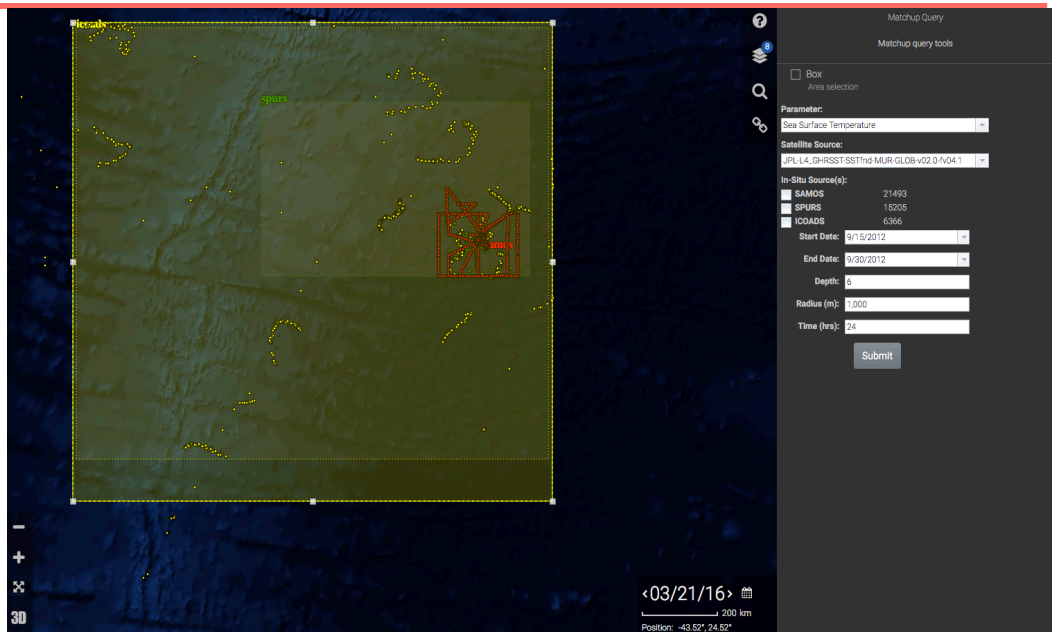
DOMS
Distributed Oceanographic Match-Up Service

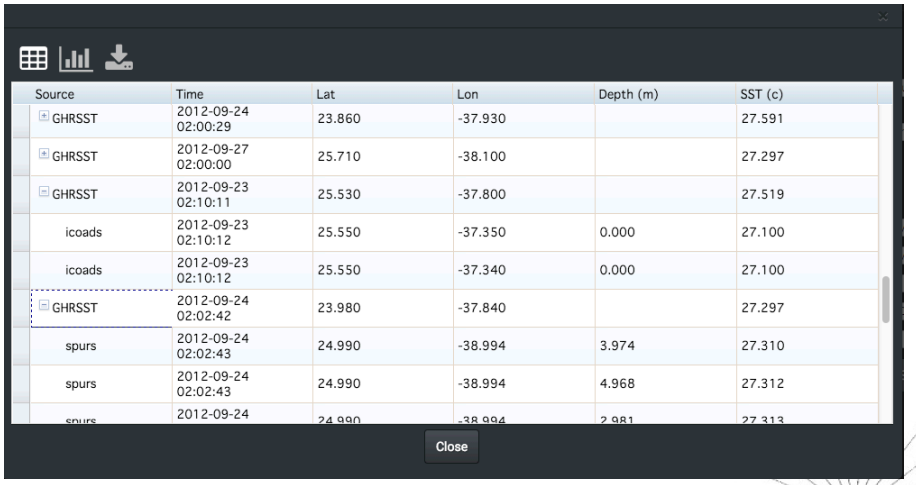
https://mdc.coaps.fsu.edu/doms

ESTO
Earth Science Technology Office

DOMS Web Portal

- Establish portal interface
- Interactive data section and filtering
- Common mapping client for tiled data visualization
- Data download
- Data lineage





Source	Time	Lat	Lon	Depth (m)	SST (c)
GHRSST	2012-09-24 02:00:29	23.860	-37.930		27.591
GHRSST	2012-09-27 02:00:00	25.710	-38.100		27.297
GHRSST	2012-09-23 02:10:11	25.530	-37.800		27.519
icoads	2012-09-23 02:10:12	25.550	-37.350	0.000	27.100
icoads	2012-09-23 02:10:12	25.550	-37.340	0.000	27.100
GHRSST	2012-09-24 02:02:42	23.980	-37.840		27.297
spurs	2012-09-24 02:02:43	24.990	-38.994	3.974	27.310
spurs	2012-09-24 02:02:43	24.990	-38.994	4.968	27.312
spurs	2012-09-24	24.990	-38.994	2.981	27.313

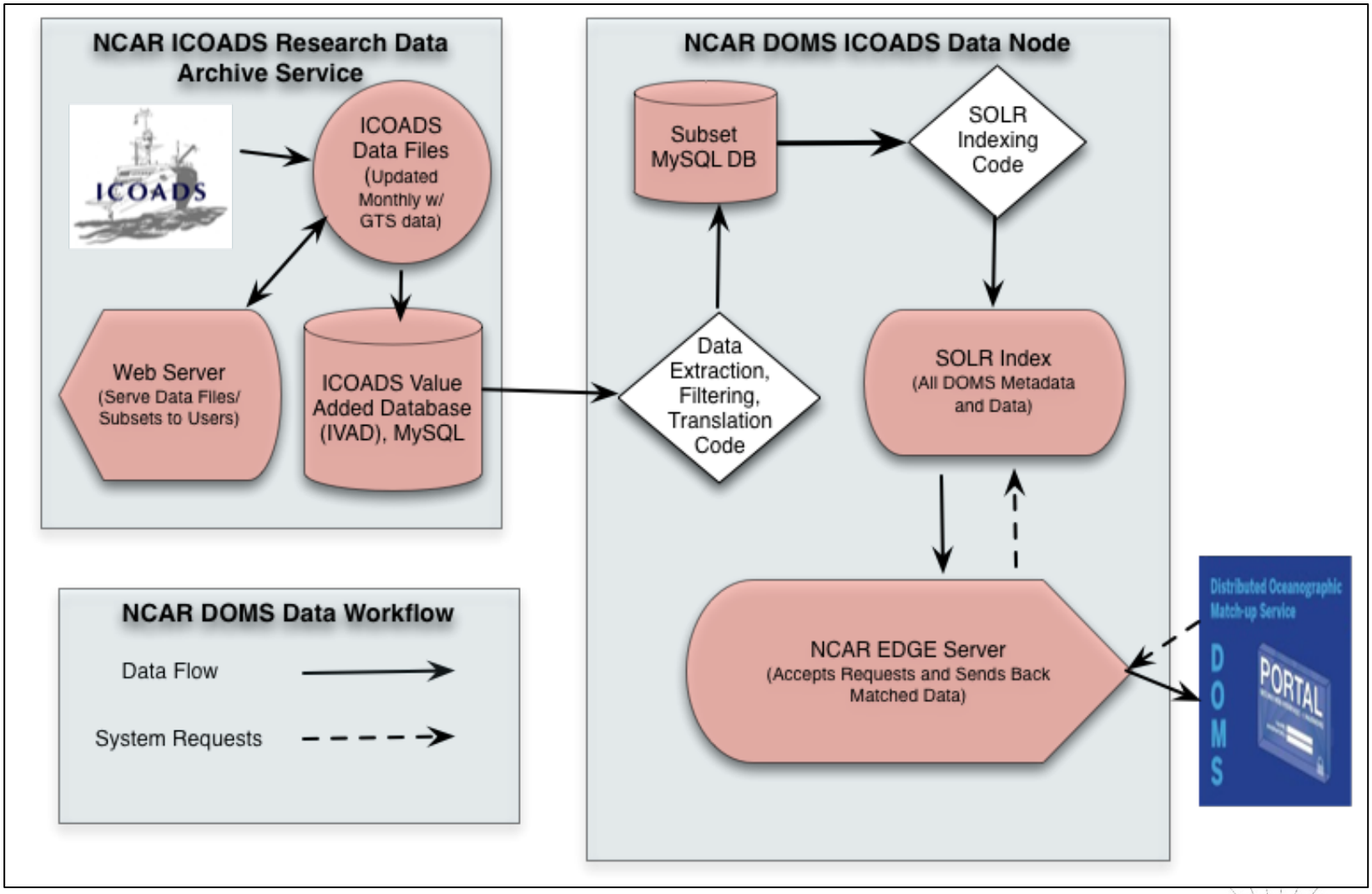
Close

DOMS Distributed Oceanographic Match-Up Service

https://mdc.coaps.fsu.edu/doms

ESTO Earth Science Technology Office

Data Workflow at NCAR



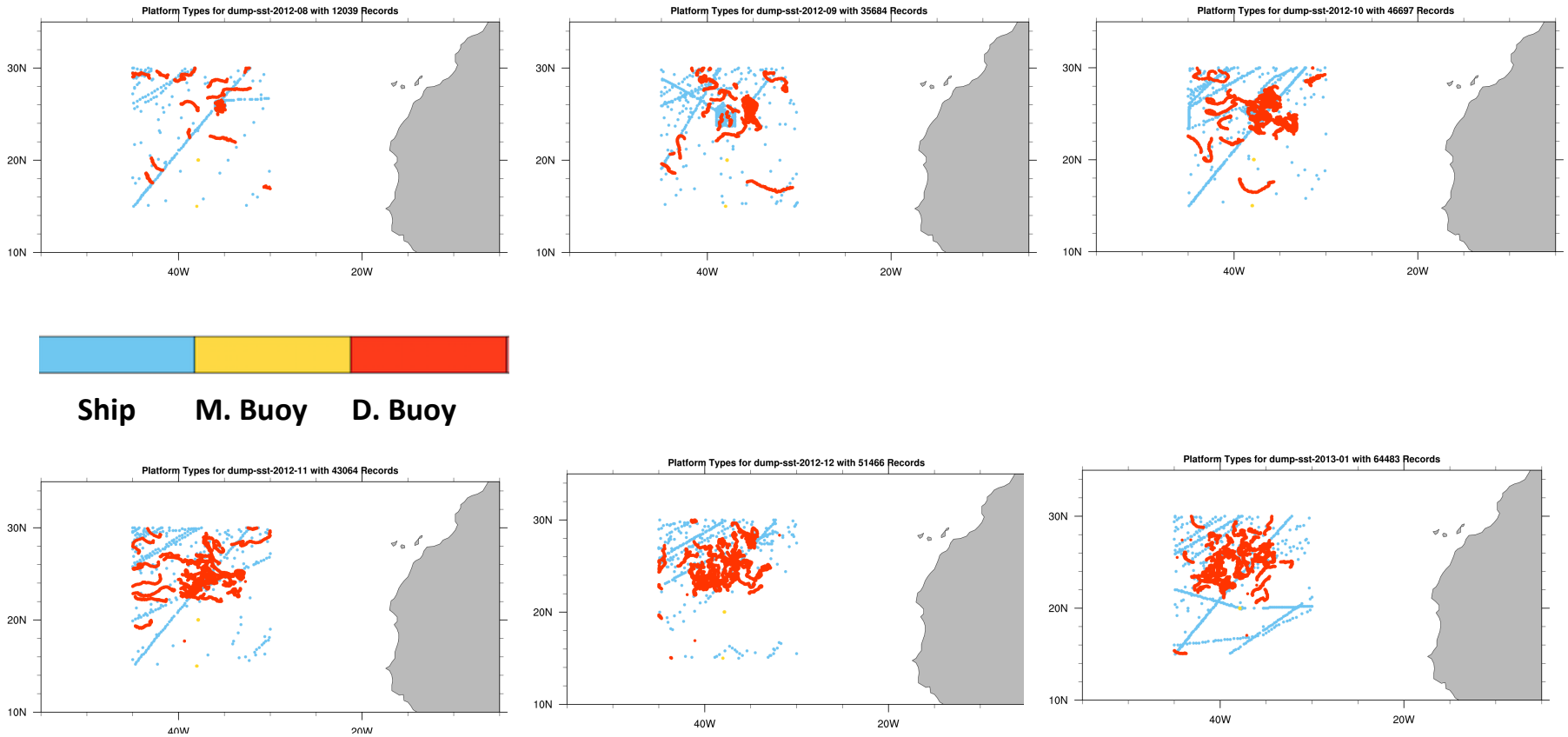
Subset IVADDB

- The ICOADS IMMA format is complex
  - –E.g. SST can be acquired from several different tables and coded logic is required to determine best choice.
  - – Indexing directly into SOLR is not an efficient approach

- Do data field transformation
  - – E.g. convert 0-360E longitude reference to -180W to 180E, simplify QC flagging, combine fields to make ICOADS specific metadata string
  - – Using parallel processing approach

Data Activities -ICOADS Release 2.5 for SPURS1

ICOADS R2.5 ships, drifting and moored buoys. SST in SPURS1 Region, 2012-08 to 2013-01



Data Activities -ICOADS Release 2.5 for SPURS1

ICOADS R2.5 ships, drifting and moored buoys. Wind in SPURS1 Region, 2012-08 to 2013-01

Summary

- All three in-situ data hosts have established public access nodes and machine-to-machine matchup.
  - Three way data queries, data sub-setting, and preliminary data matching.
- PO.DAAC satellite node is established for select SST datasets.
- The partners have agreed upon homogenous data standards (e.g., units, date/time stamp, device/parameter naming).
- Web portal interface at JPL for users to browse and to submit match-up requests interactively (Testing Mode).
- In the second year of the two year project, received high mark for annual review for the first year.

Future Work

- Update SOLR Index with ICOADS R3.0.
- Establish PO.DAAC satellite node for selected Wind and SSS datasets.
- Improve algorithm speed for real time matching at the record level.
- Add many enhancements to the user interface: filtering choices, dataset selection, and matching tolerances.
- Good mid-term review (January 2016) opens possibility of continued funding after the initial first two years. Projects for the out years:
  - Add more satellite datasets, e.g. ocean color
  - Bring in new in situ data partners
  - Harden the interoperable API to run entire satellite missions in the back ground.

Questions?

Development of DOMS is funded by NASA ESTO via the AIST program under grants FSU (NNX15AE29G), NCAR (NNX15AG22G), and JPL.