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

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• 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

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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.

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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

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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

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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
- 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.

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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

<table>
<thead>
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<th>Ship (cruise #)</th>
<th>Dates</th>
<th>Country</th>
<th>Chief Scientist</th>
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<td>Thalassa</td>
<td>16-Aug - 13-Sep-2012</td>
<td>France</td>
<td>Reverdin</td>
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<tr>
<td>Knorr (289)</td>
<td>6-Sep - 9-Oct-2012</td>
<td>US</td>
<td>Schmitt</td>
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<td>14-Mar - 10-Apr-2013</td>
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<td>Font</td>
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<td>Endeavor-2 (533)</td>
<td>19-Sep - 13-Oct-2013</td>
<td>US</td>
<td>Fratantoni</td>
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Satellite Data: PO.DAAC

- **SST:** L2 GHRST-MODIS-A L2P, GHRST-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; 12hr repeat)

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Distributed Design

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Distributed Oceanographic Match-Up Service

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

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Data Workflow at NCAR

NCAR ICOADS Research Data Archive Service
- ICOADS Data Files (Updated Monthly w/ GTS data)
- Web Server (Serve Data Files/Subsets to Users)
- ICOADS Value Added Database (IVAD), MySQL

NCAR DOMS ICOADS Data Node
- Subset MySQL DB
- SOLR Indexing Code
- Data Extraction, Filtering, Translation Code
- SOLR Index (All DOMS Metadata and Data)

NCAR DOMS Data Workflow
- Data Flow
- System Requests

NCAR EDGE Server (Accepts Requests and Sends Back Matched Data)

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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

Platform Types for dump-sat-2012-08 with 12000 Records

Platform Types for dump-sat-2012-09 with 30000 Records

Platform Types for dump-sat-2012-10 with 40000 Records

Platform Types for dump-sat-2012-11 with 45000 Records

Platform Types for dump-sat-2012-12 with 51496 Records

Platform Types for dump-sat-2013-01 with 64483 Records
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 background.
Questions?

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Disclaimer: Any opinions, findings, and conclusions or recommendations provided are those of the contributors to the DOMS project and do not necessarily reflect the views of NASA.

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