Tools, Services & Support of Aquarius/SAC-D Salinity Data Archival and Distribution through PO.DAAC

Vardis M. Tsontos   &   Jorge Vazquez

PO.DAAC, Jet Propulsion Laboratory, California Institute of Technology

vardis.m.tsontos@jpl.nasa.gov   Jorge.Vazquez@jpl.nasa.gov

National Aeronautics and Space Administration

I. ABSTRACT

The Physical Oceanography Distributed Active Center (PO.DAAC) serves as the official NASA repository and distribution node for all Aquarius/SAC-D data products in close collaboration with the project. Here we report on the status of Aquarius data holdings at PO.DAAC, the range of data services and access tools that we provide in support of this mission, and new efforts underway to support in-situ salinity datasets from the SPURS field campaign. Particular emphasis is placed on new tools and services that have come online since the Aquarius v3.0 dataset release. These range from OPeNDAP and THREDDS data access services, to web-based visualization via PO.DAAC's State of the Ocean (SOTO) tool and LAS, to PO.DAAC's new, advanced L2 subsetting tool called HITIDE (High-level Tool for Interactive Data Extraction). Dataset discovery via the PO.DAAC web-portal are also described.

Functionality	Tool/Service
Data Discovery	PO.DAAC Portal
	Consolidated Web-services (PO.DAAC-CWS)
Data Access	FTP
	THREDDS
	OPeNDAP
Visualization/Subsetting	PO.DAAC L3-Browser
	PO.DAAC SOTO (L3)
	LAS (L3)
	HiTIDE (L2)
	PO.DAAC-CWS (L2 & 3)

II. SALINITY DATASETS

Aquarius Mission Datasets *(Public)*
- Level 0, 1A
- V3.0 Products:
  Level 2
  Level 3: Mapped Salinity & SST adjusted, Wind Speed, Ancillary SST (Daily,7day,Monthly,Seasonal,Annual x Ascending/Descending/Combined)
- Data Reader Software: Matlab, IDL
- V3.0 Documentation Package: (12 items) eg. User's Guide, ATBD
- CalVal Datasets: evaluation versions (24), MWR, Rain Rate, WWAV

SPURS In-Situ Data *(coming soon)*
- SPURS I: 5 cruises Sep.2012–Nov.2013, N. Atlantic Salinity Max Region
- Platforms/Datasets:
  Floats, Salinity Drifters, TSG, L/ADCP, U/CTD, Meteo, "Ecomapper"
  Microstructure profiles, Surface profiler, "Sea Snake", SeaSoar
  Wave Gliders, Sea Gliders, Tenuse Glider, Flux & PICO Moorings

III. DATA DISCOVERY & INTEROPERABILITY STANDARDS

**PO.DAAC Web-Portal** *http://podaac.jpl.nasa.gov*
- Faceted search of data set metadata
- Filter by: keyword, mission, platform, parameter sensor, collection, spatio-temporal attributes
- Exposure of key descriptive metadata & access links
- Descriptive Aquarius & Salinity information pages

Metadata Standards for Discoverability & Interoperability
- PO.DAAC works closely with data providers to promote implementation of CF, ACDD, ISO-19115/11179, and NASA GCMD compliant metadata standards
- Conformity to such geospatial & metadata registry standards enhances interoperability with tools/services and data discoverability

PO.DAAC Webs-Services for Automated Search
- Consolidated Web-Services (CWS) for dataset & granule-level data discovery *(see IV below)*
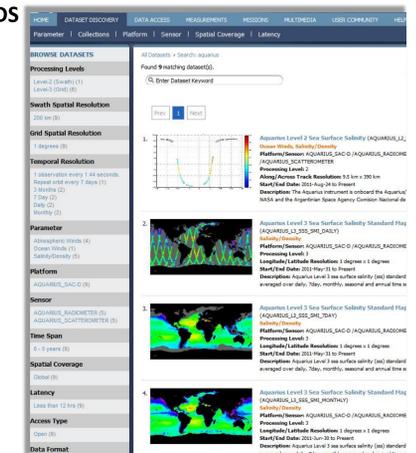
IV. LEVEL 3 DATA VISUALIZATION & SUBSETTING: Web-based Tools for Gridded Data Products

SOTO *("State of the Ocean")* by PO.DAAC
- Browse/Animate Aquarius v3.0 Salinity and other mapped gridded satellite data (eg.SST,SSH,Winds, Currents)
- View latest 30 day data series *(currently)*
- New *2D* interface: additionally supports layering via opacity controls, Stateful URL sharing.

http://podaac-tools.jpl.nasa.gov/soto/
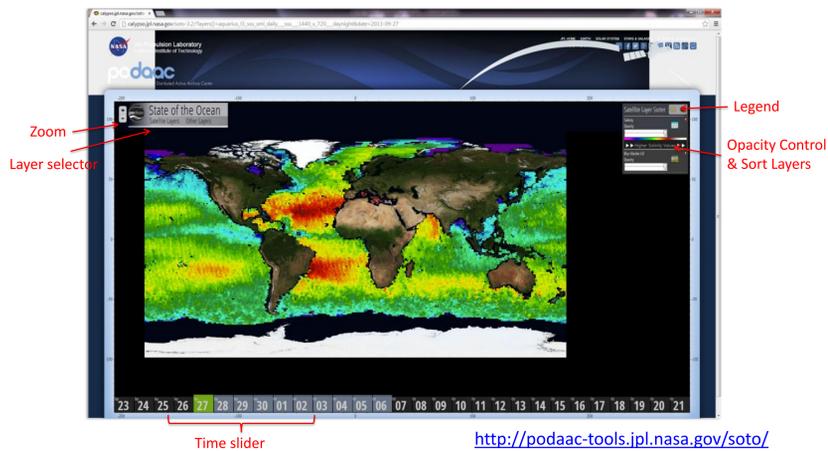
LAS (Live Access Server) *by NOAA*
- Visualize various L3 satellite data series: (eg. Aquarius L3 SSS Daily, 7d & Monthly data)
- Spatio-temporal subsetting
- Plotting: Maps, Hovmoller, Line-plots (Transect & Point Time series)
- Analysis: visual comparisons, data transformations, layer differencing
- Export: various formats (eg. ASCII, CSV, NetCDF)

http://thredds.jpl.nasa.gov/las/getUI.do
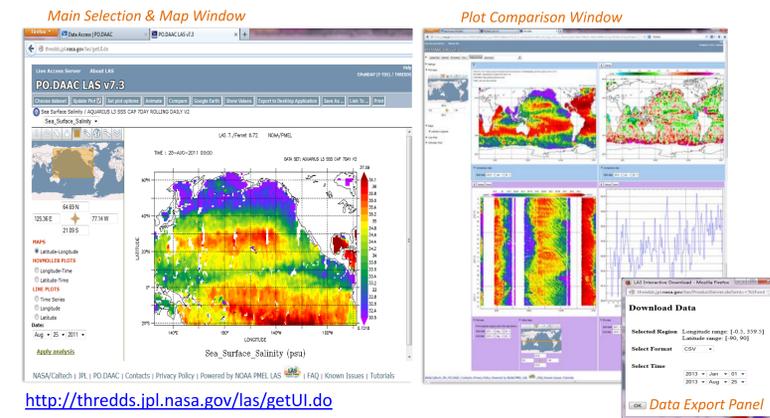
V. LEVEL 2 DATA IMAGING & SUBSETTING TOOLS

HiTIDE (**HI**gh-level Tool for **I**nteractive **D**ata **E**xtraction) by PO.DAAC
- Web-based tool for interactive search, imaging & extraction of L2 "swath" data
- Intuitive Interface: Filter specification, Mapping (zoom, pan etc.)
- Filtering: Dataset-type, Temporal, Spatial (bounding box)
- Returns: list of data files matching filter criteria with mapped swaths
- Imaging of select variables (backend - customizable variable list per dataset)
- Export subsetted granule data (NetCDF, HDF)
- Powered by Web-services: CWS, OPeNDAP

VI. WEBSERVICES
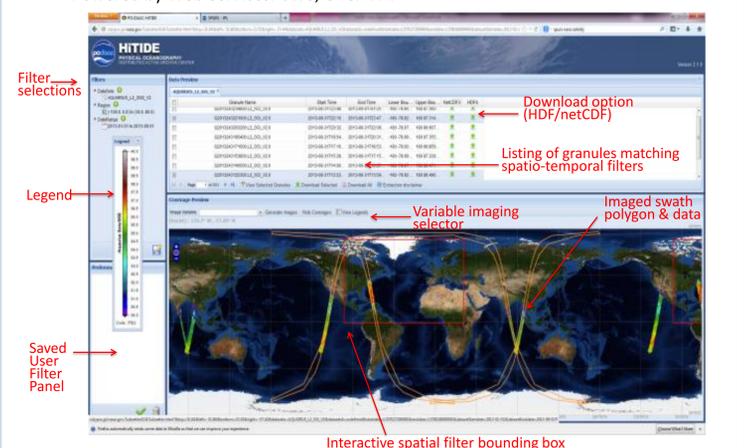
OPeNDAP (http://opendap.jpl.nasa.gov/opendap/)
- **Open**-source Project for a **N**etwork **D**ata **A**ccess **P**rotocol (*http://opendap.org/*)
- Data transport architecture and HTTP-based protocol widely used to serve and subset earth science data
- Data array *Index-based* subsetting
- Includes standards for encapsulating structured data, annotating the data with attributes and adding semantics that describe the data
- All Aquarius L1 - L3 data accessible OPeNDAP:
  http://podaac-opendap.jpl.nasa.gov/opendap/allData/aquarius/

Interactive subsetting and file metadata exposure via OPeNDAP Form
eg. http://opendap.jpl.nasa.gov/opendap/SalinityDensity/aquarius/L3/mapped/V2/7day/SCI/2011/237/Q20112322011238.L3m_7D_SCI_V2.0_SSS_1deg.bz2.html

Granule subsetting via extended OPeNDAP URL with parameters

HTTP request   OPeNDAP Data Path

http://podaac-opendap.jpl.nasa.gov:80/opendap/allData/aquarius/L3/mapped/V3/7day/SCI/2014/015/Q20140152014021.L3m_7D_SCI_V3.0_SSS_1deg.bz2?/l3m_data[30:1:90][105:1:185]

Variable list   Subset Array index range & step

THREDDS (http://podaac.jpl.nasa.gov/podaac_thredds)
- **Th**ematic **R**eal-time **E**nvironmental **D**istributed **D**ata **S**ervice (*https://www.unidata.ucar.edu*)
- Webservice and HTTP-based protocol widely used to aggregate, serve and subset earth science data
- THREDDS catalogs: logical granule aggregations (eg. Aquarius SSS 7day time series)
- Subsetting by-value (*Lat/Lon/Time*) via NCSS service
- Supports OGC standards: WMS & WCS services
- CF-interoperable & NCML support
- Supports output file conversion to netCDF
- All Aquarius L3 (Daily, 7d, Monthly) data accessible via THREDDS:
  http://thredds.jpl.nasa.gov/thredds/catalog/ncml_aggregation/**SalinityDensity**/aquarius/catalog.html
  http://thredds.jpl.nasa.gov/thredds/catalog/ncml_aggregation/**OceanWinds**/aquarius/catalog.html

Interactive subsetting via THREDDS NCSS Form
http://thredds.jpl.nasa.gov/thredds/**ncss**/grid/ncml_aggregation/SalinityDensity/aquarius/aggregate__AQUARIUS_L3_SSS_CAP_7DAY_V3.ncml/dataset.html
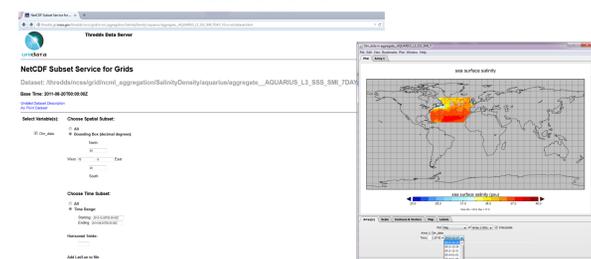
Spatio-Temporal subsetting via structured THREDDS URL with parameters

HTTP request   Catalog reference

http://thredds.jpl.nasa.gov/thredds/ncss/grid/ncml_aggregation/SalinityDensity/aquarius/aggregate__AQUARIUS_L3_SSS_SMI_7DAY_V3.ncml?var=l3m_data&north=60&south=20&east=-5&west=-75&time_start=2013-12-20T00:00:00Z&time_end=2014-09-24T00:00:00Z

Variable list   Spatial bounding box   Time range filters

PO.DAAC CWS: "**C**onsolidated **W**eb-**S**ervices"
http://podaac.jpl.nasa.gov/ws/
- Integrated set of PO.DAAC Web-services for dataset/granule search & subsetting
- Accessible via standard Web HTTP protocol via a standard URL with well-defined parameter extensions
  (General Form: http://podaac.jpl.nasa.gov/ws/service?parameters)
- Returns: XML structure or in JSON (*JavaScript Object Notation*) format
- Utility: - facilitates programmatic calls to CWS via HTTP request
  - access and drill-down through the data information hierarchy

Dataset Discovery
↓
Dataset Metadata
↓
Granule Search
↓
Granule Metadata
↓
Granule Subset/Extract

PO.DAAC Web Services Overview

Example Aquarius use case & CWS workflow:

Step	CWS Request	Response / Result
1. List Aquarius datasets	http://podaac.jpl.nasa.gov/ws/search/dataset?keyword=aquarius	
2. Get dataset metadata for monthly SSS product	http://podaac.jpl.nasa.gov/ws/metadata/dataset?format=gcmd&shortName=AQUARIUS_L3_SSS_SMI_MONTHLY_V2	
3. List all related granules within a date range	http://podaac.jpl.nasa.gov/ws/search/granule?shortName=AQUARIUS_L3_SSS_SMI_MONTHLY_V2&startTime=2013-01-01T08%3A10%3A07Z&endTime=2013-06-30T23%3A10%3A07Z&format=html&pretty=true	
4. Get metadata for a specific granule	http://podaac.jpl.nasa.gov/ws/metadata/granule?format=iso&shortName=AQUARIUS_L3_SSS_SMI_MONTHLY_V2&granuleName=Q20130932013059.L3m_MO_SCI_V2.0_SSS_1deg	
5. Get spatial subset of granule data (CWS L2-SSS)		

URS CL#: 14-4694