The Integrated Ocean Observing System HF Radar Network: U. S. Status

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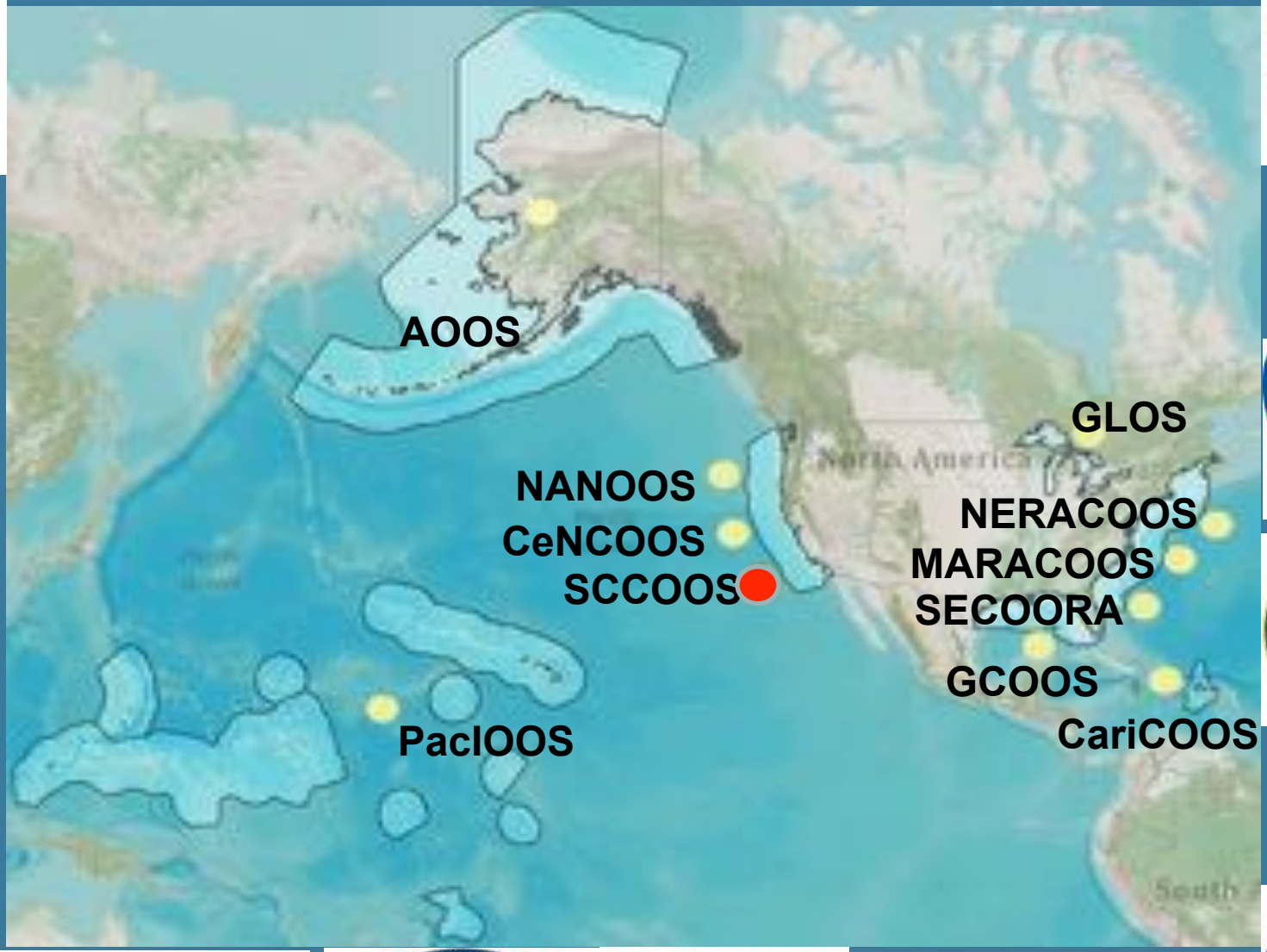
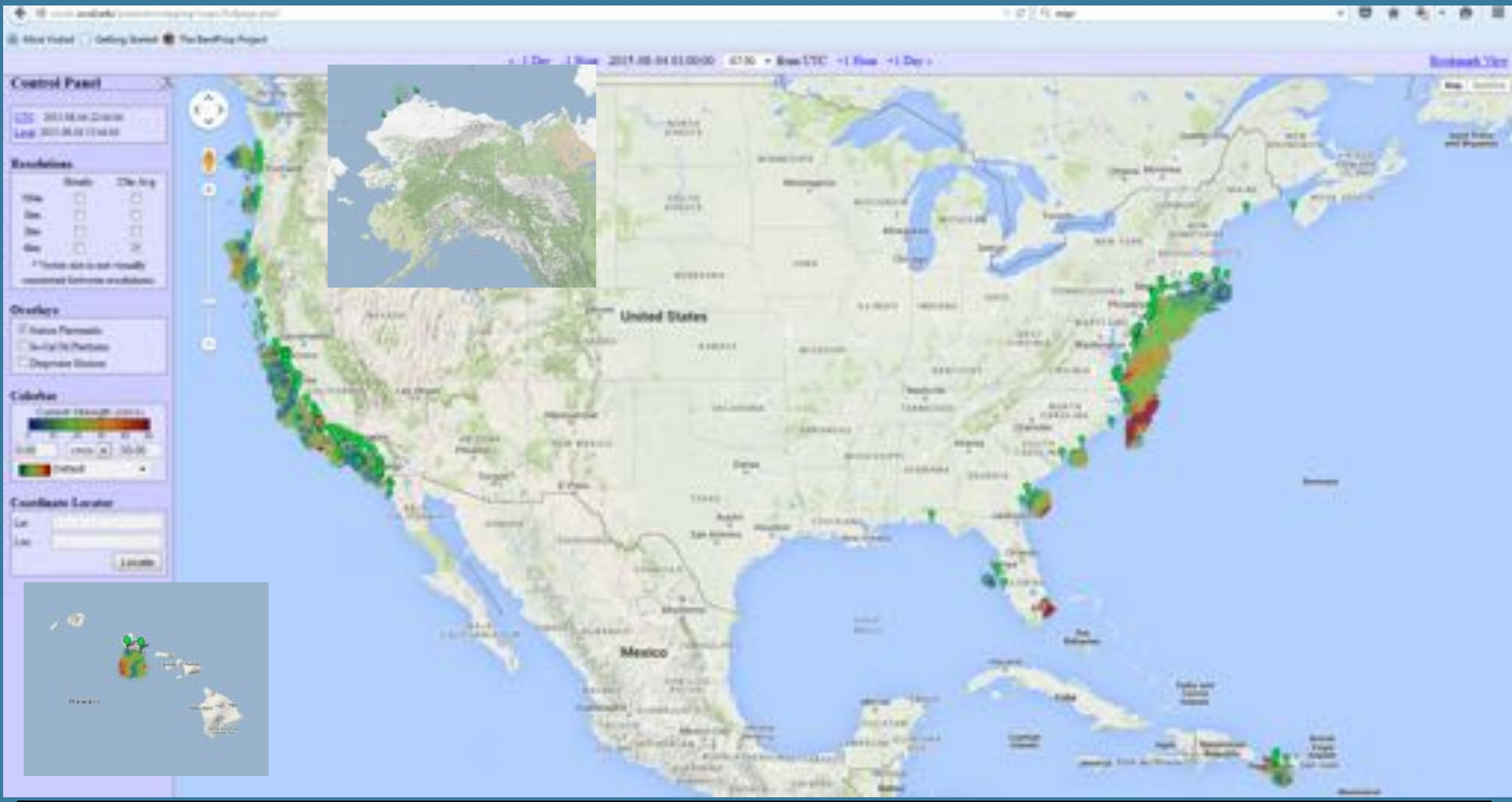
IOOS Coastal Component
11 Regional Associations; 17 Federal Agencies



IOOS HF Radar Network (HFRNet)



Years of Operation: 11 years
Number of files: approx. 10+ million
2009/2015 – National HF Radar Plan

Participating Organizations: 33
Number of Physical Sites: ~140

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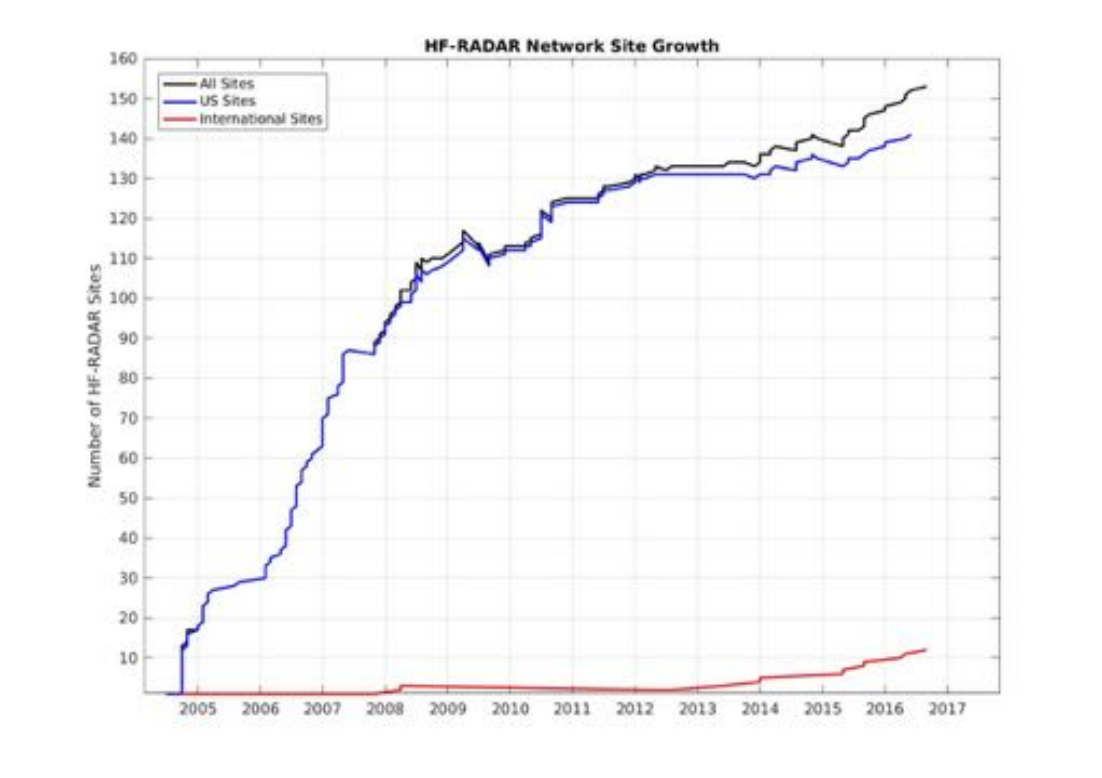
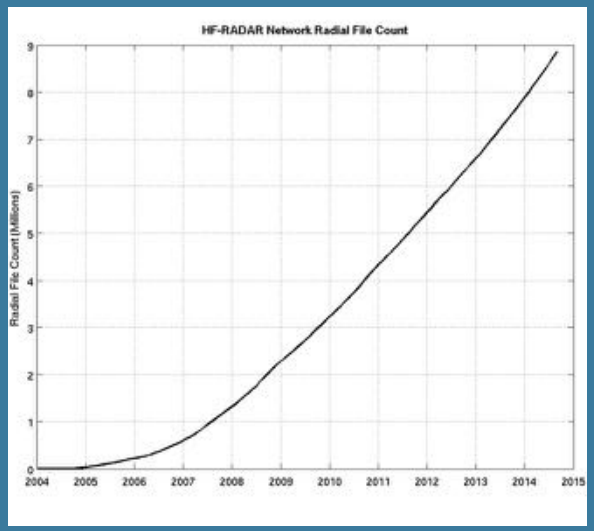
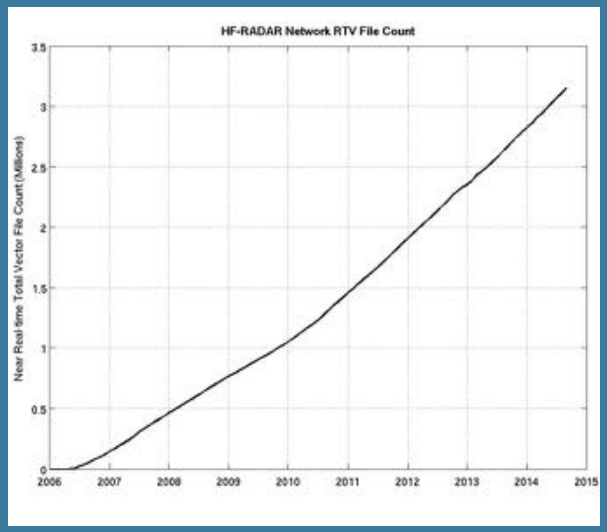
U.S. IOOS HFRNet Growth





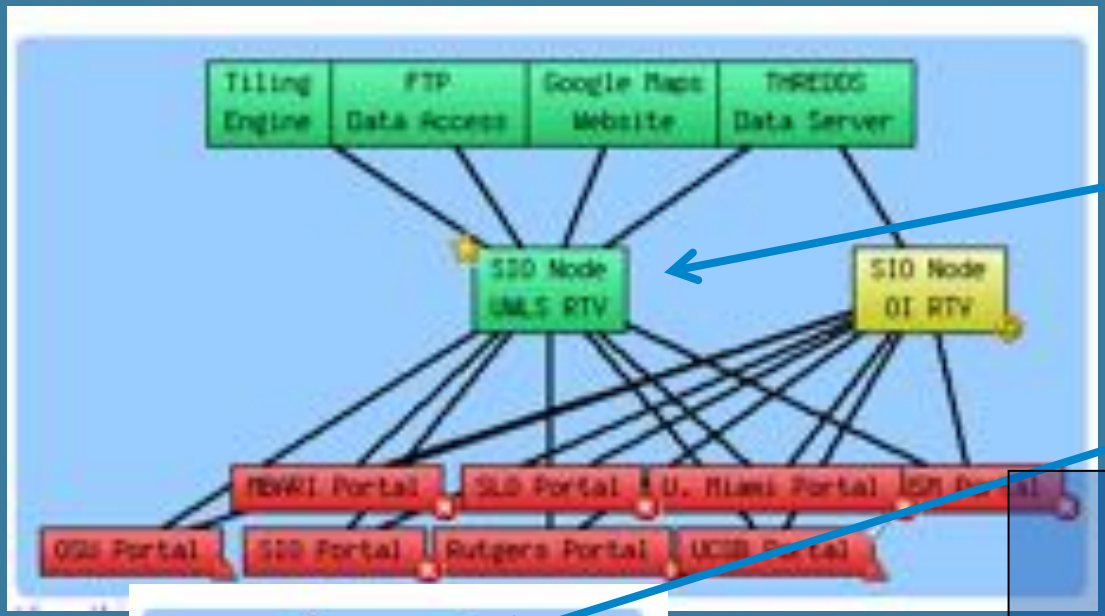


Scripps

- Backend management and distribution
- Online visualization and interactive display
- Advanced programming interface
- Data Services for integration
- Site Diagnostics and IOOS Metrics

Network Architecture

Data Acquisition



Example Node to Site Aggregator communications

Example Site Aggregator to Site communications

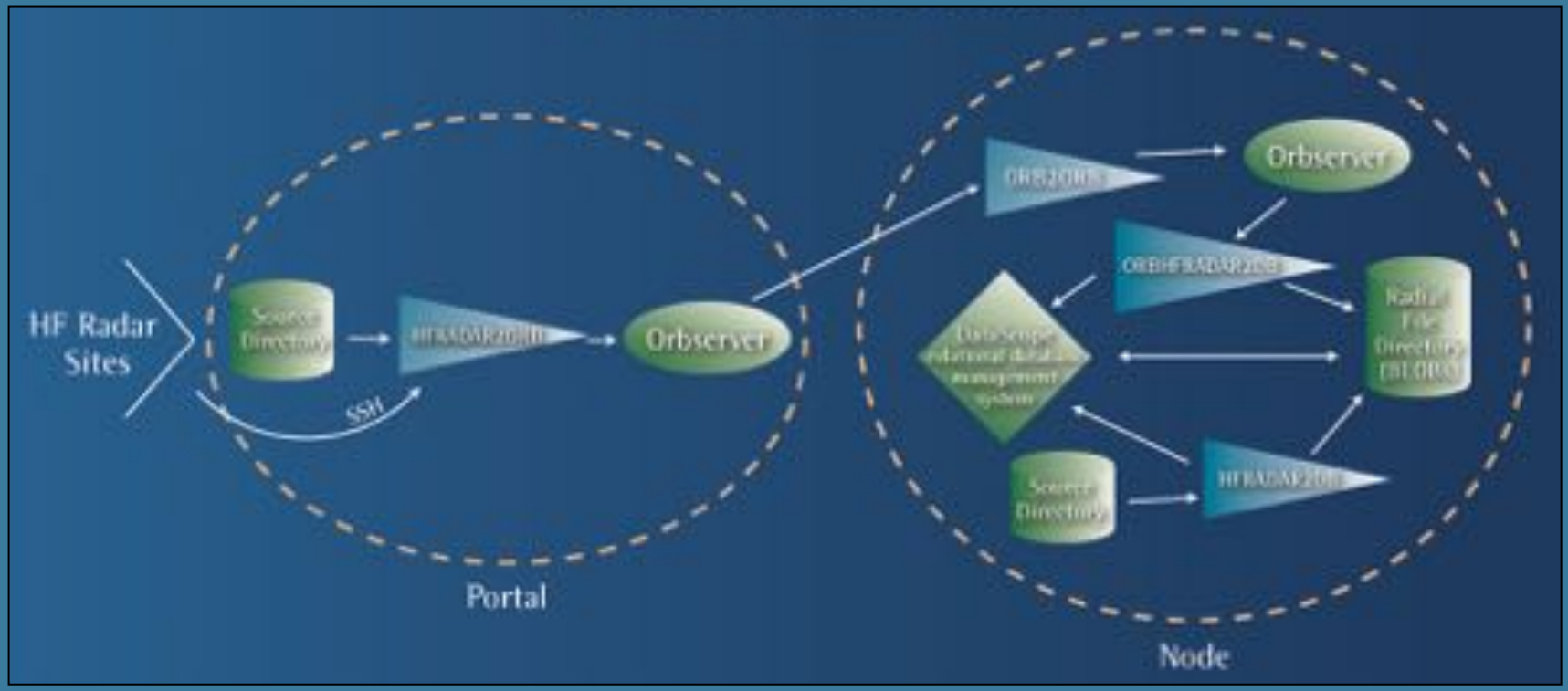
Site - the individual field installations of HF radar equipment

Portal or Site Aggregator - a local regional operations center which maintains multiple installations

Node - Centralized locations which aggregate data from multiple regions

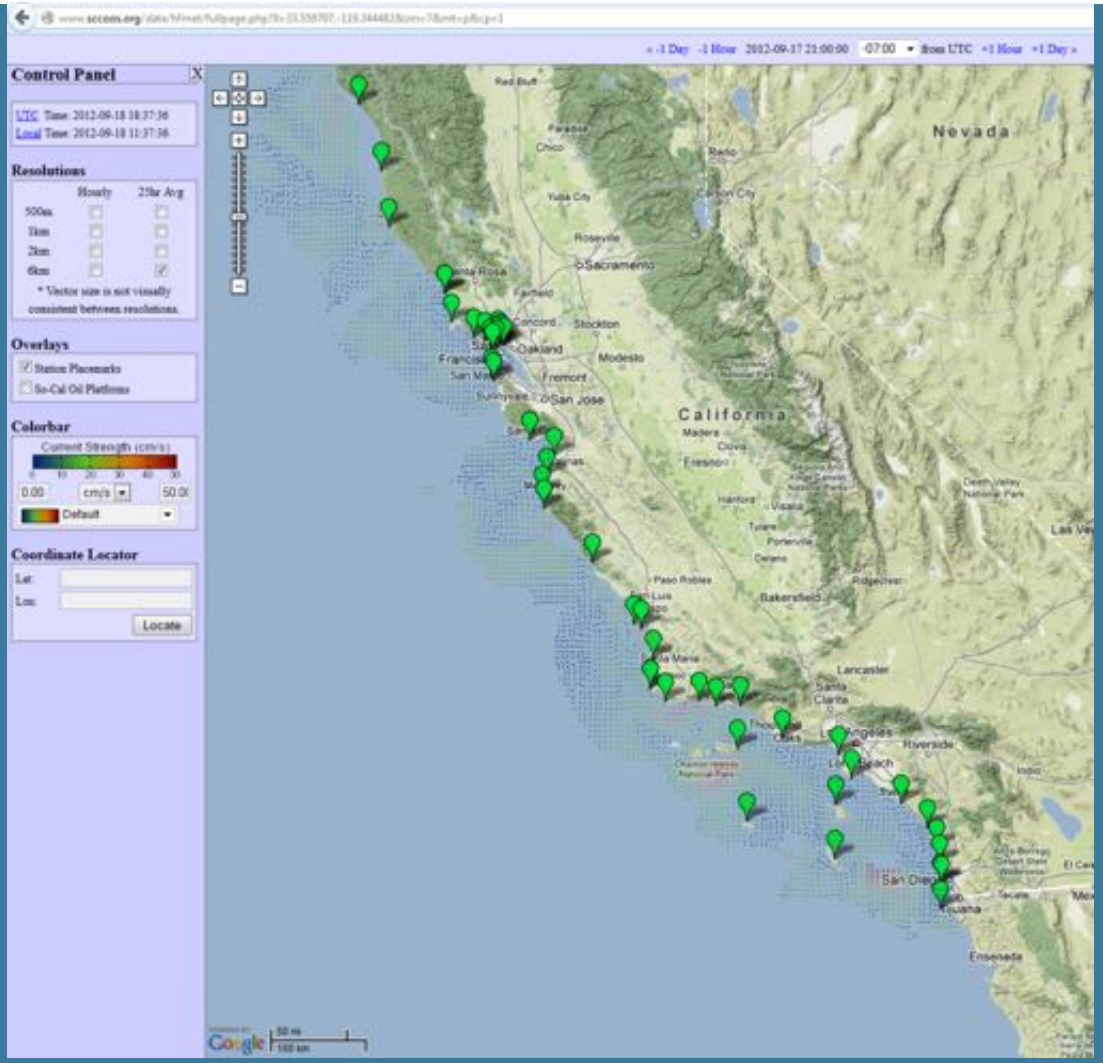
Data Acquisition

Data Flow



- Portals/Site Aggregators server as ‘point-of-entry’ machines for radial data
- Nodes are typically used as independent data concentrators
- Ingestion of local archive volumes may be achieved through hfradar2db

HF Radar Public Data Availability



1.) Online Visualization – http://cordc.ucsd.edu/projects/mapping/maps/fullpage.php
Online visualization of HF radar surface currents with ability to change date, resolution, colorbar, and station information

2.) Web Overlays - http://cordc.ucsd.edu/projects/mapping/api/
Application programming interface (api) that allows programmers to overlay the currents into any website

3.) THREDDS access – http://sdf.ndbc.noaa.gov/thredds/catalog.html http://hfrnet.ucsd.edu/thredds/catalog.html
THREDDS service that allows folks to acquire or used the data via thredds for processing and/or visualization.

4.) Diagnostics - http://cordc.ucsd.edu/projects/mapping/stats/?sta=SDBP&aff=SIO
Individual station statistics and diagnostics for operators

5.) Archiving – NCEI totals starting in January, 2015
2008 (east coast) / 2009 (west coast)

METRICS FY15 (Oct ’14 - Sept ‘15)

The percentage of time NOAA IOOS funded radars are **operational** during a given reporting period.

FY15

Location	Q1	Q2	Q3	Q4	FY
West Coast	84%	81%	81%	83%	81%
East Coast	81%	77%	75%	65%	74%
All	83%	79%	78%	75%	78%

FY14

Location	Q1	Q2	Q3	Q4	FY
West Coast	77%	76%	76%	78%	74%
East Coast	82%	68%	71%	72%	73%
All	79%	73%	74%	76%	73%

Pick a year: 2015 2014 2013 2012

West Coast Stations JUMP TO East Coast & GOM Stations

Click on column to sort

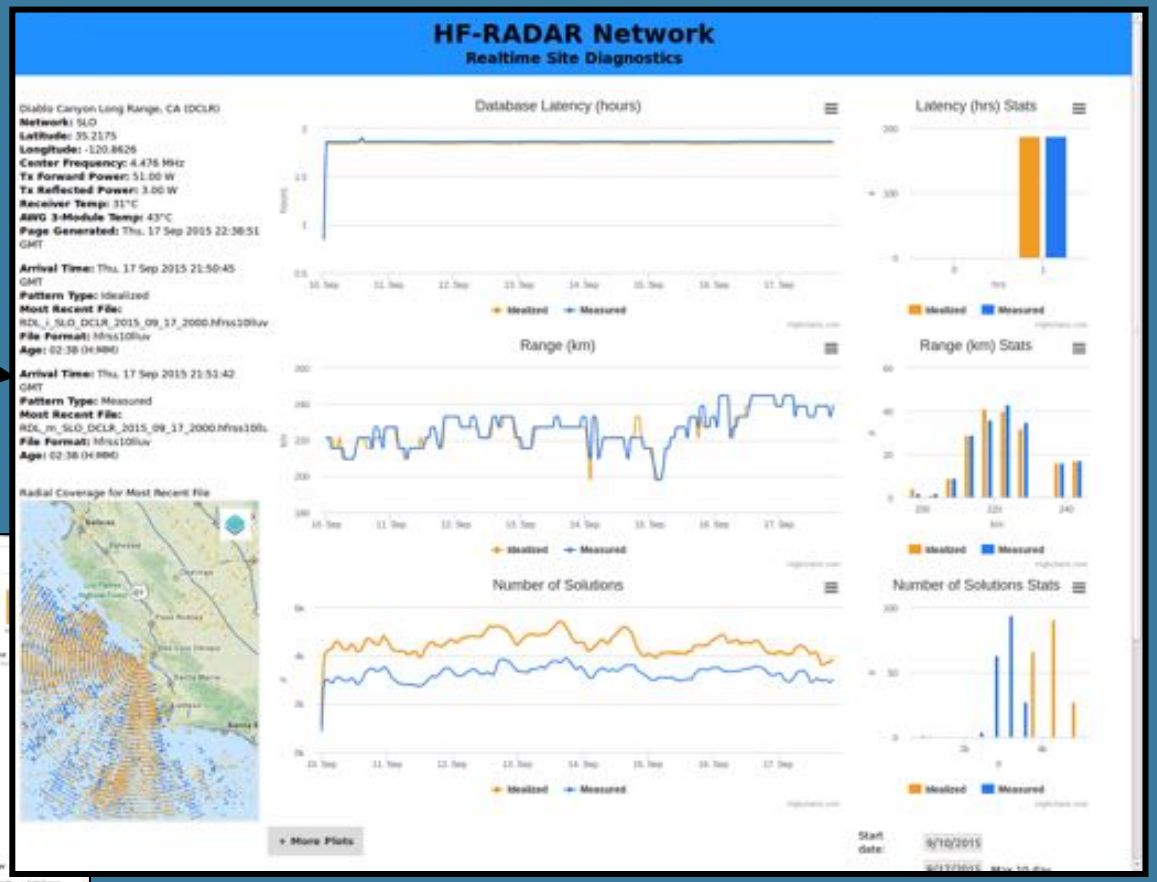
West Coast

Station	Network	Latitude	Longitude	Frequency	2014-10	2014-11	2014-12	2015-01	2015-02	2015-03	2015-04	2015-05	2015-06	2015-07	2015-08	2015-09	TOTAL
SDCI RDLi	IOO	32.4140867	-117.2437333	24.800262				77.96 % 580 / 744	85.43 % 569 / 672	100.00 % 744 / 744	100.00 % 720 / 720	97.31 % 724 / 744	97.22 % 700 / 720	97.31 % 724 / 744	96.24 % 716 / 744	49.37 % 190 / 384	83.86 % 5910 / 8434
SDCI RDLm	IOO	32.4140867	-117.2437333	24.800262				0.00 % 0 / 744									0.00 % 0 / 8434
SDBP RDLi	IOO	32.5399167	-117.1222667	25.799804	91.80 % 683 / 744	74.44 % 536 / 720	91.94 % 684 / 744	90.86 % 713 / 744	81.70 % 544 / 672	74.06 % 551 / 744	58.75 % 423 / 720	93.41 % 695 / 744	95.83 % 690 / 720	93.41 % 695 / 744	96.38 % 668 / 744	83.07 % 319 / 384	85.54 % 7199 / 8414
SDBP RDLm	IOO	32.5399167	-117.1222667	25.799804	92.20 % 712 / 744	90.69 % 653 / 720	90.59 % 720 / 744	100.00 % 744 / 744	96.73 % 650 / 672	76.75 % 571 / 744	75.42 % 543 / 720	96.24 % 716 / 744	87.36 % 629 / 720	92.47 % 688 / 744	93.82 % 698 / 744	72.44 % 282 / 384	90.68 % 7632 / 8414
SDPL RDLi	IOO	32.6658333	-117.2298333	24.800000	95.16 % 708 / 744	96.25 % 693 / 720	92.20 % 712 / 744	98.12 % 730 / 744	100.00 % 672 / 672	98.79 % 735 / 744	98.44 % 726 / 720	97.18 % 723 / 744	97.22 % 700 / 720	98.84 % 719 / 744	96.37 % 720 / 744	92.19 % 354 / 384	97.15 % 8192 / 8434
SDPL RDLm	IOO	32.6658333	-117.2298333	24.800000	96.02 % 714 / 744	97.92 % 705 / 720	90.86 % 714 / 744	97.72 % 727 / 744	98.66 % 663 / 672	96.23 % 716 / 744	96.81 % 718 / 720	96.91 % 721 / 744	97.22 % 700 / 720	96.91 % 721 / 744	96.37 % 717 / 744	78.65 % 302 / 384	96.74 % 8160 / 8434
SDWW RDLi	IOO	32.6799167	-117.2476167	25.400000	100.00 % 744 / 744	100.00 % 720 / 720	100.00 % 744 / 744	100.00 % 744 / 744	100.00 % 672 / 672	99.73 % 742 / 744	100.00 % 720 / 720	97.31 % 724 / 744	97.22 % 700 / 720	96.38 % 717 / 744	97.45 % 725 / 744	97.73 % 375 / 384	98.27 % 8278 / 8434
SDSL RDLi	IOO	32.8709833	-117.2525333	5.200000	42.20 % 314 / 744	98.06 % 706 / 720	0.00 % 0 / 744		71.88 % 483 / 672	94.62 % 704 / 744	100.00 % 720 / 720	93.41 % 695 / 744	94.44 % 680 / 720	93.68 % 697 / 744	94.35 % 702 / 744	87.24 % 335 / 384	76.54 % 6452 / 8434
SDSL RDLm	IOO	32.8709833	-117.2525333	5.200000	0.00 % 0 / 744	92.08 % 663 / 720	0.00 % 0 / 744				92.87 % 667 / 720	72.37 % 538 / 744	78.19 % 563 / 720	84.11 % 626 / 744	85.08 % 633 / 744	75.52 % 290 / 384	62.58 % 5277 / 8434

An HF radar derived data file where the number of *Observed* radial solutions meets or exceeds a nominal number of radial solutions (X - 300) and the file was reported within (Y - 25) hours of the observation.

Radial Diagnostics

Improvements: operator input and outage estimages



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Climatology Products

Radial velocities

- ROWG community endorses two versions of radial velocity data – the near-real time version and, as needed, a reprocessed or otherwise Q.C.'d version

Total velocities

- Now: HFRNet reprocessing currently 26 hours for near real-time
- Soon: Climatological data - monthly and annual statistics (mean, variance, minimum and maximum) of HFR derived surface currents (from 2012)
- Sub-groups to Level 2 data:
  - Level 2a: Near real-time total velocities
  - Level 2b: Monthly (or some interval) reprocessed data with any available

IOOS Working Group Initiatives

Equipment Inventory: ***15 year old hardware***
- **# of radars**
- **supporting infrastructure**
- **communications**

O&M costs: ***$ annual operating costs not budgeted***
- **staffing**
- **hardware**
- **calibrations**
- **infrastructure**

Metrics: ***google analytics***
- **Applications**
- **Users**
- **Uptime**

Thredds Server

http://hfrnet.ucsd.edu/thredds

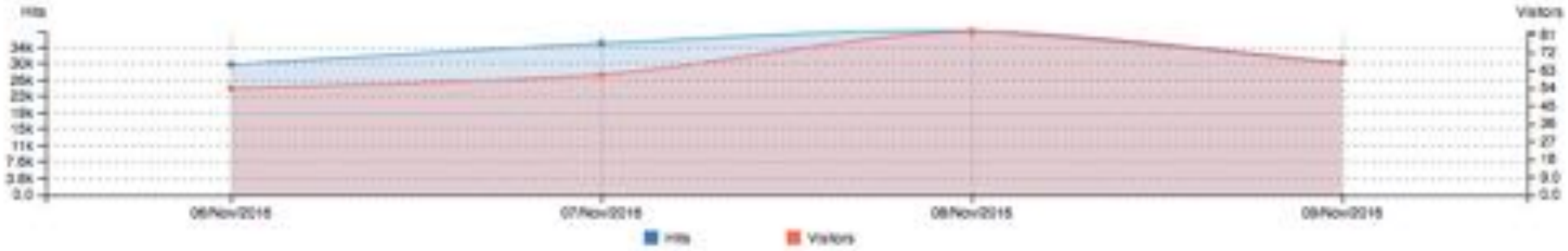
» Overall Analyzed Requests (06/Nov/2016 - 09/Nov/2016)

Total Requests	Valid Requests	Failed Requests	Processed Time	Unique Visitors	Unique Files
133,273	133,273	0	60	265	12,550
Excl. IP Hits	**Referrers**	**Unique 404**	**Static Files**	**Log Size**	**Bandwidth**
0	0	562	41	28.8 MiB	151 GiB

» Unique visitors per day - Including spiders

Plot Options

Hits having the same IP, date and agent are a unique visit.



#	Hits	Visitors	Bandwidth	Data
	133,273 Max: 37,766 Min: 30,092	265 Max: 83 Min: 54	151 GiB Max: 42.0 GiB Min: 34.0 GiB	
1	30,442 (22.84%)	67 (25.28%)	34.4 GiB (22.72%)	09/Nov/2016
2	37,766 (28.34%)	83 (31.32%)	42.0 GiB (27.71%)	08/Nov/2016
3	34,973 (26.24%)	61 (23.02%)	41.1 GiB (27.13%)	07/Nov/2016
4	30,092 (22.58%)	54 (20.38%)	34.0 GiB (22.45%)	06/Nov/2016

HF Radar Public Data Distribution and Benefits

1. Search and Rescue - U.S. Coast Guard - Search and Rescue Optimal Planning System (SAROPS)

2. Oil Spill Response –
   - California Office of Prevention and Response (OSPR)
   - NOAA Office of Response and Restoration (OR&R) Emergency Response Division (ERD) - General NOAA Operational Modeling Environment (GNOME)

3. Assessment - OR&R Assessment and Restoration Division (ARD) - Environmental Response Management Application (ERMA)

4. Weather - NOAA National Weather Service (NWS) Advanced Weather Interactive Processing System (AWIPS-II) HFR Rollout Weather Forecast Offices (WFO) – Boston and Miami, July 6, 2015

Data Management Standards

- **Standard for Gridded Velocity Format** –

Network Common Data Format (NetCDF) format
http://www.unidata.ucar.edu/software/netcdf/

- **Standard Metadata Naming Conventions for data**–

Climate Forecast Interoperability
http://cfconventions.org/

- **Standard Metadata for Dataset Discovery**

Attribute Convention for Dataset Discovery (ACDD)
http://wiki.esipfed.org/index.php/Attribute_Convention_for_Data_Discovery

Example can be found at:
http://www.cordc.ucsd.edu/projects/mapping/documents/HFRNet_RTV-NetCDF.pdf

- Standard Distribution Service–

THREDDS Data Server (TDS)
http://www.unidata.ucar.edu/software/thredds/current/tds/

High Frequency Radar Network (HFRNet)
Global Partnerships

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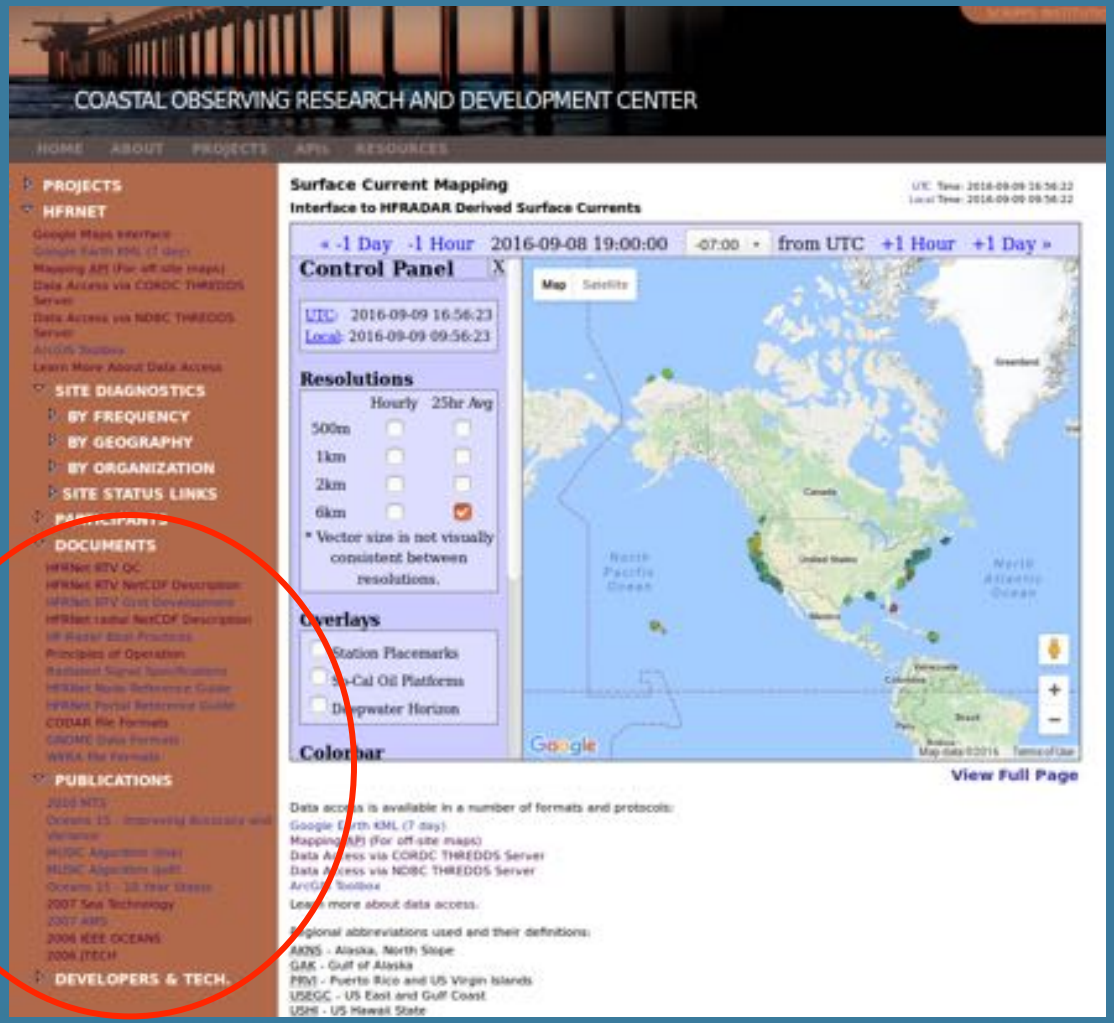
http://www.emodnet-physics.eu/map/

Portugal, Italy and Spain

Thank You

Resources

http://cordc.ucsd.edu/projects/mapping



Global Perspective

GEOSS Portal

The Global Ocean Observing System GOOS

INTEGRATED OCEAN OBSERVING SYSTEM

HFRNet