



Goal 2: Ensure HFR data is available in a single standardized format in near real-time

Status of the U.S. Radar Network

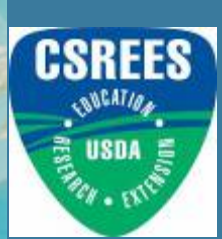
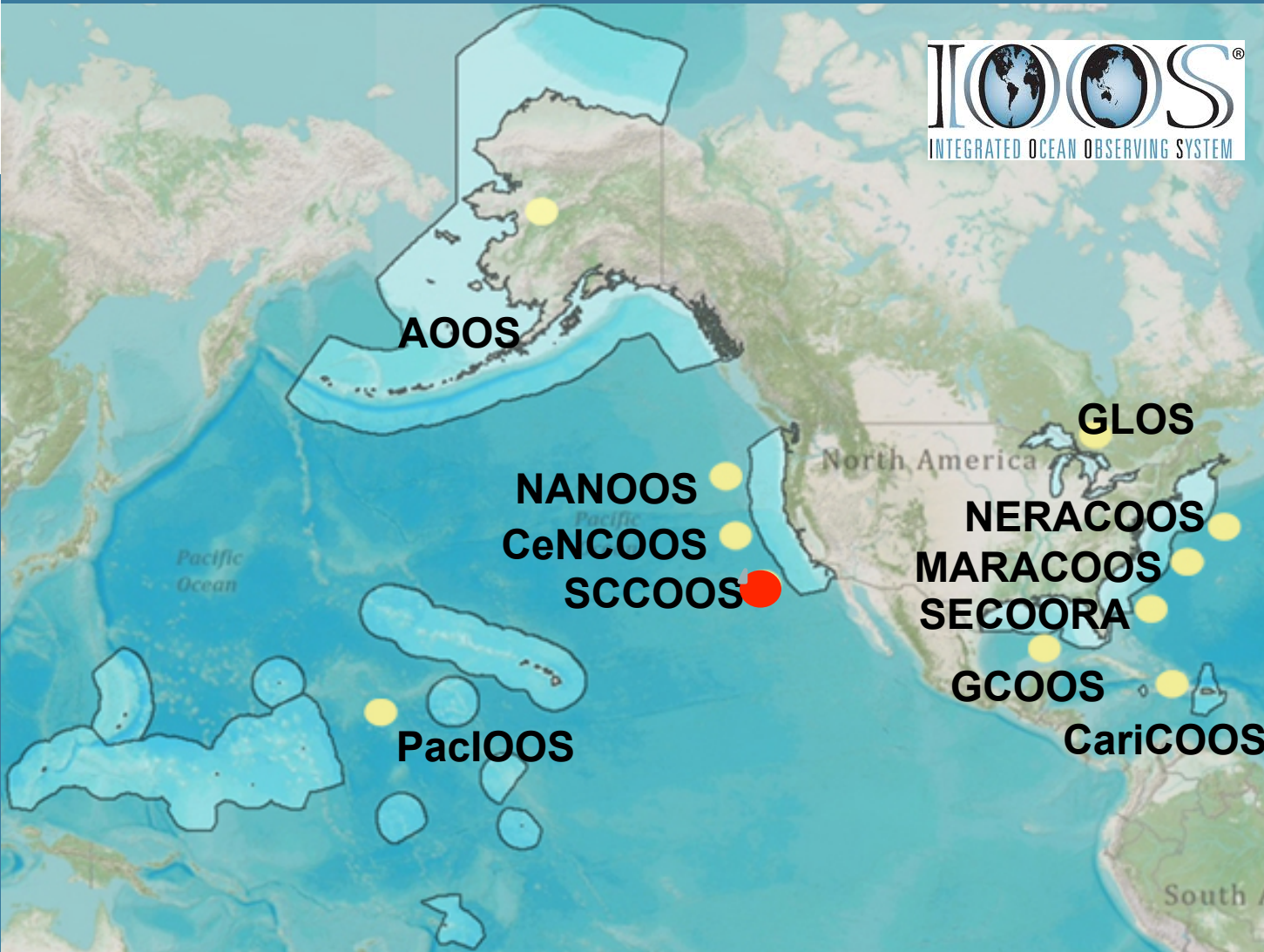
Lisa Hazard

Dr. Eric Terrill

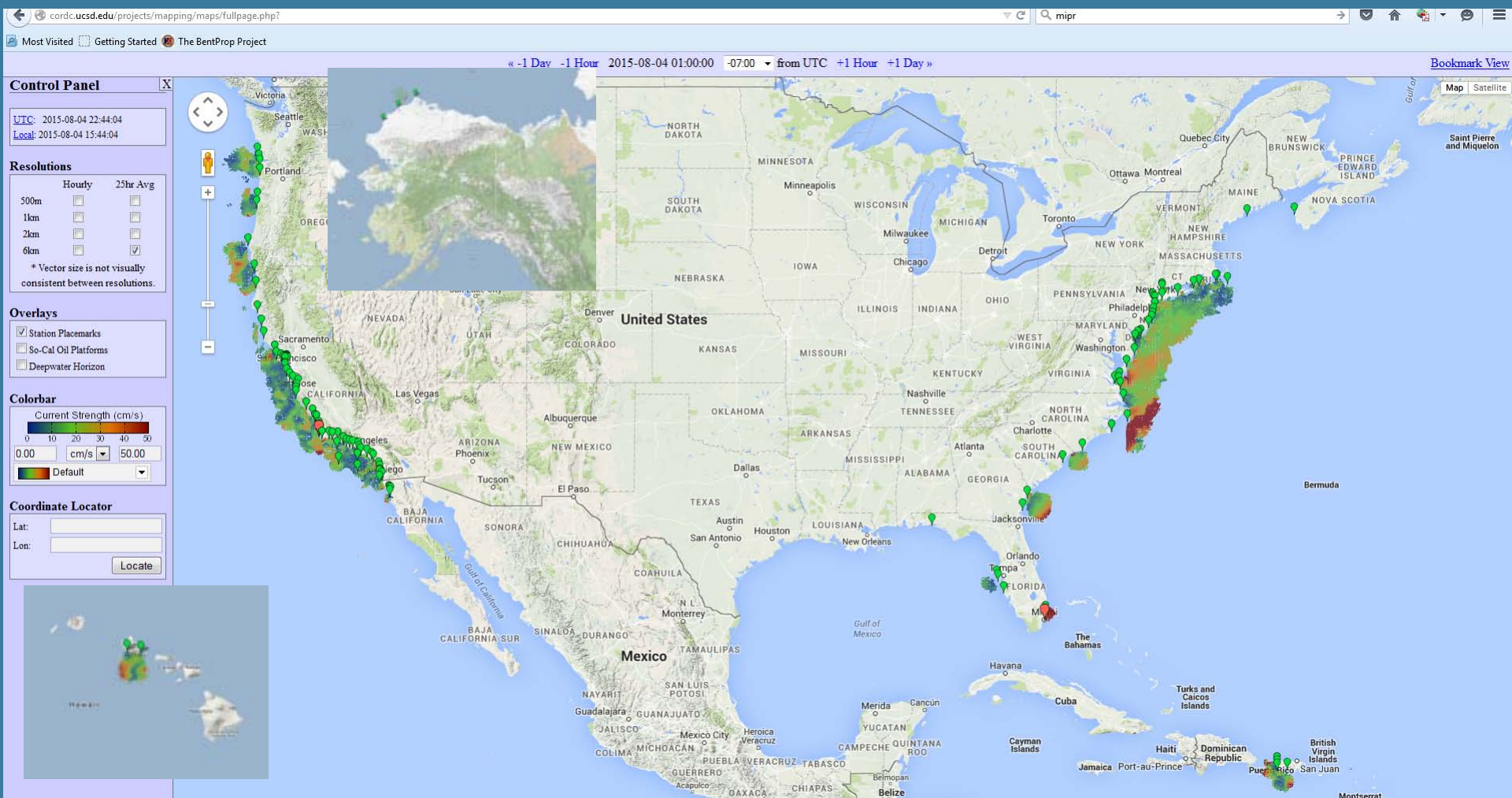
Scripps Institution of Oceanography

U.S. IOOS Coastal Component

11 Regional Associations; 17 Federal Agencies



IOOS HF Radar Network (HFRNet)



Years of Operation: 10 years

Participating Organizations: 33

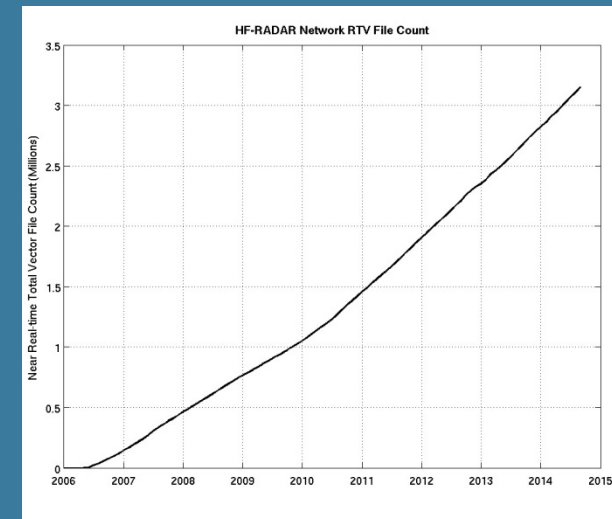
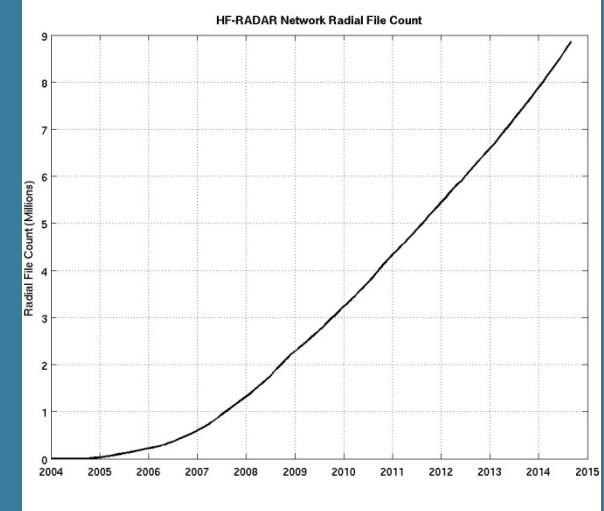
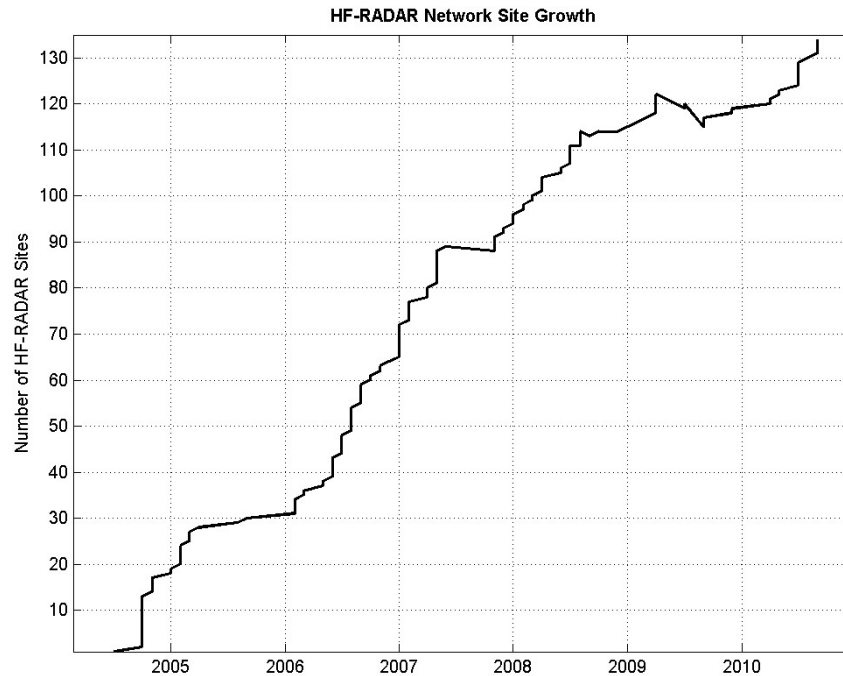
Number of files: approx. 10 million

Number of Physical Sites: 138

2009/2015 – National HF Radar Plan



U.S. IOOS HFRNet Growth

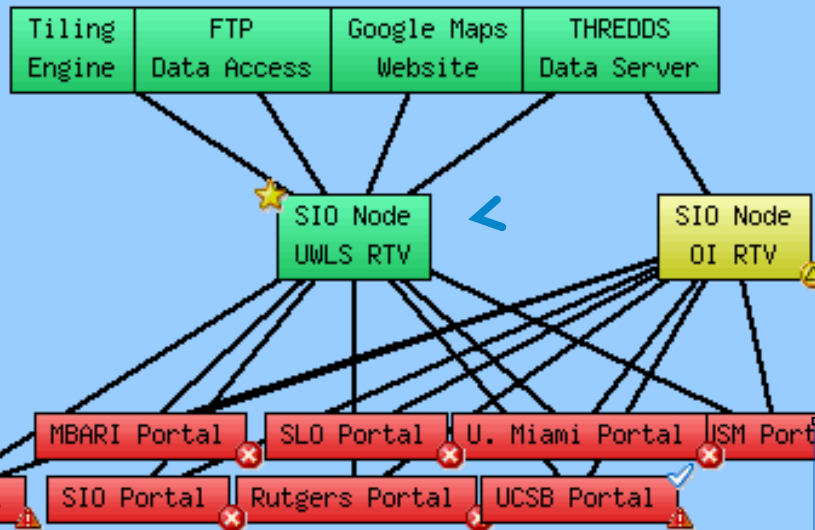


Scripps

- 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



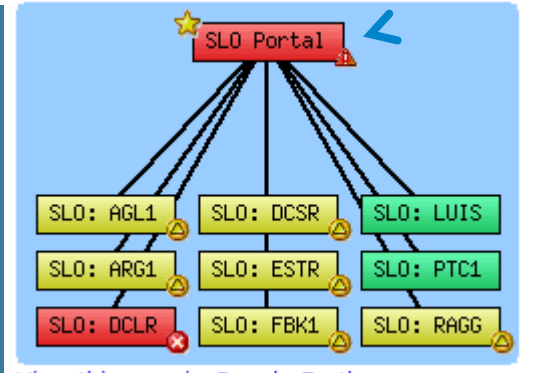
Example Node to Site Aggregator communications

Example Site Aggregator to Site communications

Site - the individual field installations of HF radar equipment

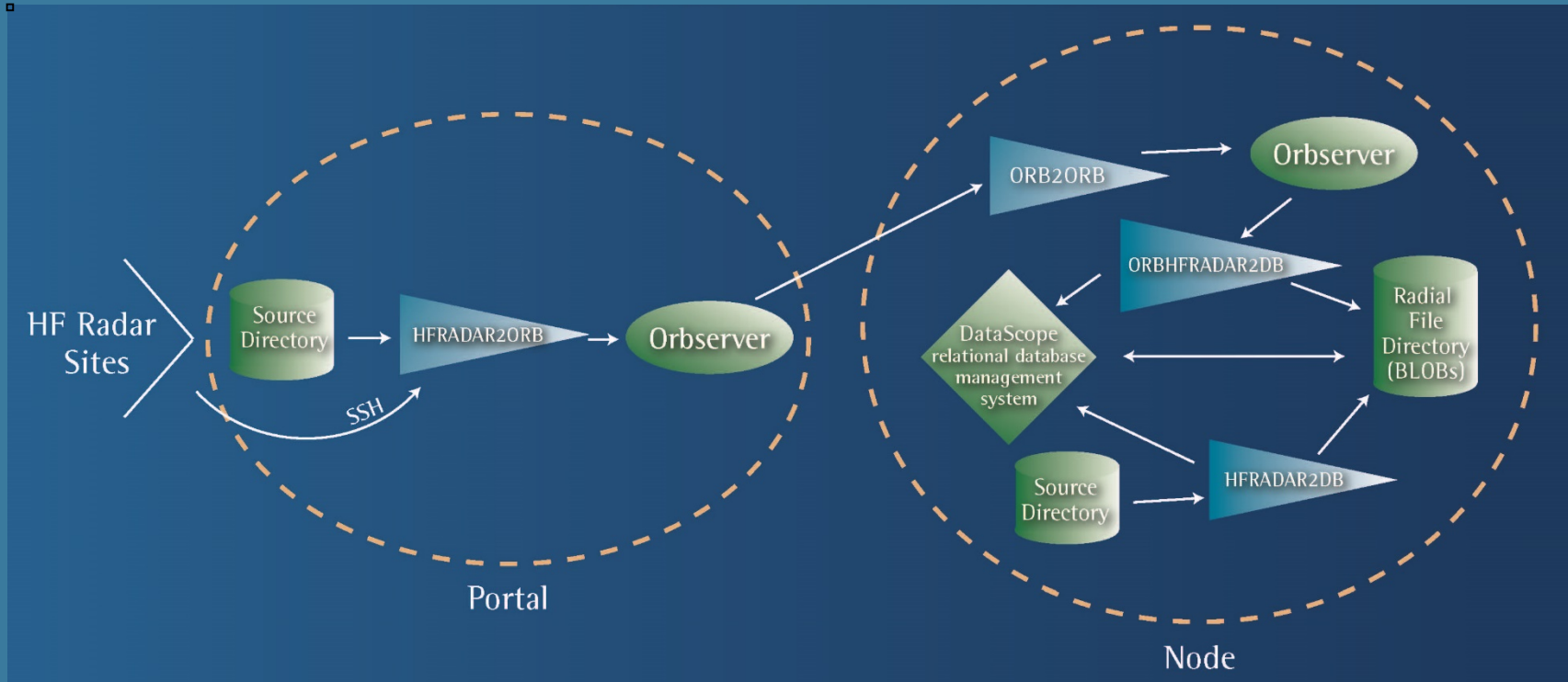
Portal or Site Aggregator - a local regional operations center which maintains multiple installations

Node - Centralized locations which aggregate data from multiple regions



Data Acquisition

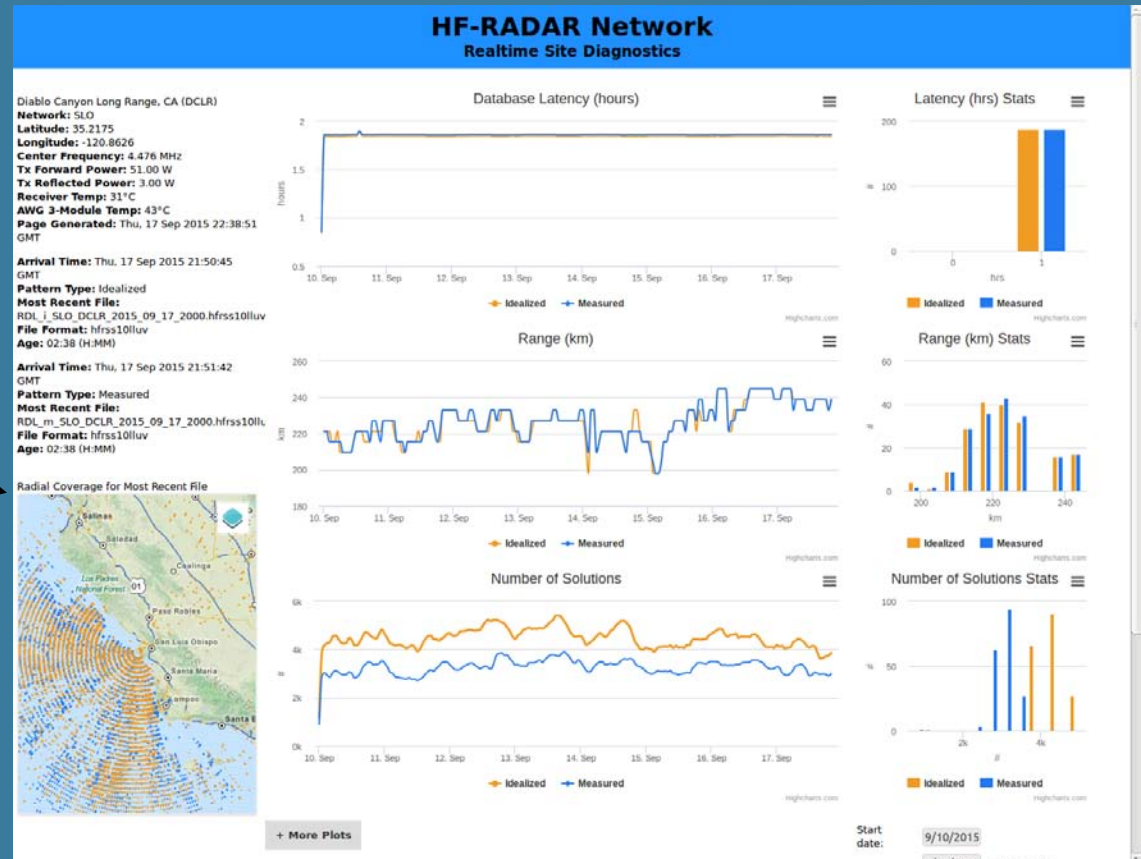
Data Flow



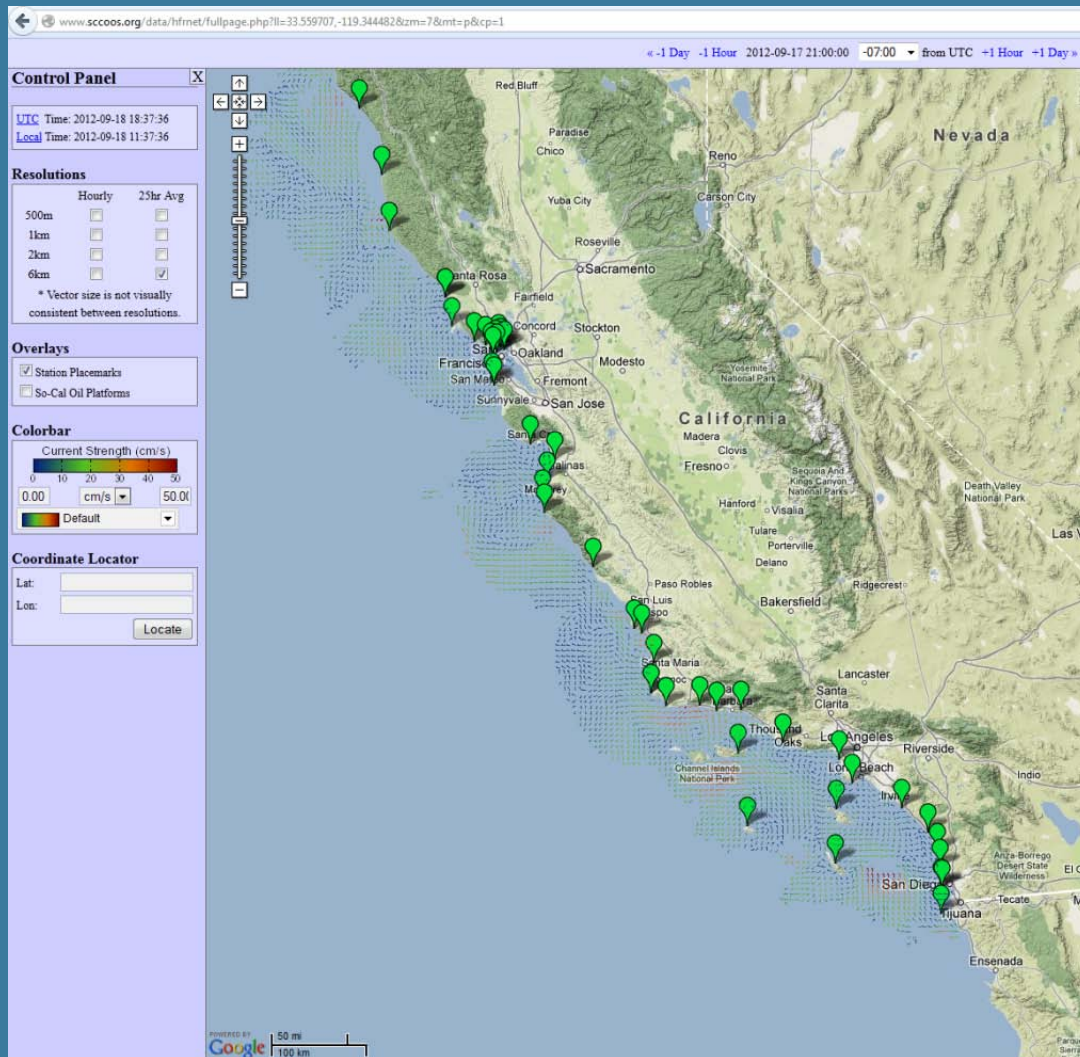
- Portals/Site Aggregators server as 'point-of-entry' machines for radial data
- Nodes are typically used as independent data concentrators
- Ingestion of local archive volumes may be achieved through hfradar2db

Google Maps Interface

Radial Diagnostics



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://hfrnet.ucsd.edu/thredds/catalog.html>
THREDDS service that allows folks to acquire or use 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 – NODC totals starting in January, 2015 & backfill to 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

FY14

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%

Location	Q1	Q2	Q3	Q4	FY
West Coast	77%	76%	76%	78%	74%
East Coast	82%	68%	71%	72%	71%
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	SIO	32.41406670	-117.24373330	24.800262				77.96 % 580 / 744	96.43 % 648 / 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	69.27 % 266 / 384	93.66 % 5822 / 6216
SDCI RDLM	SIO	32.41406670	-117.24373330	24.800262				2.02 % 15 / 744									0.24 % 15 / 6216
SDBP RDLi	SIO	32.53591670	-117.12226670	25.799804	91.80 % 683 / 744	74.44 % 536 / 720	91.94 % 684 / 744	95.56 % 711 / 744	81.70 % 549 / 672	74.06 % 551 / 744	58.75 % 423 / 720	93.41 % 695 / 744	95.83 % 690 / 720	91.40 % 680 / 744	89.78 % 668 / 744	83.07 % 319 / 384	85.34 % 7189 / 8424
SDBP RDLM	SIO	32.53591670	-117.12226670	25.799804	95.70 % 712 / 744	90.69 % 653 / 720	99.19 % 738 / 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	93.55 % 696 / 744	73.44 % 282 / 384	90.48 % 7622 / 8424
SDPL RDLi	SIO	32.66583330	-117.23958330	24.500000	99.19 % 738 / 744	98.75 % 711 / 720	95.70 % 712 / 744	98.12 % 730 / 744	100.00 % 672 / 672	98.79 % 735 / 744	99.44 % 716 / 720	97.18 % 723 / 744	97.22 % 700 / 720	96.64 % 719 / 744	96.77 % 720 / 744	82.29 % 316 / 384	97.25 % 8192 / 8424
SDPL RDLM	SIO	32.66583330	-117.23958330	24.500000	98.92 % 736 / 744	97.92 % 705 / 720	95.56 % 711 / 744	97.72 % 727 / 744	98.36 % 661 / 672	98.25 % 731 / 744	99.31 % 715 / 720	96.91 % 721 / 744	97.22 % 700 / 720	96.51 % 718 / 744	96.37 % 717 / 744	79.95 % 307 / 384	96.74 % 8149 / 8424
SDWW RDLi	SIO	32.67991670	-117.24741670	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	94.89 % 706 / 744	97.45 % 725 / 744	87.76 % 337 / 384	98.27 % 8278 / 8424
SDSL RDLi	SIO	32.87058330	-117.25253330	5.200000	42.20 % 314 / 744	98.06 % 706 / 720	2.28 % 17 / 744		71.88 % 483 / 672	94.62 % 704 / 744	100.00 % 720 / 720	93.41 % 695 / 744	84.44 % 608 / 720	88.04 % 655 / 744	94.76 % 705 / 744	87.24 % 335 / 384	70.54 % 5942 / 8424
SDSL RDLM	SIO	32.87058330	-117.25253330	5.200000	6.18 % 46 / 744	92.08 % 663 / 720	2.28 % 17 / 744				50.97 % 367 / 720	71.37 % 531 / 744	78.19 % 563 / 720	64.11 % 477 / 744	85.08 % 633 / 744	75.52 % 290 / 384	42.58 % 3587 / 8424
SDSC RDLi	SIO	32.91775000	-118.48690000	5.234951	100.00 % 744 / 744	99.86 % 719 / 720	97.45 % 725 / 744	83.60 % 622 / 744	100.00 % 672 / 672	98.79 % 735 / 744	100.00 % 720 / 720	97.31 % 724 / 744	96.81 % 697 / 720	94.35 % 702 / 744	97.31 % 724 / 744	88.54 % 340 / 384	96.44 % 8124 / 8424
SDSE RDLi	SIO	33.02450000	-117.28610000	24.799804	100.00 % 744 / 744	97.78 % 704 / 720	100.00 % 744 / 744	100.00 % 744 / 744	100.00 % 672 / 672	95.43 % 710 / 744	96.53 % 695 / 720	96.91 % 721 / 744	96.81 % 697 / 720	84.81 % 631 / 744	68.41 % 509 / 744	69.27 % 266 / 384	93.03 % 7837 / 8424
SN11 RDLi	UCSB	33.28050000	-119.52245000	13.439650	99.87 % 743 / 744	92.64 % 667 / 720	31.45 % 234 / 744				97.50 % 702 / 720	97.45 % 725 / 744	94.03 % 677 / 720	97.45 % 725 / 744	12.63 % 94 / 744		54.21 % 4567 / 8424
SN11 RDLM	UCSB	33.28050000	-119.52245000	13.439650	99.87 % 743 / 744	92.64 % 667 / 720	31.45 % 234 / 744				97.50 % 702 / 720	97.45 % 725 / 744	94.03 % 677 / 720	97.45 % 725 / 744	12.63 % 94 / 744		54.21 % 4567 / 8424

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



Data, DAta, DATa, DATA

DATA

METADATA

units

limits

scale

domain

...

Provider

content

reference

...

FILES, DATABASE

INTEGRATED or EXTERNAL

Data Management
& Distribution

file hosting

web services

APPLICATIONS AND DECISION MAKING

Management Decision Impacts: *Is change/impact as a result of the management decision?*
External Human Influences: *Are they present, Are they avoidable, Are they external to region?*
Natural Variability: *Are observed changes caused by natural variability? E.g. – climate change?*

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/>

Data Management Standards

- Standard for Gridded Velocity Format – Network Common Data Format (NetCDF) format
<http://www.unidata.ucar.edu/software/netcdf/>

Definition: NetCDF is a set of software libraries and self-describing, machine-independent data formats that support the creation, access, and sharing of array-oriented scientific data.

What is it: Software package to transform your data into a format that has defined tags

Why is it useful: your data can be read by supporting applications without having to translate

```
netcdf foo {      // example netCDF specification in CDL

dimensions:
lat = 10, lon = 5, time = unlimited;

variables:
    int      lat(lat), lon(lon), time(time);
    float    z(time,lat,lon), t(time,lat,lon);
    double   p(time,lat,lon);
    int      rh(time,lat,lon);

    lat:units = "degrees_north";
    lon:units = "degrees_east";
    time:units = "seconds";
    z:units = "meters";
    z:valid_range = 0., 5000.;
    p:_FillValue = -9999.;
    rh:_FillValue = -1;

data:
    lat    = 0, 10, 20, 30, 40, 50, 60, 70, 80, 90;
    lon    = -140, -118, -96, -84, -52;
}
```

Data Management Standards

- Standard Metadata Naming Conventions for data–
Climate Forecast Interoperability

<http://cfconventions.org/>

What is it: Naming conventions for variables. Provides detailed standardized description for each variable

Why is it useful: Facilitates building applications for extraction, analysis and display

▼ surface eastward sea water velocity

The surface called "surface" means the lower boundary of the atmosphere. "Water" means water in all phases, including frozen i.e. ice and snow. A velocity is a vector quantity. "Eastward" indicates a vector component which is positive when directed eastward (negative westward).

m s-1

```
varid_v = netcdf.defVar( ncid, 'v', 'float', [dimid_range dimid_bearing dimid_t] );  
netcdf.defVarDeflate(ncid, varid_v, true, true, 6);  
netcdf.putAtt( ncid, varid_v, 'valid_range', single( [-1e3 1e3] ));  
netcdf.putAtt( ncid, varid_v, 'standard_name', 'surface_northward_sea_water_velocity' );  
netcdf.putAtt( ncid, varid_v, 'units', 'cm s-1' );  
netcdf.putAtt( ncid, varid_v, 'coordinates', 'lon lat' );
```

Data Management Standards

- Standard Metadata for Dataset Discovery

http://wiki.esipfed.org/index.php/Attribute_Convention_for_Data_Discovery

What is it: *Dataset level metadata*

Descriptive information about the data

Why is it useful: *Dataset discovery – making it easier for users to find your data*

Crosswalk metadata standards (e.g. ISO 19115, FGDC, Dublin Core)

Global Attributes

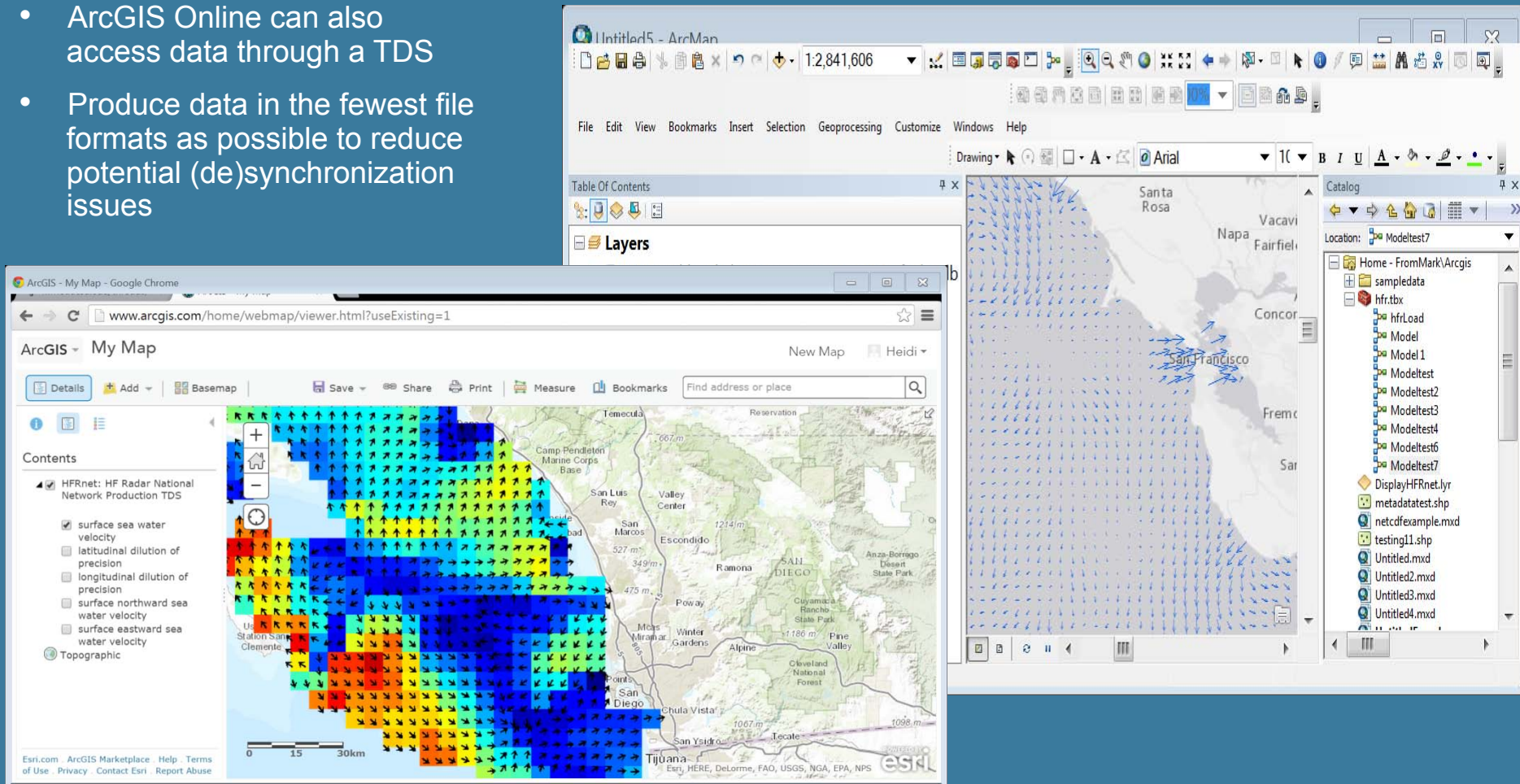
Highly Recommended

Attribute	Description
title	A short phrase or sentence describing the dataset. In many discovery systems, the title will be displayed in the results list from a search, and therefore should be human readable and reasonable to display in a list of such names. This attribute is also recommended by the NetCDF Users Guide and the CF conventions .
summary	A paragraph describing the dataset, analogous to an abstract for a paper.
keywords	A comma-separated list of key words and/or phrases. Keywords may be common words or phrases, terms from a controlled vocabulary (GCMD is often used), or URIs for terms from a controlled vocabulary (see also "keywords_vocabulary" attribute).
Conventions	A comma-separated list of the conventions that are followed by the dataset. For files that follow this version of ACDD, include the string 'ACDD-1.3'. (This attribute is described in the NetCDF Users Guide .)

Data Distribution

THREDDS and ArcGIS

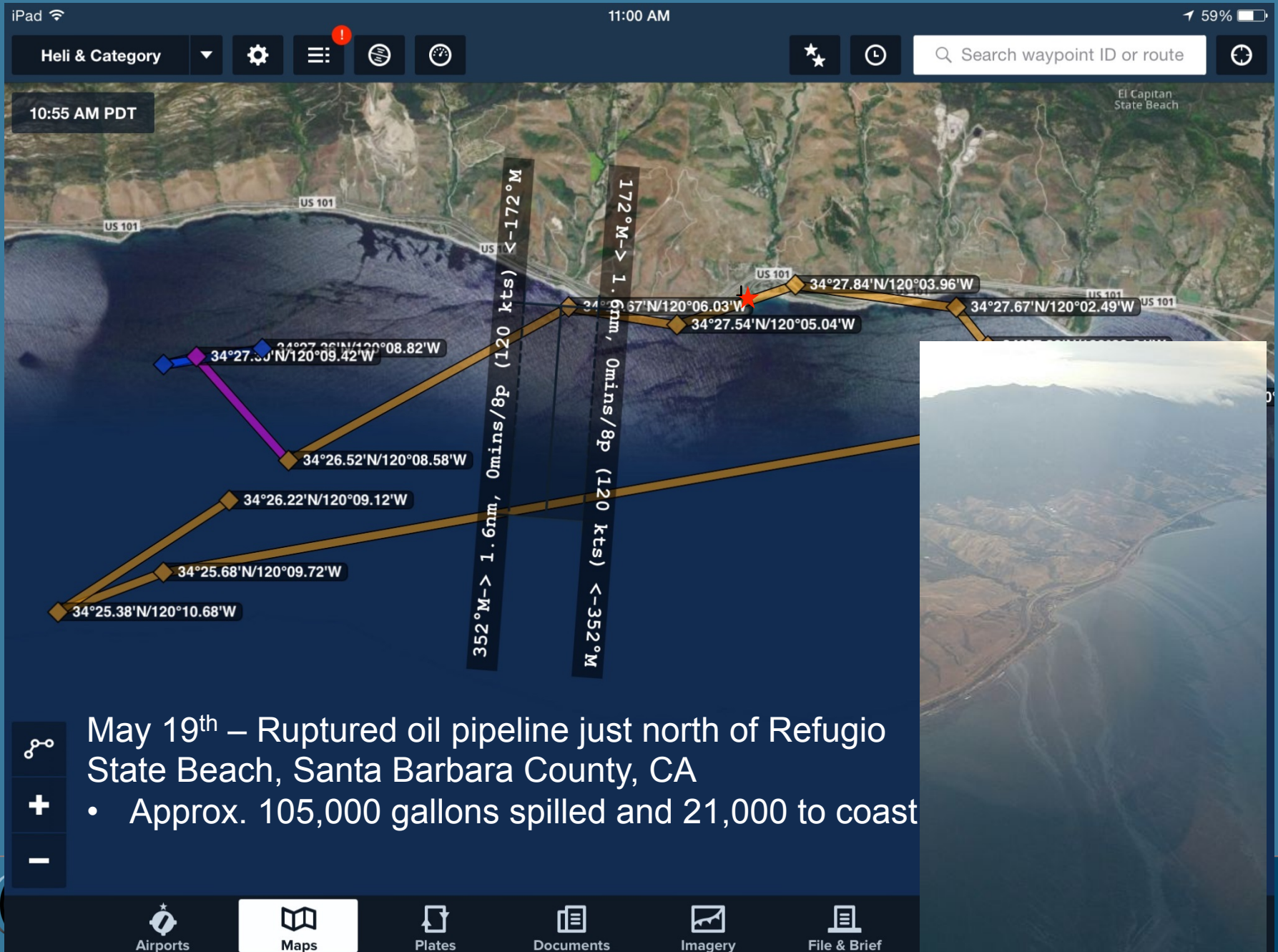
- Migrating ArcMap users from FTP and shapefiles to direct access with TDS
- ArcGIS Online can also access data through a TDS
- Produce data in the fewest file formats as possible to reduce potential (de)synchronization issues



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

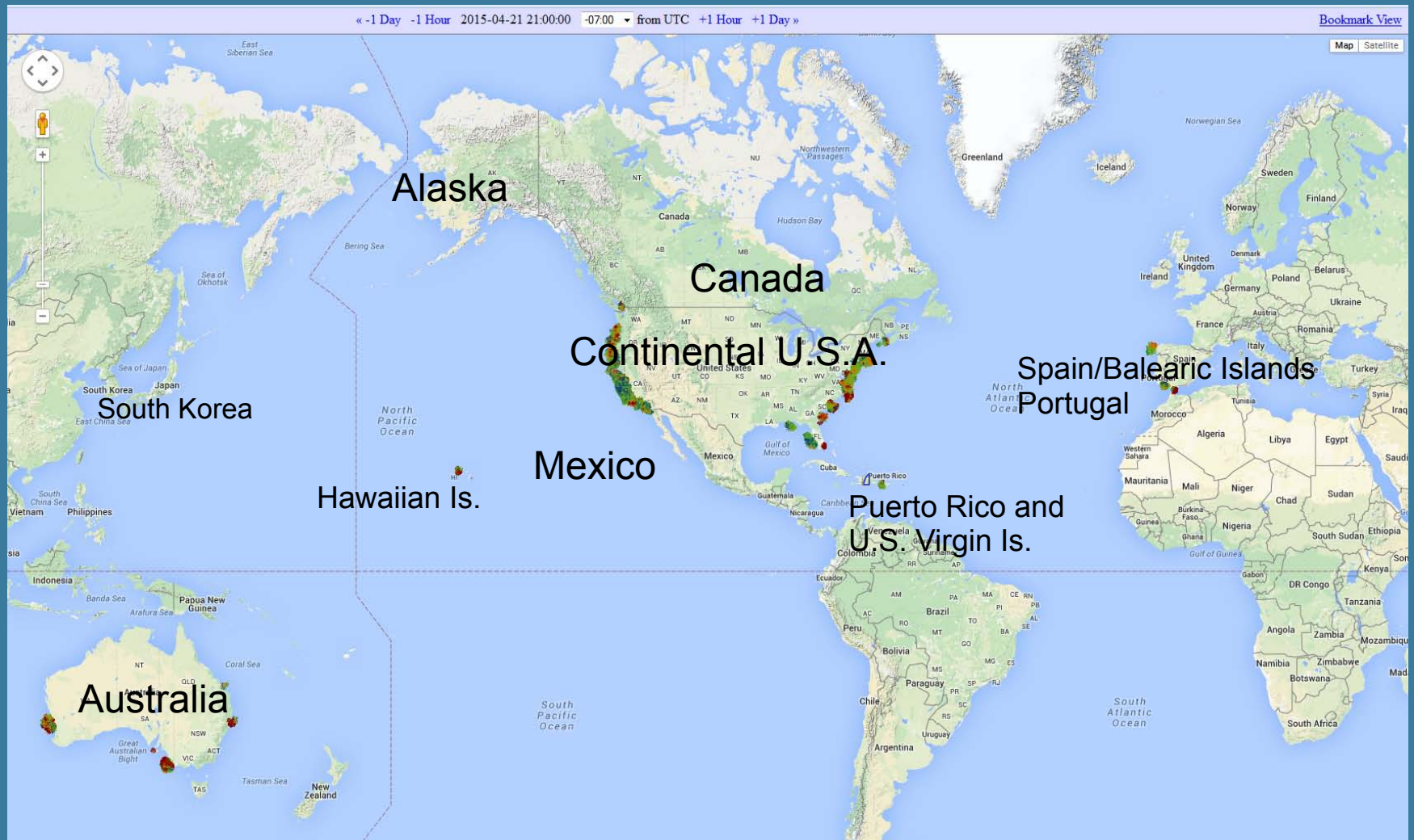
Refugio Oil Spill Map from May 20th, 2015



SCCOOS HF Radar Coverage with Temporary Installation for Refugio Spill support

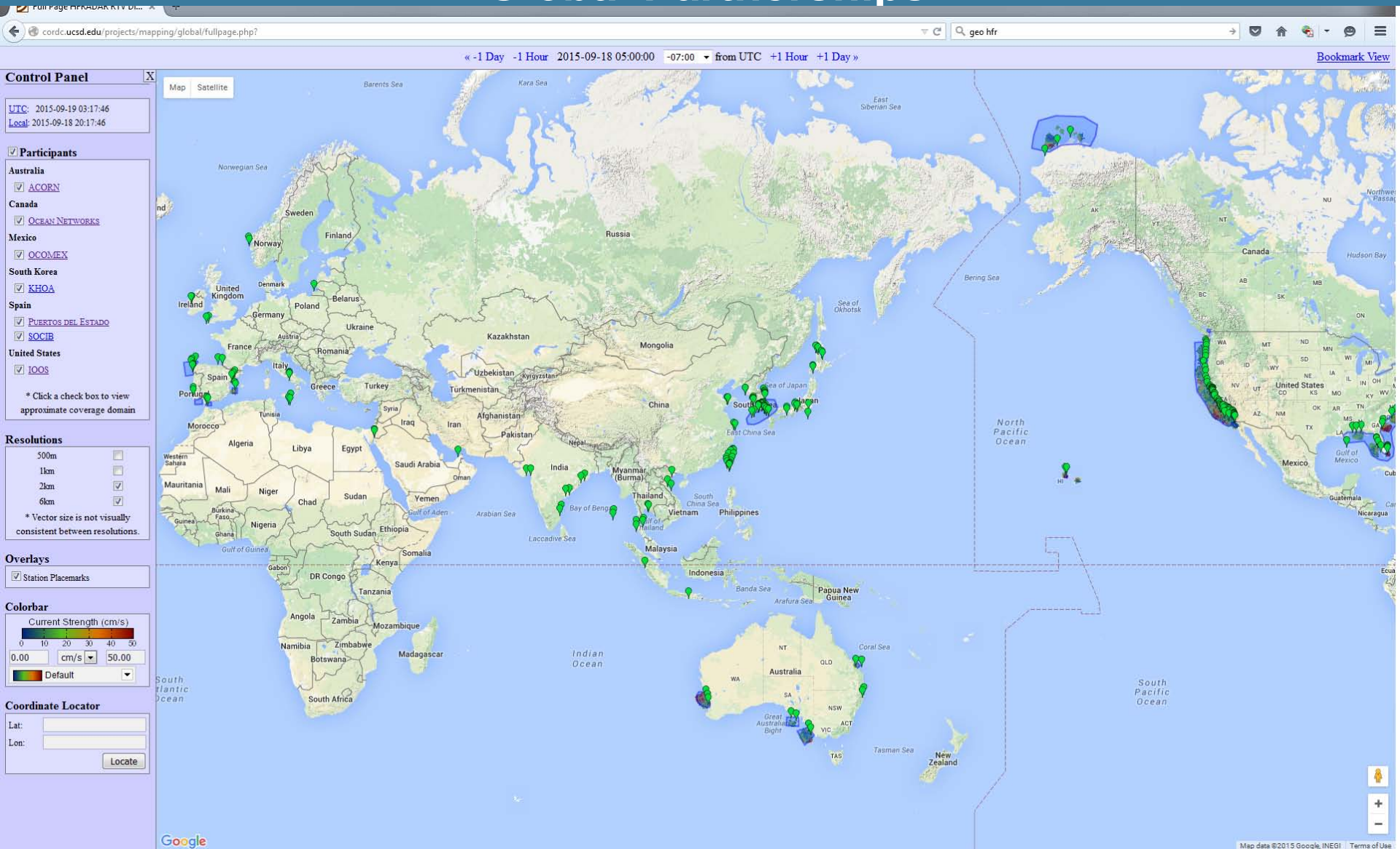


High Frequency Radar Network (HFRNet) Global Partnerships



High Frequency Radar Network (HFRNet)

Global Partnerships



High Frequency Radar Network (HFRNet) Global Partnerships

Questions?

Discussions:

Data Distribution: THREDDS Data Server ; ftp; http; https
file modification times are preserved during the file copy.

Data Availability: account for reprocessing – U.S. network 25hrs

Time: UTC

Thank You

