Observations Coordination Group (**OCG)**
High Frequency Radar Network

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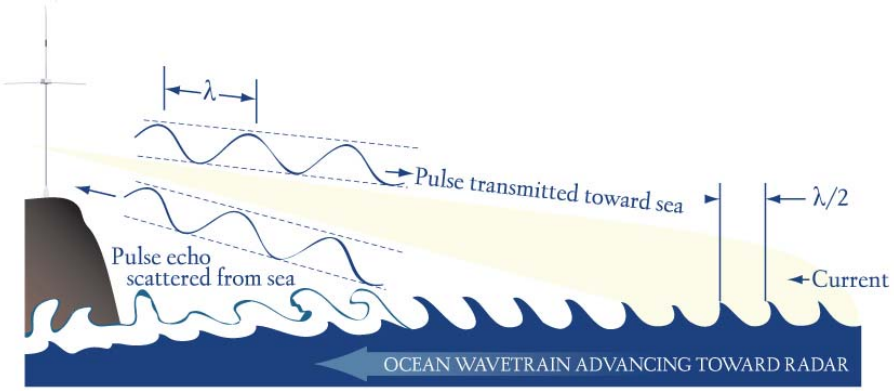
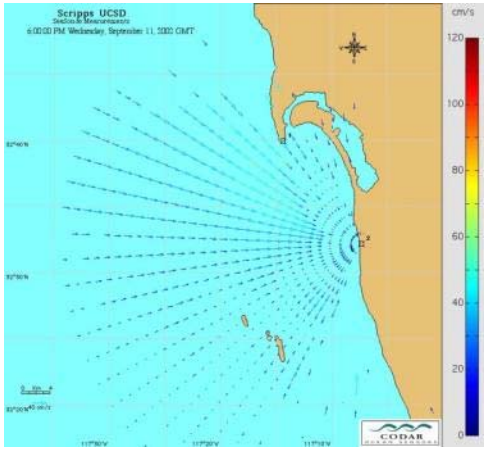
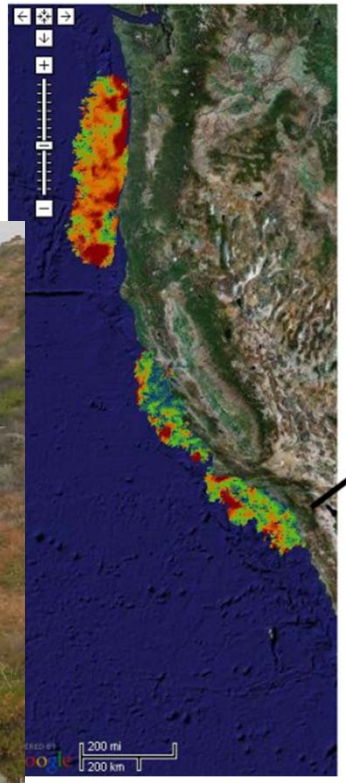
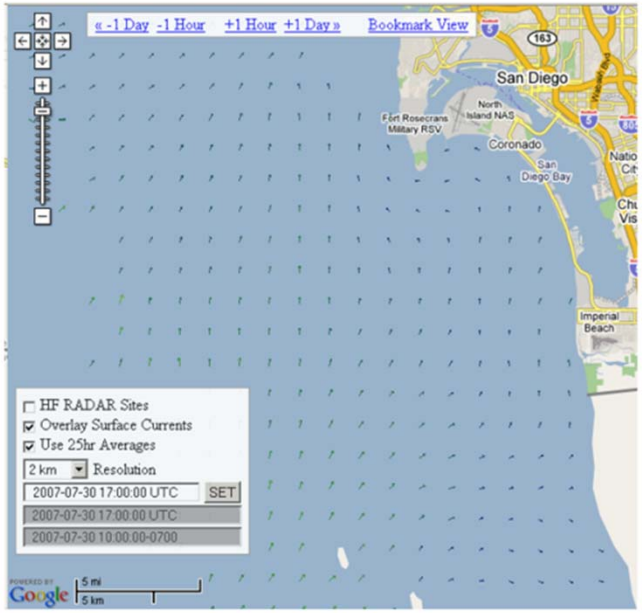
9th Session of the JCOMM Observations Coordination Group
14 - 17th May 2018, Brest, France

HFR Technology Overview



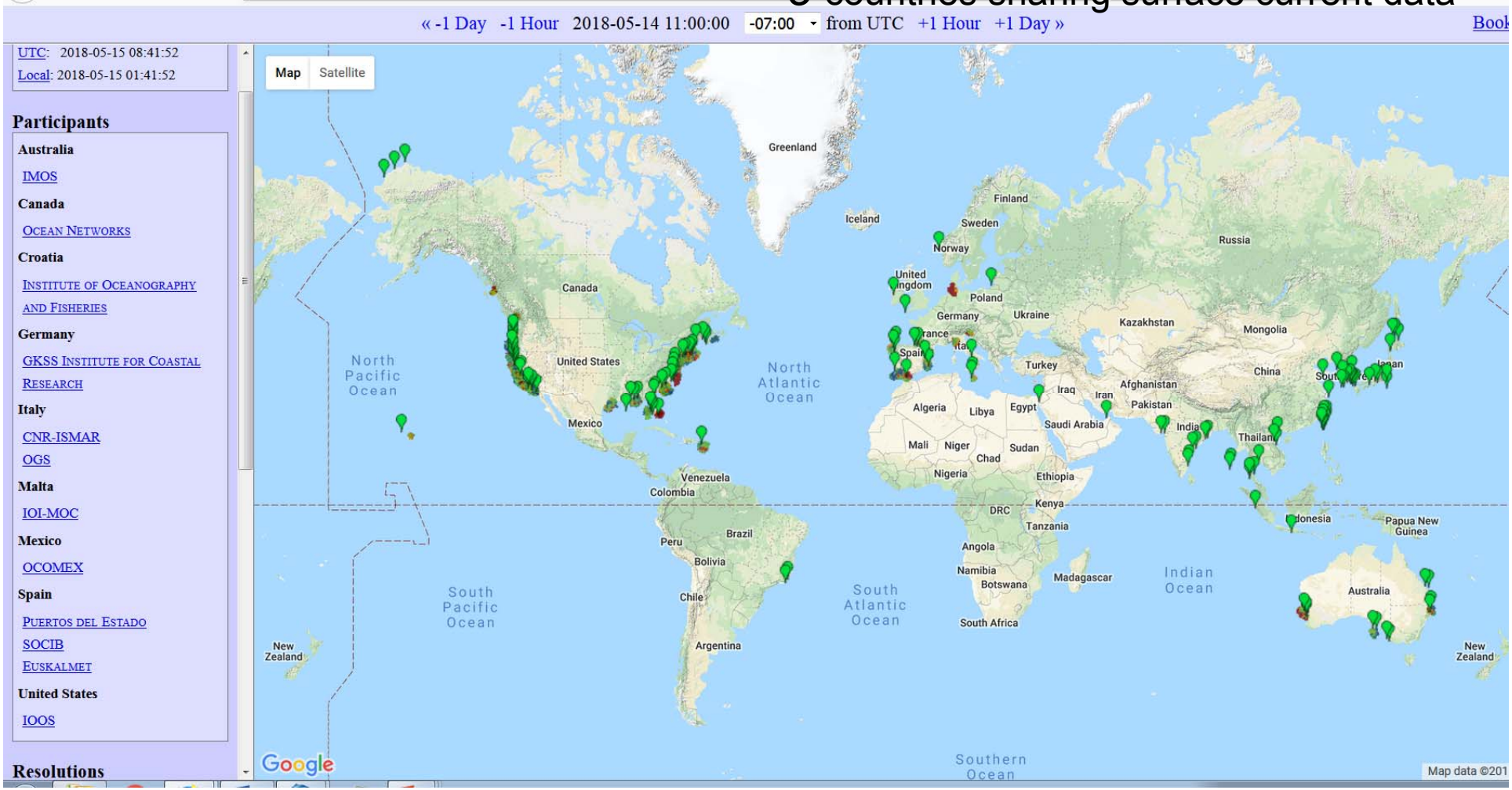






Network Update

- >300 stations operating in
- 25 countries with
- 9 countries sharing surface current data



HF Radar – Surface Currents

	Country	Organization
1	Australia	Integrated Marine Observing System (IMOS)
2	Canada	Ocean Networks
3	Croatia	Institute of Oceanography and Fisheries
4	Germany	Helmholtz-Zentrum Geesthacht Centre for Materials and Coastal Research
5	Italy	CNR, Consiglio Nazionale delle Ricerche
		OGS, Istituto Nazionale di Oceanografia e di Geofisica Sperimentale
6	Malta	University of Malta, Physical Oceanography Unit (PO-Unit), International Ocean Institute-Malta Operational Centre (IOI-MOC)
7	Mexico	Observatorio de Corrientes Oceánicas MEXicanas (OCOMEX)
8	Spain	Puertos del Estado
		SOCIB, Balearic Islands Coastal Observing and Forecasting System
		Meteorological Agency (Euskalmet)
9	United States	Integrated Ocean Observing System (IOOS)

-	Republic of Korea	Korea Hydrographic and Oceanic Administration (KHOA)

Global Stations – shared google document
Global Shared Data Repository – European Marine Observation and Data Network (EMODnet)
Global Shared Data Visualization – google map visualization

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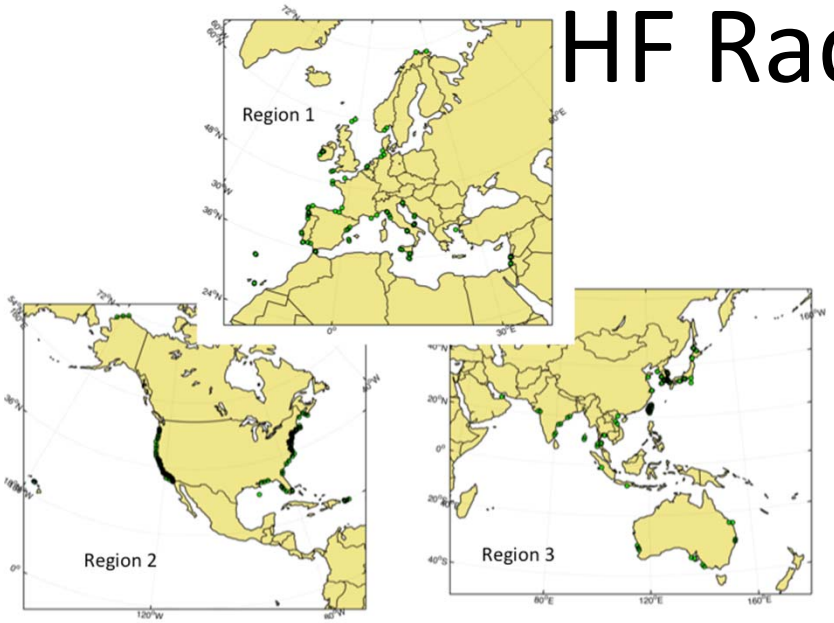
HF Radar Network



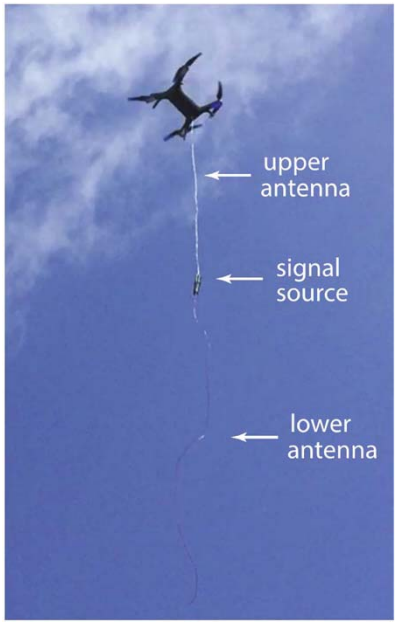
Foci for the Next Year

- Develop metrics and targets for the network
- Encourage more networks to share their data
- Fourth Ocean Radar Conference for Asia, June 2-4 2018
- Radiowave Operators Working Group meeting scheduled for October 16-18, 2018 in Santa Cruz, CA

Recent Achievements

- Australia: New 2 station network installed near Newcastle, Australia
- Canada: Canadian has grown its network to 11 stations with another 2 coming online later this year
- Croatia: Croatia Institute of Oceanography and Fisheries, Italy Institute of Marine Sciences and five other networks began sharing their surface current measurements
- Europe: HF Radar products are being implemented in the European Union's Copernicus Marine Service from 2019
- Malta: THe CALYPSO HF radar network in the Malta-Sicily area has secured funding to add 3 new radar sites in 2019 to a total of 7 stations that will also cover an extensive stretch of sea south of the Maltese Islands
- Mexico: MEXIOOS plans to install a total of 14 stations over the next two years.
- United States: The United States has recorded surface currents at the regional scale for the past decade.
- 14th Radio Oceanography Workshop (ROW 2017) held 19-21 September 2017 in Luneburg, Germany
- EuroGOOS HF Radar Task Team has established standards for Total and Radial Velocities data management (Metadata, format, QC).

Opportunities



- Calibrations via drones
- HF Radar – Surface Currents

  Version 1.0 of the QARTOD manual for near real-time quality control of high frequency radar surface currents
- HF Radar - Waves

  Operational testing by several countries (e.g. Australia, Spain, United Kingdom, United States), but no coordinated efforts
  Readiness level – PILOT
- HF Radar - Meteotsunami Warning

  Highlights - international concept efforts (e.g. Canada, United States)
  Readiness level – CONCEPT
- Operational integration into products

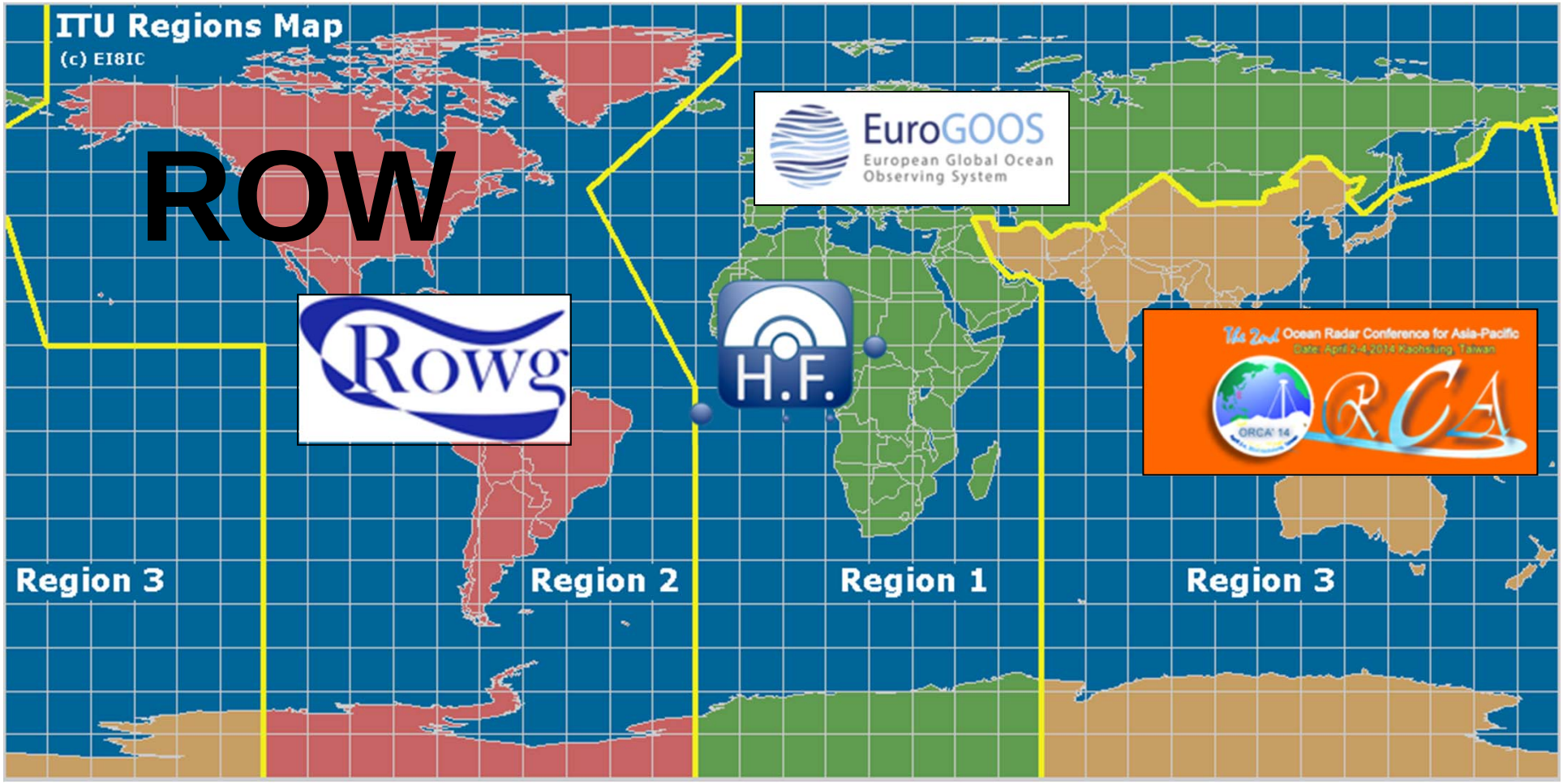
Operational Integration – U.S. Example

Challenges

- Data sharing policies
- Frequency allocation within ITU bands
- Frequency sharing mechanisms
- Sustained funding (O&M)

- Operational integration into products

Opportunities for Coordination



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Opportunities for Coordination

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

- Standard Metadata Naming Conventions for data – Climate Forecast Interoperability
  http://cfconventions.org/

- Standard Metadata for Dataset Discovery
  http://wiki.esipfed.org/index.php/Attribute_Convention_for_Data_Discovery

- Standard Distribution Service– THREDDS Data Server (TDS)
  http://www.unidata.ucar.edu/software/thredds/current/tds/

- Standard Metadata for Dataset Discovery
  http://wiki.esipfed.org/index.php/Attribute_Convention_for_Data_Discovery

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.)

Metric Development - Example

- **Definition** – The percentage of time funded radars are operational during a given reporting period.

- **Calculation** - Divide the number of *Operational Radial Files** reported to HFRNet by the total number of expected radial files in a given reporting period.

$$\text{Metric (in \%)} = \frac{\text{\# of Operational Radial Files}}{\text{\# of expected Radial Files}} * 100$$

The performance metric will be based on the operation of the U.S. array over a 12 month fiscal cycle (October through September) or otherwise defined reporting cycles (e.g. quarterly cycle).

* Defined next page

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Operational Radial File

- Definition - 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.

___

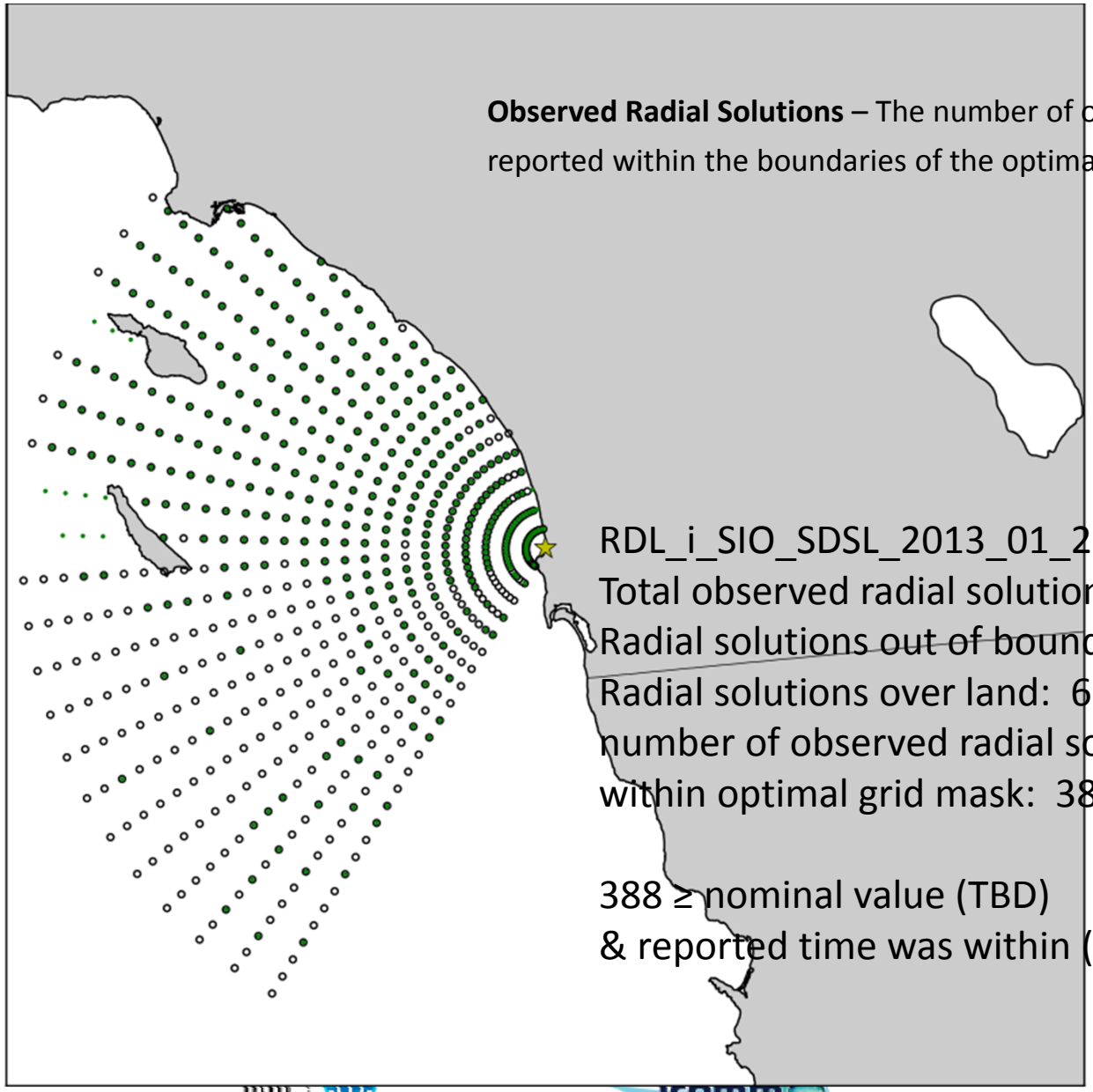
X = 300 solutions – *may vary based on location and ocean conditions*

Y = 25 hours**

- Calculation - # observed radial solutions ≥ nominal value within the optimal grid *(site specific)* and file reported within Y hours of the observation.
- Note: there are a small number of sites (about 6) with topographic barriers - never be able to reach 300 points per hour. These sites must only meet a 200 point threshold.
- There is an even smaller set of sites (currently only 4) having severe limitations whose threshold is only 75 points.

**Based on HFR community input

Example: Observed Radial Solutions



Observed Radial Solutions – The number of observed grid solutions reported within the boundaries of the optimal radial grid.

RDL_i_SIO_SDSL_2013_01_25_0400.hfrss10lluv
Total observed radial solutions: 880
Radial solutions out of bounds: 429
Radial solutions over land: 63
number of observed radial solutions within optimal grid mask: 388

388 ≥ nominal value (TBD)
& reported time was within (Y) 25 hours of observation

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FRAMEWORK PROCESSES BY READINESS LEVELS

Readiness Levels	Requirements Processes	Coordination of Observational Elements	Data Management & Information Products
Mature			
Level 9 "Sustained"	Essential Ocean Variable: • Adequate sampling specifications • Quality specifications	System in Place: • Globally • Sustained indefinitely • Periodic review	Information Products Routinely Available: • Product generation standardized • User groups routinely consulted
Level 8 "Mission qualified"	Requirements "Mission Qualified:" • Longevity/stability • Fully scalable	System "Mission Qualified:" • Regional implementation • Fully scalable • Available specifications and documentation	Data Availability: • Globally available • Evaluation of utility
Level 7 "Fitness for purpose"	Validation of Requirements: • Consensus on observation impact • Satisfaction of multiple user needs • Ongoing international community support	Fitness-for-Purpose of Observation: • Full-range of operational environments • Meet quality specifications • Peer review certified	Validation of Data Policy • Management • Distribution
Pilot			
Level 6 "Operational"	Requirement Refined: • Operational environment • Platform and sensor constraints	Implementation Plans Developed: • Maintenance schedule • Servicing logistics	Demonstrate: • System-wide availability • System-wide use • Interoperability
Level 5 "Verification"	Sampling Strategy Verified: • Spatial • Temporal	Establish: • International commitments and governance • Define standardized components	Verify and Validate Management Practices: • Draft data policy • Archival plan
Level 4 "Trial"	Measurement Strategy Verified at Sea	Pilot project in an operational environment	Agree to Management Practices: • Quality control • Quality assurance • Calibration • Provenance
Concept			
Level 3 "Proof of concept"	Proof of Concept via Feasibility Study: • Measurement strategy • Technology	Proof of Concept Validated: • Technical review • Concept of operations • Scalability (ocean basin)	Verification of Data Model with Actual Observational Unit
Level 2 "Documentation"	Measurement Strategy Described • Sensors • Sensitivity • Dependencies	Proof of Concept: • Technical capability • Feasibility testing • Documentation • Preliminary design	Socialization of Data Model • Interoperability strategy • Expert review
Level 1 "Idea"	Environment Information Need and Characteristics Identified: • Physical • Chemical • Biological	System Formulation: • Sensors • Platforms • Candidate technologies • Innovative approaches	Specify Data Model • Entities, Standards • Delivery latency • Processing flow

Figure 9. A Detailed View of Framework Processes for Varying Levels of Readiness.

Assessment
HF Radar Network
surface currents

- ✓ Global
- ✓ Sustained – pending funding
- ✓ Coordinated
  - ✓ Best practices
  - • Governance
  - • Strategy
  - ✓ Standards
  - ✓ Development plans
- • Free and distributable
- ✓ Timely – near real-time
- ✓ Essential Ocean Variable
- ✓ Defined Mission
- ✓ *Best Practices/Standards*
  - ✓ *Already mentioned*
- ✓ 'PILOT' - Minimum

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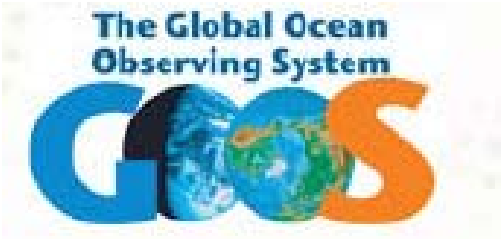
Request for OCG – Wiring Diagram

GEOSS Portal