



The Global Ocean Observing System



# The Global High Frequency Radar Network

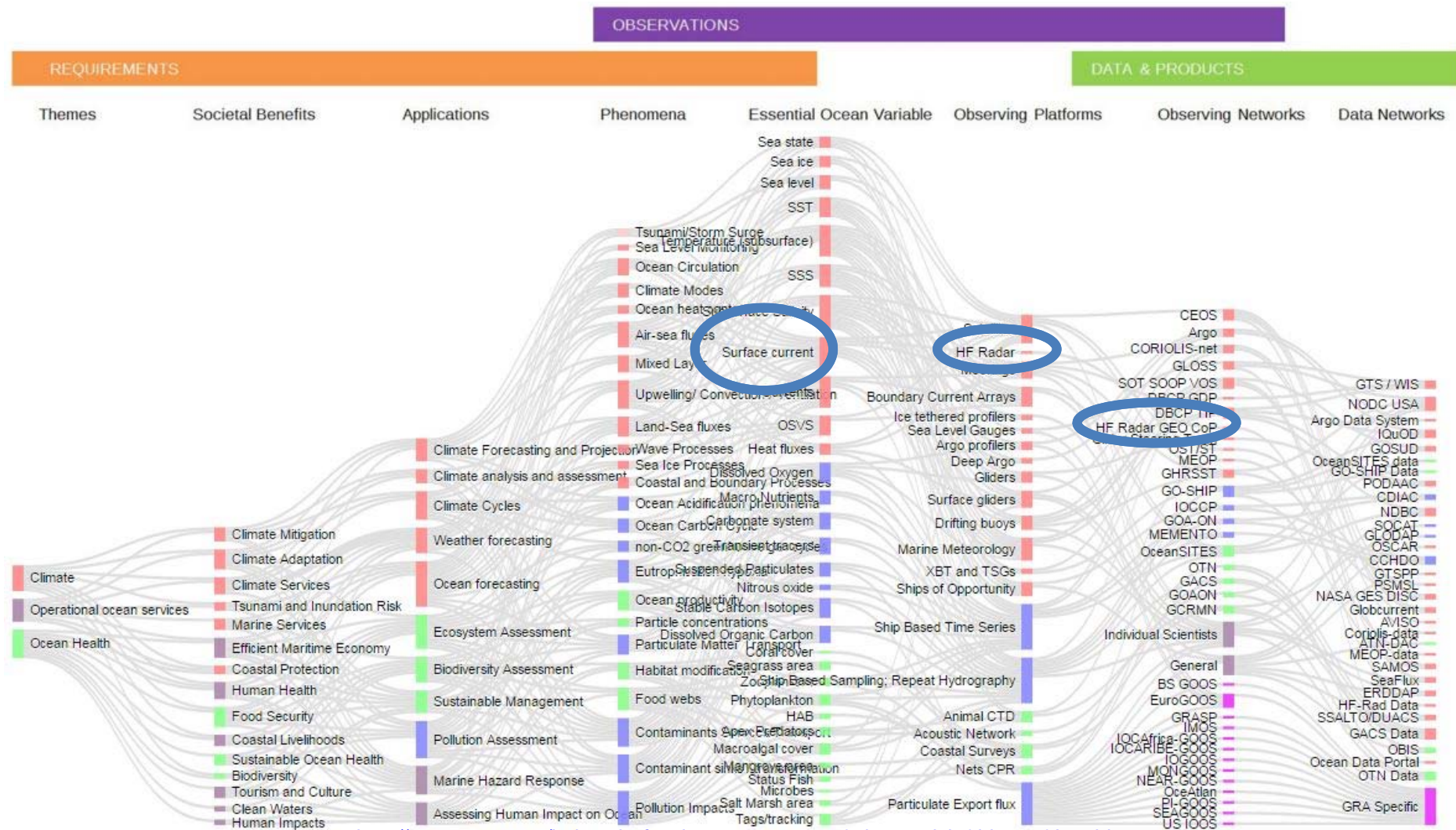
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# GOOS Strategic Mapping



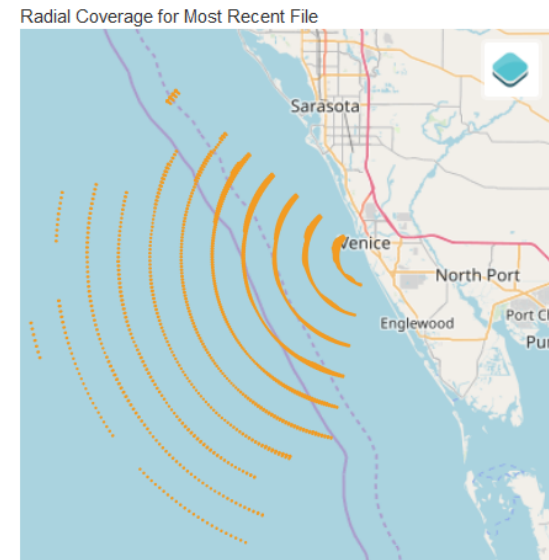
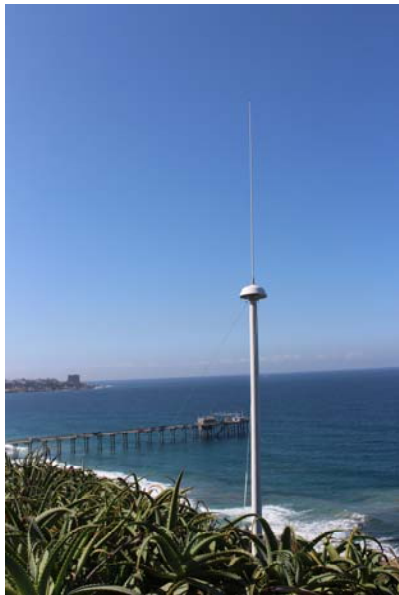
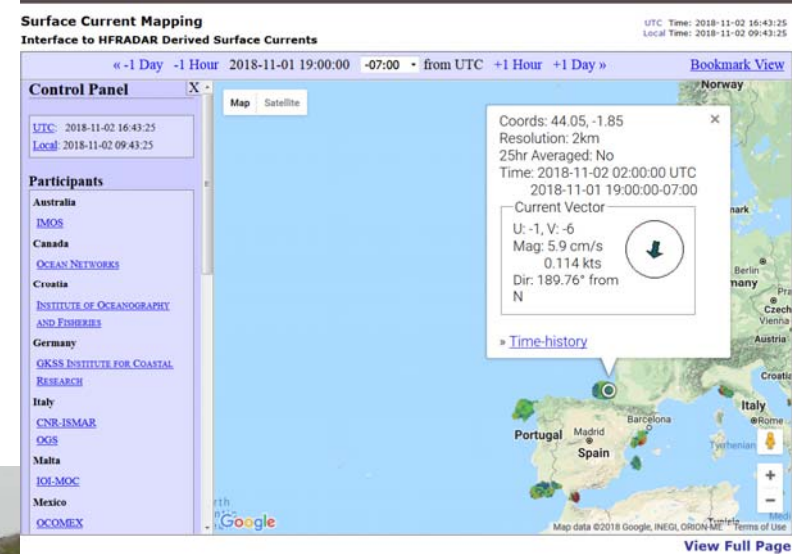
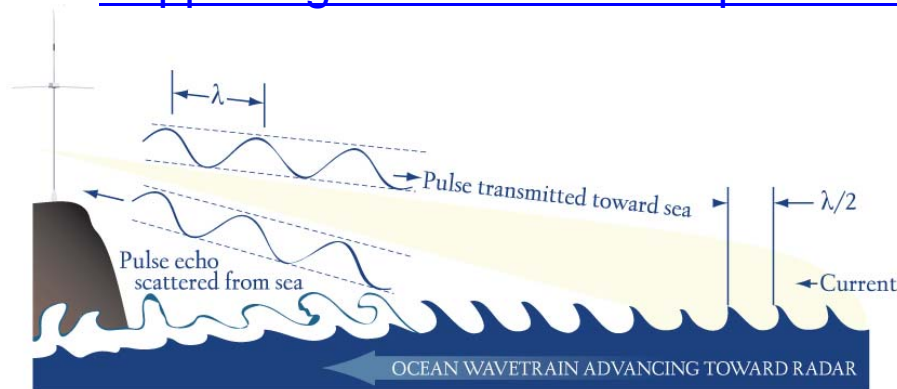
[http://goosocean.org/index.php?option=com\\_content&view=article&id=120&Itemid=277](http://goosocean.org/index.php?option=com_content&view=article&id=120&Itemid=277)



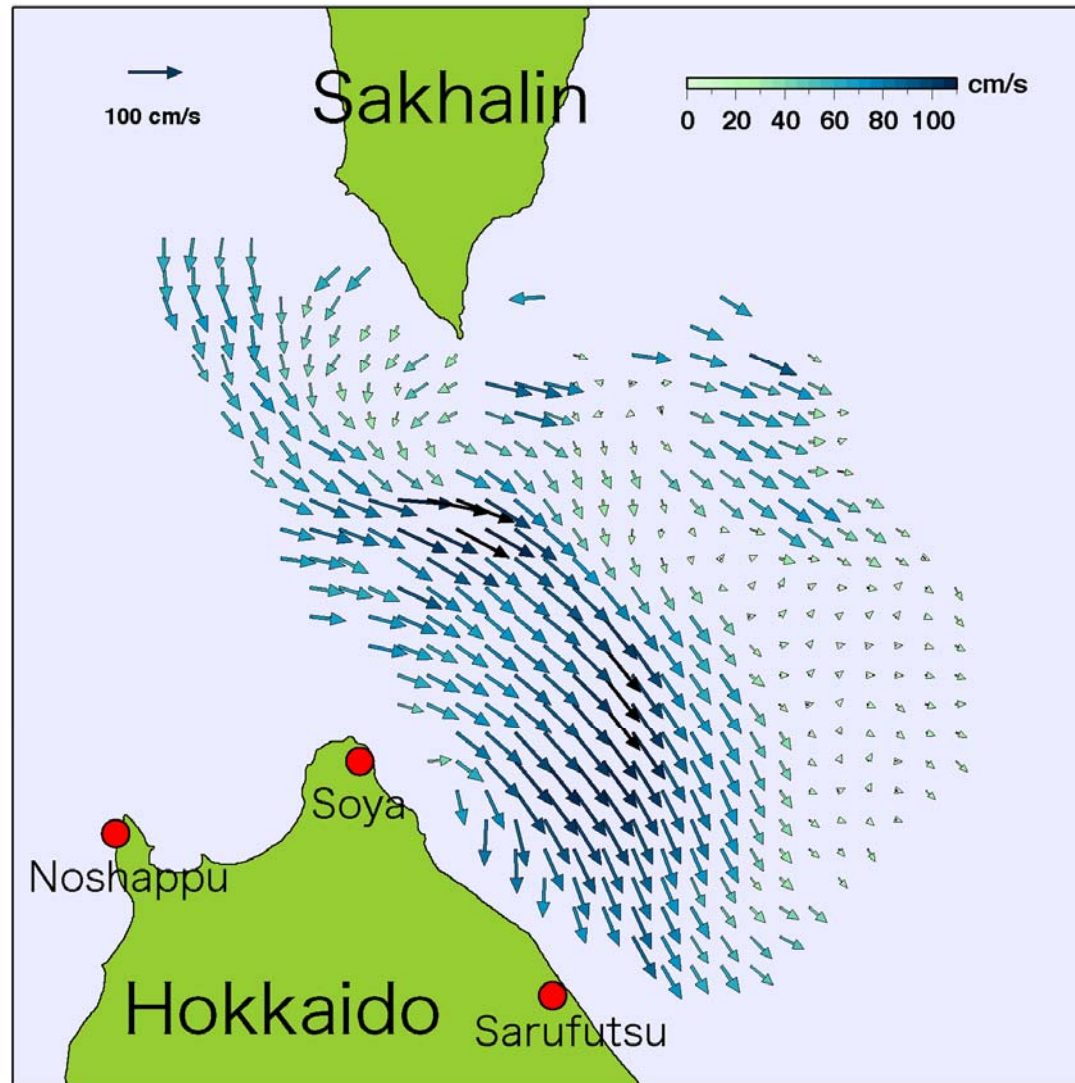


# HFR Technology Overview

## “High-Frequency Radar: Supporting Critical Coastal Operations with Real-time Surface Current Data”



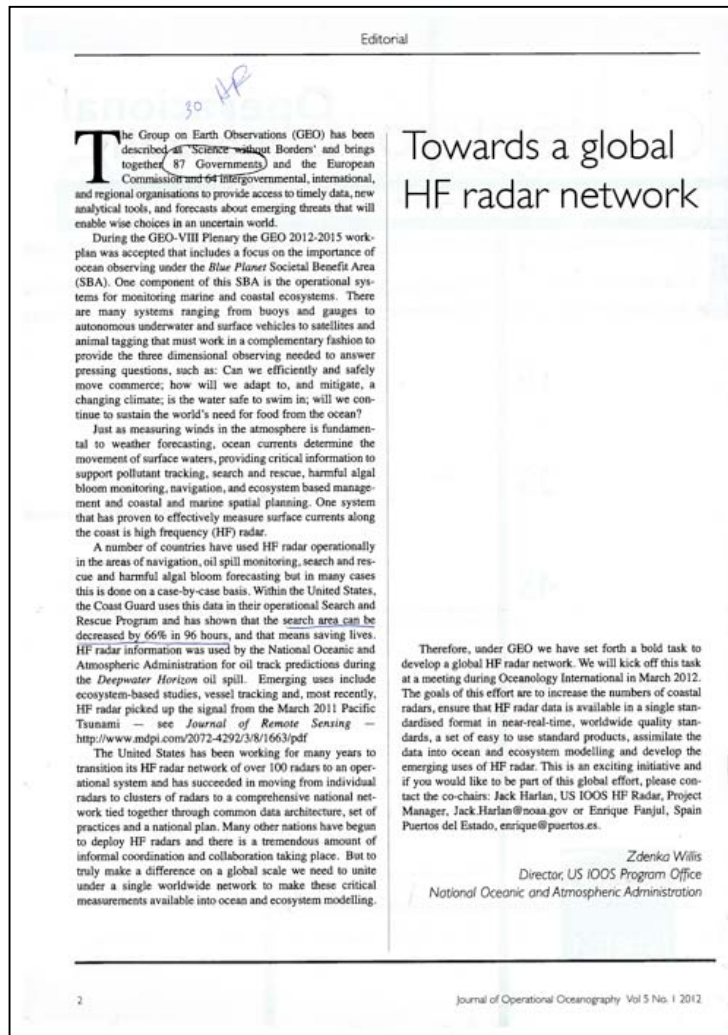
# Example of Observed Snapshot



17h20m (JST)  
3 Aug 2003

Real-time current maps are available from our web site.  
<http://wwwoc.lowtem.hokudai.ac.jp/hf-radar/index.html>

# The Global HF Radar Network



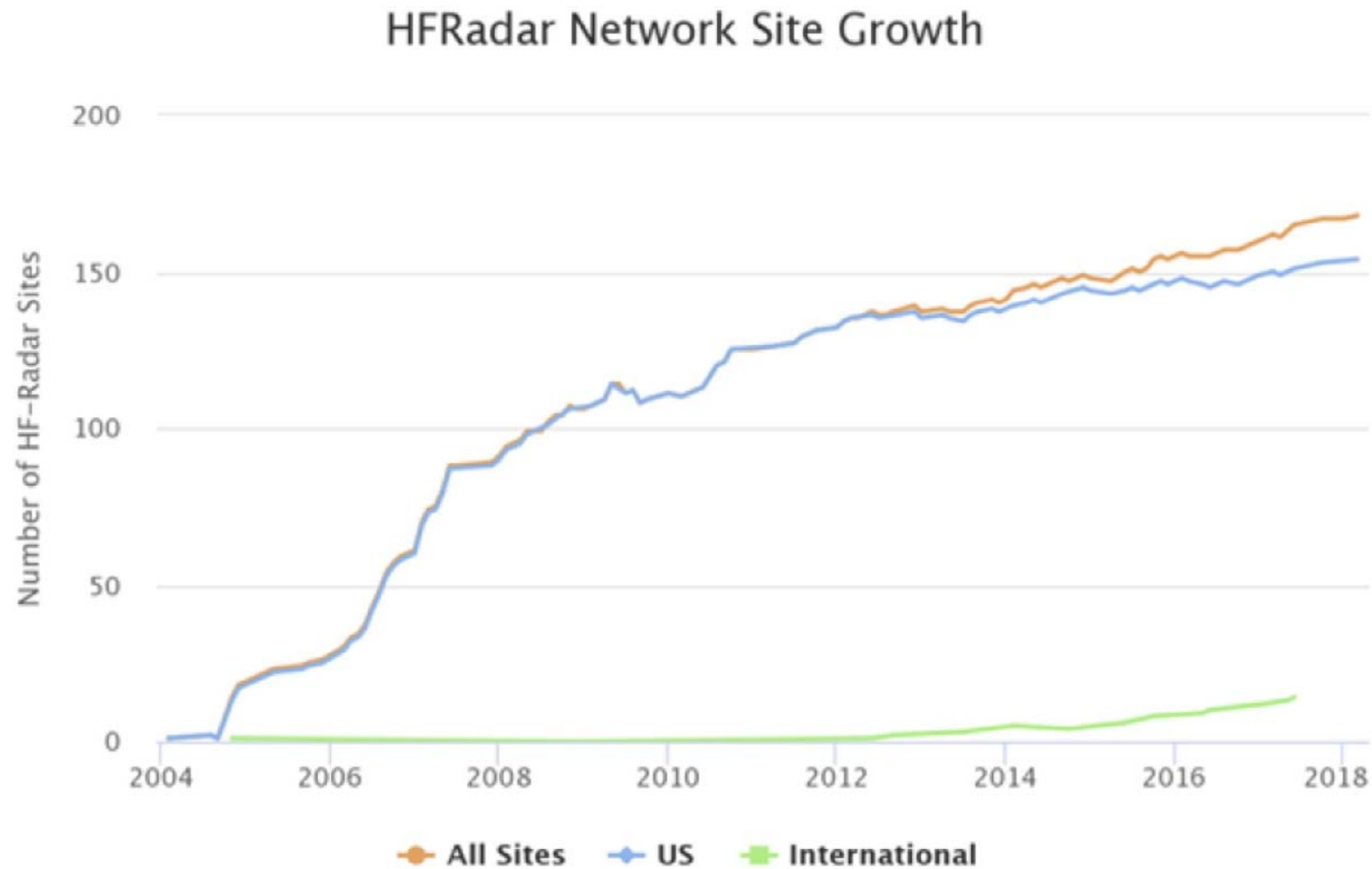
- Established in March 2012
- Meetings Held
  - 2012 England
  - 2013 Norway
  - 2014 Taiwan
  - 2015 Greece
  - 2016 United States
- Presentations available here  
<http://global-hfradar.org/meetings.html>



# Goals for Global HF Radar Network

- 1) Increase the number of coastal radars**
- 2) Ensure HFR data is available in a single standardized format in near-real-time,**
- 3) Assimilate data into ocean and ecosystem models**
- 4) A set of easy to use standard products**
- 5) Worldwide Quality Standards**
- 6) Develop emerging uses of HF radar**

# Growth in the United States

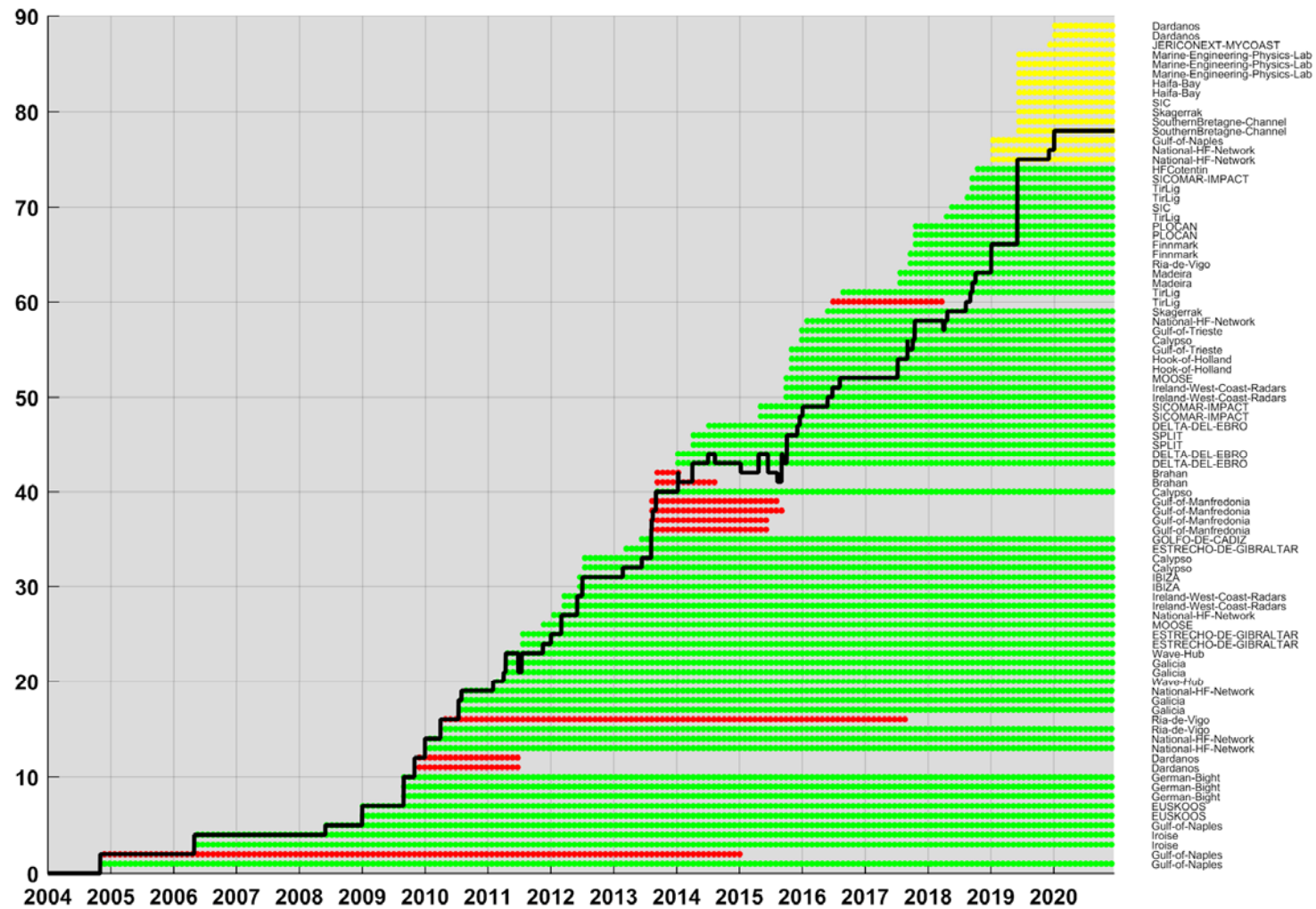


Highcharts.com



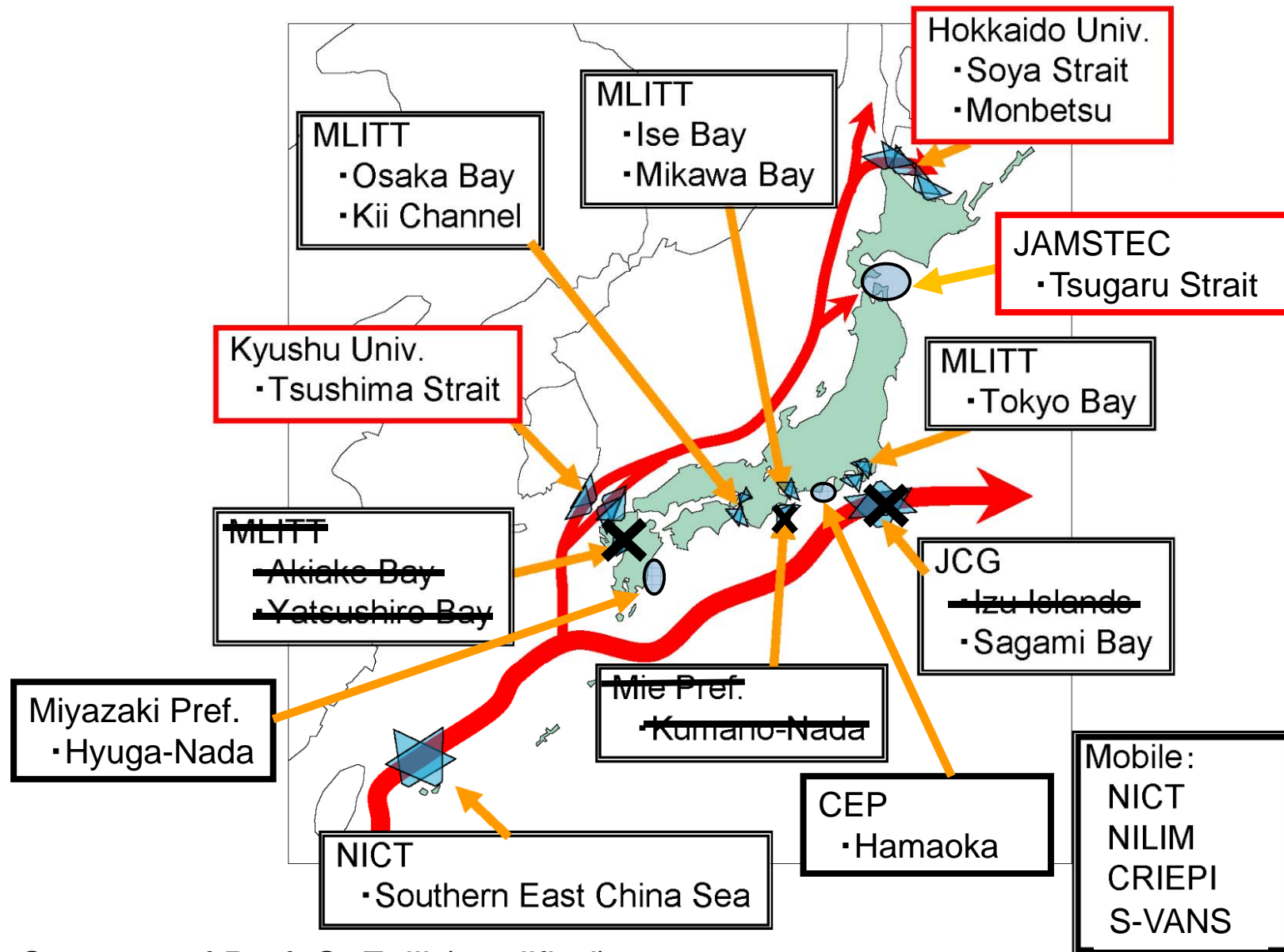


# Growth in Europe



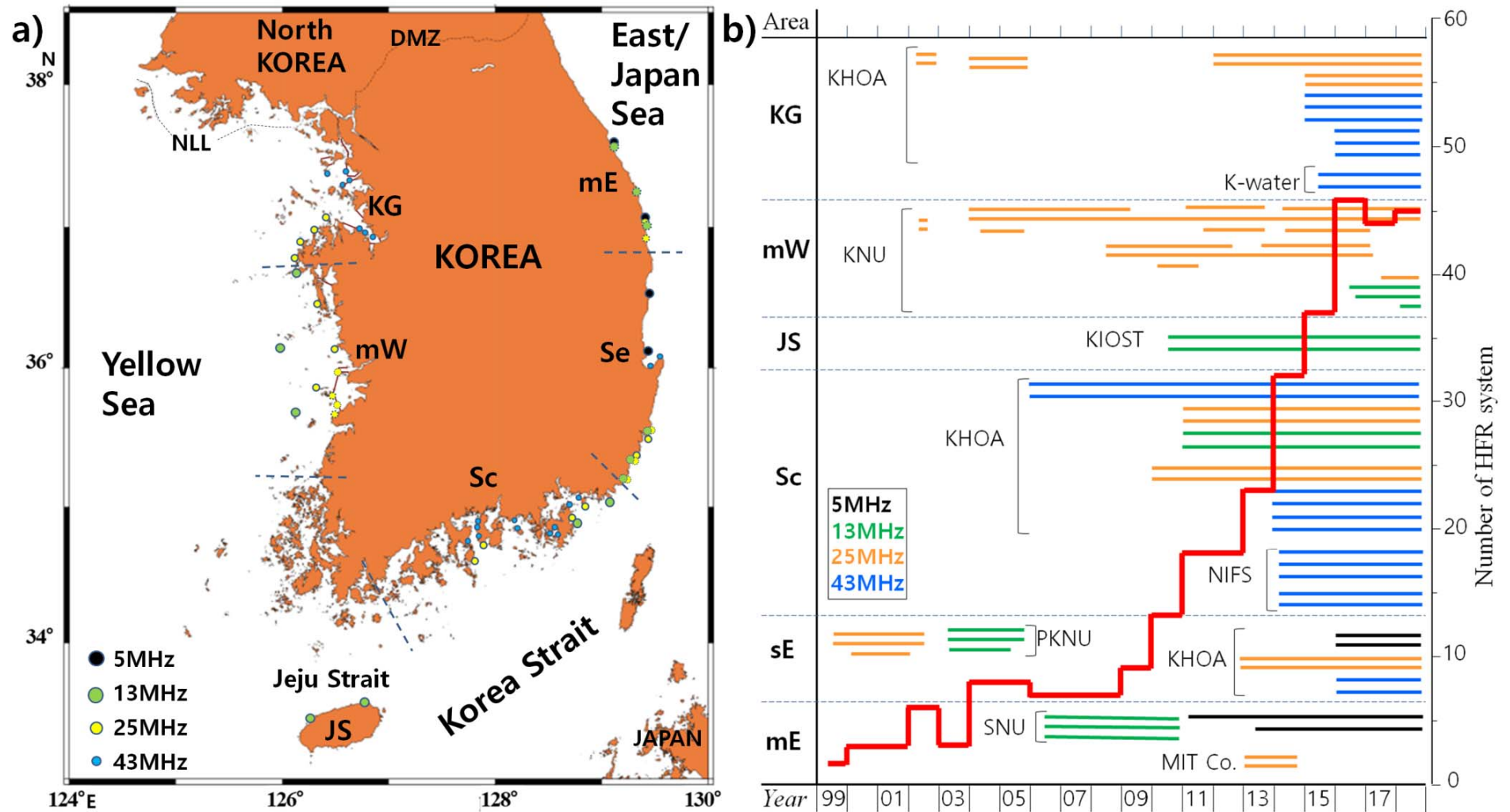


# HFR in Japan

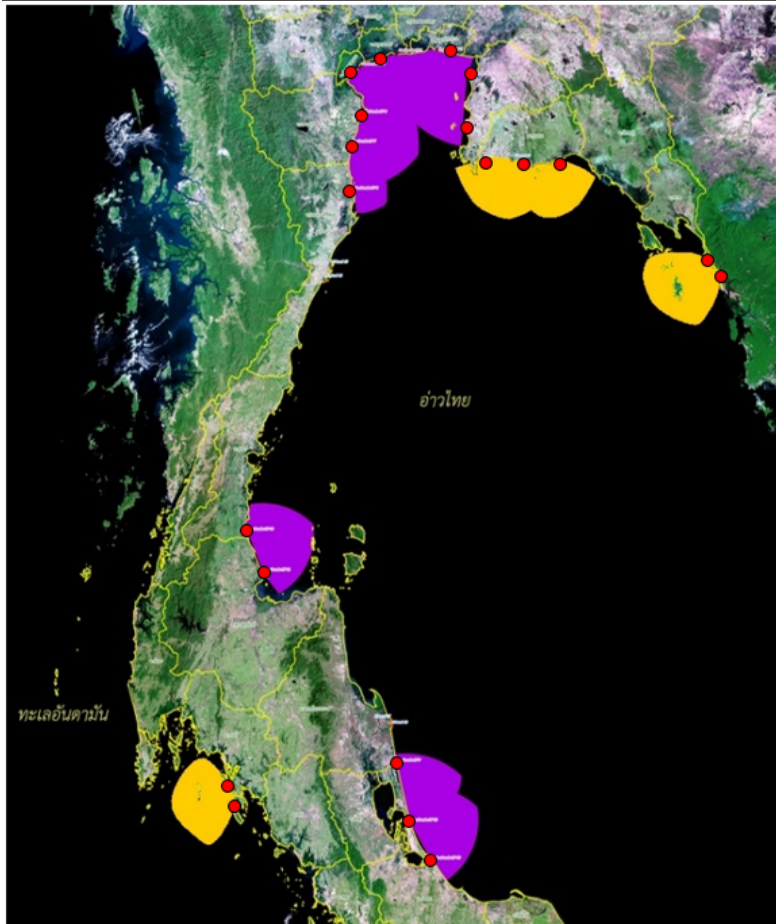


Courtesy of Prof. S. Fujii (modified)

# Growth in Korea



# HFR in Thailand

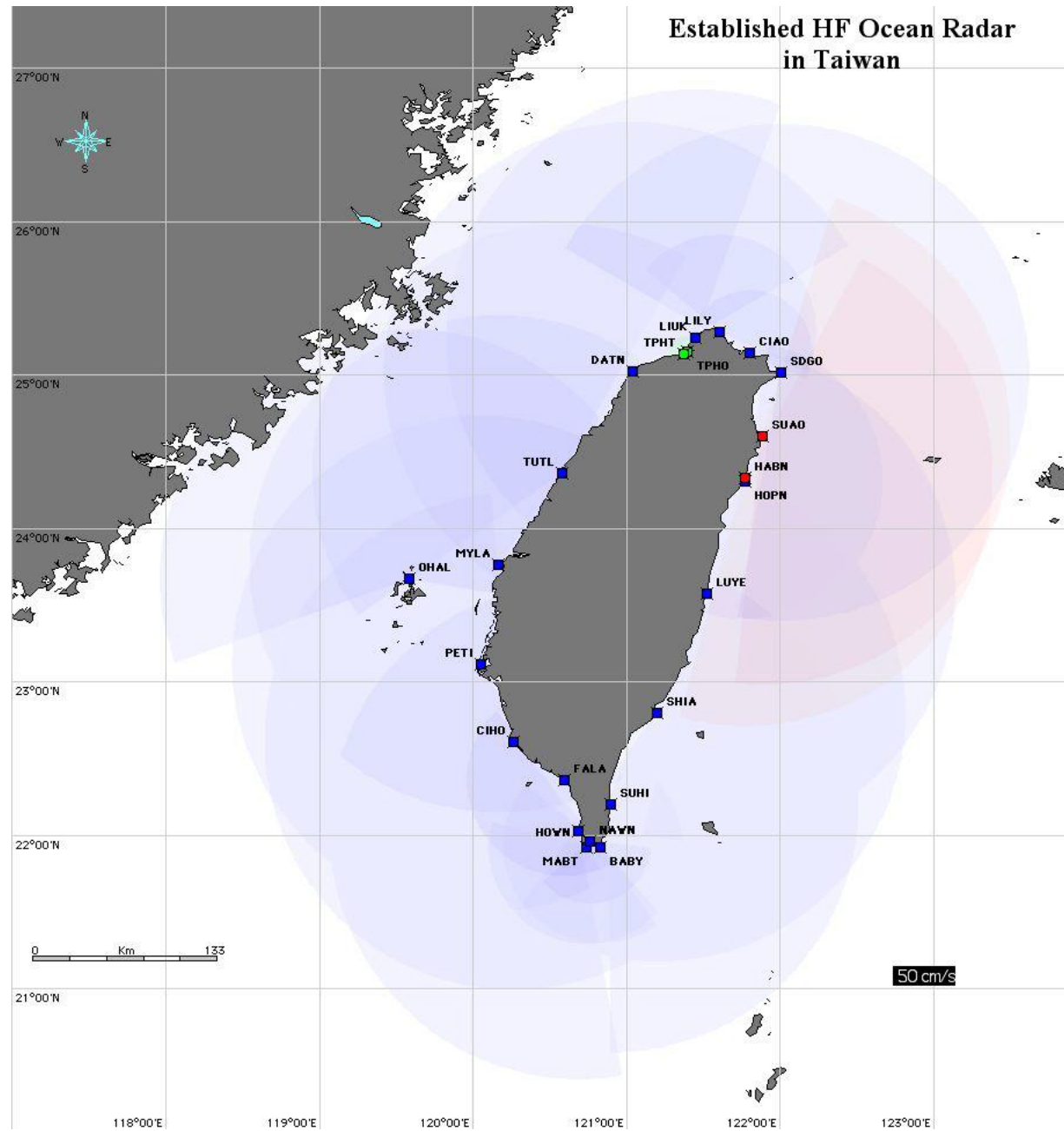


Coastal radar stations (Purple is phase 1 and yellow is phase 2)



Picture of coastal radar station installed in the area

# Established HF Ocean Radar in Taiwan





# Community White Paper on the Global HFR Network



Roarty H. et al., “The Global High Frequency Radar Network.” *Frontiers in Marine Science*, 6:164. doi: 10.3389/fmars.2019.00164, May 2019

## The Global High Frequency Radar Network

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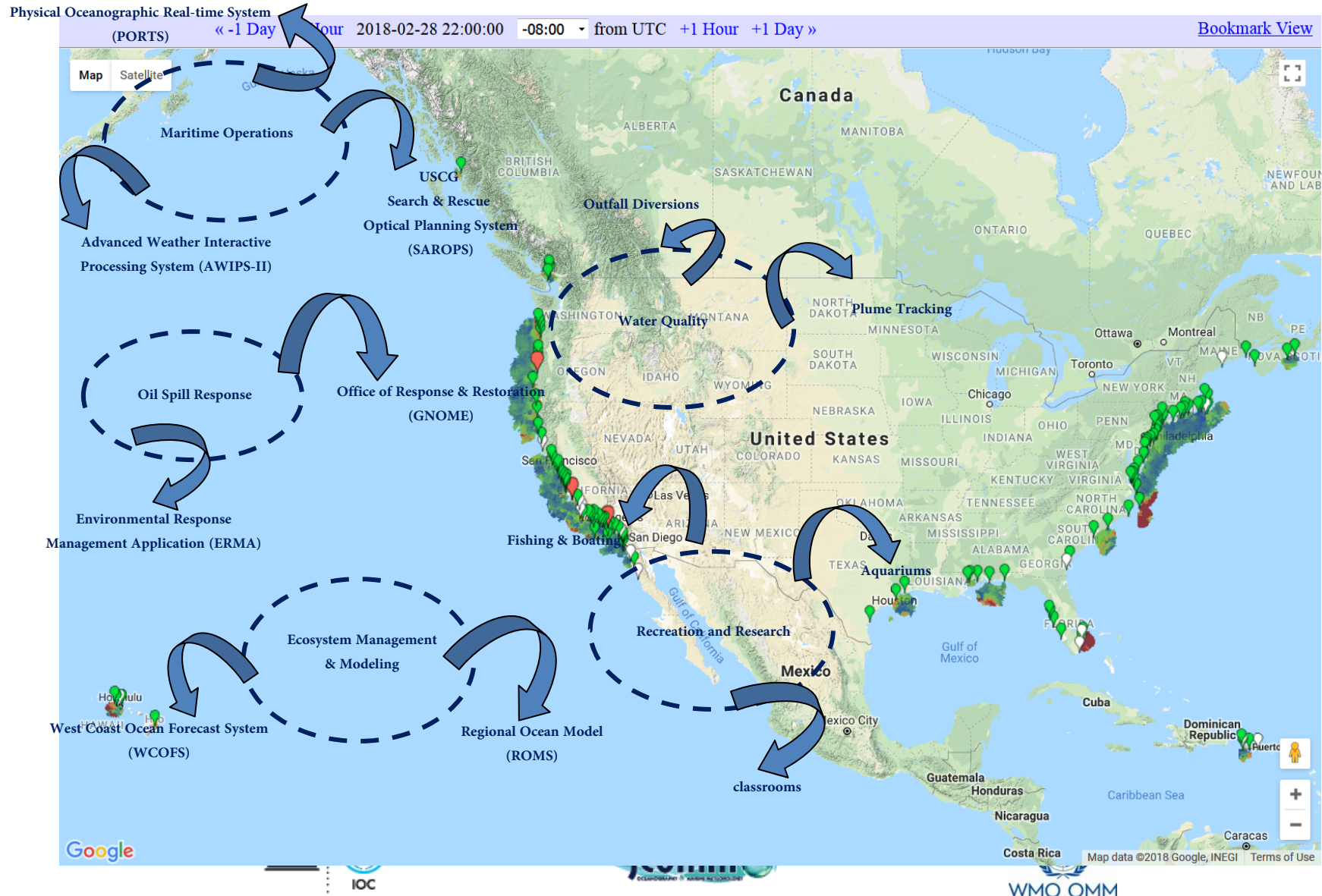
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Academic, government, and private organizations from around the globe have established High Frequency radar (hereinafter, HFR) networks at regional or national levels. Partnerships have been established to coordinate and collaborate on a single global HFR network (<http://global-hfradar.org/>). These partnerships were established in 2012 as part of the Group on Earth Observations (GEO) to promote HFR technology and increase data sharing among operators and users. The main product of HFR networks are continuous maps of ocean surface currents within 200 km of the coast at high spatial (1–6 km) and temporal resolution (hourly or higher). Cutting-edge remote sensing technologies are becoming a standard component for ocean observing systems, contributing to the paradigm shift toward ocean monitoring. In 2017 the Global HFR Network was recognized by the Joint Technical WMO-IOC Commission for Oceanography and Marine Meteorology (JCOMM) as an observing network of the Global Ocean Observing System (GOOS). In this paper we will discuss the development of the network as well as establishing goals for the future. The U.S. High Frequency Radar Network (HFRNet) has been in operation for over 13 years, with radar data being ingested from 31 organizations including measurements from Canada and Mexico. HFRNet currently holds a collection from over 150 radar installations totaling millions of records of surface ocean velocity measurements. During the past 10 years in Europe,

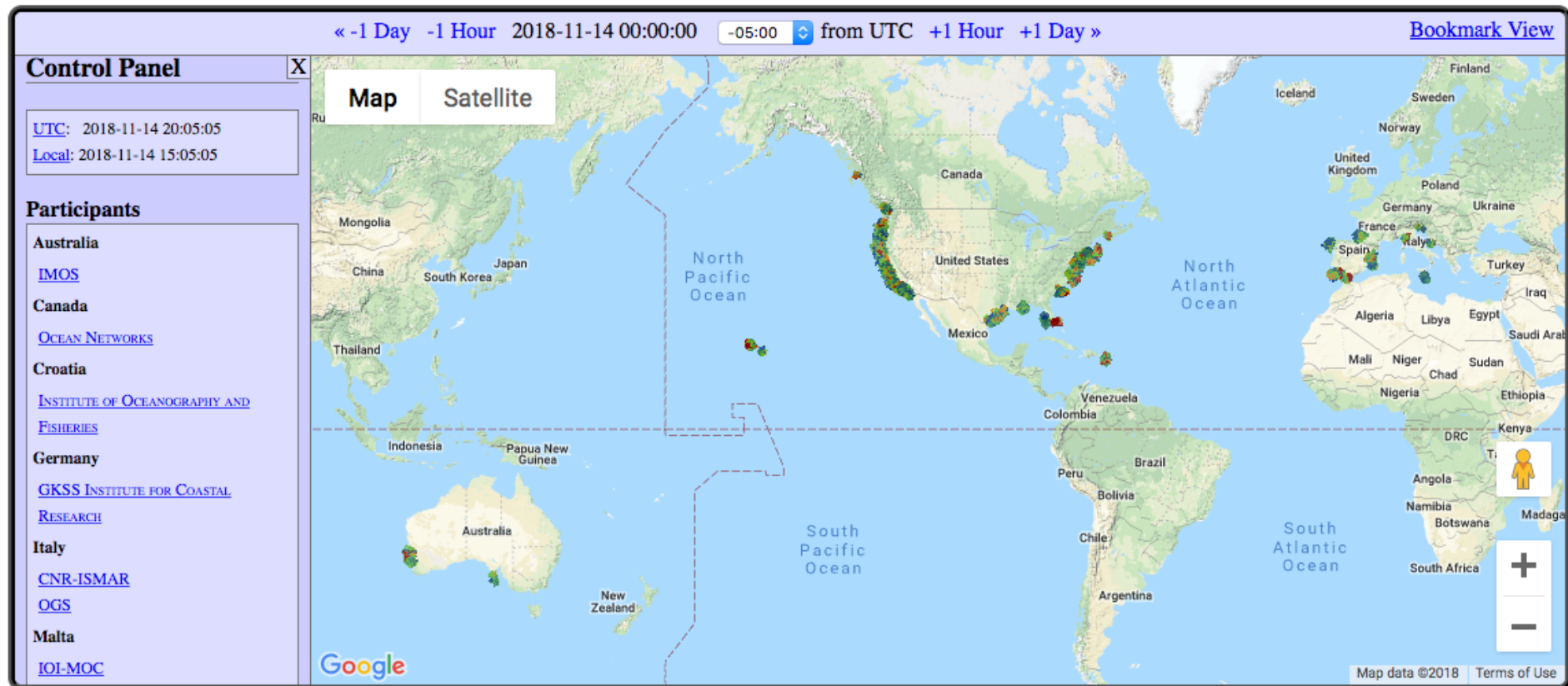


# Operational Integration - United States



# Network Update

- >350 stations operating in
- 35 countries with
- 9 countries sharing surface current data



<http://global-hfradar.org>



# HF Radar – Surface Currents Data Sharing

	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)

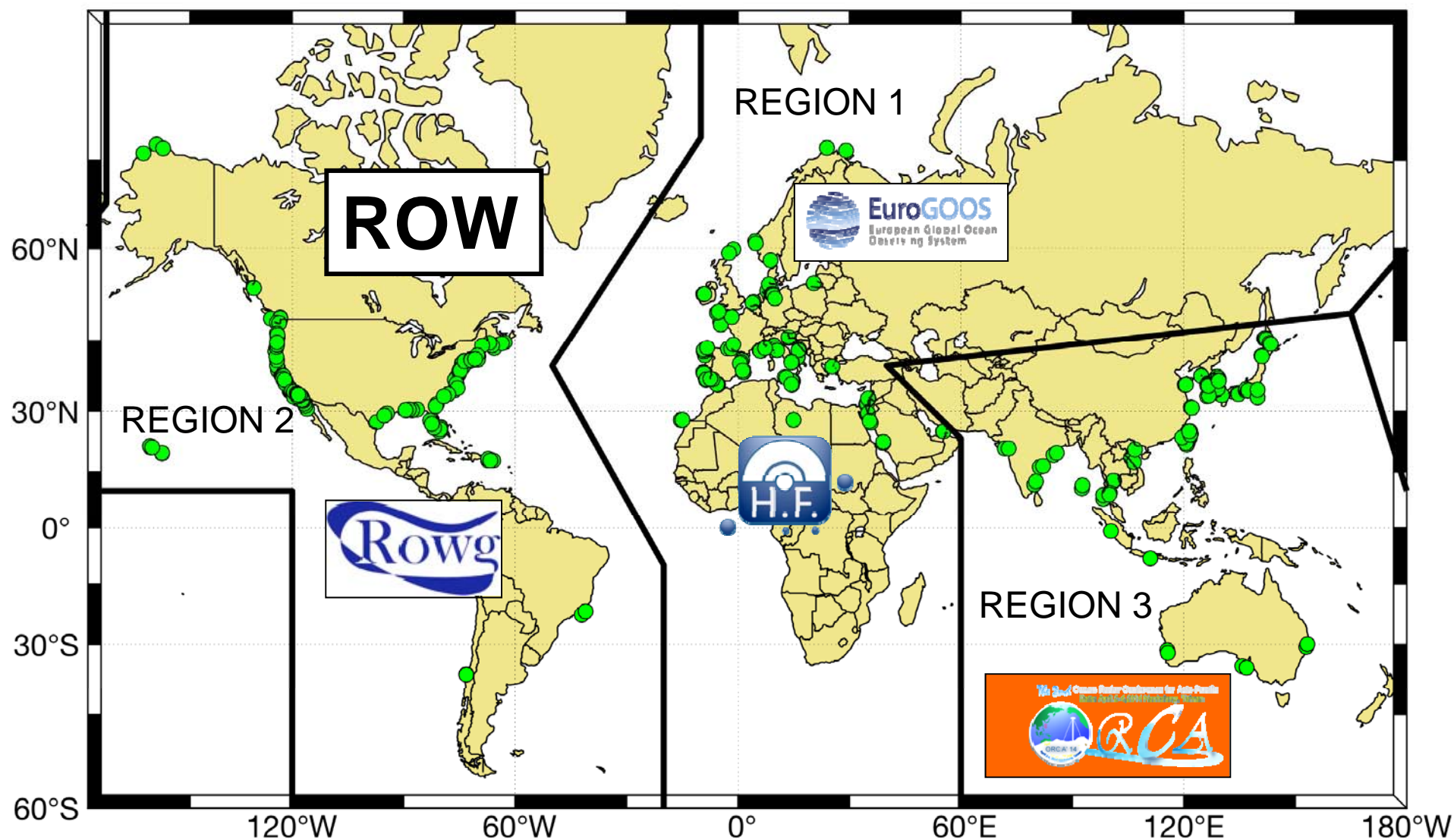
[Global Shared Data Repository](#) – European Marine Observation and Data Network (EMODnet)

[Global Shared Data Visualization](#) – google map visualization





# Opportunities for Coordination



WMO OMM



# International Radiowave Oceanography Workshop (ROW)

Homepage for [radiowaveoceanography.org](http://radiowaveoceanography.org)

[Home](#) [Registration](#) [Abstracts](#)



**ISSOR**

International Summer School  
On Radio-oceanography

ROW 2019

<http://paduan.org/row/>

Dear  
Colleagues:

We are pleased  
to announce  
two coordinated  
scientific  
meetings based  
on the use of  
high frequency  
(HF) radar for  
oceanography:

The  
International  
Summer School  
On Radio  
oceanography  
(ISSOR; 25-28

August 2019) The Radiowave Oceanography Workshop 2019 (ROW2019; 28-30 August 2019)

These events will take place back-to-back during this period in Victoria, B.C. CANADA. Our hosts will be Ocean Networks Canada at the University of Victoria.





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## Summer school on HF and X-band radars

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ISSOR'19

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**WELCOME** <https://radarschool.sciencesconf.org/resource/page/id/5>



In the framework of ANR HYD2M (P.I: A.-C. Bennis) concerning the impacts of wave-current interactions on tidal stream energy estimation, we plan to install four phased array HF radars (operated by Caen University), one VHF radar (operated by Caen University, CNAM-Intechmer and MIO) and one X-band radar (operated by DCNS) in Cap de la Hague to measure surface currents and sea states in Alderney race where the strongest tidal current in Western Europe occurs (up to 12 knots). It is a challenge to operate HF, VHF and X-band radars in such hydrodynamic conditions.

With this in mind, we have organised a summer school on HF and X-band radars.





# Summary

- The Global High Frequency Radar Network is now expanding over 35 countries and 350 radars. 9 countries are sharing data via the global network (<http://global-hfradar.org/>).
- HFR technology can be found in a wide range of applications: for marine safety, oil spill response, tsunami warning, pollution assessment, coastal zone management, tracking environmental change, numerical model simulation of 3-dimensional circulation, and research to generate new understanding of coastal ocean dynamics.
- The Global HFR Network is an example of national inter-agency and inter-institutional partnerships for improving oceanographic research and operations.
- As global partnerships grow, these collaborations and improved data sharing enhance our ability to respond to regional, national, and global environmental and management issues.
- An active global HFR network is crucial for pushing forward HFR scientific developments, promoting training activities, encouraging the integration of the HFRs into operational maritime monitoring and environmental assessment, and boosting networking toward an integrated, evolving and sustained HFR global network over the next decade.





# Questions?

Send them to Hugh, [hroarty@marine.rutgers.edu](mailto:hroarty@marine.rutgers.edu)

