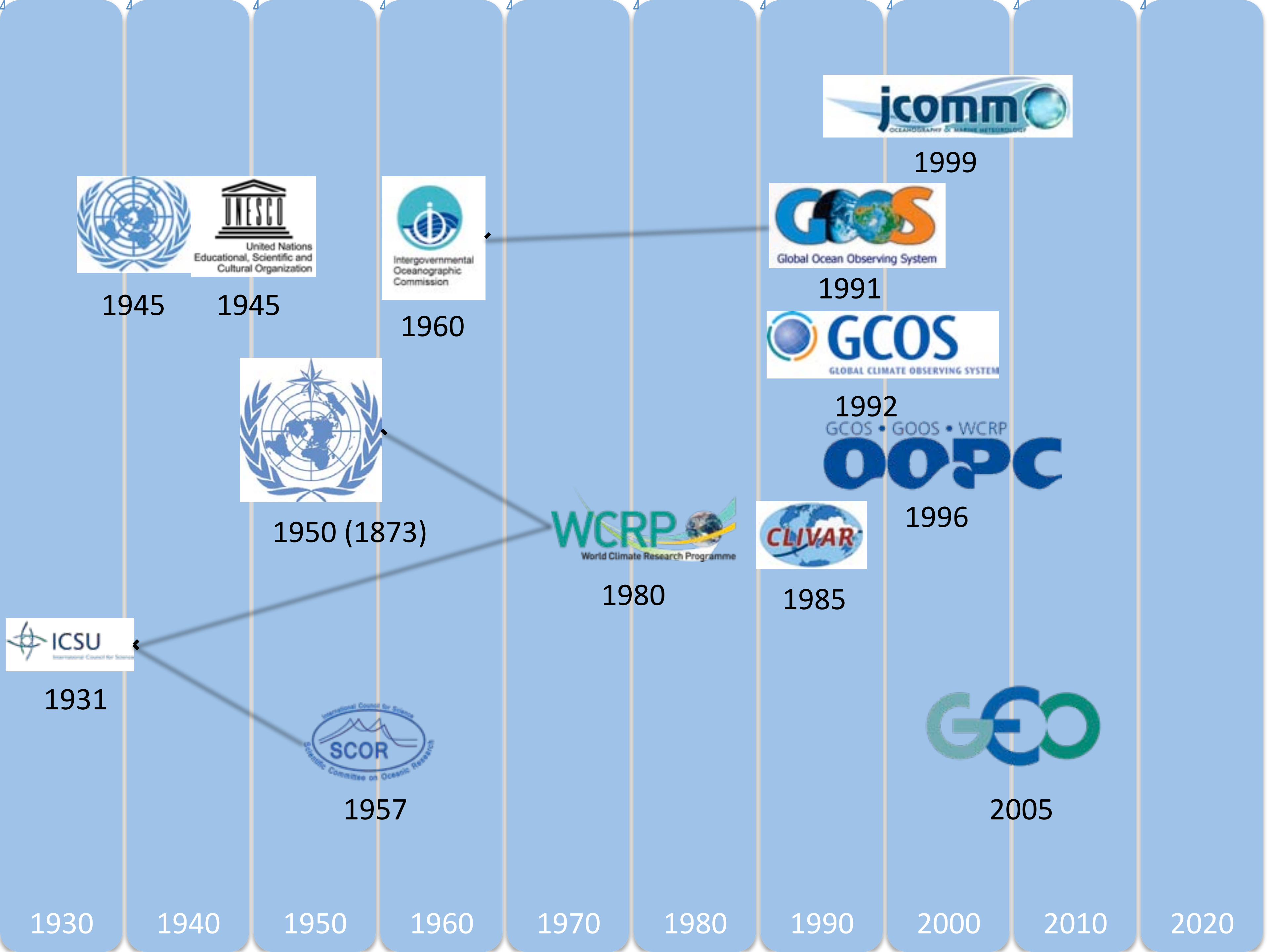
HF Radar as a New Observing Element of GOOS

December 12, 2016

Dr. Hugh Roarty



jcomm
1999
United Nations Educational, Scientific and Cultural Organization
1945
1945
Intergovernmental Oceanographic Commission
1960
Global Ocean Observing System
1991
GCOS
GLOBAL CLIMATE OBSERVING SYSTEM
1992
GCOS • GOOS • WCRP
OOPC
1996
1950 (1873)
WCRP
World Climate Research Programme
1980
CLIVAR
1985
ICSU
1931
SCOR
Scientific Committee on Oceanic Research
1957
GEO
2005
1930
1940
1950
1960
1970
1980
1990
2000
2010
2020

What is the GOOS?

Gliders

Regional Marine Instrument Centre (RMIC)

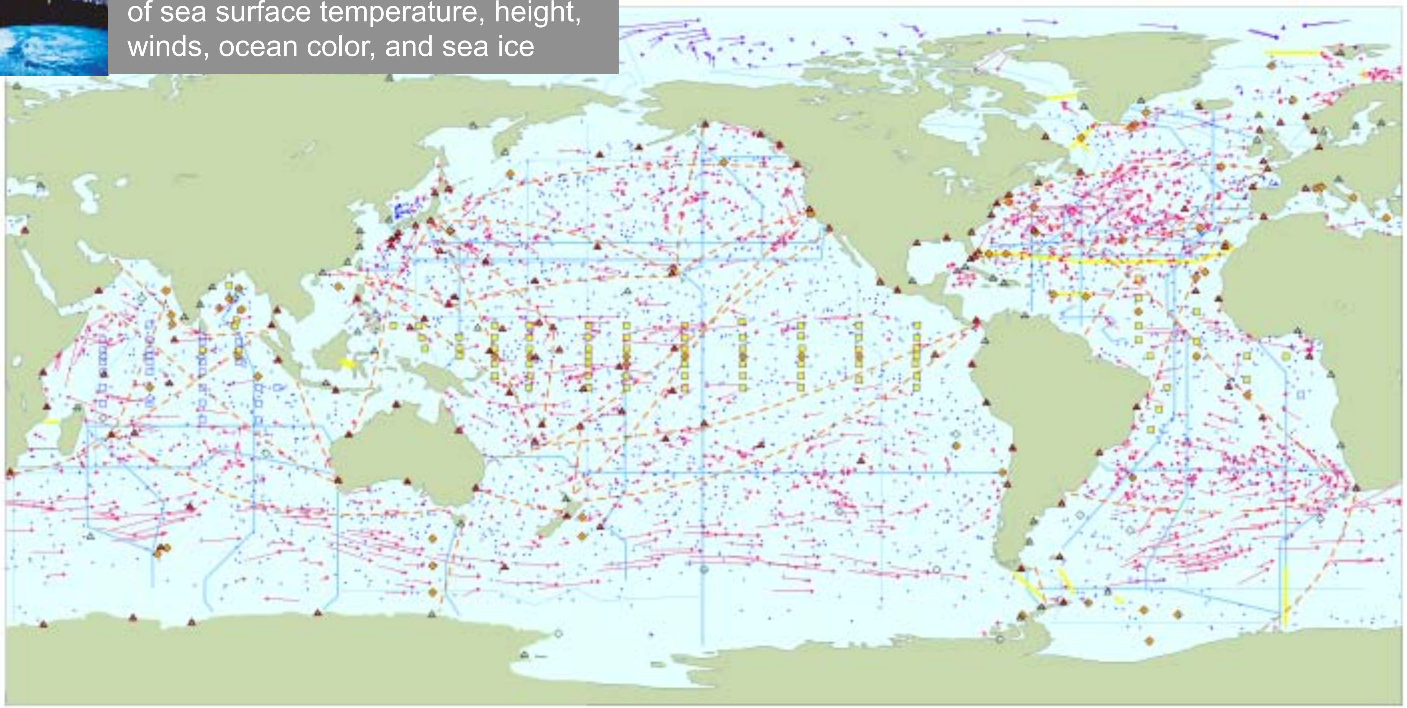
OSMC Observing System Monitoring Center

Coastal Networks
GOOS Regional Alliance

Recent Interaction with JCOMM OCG

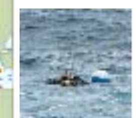
Total in situ networks 66% Dec 2015

continuous satellite measurements of sea surface temperature, height, winds, ocean color, and sea ice



100% **Surface measurements** from volunteer ships (VOS)

250 ships in VOSclim pilot project



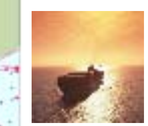
100% Global **drifting surface buoy** array

ice buoys

5° resolution array: 1250 floats

40% **Tide gauge** network (GLOSS committed)

Fast data Slow/no data GPS 300 real-time reporting gauges



37% **XBT** sub-surface temperature section network

37000 XBTs deployed

100% Argo **profiling float** network

3° resolution array: 3200 floats

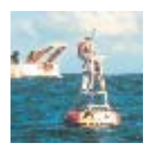
62% Repeat **hydrography** and **carbon inventory**

(Planned)

Full ocean survey in 10 years

70% Global **time series** network

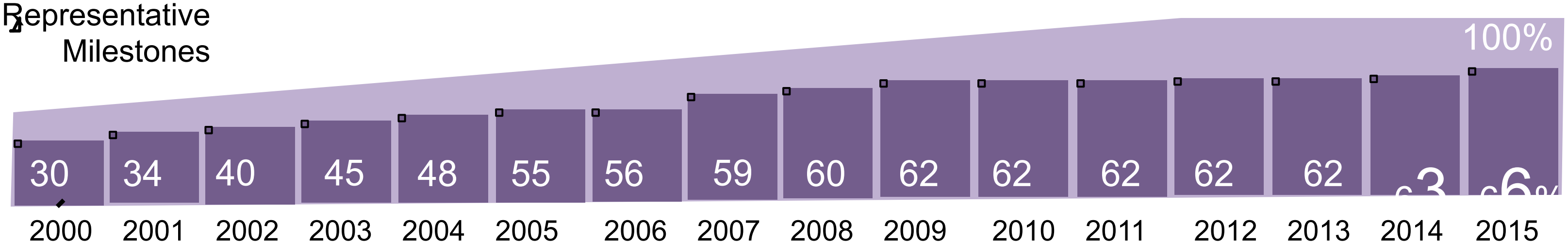
87 combined sites



71% Global tropical **moored buoy** network

125 moorings planned

Representative Milestones



Original goal for full implementation by 2010

System % sustained, of initial goals

GEO, the Group on Earth Observations

An Intergovernmental group with 99 Members and 87 Participating Organizations

U.S. Department of State, Washington DC
July 31, 2003

Space-based Assets

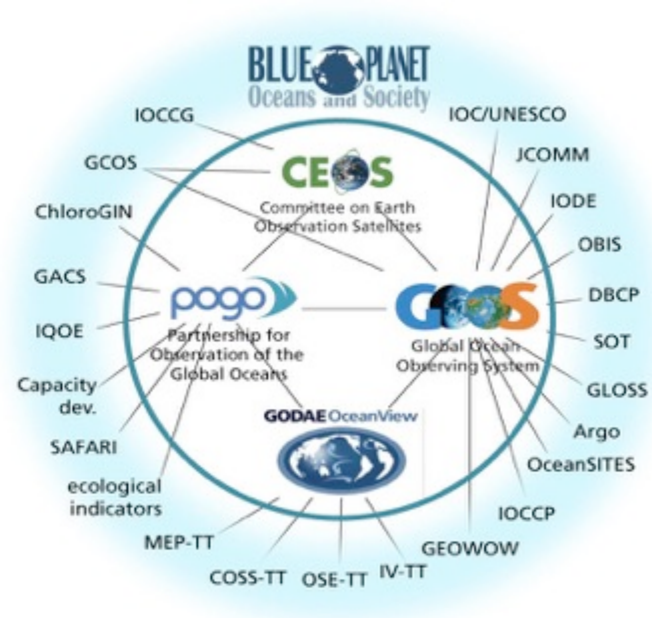
Source GEO Secretariat

87 Participating Organizations

Bridging Ocean Communities

(Australia, Canada, EC, UK, USA, CEOS, GCOS, GOOS, IOC, POGO, UNESCO, WMO)

- Mobile App (AIP-7)
- Crowd sourcing on Species
- Regional Research Projects
- Scholars Trained
- New Website
- 2015 Blue Planet Symposium
- Trans-Atlantic EC-US Canada Initiative



IOC © G

Timeline

- Sep 2015 – 4th Global HFR Meeting, GOOS RA
- Apr 2016 – JCOMM OCG/OOPC
- Jun 2016 – GOOS Steering Committee
- Dec 2016 – 5th Global HFR Meeting
- Feb 2017 – GOOS Steering Committee
- Mar 2017 – OOPC

Observations Coordination Group (OCG) Seventh Meeting

COASTAL: HF Radar

~~31.~~32. ACTION: DBCP to consider whether the -HF Radar should be considered as part of the DBCP Waves pilot project in part to address questions regarding validation of HF Radar wave information (Jon Turton)

~~32.~~33. RECOMMENDATION: Several p~~P~~otential activities between HF Radar and JCOMM OCG, ~~points of collaboration with JCOMM~~ (to be discussed, elaborated) were identified:~~.~~

- Standards and best practices (potential for OCG to review/approve HF Radar guides)~~.~~
- Calibration/ validation, and quality control. (see Action 32)
- Engaging in DBCP Waves (PP-WET) [isn't the same as the previous bullet?]
- Engaging in the OOPC boundary current activity (action to be discussed with OOPC)
- Connection with Services Area (ETWCH/ETOOFS) (action to be discussed with DMSFA)~~.~~

34. ACTION: HF Radar Team and JCOMM OCG exec to consider whether JCOMM HF Radar to be proposed as a Joint JCOMM/GEO group.

~~33.~~35. ACTION: Review ocean applications part on HF radar in WMO Statement of Guidance (Guimei and Hugh)

SOCIB....

7. Engaging new networks.

~~34.~~36. ACTION: Liaise with Animal Telemetry N~~n~~etwork to discuss potential/need for ~~global~~ coordination activity for JCOMM OCG interactions with ATN 'animals as platforms for concern'

Essential Climate Variables (ECVs)
Essential Ocean Variables(EOVs)

			Carbon dioxide partial pressure	Cloud properties	Nutrients	Ocean acidity	Ocean colour	Oxygen	Phytoplankton.	Precipitation	Pressure	Sea ice	Sea level	Sea state	Tracers.	Water vapour	Wind speed and direction	Currents	Heat flux/radiation	Ocean Surface Vector Stress	Radiation Budget	Salinity	Temperature
Essential Climate Varibale	Atmospheric	Upper Air		■												■	■				■		■
		Surface								■	■					■	■				■		■
	Oceanic	Surface	■			■	■		■			■	■	■				■				■	■
		Sub-Surface	■		■	■		■							■			■				■	■
Essential Ocean Varibale	Oceanic	Surface										■	■	■				■	■	■		■	■
		Sub-Surface																■				■	■

GOOS Strategic Mapping

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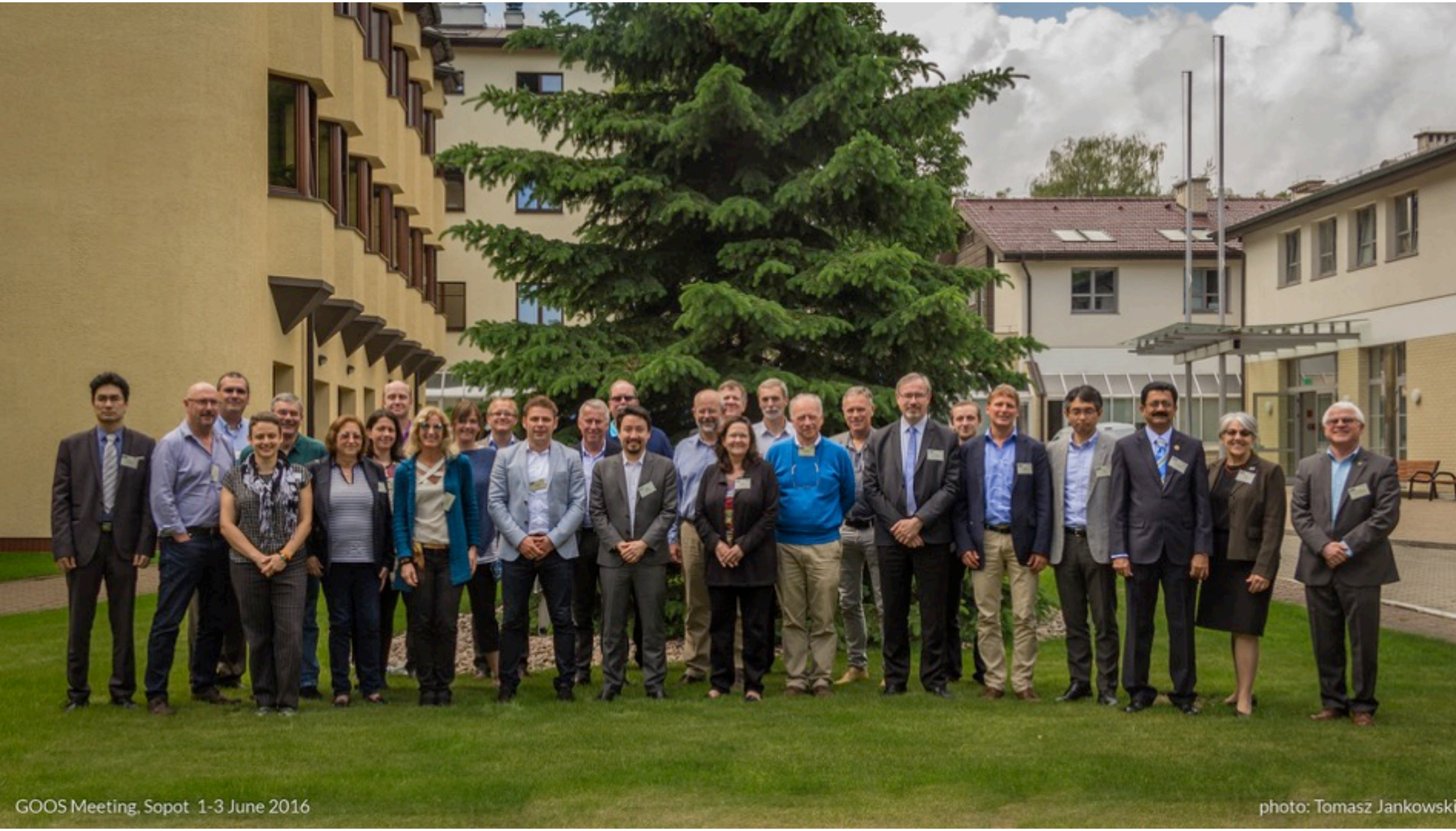
GOOS Steering Committee



Observing System/Element Specification: International High Frequency Radar

Introduction/Motivation for Element/Network Design

Ocean currents determine the movement of surface waters, providing critical information to support pollutant tracking, search and rescue operations, harmful algal bloom monitoring, vessel navigation, ecosystem-based management, and marine spatial planning. High frequency radar technology (known as "HF radar" or simply "HFR") is recognized as a cost-effective solution to augment the existing *in-situ* measurements with unprecedented spatial and temporal resolutions. Through the Group on the Earth Observation (GEO), the Global HF Radar task worked to connect the many countries operating HF Radar and to support the transition of these systems to a sustained effort. The technological infrastructure is scalable to go global, and is something we can pursue. The use of High Frequency radar by the United States Coast Guard has reduced search areas by 66% after 96 hours. Assimilation of High Frequency radar data into ocean models has reduced forecast error by 30%.

Brief History

There are approximately 380 High Frequency radars operating in 36 countries around the globe, located as appropriate based on their requirements. The United States, through the Integrated Ocean Observing System (IOOS); Australia, through the Integrated Marine Observing System (IMOS); and Spain, through Puertos del Estado, have all set up HFR networks that are now providing sustained measurements being used by operational programs. EUROGOOS has set up an HFR task team with similar purposes in Europe. The Ocean Radar Community for Asia-Pacific Rim formed recently formed to promote the exchange of technology, development and research in ocean radar among Asian countries. The island of Taiwan was an early adopter of HF radar and was the first to have a fully operational network. The GEO and international community has formed to share best practices on data management and further integration of the data into models and new products and services.

Objectives

- Promote the extension of the use of the HF radar technology
- Ensure that HF radar data is available in a single standardized format in real-time
- Establish worldwide quality standards
- Distribute a set of easy to use standard products
- Assimilate the data into ocean and ecosystem models
- Develop emerging uses for the data obtained with this technology

Design and Data

The coastal networks must be designed by individual countries and/or national observing systems to meet their requirements. The United States, IOOS program has a requirement that the 6 km surface current

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ABSTRACT

The contributions of autonomous underwater gliders as an observing platform in the *in-situ* global ocean observing system (GOOS) are investigated. The assessment is done in two ways: First, the existing *in-situ* observing platforms contributing to GOOS (floats, surface drifters, moorings, research/commercial ships) are characterized in terms of their current capabilities in sampling key physical and bio-geochemical oceanic processes. Next the gliders' capabilities are evaluated in the context of key applications. This includes an evaluation of 140 references presented in the peer-reviewed literature.

It is found that GOOS has adequate coverage of sampling in the open ocean for several physical processes. There is a lack of data in the present GOOS in the transition regions between the open ocean and shelf seas. However, most of the documented scientific glider applications operate in this region, suggesting that a sustained glider component in the GOOS could fill that gap.

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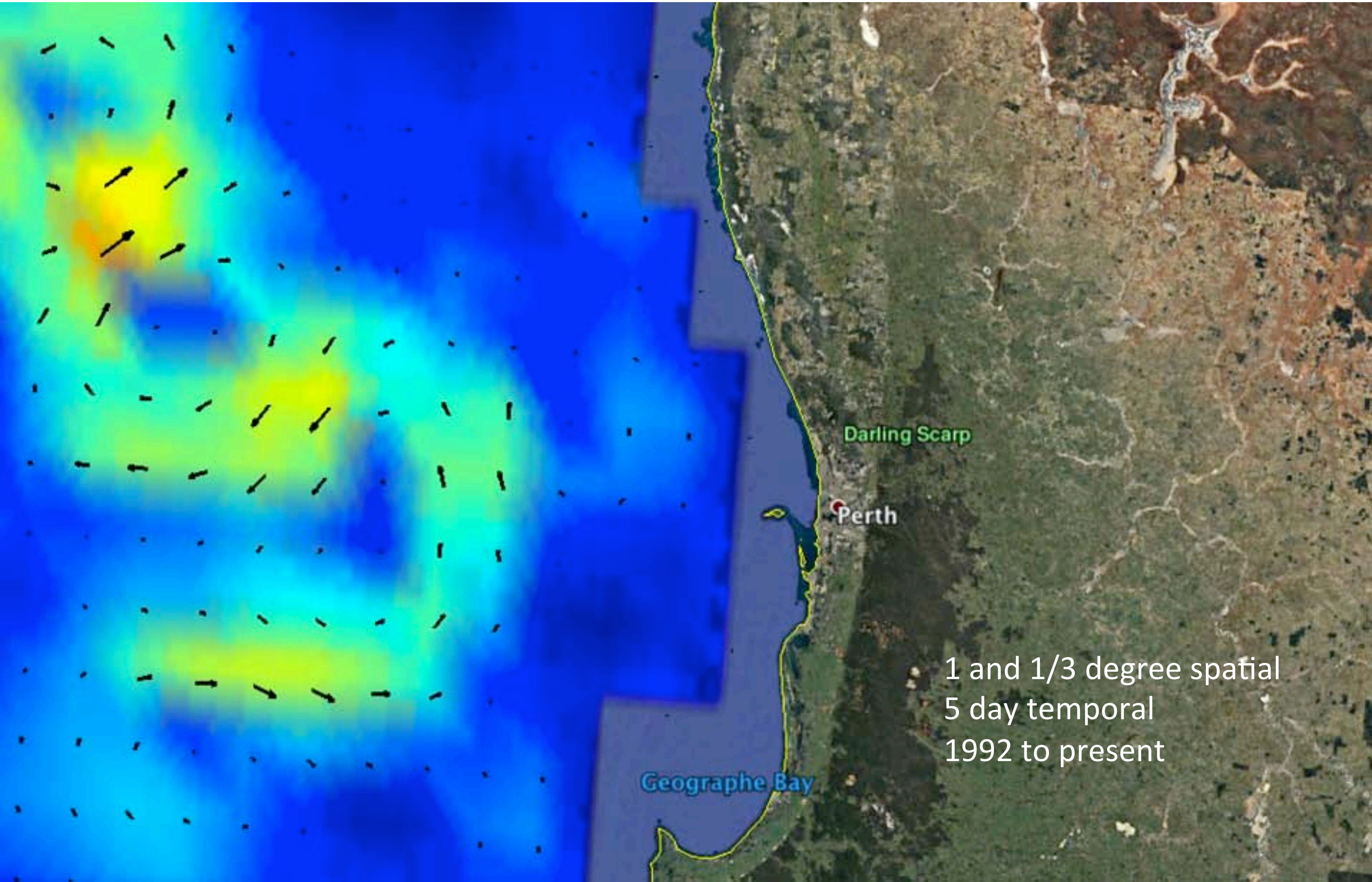
NASA OSCAR Product



1 and 1/3 degree spatial
5 day temporal
1992 to present