# 15th Observation Coordination Group (OCG-15)

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# GOOS Network OCG-15 Report: High Frequency Radar Networks

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## 1. Highlight the key network successes

*Region 01 (Europe, Africa, Middle East):*

- Publication of the EU HFR Node website (https://www.hfrnode.eu/)
- Allocation of WMO platform codes to the European HFR stations and integration of wmo_platform_code global attribute in HFR radial datasets.
- Allocation of DOIs to all the connected HFR networks (https://www.hfrnode.eu/networks/ ).
- The European High-Frequency Radar Node REST-API streamlines M2M discovery of updated metadata from European HFR stations
- Periodic newsletters to keep the community updated on the latest findings, ongoing initiatives and projects and to boost interactions and collaborations.

*Region 02 (North and South America):*

- Nine new site installations
    - Single antenna long-range CODAR SeaSonde® HF Radar at Salisbury Beach State Reservation in Massachusetts (SBSR)
    - CARICOOS HF-radar network has been expanded with the addition of two new mid-range CODAR SeaSonde® HF-radar systems located in Toa Baja and Fajardo
    - Installation of a long-range CODAR SeaSonde® at Jennette's Pier in Nags Head, NC (JENN). The work is a component of a NASA Surface Water & Ocean Topography (SWOT)
    - Texas A&M's Geochemical and Environmental Research Group recently installed a new station at Port Mansfield, TX (PMGC).
    - Research, Applied Technology, Education Services, Inc. (RATES)is working to fill data gaps in Texas Bays. RATES has installed five new

radars in Texas since the beginning of 2023 — three in Galveston Bay and two stations in Sabine Lake.
    - SECOORA HFR teams at ECU and UNC on their restored the "OCRA" HFR station at Ocracoke, North Carolina (OCRA. OCRA was originally established as part of the NSF-funded PEACH project but was destroyed during Hurricane Dorian in August 2019
    - SCCOOS personnel installed a new standard-range CODAR Seasonde at Channel Islands National Park (CINP).
    - University of South Florida installed a low-power long range HFR at Fort Jefferson Dry Tortugas National Park (JEFF).
    - CARICOOS has installed the first High-Frequency Radar (HFR) in the U.S. Virgin Islands on Water Island, St. Thomas. (THOM)
- HF radar installations are planned for the coast of Louisiana. The radar measurements value at the local and regional level was the impetus for the installations.
- The spatial coverage of the Short-Term Prediction System (STPS) which utilizes HF radar surface current measurements for the prediction was expanded nationally.
- A workable solution has been devised to mitigate interference from offshore wind turbines. This includes adjusting the radar operating parameters and updating software as well as working with the Bureau of Ocean Energy Management to include the requirement that additional non HF radar sensors be embedded within offshore wind farms to supplement the HF radar measurements and allow for cross comparison validation and correction.
- Ocean Networks Canada (ONC) continues to manage one WERA radar and ten CODARs (two of them belonging the federal Department of Fisheries and Oceans) on the west coast of British Columbia. ONC is also archiving data from two CODAR stations, SCOV and MEDH, which are co-owned by Dalhousie University and Defence Research and Development Canada (DRDC) and operated by Dalhousie University. The long-awaited move of ONC's VION CODAR 4 km seaward was finally accomplished in January, 2024. The range of current measurements has increased by about a third; the improvement is expected to be even more evident once the spring freshet arrives, decreasing the salinity of the Strait of Georgia in May/June.
- In partnership with Fisheries and Oceans Canada, Ocean Networks Canada held a High-Frequency Radar workshop (March 20-21, 2023). The workshop covered the practical uses that HF Radars offer for operational activities in coastal regions. Participants included various departments within the Federal Government who have shown an interest in HF Radars use.

*Region 03 (Asia and Oceania):*

- The annual meeting of HFR user communities in ***Japan*** was held December 19-20, 2023 in Fukuoka. The theme for the meeting was "Development and Application of Sea State Monitoring System using Ocean Radars". There were

12 presentations. At present, approximately 40 HF ocean radars are in operation in Japan.

- In ***Taiwan***, on September 18, 2023, a government cross-departmental expert consultation meeting was organized, inviting representatives from 14 departments to engage in discussions on the operation and data application of ocean radars to their respective administrative areas. The aim was to harness collective wisdom and build a consensus on the operation and application of an integrated ocean radar observation network. From 2025, a plan is scheduled to be put forward for a more complete and socially beneficial ocean radar observation network for the seas around Taiwan. Furthermore, on October 23 and 24, 2023, the National Academy of Marine Research held an ocean radar workshop targeting industry, government, academia, and research participants, with over 80 people in attendance and 12 presentations related to ocean radar given during the event.
- Currently, the use of HFR network in ***Thailand*** has been widely used. The system is developed to respond to marine and coastal management for the government, private and coastal communities. The HFR system in Thailand can be viewed at http://coastalradar.gistda.or.th/. There are 18 HFR stations along the Gulf of Thailand and the Andaman Sea. In the past 15 years, there have been many cases of successful use of this system, such as oil spills management in the gulf of Thailand and coastal erosion risk assessment etc.

**2. How has the network advanced across the OCG Network Attribute areas[1]**

*Region 01 (Europe, Africa, Middle East):*

- Integration of new networks in the operational workflow for the distribution of Near Real Time and Delayed Mode surface current datasets: HFR-Vestlandet (Western Norwegian Coast), HFR-ICATMAR (Catalunya), HFR-Granitola (Sicily Channel).
- Periodic revision/update of the documentation of the European standard HFR data model (available on the OBPS repository at https://doi.org/10.25607/10.25607/OBP-944.2).
- Setup and publication of the ERDDAP Data Server for discovery and access of Near Real Time surface current data ( https://erddap.hfrnode.eu )
- Development and entry in service of the new Python3 toolbox for the operational workflow for the distribution of Near Real Time and Delayed Mode surface current datasets (https://github.com/LorenzoCorgnati/EU_HFR_NODE_pyHFR ).
- Improvement of the operational monitoring of the European network: Operational map and outage reporting tool HOORT available on the EU HFR Node website.

*Region 02 (North and South America):*

[1] https://oceanexpert.org/downloadFile/45372

- The 13th Radiowave Operators Working Group will take place May 21-23, 2024. The charter of ROWG is to foster collaboration between new and experienced HF radar operators.
- Radiowave Oceanography Workshop 2024 (ROW2024) is scheduled for 03-05 September 2024 and will be held in Plymouth, U.K.
- Members from Region 1 and 2 held a video call with OceanOps in January 2024 to discuss implementation of the OCG data strategy.
- The NOAA Ocean Technology Transfer (OTT) Program awarded a program to CODAR Ocean Sensors "Improving HF Radar Ocean Observation with Artificial Intelligence". The goal of this project is to address long standing needs identified by high-frequency radar data producers and users for more accurate observations, inclusion of measurement uncertainties, and more efficient calibration. Toward this end CODAR has developed and tested the application of open source AI methods to HFR signal processing. This project will transition this technology to a fully operational software system that is tested, validated, fully integrated in the SeaSonde software suite. The outcomes will improve the quality of available HFR data through the U.S. Integrated Ocean Observing System and other data-sharing entities.

*Region 03 (Asia and Oceania):*

**3. Future Plans[2] and Opportunities - at network and/or cross-network OCG level**

*Region 01 (Europe, Africa, Middle East):*

- Contribute in the Global Data Implementation Strategy to the HF Radar network, particularly looking at ERDDAP data services and the m2m exchange of metadata with OceanOPS
- Organize in person meeting as side event of the ROW Fall 2024 (3-5 September 2024)
- Design and development of advanced Quality Control procedures based on Artificial Intelligence and non velocity-based parameters.
- Development of added-value products (gap-filling, physical components of the surface field, FSLEs, other data from HF radars)
- Collaboration between European and US colleagues for improving hfradarpy toolbox and EU_HFR_NODE_pyHFR toolbox.

*Region 02 (North and South America):*

- A Request for Information was released regarding desired features of the upcoming replacement and upgrade of the IOOS Surface Currents Program's HFRNet data assembly center.

[2] Future plans on implementation, instrumentation, data management, test, new sensors, plan for new EOV/ECV observations, capacity development, etc.

- We contributed a section on HF radar to the WMO Handbook on Use of Radio Spectrum for Meteorology: Weather, Water and Climate Monitoring and Prediction
- Progress was made this year in advancing in a beta stage, measuring waves at a multi-regional scale.
- US IOOS is developing a server to deliver lower level data files (Range) from the HFR stations
- Ocean Networks Canada (ONC) are planning to deploy a low-power CODAR in an *APRS World* solar and wind-powered enclosure somewhere on the West Coast later this year. This will be a test deployment, intended to evaluate the practicality of running self-powered HF radars in remote locations. If successful, this trial may be the first step towards ONC establishing a chain of CODARs in Canada's arctic in years to come.
- The ***Mexican*** Radar Network was financed by the project Gulf of Mexico Large Marine Ecosystem GOM-LME (https://gulfmexico.org/) to operate 15 radar stations all along the Mexican shore of the southern Gulf of Mexico (2024-2027). One new site was installed in Cayo Arcas, a pristine cay (island) located about 150 km offshore in front of Cd del Carmen Campeche. You can see the site already operating here. We are working to bring our data available to the USA-Radar Network, trough IOS-GCOOS.

*Region 03 (Asia and Oceania):*

- Integrated Marine Observing System (IMOS, Australia) operational budget extended from 2023 to 2027
- IMOS - Ocean Radar Facility involved in supporting the installation of HFR systems in Niue, southern Pacific, as part of a bigger project funded and managed by the SPC

**4. Challenges and Concerns - at network and/or cross-network OCG level**

*Region 01 (Europe, Africa, Middle East):*

- Funding the Regional coordination and Node in Europe is still a challenge.
- Unlock HFR data potential: boost the integration of HFR data in data downstream services, engage end-users, more science-based from HFR observations, enhance the applications development, promote the development and delivery of operational added-value products.
- Unlock HFR data assimilation, crucial to improve the model performance; use HFR data to assess the SWOT satellite mission.

*Region 02 (North and South America*

- Proposed funding for the Regional Associations within the U.S. IOOS office budget is $10 million. This is a reduction of more than 76% from the budgets enacted in fiscal years 2023 and 2024. If enacted, funding at this level would cripple the nation’s HF radar observations.

- The Mexican Radar Network stations in the Caribbean were vandalized, however we will rebuild them later this year.

*Region 03 (Asia and Oceania):*
- The Ocean Radar Conference for Asia (ORCA) did not take place this year on its anticipated 4 year cycle.
- Still difficult to engage Asian community in the Global HFR network

**5. Asks from OCG (Exec, networks, OceanOPS, and/or GOOS), perhaps related to the responses to parts 3 and 4 and how OCG can support your network**

*Region 01 (Europe, Africa, Middle East):*
- Coordination on Regional networks integration

*Region 02 (North and South America*
- Help networks discuss the treatment of lower level data files (archiving, developing value for the data, use in reprocessing
- Help sponsor the development of a standard for a radial velocity file and total vector file
- Sponsor the development of a international database of HFR station locations and parameters similar to the weather radar database https://wrd.mgm.gov.tr/Home/Wrd

*Region 03 (Asia and Oceania):*

**6. Recent publications, articles, etc. (if you want to share)**

https://www.zotero.org/groups/2601948/eurogoos_hfradar_taskteam

24 presentations at Ocean Sciences 2024 utilizing HF radar measurements
Here is a link to a compiled listing of posters and presentations

"Expansion of High-Frequency Radar Coastal Wave Observations and Applications to the National Weather Service", 104th American Meteorological Society Annual Meeting