

CALYPSO South: Pushing coverage and value of CODAR HFR Observations & Derived Products in Malta and Sicily

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Qawra, Malta / 18th of April of 2018 / CALYPSO South KO meeting

Talk Outline

1. Brief Introduction to QUALITAS company
2. State of the art in European HFR observing
 1. Main HFR-related upgrades in CALYPSO South

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Introduction to QUALITAS Remos

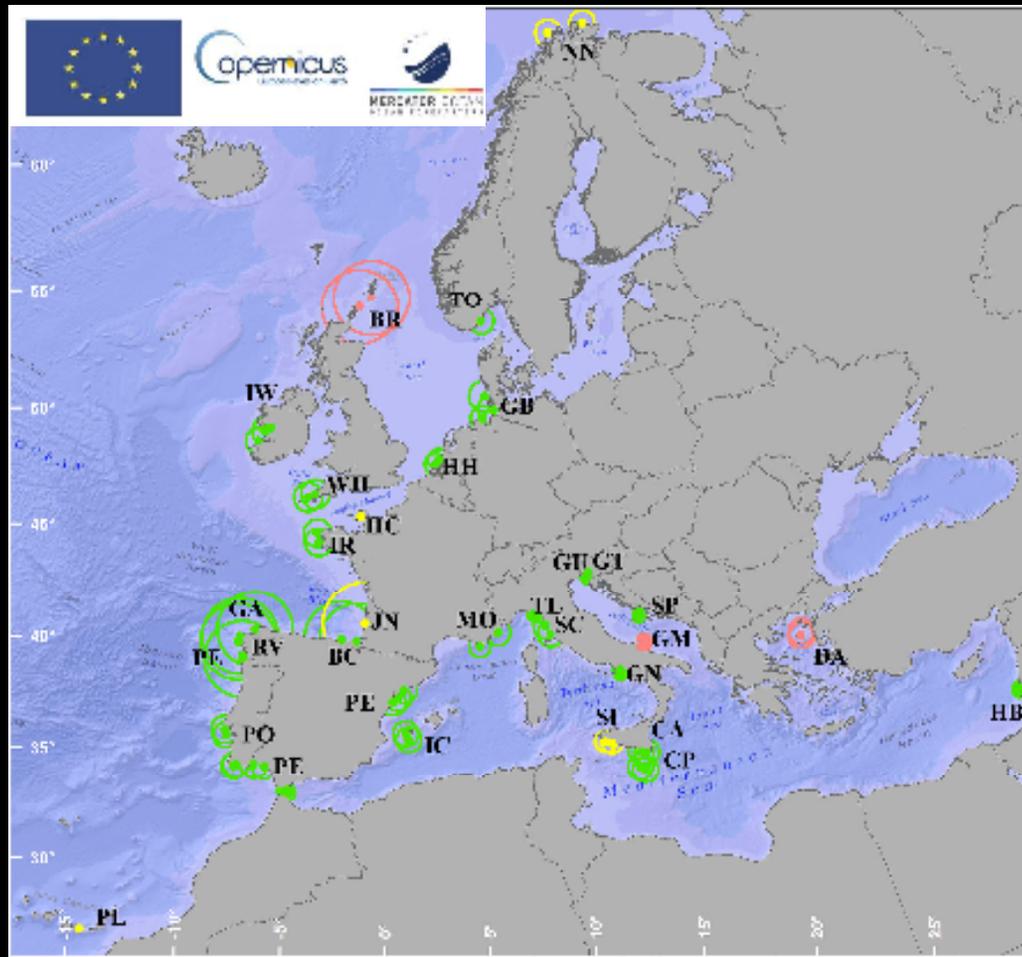
- QUALITAS Remos is a Spanish engineering company founded in 2002 with 20 scientists and technical staff and offices in Madrid, Lisbon and Casablanca
- European leader in alliance with CODAR Ocean Sensors in High Frequency Radar technology to monitor sea surface currents and waves. More than 50 systems deployed in the EMEA region
- Experts in Advanced Marine Information and Decision Support Systems. Our PORTUS Marine Information System is being used in > 10 countries
- Active in EU R&D ecosystem, EU Cross-Border, Transnational and Interregional co-operation programmes (partner or sub-contractor)



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General view of the European Systems



As of January 2017

23 operators

60 sites

51 currently operational

9 past installations

78% CODAR Systems

6 new systems/year

MONGOOS 31 sites (52%)

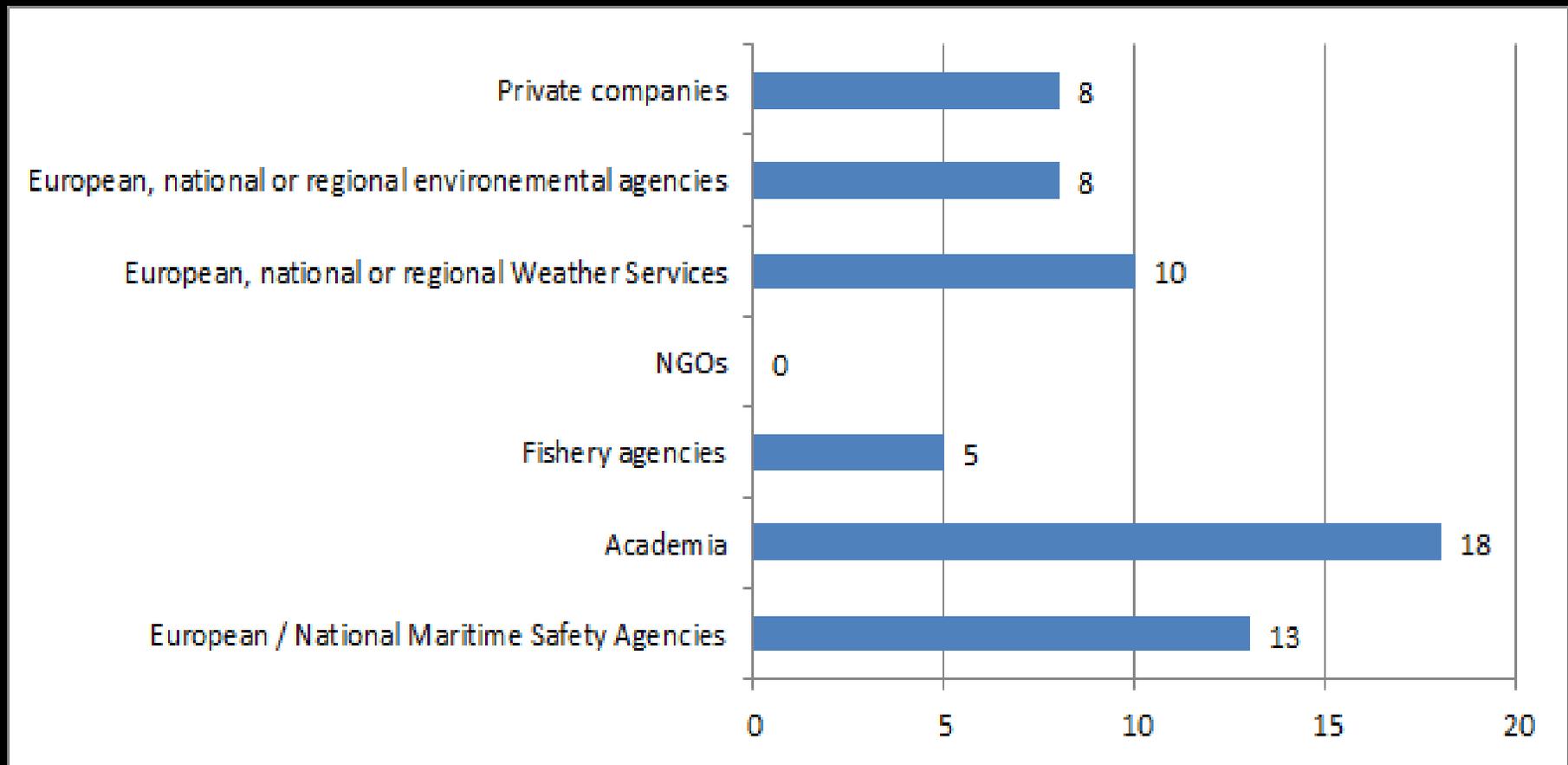
IBIROOS 17 sites (28%)

NOOS 12 sites (20 %)



From: MADER J., RUBIO A., ASENSIO J.L, NOVELLINO A., ALBA M., CORGNATI L., MANTOVANI C., GRIFFA A., GORRINGE P., FERNANDEZ V. (2016) "THE EUROPEAN HF RADAR INVENTORY." EUROGOOS PUBLICATIONS. CMEMS INCREASE PROJECT

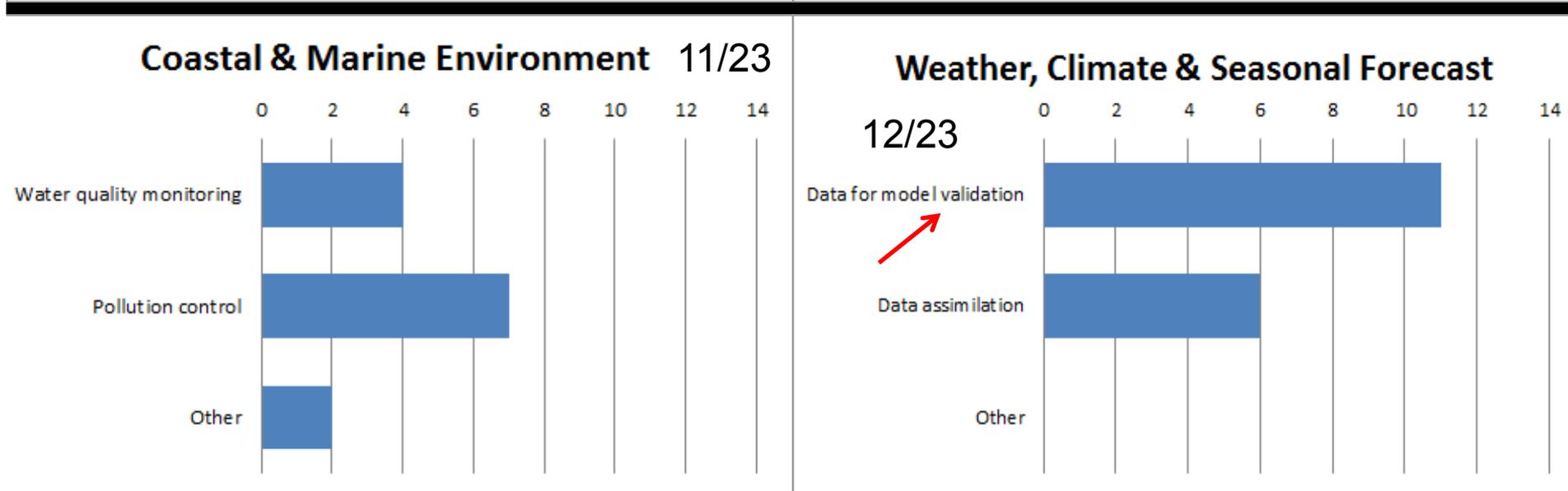
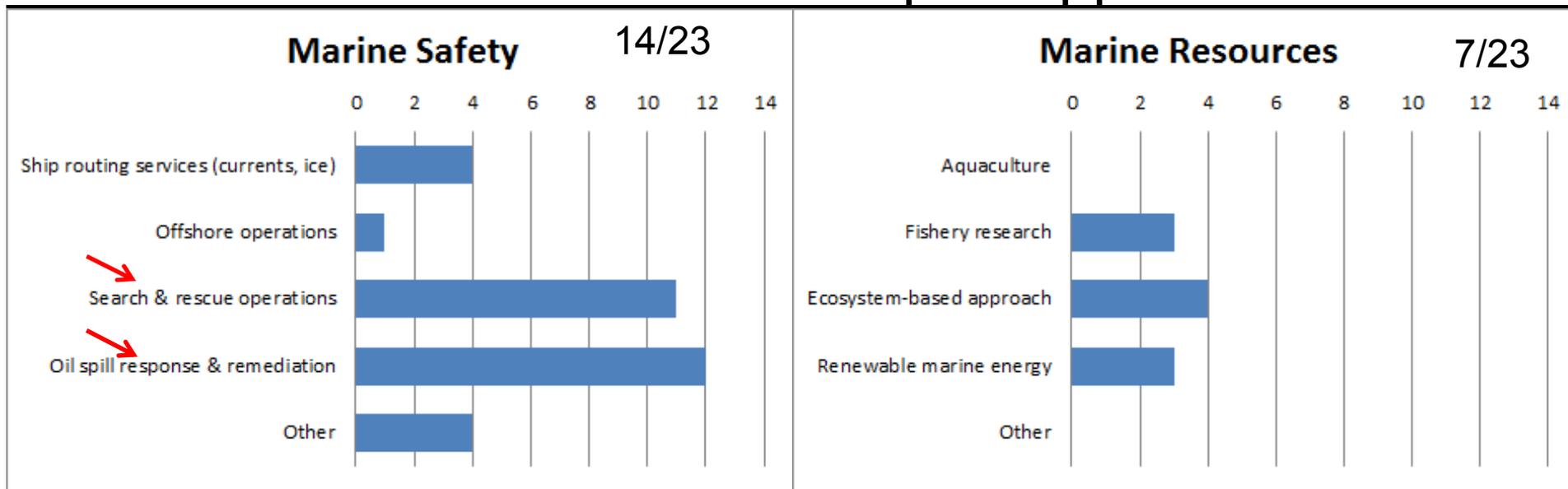
Use of HFR data in Europe / User profile



Most commonly identified users:
Academia and Marine Safety agencies

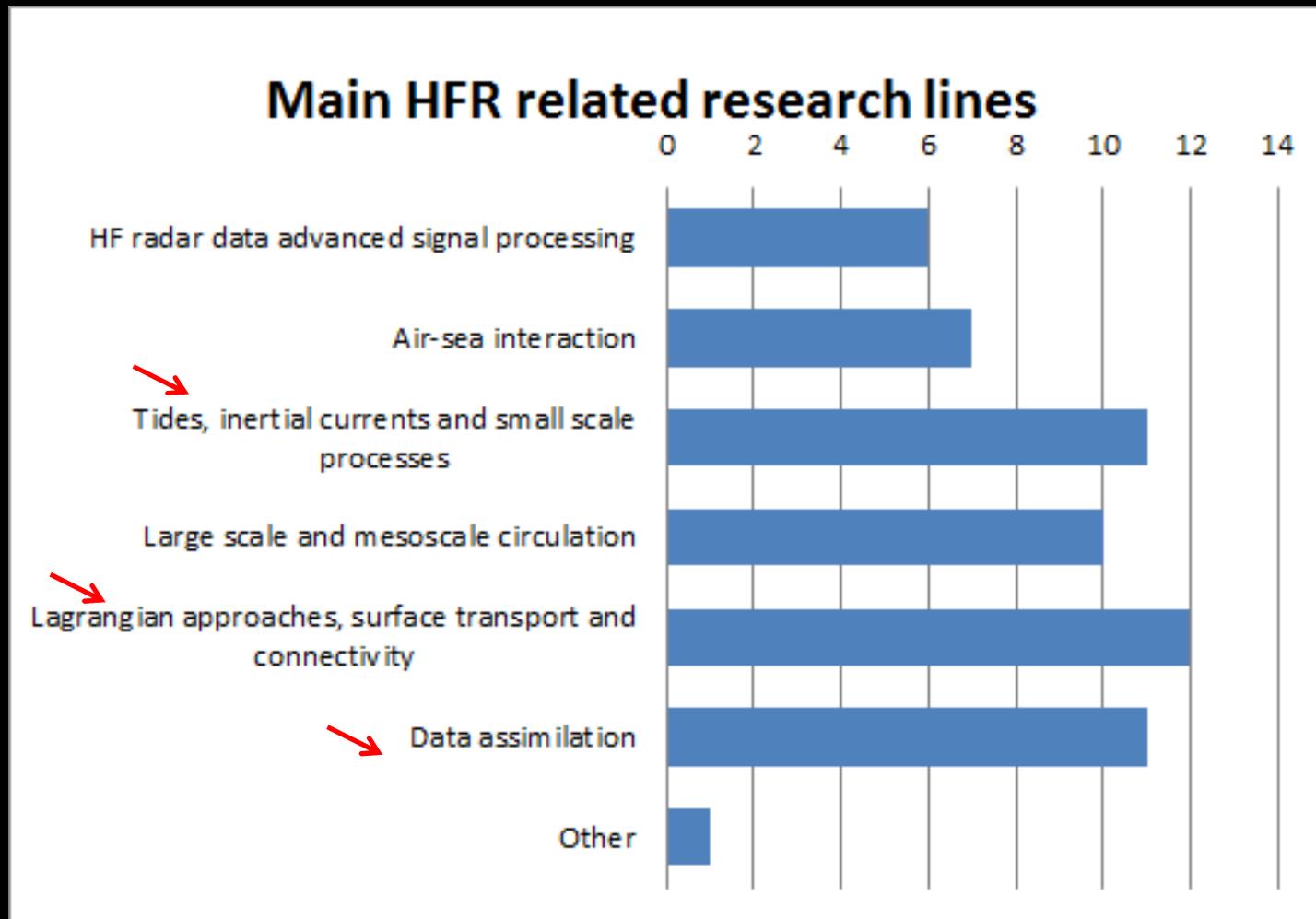
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Use of HFR data in Europe / Applications



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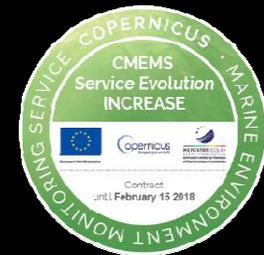
Use of HFR data in Europe / Applications



Growing use in data assimilation and tool for model validation.

From: MADER J., RUBIO A., ASENSIO J.L., NOVELLINO A., ALBA M., CORGNATI L., MANTOVANI C., GRIFFA A., GORRINGE P., FERNANDEZ V. (2016) "THE EUROPEAN HF RADAR INVENTORY." EUROGOOS PUBLICATIONS. CMEMS INCREASE PROJECT

HF radar coordination at European level



- 2015 - **HF radar task team** (chaired by AZTI) created under **EuroGOOS** umbrella in 2015 to help coordinate European activities around the development and use of this coastal technology (standards, products, QA/QC, promote joint R&D...). Visibility also inside GOOS and GEO
- 2017 – 30 HFRs (including CALYPSO) integrated into **EMODNET Physics Portal** to provide a freely available single point of access at European level to display HFR data
- January 2018. Start of a new European project funded by Copernicus Marine Environment Monitoring Service (CMEMS) to work on the integration of HFRs into an operational EU service with the potential of being **delivered directly through CMEMS in the next 3 years**

Application Case Study 1: Model Skill assessment in CMEMS

a) NARVAL
IBI-MFC VALIDATION TOOL

On-Line Mode | Delayed Mode

Validation (IBI VS Observations)

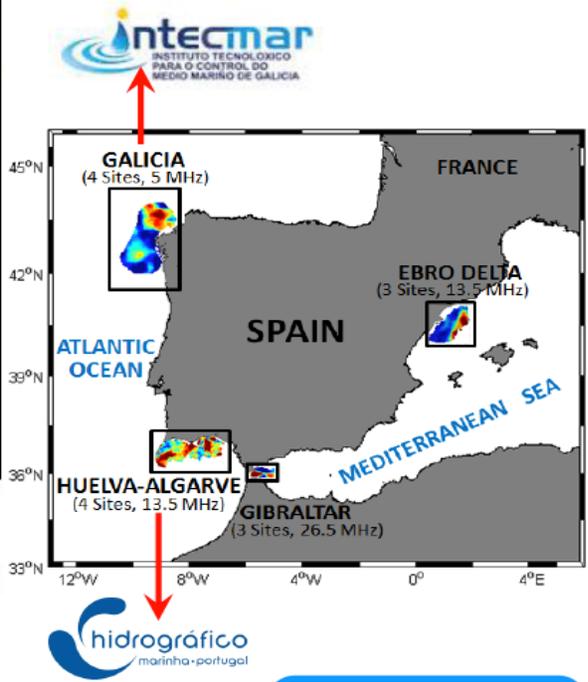
IBI validation metrics: Availability

SST (L3, L4) | SAL | **CURRENTS**

CMEMS

The present web service dedicated to the IBI-MFC product quality dissemination has been developed in the frame of the Copernicus Marine Environment Monitoring Service (CMEMS)

On-line Help



b) NARVAL
MyOCEAN IBI-MFC VALIDATION TOOL

On-Line Mode | Delayed Mode

IBI-VS- HF radar

IBI validation metrics: Availability

EBRO DELTA | GALICIA | GIBRALTAR | EBRO DELTA | HUELVA-ALGARVE

Select date: 2014 | Spring (Mar-May)

Select HF radar: EBRO DELTA

Select metric: MAP: MEAN, BIAS, RMSE, CORR, COMPLEX CORR

MAP: MEAN, BIAS, RMSE, CORR, COMPLEX CORR

TIME SERIES: MEAN, BIAS, RMSE, CORR

STATISTICS BY TIME PERIOD

SUMMARY OF STATISTICS

SHOW INFO!

• 4 systems
• 14 sites

Puertos del Estado

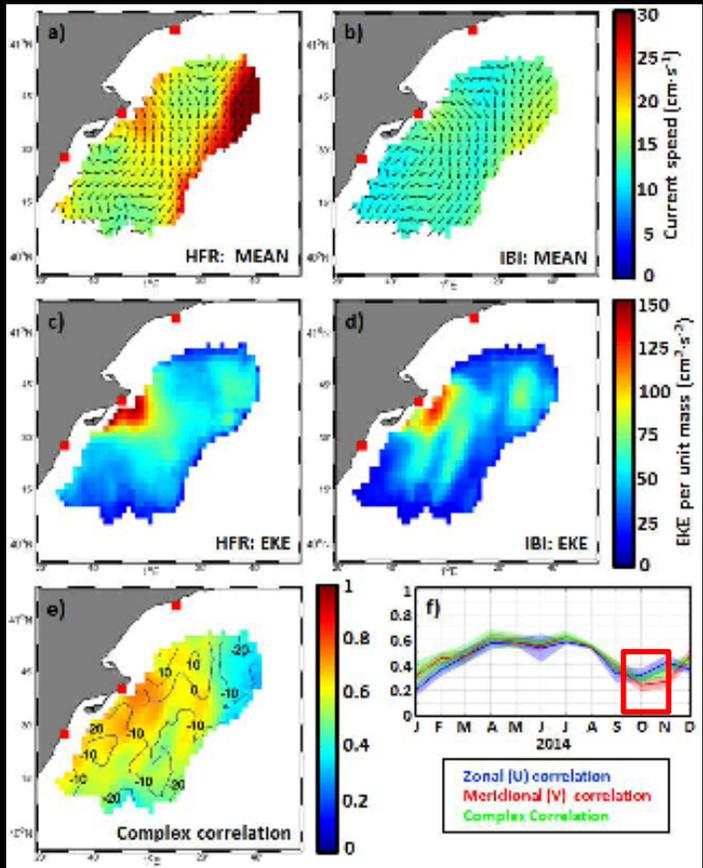
GOBIERNO DE ESPAÑA

MINISTERIO DE FOMENTO

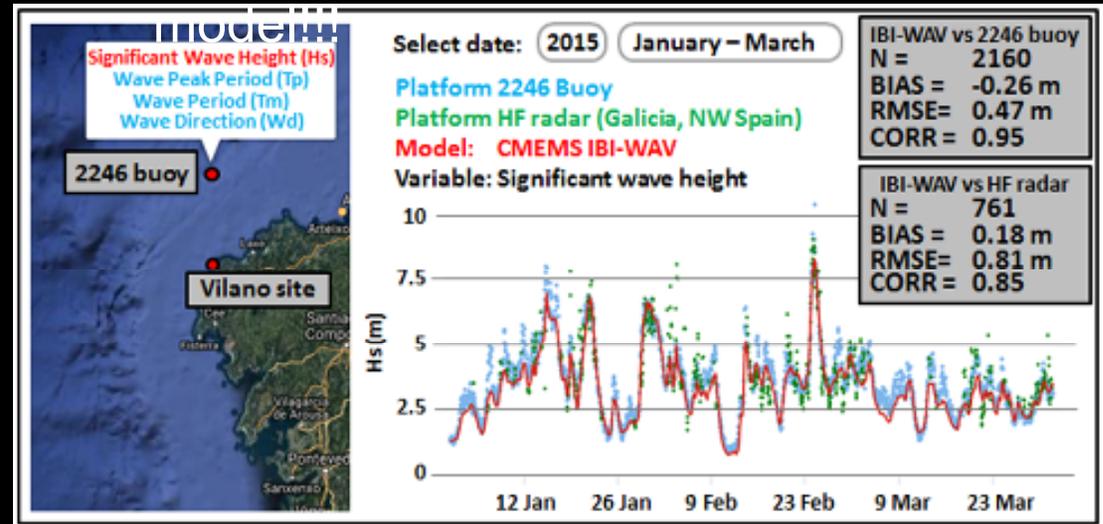
- Puertos del Estado has developed an operational real-time web tool in CMEMS to validate marine forecasts for the IBI Region called NARVAL (North Atlantic Regional VALidation)
- HF radar used as benchmark to validate surface currents forecasts (annual, seasonal, monthly comparisons) and now also used for validation of wave models!!!

• Available in 4 different areas with a total of 14 HF radars providing data

Application Case Study 1: Model Skill assessment in CMEMS



From April 2017 also HF radar wave data to evaluate new IBI-WAV



Intercomparison of significant wave height in NW Spain (Jan-Mar 2015). IBI-WAV model (red line) validated against buoy data (blue dots) and HFR data (green dots).

Skill assessment example for surface currents in the Ebro Delta in Spring 2014 (mean surface currents maps, complex correlation maps, eddy kinetic energy maps, skill score time series...). Decrease in IBI model performance during the last quarter of 2014 (especially in October)

Application Case Study 2: SAR in Spain

SASEMAR: The Spanish Maritime Safety Agency



HF radar data + PdE modeled outputs

Daily Ingested by SASEMAR's Environmental Data Server (EDS)

Optimize SAR activities & oil pollution preparedness

Critical areas like the Strait of Gibraltar



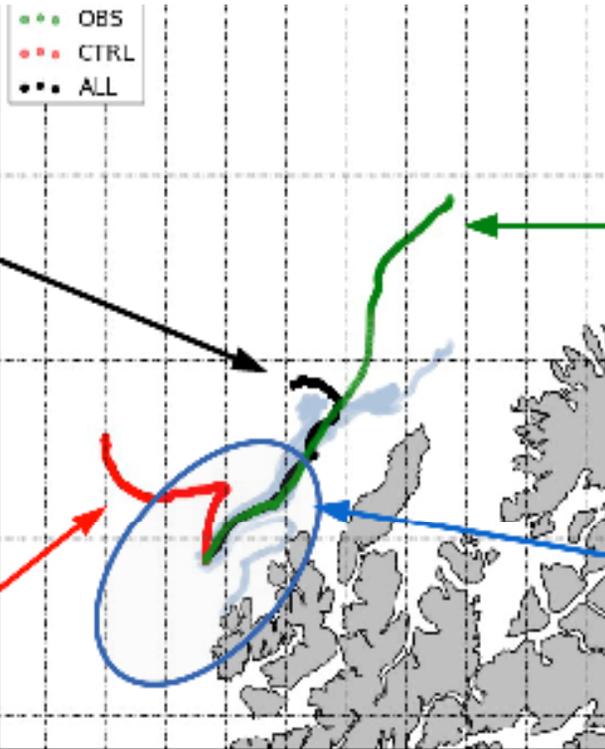
Application Case Study 3: Oil Spill Trajectory Modeling

Sperrevik, K. H. Christensen, and J. R.hrs, "Observing and modeling currents on the continental slope: assimilation of high frequency radar currents and hydrography profiles", Ocean Sci., 2014



Ocean model
with HF data

Ocean model
without HF data



Drifter

HF radar
coverage

Oil spill response/forecasting is main driver for HF radar deployment in Norway.

Assimilating HF radar data yields significant improvement in surface current analyses and predictions → best way to improve oil spill drift predictions

Application Case Study 4: Oil Spill Trajectory Modeling

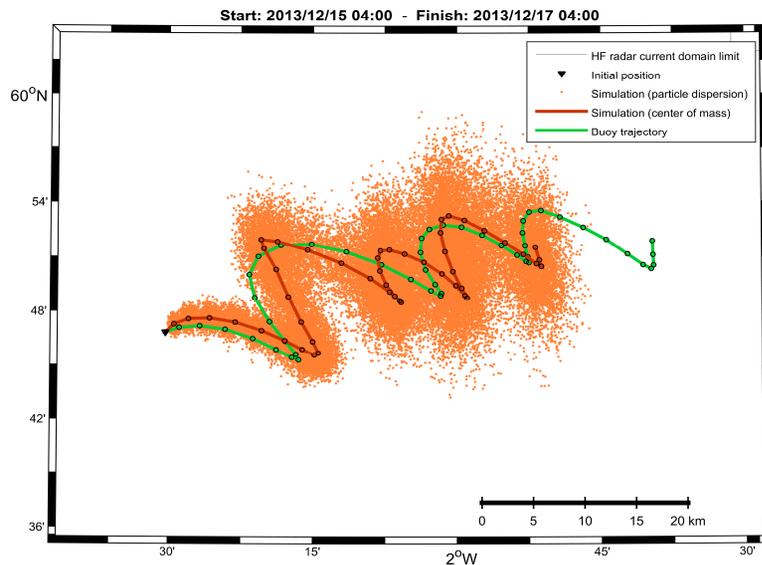


Abascal, Sanchez et al., : "Operational oil spill trajectory modelling using HF radar currents: A northwest European continental shelf case study." Marine Pollution Bulletin, 2017

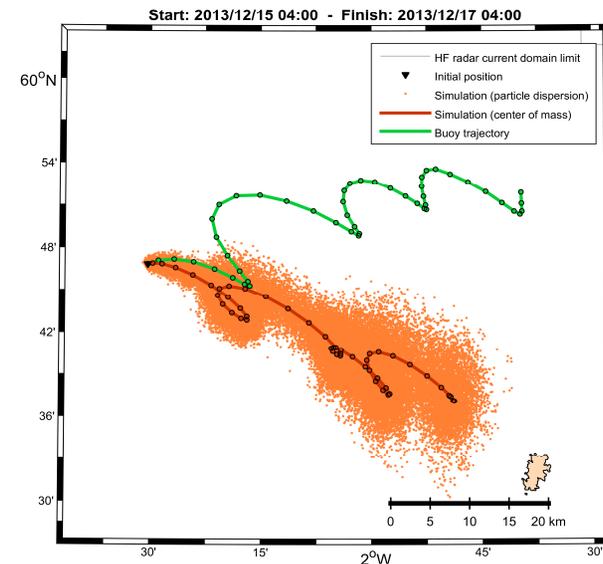
HF radar (orange) vs. drifter (green)

Modeled (orange) vs. drifter (green)

Buoy trajectory and simulation comparison



Buoy trajectory and simulation comparison



Distance error (real drifter trajectory vs. predicted) after 48h of simulation is *reduced 40% on average* when using HF radar derived **HFR data vs. CMEMS** as forcing

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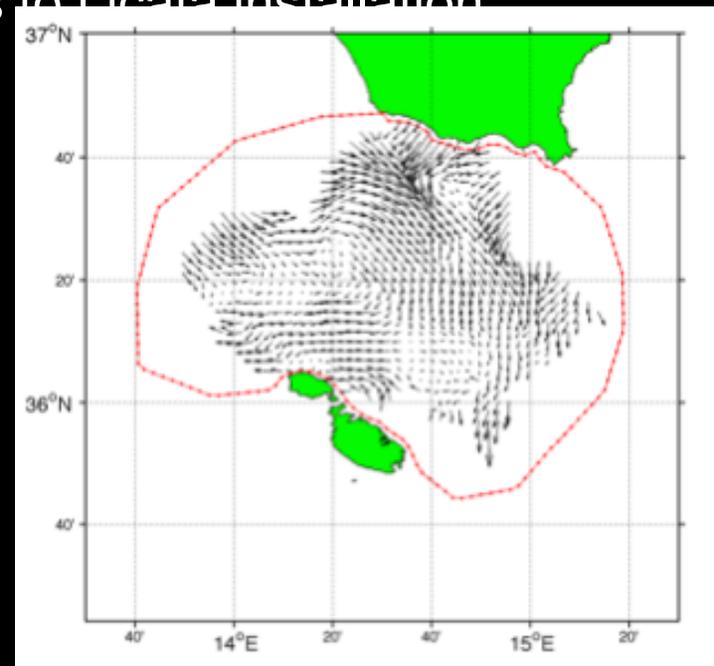
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Increased coverage / increased data quality

- 3 new radar stations. > 7.000 additional km² will be covered
- Surface currents data available closer to the coast and with no gaps thanks to different Gap-filling and interpolation techniques that will be implemented
- Increase coverage but also increased data quality in current Malta-Cyprus CALYPSO field thanks to Licata installation



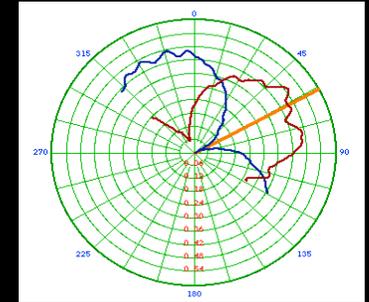
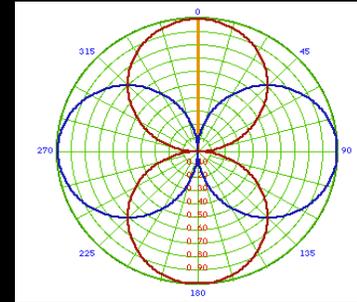
New CALYPSO HFR coverage after installation of 3 additional radars



Complete and uniform 2D surface currents field will be provided thanks to gap-filling techniques

Automatic calibration/pattern measurement technology

- The calibration of the radars requires the measurement of the antenna pattern which changes depending on the antenna's surrounding environment



- A measured pattern improves the direction-finding capabilities of the system removing bearing errors which, in turn, could cause current velocity errors
- The traditional way of measuring the antenna pattern is to use an external device (called transponder) which is carried inside a boat that describes an arc with fixed radius around the receive antenna. Very

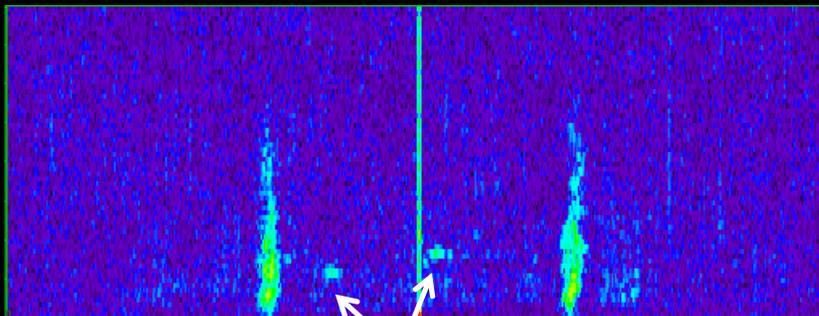


but:

- Requires a dedicated boat and specialized personnel
- The antenna pattern measurement is only valid if the antenna surrounding environment doesn't change, i.e. it

Automatic calibration/pattern measurement technology

- As part of CALYPSO South, a new technology developed by CODAR and called Automatic-Antenna Pattern Measurement kit will be integrated into CALYPSO radars (AIS receiver + software)
- This kit associates echoes in spectral HF Radar data from passing vessels with vessel positions from AIS messages, allowing continuous automatic monitoring of the Antenna Pattern – no dedicated boat needed
- Instead of previous method that provided a “picture” of the pattern we will now have a “movie” showing daily pattern data



Ships in spectral data “seen” by the radars!!



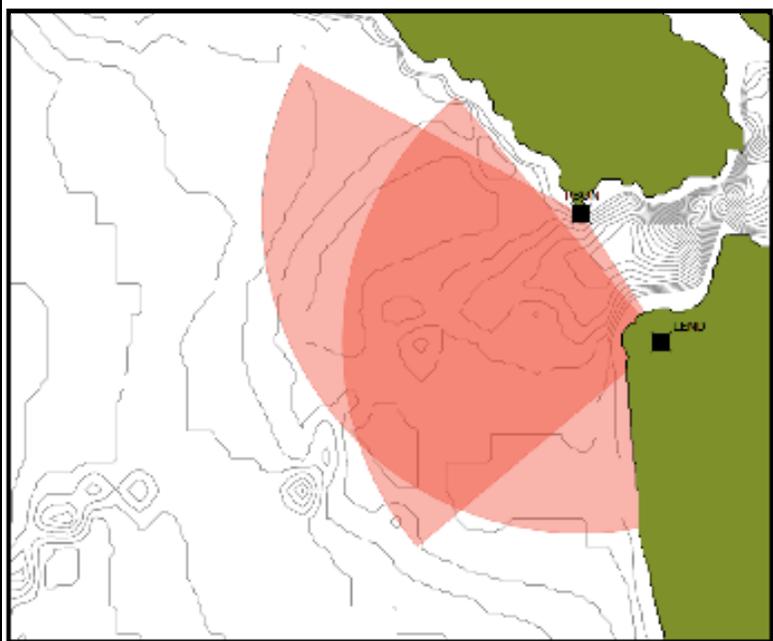
AIS ship positions

Automatic calibration/pattern measurement technology

- This new hardware + software kit will enhance CALYPSO data quality by
 - Improving bearing measurement, surface currents and waves accuracy
 - Allowing early detection of changes in the antenna pattern due to both environmental causes or hardware faults
- And of course... CALYPSO partners will also receive real-time AIS data from ships navigating the area that could be used for additional applications (e.g. check against illegal spillage of oil by ships)

Major software upgrade / Radial and Combine sites

- Improved Wave Processing & QC – additional filter of outliers, temporal average and spatial average for improved reliability of HFR wave data.
- New CallSign™ Feature – CallSign fulfills new International Telecommunications Union requirements that each oceanographic HF radar should routinely transmit a Morse Code to perfectly identify the origin of transmissions transmitted by these oceanographic radars



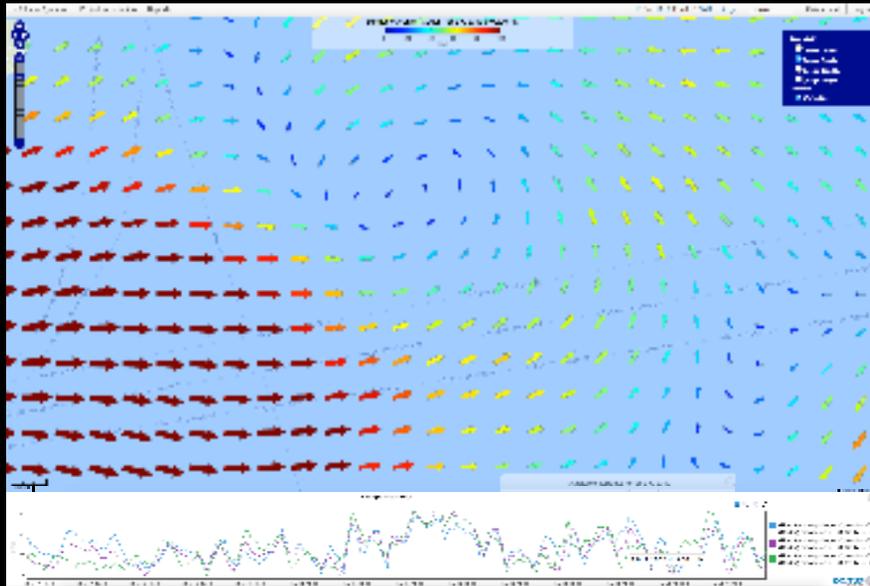
SeaDisplay radial coverage & bathymetry

- Upgraded User Interfaces - An upgraded world database extraction tool provides smooth and efficient zoom navigation. Integrated bathymetry adds a crucial data layer

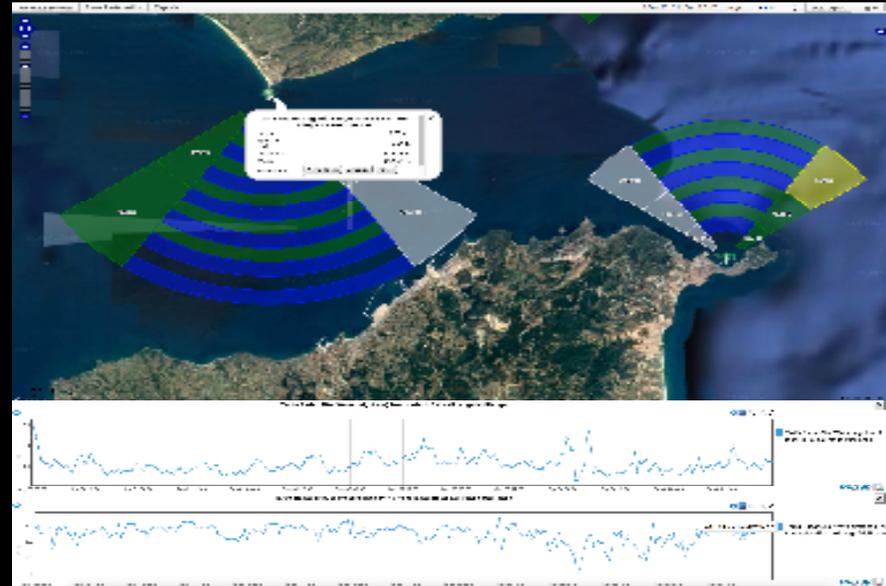
Major software upgrade/ PORTUS Marine Information

HF radar measurements

HFR currents

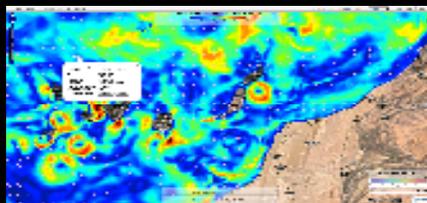


HFR waves

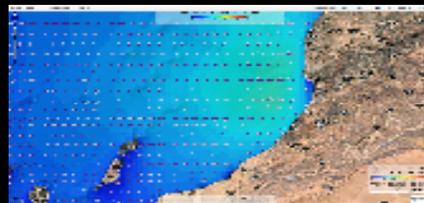


Global Ocean and Atmospheric Forecasting System layers

Currents



Waves



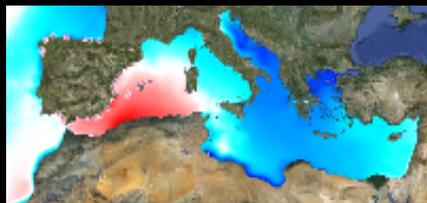
Pressure



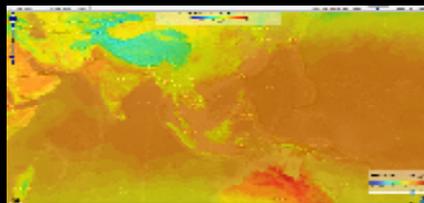
Rain



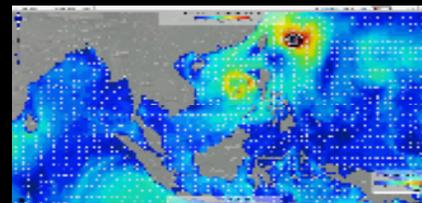
Sea Level



SST



Wind



Cloud coverage



Thanks!

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