



LOTUS

4 February 2016

Work package 5

Applications of new GMES data in value-adding ocean services

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Objectives

- The WP5 has developed new and improved coastal oceanographic services by utilizing the data features emerging with Sentinel-3.
- The services primarily utilize the increased resolution of the SRAL SAR and place emphasis on value adding integration with complementary data such as ocean modelling, in situ data and multiple sensors.
- The services are developed to have a global applicability.



WP 5 Tasks

- Task 5.1 Improved wave and wind design data (DHI and CLS)
- Task 5.2 Characterization of coastal scale hydrodynamics (DHI and DTU)
- Task 5.3 New current design and forecast data (DHI, DTU, CLS, and Starlab)
- Task 5.5 Climate change services (CLS and DHI)

Participants:

- DHI
- CLS
- Starlab

Deliverables

List of deliverables

Deliverable Number ⁶¹	Deliverable Title	Lead beneficiary number	Estimated indicative person-months	Nature ⁶²	Dissemination level ⁶³	Delivery date ⁶⁴
D5.1	End-to-end demonstration of improved wave and wind design data	5	4.00	R	PU	24
D5.2	Characterization of coastal scale hydrodynamics using SRAL SAR	5	8.00	R	PU	30
D5.3	End-to-end demonstration of improved surface current design data	5	8.00	R	PU	33
D5.4	Environmental vulnerability maps combining MERIS, S3 and surface ocean current products	2	3.00	R	PU	30
D5.5	Surface current, eddy and front detection climate change services	5	5.00	R	PU	33
		Total	28.00			

02.

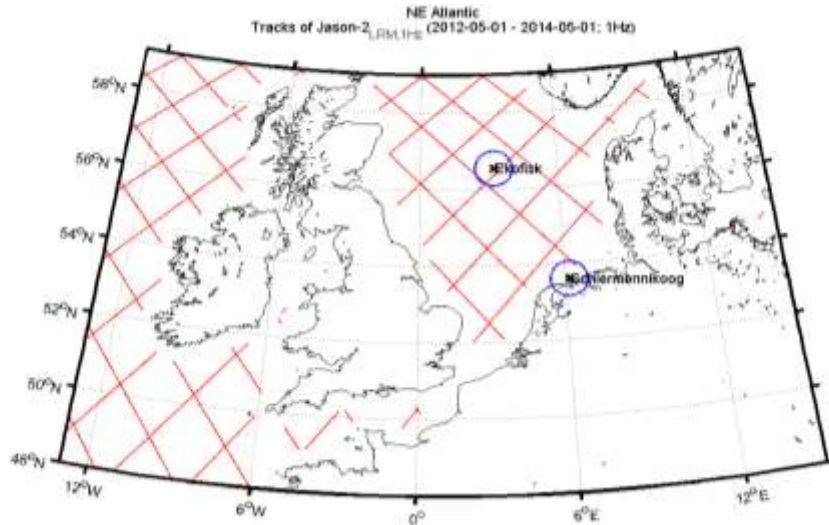


5.1 Improved design data

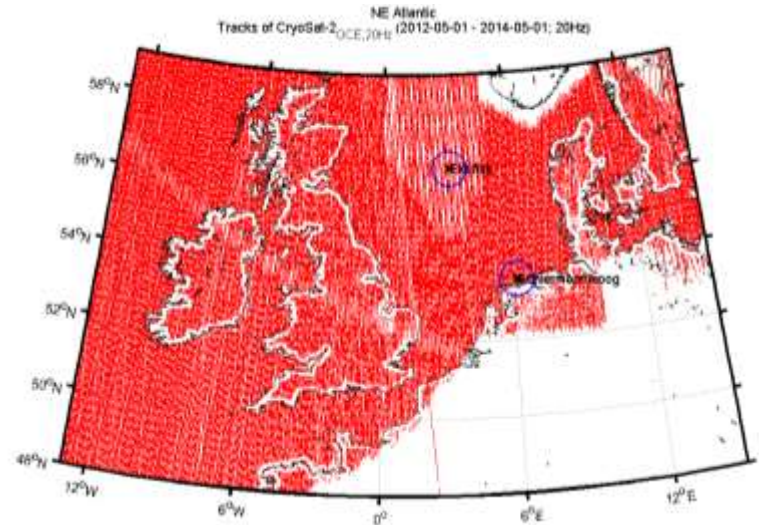


Altimeter coverage in NE Atlantic (after quality screening)

Jason-2
(LRM, 1Hz) DHI



CryoSat-2
(SAR, 20Hz) STARLAB

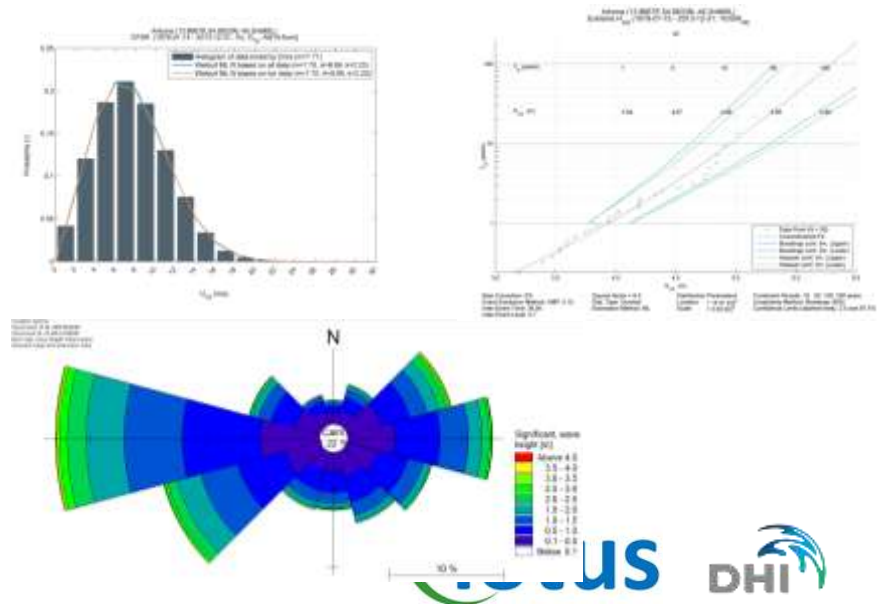


- No data of Norwegian coast
- Data on land (except near coast)
- Strange pattern in Central Northern North Sea

Fast assessment of wave and wind conditions

Purpose: To provide fast assessment of wave and wind conditions - in particular for remote coastal areas with limited other sources of information – or to supplement initial assessment.

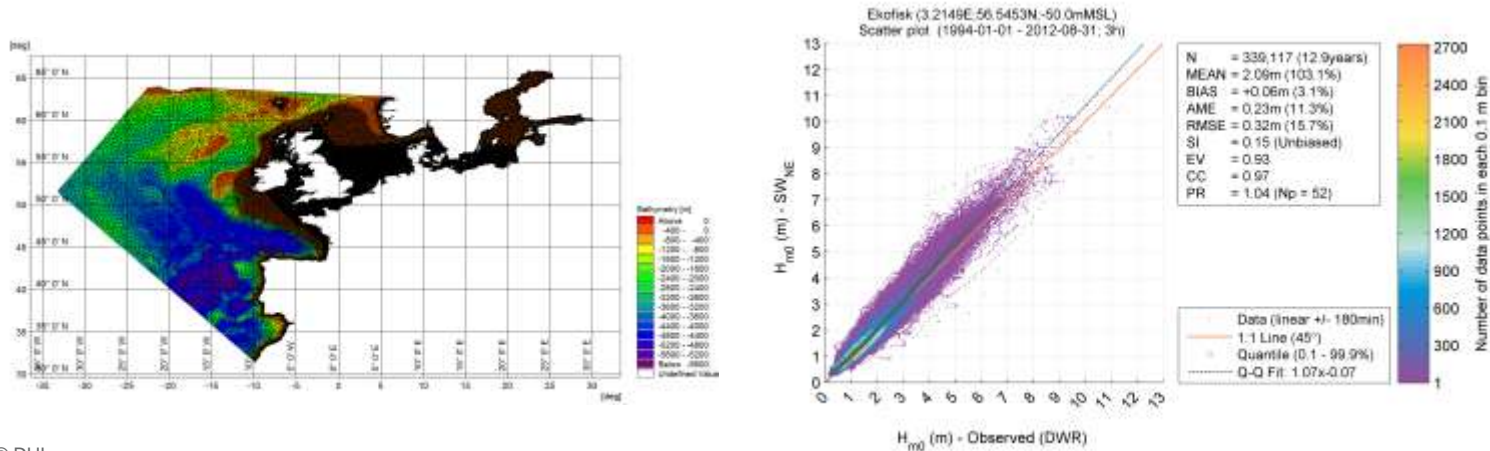
Example: Planning and design of offshore wind farms:



Calibration and validation of numerical models

Purpose: To demonstrate calibration and validation of numerical wave and wind models on a spatial scale in order to increase accuracy and reduce uncertainty of model data.

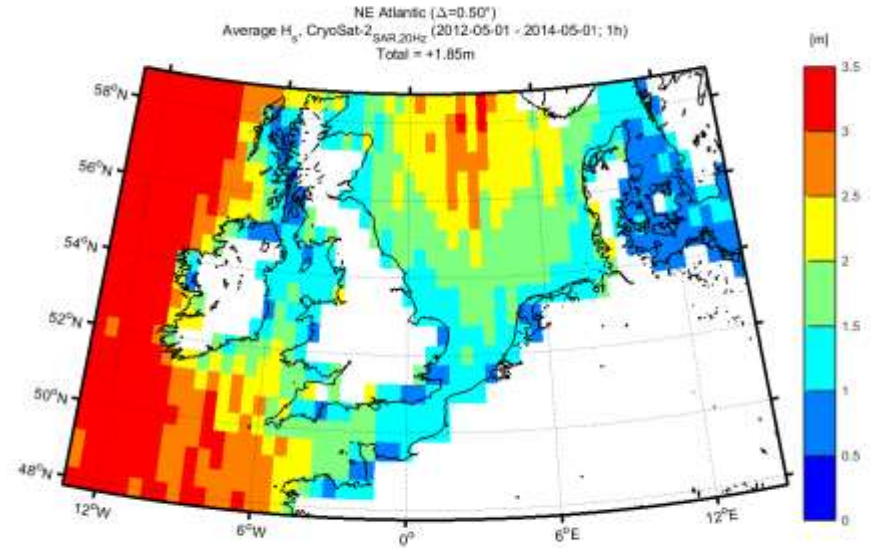
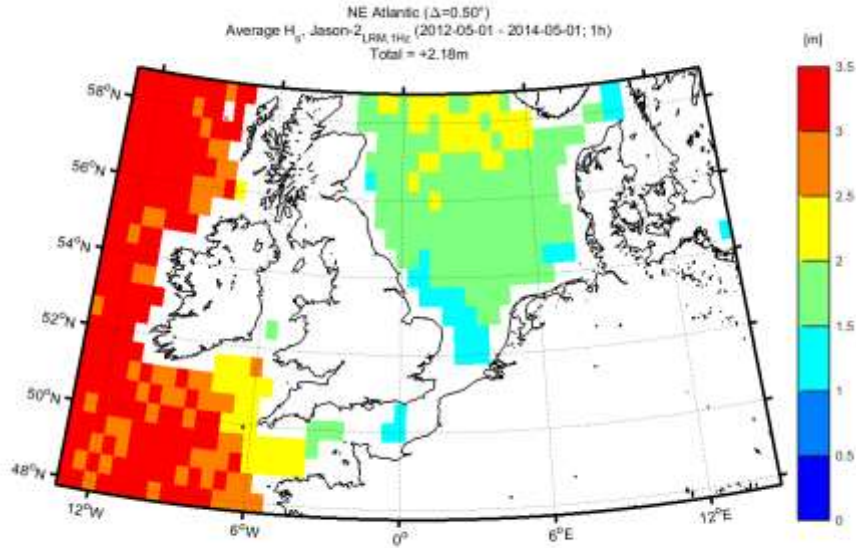
Model data of H_s was adopted from the DHI hindcast database based on a Mike 21 Spectral Wave Model (M21SW) forced by CFSR wind data:



Comparison Average H_s

Jason-2
(LRM, 1Hz) DHI

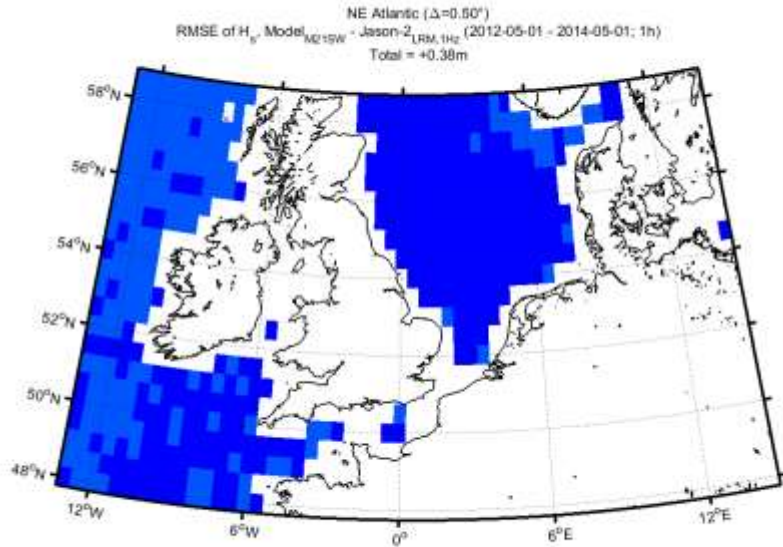
CryoSat-2
(SAR, 20Hz) CLS



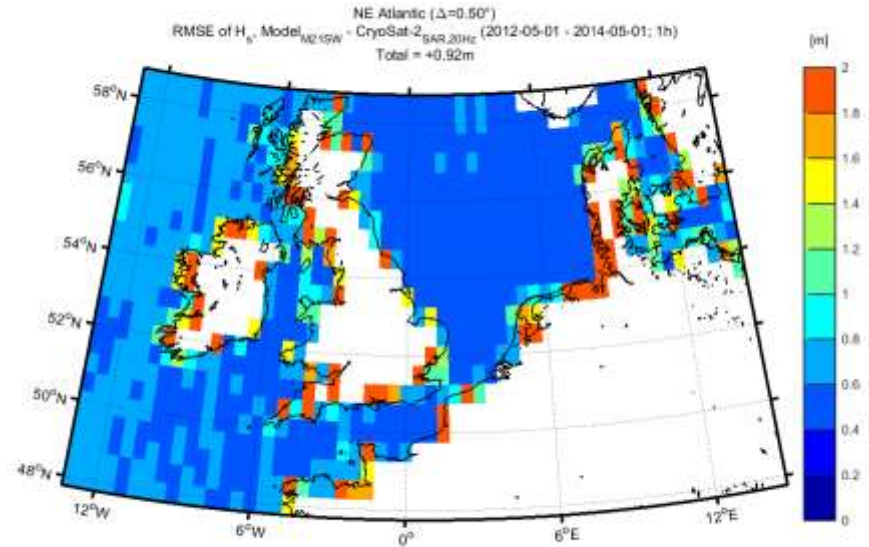
Model-EO RMSE of H_s

Jason-2
(LRM, 1Hz) DHI

CryoSat-2
(SAR, 20Hz) CLS



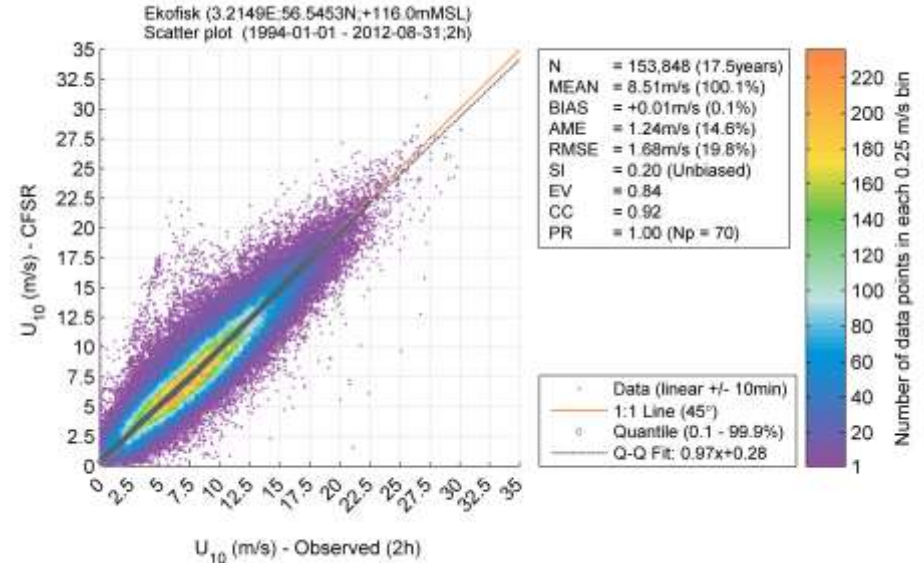
- RMSE < 0.4 (North Sea)



- RMSE < 0.6 (North Sea)
- RMSE ~ 1-3 (near-shore) (possibly due to lack of proper quality screening?)

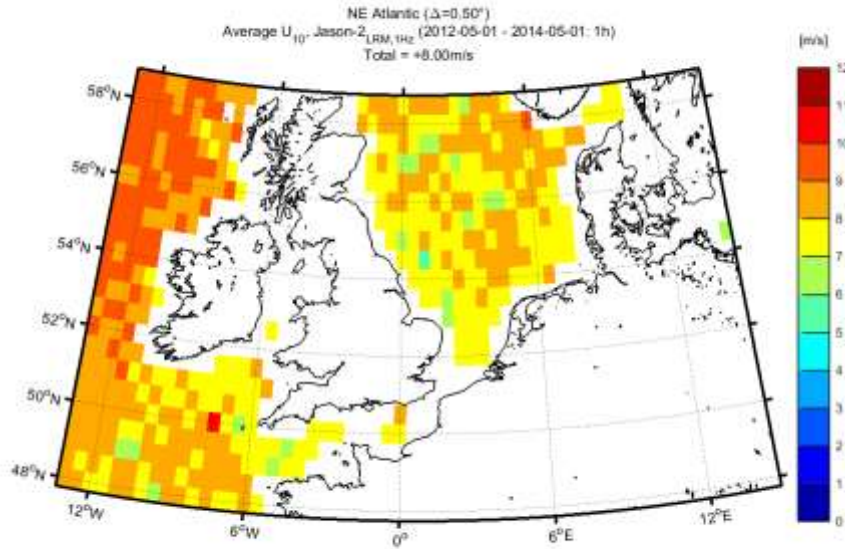
Calibration and validation of numerical models

Model data of U_{10} was adopted from the global CFSR (Climate Forecast System Reanalysis) atmospheric modelling system provided by NOAA.

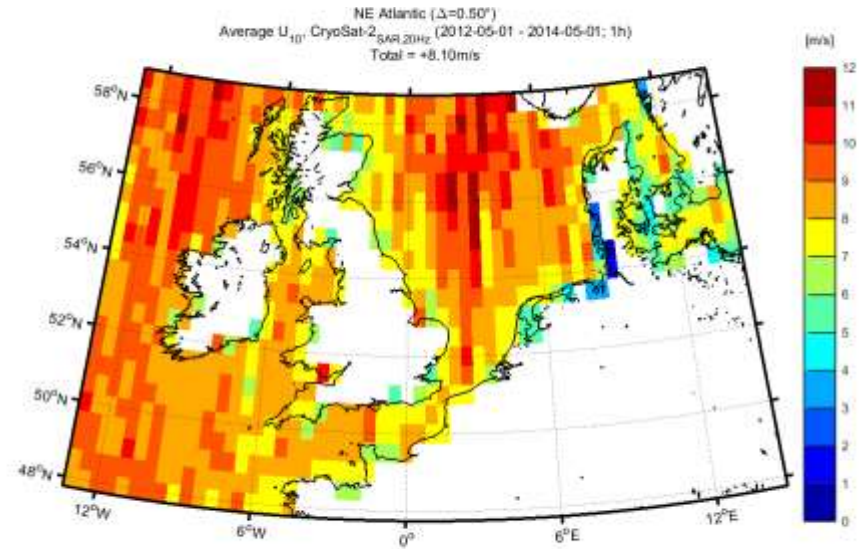


Average U_{10}

Jason-2
(LRM, 1Hz) DHI



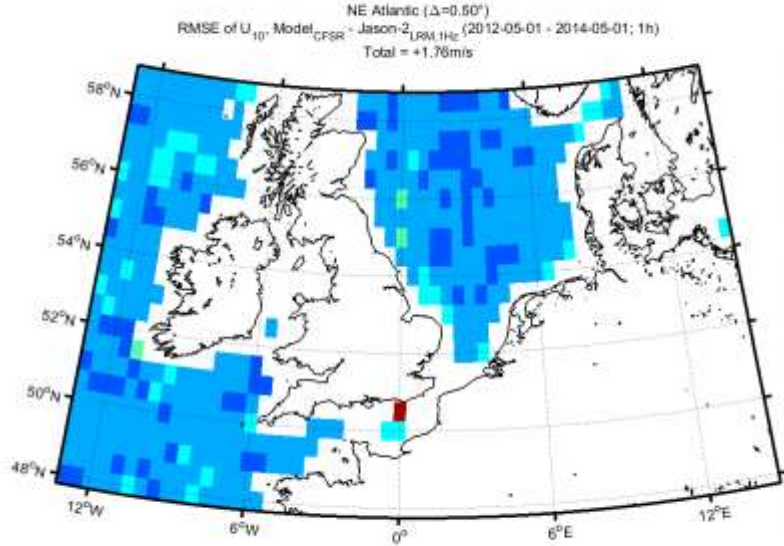
CryoSat-2
(SAR, 20Hz) CLS



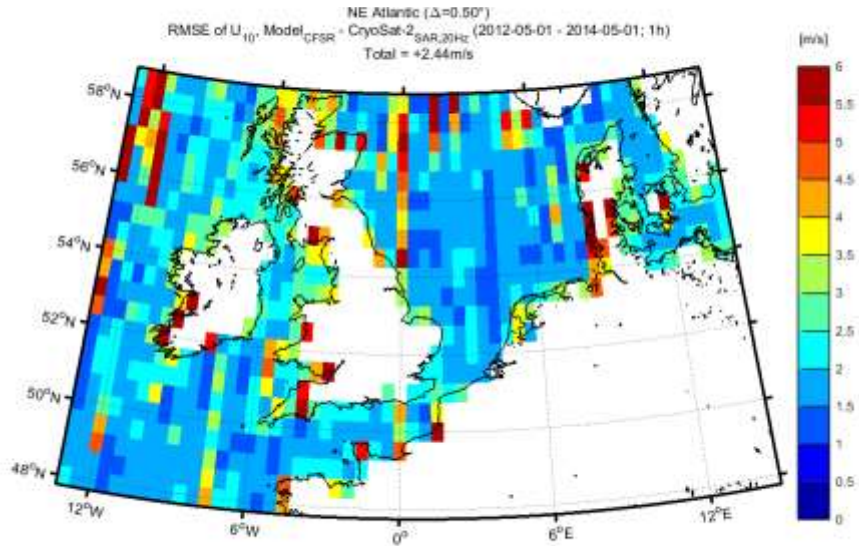
- $N_{\min} = 200$

RMSE of U_{10}

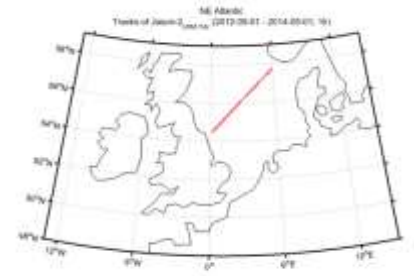
Jason-2
(LRM, 1Hz) DHI



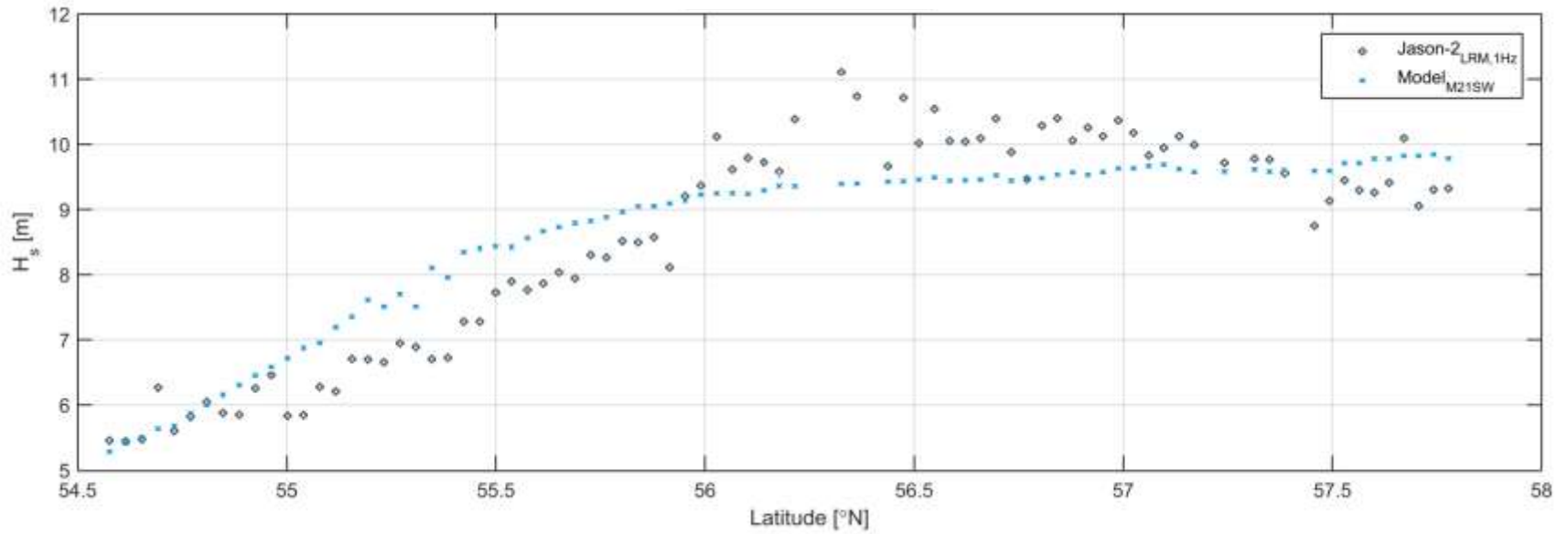
CryoSat-2
(SAR, 20Hz) CLS



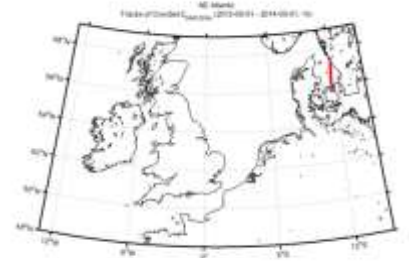
Along track Spatial distribution of extreme waves and wind



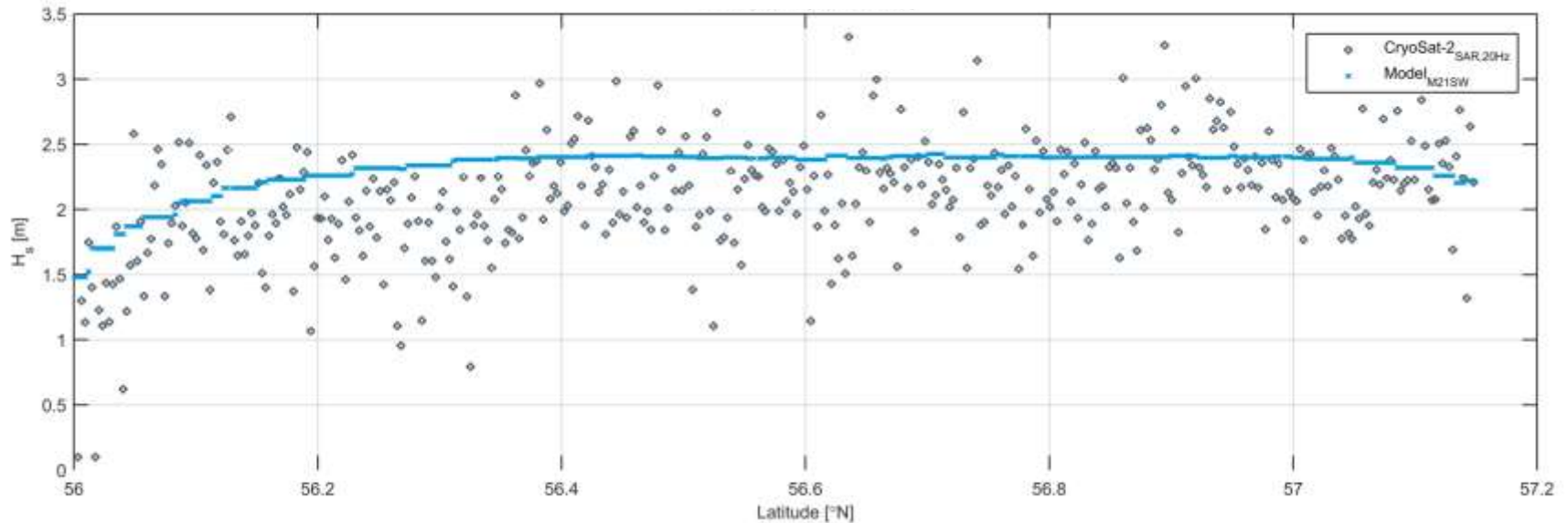
Track during Hurricane 'Bodil' (2013-12-05) – North Sea – Jason 2



Spatial distribution of extreme waves and wind



Track during Hurricane 'Bodil' (2013-12-05) – Inner Danish Waters – CryoSat-2



5.2 Characterization of coastal scale hydrodynamics



Coastal scale hydrodynamics

- Improved hydrodynamics near coasts
 - Marinas, Ports and navigation
 - Inlets
 - SAR and safety
 - Coastal and urban flooding
 - Aquaculture
- Wind setup and upwelling
- Coastal currents
- Siltation



Examples of services and applications

- Port of Hanstholm
 - Exposed entry to port
 - Complex currents and siltation
 - Enhanced forecasting and decision support system to increase safe berthing and efficiency
- Port of Gothenburg
 - Complex navigation at entry
- Offshore Windfarms
 - Design and operation



Beslutningsstøtteværktøj Hanstholm Havn



Port of Hanstholm Users



Navigation

- Waves
- Currents
-

Wave agitation

- Load/Unload
- Ferries
- Mooring



Waveenergy testcenter

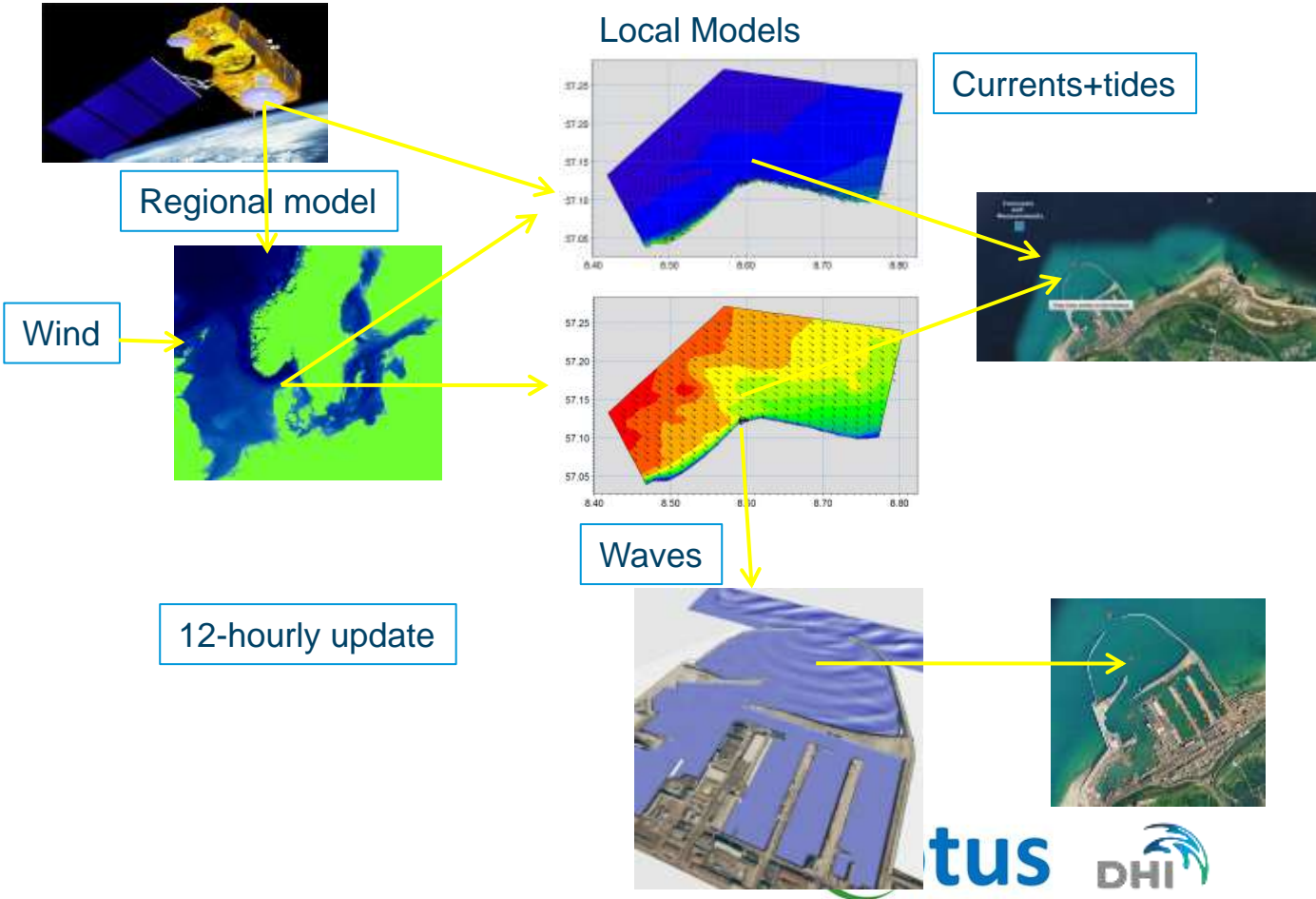
- Production/Resource
- Operations
- Weather

Surfers
("Cold Hawaii")

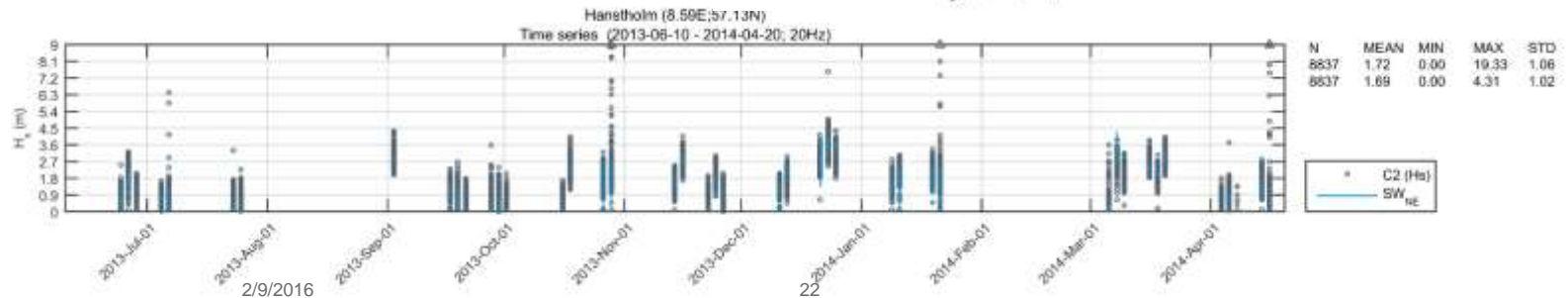
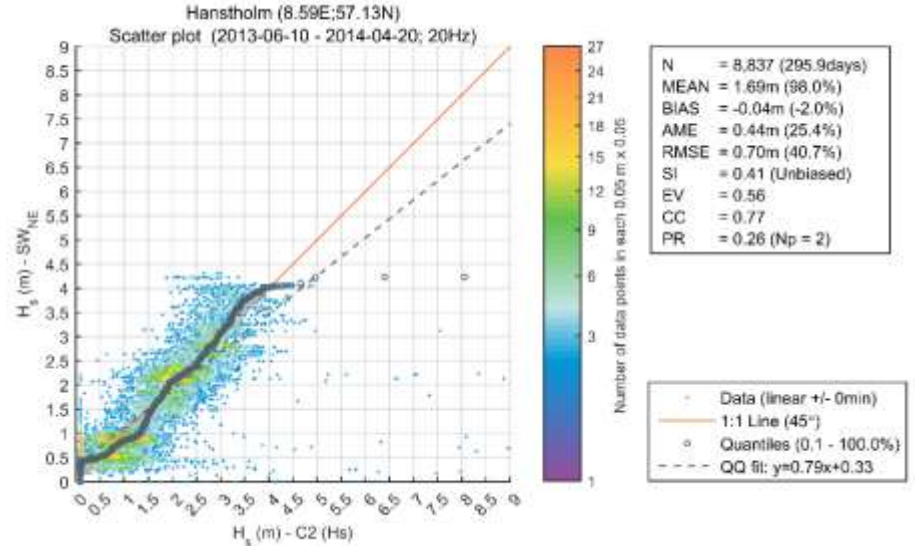
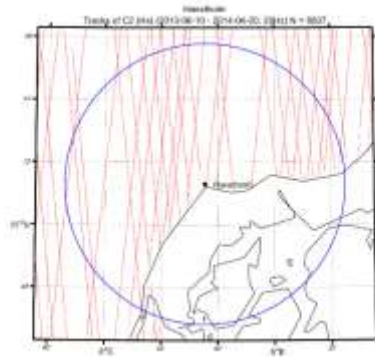
- Waves
- Wind
- Tourists

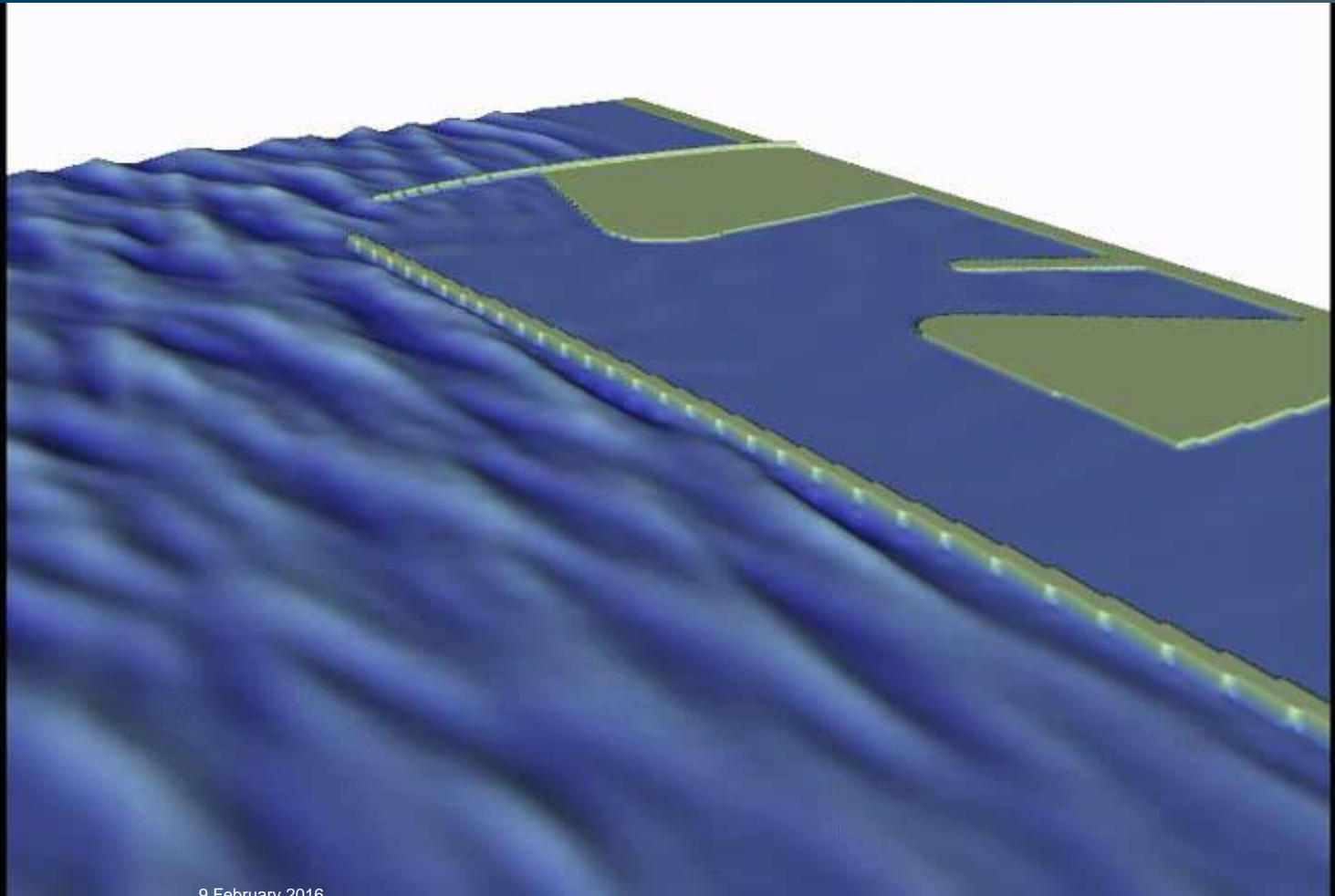


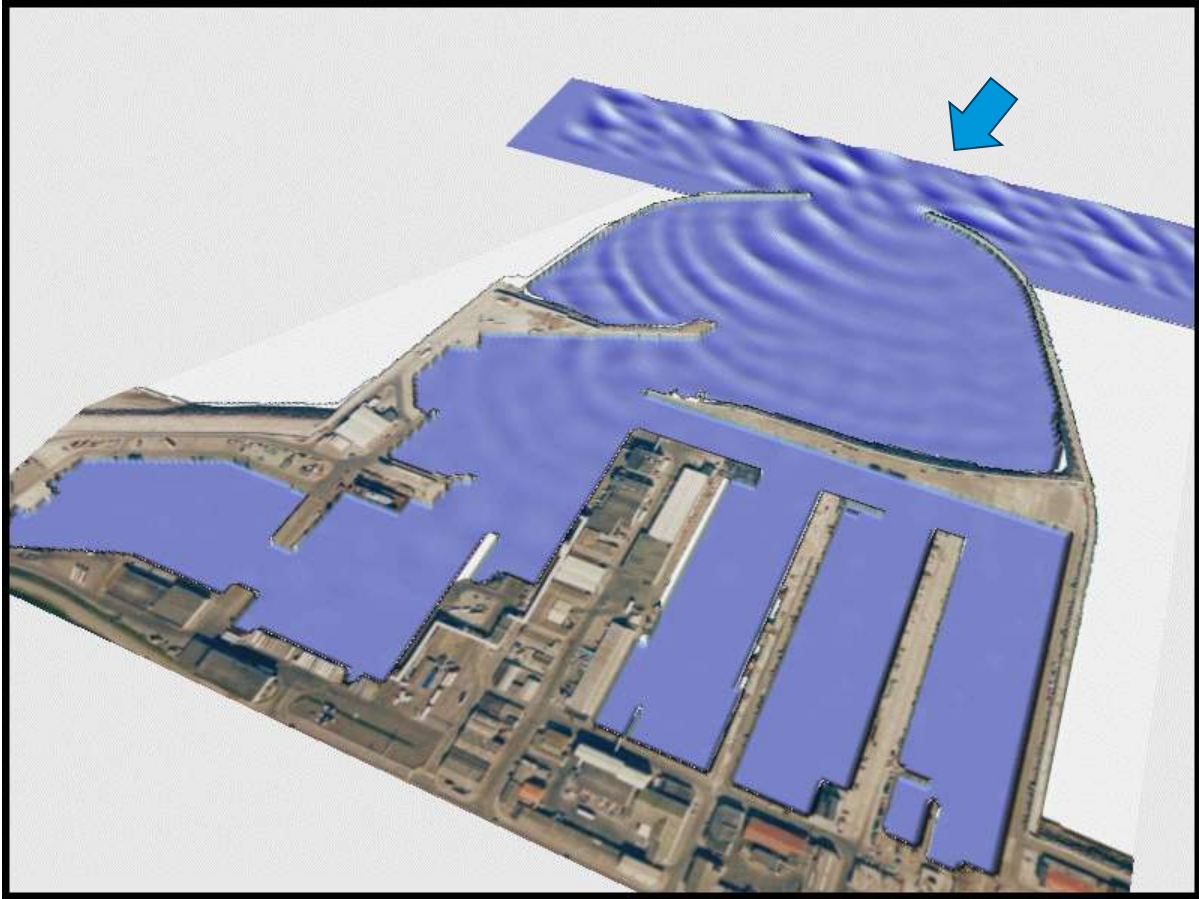
Overview



Hanstholm near coastal waves

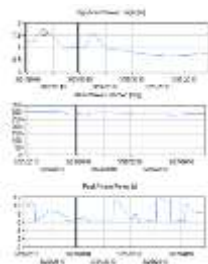




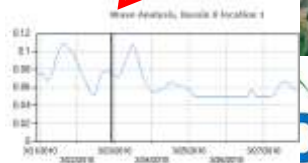
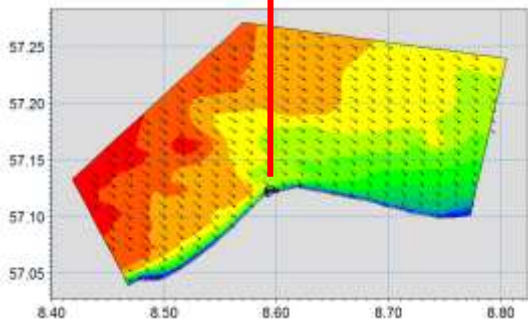
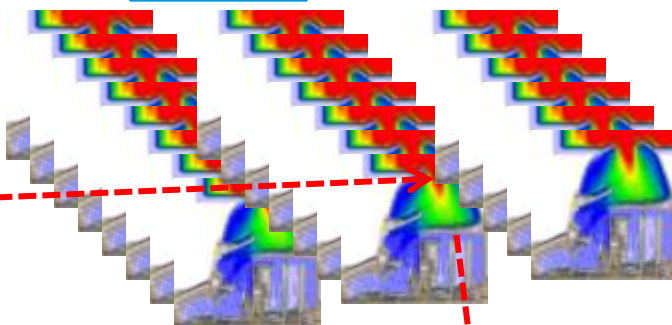


Determine the expected wave conditions inside the port

Database



At Entrance:
•Wave height
•Period
•Direction



Event Manager

- Objective: to send alerts (Email and SMS) to users when certain parameters are forecasted to exceed user defined values.
- Values are set by the users through a web menu.

We have chosen 6 parameters to start with.

More can easily be added.

Global	Average wind speed and direction. Wind speed <input type="text" value="10"/> m/s
Entrance	(1) Harbour entrance Wave height Entrance <input type="text" value="1.5"/> meters Current speed Entrance <input type="text"/> m/s
Buoy	(2) This data is forecasted at the same location as the waverider buoy, a measurement facility located North West from the port Wave height Buoy <input type="text" value="4"/> meters Current speed Buoy <input type="text"/> m/s Surface Elevation Buoy <input type="text"/> meters
WEC Site	(3) Forecasts for the Wave Energy Converter Wave height WEC <input type="text"/> meters Wave power WEC <input type="text"/> kW/m
Surfing area	(4) Forecasts for the surf area Wave height Surfing Area <input type="text"/> meters
Ferry terminal	(5) Ferry terminal Wave height Ferry Term. <input type="text"/> meters
Auction Quay	(6) Quay allocated to fishing vessels Wave height <input type="text"/> meters

For the coming 48 hours



Alerts are sent at 14:00



Morphological model of port siltation

Morphological simulation of one design year including an extreme storm event



Select Map Type

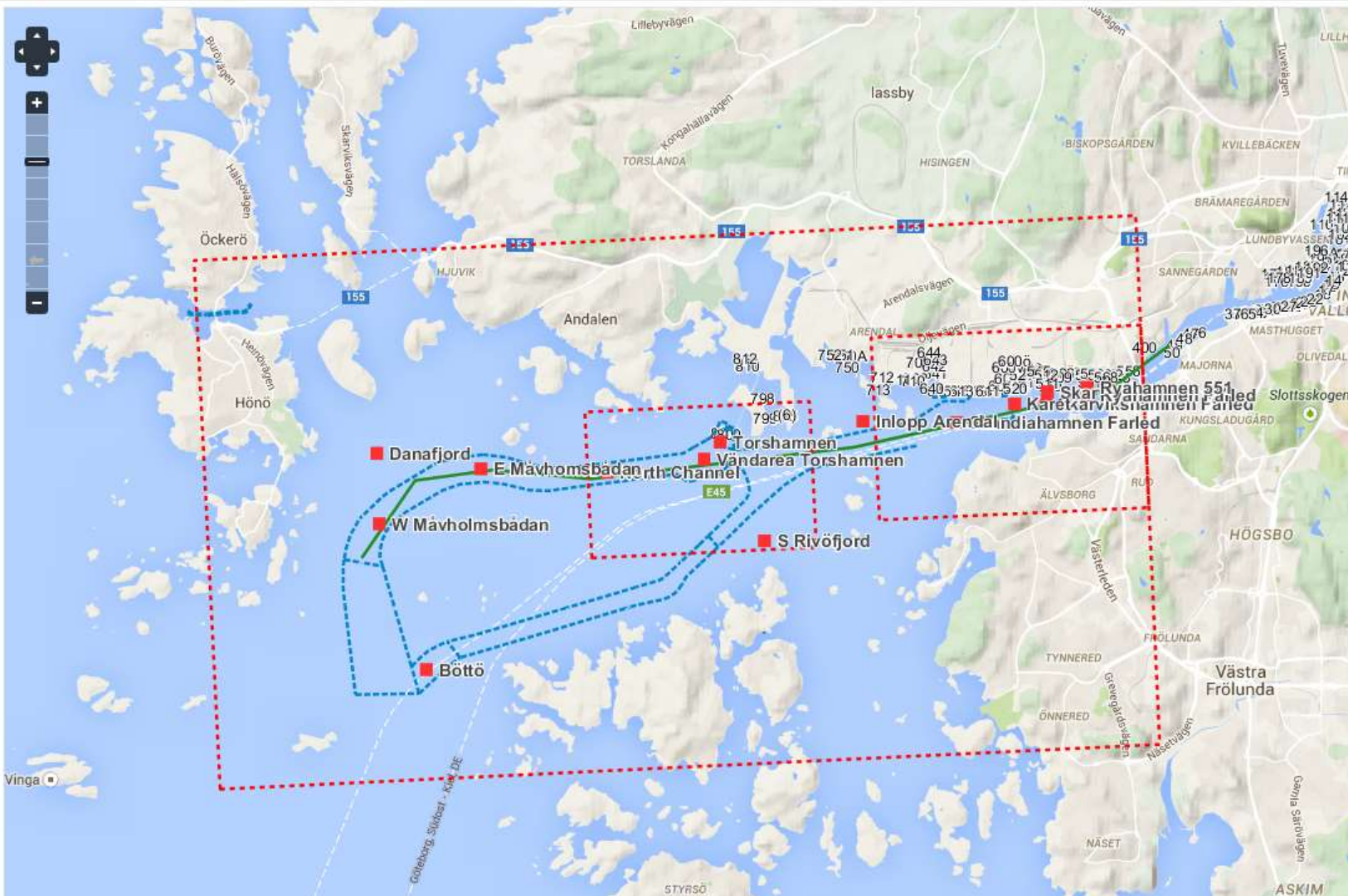
- Google Physical
- Google Streets
- Google Hybrid
- Google Satellite

Select Map Features

- Berth No.
- Navigation Channel
- Density Transect
- Animation Area

Click red square to see time series

Show Default View



Offshore Renewables

- Metocean conditions important for LCOE for offshore wind by
 - Design conditions
 - Installation
 - Operations and Maintenance
- Additional for wave and tidal energy
 - Power ressource estimation
 - Site screeening and selection
- Development of offshore aquaculture

Horns Rev Offshore Wind Power Plant

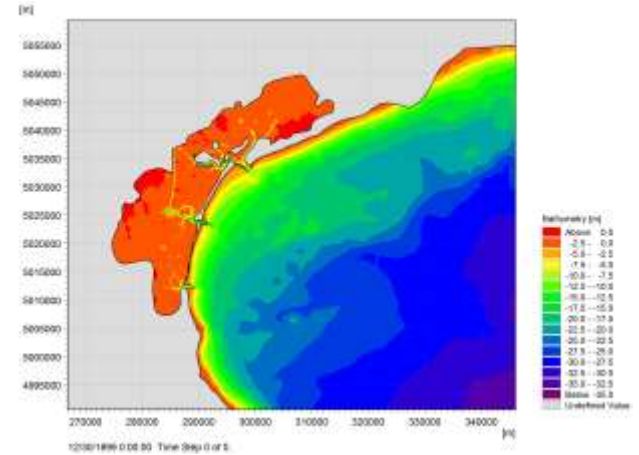


Meygen Inner Sound Tidal Power

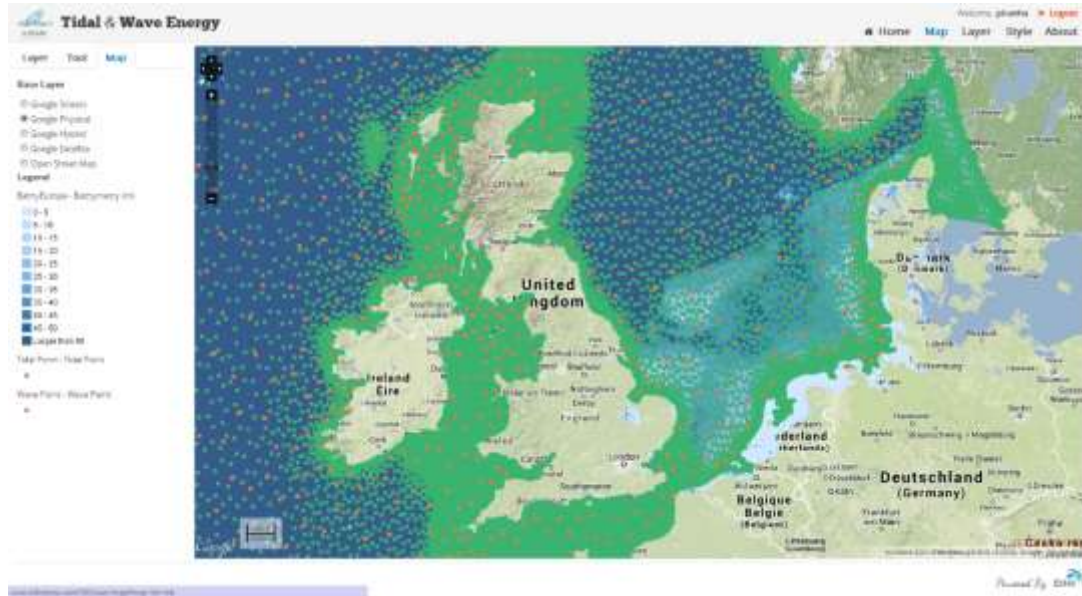


Venezia Lagoon

- Storm surge (Alte Aqua)
- Water level forecast for gate operation
- Complicated navigation through gates
- Water quality issues during gate closure



SI Ocean European resource and constraint map



Hindcast data available 24/7 on waterdata.dhigroup.com

The screenshot shows the WaterData website home page. At the top, there is a navigation bar with 'Home', 'Data search', 'Collections', and 'About'. Below this is a large banner image of a blue wave. A search box is overlaid on the banner, containing the text 'Searching in 30 datasets' and a list of categories: 'ocean', 'forecast', 'weather', 'river', 'temperature', 'growth', 'fish', 'estuary', 'wind', 'flow', 'current', and 'hydrology'. Below the search box is a 'Q Search' button. To the right of the banner, there is a 'Data search' button and a 'Q Search' button. Below the banner, there is a section titled 'WATER DATA FIT FOR USE' with a paragraph of text: 'WaterData not only provides access to a wide range of quality data for water environments, but this portal also provides an access to data ready to fit your project needs. Furthermore, the data comes with recommendations from our experts, who explain how they may be used, and what alternatives exist. This portal is for data related to water - be it flow, energy, environment or usability. We have checked and used all data indexed and available here. It is distributed in formats that are easy to use for both modeling and other analyses. Data sources include model data, measured data (in situ) and remote sensing data. We are always interested to hear about other potential datasets for inclusion, so please feel free to use our online chat portal or email us to ask us your questions or express your views.' Below this text is a section titled 'Featured datasets' with a 'Global Wind Data (CFSR) 1979-2012' entry. The entry includes a 'Global Wind Data (CFSR) 1979-2012' title, a 'Published 2013-01-07 02:35:58 by DHI' date, and an 'Overview of dataset: The Climate Forecast System Reanalysis (CFSR) by the National Centers for Environmental Prediction (NCEP) in the US includes high accuracy wind data for the period 1979-2012.'

The screenshot shows the WaterData website search results page. At the top, there is a navigation bar with 'Home', 'Data search', 'Collections', and 'About'. Below this is a search bar with the text 'CCMP-Cross-Calibrated, Multi-Platform Ocean Wind Velocity Product'. To the right of the search bar are buttons for 'Q Search', 'Map', and 'List'. Below the search bar, there is a section titled 'Result(s)' with 'Found 4 datasets'. Below this is a map of the world showing the location of the datasets. The map is titled 'Global Datasets' and has a 'We are here' sign pointing to the location of the datasets. The map shows the location of the datasets in the Indian Ocean, near the South China Sea. Below the map, there is a 'Chat now' button.

5.3 New current design and forecast data (JEM)



5.5 Climate change services (CLS)



WP 5 - Conclusions

- The WP has developed procedures and models that utilize high resolution EO
- The MIKE 3/21 has been extended with an along-track Data Assimilation. This feature will be released to users in EU and globally
- Data-fusion procedures has been developed to develop combined model EO products for metocean design data. The new data products are available to e.g. ports, the maritime industry or offshore wind developers in EU
- Examples of services using LOTUS related products have been demonstrated





Thank you for your attention ...

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