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

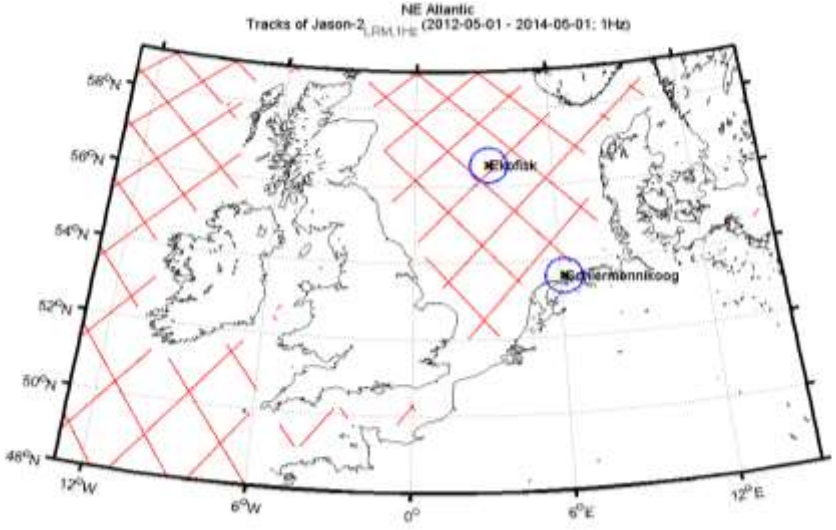
List of deliverables						
Delive-rable Number [61]	Deliverable Title	Lead benefi-ciary number	Estimated indicative person-months	Nature [62]	Dissemi-nation level [63]	Delivery date [64]
D5.1	End-to-end demonstration of improved wave and wind design data	5	4.00	R	PU	24
D5.2	Characterization of coastal 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.

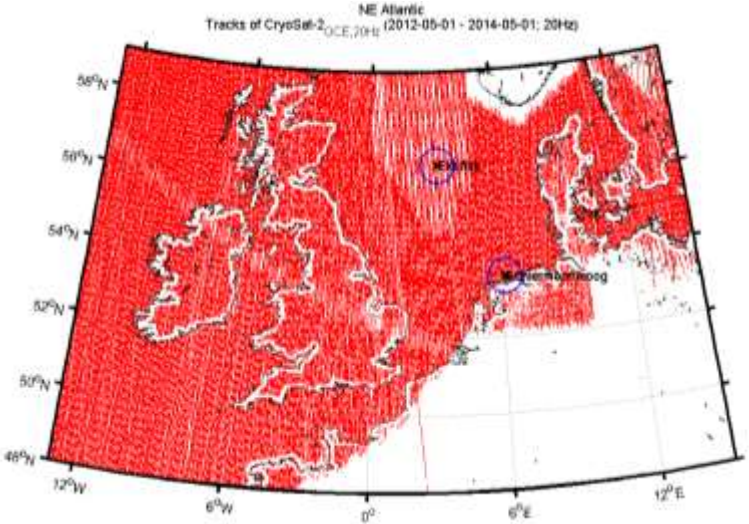
5.1 Improved design data

Altimeter coverage in NE Atlantic (after quality screening)

Jason-2
(LRM, 1Hz) DHI



CryoSat-2
(SAR, 20Hz) STARLAB

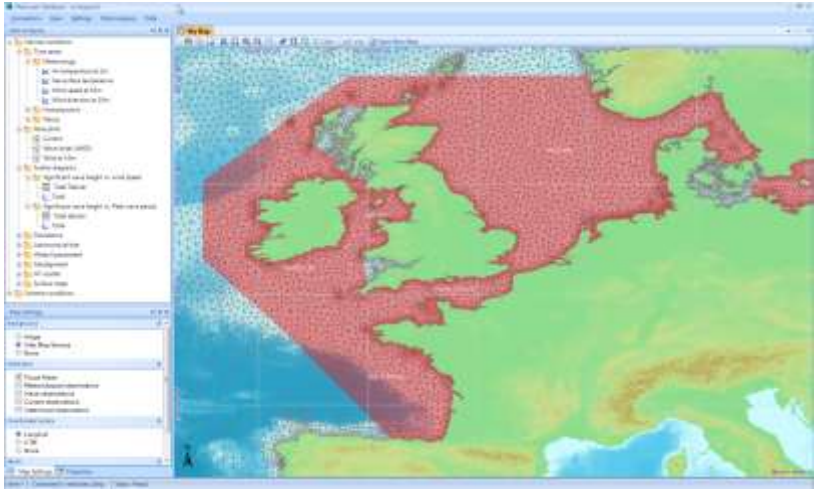


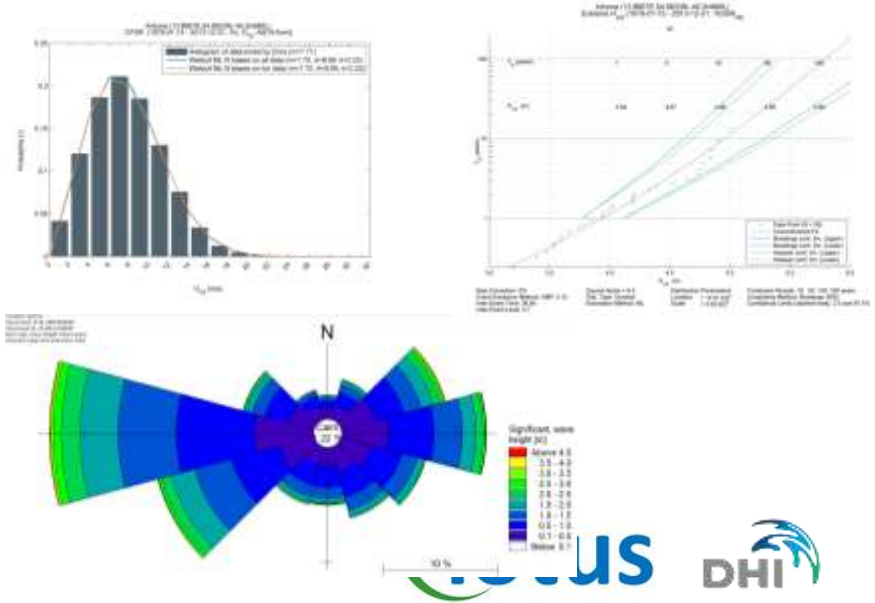
- No data of Norwegian coast
- Data on land (except near coast)
- Strange pattern in Central Northern North Sea

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:

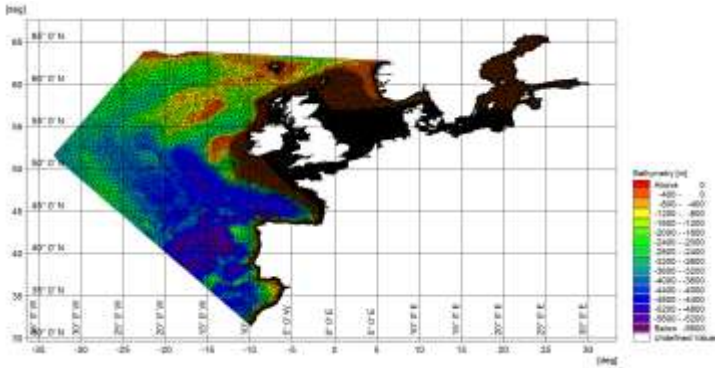


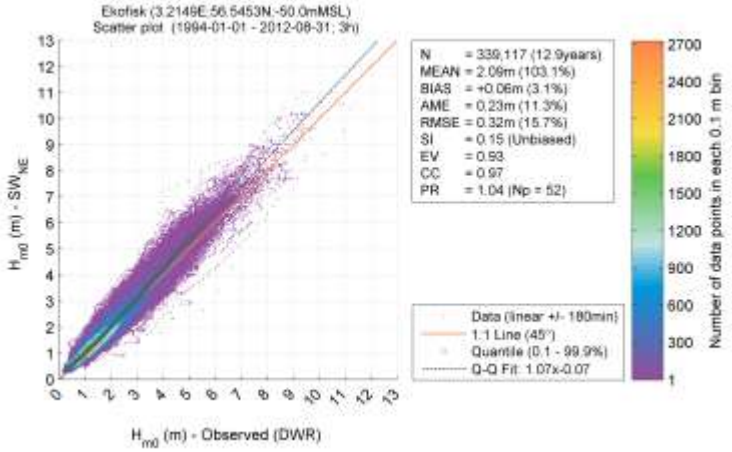


Calibration and validation of numerical models

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.

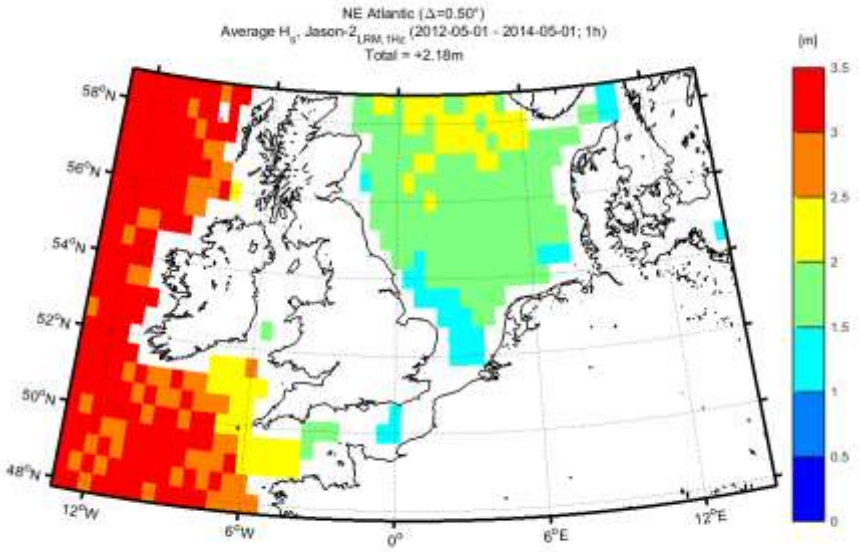
Model data of H_s was adopted from the DHI hindcast database based on a Mike 21 Spectral Wave Model (M21SW) forced by CFSR wind data:



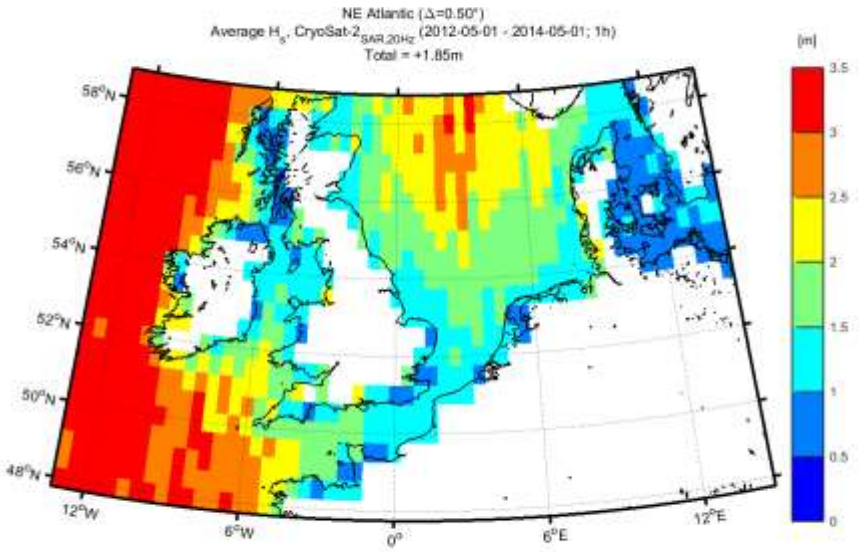


Comparison Average H_s

Jason-2 (LRM, 1Hz) DHI

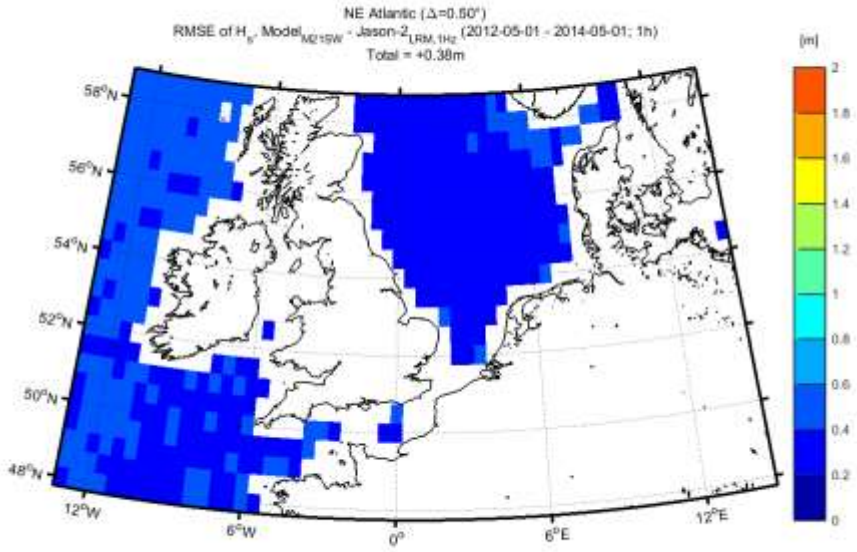


CryoSat-2 (SAR, 20Hz) CLS



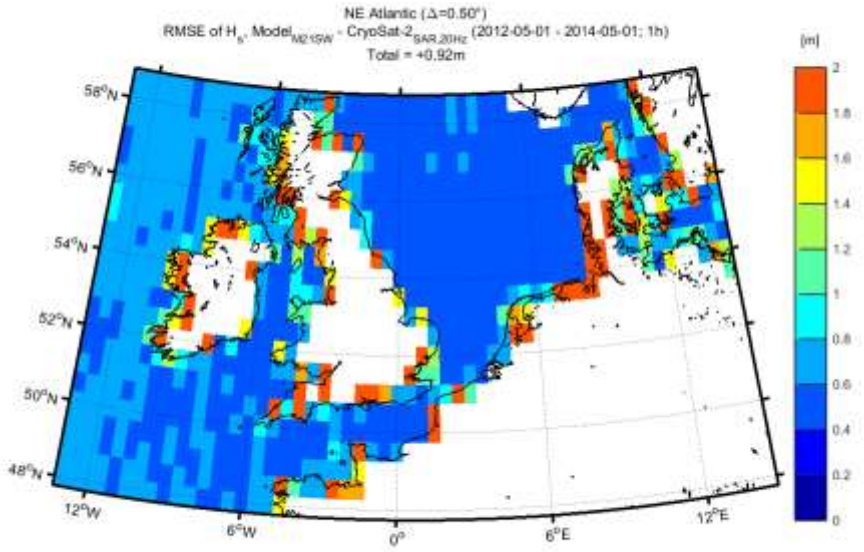
Model-EO RMSE of H_s

Jason-2 (LRM, 1Hz) DHI



- RMSE < 0.4 (North Sea)

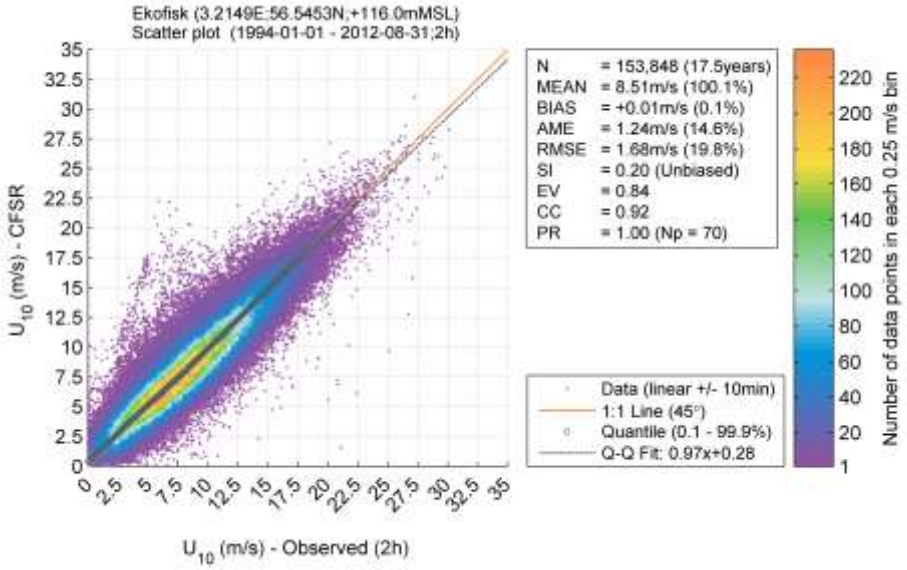
CryoSat-2 (SAR, 20Hz) CLS



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

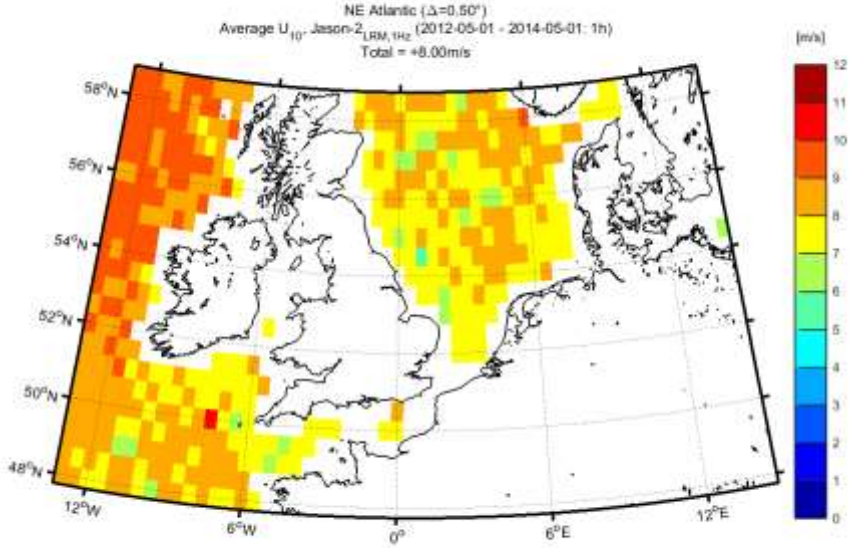
Calibration and validation of numerical models

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

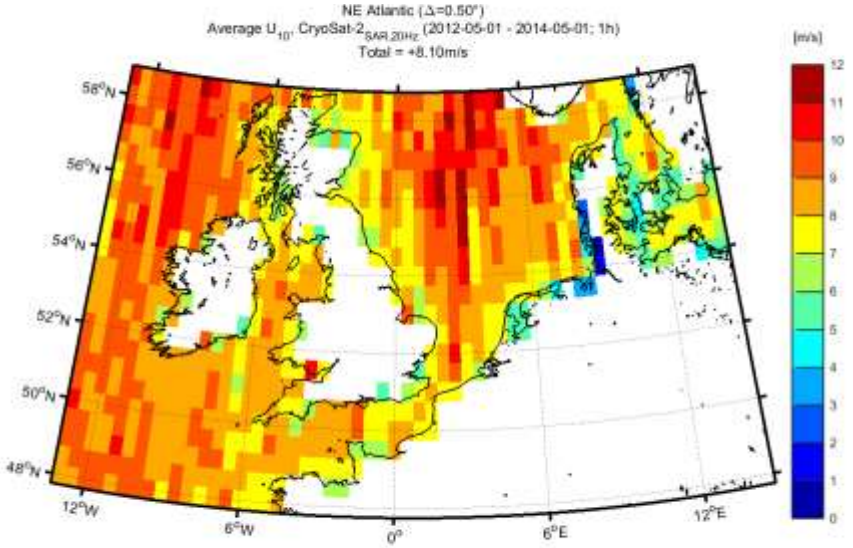


Average U_{10}

Jason-2 (LRM, 1Hz) DHI



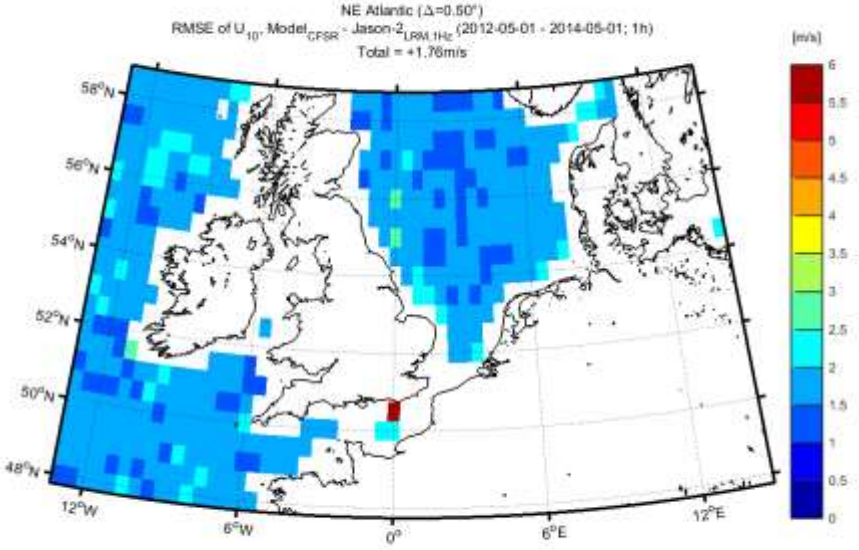
CryoSat-2 (SAR, 20Hz) CLS



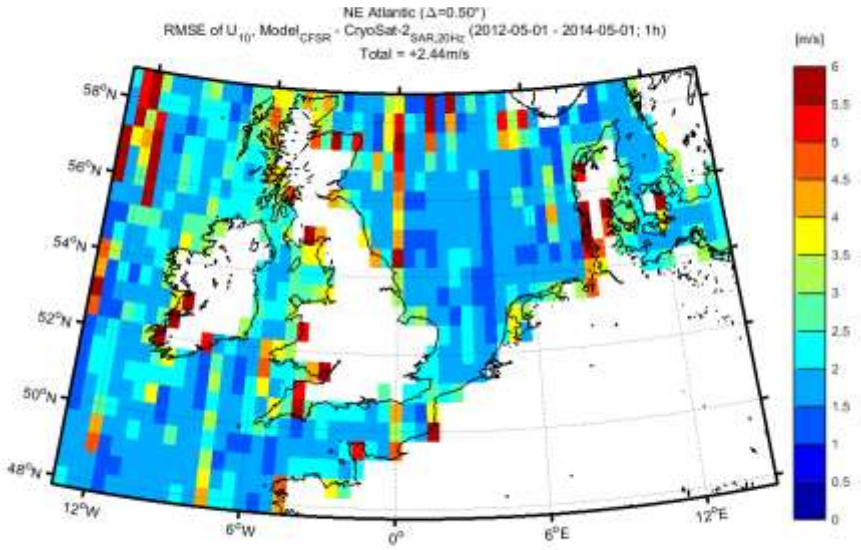
- N_{min} = 200

RMSE of U_{10}

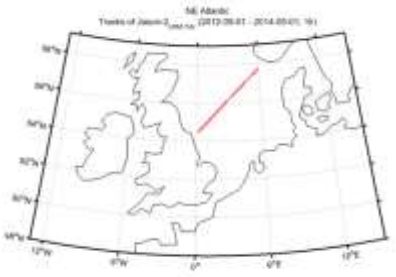
Jason-2 (LRM, 1Hz) DHI



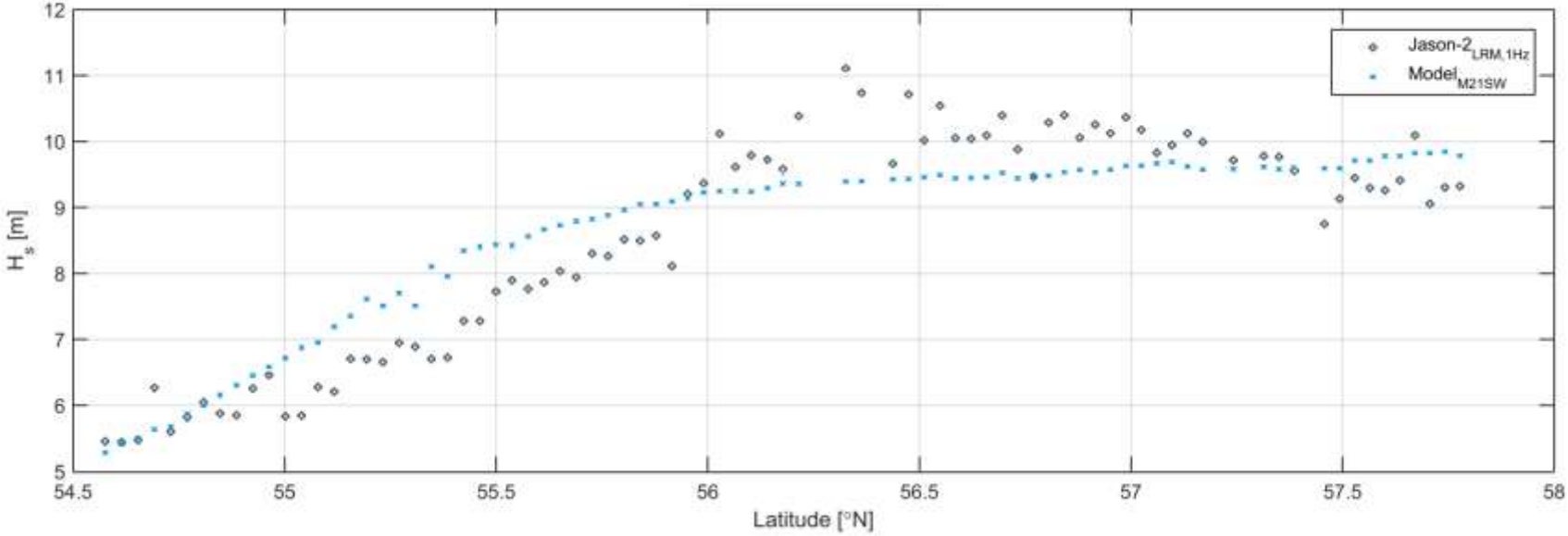
CryoSat-2 (SAR, 20Hz) CLS



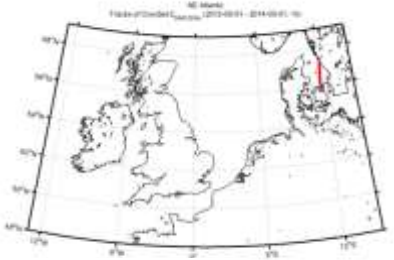
Along track Spatial distribution of extreme waves and wind



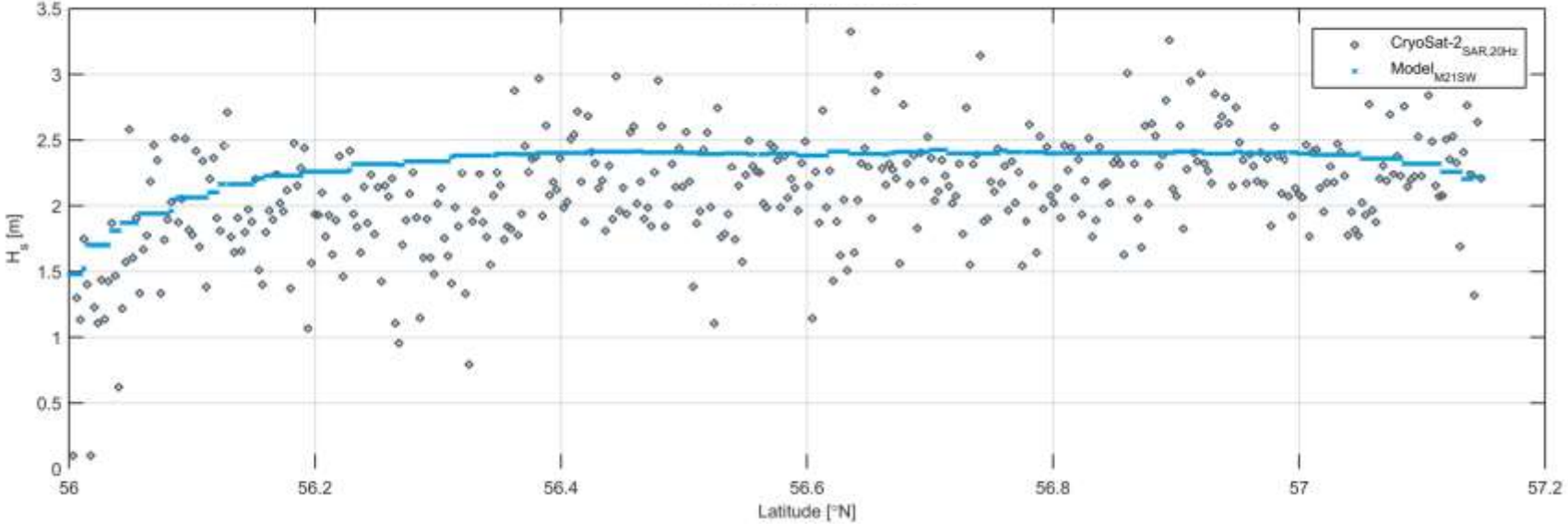
Track during Hurricane ‘Bodil’ (2013-12-05) – North Sea – Jason 2



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

Wave agitation

- Load/Unload
- Ferries
- Mooring

Navigation

- Waves
- Currents
-

Waveenergy testcenter

- Production/Resource
- Operations
- Weather

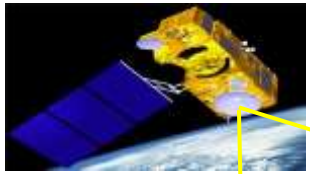
Surfers
(”Cold Hawai”)

- Waves
- Wind
- Tourists

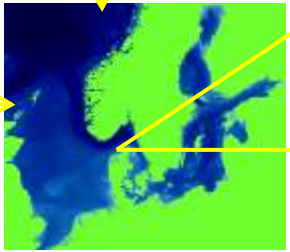
lotus

DHI

Overview

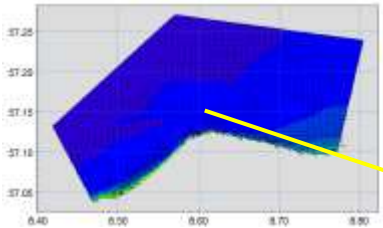


Regional model

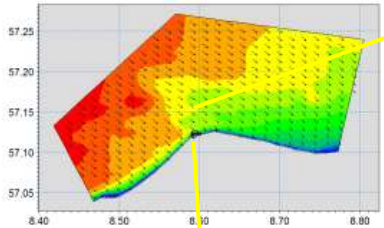


Wind

Local Models

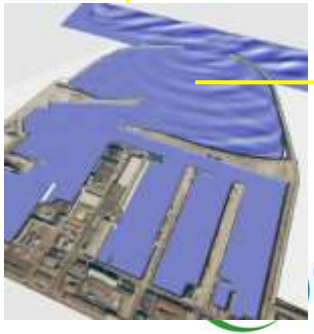


Currents+tides

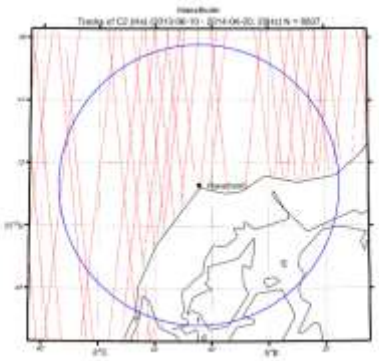


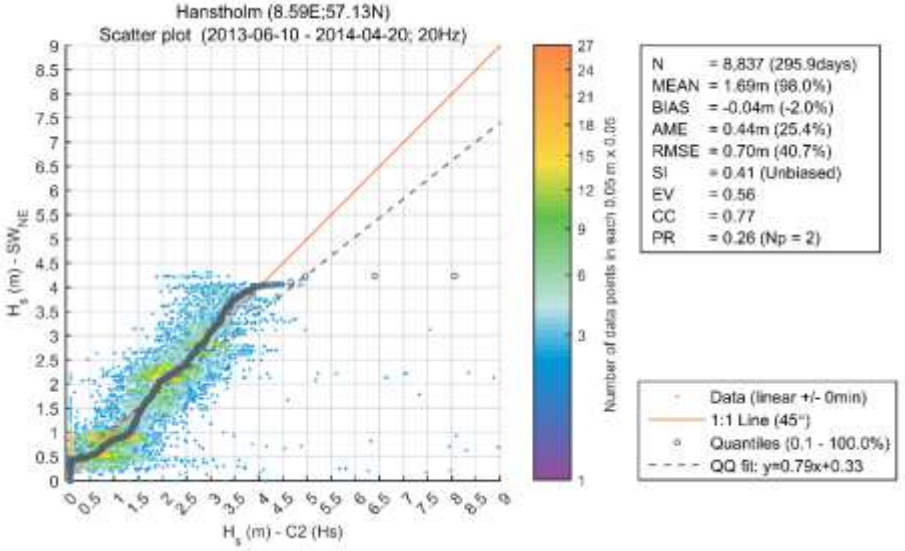
Waves

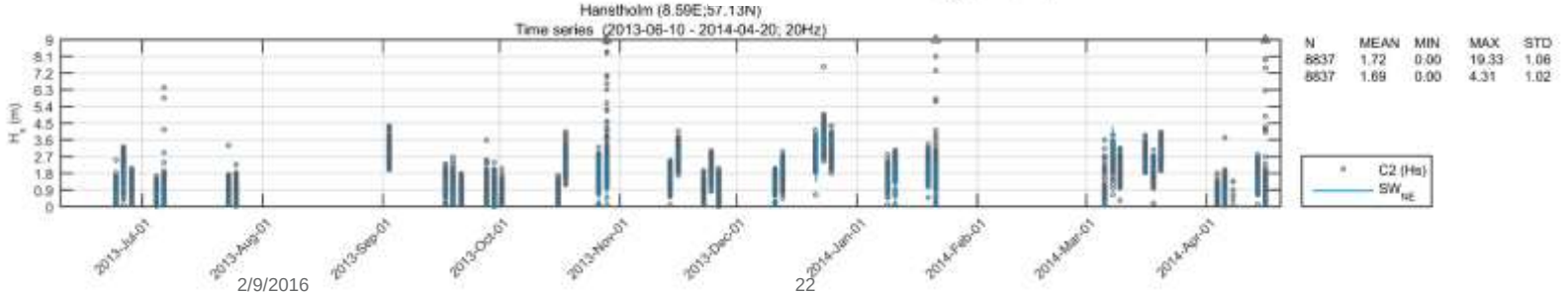
12-hourly update

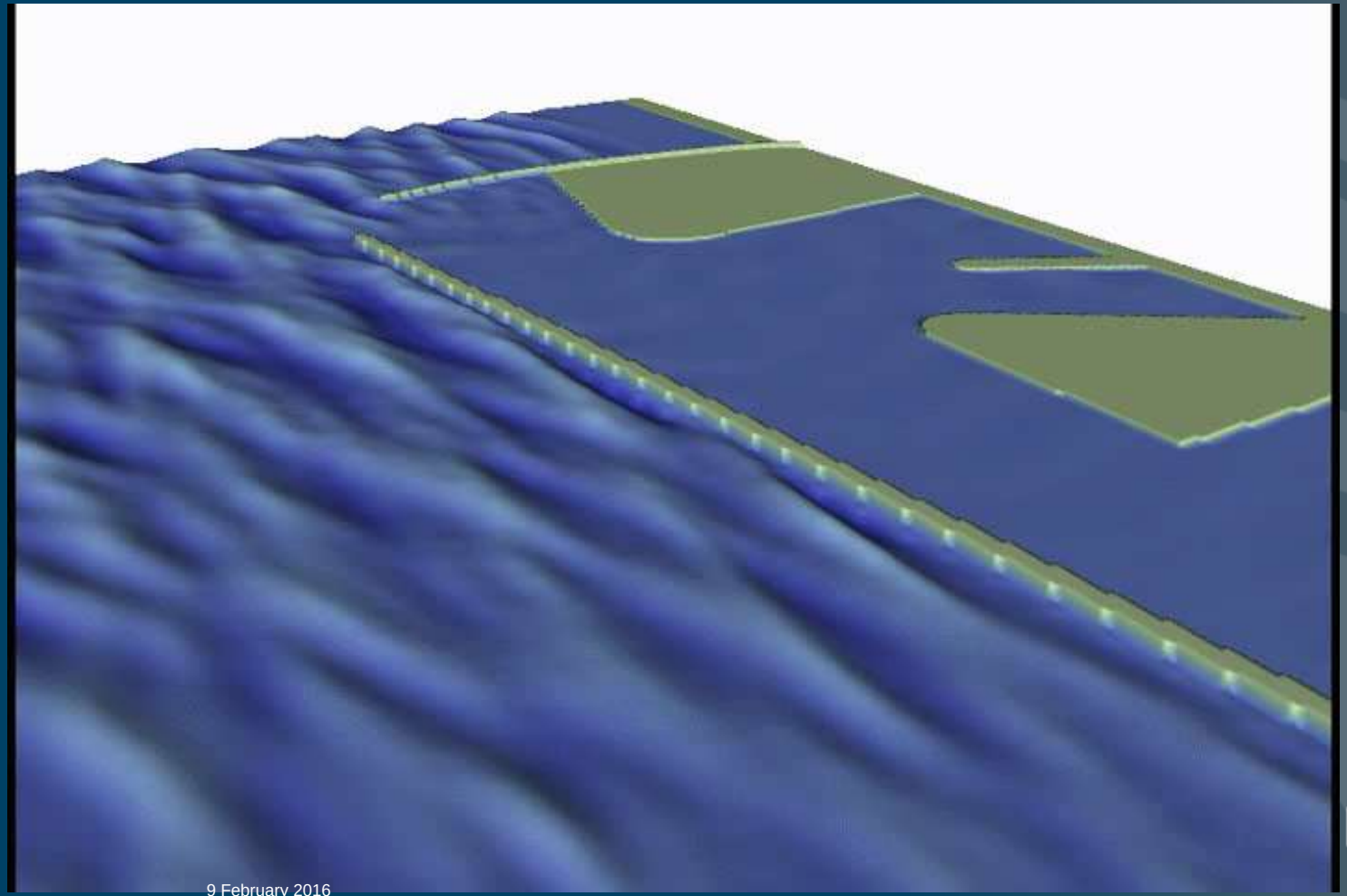


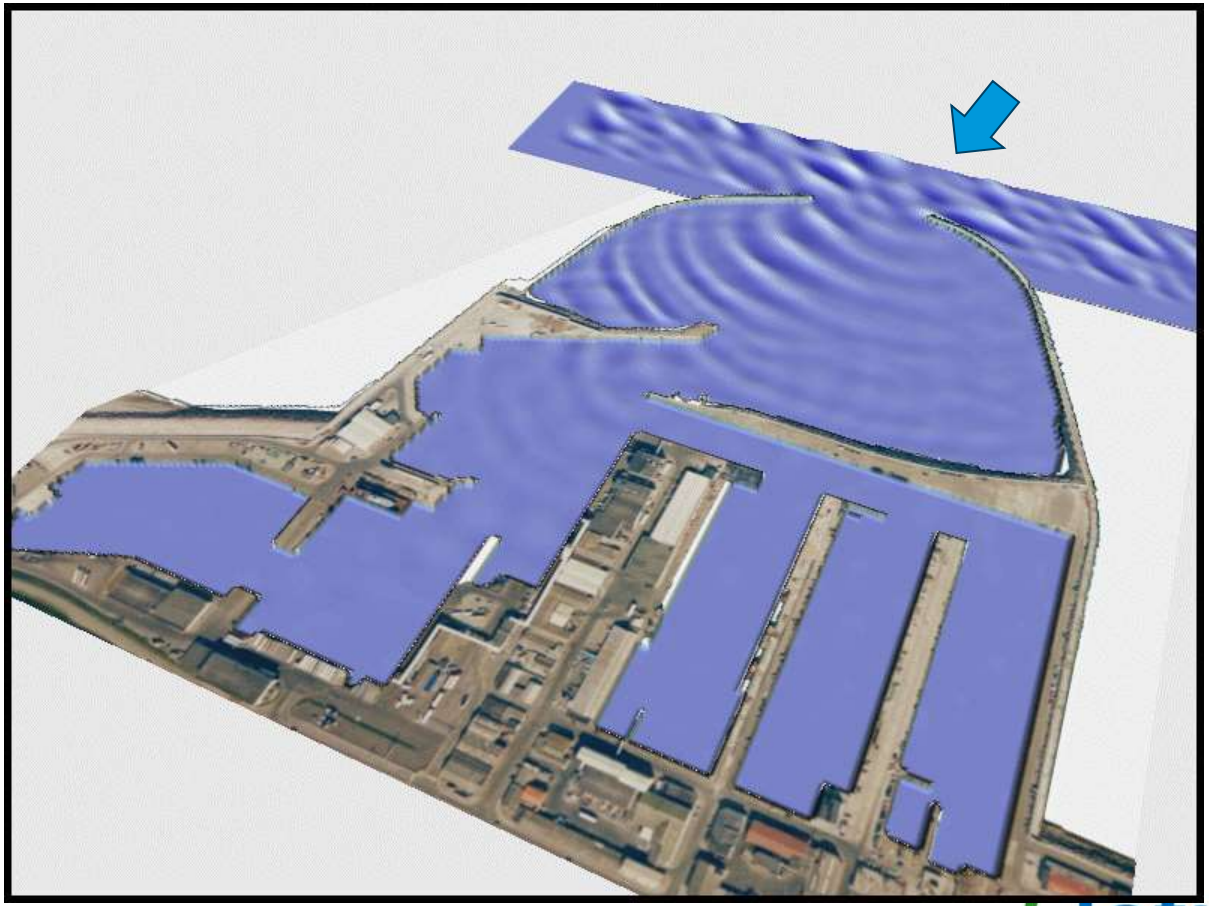
Hanstholm near coastal waves





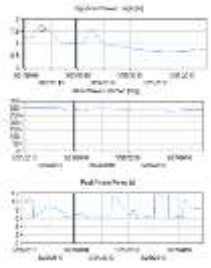




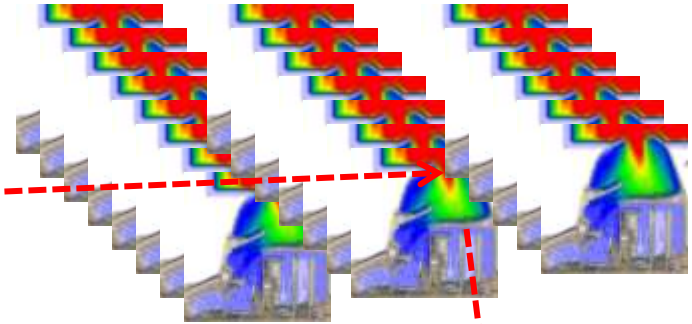


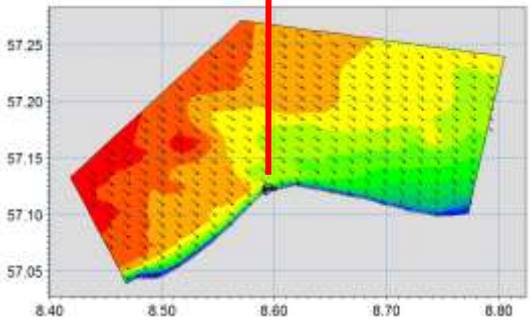
Determine the expected wave conditions inside the port

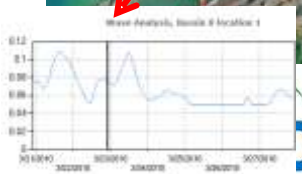
Database



At Entrance:
- Wave height
- Period
- Direction

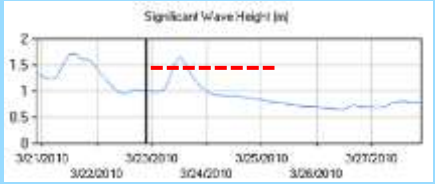






Event Manager

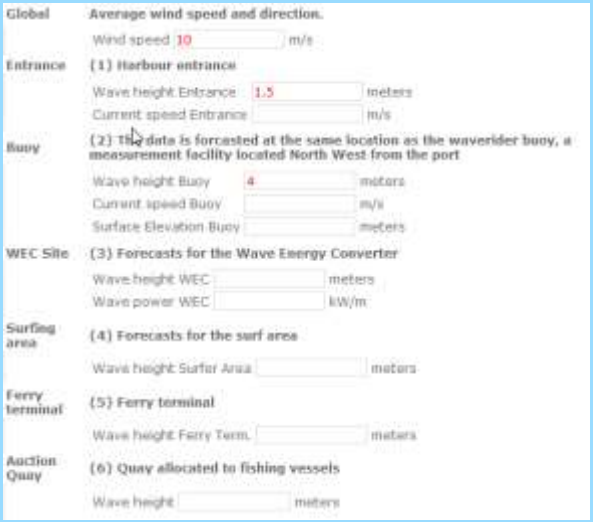
- Objective: to send alerts (Email and SMS) to users when certain parameters are forecasted to exceed user defined values.
- Values are set by the users through a web menu.



Alerts are sent at 14:00

We have chosen 6 parameters to start with.

More can easily be added.



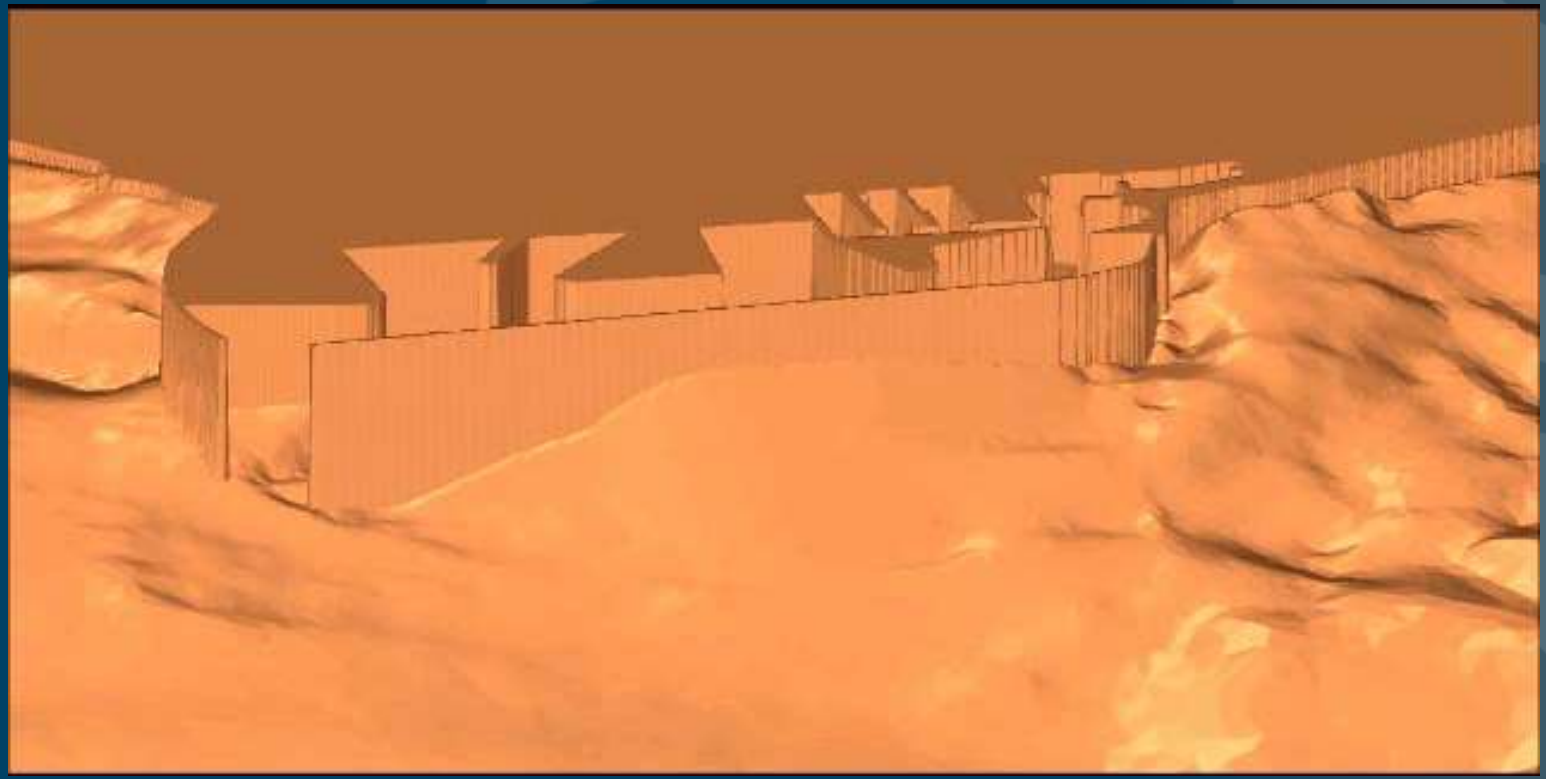
For the coming 48 hours

lotus

DHI

Morphological model of port siltation

Morphological simulation of one design year including an extreme storm event



ect Map Type

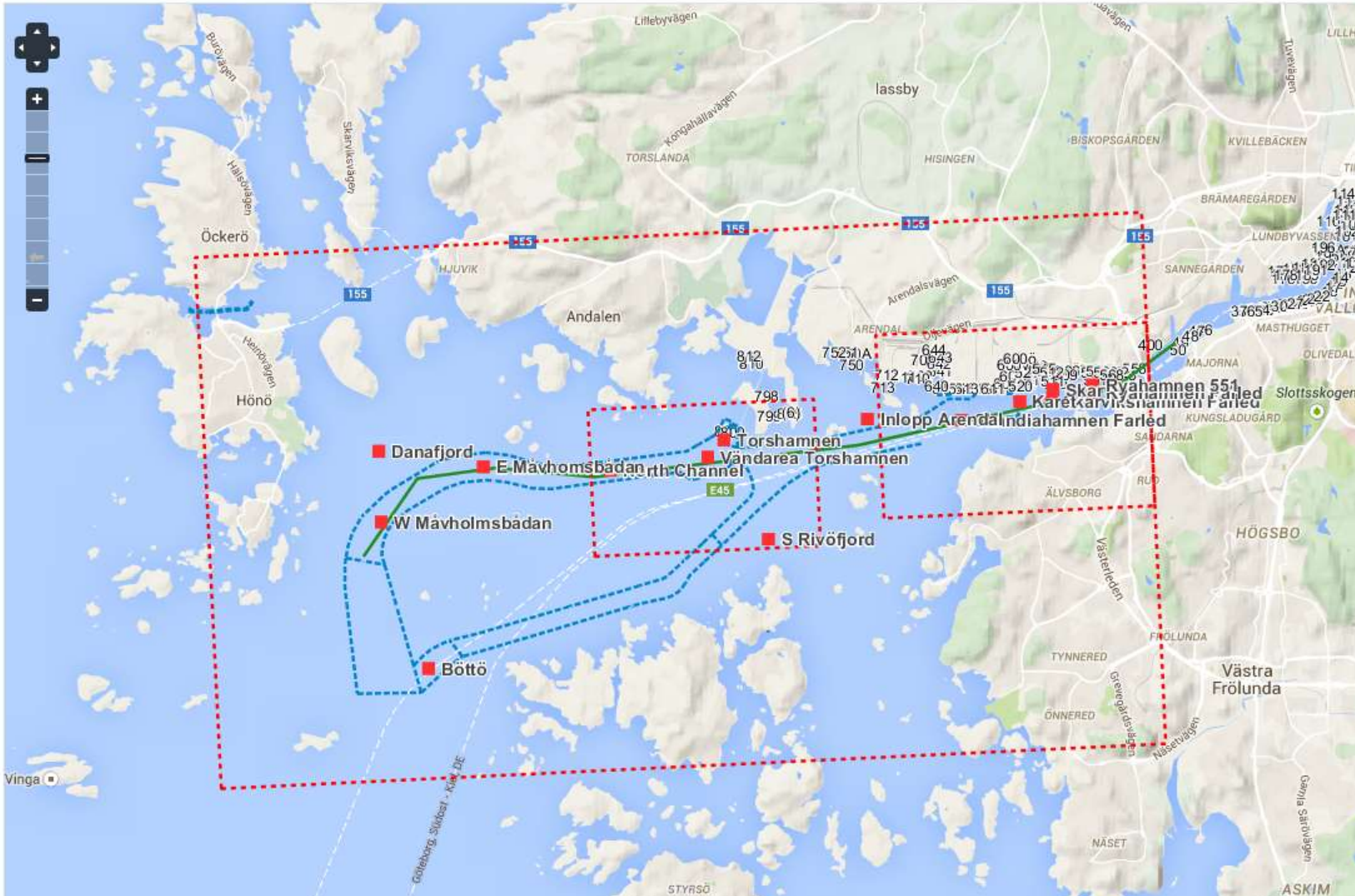
Google Physical
Google Streets
Google Hybrid
Google Satellite

ect Map Features

Berth No.
Navigation Channel
Density Transect
Animation Area

k red square to see time series

Show Default View



Offshore Renewables

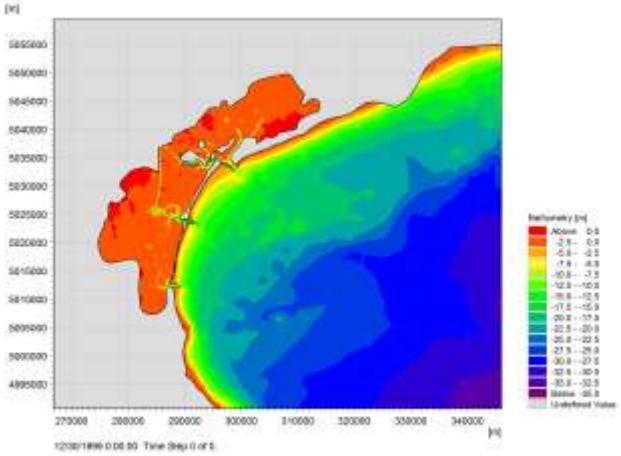
- Metocean conditions important for LCOE for offshore wind by
  - Design conditions
  - Installation
  - Operations and Maintenance
- Additional for wave and tidal energy
  - Power ressource estimation
  - Site scrfeening and selection
- Development of offshore aquaculture

Horns Rev Offshore Wind Power Plant

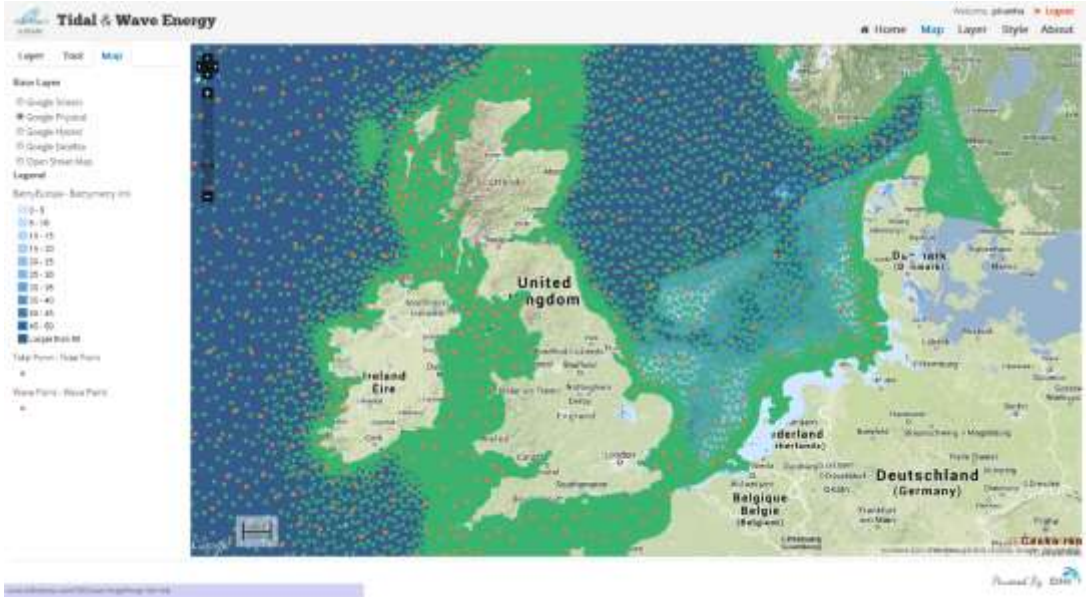
Meygen Inner Sound Tidal Power

Venezia Lagoon

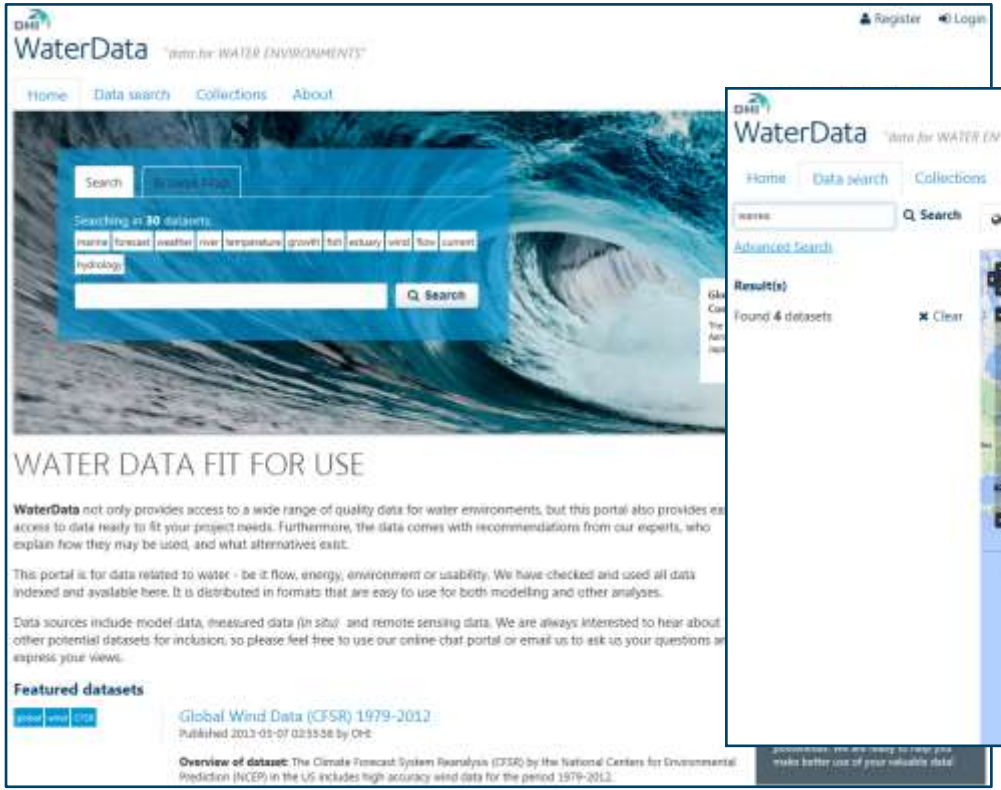
- Storm surge (Alte Aqua)
- Water level forecast for gate operation
- Complicated navigation through gates
- Water quality issues during gate closure

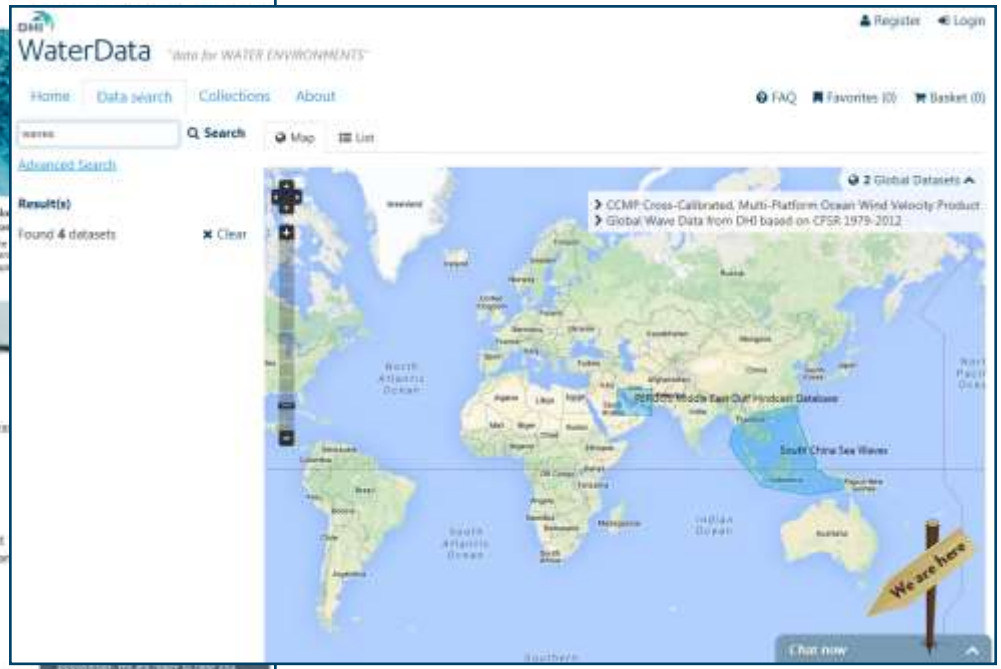


SI Ocean European ressource and constraint map



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





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 …

Ole Svenstrup Petersen (osp@dhigroup.com)