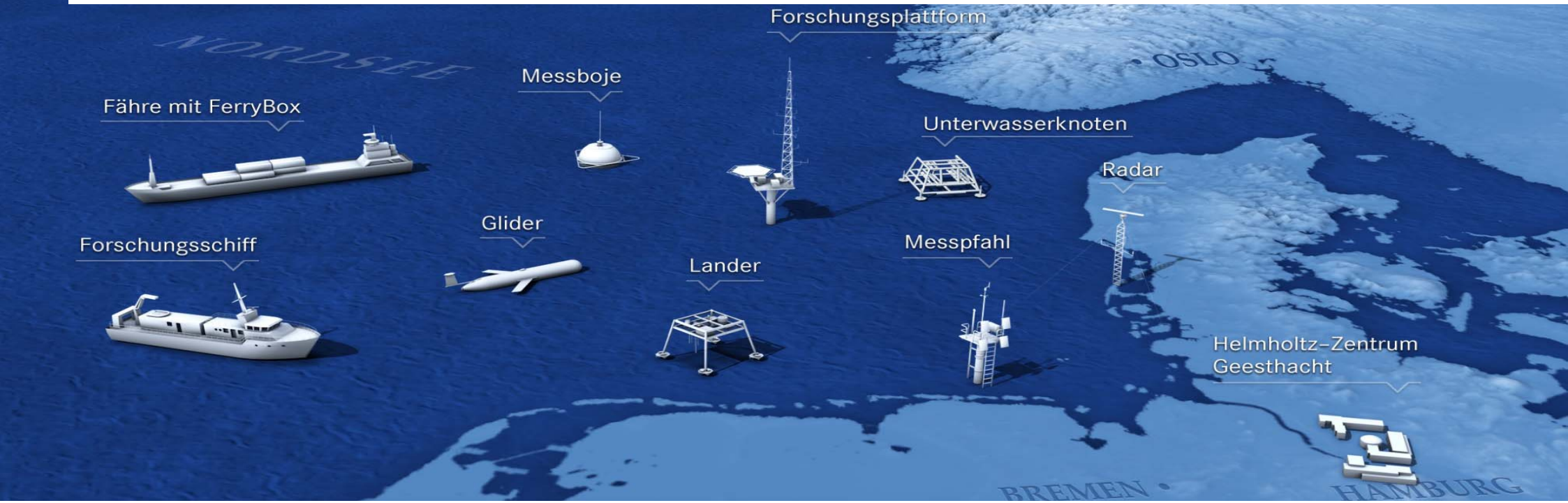
The Coastal Observing System for Northern and Arctic Seas (COSYNA): Challenges and Solutions for an Integrated Measurement and Modelling Approach

Holger Brix



Co-Authors: Burkard Baschek, Gisbert Breitbach, Christiane Eschenbach, Jochen Horstmann, Wilhelm Petersen, Rolf Riethmüller, Friedhelm Schroeder, Emil Stanev, and Johannes Schulz-Stellenfleth

Helmholtz-Zentrum Geesthacht
Zentrum für Material- und Küstenforschung


COSYNA

COSYNA and its Partners

Helmholtz-Zentrum Geesthacht
Zentrum für Material- und Küstenforschung

Partners and Co-Operation

- During Phase I, “hardware” financed by the Helmholtz-Zentrum Geesthacht (HZG)
- Building on a community system of external partners from universities, research centres and authorities to run and develop measurement network
- Harmonization with other European observing systems
- Organisation through working groups on
  - Science
  - Data management
  - Instrument Systems (e.g., Underwater Nodes)

Landesbetrieb für Küstenschutz, Nationalpark und Meeresschutz Schleswig-Holstein
BSH Bundesamt für Seeschiffahrt und Hydrographie
marum The ocean in depth!
GEOMAR
NLWKN
Zentrum für Marine und Atmosphärische Wissenschaften
ICBM
AWI Alfred-Wegener-Institut für Polar- und Meeresforschung in der Helmholtz-Gemeinschaft
BAW Bundesanstalt für Wasserbau Kompetenz für die Wasserstraßen

From Measurements to Products, Information, and Science

The integrated approach:

- **Measurement data**
  - from a variety of platforms
- **Products**
  - from a combination of measurements and numerical models (data assimilation)
- **Data**
  - publically available through data portals
- **Information**
  - provided in usable form for stakeholders and the public
- **Science**
  - use of all of the above to tackle scientific questions

Fixed Stations

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Hörnum

Cuxhaven

Elbe-HPA

FINO-3

COSYNA-Infrastructure for complex long-time observations

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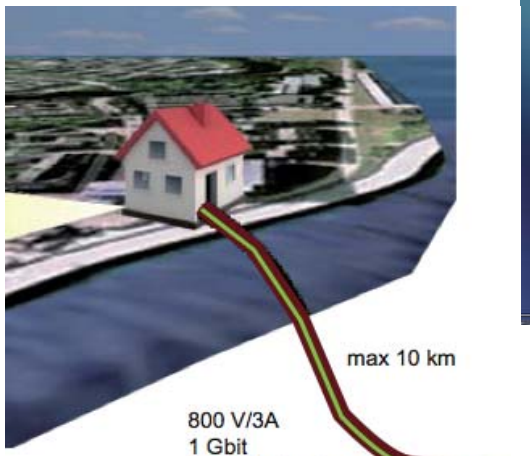
WLAN (300Mbit/s) connection to land (AWI → HZG)



REMOS1

3D in-situ-image recognition → fish

MOKI zooplankton recorder

ADCP/CTD/Turb/Fluo/O_2

SedObs & NusObs

energy & material fluxes

bottom – water column

Surface Transects: The FerryBox

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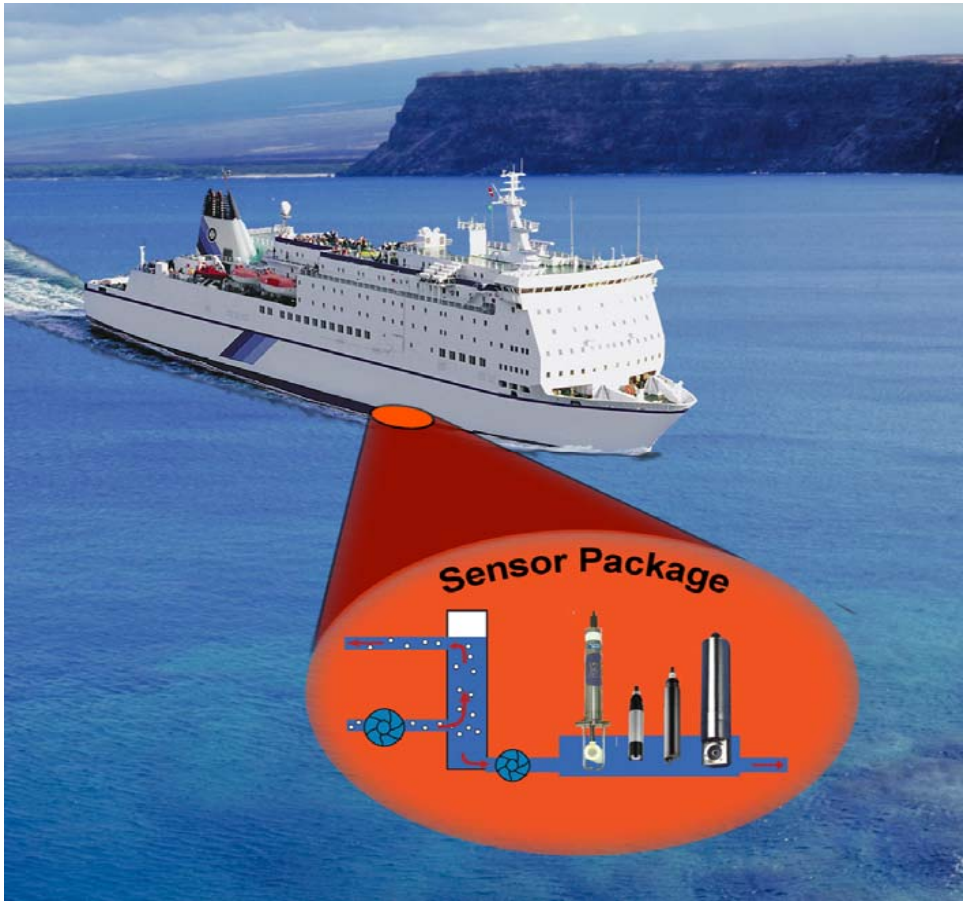
Monitoring system designed to:

- *measure key quantities automatically on board of ferries or other ships of opportunity*
- *regular routes or stationary*
- *transmit data automatically to land*



Cruise liner “MeinSchiff3“
Recent Chlorophyll-a Data from April 2015

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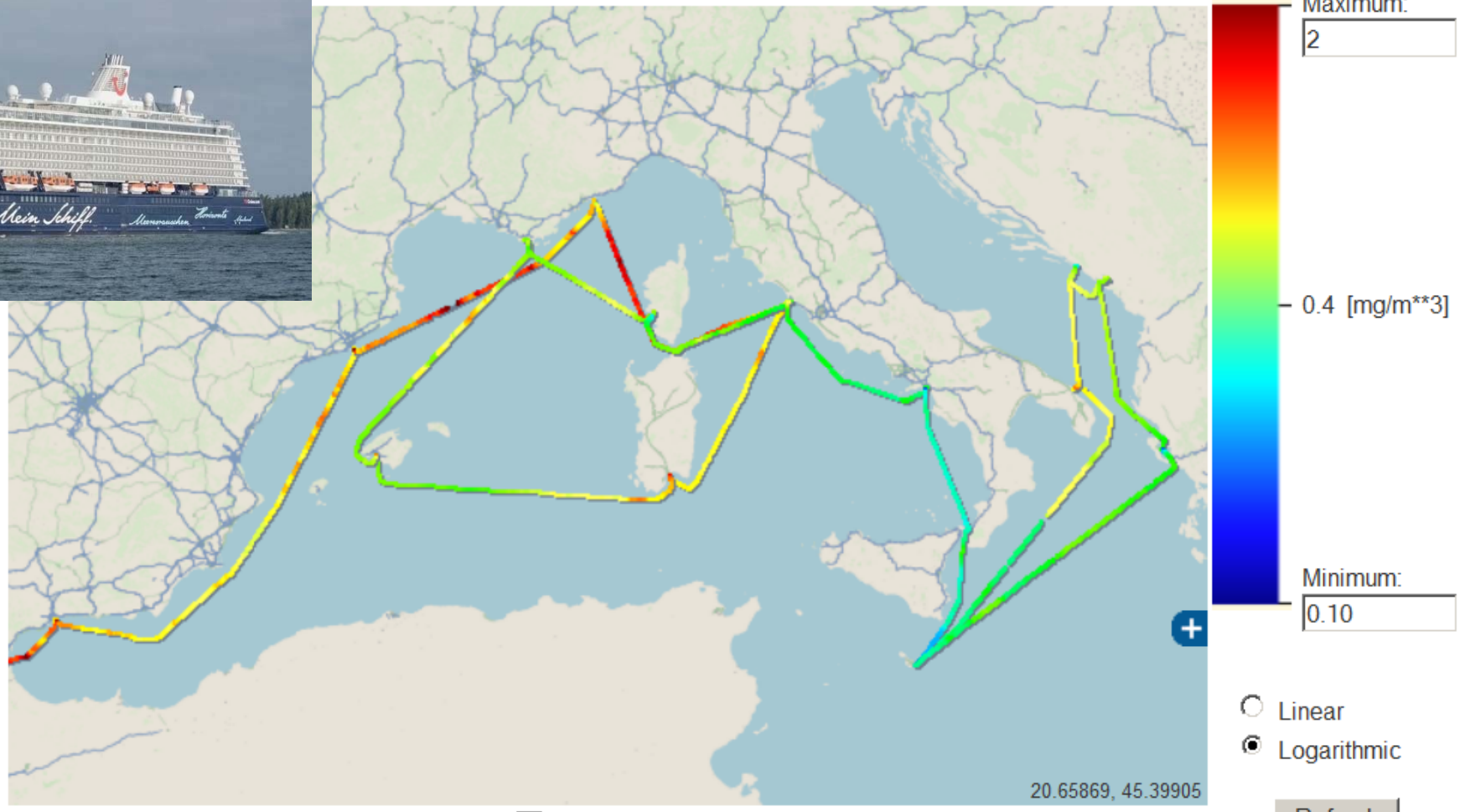
Date range: 28.03.2015 - 28.04.2015

Modify size: − + Click and drag for panning. <SHIFT>-click and drag for zooming.

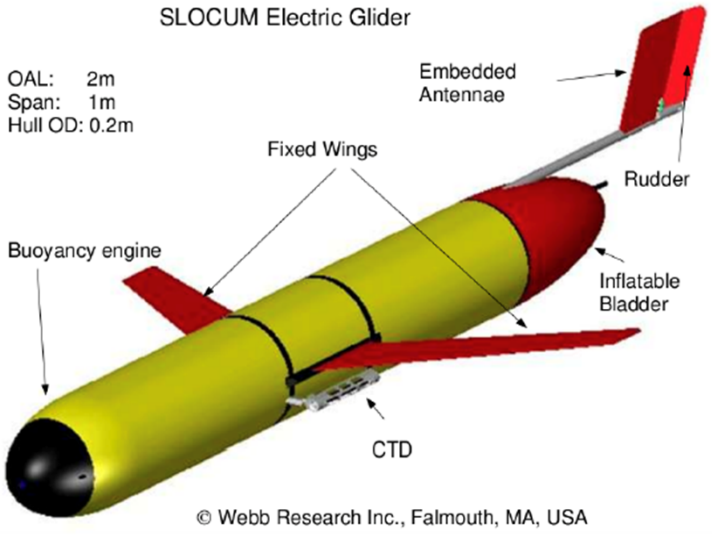


Platforms:

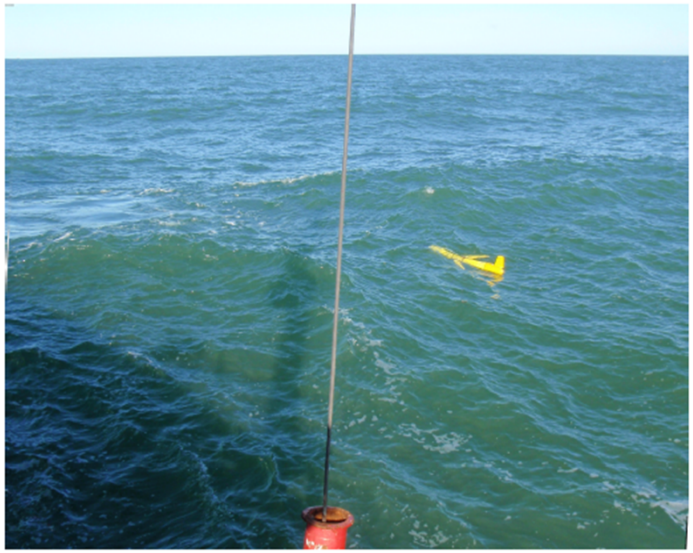
show **Ferrybox on MeinSchiff3 provided by TUI and HZG**

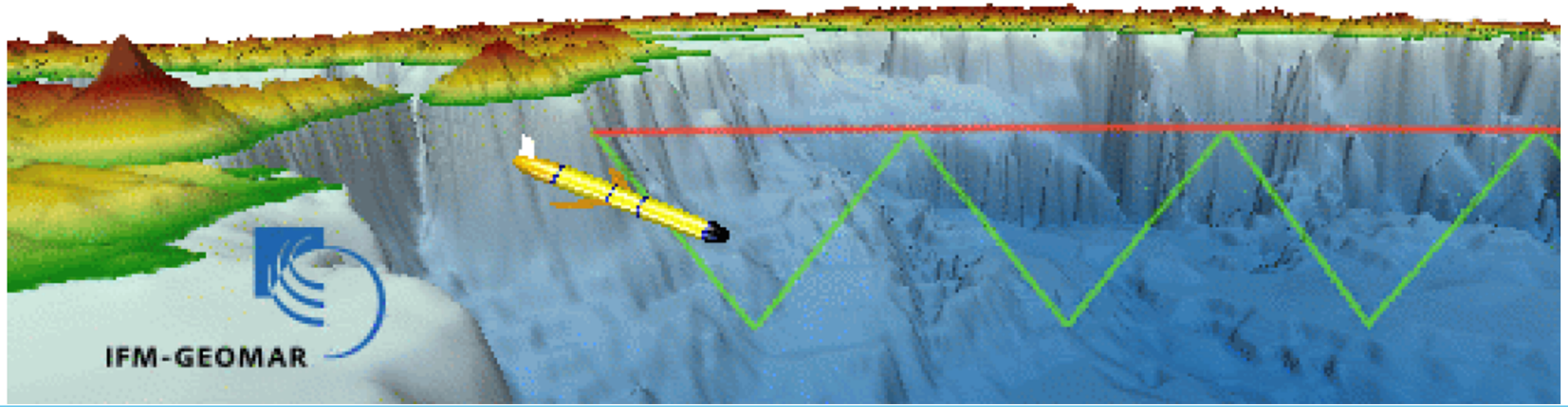
Gliders

The underwater glider



Amadeus





Scanfish

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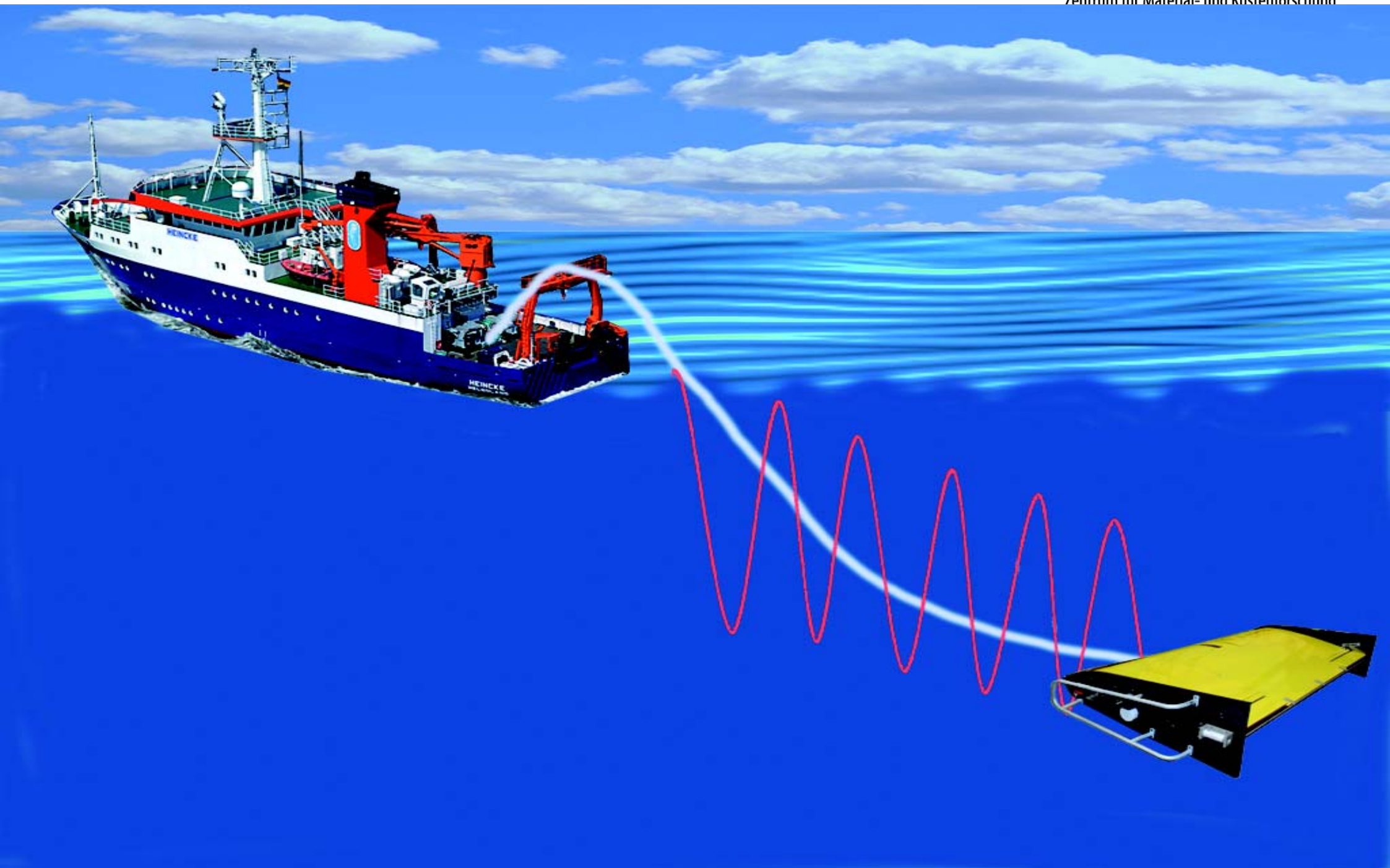

Current Maps and Predictions

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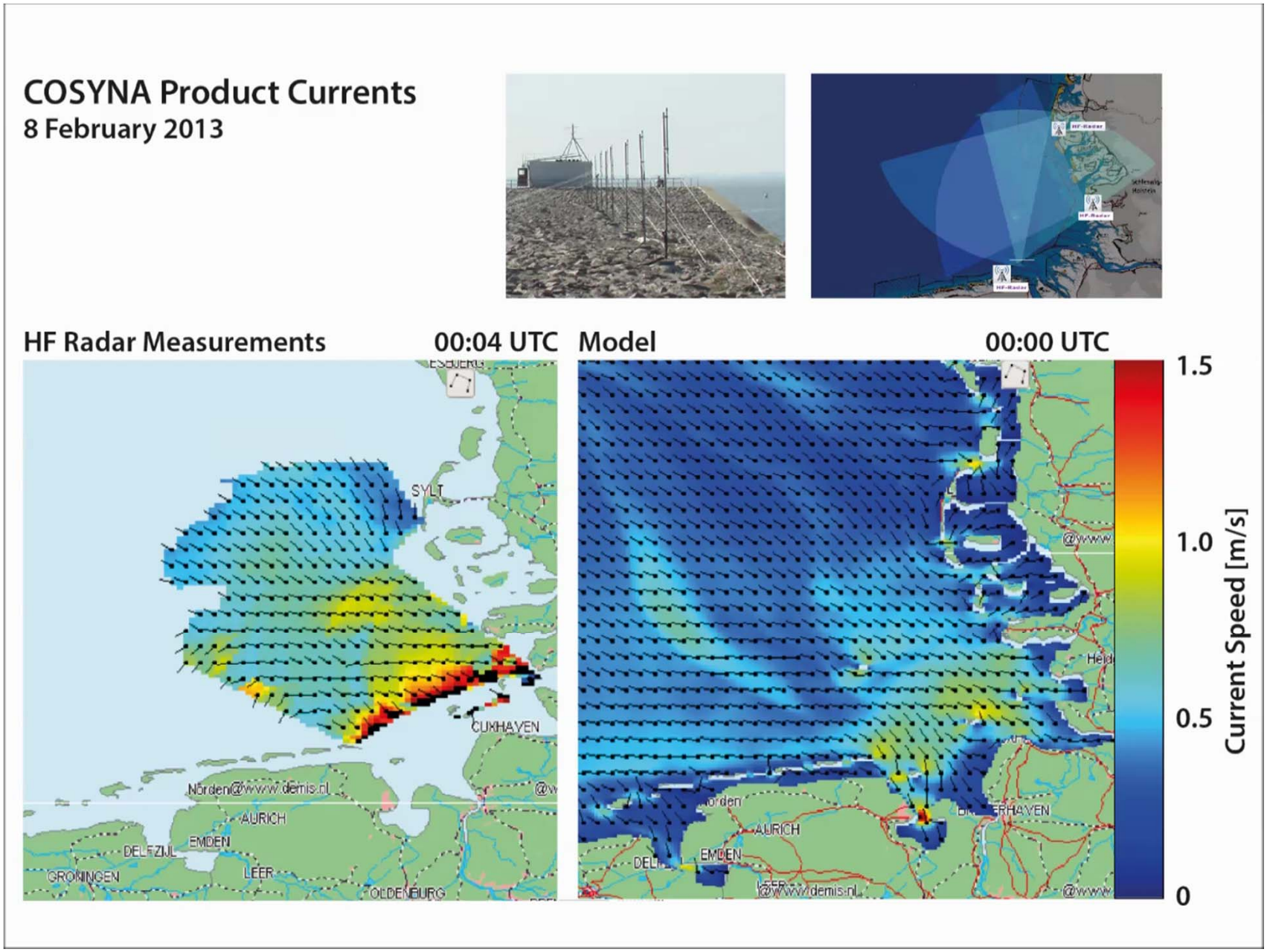

Comparison of model and measurements

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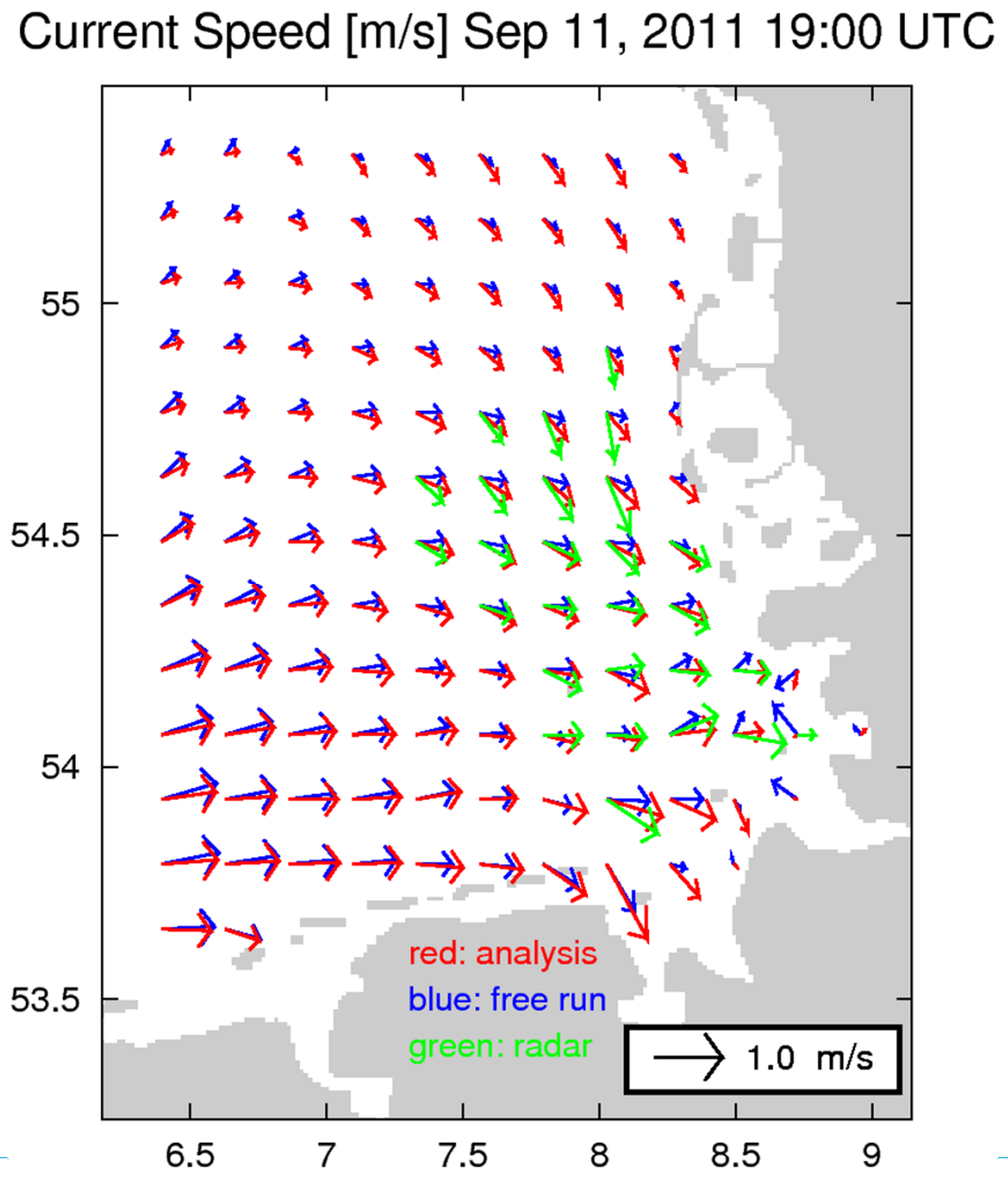

Validation

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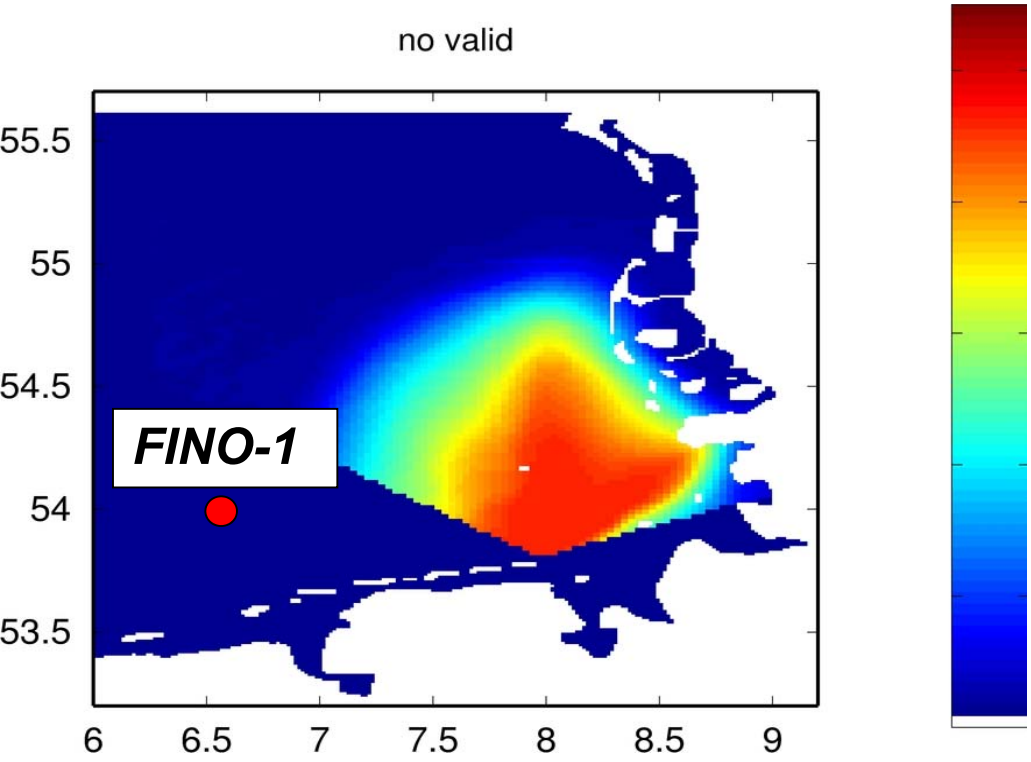

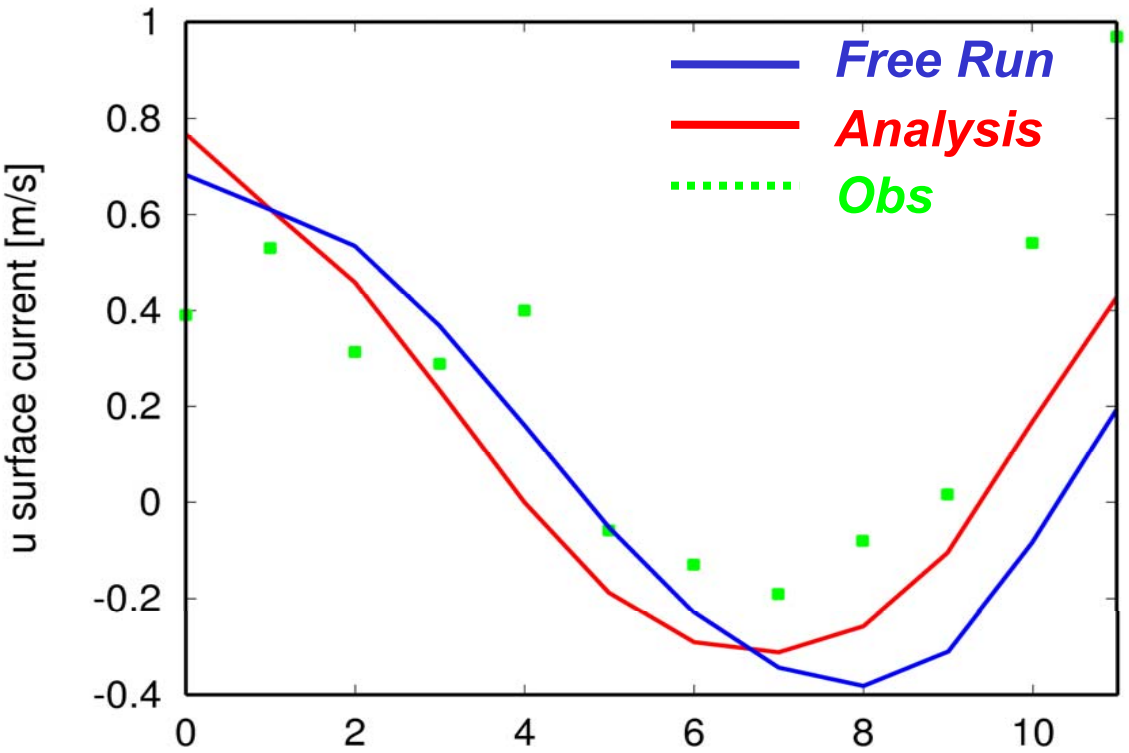

Combined Measurements

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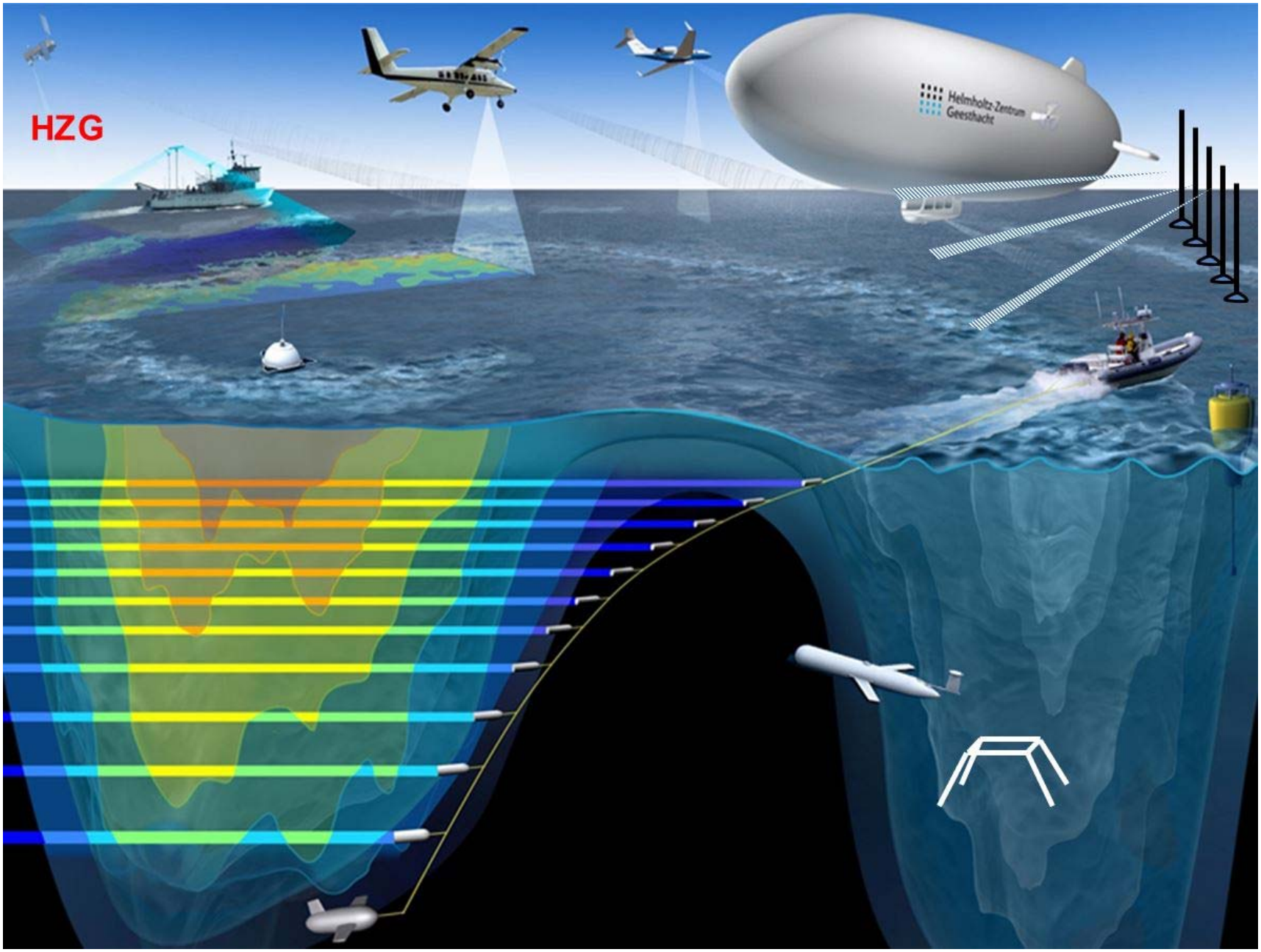

Integrated Approach

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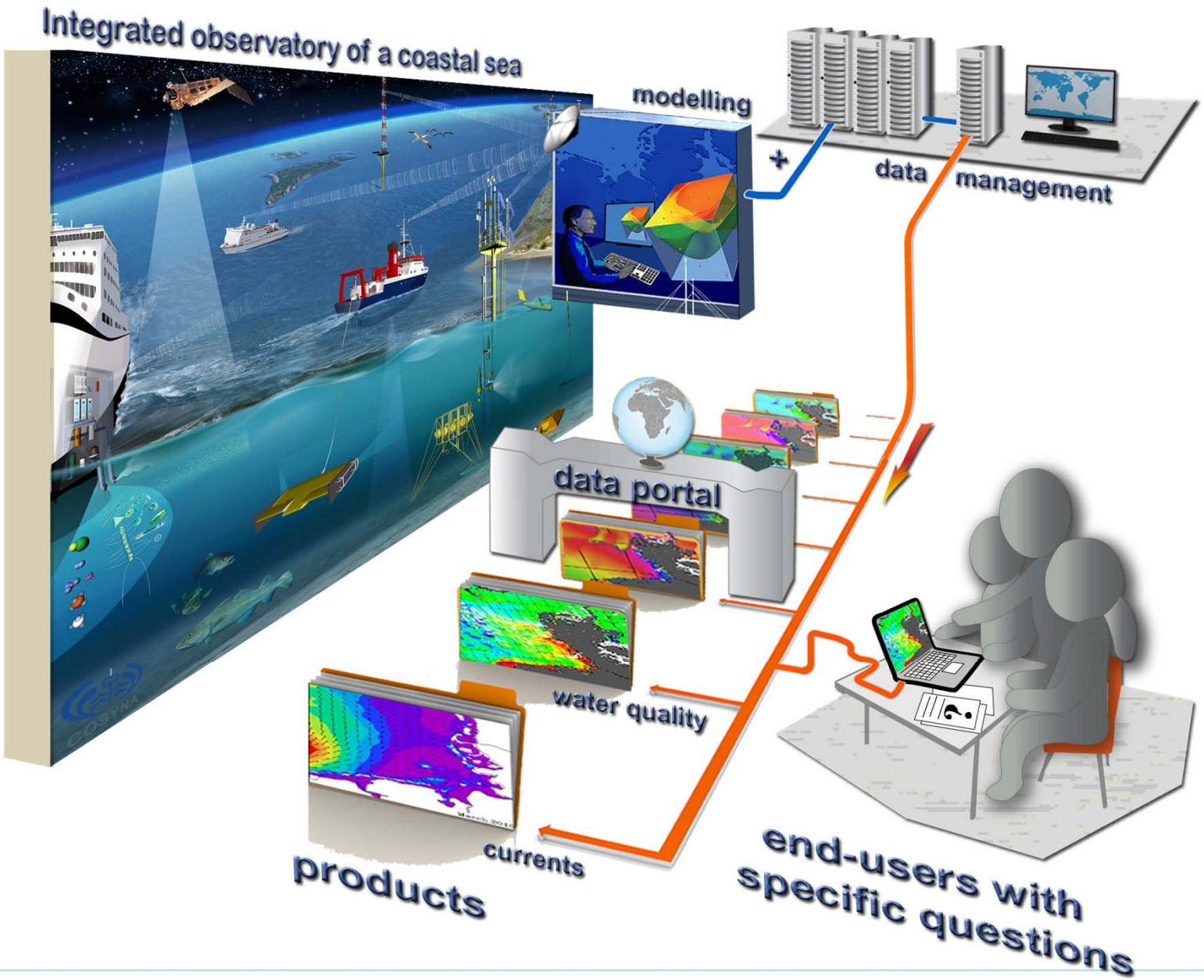

Challenges

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- **From data to useful information**
  - translating data into useful information for users
- **Ensuring data quality**
  - make measurements of high quality comparable and useful
- **Connect science and observations**
  - ensure mutual feedback between scientific questions and instrument development and use
  - keep approaches open for interdisciplinary questions
  - coordinate partners
- **Transfer local / regional knowledge to a larger scale**
  - investigate the importance of coastal regions for regional and global scales

Integrated Approach

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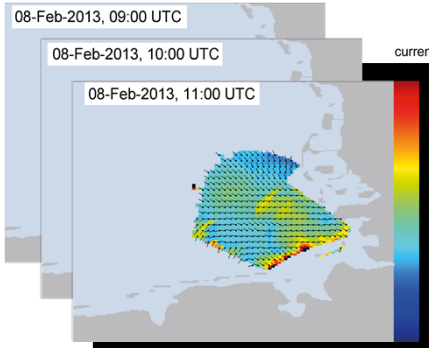
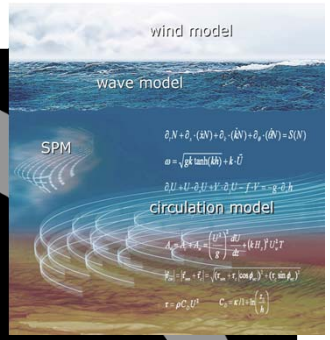
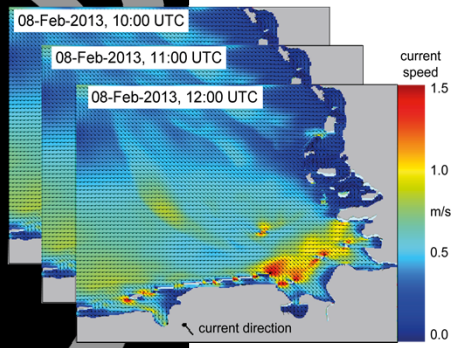
Observations



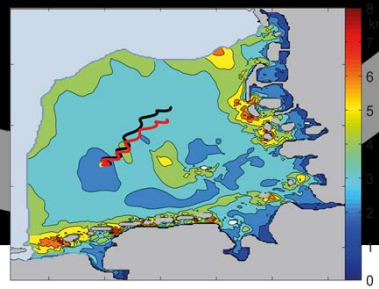
Models & Data Assimilation



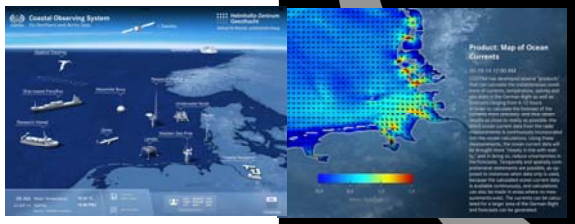
Products



Forecast Quality



Applications



Example: Offshore Windparks

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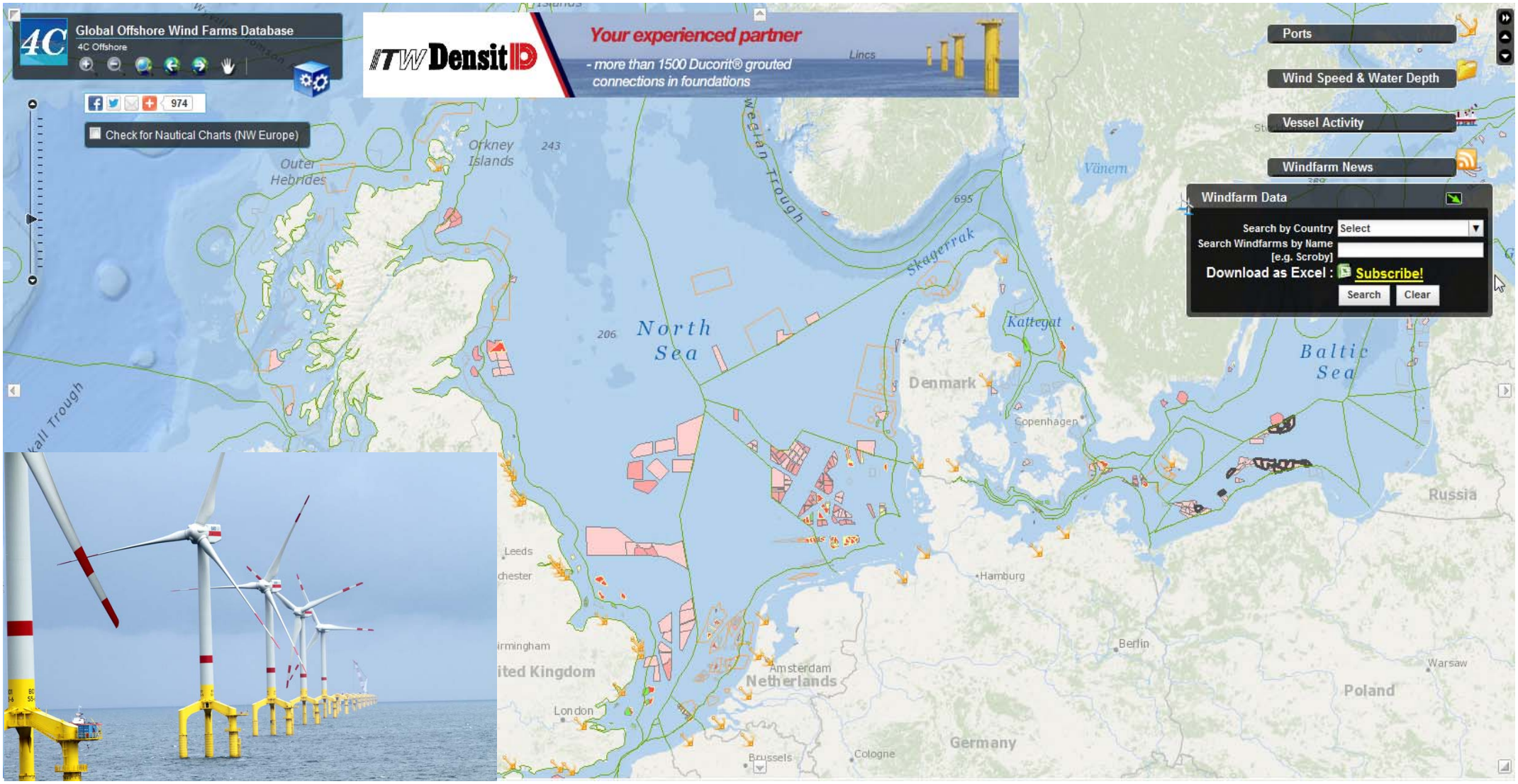

BARD 1

http://www.4coffshore.com

Integrated Approach – Example: Currents and Waves for Offshore-Industry

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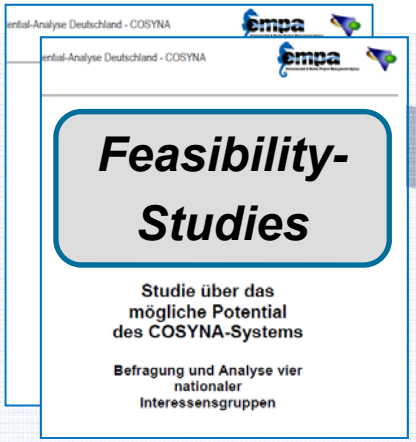
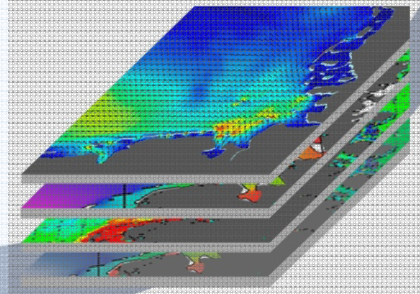
Applications ???

Feasibility-Studies

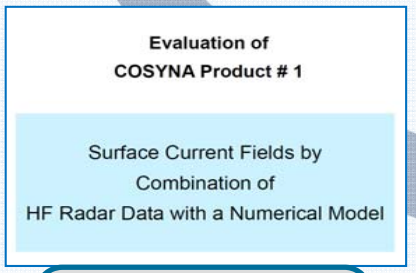


Product-Realisation



Data Portal

External Review



User Feedback

Product Lifecycle

COSYNA –Products (synoptic maps)

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	Observations		Model	Assimilation
	Real Time	Mon. Means	Mod.Only	Obs..&Model
Products				
Currents	●	●	●	●
Sea State	●	●	●	
Temperature	●	●	●	●
Salinity	▨		●	●
Wind	●			
Susp. Matter	(●)	●	●	●
Chlorophyll	(●)	●		
CDOM	(●)	●		
Experimental Products				
POC, POM		●		
DOC		●		
Produktivity		●		
Ship Recognition	●			

● Existing ● Med.-Term ● Long-Term ▨ Transects along FBox-Routes

Challenges

Helmholtz-Zentrum Geesthacht
Zentrum für Material- und Küstenforschung

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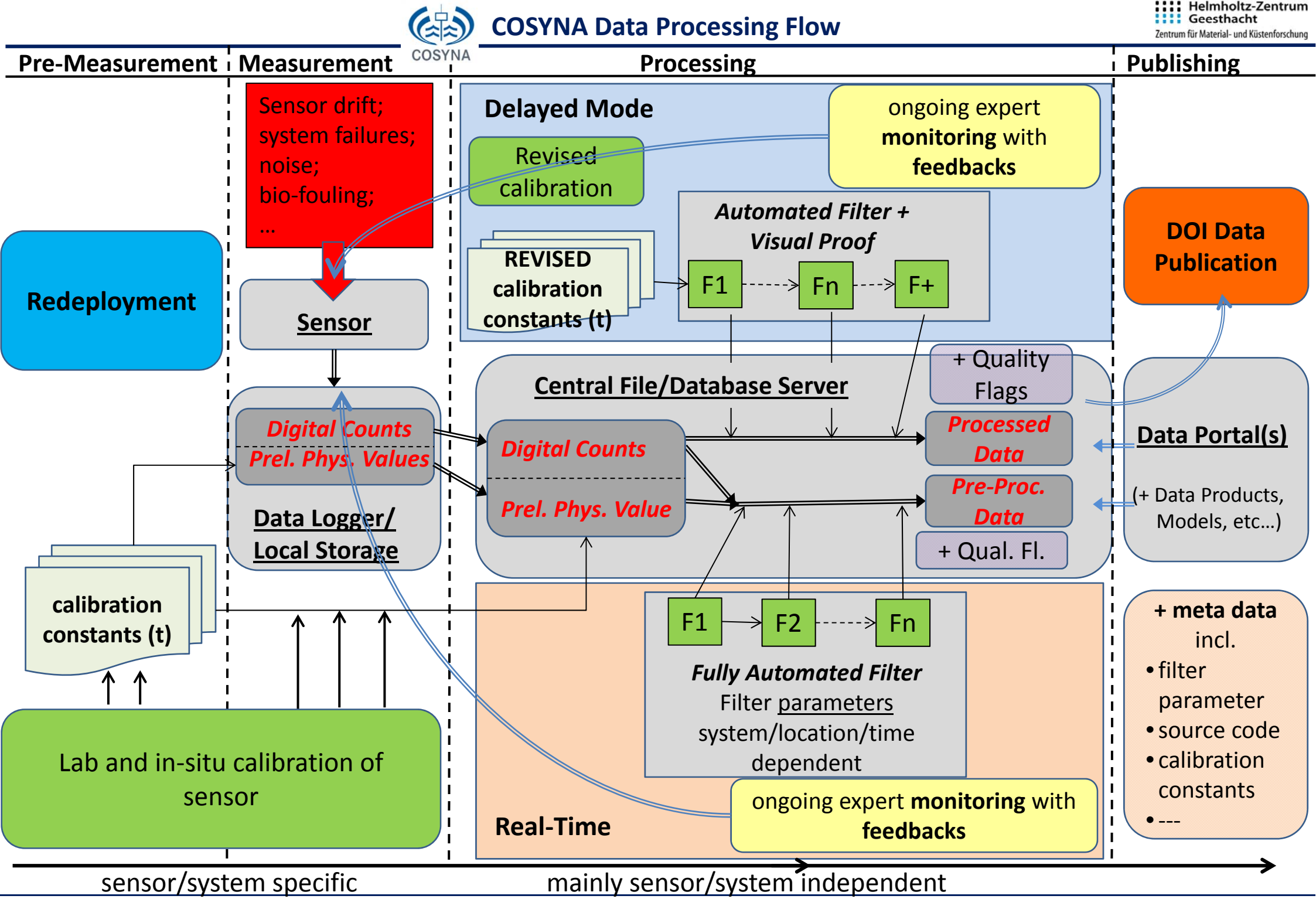
COSYNA Data Processing Flow
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COSYNA
Pre-Measurement
Measurement
Processing
Publishing
Sensor drift;
system failures;
noise;
bio-fouling;
…
Delayed Mode
Revised calibration
ongoing expert monitoring with feedbacks
Automated Filter + Visual Proof
REVISED calibration constants (t)
F1
Fn
F+
DOI Data Publication
Redeployment
Sensor
Central File/Database Server
+ Quality Flags
Digital Counts
Prel. Phys. Values
Digital Counts
Prel. Phys. Value
Processed Data
Pre-Proc. Data
+ Qual. Fl.
Data Portal(s)
(+ Data Products, Models, etc…)
Data Logger/ Local Storage
calibration constants (t)
F1
F2
Fn
Fully Automated Filter
Filter parameters
system/location/time dependent
+ meta data
incl.
• filter parameter
• source code
• calibration constants
• ---
Lab and in-situ calibration of sensor
Real-Time
ongoing expert monitoring with feedbacks
sensor/system specific
mainly sensor/system independent

Challenges

Helmholtz-Zentrum Geesthacht
Zentrum für Material- und Küstenforschung

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Zentrum für Material- und Küstenforschung

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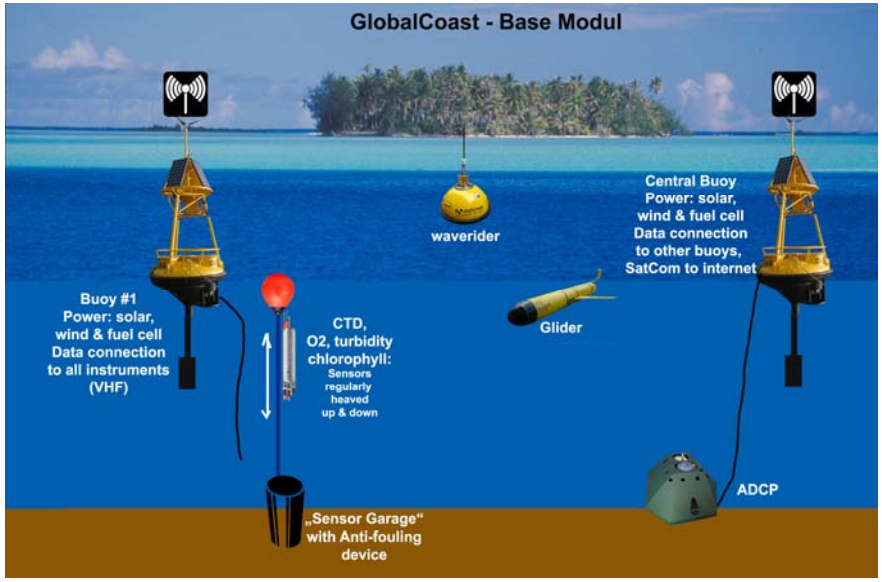
HZG Project: The Global Coast

Helmholtz-Zentrum Geesthacht
Zentrum für Material- und Küstenforschung

Idea: To evaluate selected typical coastal water bodies in different world regions and their relevance for global processes in cooperation with local partner institutions using a combination of measurements and models adapted to the regions' characteristic problems and research questions.

Methods: Tailored monitoring and analysis strategy using a combination of automated time series (e.g., point measurements from buoys, under water nodes), remote sensing (satellite and radar based) and selected ship cruises, as well as hydrographical and biogeochemical modelling (with adapted complexity, e.g. grid sizes and form, processes etc.).



Thank you for your attention

ευχαριστώ πολύ!