

HZG Hydrodynamic Modelling: Possible applications to the „Baltic Sea Model Intercomparison Project” (BMIP)

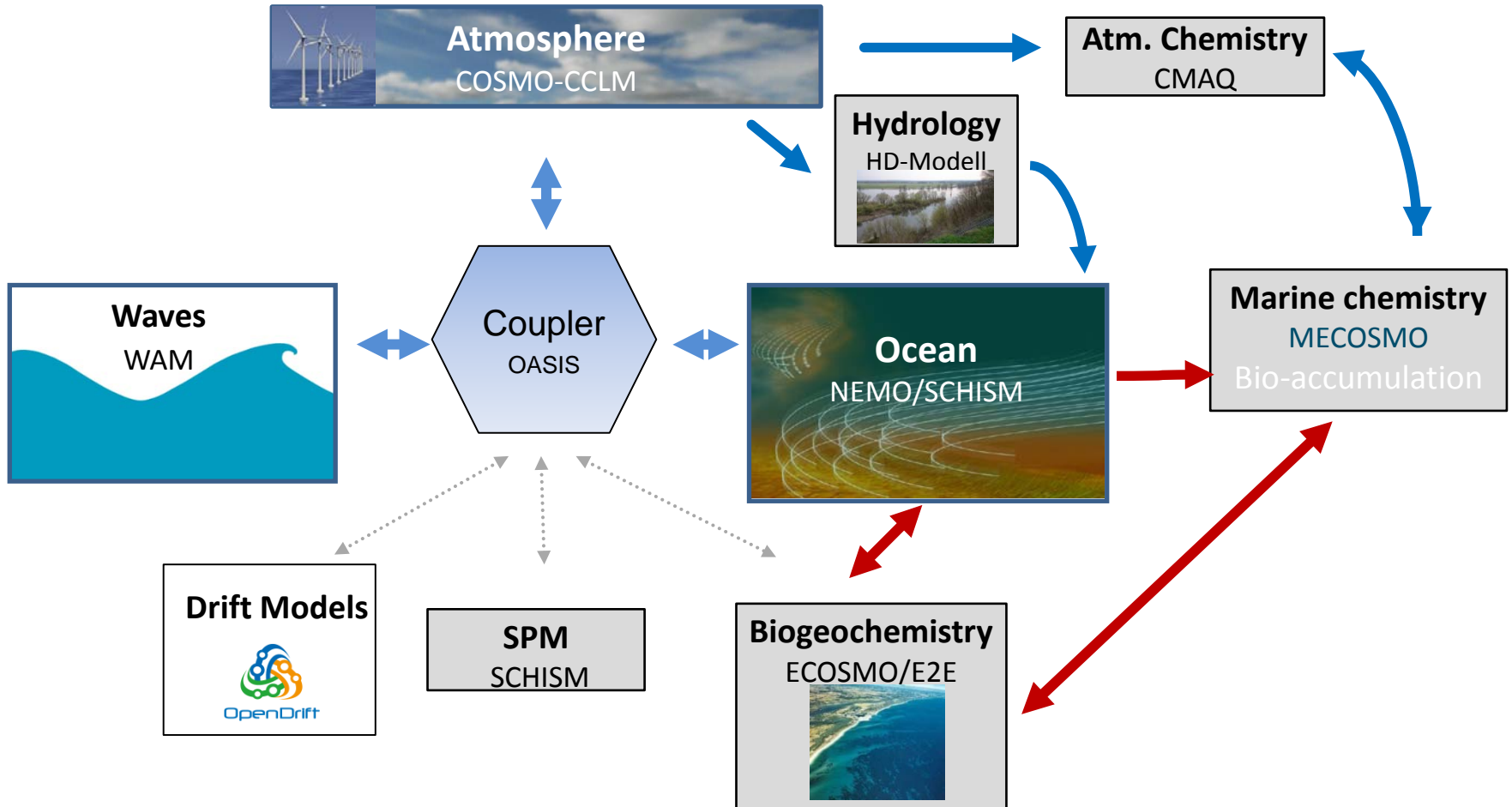
E. V. Stanev

*Kickoff meeting of BMIP
22 November 2018
Warnemünde,*

Research questions:

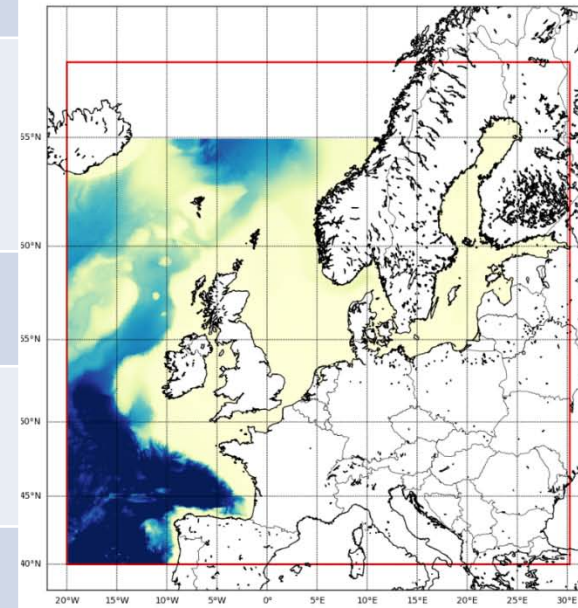
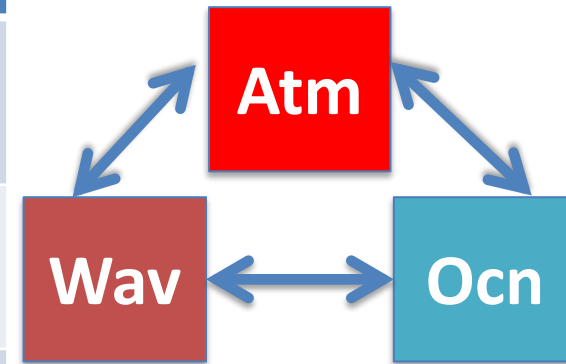
- Hydrographic conditions, including
 - overturning circulation
 - response to atmospheric forcing
 - inter-basin exchange
 - coupled processes
- Process studies
 - salt and water inflows,
 - isopycnic and diapycnic mixing,
 - upwelling, intrusions and water mass renewal,
 - ice formation
 - wind waves
 - basin modes

GCOAST Modell system (coupling)



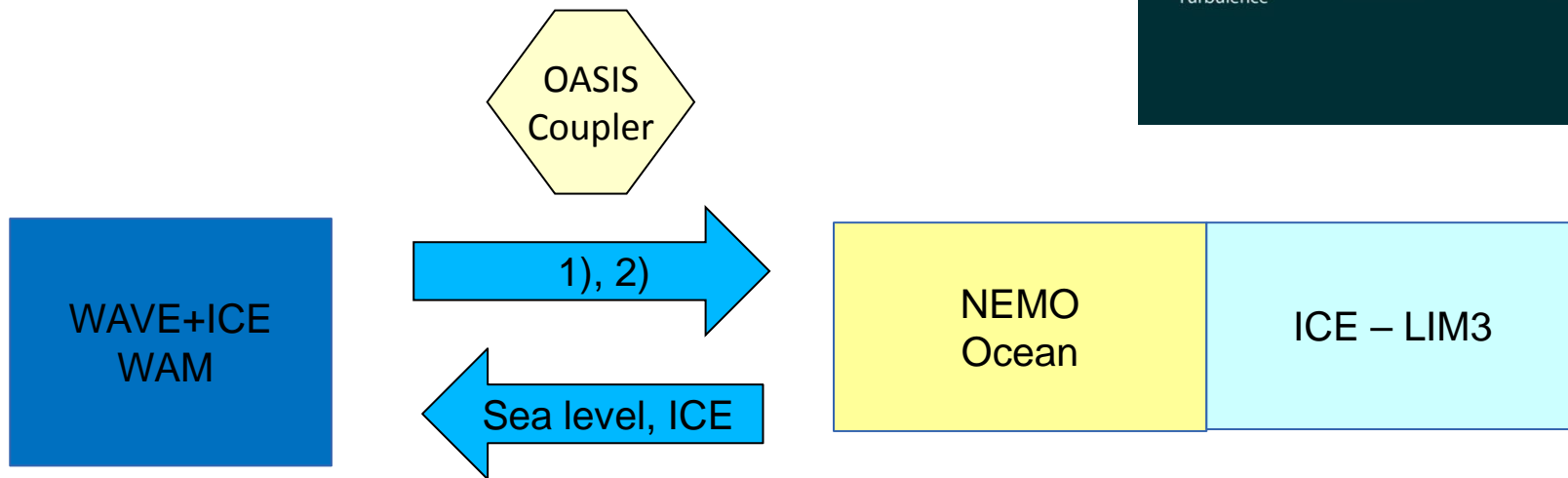
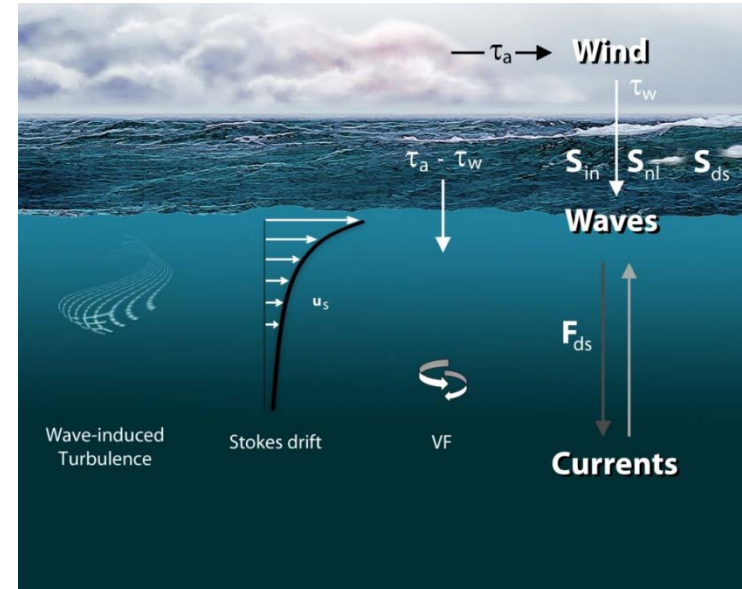
Coupled Model Setup (structured-grid models)

	NEMO 3.6	WAM 4.6.2	COSMO
Horizontal grid	3.5 km covering North Sea and Baltic Sea	Same as NEMO	7 km covering NW European seas
Vertical grid	51 s-layers, emphasis on surface	N/A	55 levels
Initial field	CMEMS UKMO Data	EWAM wave data	COSMO-EU Model
Boundary condition	OSU tides, CMEMS UKMO Data for T,S,U,V, SLH	EWAM wave data	NCEP data
Forcing	ERA-5, COSMO	Same as NEMO	ERA Boundary data
Vertical diffusion scheme	GLS (<i>k-eps</i>)	N/A	
Ice	LIM-3	NEMO, ice parameterization	NEMO, N/A



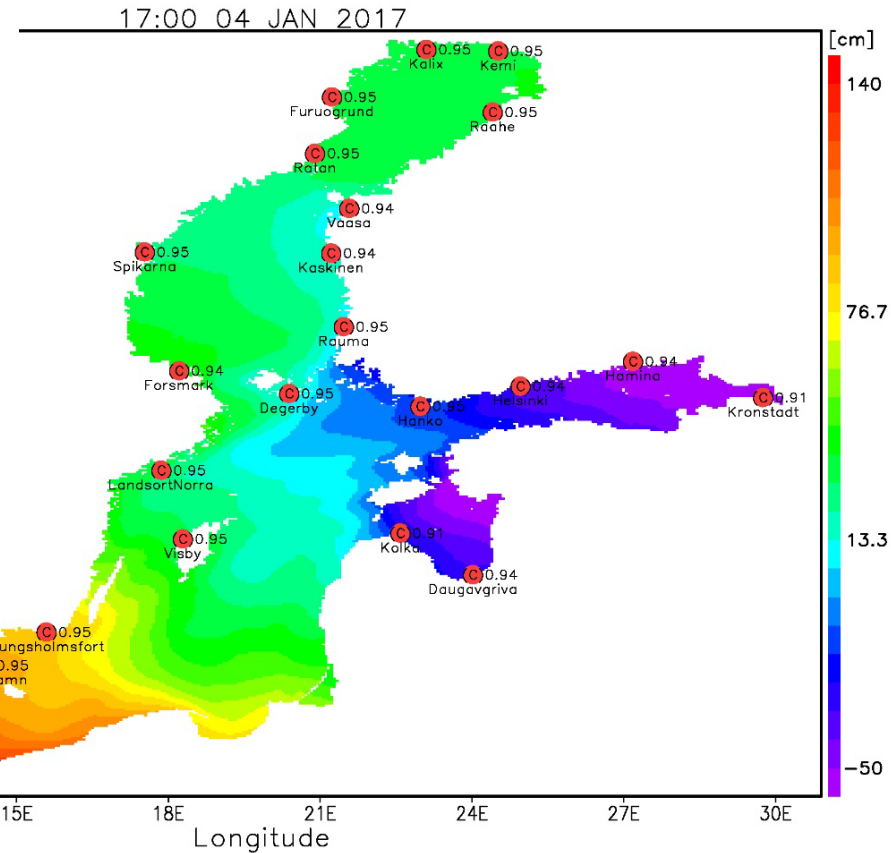
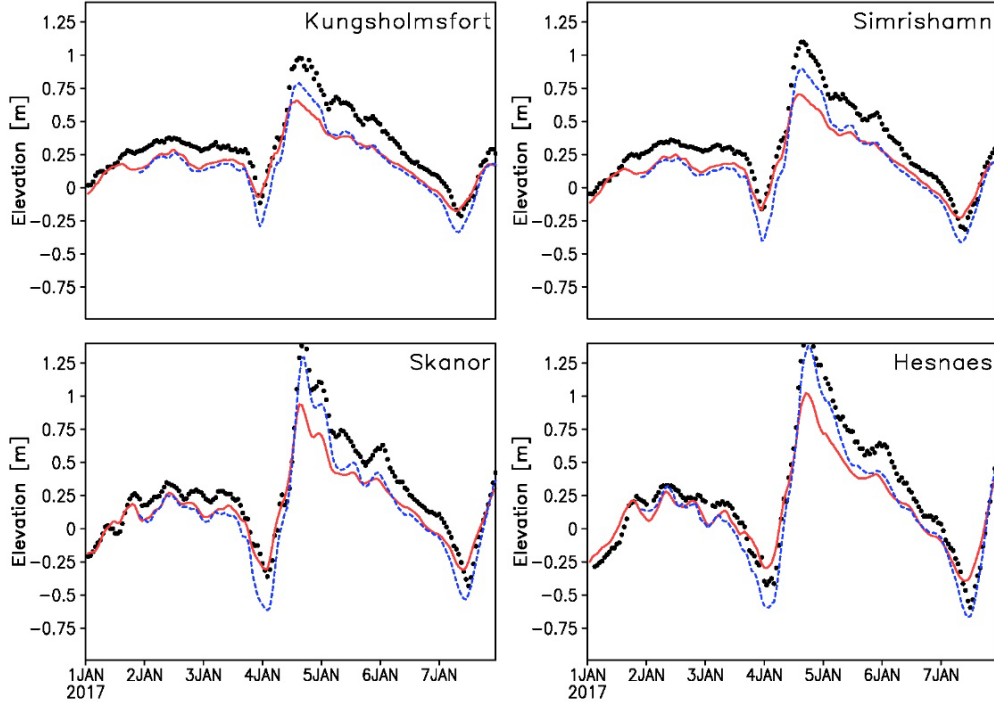
Wave-current interaction

- (1) The Stokes-Coriolis forcing (Hasselmann, 1970; Breyvik, 2015, 2016)
- (2) Sea state dependent momentum flux (Janssen, 1989; Janssen, 2012, Staneva et al., 2016, 17)



Impact of waves on Surge

● TGAUGE — GCWAM5 — TAUST5



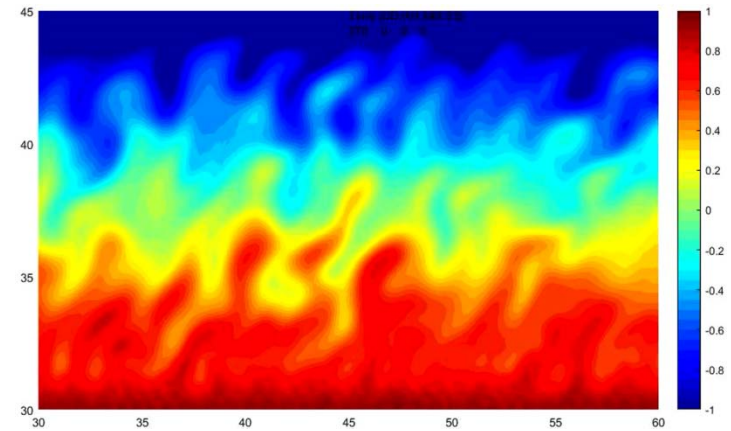
The model *Semi-implicit Cross-scale Hydroscience Integrated System*

Model; www.schism.wiki



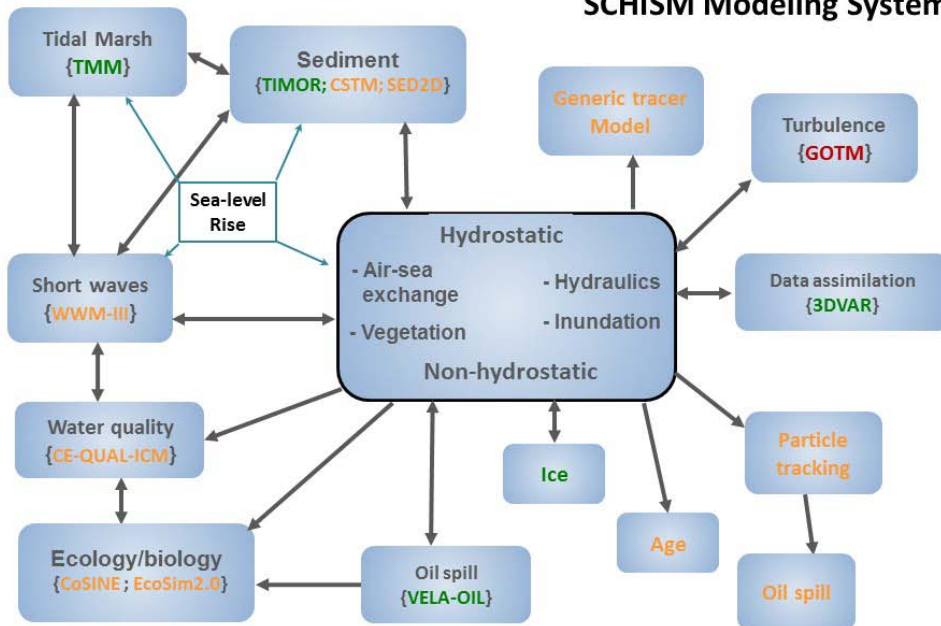
3D, primitive equations, unstructured-grid.

- Upgrade from an existing model (*SELFE*, A *Semi-implicit Eulerian-Lagrangian Finite Element* model for cross-scale ocean circulation).
- Uses hybrid finite element and finite volume approach.
- *New viscosity formulation* (effectively filters out spurious modes without introducing excessive dissipation).



- New higher-order implicit advection scheme for transport (TVD^2) is proposed to effectively handle a wide range of Courant numbers
- Addition of *quadrangular* elements into the model
- Flexible vertical grid system (Zhang et al. 2015, OM)
- *Model polymorphism* that unifies 1D/2DH/2DV/3D cells in a single model grid.

SCHISM Modeling System

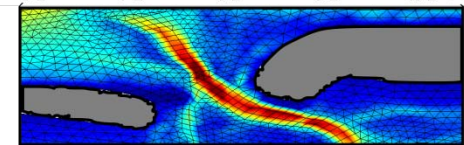
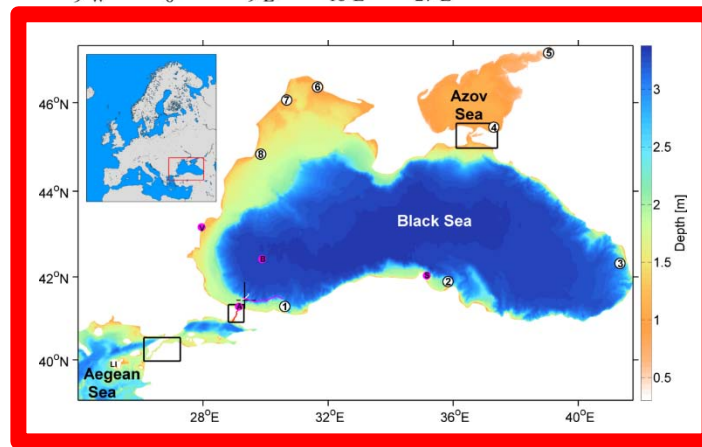
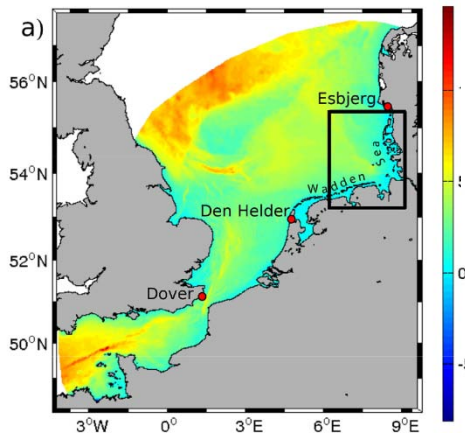
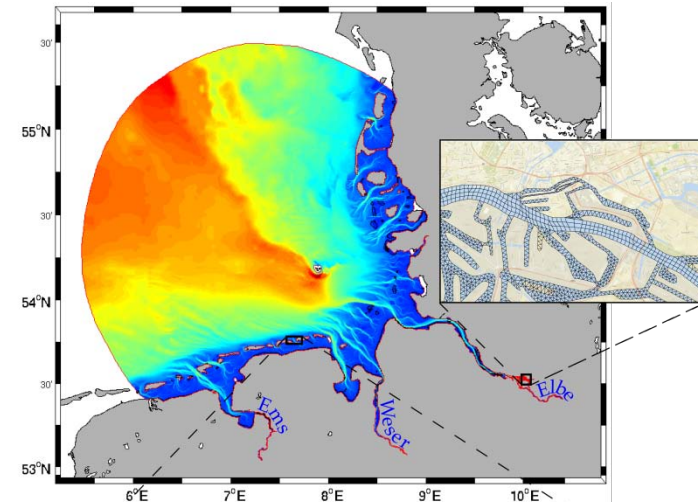
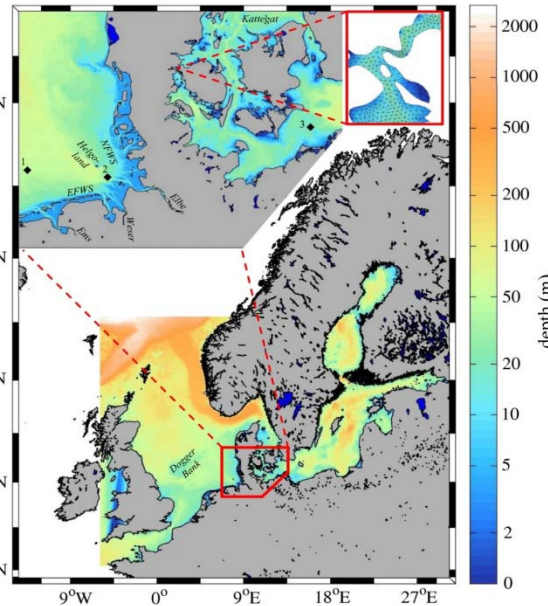
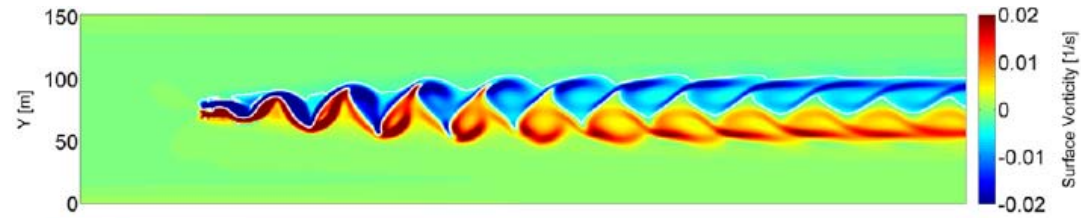
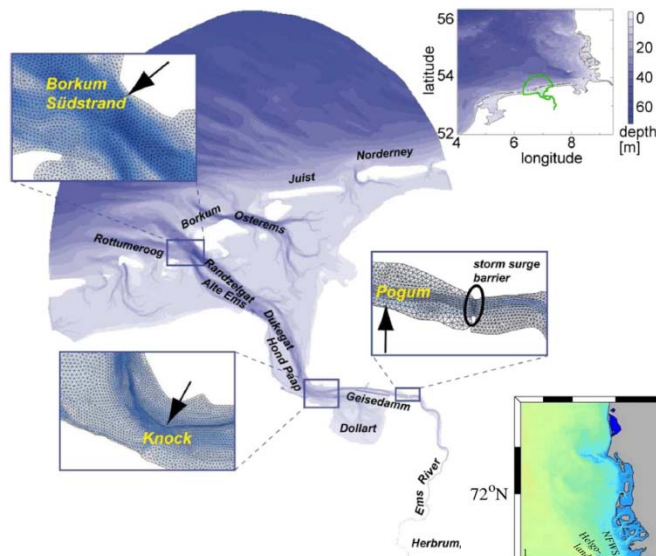


Status of models: **Open-released** / **Ready-to-be-released** / **In-development** / **Free-from-web**
 {model name} / : Dynamic Core

Zhang Y.J., F. Ye, E. V. Stanev, and S. Grashorn (2016a): Ocean Modelling.

Seamless modelling (our model areas)

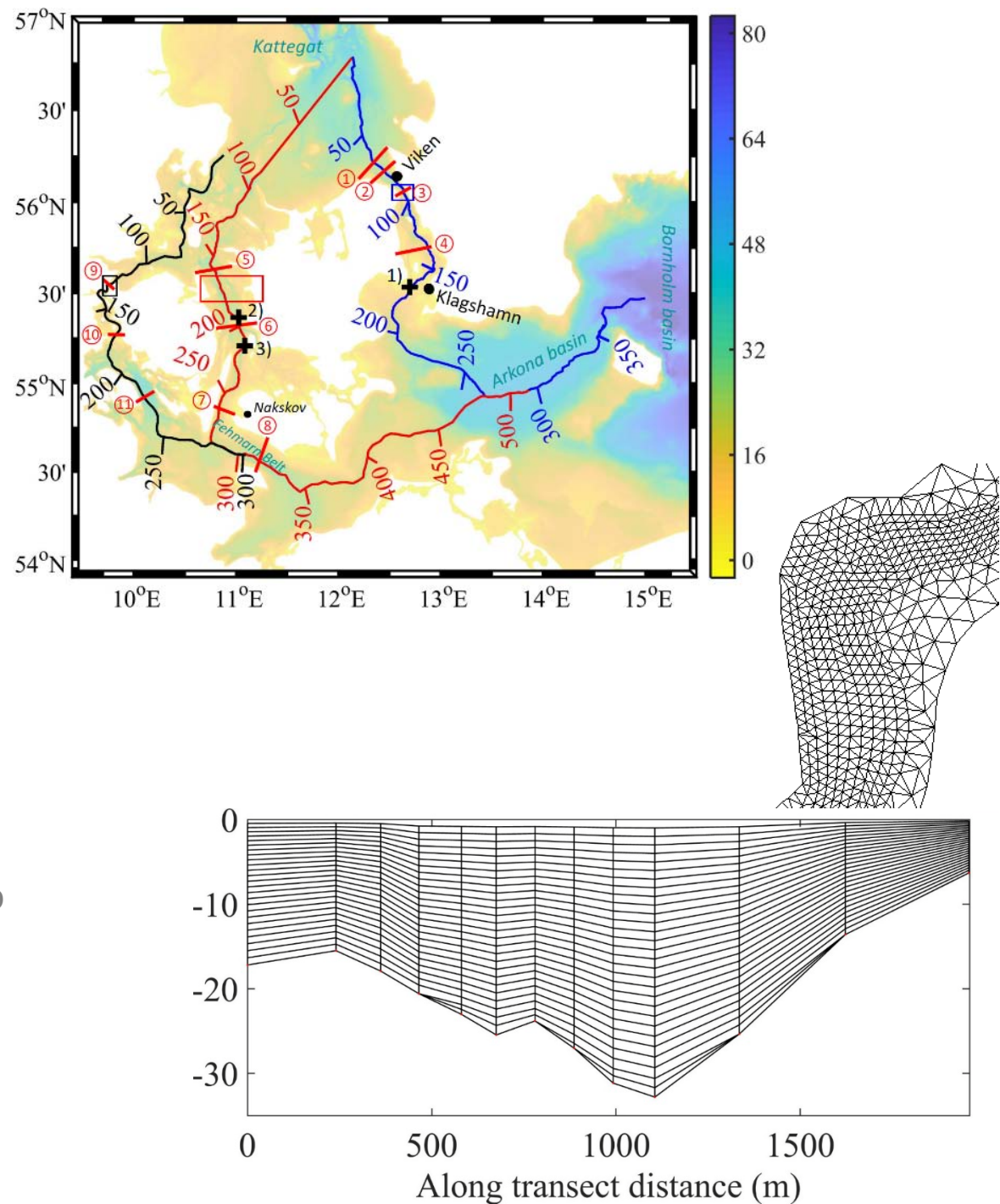
... and the model is **SCHISM**



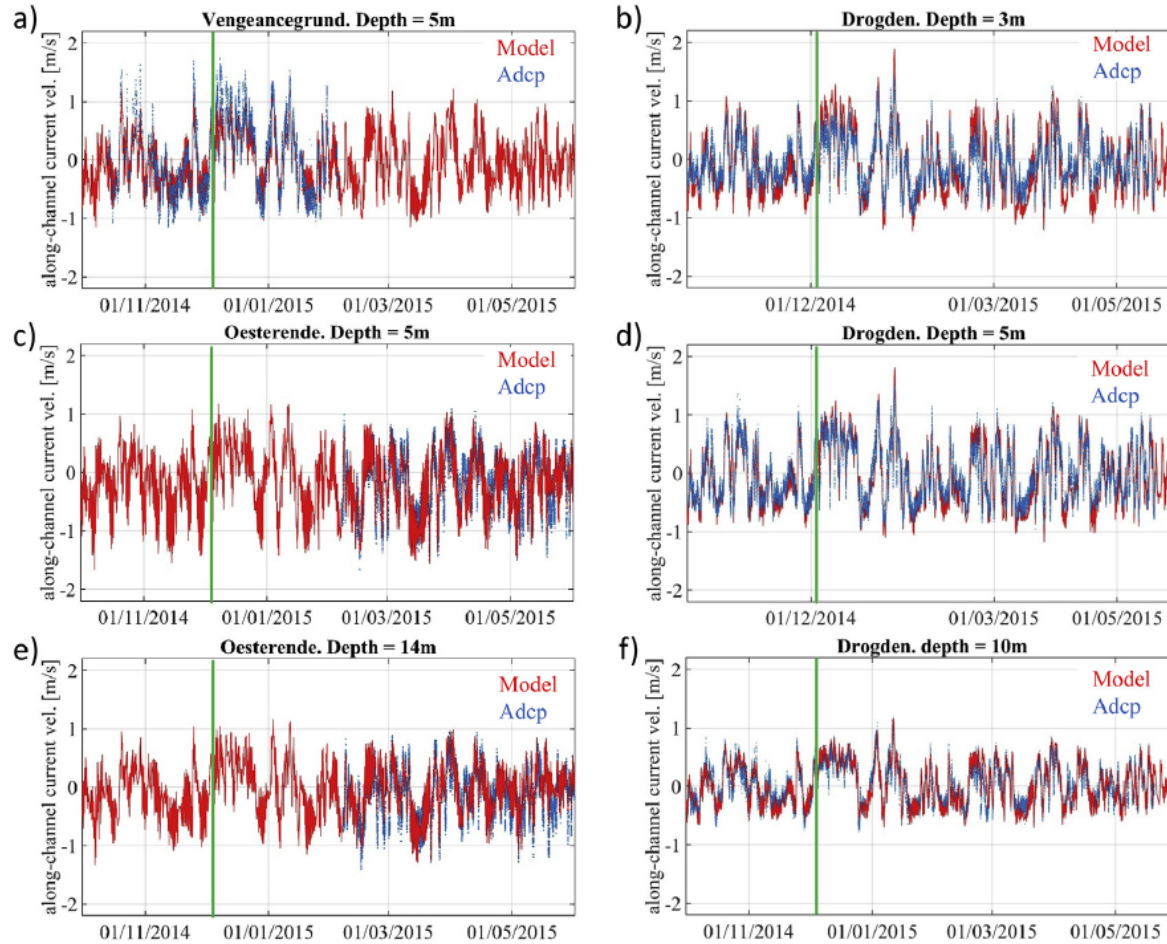
Grashorn, S. and E.V. Stanev (2016)
Pein et al. (2014;2016)
Jacob, B., E. V. Stanev, Y.J. Zhang (2016)
Zhang, Y.J., E.V. Stanev, S. Grashorn (2016a, b)
Jacob and Stanev (2016)
Schloen, J., E. V. Stanev, S. Grashorn (2017)
Stanev, Grashorn and Zhang (2017)

The coupled Baltic Sea-North Sea model

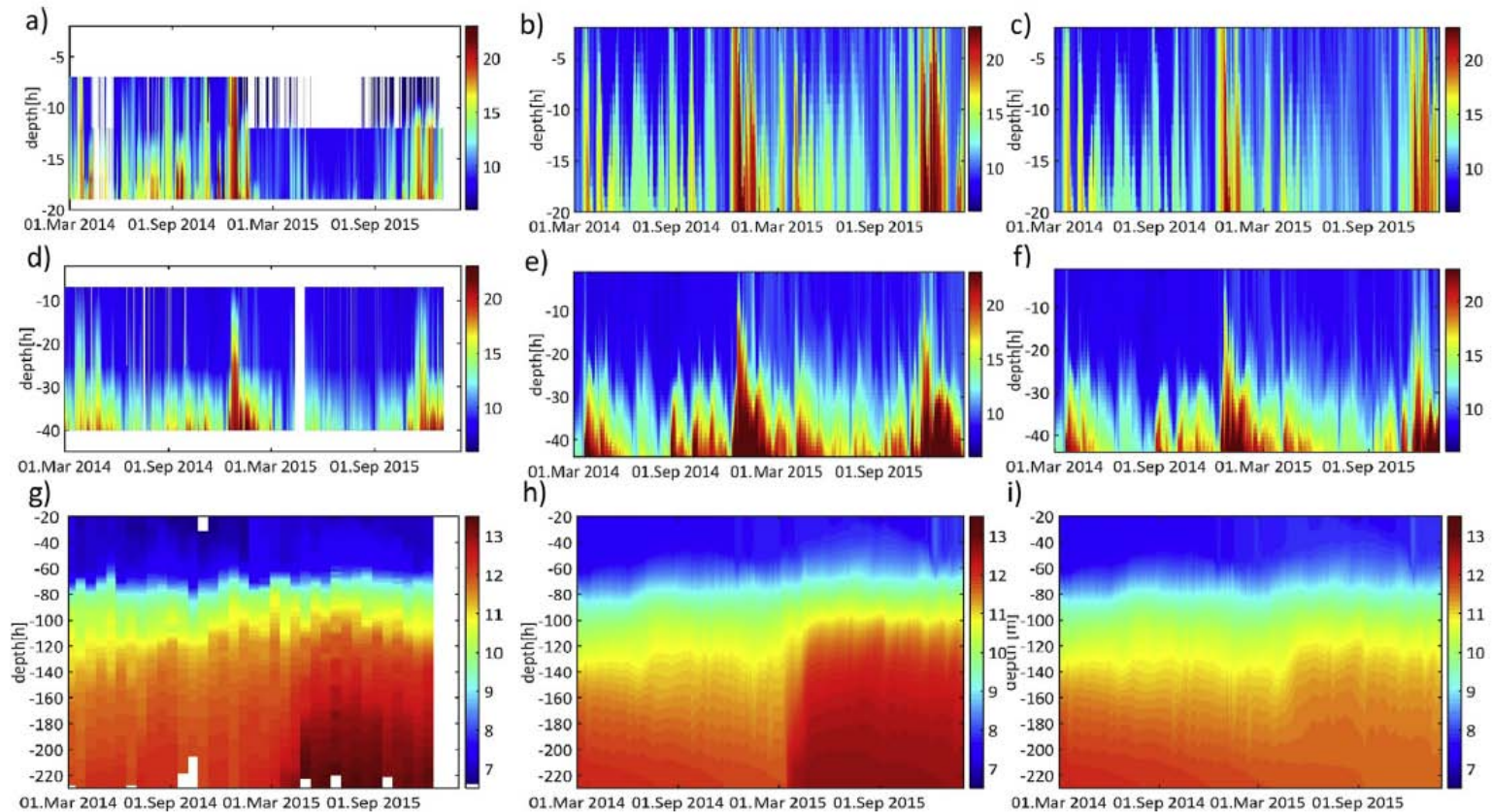
- Model area comprises North Sea and Baltic Sea
- Horizontal resolution: ~3km, ~80m in the Little Belt
- Open boundary forcing: Copernicus AMM7 (7km)
- Atmospheric forcing: DWD Cosmo EU (7km)
- River forcing: SMHI Ehype from 34 rivers charging into NS and BS



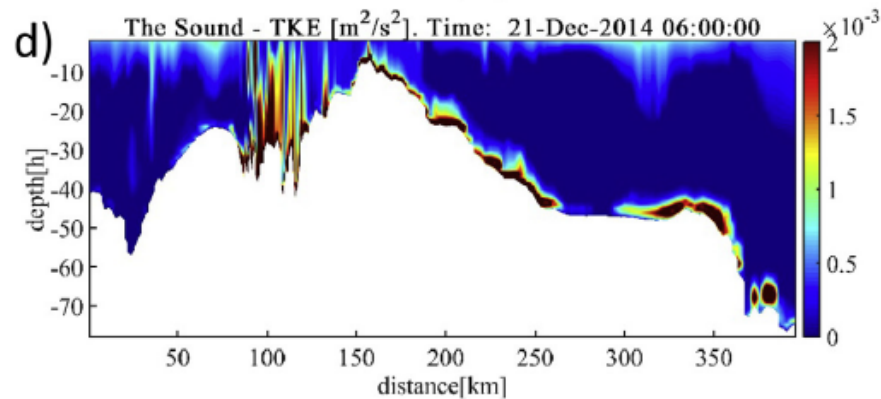
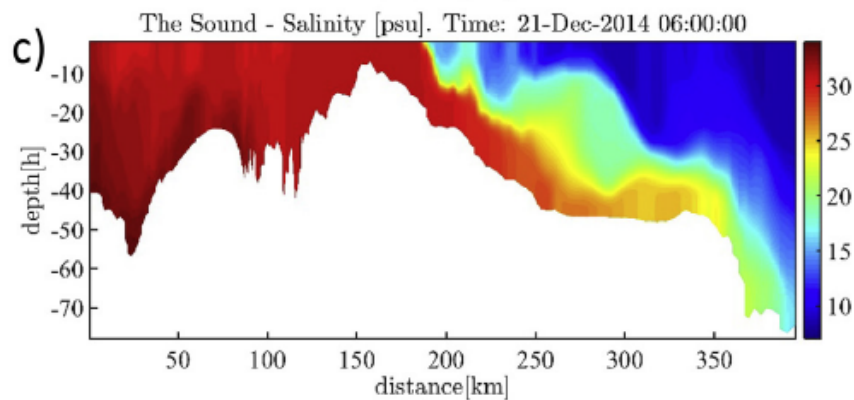
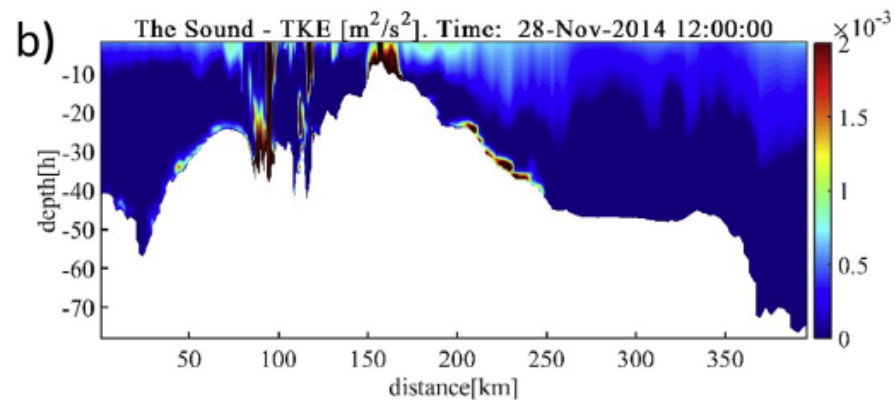
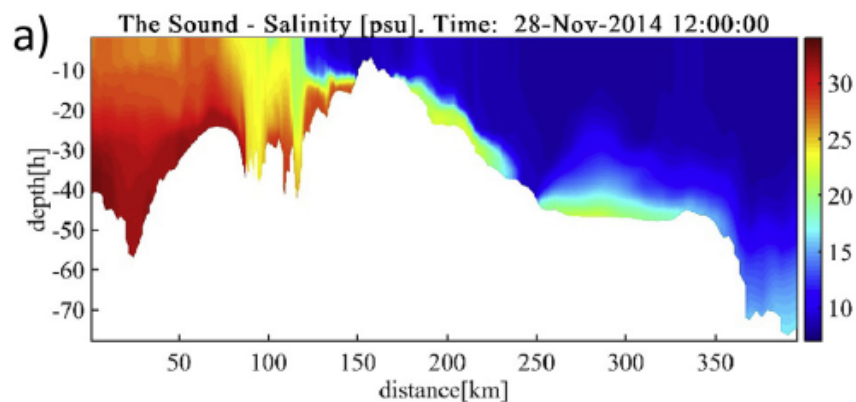
VALIDATION ADCP



INFLOW IN REALITY AND IN DIFFERENT SET-UPS



GRAVITY FLOW IN THE DANISH STRAITS



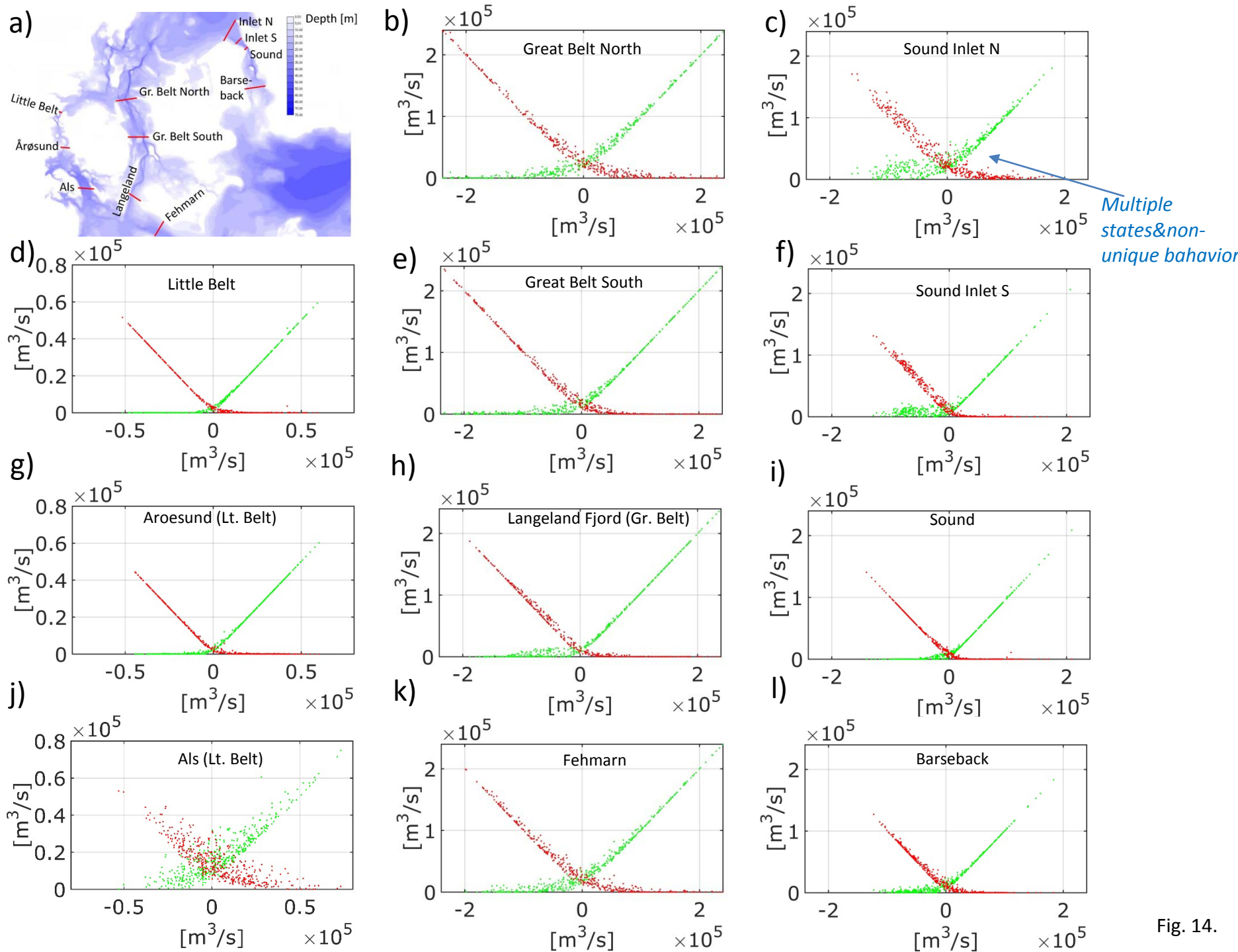


Fig. 14.