ROFI of the Elbe river during flood event, unstructured-mesh model study.

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ROFI of the Elbe river during flood event, unstructured-mesh model study.

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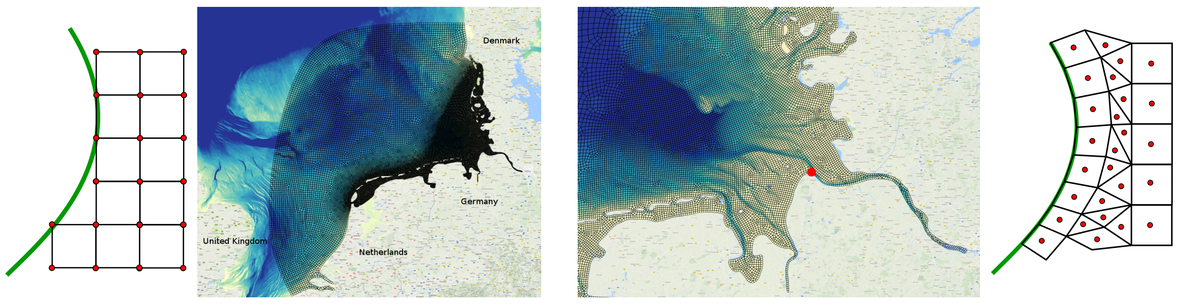
FESOM-C: coastal dynamics on mixed unstructured meshes

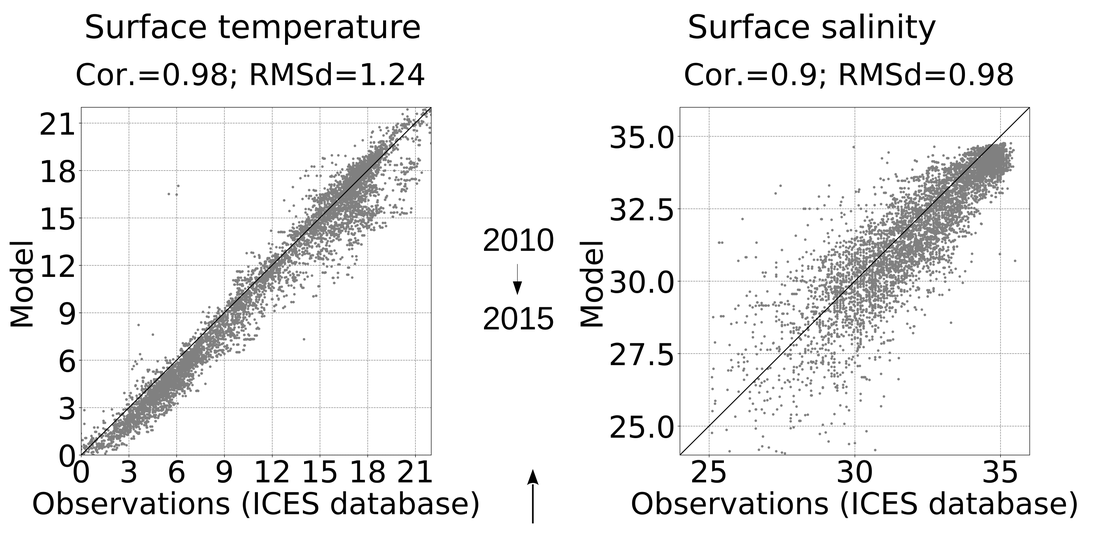
- ✔ Time-split scheme (external/internal)
- ✔ Cell-vertex finite volume discretization Danilov and Androsov (2015); Androsov et al. (2016)
- ✔ Mixed meshes (quads/triangles)
- ✔ GOTM turbulence closure model
- ✔ Vertical sigma coordinates
- ✔ Wetting-drying algorithm
- ✔ Tidal potential /Open Boundary (OB)
- ✔ Rivers through a solid boundary
- ✔ Sediment-transport model
- ✔ Boundary conditions for temperature and salinity
- ✔ Standard atmospheric forcing module
- ✔ Schemes of stabilization near OB
- ✔ The Framework for Aquatic Biogeochemical Models (FABM)



Model Setup

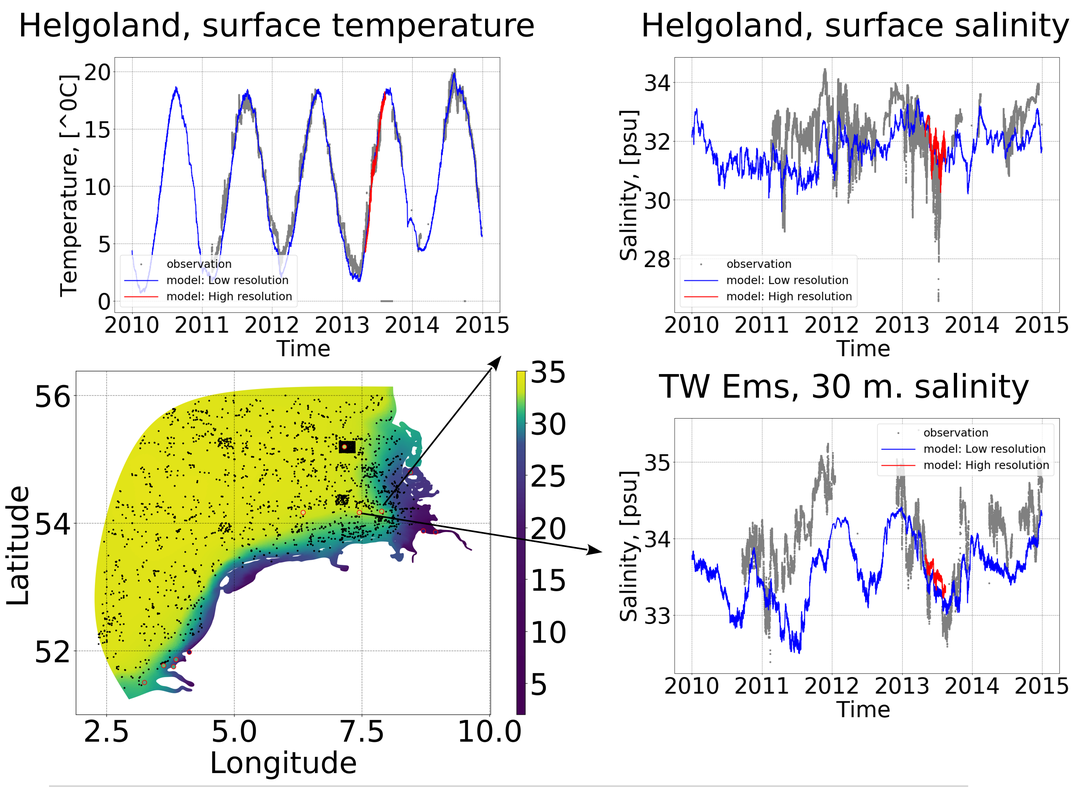
- ✔ Atmospheric forcing is FP7 UERRA ,1h / 10-20 km resolution (pers.comm. S. Schimanke, SMHI, Ridal et al., 2018)
- ✔ Daily river runoff (Radach and Pätsch, 2007)
- ✔ Salinity and Temperature at open boundary: TRIM-NP model (Weisse et al., 2015)
- ✔ EMODnet Digital Bathymetry
- ✔ 5 to 21 vertical sigma levels
- ✔ Resolution: High (0.26 – 1.6 km), Medium (0.55 – 2.2 km), Low (1 – 4 km)

Model Results



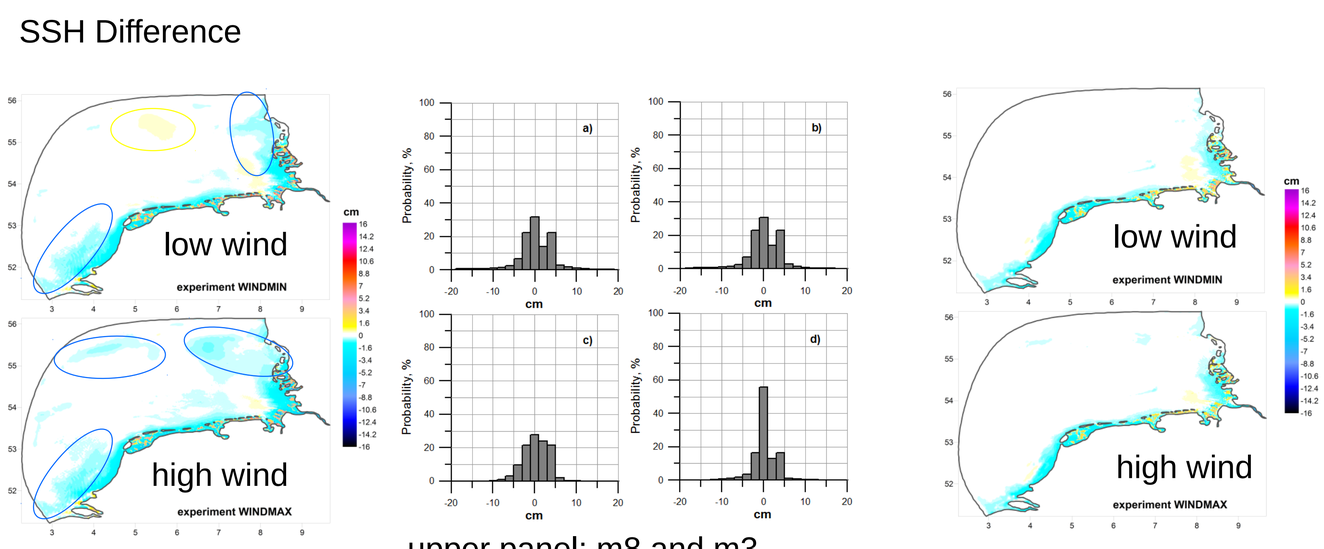
5 years run (low resolution) comparison

Sea surface salinity on 24-Jun 2013. Filled contours are model results, colored lines are observational data from FerryBox (FunnyGirl) Petersen (2014)



Mean sea surface salinity. Dots are location of ICES data. Circles are observational data (COSYNA, EMODnet).

Solution convergence on different meshes

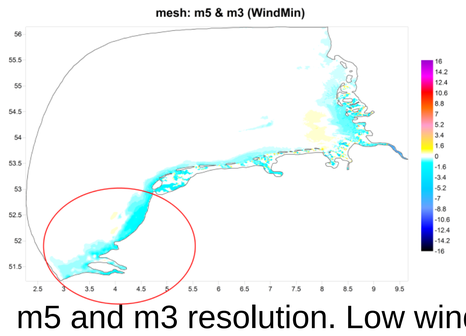


m8 and m5 resolution

upper panel: m8 and m3
lower panel: m5 and m3

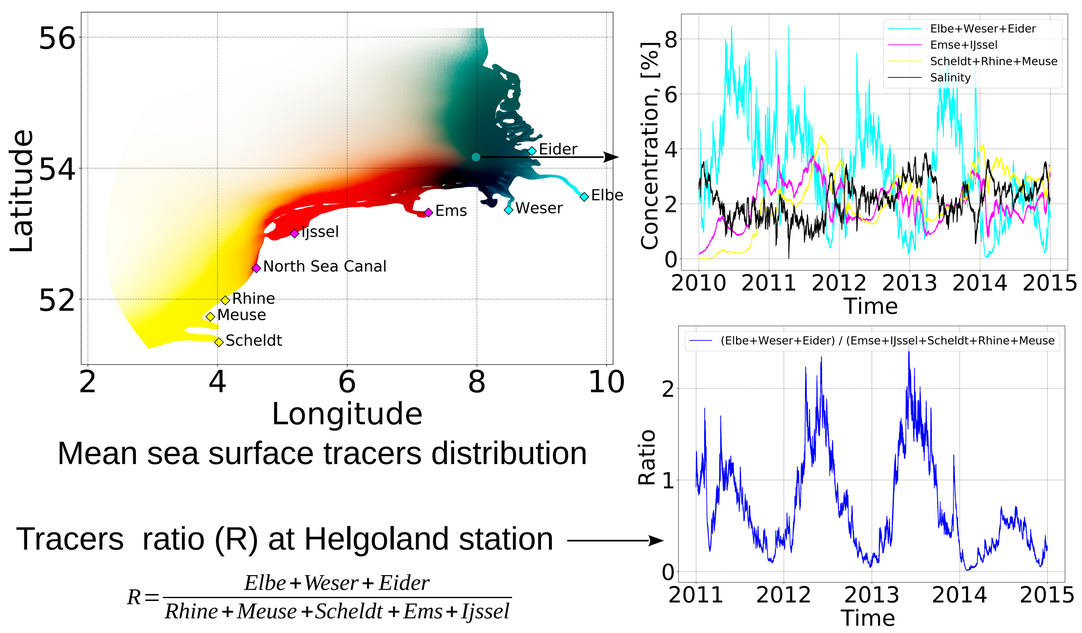
m5 and m3 resolution

	N nodes	resolution,km
m8	43.318	1 – 4
m5	134.858	0.55 – 2.2
m3	235.283	0.26 – 1.6



m5 and m3 resolution. Low wind. **Without dry nodes.**

Tracers in river outflow



Tracers ratio (R) at Helgoland station →

$$R = \frac{Elbe + Weser + Eider}{Rhine + Meuse + Scheldt + Ems + Ijssel}$$

Conclusions

- FESOM-C is ready to be used.
- Use of mixed (predominantly quadrilateral) meshes improves performance and accuracy as compared to triangular meshes.
- Elevation in zones of wetting and drying is sensitive to mesh detail, high mesh resolution is needed for solution convergence
- Future plans: Coupling with FESOM, coupled physico-biogeochemical experiments.

Reference

- A. Androsov, V. Fofonova, I. Kuznetsov, S. Danilov, N. Rakowsky, S. Harig, K. H. Wiltshire. FESOM-C: coastal dynamics on hybrid unstructured meshes. in preparation.
- A. Androsov, V. Fofonova, S. Danilov, N. Rakowsky, I. Kuznetsov, W. Hiller and K. H. Wiltshire. Fesom-coastal. In Küstenmodellierung, February 2016.
- S. Danilov and A. Androsov. Cell-vertex discretization of shallow water equations on mixed unstructured meshes. Ocean Dynamics, 65 (1):33-47, 2015. ISSN 1616-7228. doi: 10.1007/s10236- 014- 0790- x.
- G. Radach and J. Pätsch. Variability of continental riverine freshwater and nutrient inputs into the north sea for the years 1977–2000 and its consequences for the assessment of eutrophication. Estuaries and Coasts, 30(1):66–81, Feb 2007.
- M. Ridal, E. Olsson, J. Bojarova, P. Undén, H. Körnich, K. Zimmermann, and U. Andrae, A 55 year regional re-analysis over Europe, in preparation.
- R. Weisse, P. Bisling, L. Gaslikova, B. Geyer, N. Groll, M. Hortamani, V. Matthias, M. Maneke, I.Meinke, E. Meyer, F. Schwichtenberg, F. Stempinski, F. Wiese, K. Wöckner-Kluwe. Climate services for marine applications in Europe. Earth Perspectives, 2(1):3, Mar 2015.

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