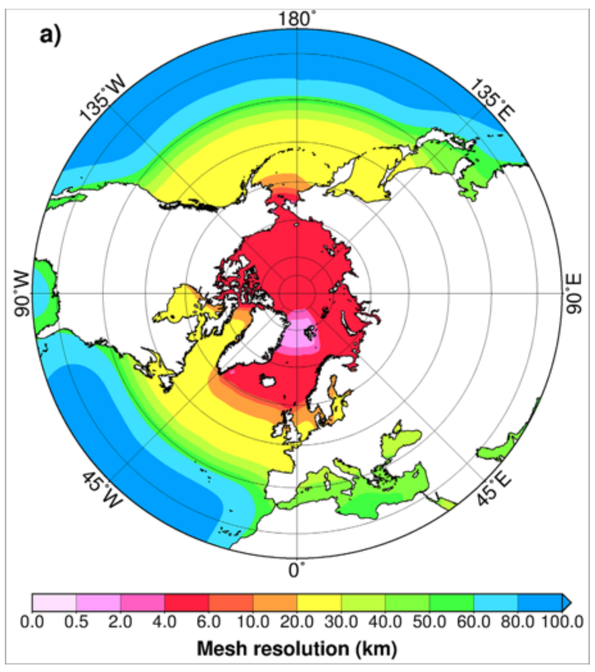
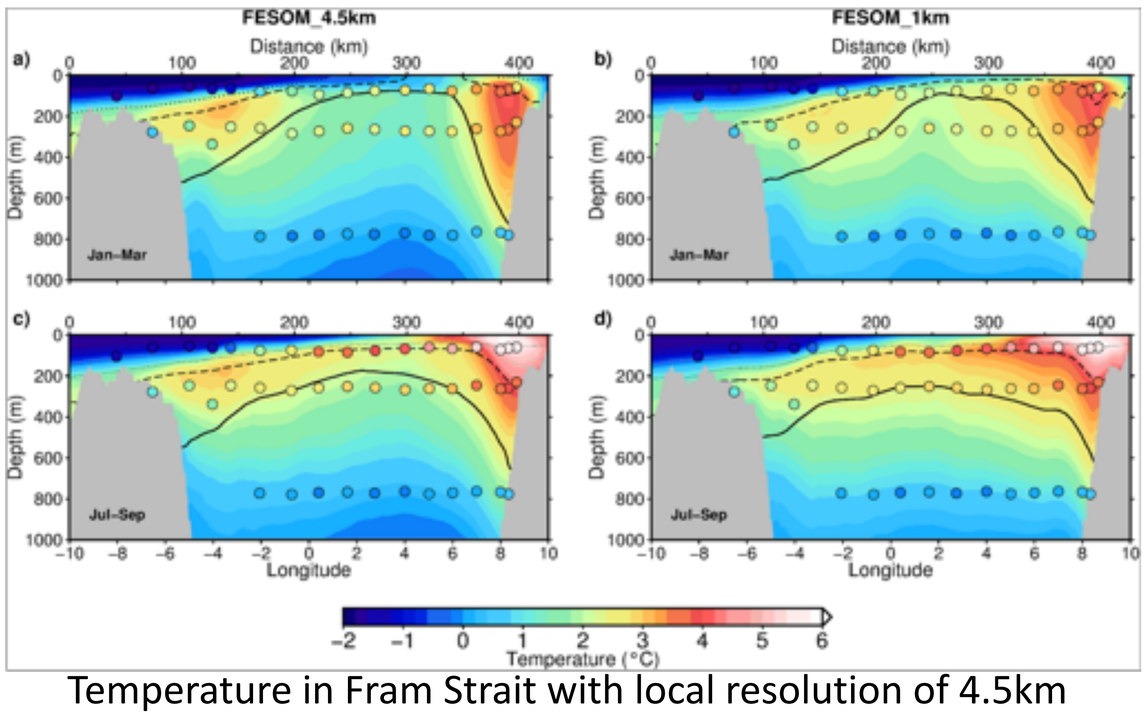
ALFRED-WEGENER-INSTITUT
HELMHOLTZ-ZENTRUM FÜR POLAR- UND MEERESFORSCHUNG

Qiang Wang, Claudia Wekerle, Nikolay Koldunov, Sergey Danilov, Patrick Scholz, Dmitry Sidorenko, Thomas Jung

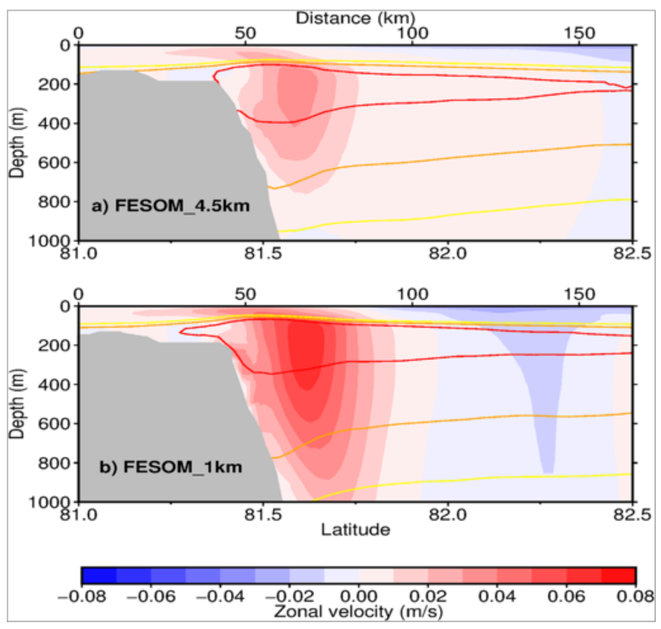
Eddy-resolving simulations with focus on the Arctic Ocean



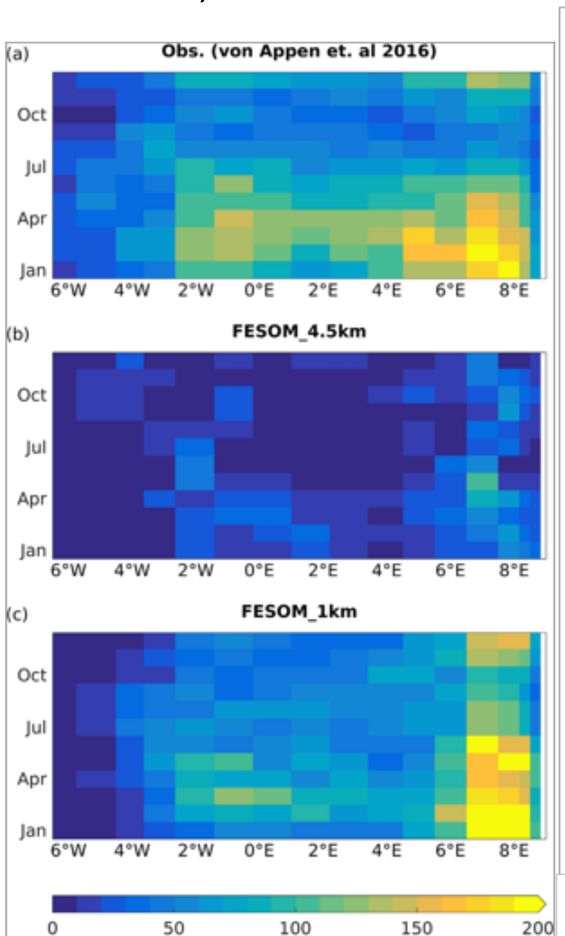
Resolution of Setup #1, 4.5km in Arctic, 1km in Fram Strait

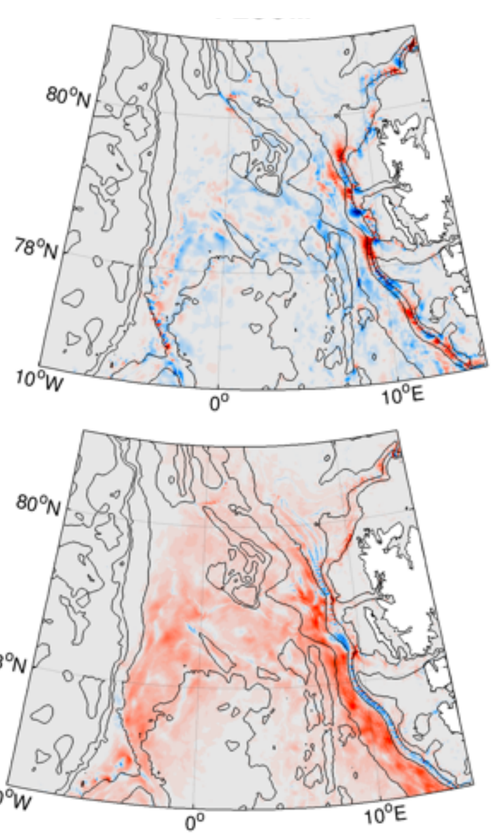


Temperature in Fram Strait with local resolution of 4.5km (left) and 1km (right).

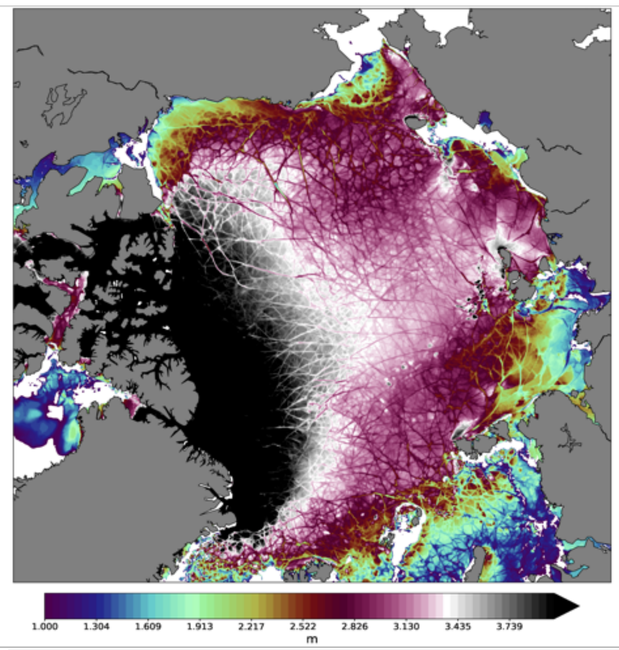


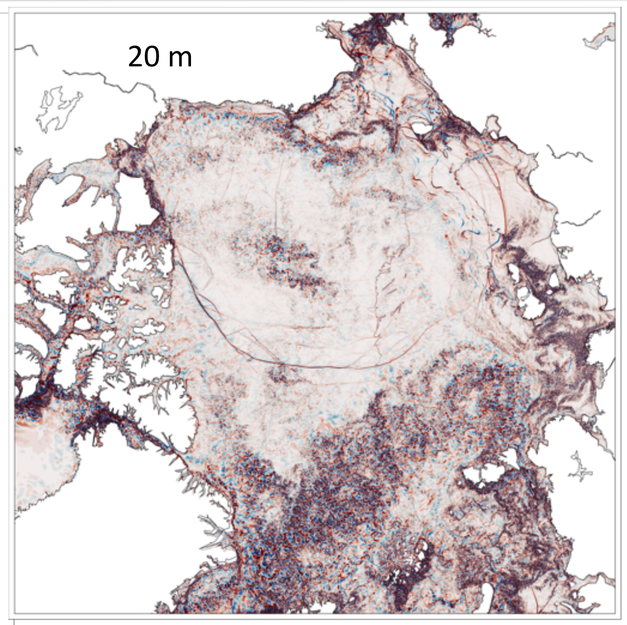
Velocity downstream Fram Strait in the two runs.

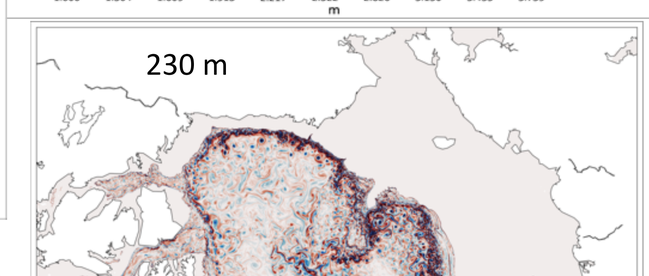


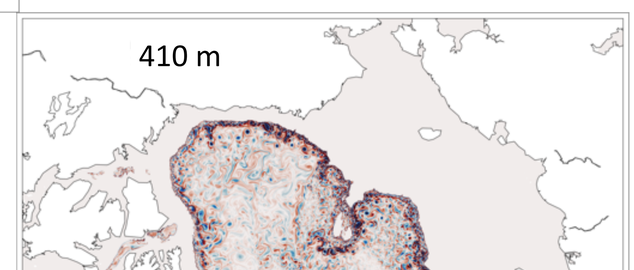


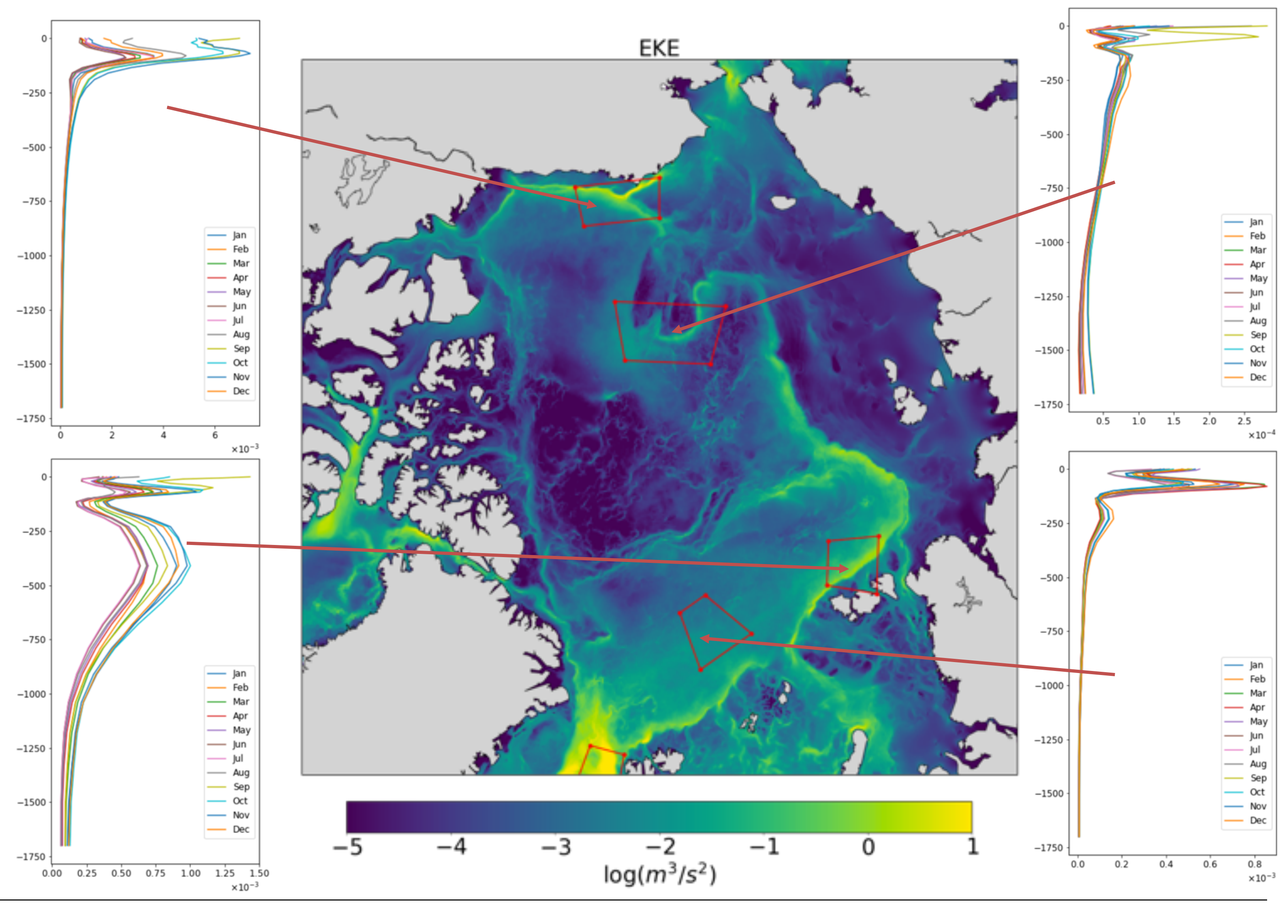
(left) Eddy kinetic energy in Fram Strait. (right) Depth integrated energy transfer from (upper) mean kinetic energy and (lower) available potential energy to eddy kinetic energy.











(upper right) Snapshots of sea ice thickness and ocean vorticity at different depth. (lower right) Vertically integrated eddy kinetic energy and vertical profiles at different locations. The simulation is done on a global mesh with 1 km resolution in the whole Arctic. (Koldunov et al., in preparation)

Summary: Unstructured-mesh models with multi-resolution functionality allow to resolve chosen regions with eddy resolving resolution in an otherwise coarser global setup. The Finite Element/volumE Sea ice Ocean Model (FESOM) is employed here. In one setup, the resolution is locally increased to 1 km in the Fram Strait, the deep passage of Atlantic Water (AW) inflow to the Arctic Ocean. The mesoscale eddies are found to be very important in setting the location of AW recirculation in the Fram Strait and the strength of the AW current entering the Arctic domain. Resolving eddies reduces the cold bias in the temperature in the central Fram Strait, and enhances the AW inflow north of the Svalbard. The simulated eddy kinetic energy shows a clear seasonal cycle, strong in winter and weak in summer, in accordance with the seasonal variation of ocean stratification. In another global simulation we use 1 km resolution in the whole Arctic region. This belongs to an on-going effort to establish an Arctic-eddy-resolving global configuration using FESOM. A few key regions where eddy activity is strong in the Arctic Ocean are identified based on the model results. Along with continuing the development of this configuration, our future work is to understand the generation and roles of mesoscale eddies in different regions of the Arctic Ocean, and to quantify their response and changes in the changing climate.

References
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Danilov, S., Sidorenko, D., Wang, Q., and Jung, T. (2017). The Finite-volumE Sea ice–Ocean Model (FESOM2), *Geosci. Model Dev.*, 10, 765-789.
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HELMHOLTZ-ZENTRUM FÜR POLAR- UND MEERESFORSCHUNG
HELMHOLTZ GEMEINSCHAFT

BREMERHAVEN

Am Handelshafen 12
27570 Bremerhaven
Telefon 0471 4831-0
www.awi.de