Investigation of Labrador Sea Dynamics with the High-Resolution Finite Element Sea Ice - Ocean Model FESOM

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The subpolar regions of the North Atlantic ocean are crucial for the global climate in terms of deep water formation, which is a major driver for the Atlantic Meridional Overturning Circulation (AMOC) that transports heat into northern latitudes and returns cold deep water masses southward. Through air-sea buoyancy fluxes and resulting vertical ventilation a homogenized deep mixing layer evolves, and the so called Labrador Sea Water (LSW) is formed. LSW is the upper component of the North Atlantic Deep Water (NADW) and an important constituent of the cold limb of the AMOC.

In this project we want to analyze the meso-scale ocean circulation in the entire North Atlantic Ocean, with a special focus in the central Labrador Sea and the surrounding boundary current system. For this purpose we will use the coupled Finite-Element Sea-Ice ocean model (FESOM). This numerical ocean model works with an unstructured triangular surface mesh, which provides the opportunity to locally highly increase the resolution in an otherwise coarser global setup without complicated grid nesting or potential loss of information due to regional boundary conditions.

The global FESOM model setup used in this project has a particular focus in the Labrador Sea as well as in the Greenland Sea, Irminger Sea and Norwegian Sea with a homogeneous meso-scale eddy resolving resolution of 6-7 km. We further increased the resolution in the Arctic and Southern Ocean as well as in the equatorial and coastal upwelling regions. The bulk of the ocean features a resolution of around 1°.

By performing a 60 years analysis with atmospheric NCEP forcing, we want to investigate the effects of eddy induced horizontal mixing between the Labrador Sea Boundary Current system and the central Labrador Sea, on the vertical convection activity. Further questions are the variability in the occurrence, life-time and propagation of meso-scale eddies in the area of the North Atlantic Ocean.
We also intend to further analyze the mechanistic understanding of the formation of Great Salinity Anomalies in the Labrador Sea and their relation to coupled atmosphere sea ice interactions.