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The regional model of Subpolar Gyre based on NEMO 4

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A regional model of Subpolar Gyre in the North Atlantic is implemented. The NNATL12 model development aimed at a realistic representation of Subpolar Northern Atlantic's complex dynamics during the satellite era (starting from 1993 to nowadays) by using a high-resolution regional model that relies on the most up-to-date atmospheric and lateral forcing datasets and modeling techniques. Configuring this model, we focused on the representation of key processes in the Northern Atlantic, such as Irminger Rings, the boundary currents, deep convection, and convective eddies, dense waters cascading through the narrow straits between the Arctic and the Atlantic basins. NNATL12 model is based on NEMO4. The model domain covers the area between 47-70˚N and 84˚W-10˚E with a grid of 1/12˚ in horizontal and 75 vertical levels. In this region, the model is partially eddy-resolving. Three lateral open boundaries and initial conditions are set from the new GLORYS12 reanalysis (Lellouche et al., 2018). The surface forcing is provided by the new RAS NAAD dynamical hindcast based on the WRF model with a spatial resolution of 14 km (Gavrikov et al. 2020). The model adopted the most recent developments in the forced ocean modeling, such as upper boundary forcing schemes (Renault et al., 2020, Brodeau et al., 2016) and local-sigma vertical coordinate in the area of the overflows (Colombo et al., 2020). The model solution is sensitive to new parameterizations and vertical coordinate, which is demonstrated in various tests. The model provides a reliable estimate of the Subpolar North Atlantic circulation system at the surface and medium depth compared to observations. The model represents the ocean stratification at depths above 2000 m showing higher temperatures in the bottom of the Irminger Sea. At daily timescales, it is capable of representing the volume transport comparable to observed values. Irminger Rings TS-structure and dynamics are simulated consistent with the glider data. Comparing to the reanalysis model overestimates the March mixed layer depths and overextends the region of convection north. At the same time, the short-scale and decadal variability of MLD are reproduced by the model. Significant improvements of the deep stratification are obtained with the implementation of the local-sigma vertical coordinate. The model provides vertical profiles of temperature and salinity similar to the observed ones. However the Denmark Strait overflow waters are still too warm, but this is for a large part due to too warm waters at the sill. The high-frequency variability in the Denmark Strait is also in good accordance with the observations.