The study of the Arctic water circulation on the basis of numerical experiments with different parameterizations

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Coupled Ice-Ocean Model

3D World Ocean Circulation Model of ICMMG based on FEM (z-level vertical coordinate)
(Kuzin 1982, Golubeva et al., 1992, Golubeva, Platov, 2002)

- Conservation laws for heat, salt and momentum with Boussinesq, hydrostatic and ‘rigid lid’ approximations
- Separation of the external and internal mode in momentum equations
- Barotropic momentum equations are expressed in term of stream function
- Finite element discretization by space on B grid with splitting up method
- Implicit and semi-implicit schemes by the time

Ice model-CICE 3.0 (elastic-viscous-plastic)
Grid and Domain

**Numerical domain:** from 20S Atlantic to Bering Strait

**Grid specification:** spherical in Atlantic (1°: 1°) + reprojected bipolar grid from 65°N (Ross Murray, 1996), 33 vertical levels

The model domain was built with horizontal resolution of 1x1° in Atlantic. The reprojected bipolar grid in Arctic has minimum spacing equal to 35km while maximum spacing is about 62km.
Experimental design

- Ocean model test run: surface restoring to Levitus climatology, monthly wind stress (Trenberth)
- Coupled model 1948-2000 years run. Daily wind stress based on the NCEP/NCAR 995Db wind velocity components for regions upper than 60°N merged with climatological wind stress (Trenberth) down to 20°S.

| No Neptune, No restoring. | Neptune, No restoring. | No Neptune, Surface salinity restoring. |
Stream function
Test 1: No Neptune parameterization. No salinity restoring.
Test 1: No Neptune parameterization. No salinity restoring.
Test 2: Neptune parameterization. No salinity restoring.
1950. Restoring vs Neptune
Test 3: No Neptune. Surface salinity restoring
Test 3: No Neptune. Surface salinity restoring
Test 2: Neptune parameterization.
No restoring. Tracers
Extra Test: Ocean module only. Arctic surface stress is resulted from Test 3 and merged at 60°N with wind stress based on NCEP/NCAR wind. Neptune with $L=3.5$ km. Surface temperature and salinity restoring.