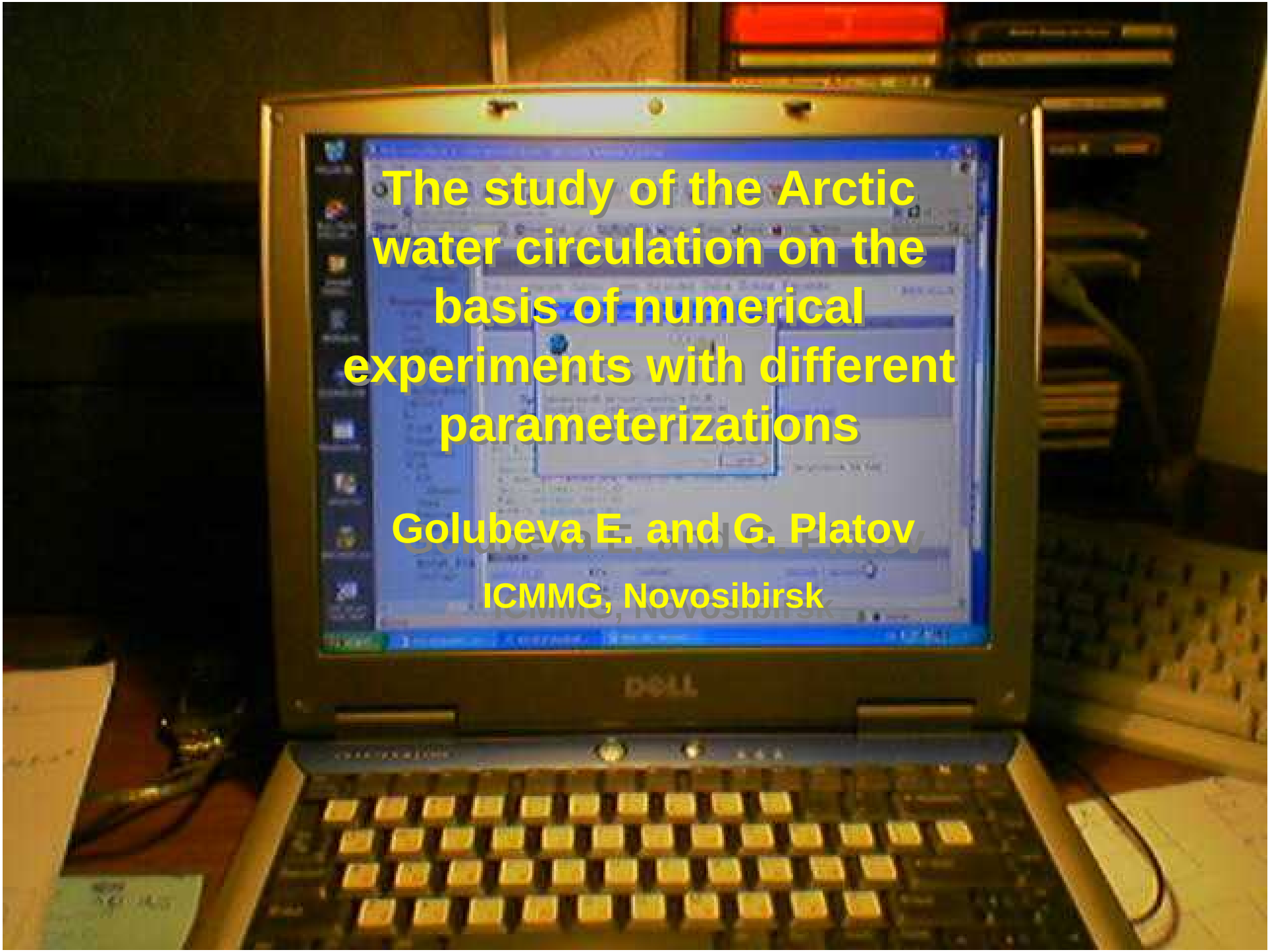

The study of the Arctic water circulation on the basis of numerical experiments with different parameterizations
Golubeva E. and G. Platov
ICMMG, Novosibirsk

Coupled Ice-Ocean Model

3D World Ocean Circulation Model of ICMMG based on FEM (z-level vertical coordinate)

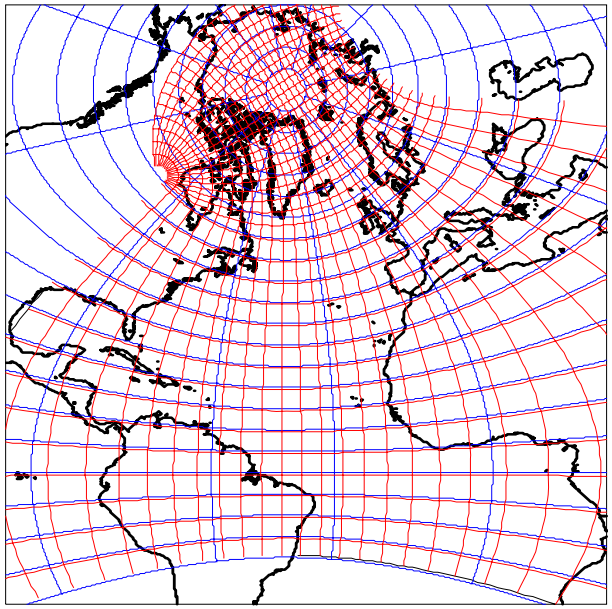
(Kuzin1982, Golubeva at al.,1992, Golubeva,Platov, 2002)

- 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)

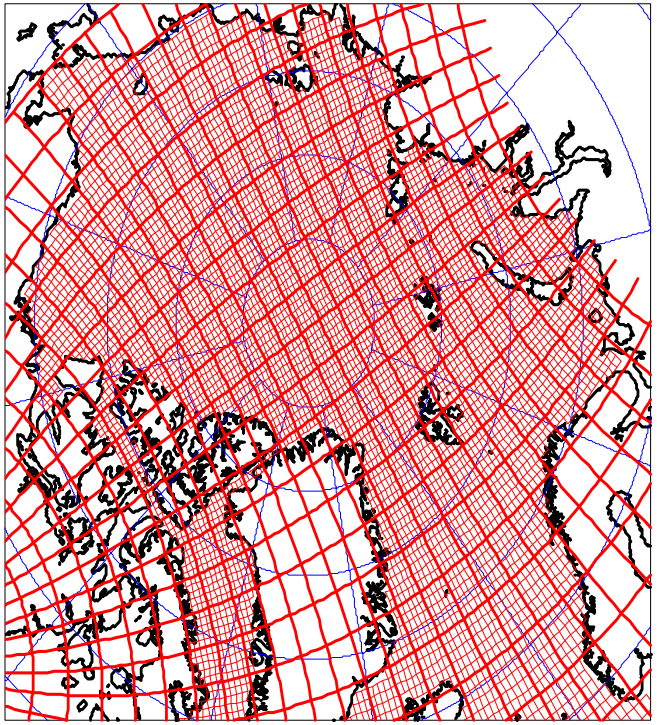
W.D.Hibler ,1979, E.C.Hunke, J.K.Dukowicz,1997, G.A.Maykut 1971
C.M.Bitz, W.H.Lipscomb 1999,J.K.Dukowicz, J.R.Baumgardner 2000, W.H.Lipscomb, E.C.Hunke 2004

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



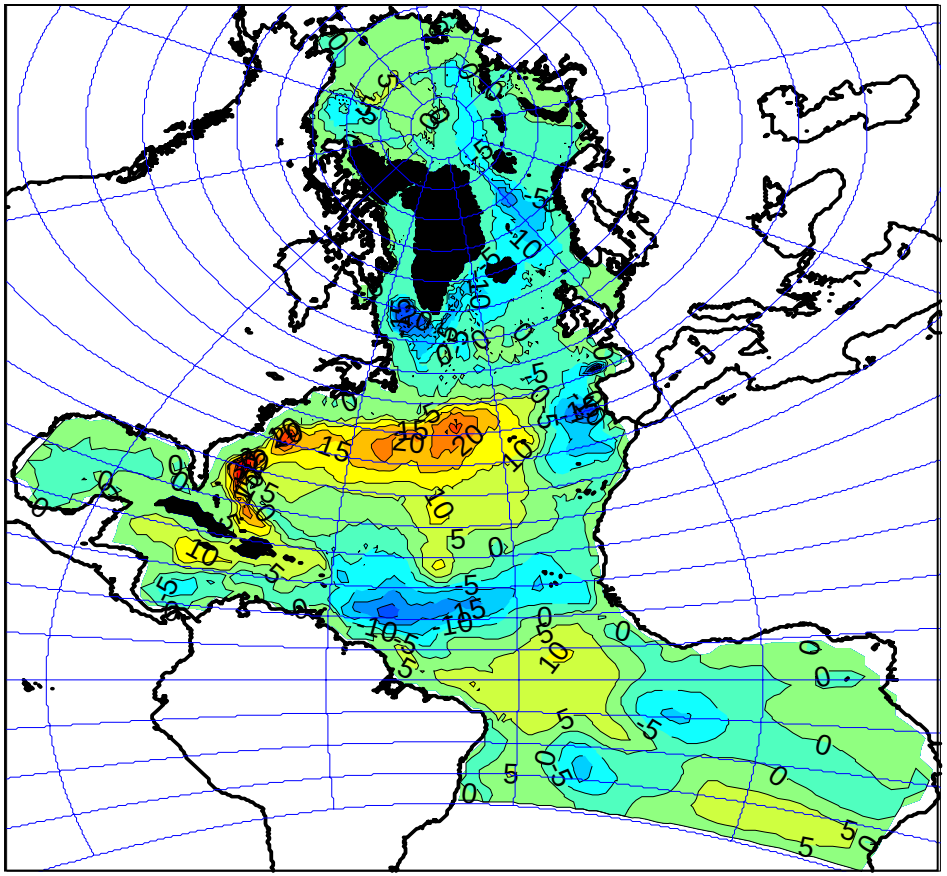
The model domain was built with horizontal resolution of $1x1^0$ in Atlantic. The reprojected bipolar grid in Arctic has minimum spacing equal to 35km while maximum spacing is about 62km.

Experimental design

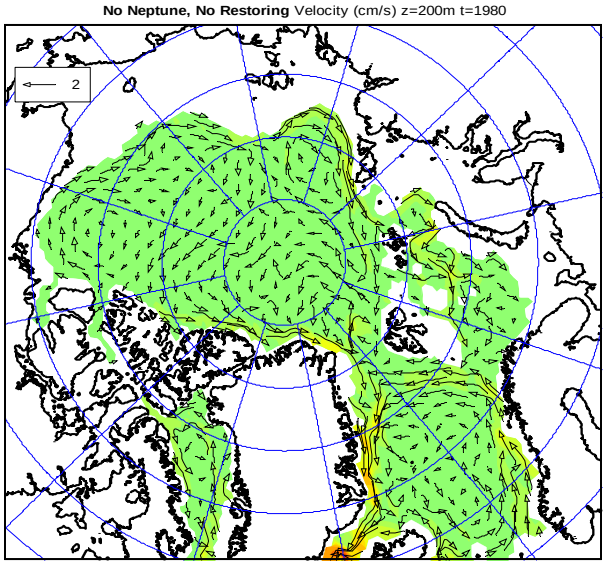
- Ocean model test run: surface restoring to Levitus climatology, monthly wind stress (Trenberth)
- Coupled model 1948-2000 years run. Daily wind stress based on the NCEP/NCAR 995Db wind velocity components for regions upper than 60^0N merged with climatological wind stress (Trenberth) down to 20^0S.

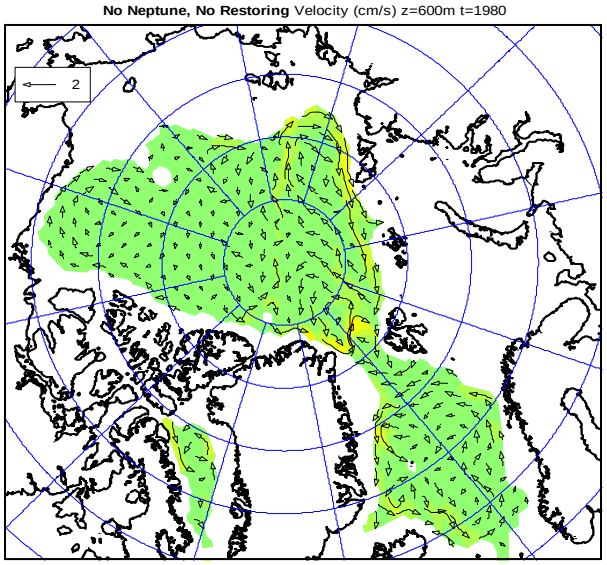
No Neptune, No restoring.	Neptune, No restoring.	No Neptune, Surface salinity restoring.

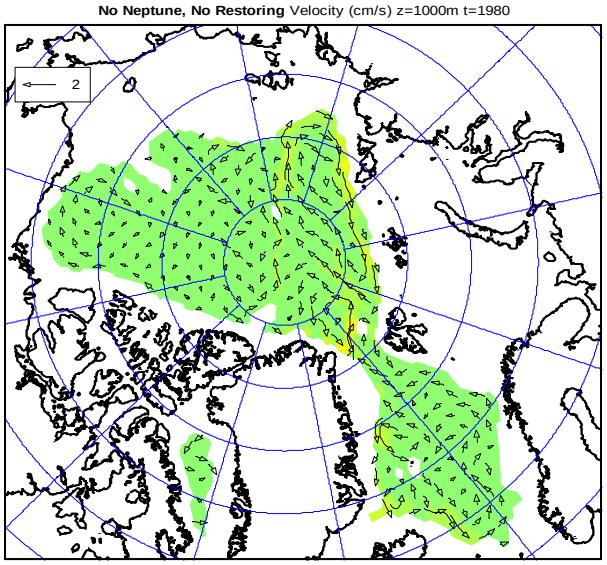
Stream function

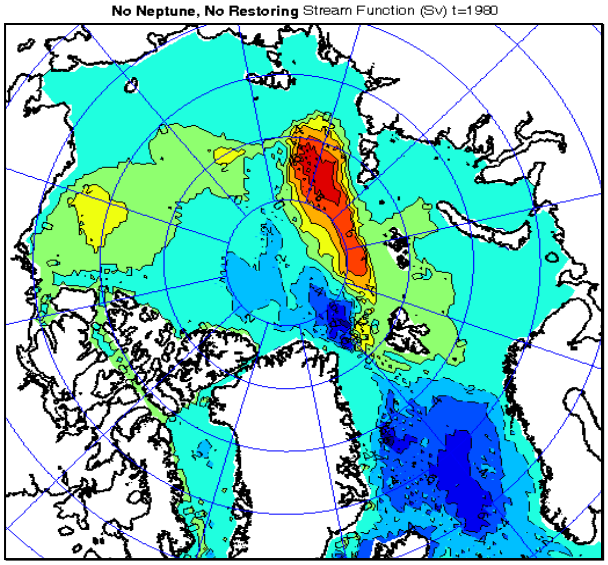


Test 1: No Neptune parameterization. No salinity restoring.

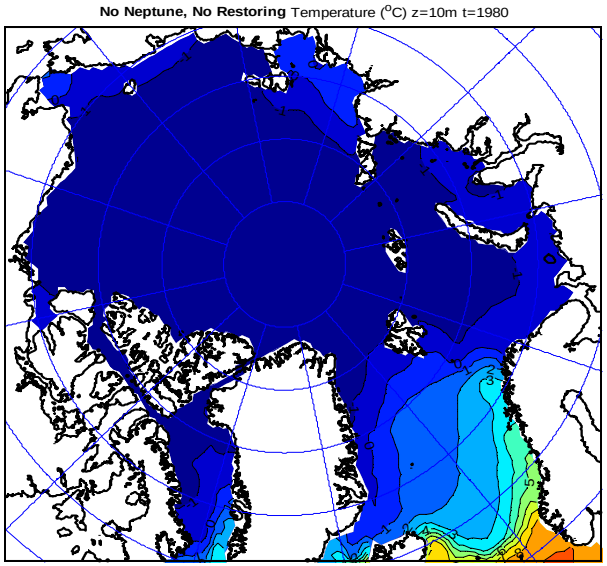


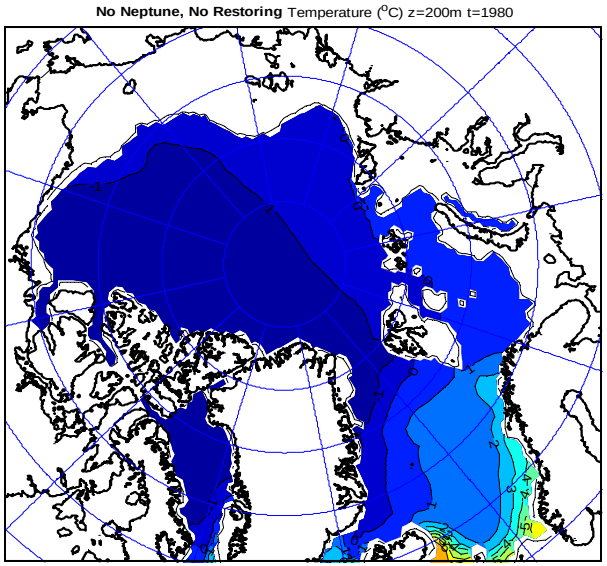


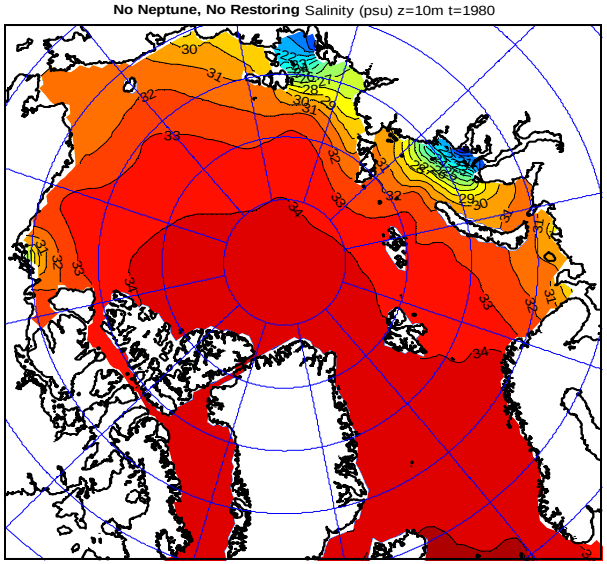


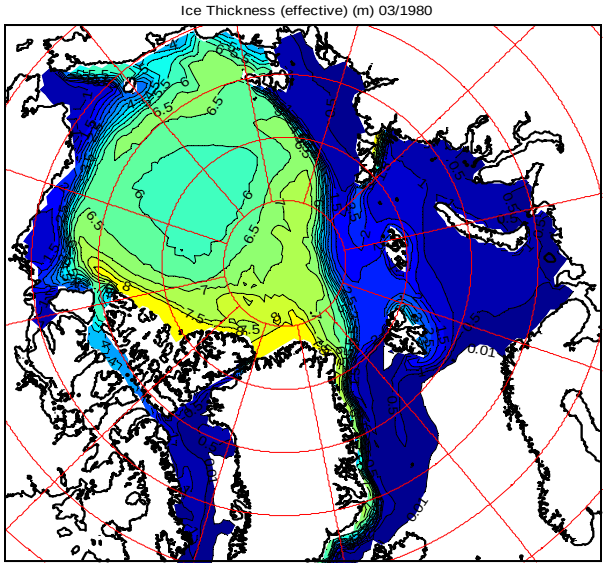


Test 1: No Neptune parameterization. No salinity restoring.

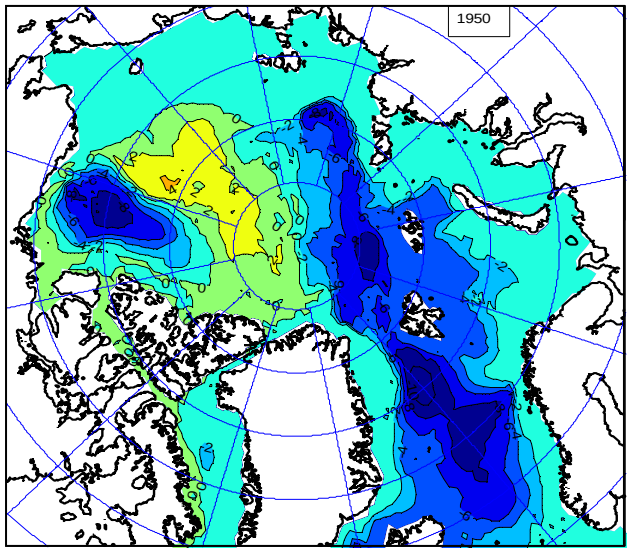


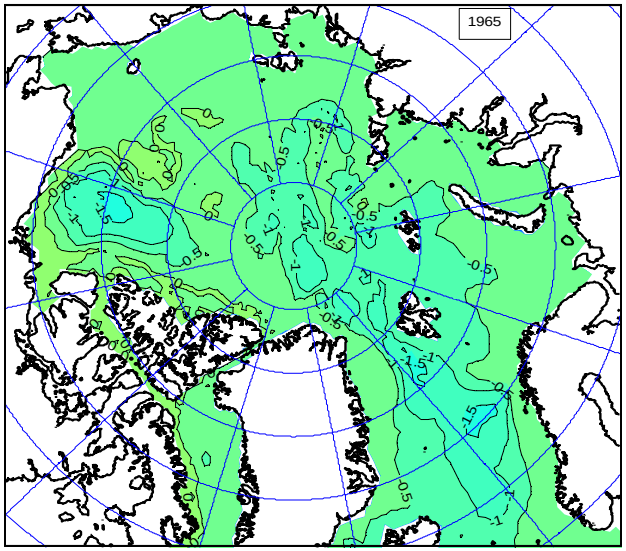


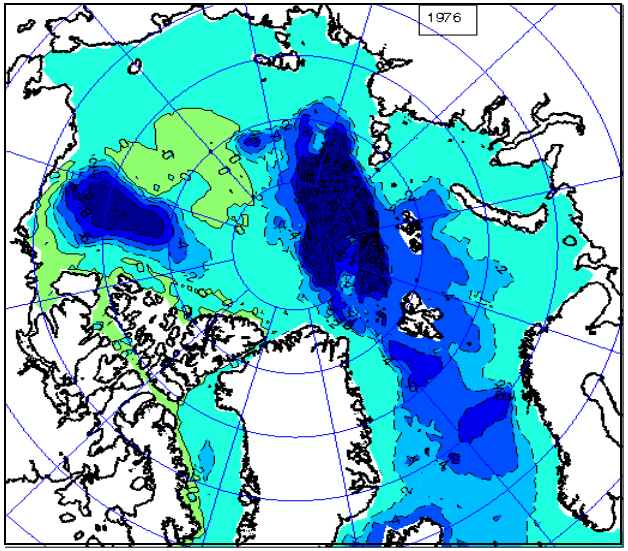


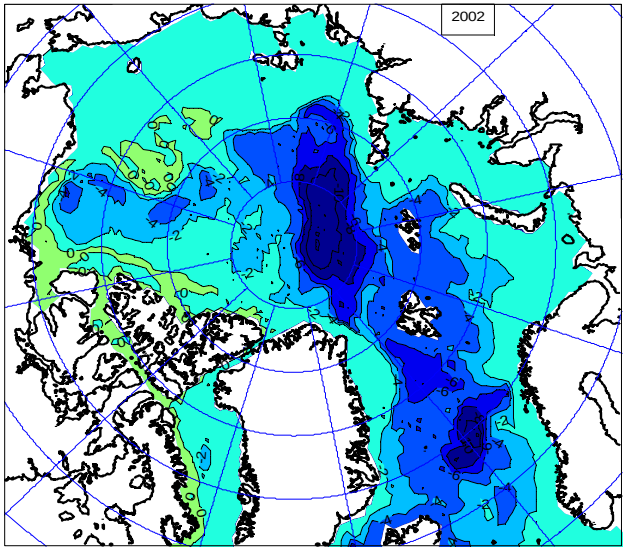


Test 2: Neptune parameterization. No salinity restoring. Stream function.

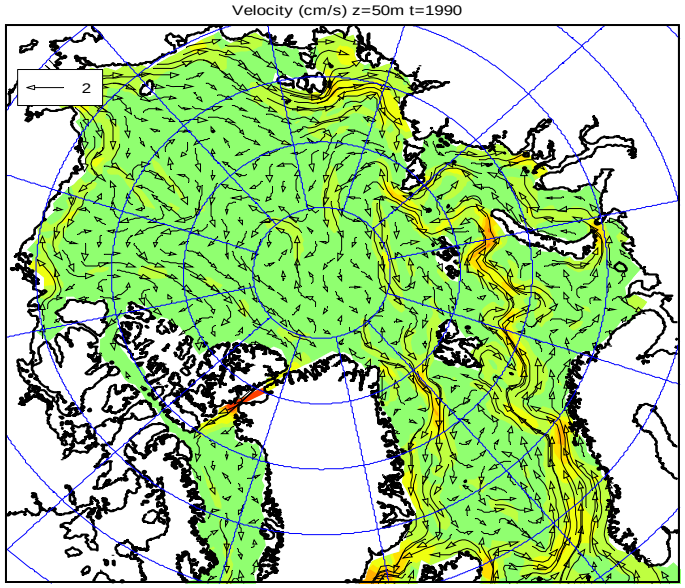


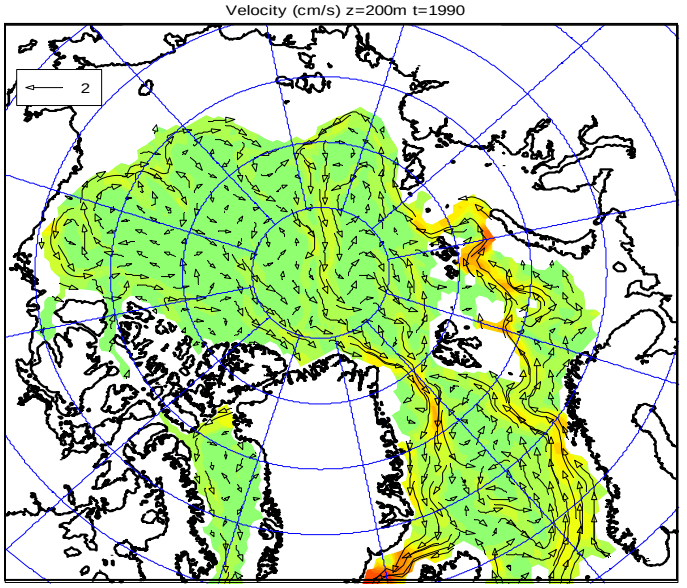


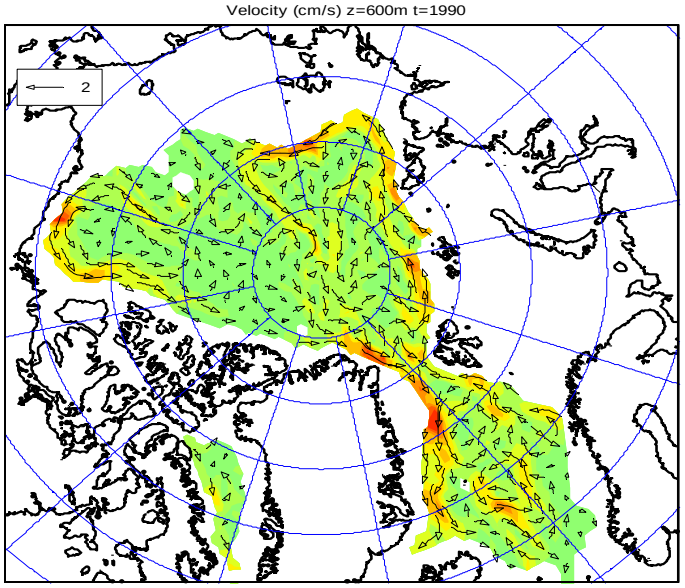


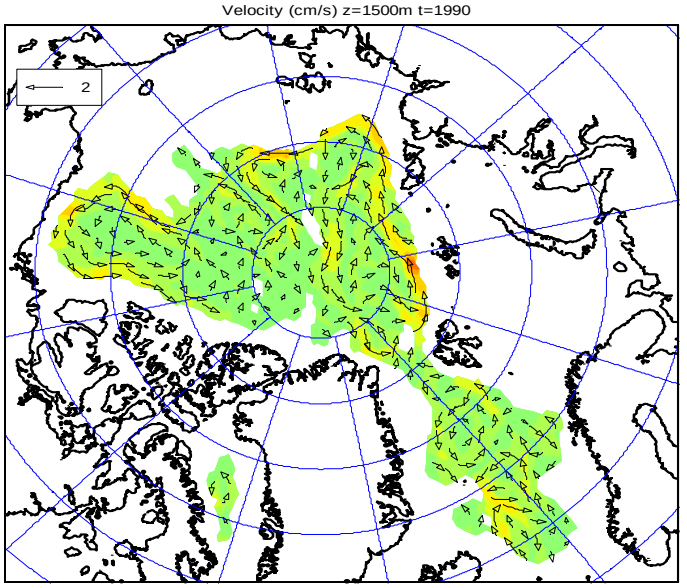


Test 2: Neptune parameterization. No salinity restoring.

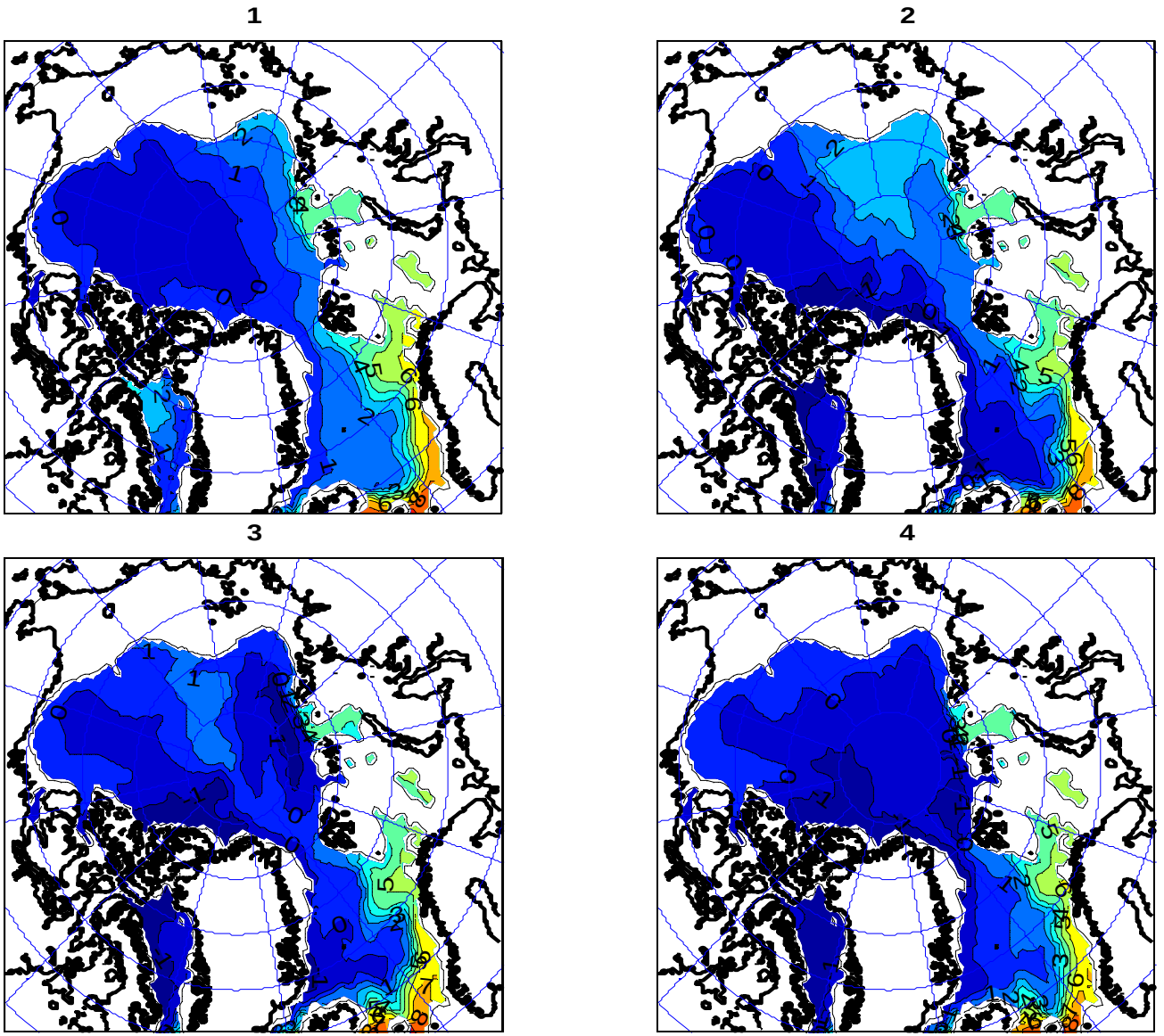




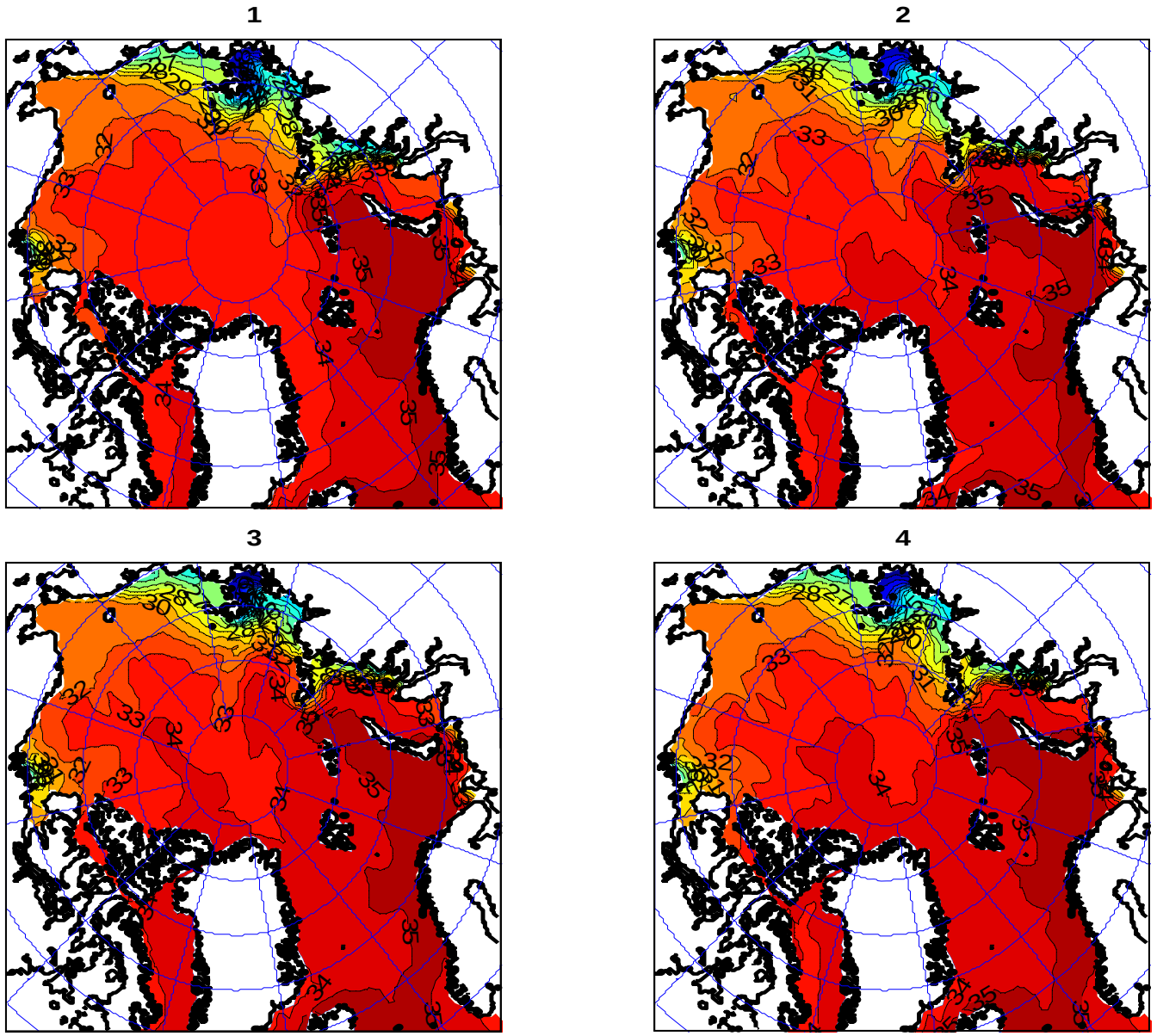




Test 2: Temperature. 300 m. 1-1952, 2-1967, 3-1976, 4 –1995.

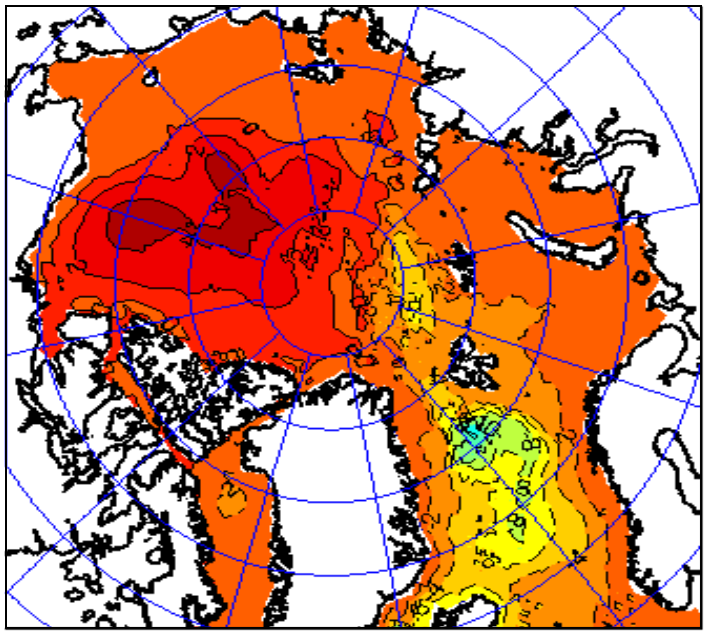


Test 2: Surface salinity. 1-1952, 2-1967, 3-1976, 4 –1995.

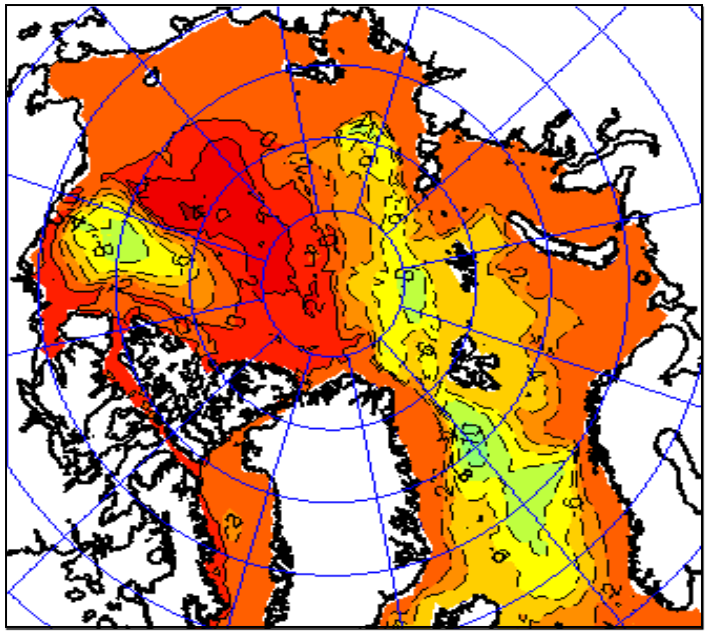


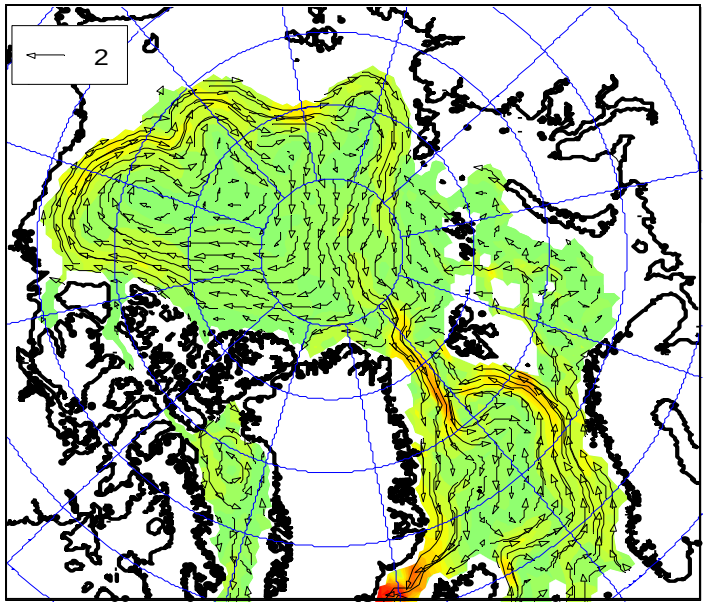
1950. Restoring vs Neptune

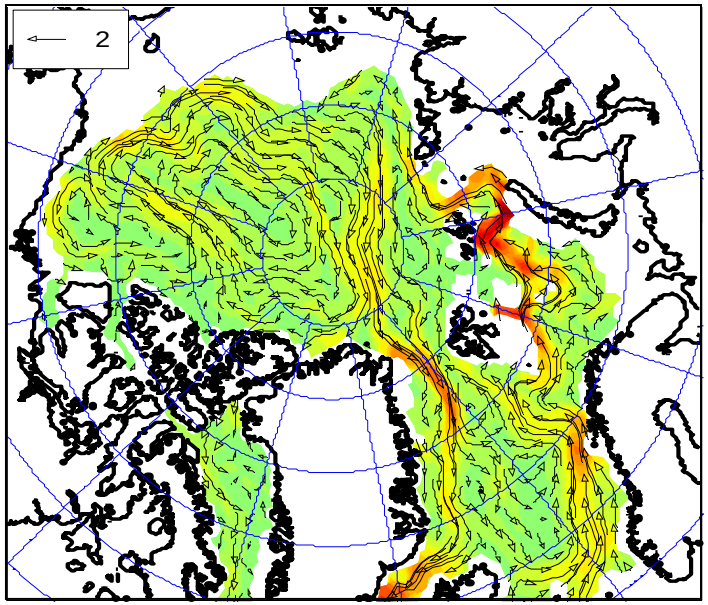
Restoring



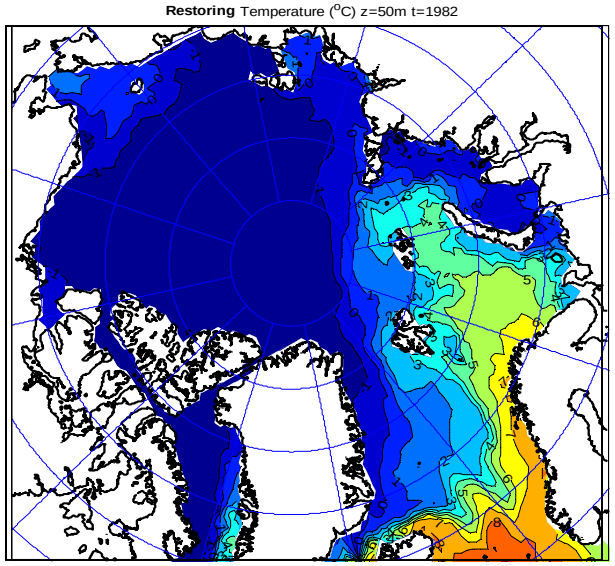
Neptune

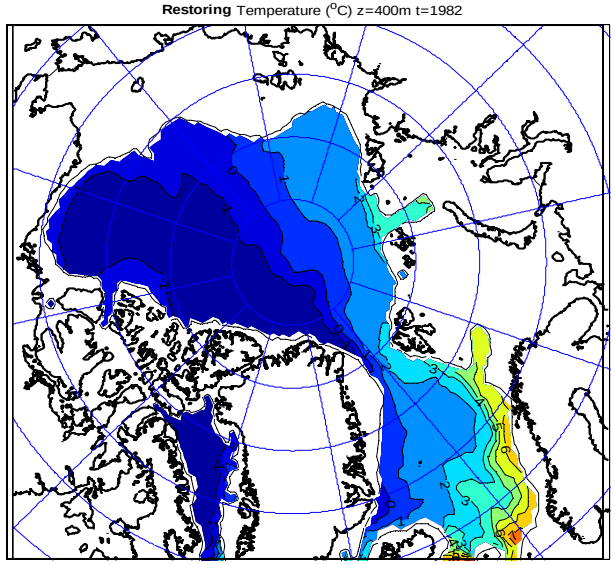


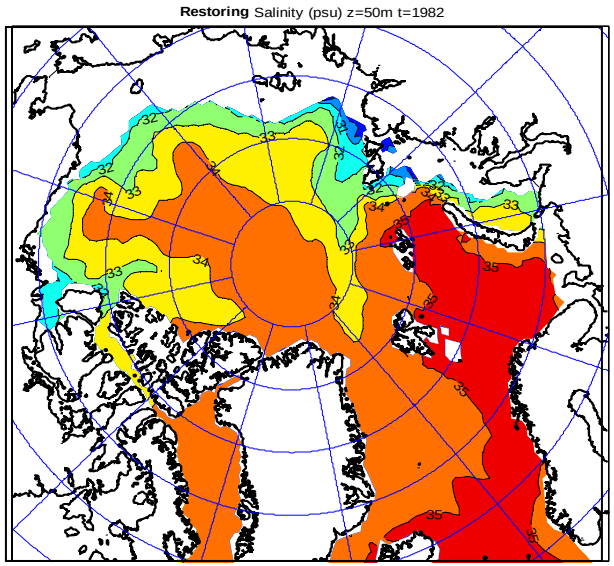


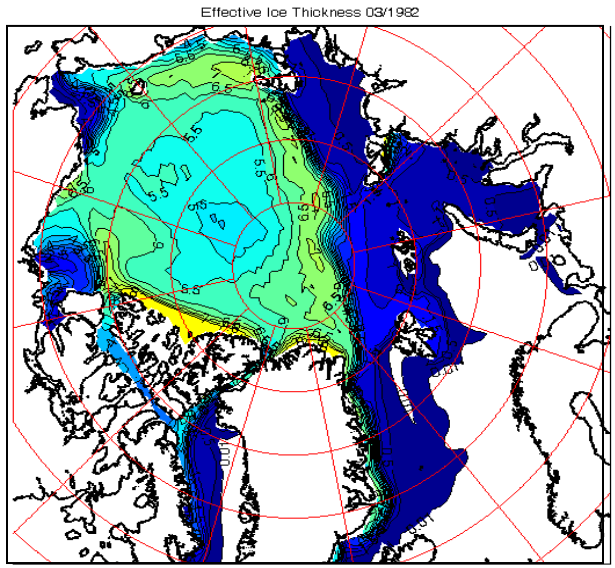


Test 3: No Neptune. Surface salinity restoring

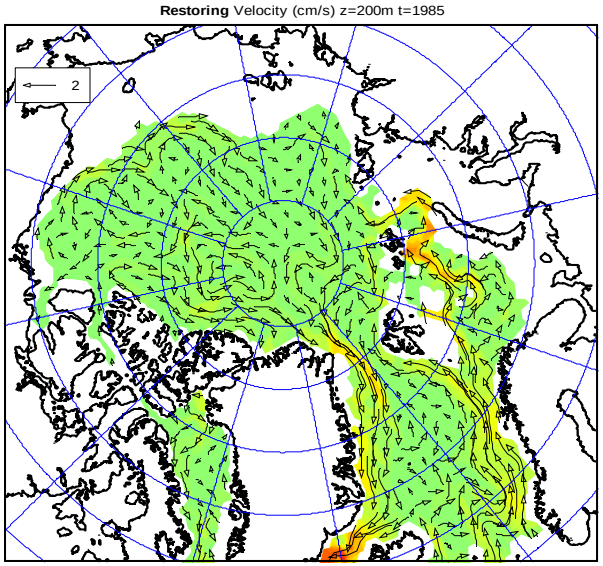


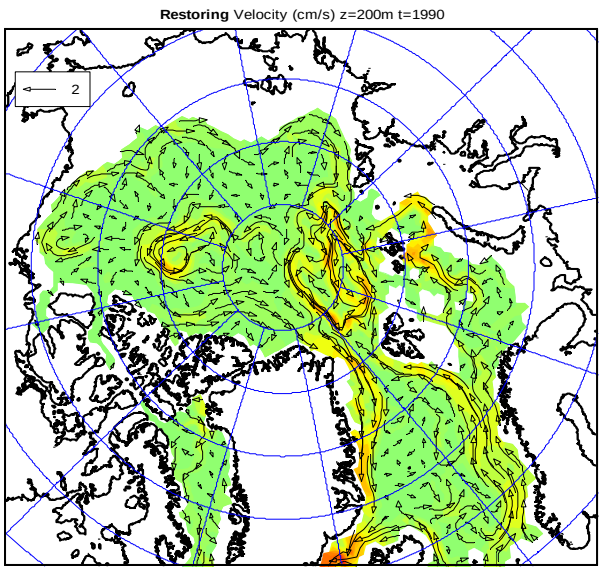


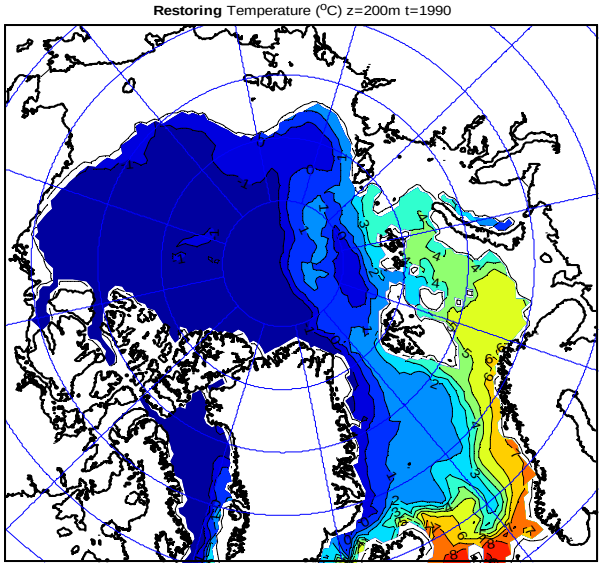


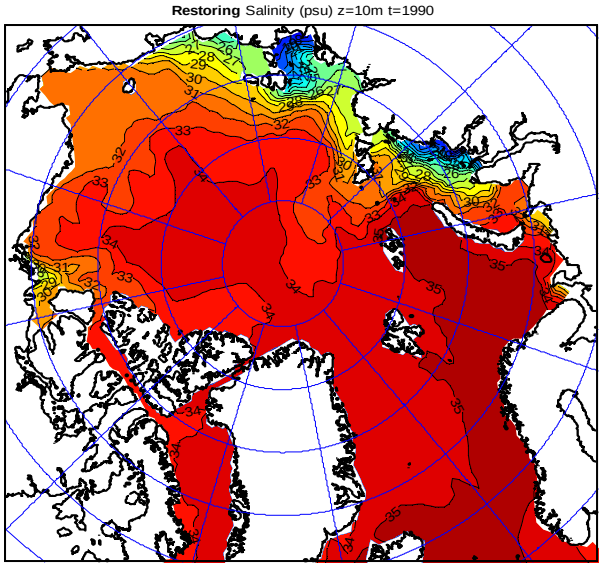


Test 3: No Neptune. Surface salinity restoring

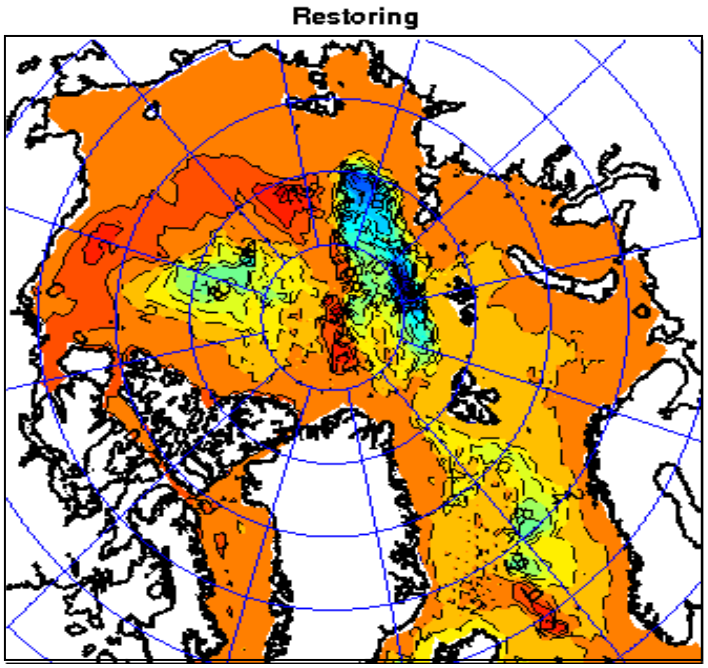


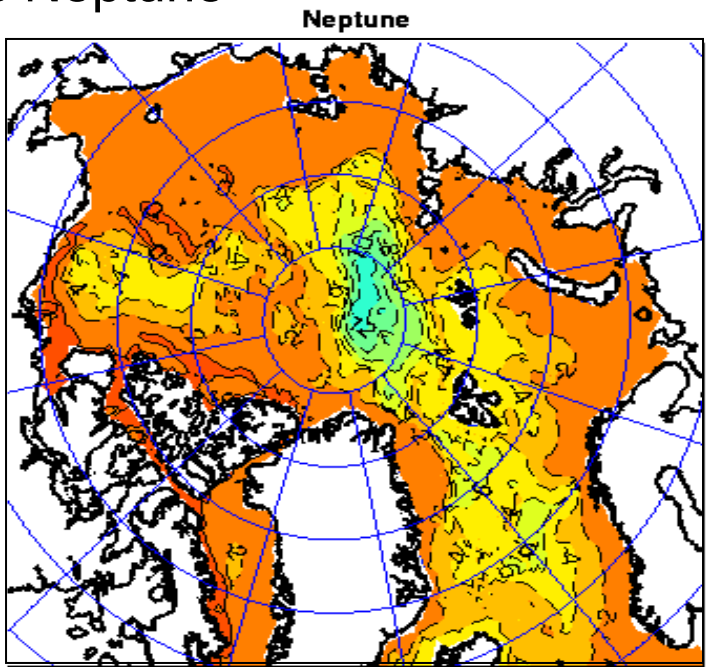


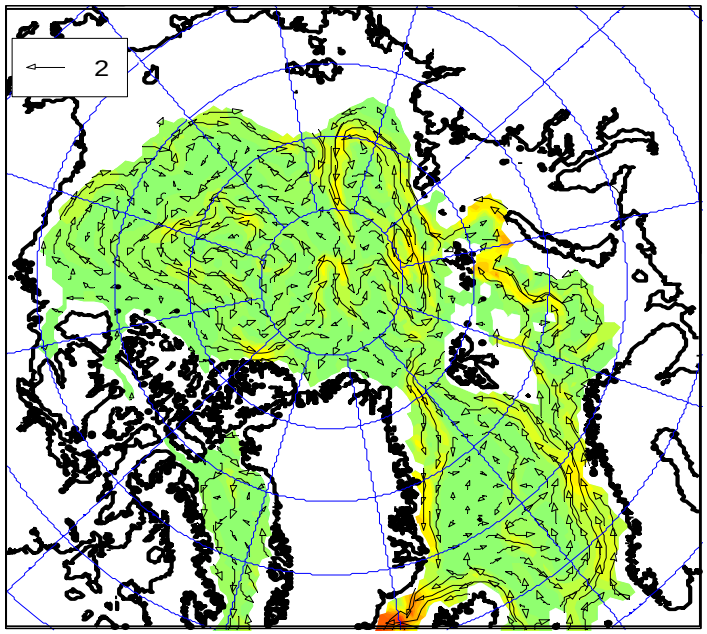


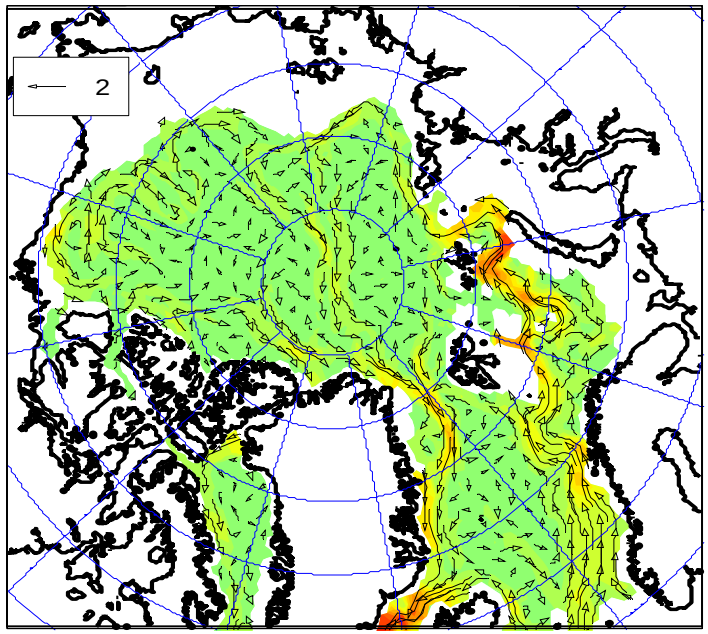


1996. Restoring vs Neptune

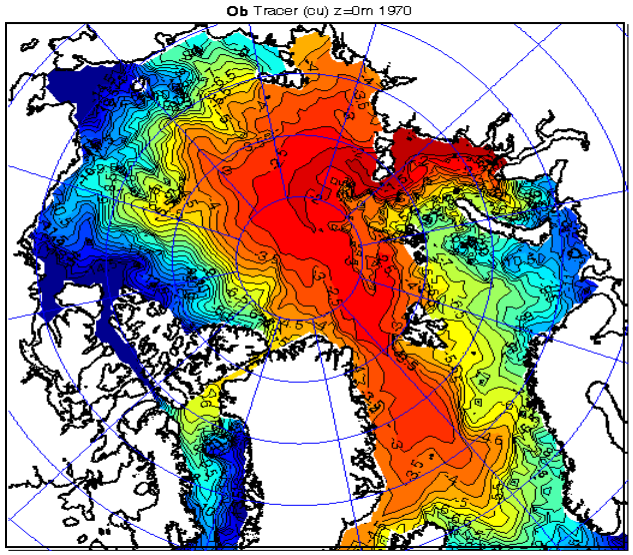


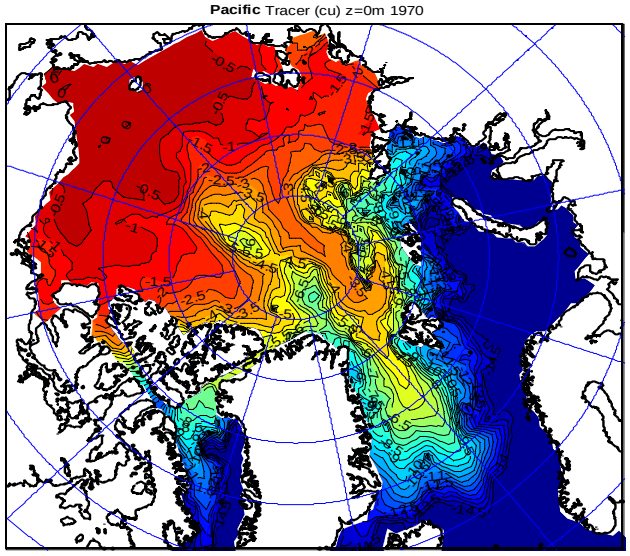


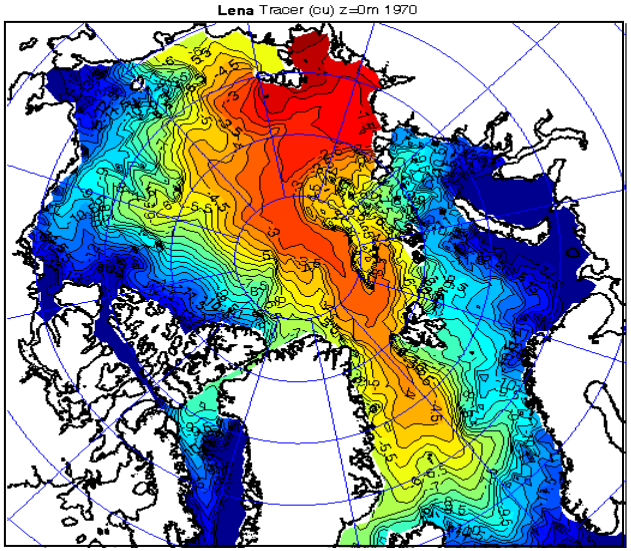


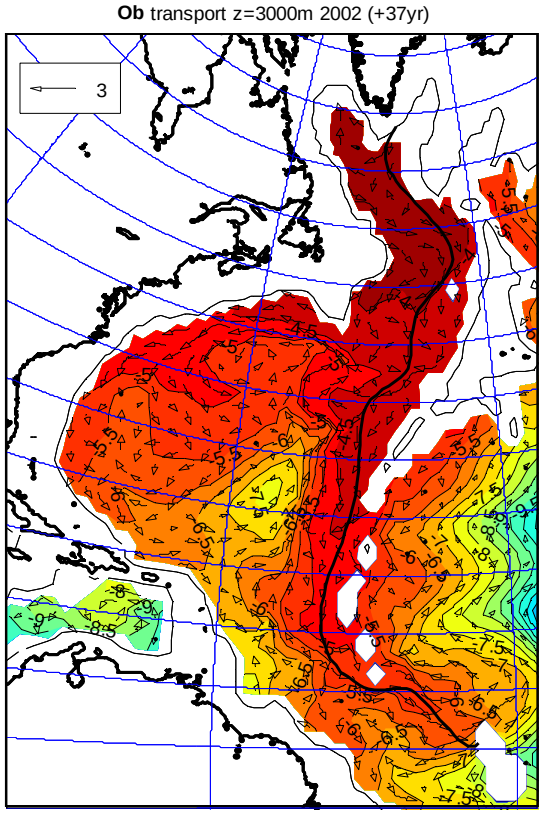


Test 2: Neptune parameterization. No restoring. Tracers

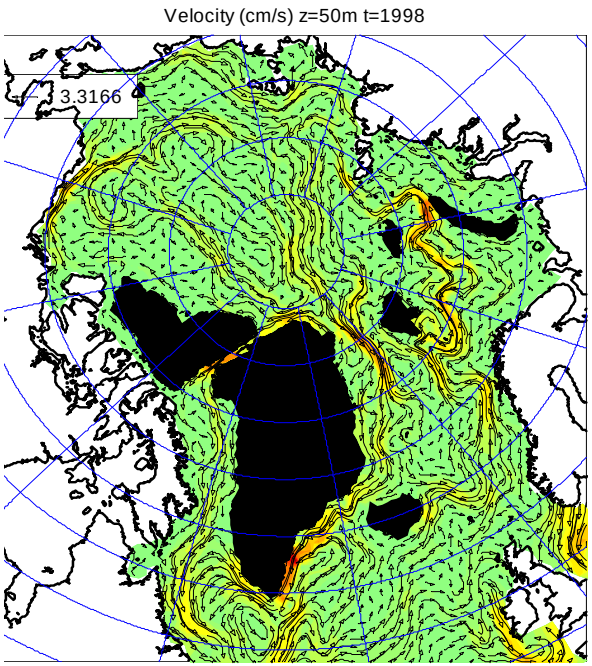


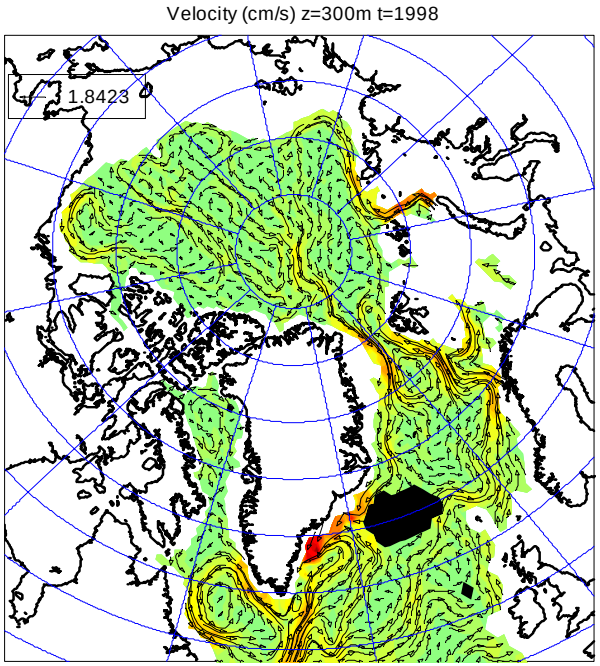


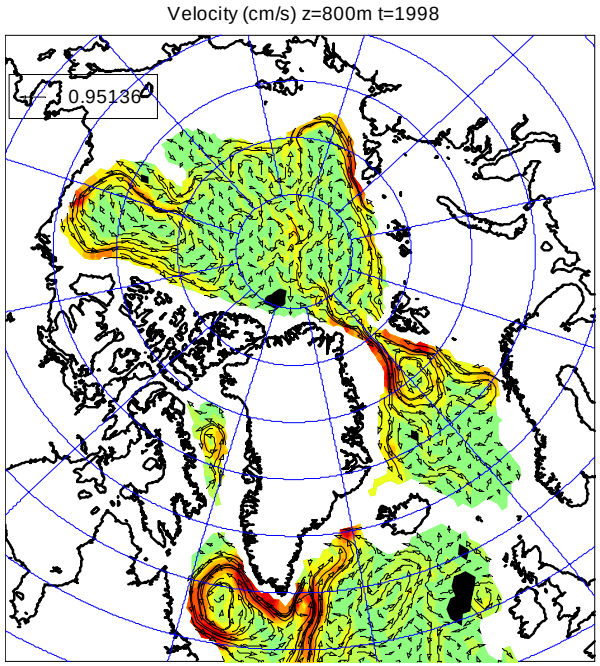




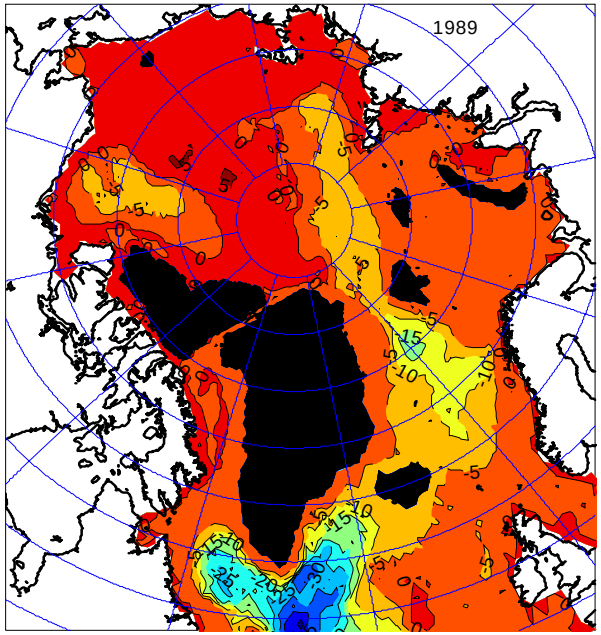
Extra Test : Ocean module only. Arctic surface stress is resulted from Test 3 and merged at 60^0N with wind stress based on NCEP/NCAR wind. Neptune with L=3.5 km. Surface temperature and salinity restoring.

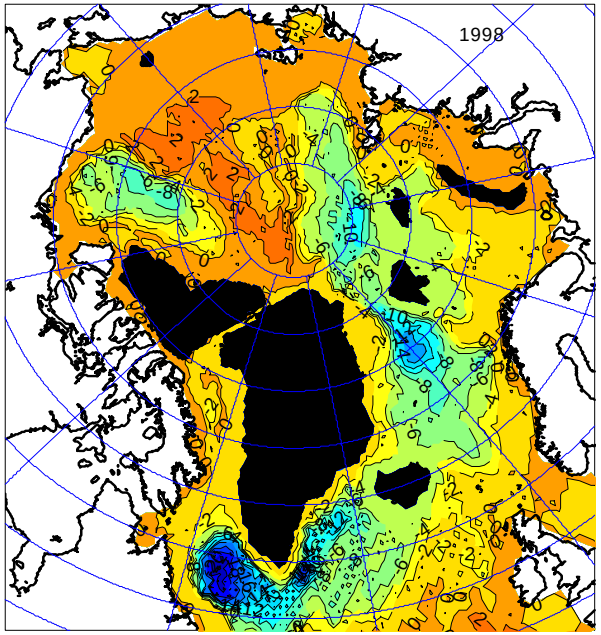




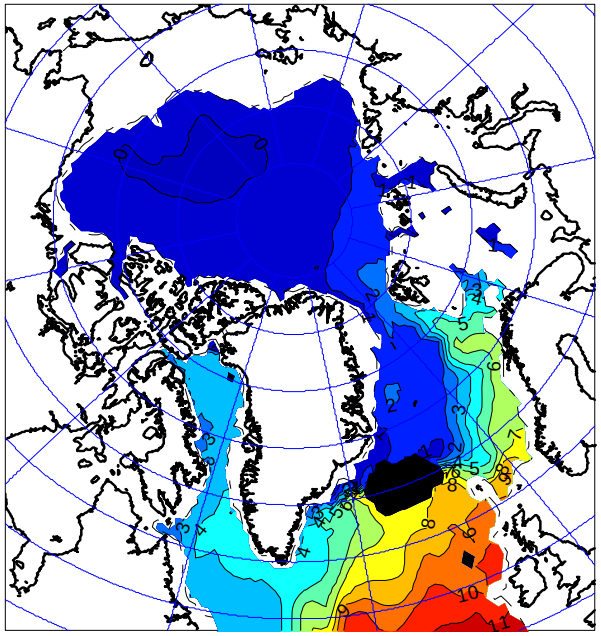


Extra test





Temperature (^{o}C) z=300m t=1979



Temperature (^{o}C) z=300m t=1989