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C-4

A comparison of vertical mixing parametrizations in the simulation of the ice and upper ocean state based on the Arctic Ocean model

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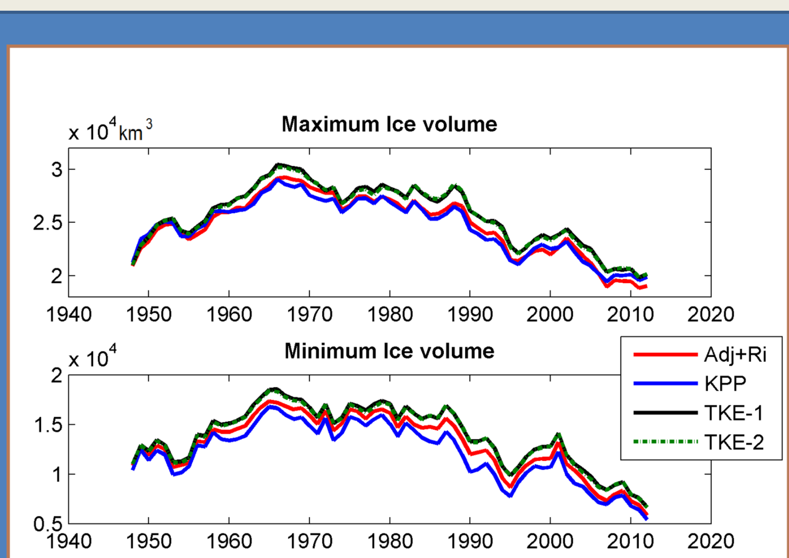
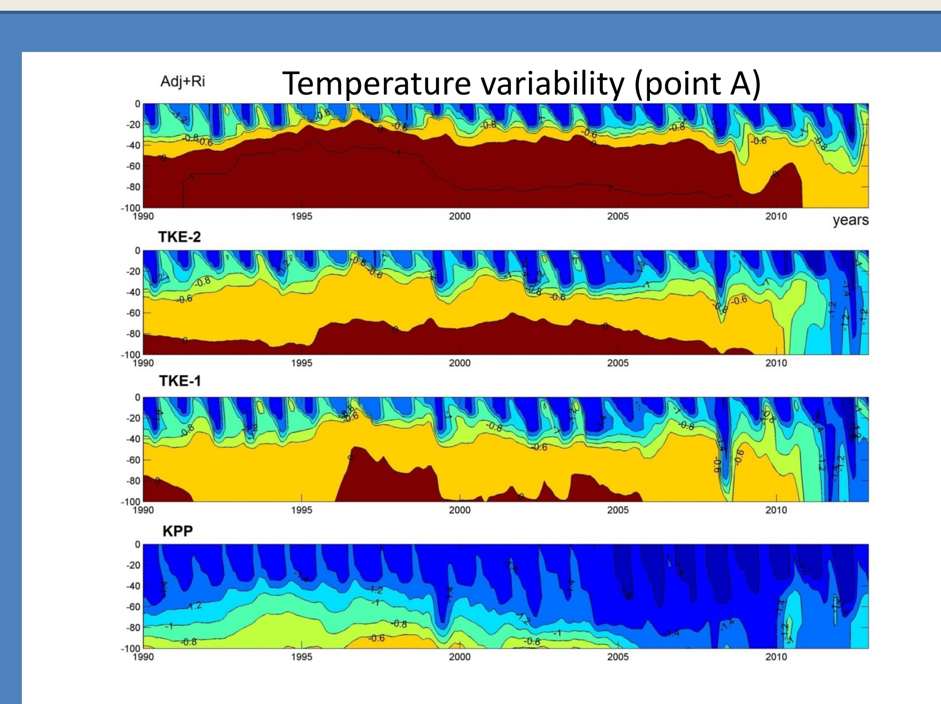
The vertical mixing in the ocean plays an important role in regulating sea surface temperature, which is a critical oceanic parameter, controlling the atmosphere-ocean heat ,energy and momentum exchanges. Because of the small-scale turbulent processes involved, the vertical mixing usually cannot be explicitly resolved in ocean general circulation models and has to be parametrized.

The three-dimensional coupled ice-ocean numerical model used in this study, is based upon the ocean model, developed in the Institute of Computational Mathematics and Mathematical Geophysics, SB RAS, and Sea ice-model- (CICE 3.14- (http://oceans11.lanl.gov/drupal/CICE) , adapted to the region of the North Atlantic (1x1 degree) and the Arctic Ocean(35 -50km). Several one-dimensional vertical mixing parametrizations were implemented from GOTM package (General Ocean Turbulence Model, http://www.gotm.net/). Among them: nonlocal K-profile parameterization (KPP, [1]), Total Kinetic Energy (TKE) with first order [2] and second order [3] coefficients . These vertical parameterizations were compared with more simple adjustment procedure based on the Richardson number, previously used in the ICMMG ocean model.

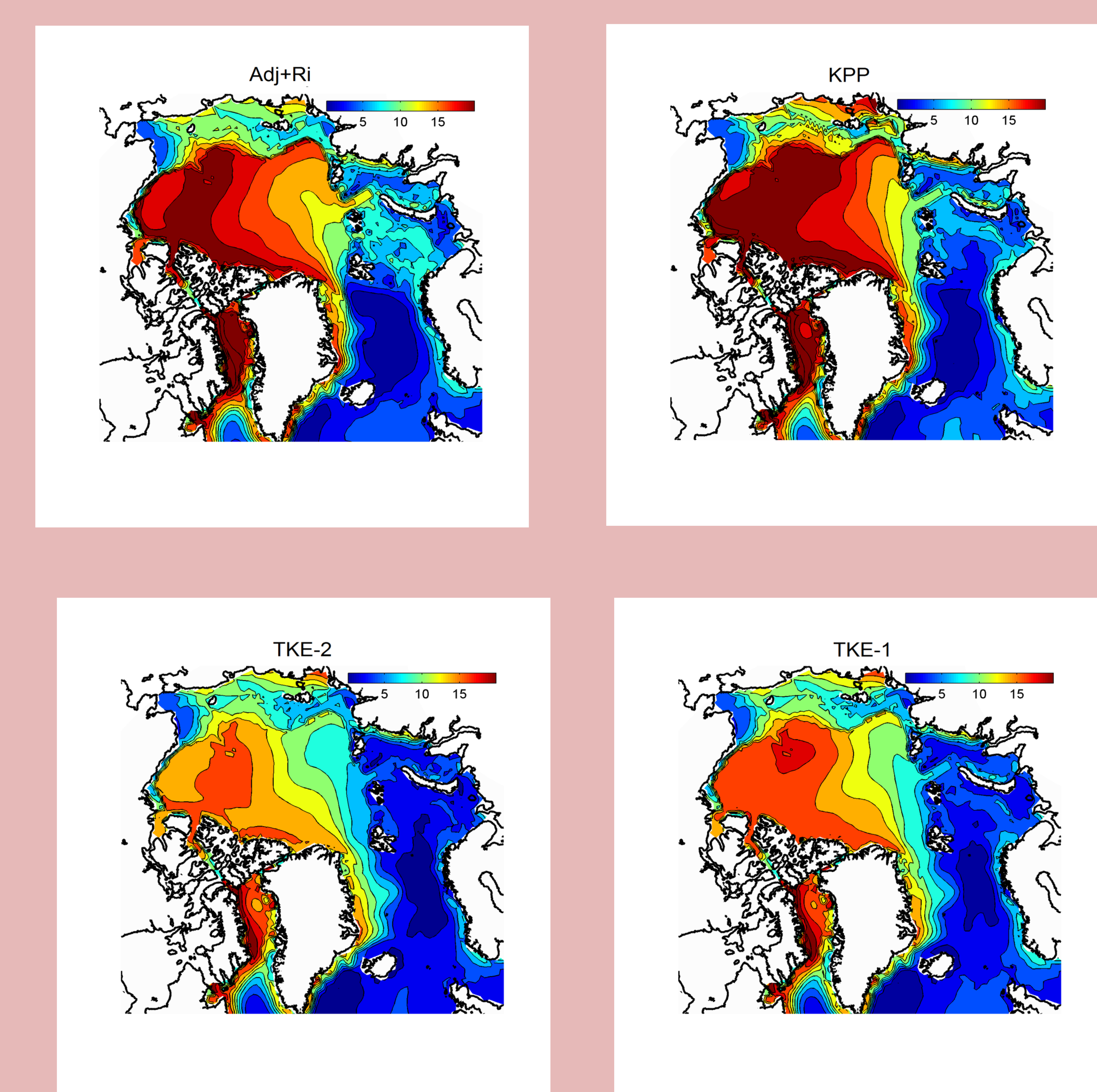
The parametrization were tested in numerical experiments which were aimed to simulate the variability of the Arctic Ocean state under atmospheric forcing (NCEP/NCAR,1948-1912).

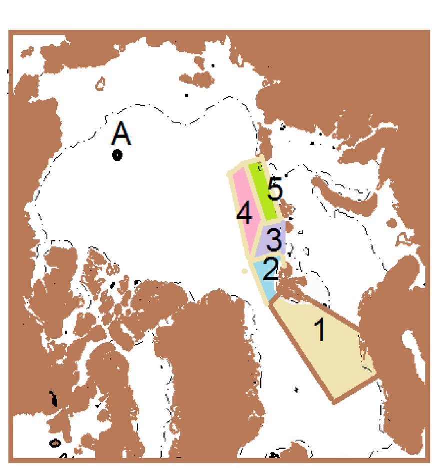


Trends of the ice volume variation are the same for all parametrizations. The quantitative differences are visible, and they are comparable to the interannual variations.



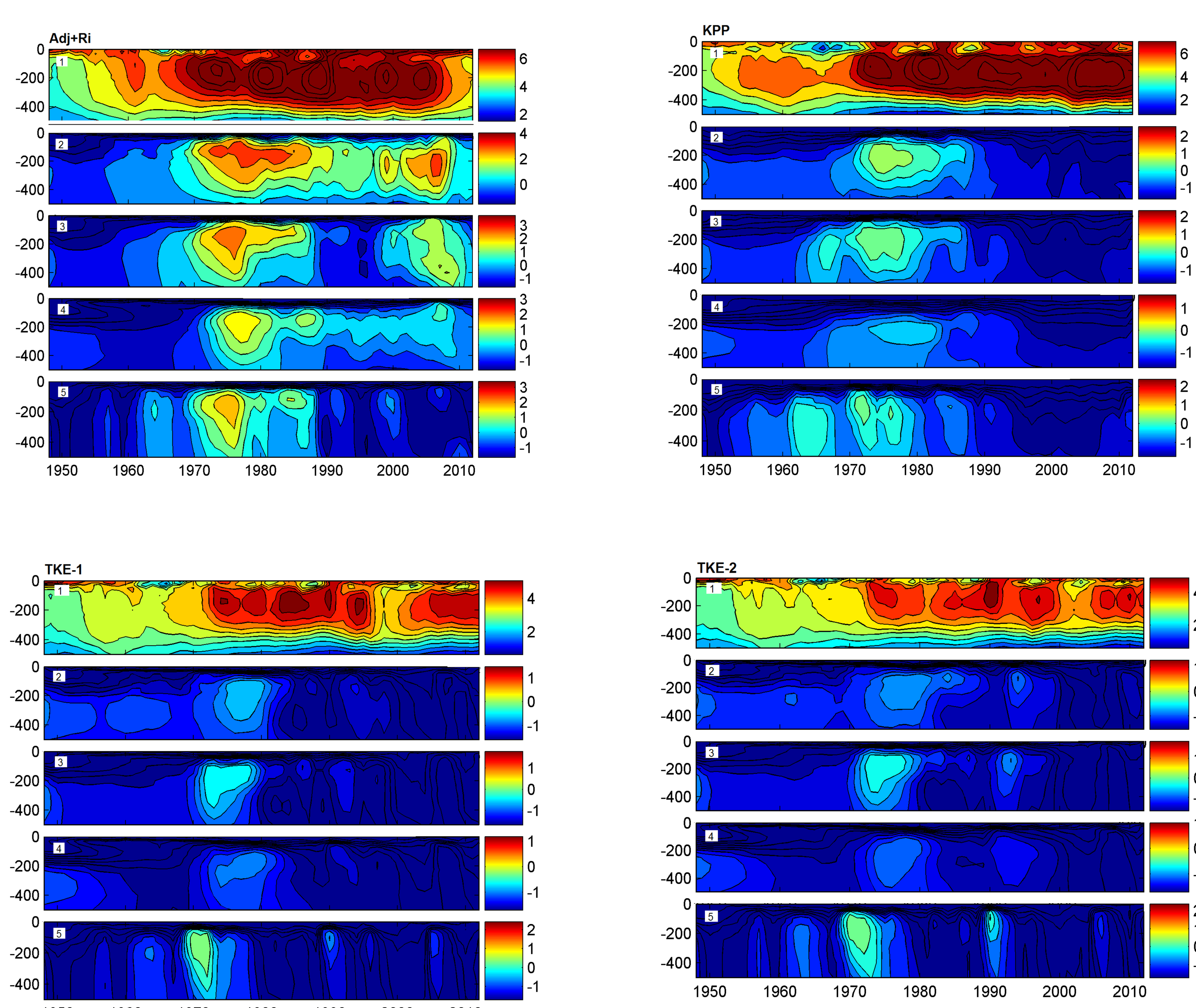
1985-2012 FWC averaged





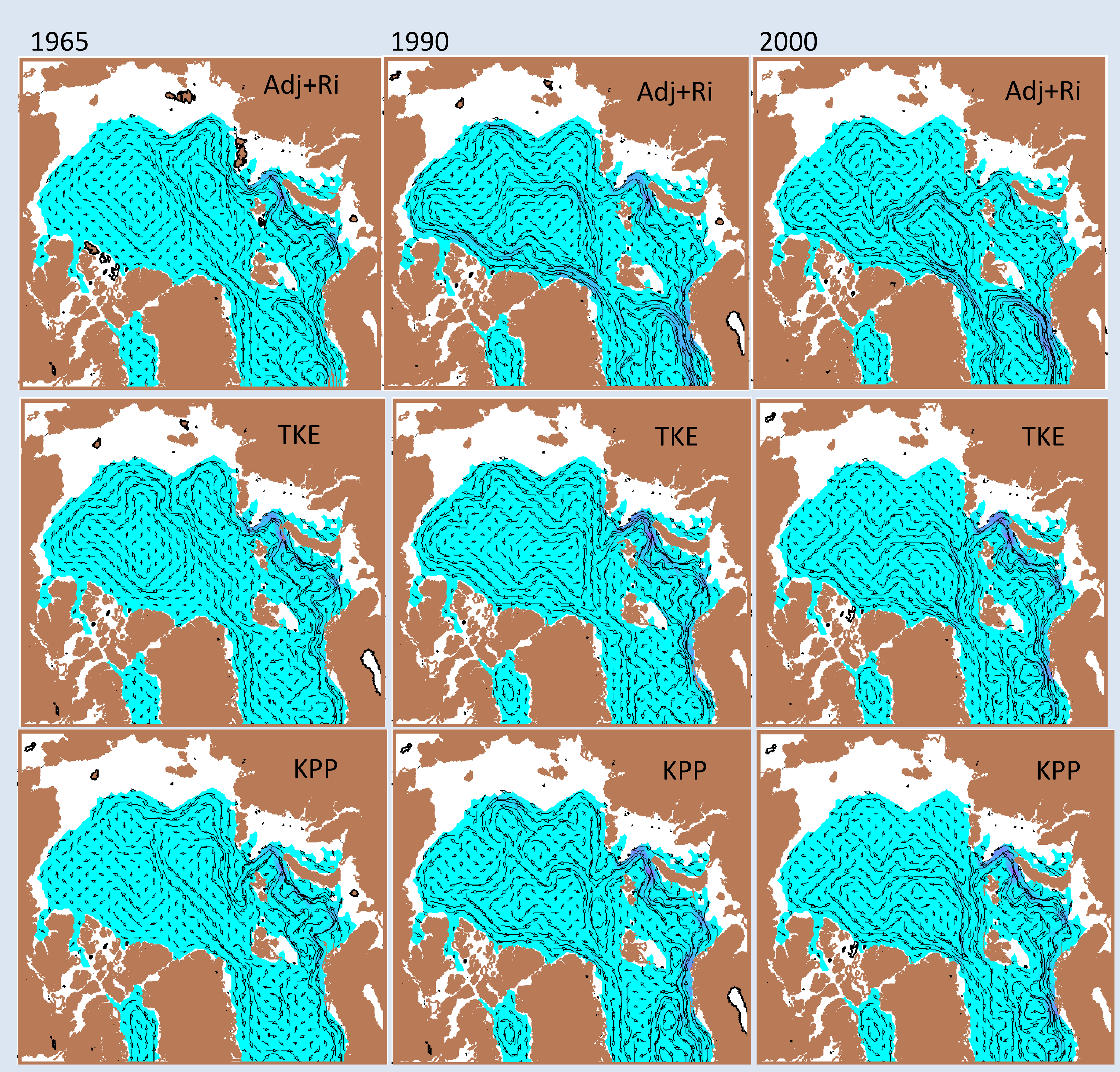
The Fram Strait and Eurasian shelf break are very sensitive regions of the Arctic Ocean model to the vertical mixing parameterizations.

Temperature, averaged over the regions



Consequences of too deep vertical mixing in the Arctic Ocean numerical model

Simulated ocean circulation variability (averaged in the layer of 100-500m)



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