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Large biases in hydrography and circulation of the Arctic Ocean in CMIP6 models

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Climate models are our best tools to quantify ongoing changes caused by the climate crisis, but they are not perfect. The Arctic Ocean is particularly challenging to simulate: complex circulation flowing through narrow gateways and around tortuous bathymetry, dense water cascading off the steep shelf break, slow exchanges in canyons, along with known biases in sea ice and neighbouring seas.

We investigate the Arctic Ocean in the historical run of 14 distinct models that participated to the latest Climate Model Intercomparison Project phase 6 (CMIP6) and find large biases in temperature, salinity, density, and depth of critical water masses, both on the shelves and in the deep basins. The biases are consistent throughout the water column and throughout the Arctic, with correlations often exceeding 0.9. However, no significant trend is observed in these biases, suggesting that the deep basins of the Arctic are not correctly ventilated already at the level of the Atlantic Water.

Using the subset of models that submitted the age of water output, we confirm this absence of ventilation by dense water overflows: the overflows occur at too few locations and are diluted at shallow depths.

Work is ongoing to relate these biases to the relevant processes, the upper water column, and fluxes through the various Arctic Ocean gateways.