Why does ACCESS-OM2-01 create realistic DSW?

A collaborative project that investigates why ACCESS-OM2-01 creates Dense Shelf Water (DSW) accurately along the Antarctic Shelf.

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ACCESS-OM2-01 produces realistic DSW and is to our knowledge the only global ocean-sea ice model to do so. A growing amount of research on ocean circulation around Antarctica is based on ACCESS-OM2-01. The aim of this project is to inform other modelling groups on the requirements to simulate DSW and to support model development in Australia, including coupled models for present day and paleo climates.

DSW formation

DSW is formed in coastal polynyas during intense sea ice formation, resulting in heat loss and brine rejection that drive vertical convection.

When DSW cascades down the continental slope, it mixes with ambient waters to form Antarctic Bottom Water, comprising a third of the global ocean volume.

Modelling challenges

Models need to

- produce dense water on the shelf, and
- export DSW down the continental slope.

A high horizontal resolution is required to simulate these processes (e.g., OM2-025 simulates open ocean convection), but horizontal resolution is not the only factor. Other eddying models fail to reproduce coastal convection.

Sensitivity experiments

Coarsened vertical grid

- increase surface grid cell to 5 m
- adjust remaining cells to keep 75 levels

CM2 winds

- apply wind stress from ACCESS-CM2-025
- only apply monthly anomalies, high-temporal resolution (storms) remain

No salinity restoring

- zero surface salinity restoring

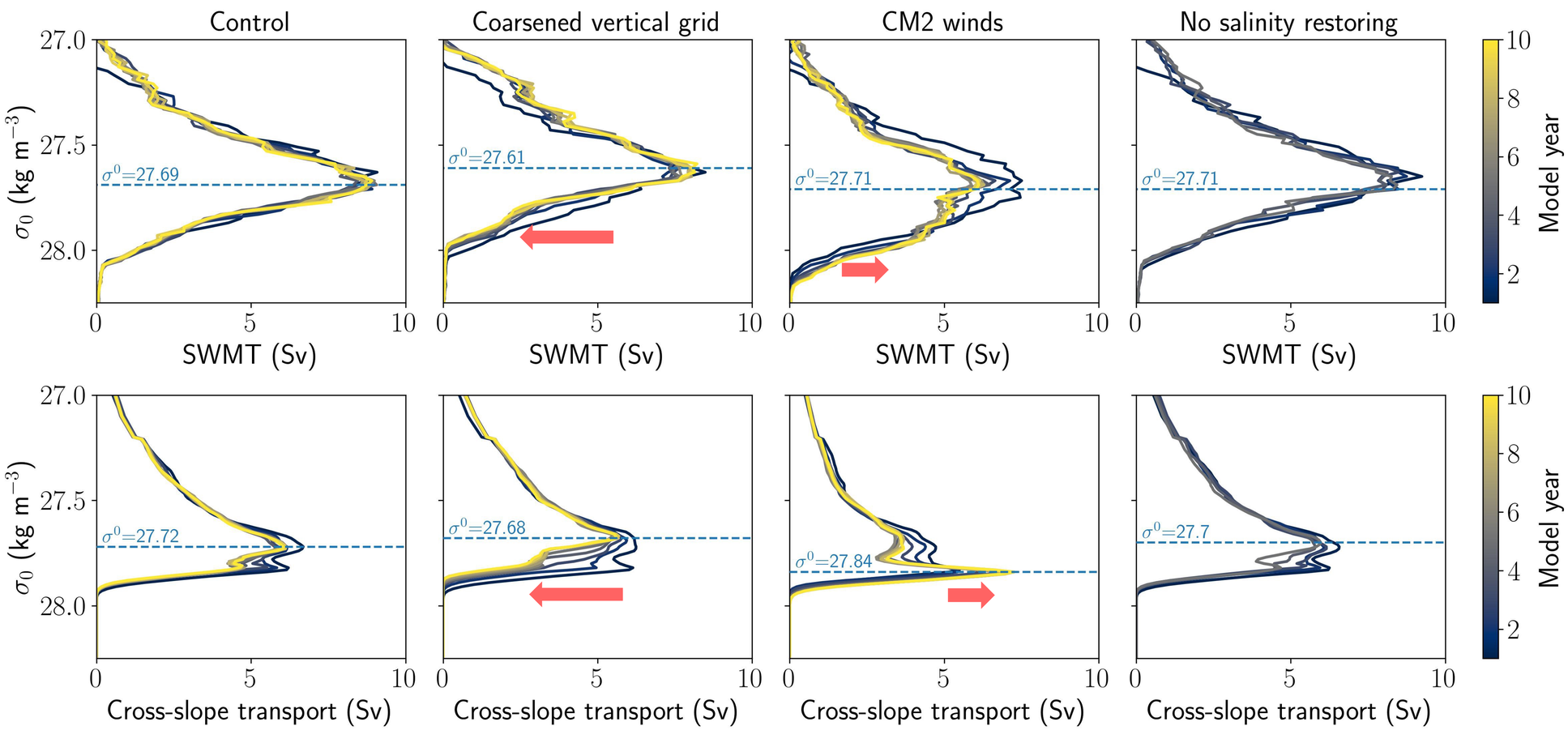

Figure: (*top*) Surface water mass transformation (SWMT) and (*bottom*) cross-slope volume transport (1000 m isobath) as a function of density for each experiment. Colours indicate time in 10-year simulation. Vertical dashed lines indicate density of maximum SWMT/cross-slope transport.

Initial results

Coarsened vertical grid

- lighter DSW
- hypothesis: larger grid cell=bigger volume, more difficult to reach higher density

CM2 winds

- denser DSW (shift from lower to higher)
- why? Ideas welcome

No salinity restoring

- minor effect
- hypothesis: already weak salinity restoring in control simulation

Future runs

Coarsened upper grid cell only →

- only adjust the surface grid cell to 5 m
- reduce levels to 72 (other cells remain)

Full CM2 forcing →

- apply all surface fluxes from CM2-025
- use 3 hourly output for all parameters

Salinity restoring →

- increase salinity restoring (to create larger perturbation)

Do you have any suggestions? Leave us a comment at our github repo!

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