Hi Knut,

Thanks again for that great presentation.

As I mentioned, here's the piece of source code in MOM6 that generates the HYCOM-like coordinate:
https://github.com/NOAA-GFDL/MOM6/blob/dev/gfdl/src/ALE/regrid_interp.F90

The algorithm can briefly be described as follows:

1. On initialization: define the target interface densities and the pre-defined minimum layer thicknesses dz (which are then cumulatively summed to find interface depths)
2. On the regrid step:

a. Interpolate to find the position of every interface density within the water column using the reconstructions of T and S (build_and_interpolate_grid)

b. Build a z* grid based on the shallowest allowable depths, accounting for the barotropic dilation of the water column

3. Sweeping down from the interface just below the free surface, take the max of the depth of the interface density within the water column and the shallowest allowed depth.
4. Optionally: Sweep down the column and adjust interface positions to ensure that layers are no thicker than a prespecified threshold and/or are not deeper than a previously set depth
5. Calculate layer heights (thicknesses) as the difference between interface positions

So for example in the HYCOM coordinate you might have something like sigma2 = [1010, 1014, 1017, 1020, 1022] and dz = [2, 2, 5, 10]. If the bathymetry is 20m, this results in nominal z* grid whose interfaces depths (positive downward) are [0, 2, 4, 9, 19, 20] (where the depth is specified to give a 20m thick water column). Let's say that build_and_interpolate grid gave something like [0, 5, 10, 15, 0] for the depth of sigma2 surface (where 0 means the surface doesn't exist in the water column), corresponding to interface depths of [0, 0, 5, 10, 15, 20] (again the last interface position is adjusted to match the bottom depth). Then, taking the maximum depth between those and the z* grid, you'd get a final grid of: 0, 2, 5, 10, 19, 20 with corresponding thicknesses of [2, 3, 5, 9, 1].

As Mike mentioned, a crucial limitation is that in the way it's implemented in MOM6, a single shallowest allowable depth for an interface applies globally. Even with that simplification, the number of free parameters in tuning the grid are 2*NK because for every interface depth, you specify a density and shallowest depth. To simplify the latter, in global simulations done at GFDL and NCAR using the HYCOM-coordinate, the nominal z* is constructed from an analytic function for layer heights that goes like factor**power.

Also as Jerome mentioned, MOM6 thickness and tracer advection are coded in a way that does allow for 0 layer thicknesses. In practice, GFDL/NCAR use a minimum layer thickness of 1mm in their global simulations.

Hope that gives you some context to look at the code. Let me know if there's a good time to meet up if you want to step through and discuss in further detail. I'd be very curious to see how the adaptive coordinate is implemented in GETM.

Best,
Andrew

One thing to add as well. MOM6 targets interface densities whereas HYCOM targets layer densities when constructing the grid.