Implementation of the Upper-Ocean Model in POP

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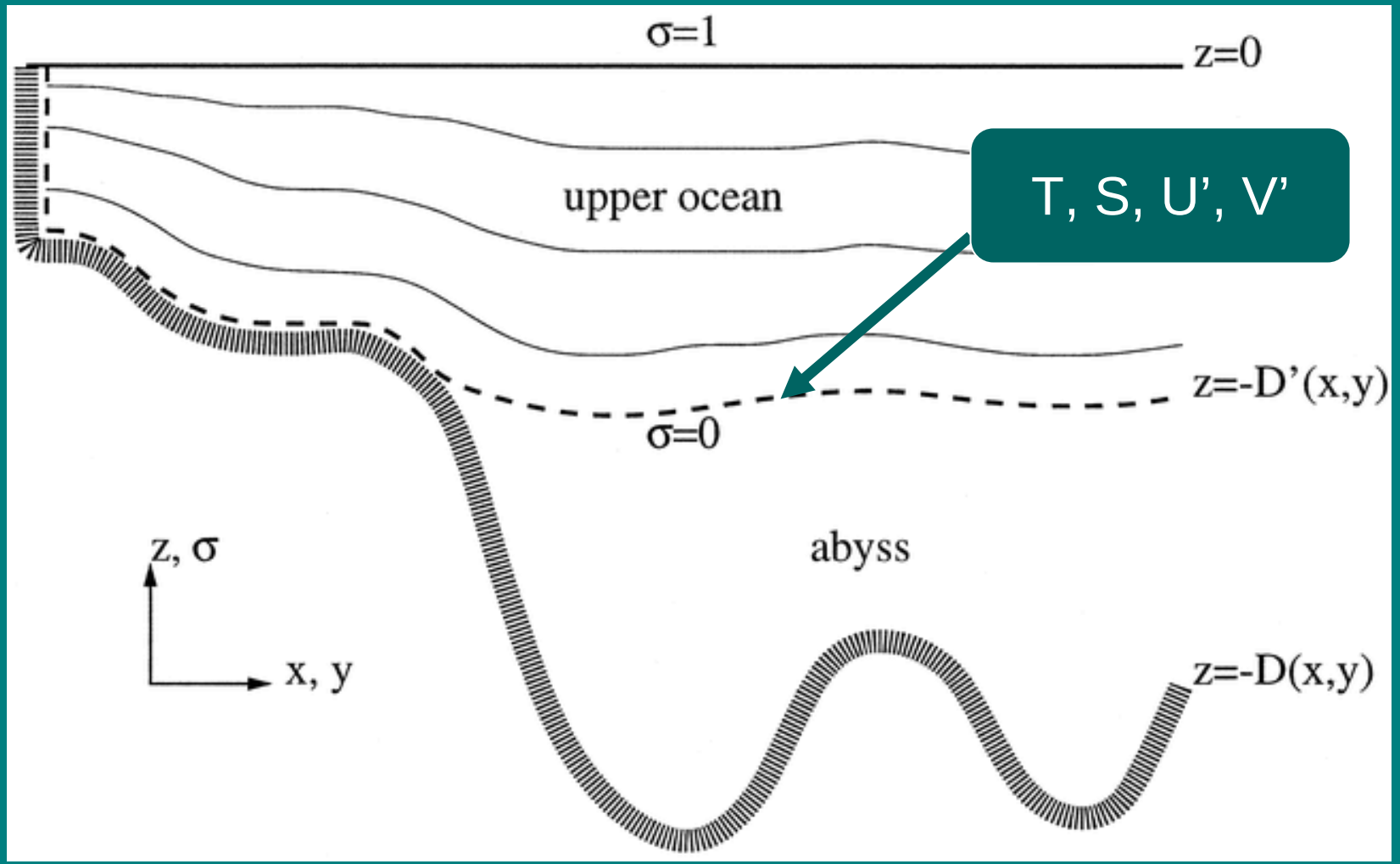
Design of the Upper-Ocean Model (UOM)

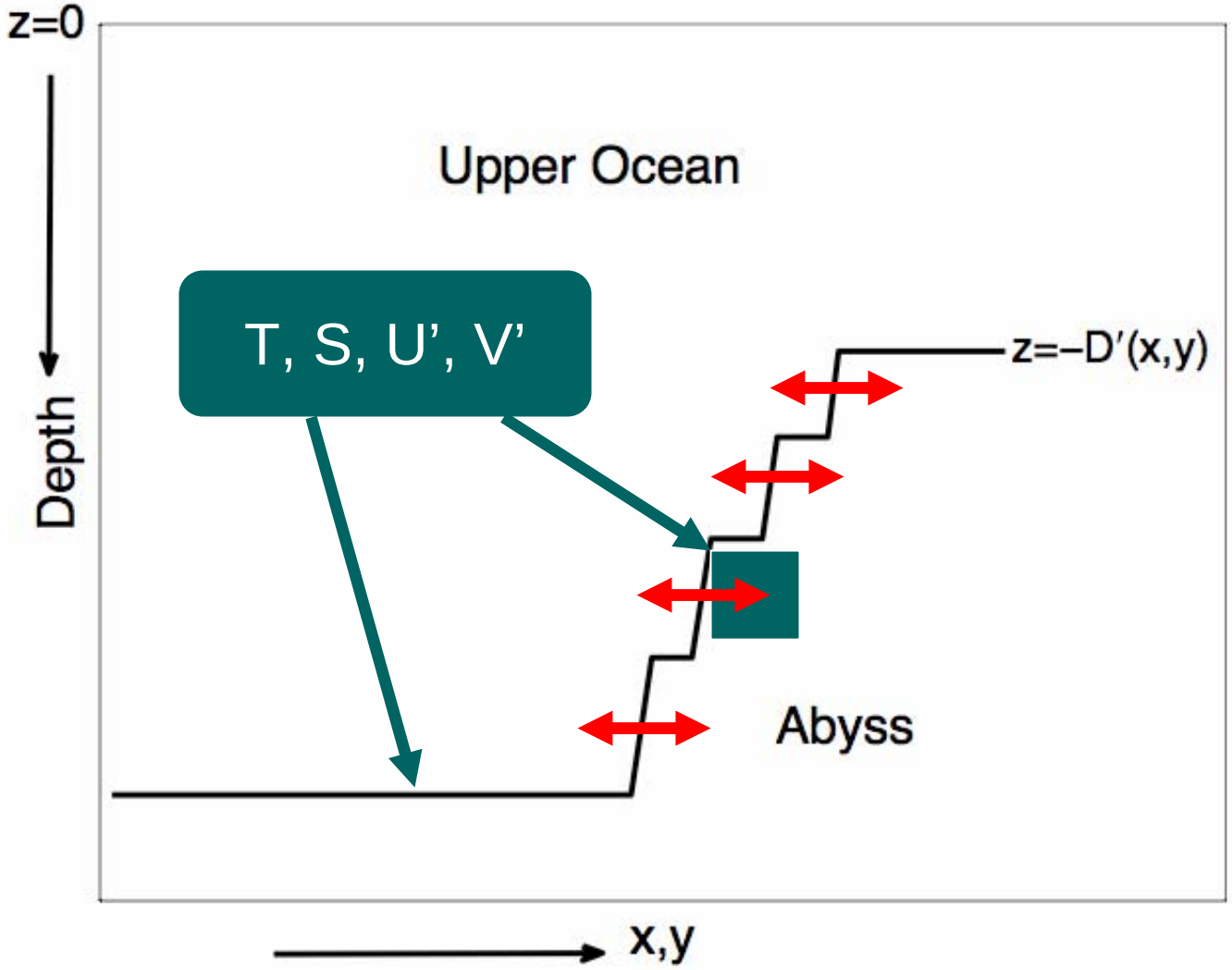
- Danabasoglu and McWilliams, 2000 (DM2000)
- Short-term climate variability of tracers is confined within the upper ocean (down to the pycnocline)
- Full dynamics in the upper ocean
- Deep climatological reservoir for tracers and baroclinic velocity
- Barotropic flow is solved using the full ocean depth, with fluctuating part of the baroclinic contributions from abyssal ocean ignored

Schema of the UOM in a σ-coordinate Model



(DM2000)

Implementation of the UOM in POP



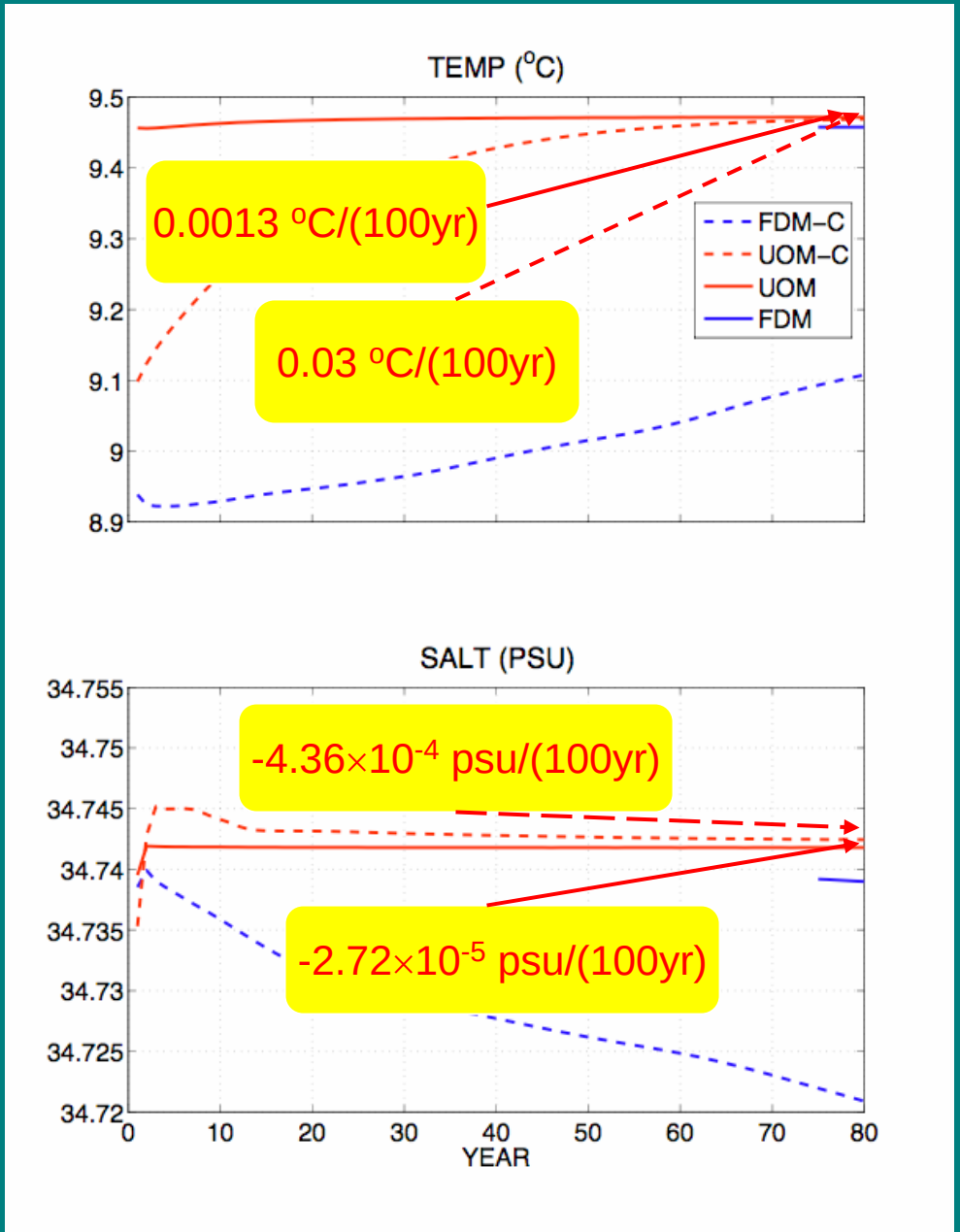
Model Setup

- Global dipole x3 grids with implicit free surface formulation
- Bulk forcing with NCEP datasets
- The FDM runs for 3000 yrs with tracer acceleration and then another 700 yrs synchronous extension to reach a “quasi-equilibrium”
- The UOM bottom boundary condition taken from the final 25 yrs of the FDM run
- The UOM starts from the FDM equilibrium solution
- The UOM-C and FDM-C starts from a state of rest and January mean Levitus climatological *T* and *S*
- The UOM bottom resides at 466m equatorward of 10^{o}, 1100m poleward of 35^{o}, and follows a cosine transition function in between

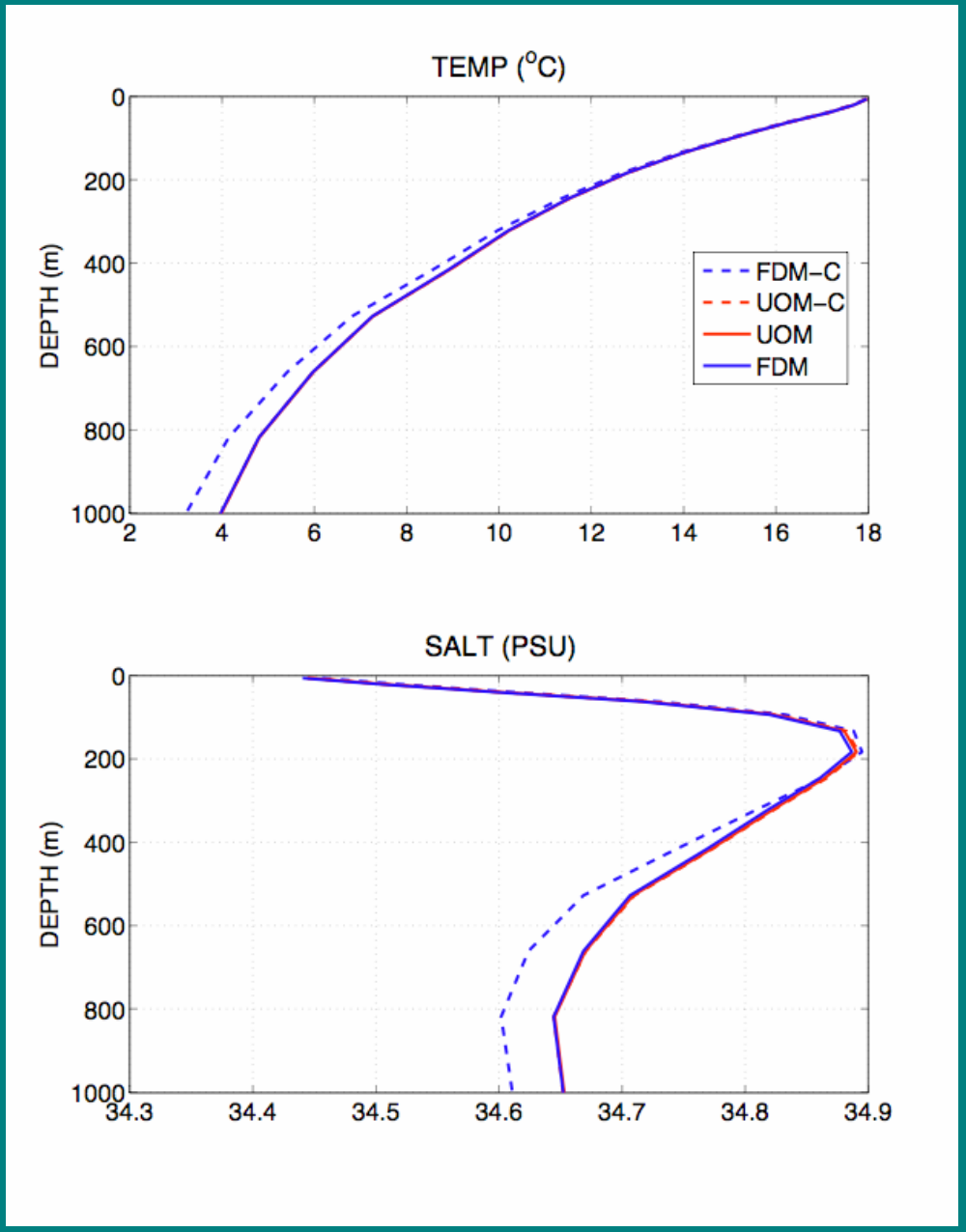
Approach to equilibrium

- The potential temperature equilibrium time scale in both UOM cases is ~40 yrs, somewhat longer than that in DM2000

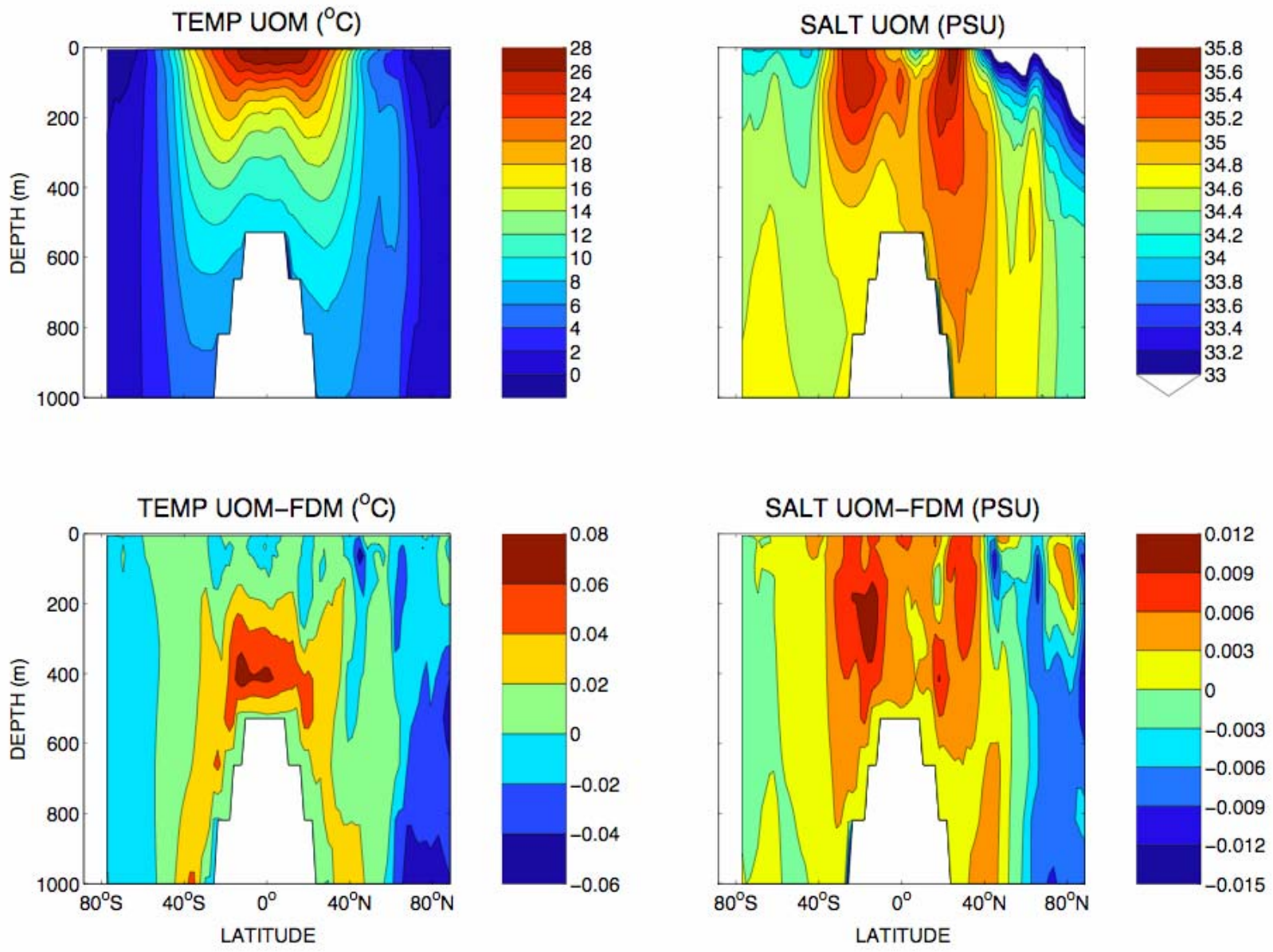
- The salinity in UOM-C undergoes an initial adjustment (~1 decade), then approaches equilibrium a little bit slower than potential temperature (~45-50 yrs)



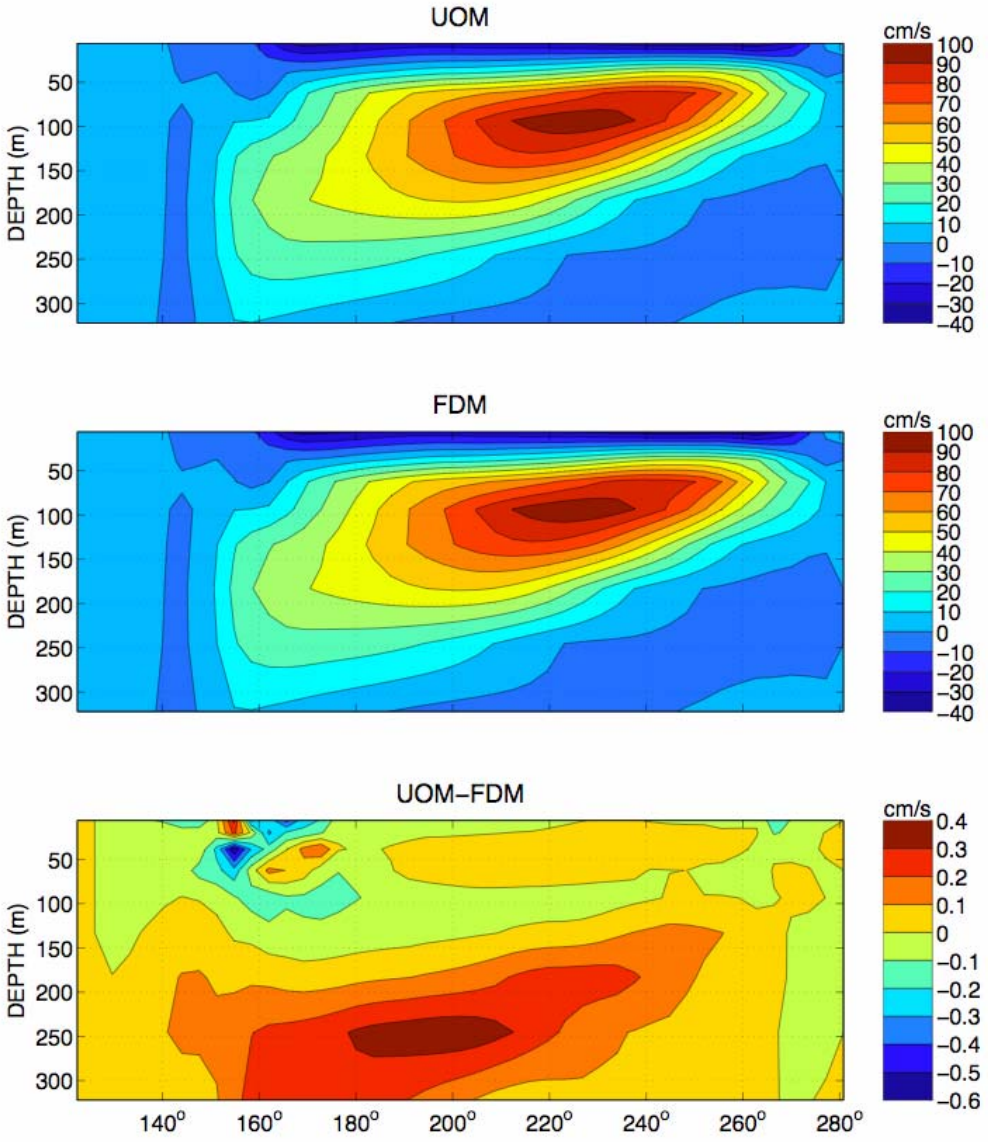
Mean Comparison I: PT and S



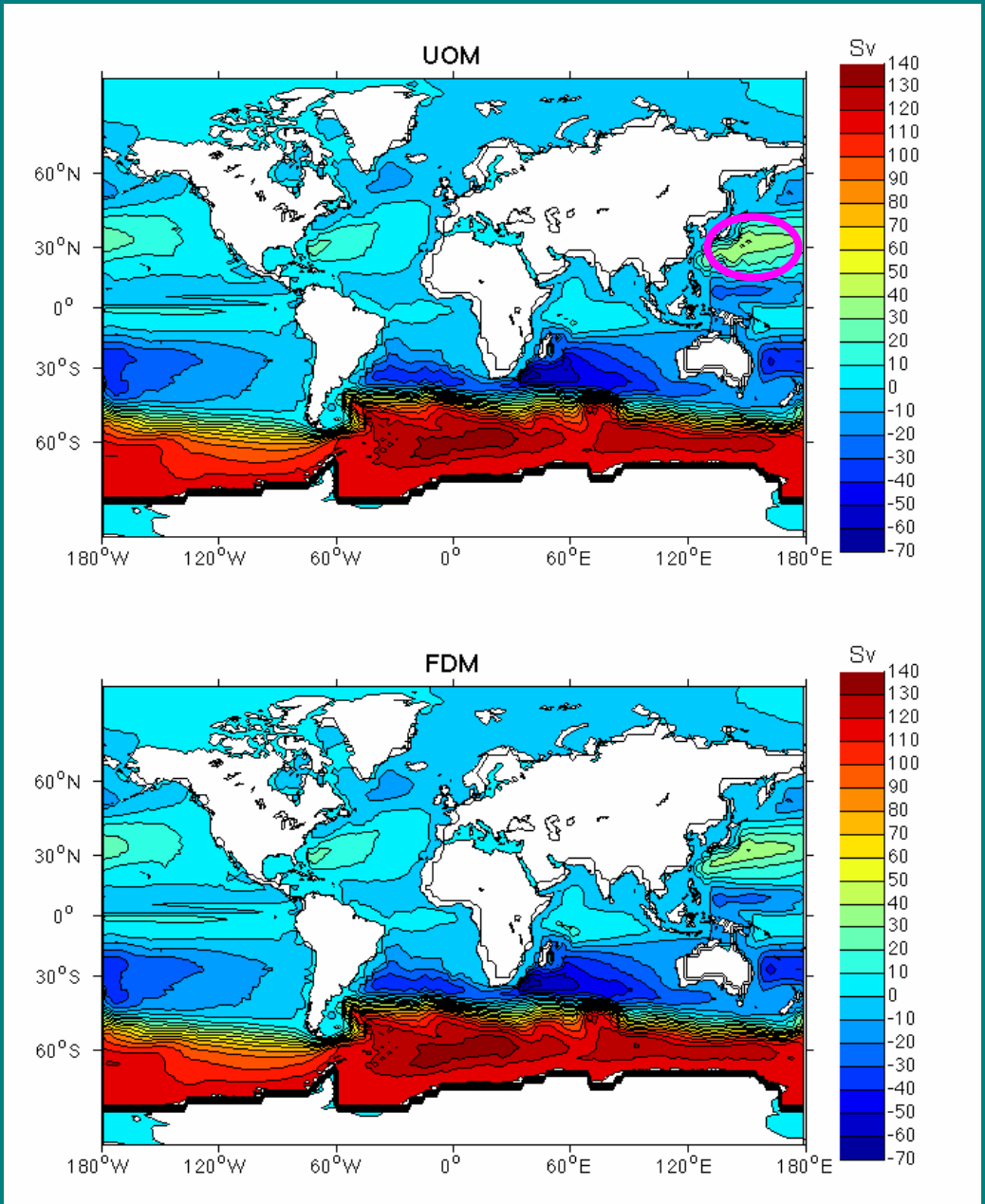
Mean Comparison II: Zonal Average PT and S



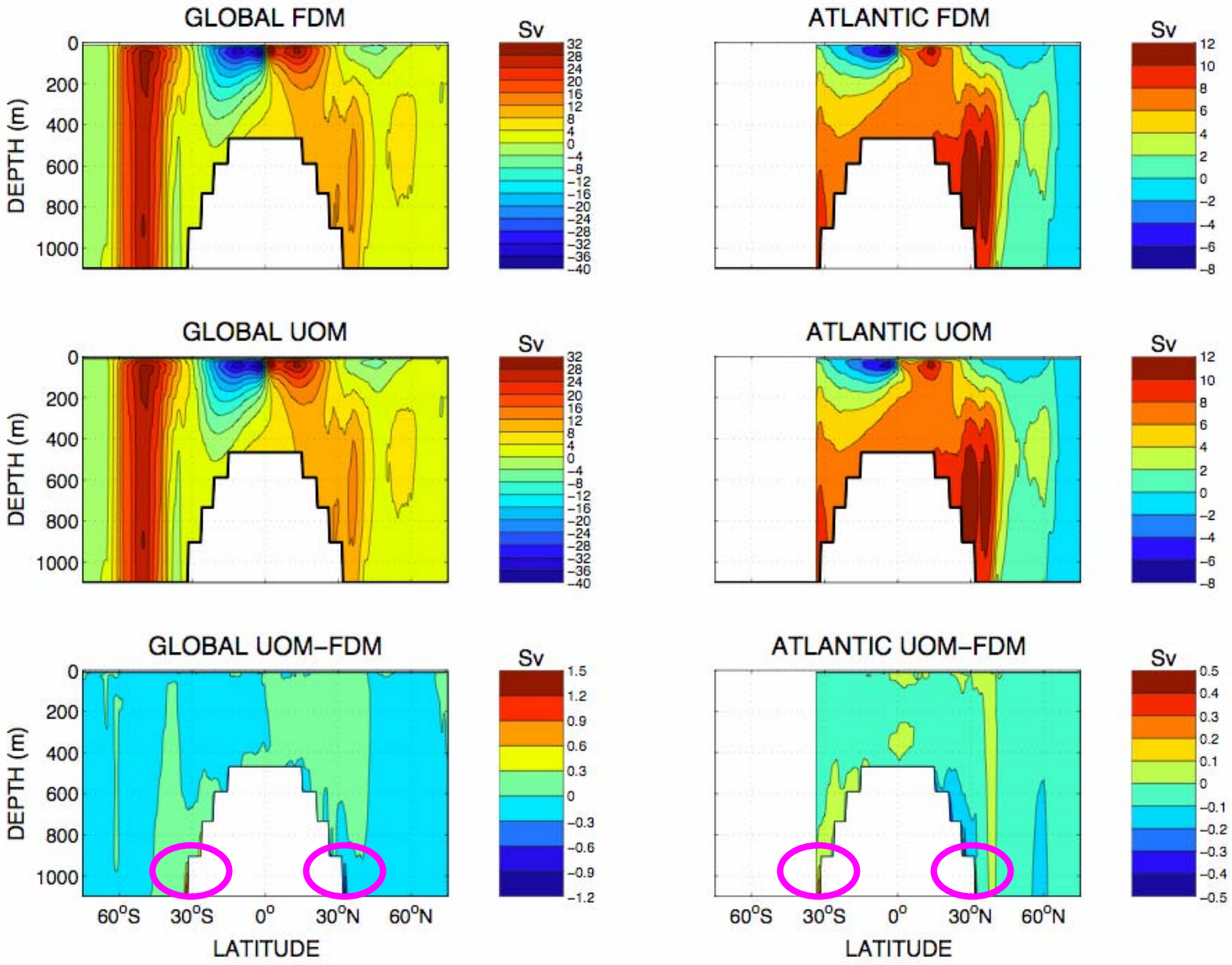
Mean Comparison III: Equatorial Flow



Mean Comparison IV: Barotropic Transport



Mean Comparison V: MOC



Future Work

- Sensitivity of the UOM equilibrium time to bottom boundary conditions
- More testing in an ocean-only setup under different surface forcing and different numerical schemes and physical parameterizations
- Testing in a coupled ocean/sea ice configuration
- Testing in a fully coupled AOGCM configuration