R: Interactive Stratospheric Ozone for v1

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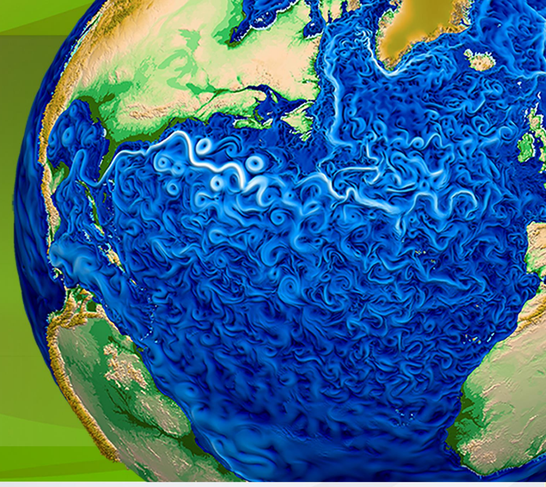
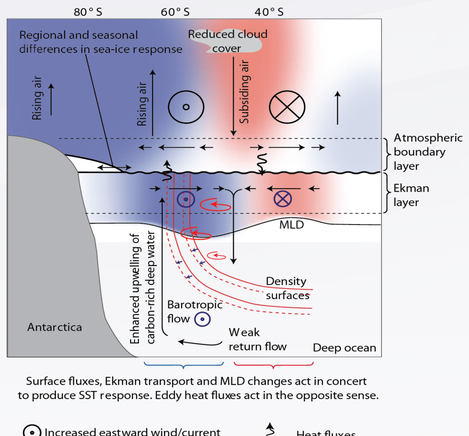


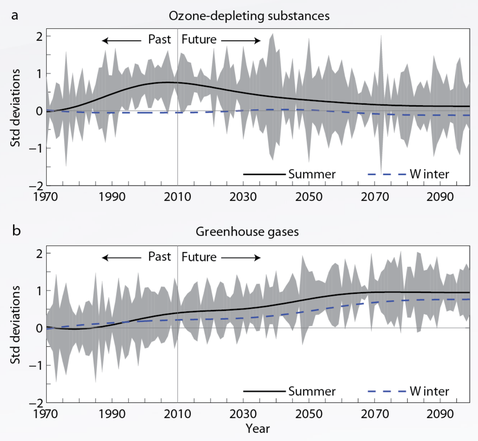
Objective

Include the effect of the Ozone hole and its variability in ACME to test its impact on the sea-ice and ice-shelves (cryosphere experiment).

Response of Ocean to Southern Annular Mode (SAM)



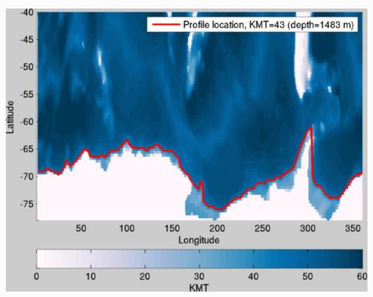
Response of SAM to Ozone Hole and Global Warming is variable



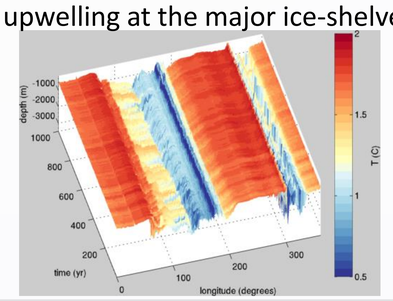
Figures from Thompson, et al., Nature Geo, 2011

Approach

Implement an Efficient Interactive Stratospheric Ozone Scheme (Linoz) in the coupled model with the ocean, sea-ice, and ice-sheets.



Hovmeuller along shelf (red line) shows greatest variability and susceptibility to upwelling at the major ice-shelves



Linoz simulates stratospheric ozone using a single tracer and pre-computed chemical tendencies

$$\frac{df}{dt} = (P-L)^o + \left.\frac{\partial(P-L)}{\partial f}\right|_o (f-f^o) + \left.\frac{\partial(P-L)}{\partial T}\right|_o (T-T^o) + \left.\frac{\partial(P-L)}{\partial c}\right|_o (c-c^o).$$

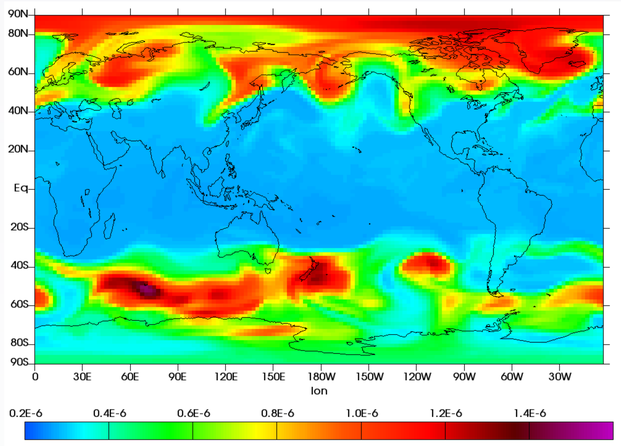
f = ozone concentration.
T = local temperature.
c = overhead ozone column.
$(P\text{-}L)$ = Net chemical tendency due to production minus loss.
^{o} = Climatological tendency or sensitivity at the climatological equilibrium point

Hsu and Prather, JGR, 2009 ; McLinden et al., JGR 2000

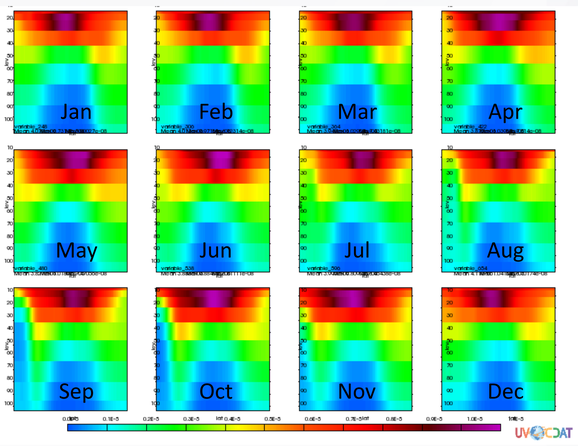
Results

Interactive Ozone has been Implemented in ACME for v1.
The results are as good or better than for previous models.

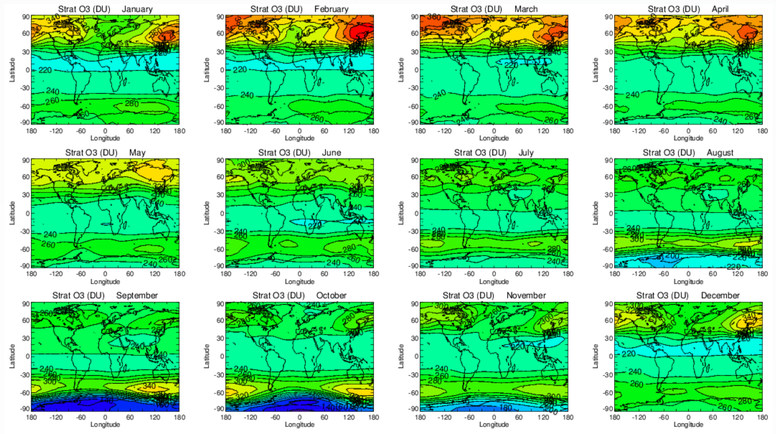
Ozone now consistent with dynamics (200mb in August 1850)



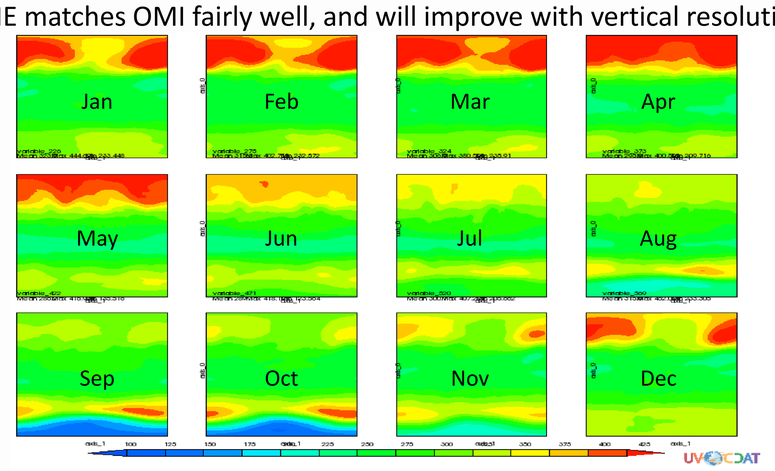
Zonal-mean ozone is realistic, and will improve with vertical resolution



Ozone Column (DU) from the OMI satellite



ACME matches OMI fairly well, and will improve with vertical resolution



ACME Accelerated Climate Modeling for Energy

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U.S. DEPARTMENT OF ENERGY

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