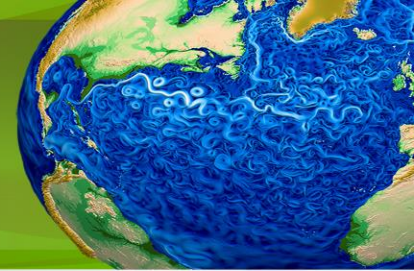


# F: Atmospheric Chemistry (Future)

Philip Cameron-Smith (LLNL), Susannah Burrows (PNNL), Scott Elliott (LANL)



## Ozone Hole

[Cryosphere v1]

- Antarctic ozone-hole affects ice-sheets.
  - Ozone hole -> surface winds (SAM) -> ocean upwelling -> ice-sheet melting.
- Interannual variability of ozone hole may affect likelihood of ice-sheet melting.
  - Implement in ACME-atm using Linoz (1 tracer),
  - ~1% computational cost.

## Methane

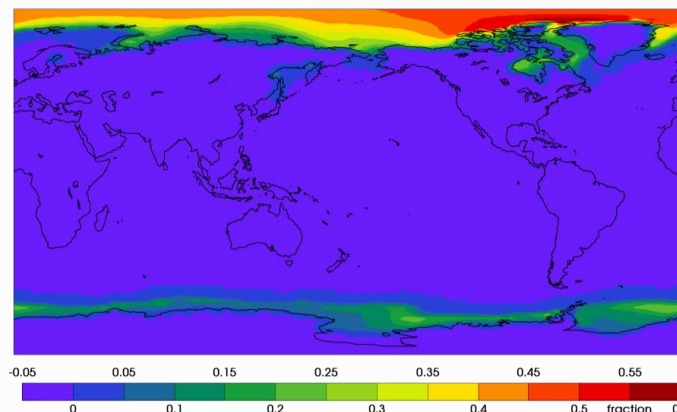
[BGC, v2]

- Methane is 2<sup>nd</sup> most important greenhouse gas.
  - Emissions -> atmospheric chemistry -> concentrations
  - Highly non-linear function of: clouds, water vapor, temperature, other chemicals.
- Implement with chemical solver and ~30 tracers.
- Dependent on:
  - Methane module in land BGC group,
  - Model top and vertical grid.

## Sulfur Cycle

[Hydro, BGC, Cryo, v2]

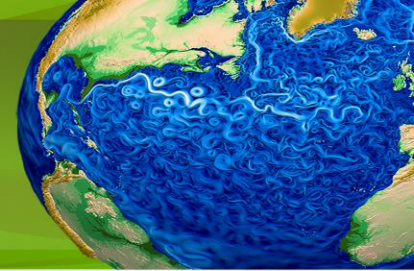
- Sulfur is top uncertainty in 20<sup>th</sup>-Century forcing, & therefore climate sensitivity [Carslaw, 2013].
- Dimethyl sulfide (DMS) affects climate:
  - Ocean ecosystem -> DMS emissions -> atm chem -> sulfate aerosols -> clouds -> climate.
  - Major aerosol source in pre-industrial and in future.
  - 4-6 W/m<sup>2</sup> global-mean in CESM1.2.2.
- In 2100-RCP8.5, it is the difference between 50% and 0% Arctic sea-ice (annual-mean).



Change in absolute annual-mean sea-ice fraction due to DMS in 2100-RCP8.5

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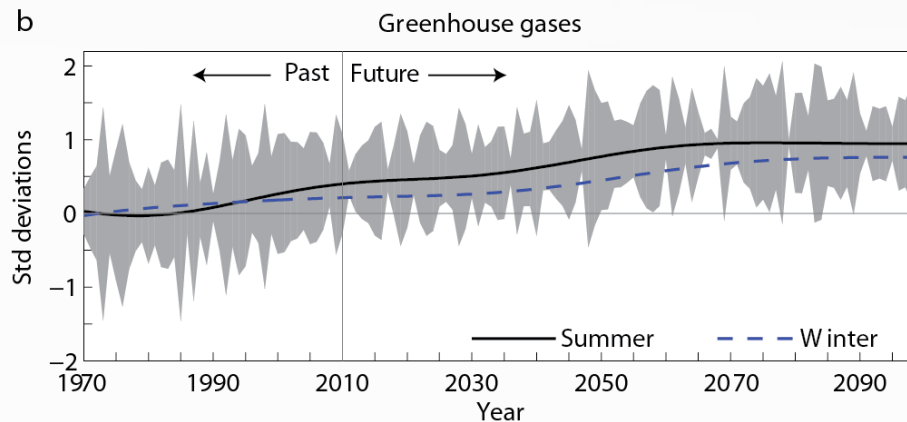
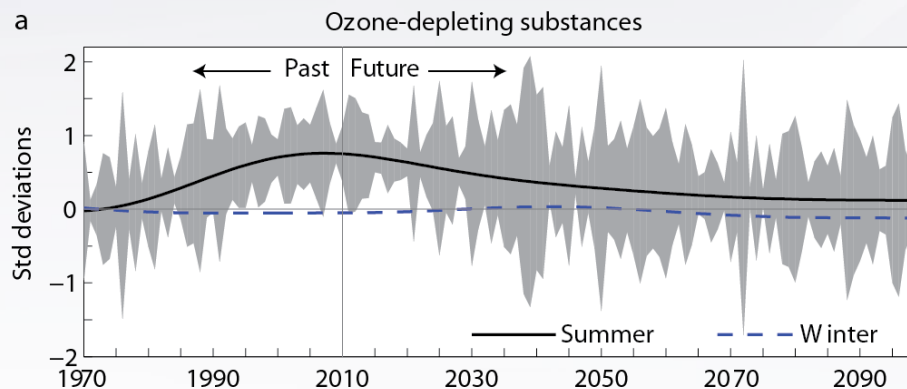
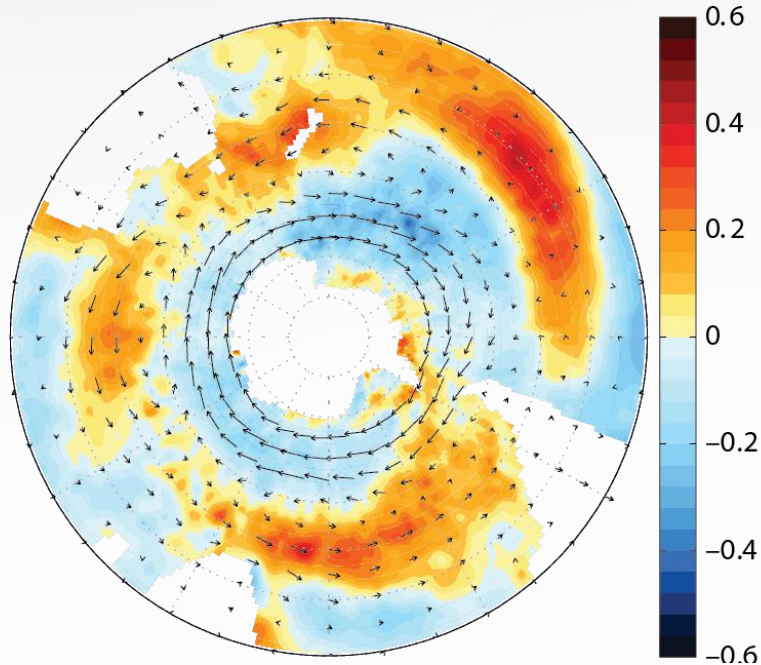


## Ozone Hole

[Cryosphere v1]

- Antarctic ozone-hole affects Southern Annular Mode (SAM).

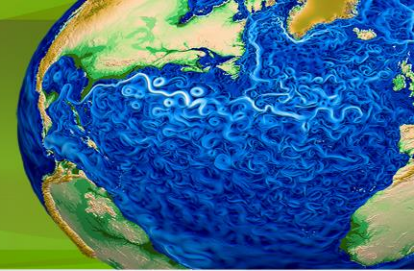
b SST and wind



[Thompson, et al., Nature Geo, 2011]

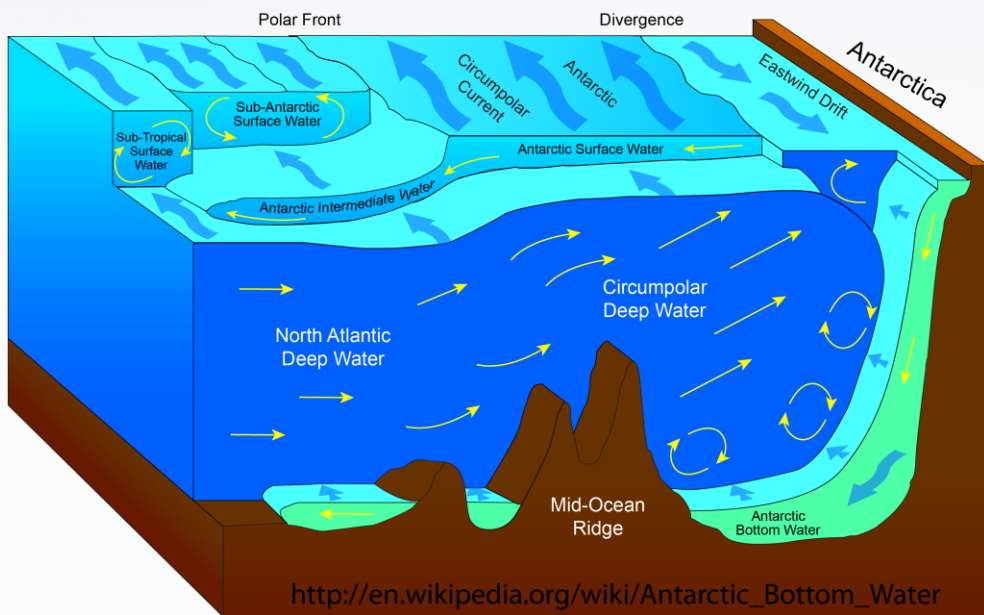
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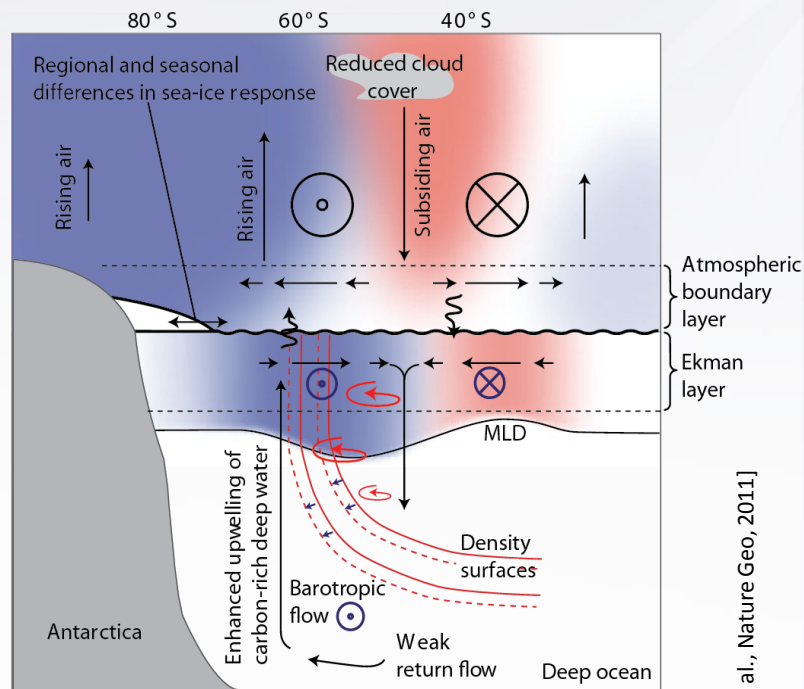


## Ozone Hole

- Interannual variability of ozone hole may affect likelihood of ice-sheet melting.
  - Implement in ACME-atm using Linoz (1 tracer),
  - ~1% computational cost.



## [Cryosphere v1]



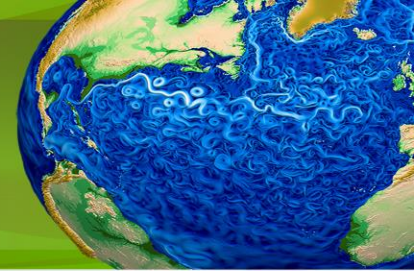
Surface fluxes, Ekman transport and MLD changes act in concert to produce SST response. Eddy heat fluxes act in the opposite sense.

- ⊙ Increased eastward wind/current
- ⊗ Increased westward wind/current
- ↑ Heat fluxes
- ↻ Eddy response

[Thompson, et al., Nature Geo, 2011]

# F: Atmospheric Chemistry (Future)

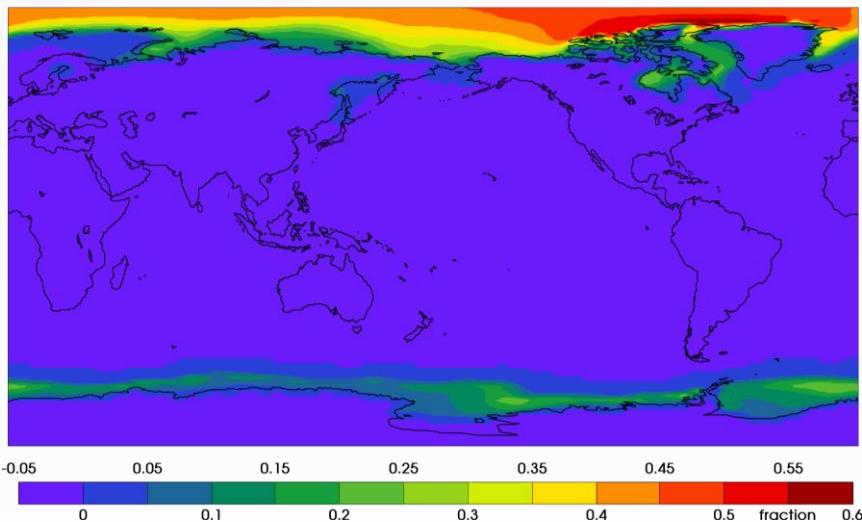
Philip Cameron-Smith (LLNL), Susannah Burrows (PNNL), Scott Elliott (LANL)



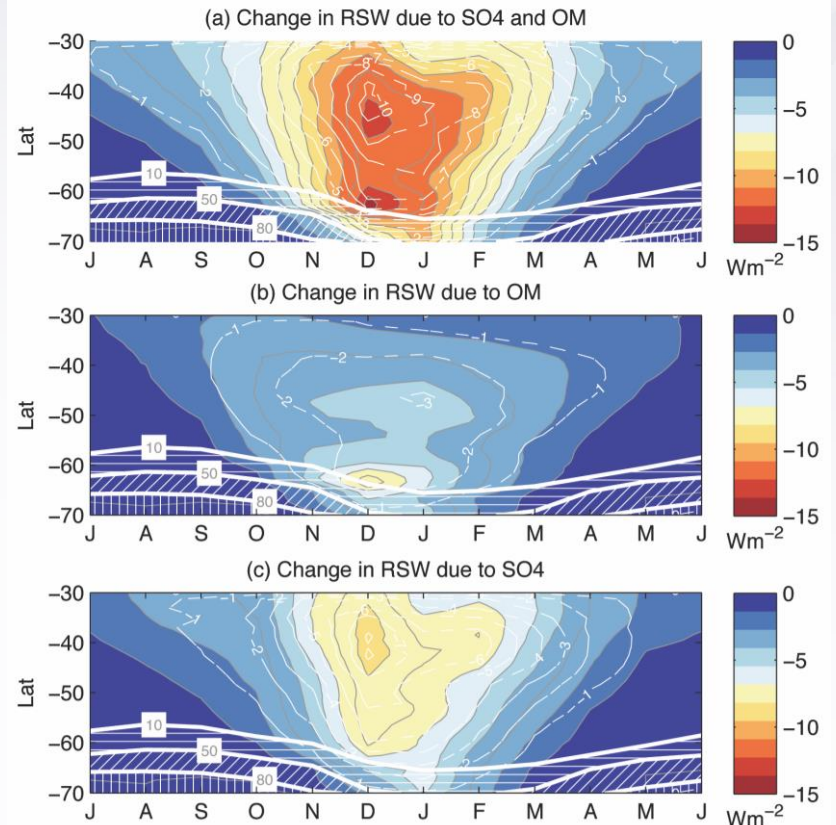
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McCoy, Burrows et al. (2015, submitted)