

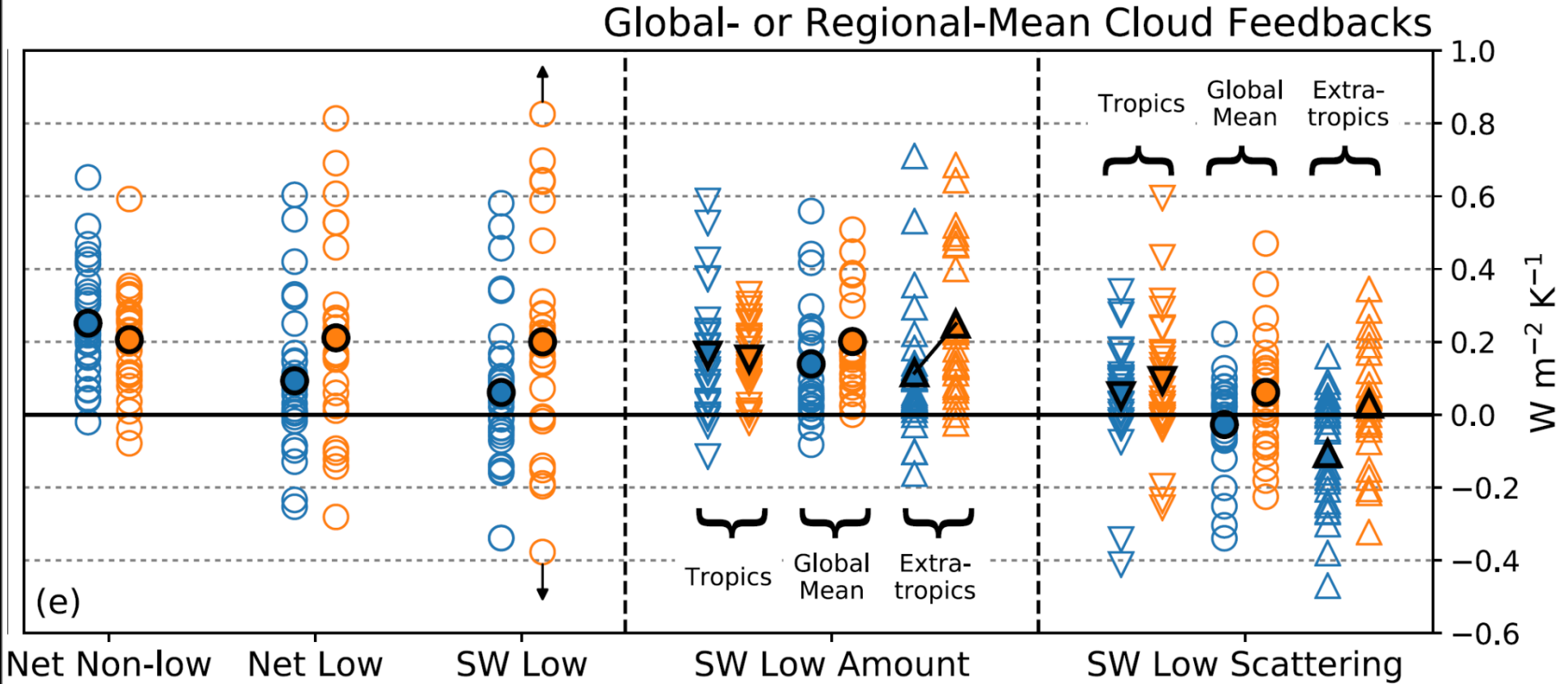
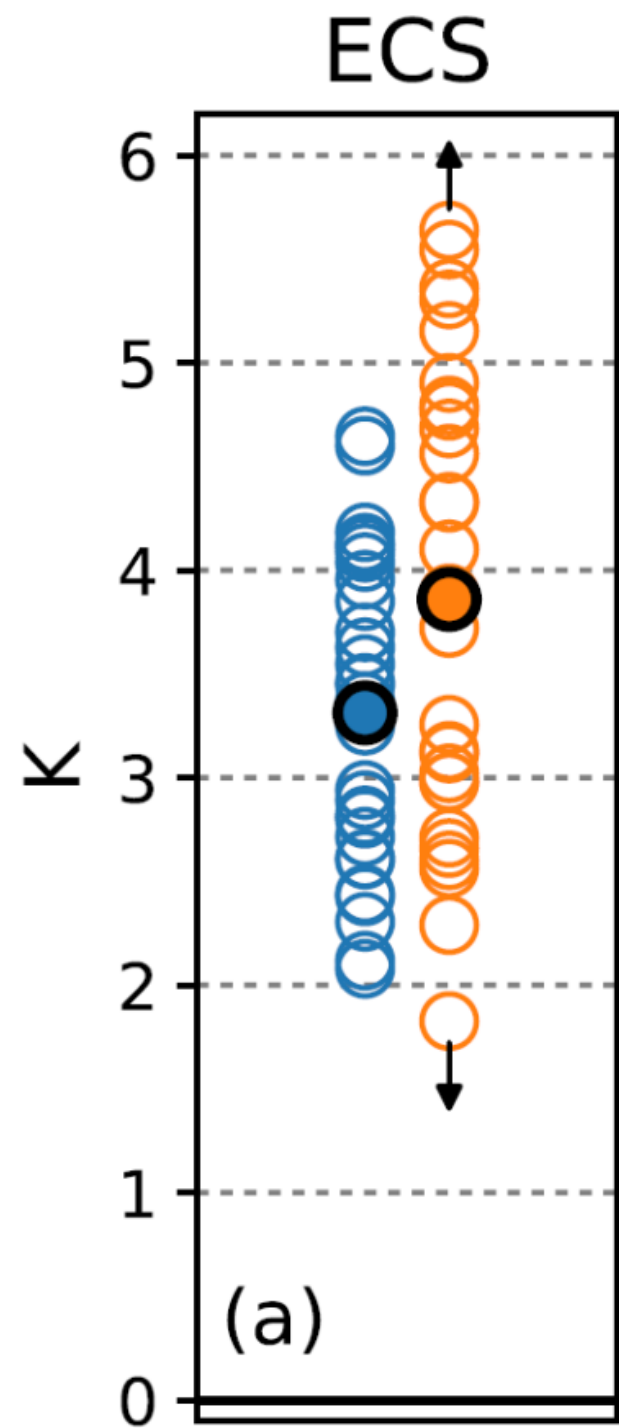
Role of AMOC in transient climate response to greenhouse gas forcing in two coupled models

Aixue Hu, Luke Van Roekel, Wilbert Weijer, Oluwayemi A. Garuba, Wei Cheng, Balu T. Nadiga

J. Climate, 33, 5845-5859, doi: [10.1175/JCLI-D-19-1027-1](https://doi.org/10.1175/JCLI-D-19-1027-1).

CESM workshop, June 17, 2020

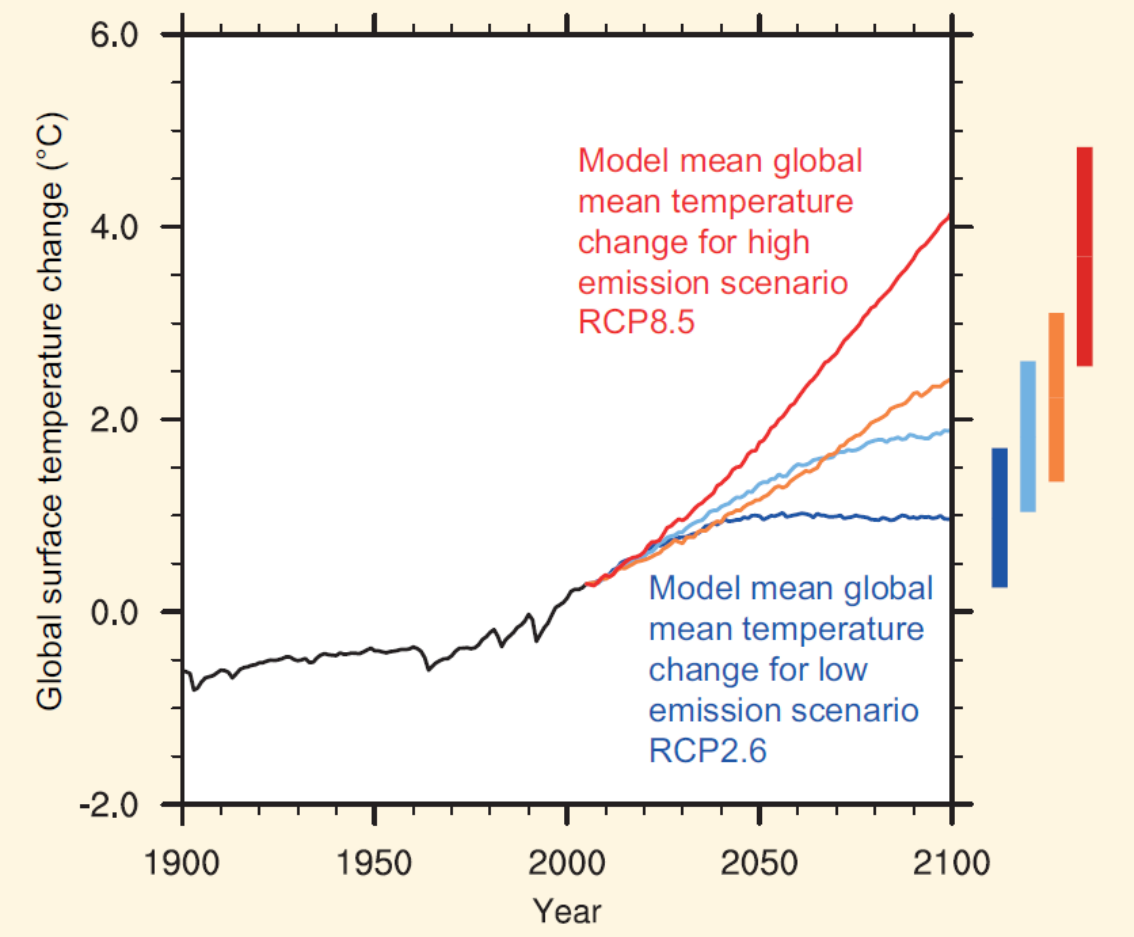
ECS is above 4.5 K in 10 out of 27 CMIP6 models, but only two CMIP5 models.



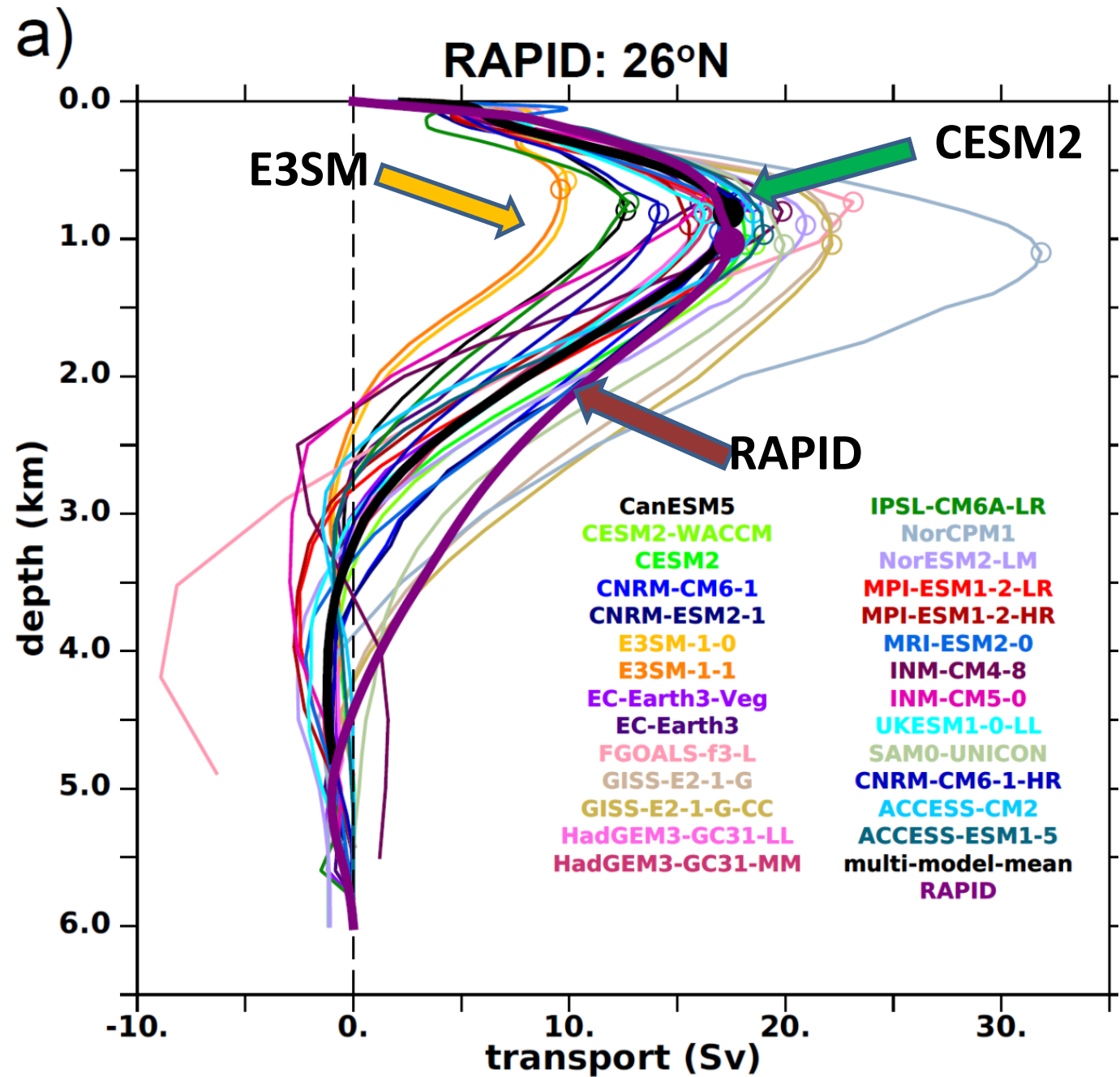
Zelinka et al., GRL, 2020

**CESM2 and E3SM1 ECS:
5.3 K**

AMOC:



IPCC AR5, Chapter 11



Weijer et al., GRL, 2020

Model and Experiments

Model: Community Earth System Model version 2 (CESM2) with 1° (CAM6, POP2, CICE5, CLM5) and Energy Exascale Earth System Model version 1 (E3SM1) with 1° (EAM, ELM, MPAS-Ocean and Sea Ice)

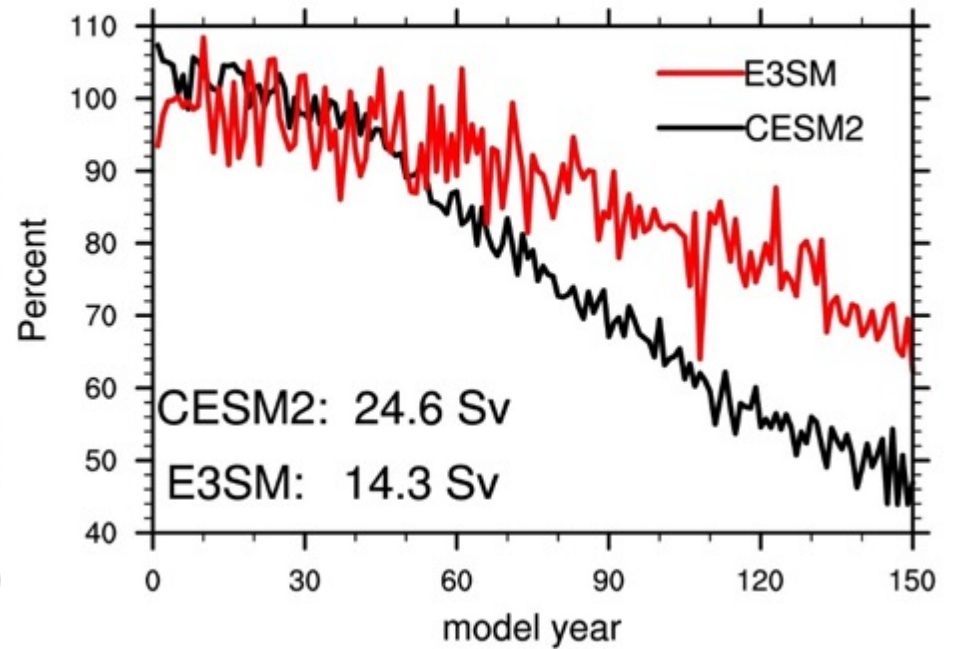
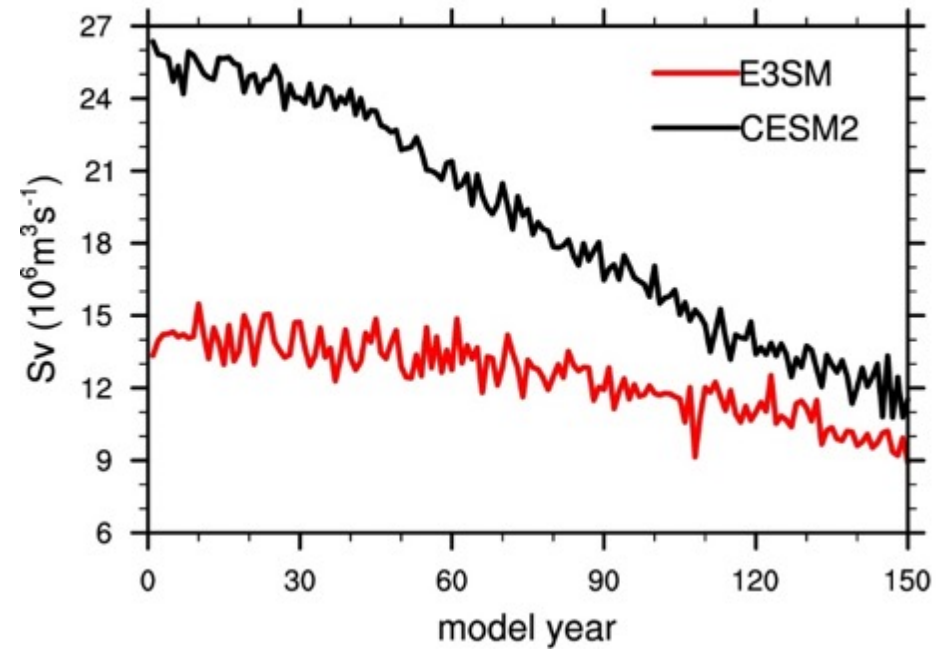
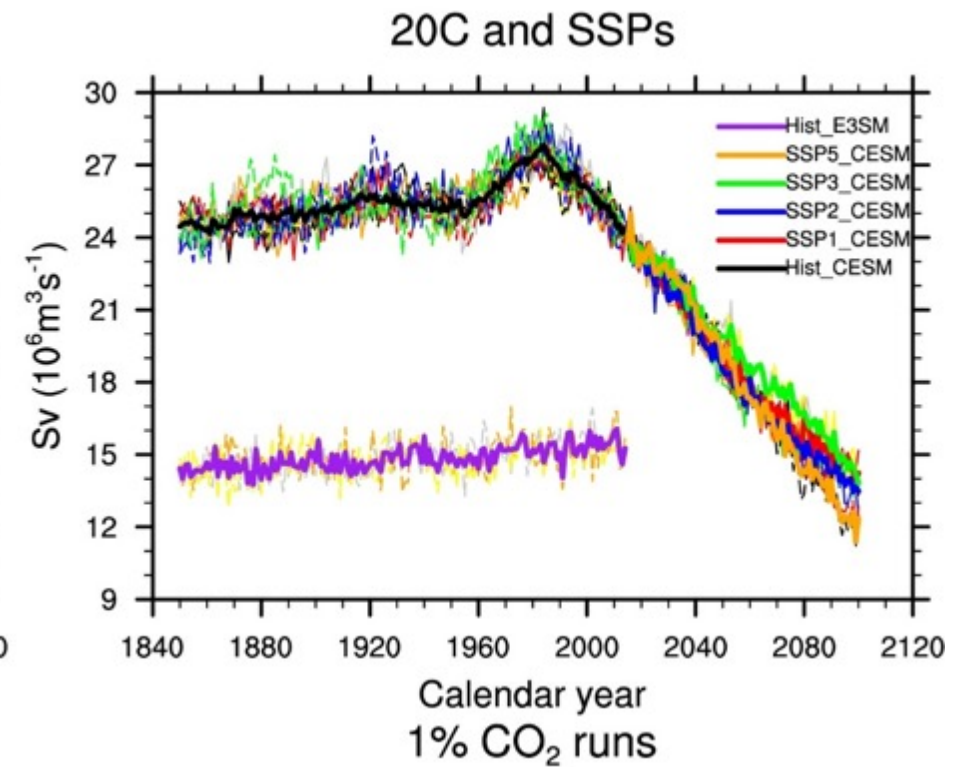
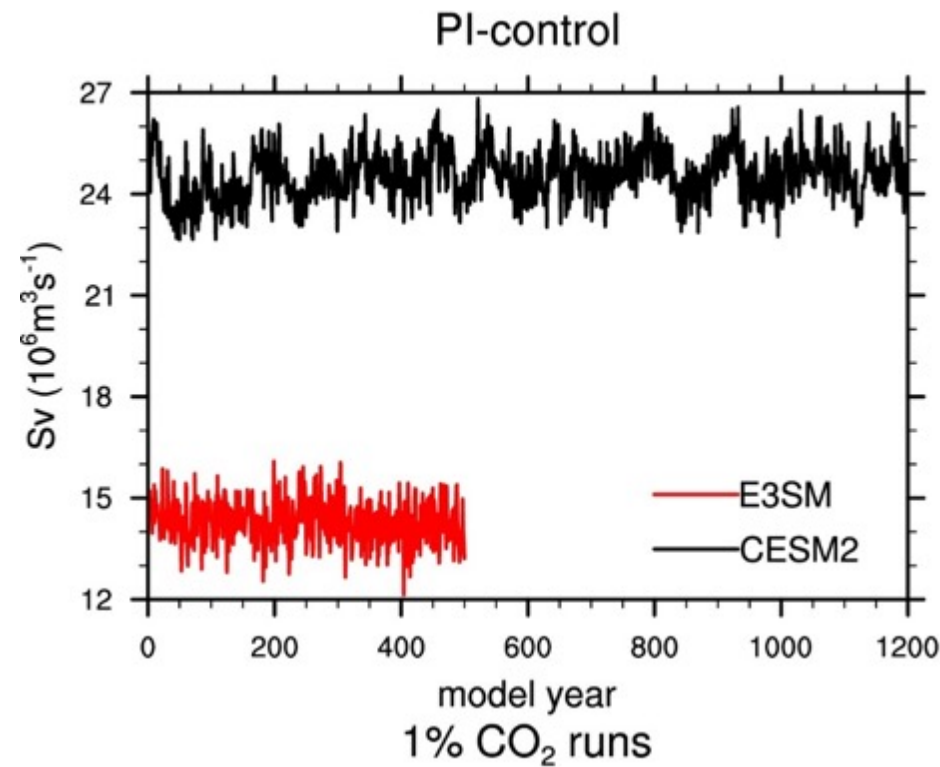
Experiments:

1850 preindustrial control: CESM2 – 1200 years; E3SM1 – 500 years

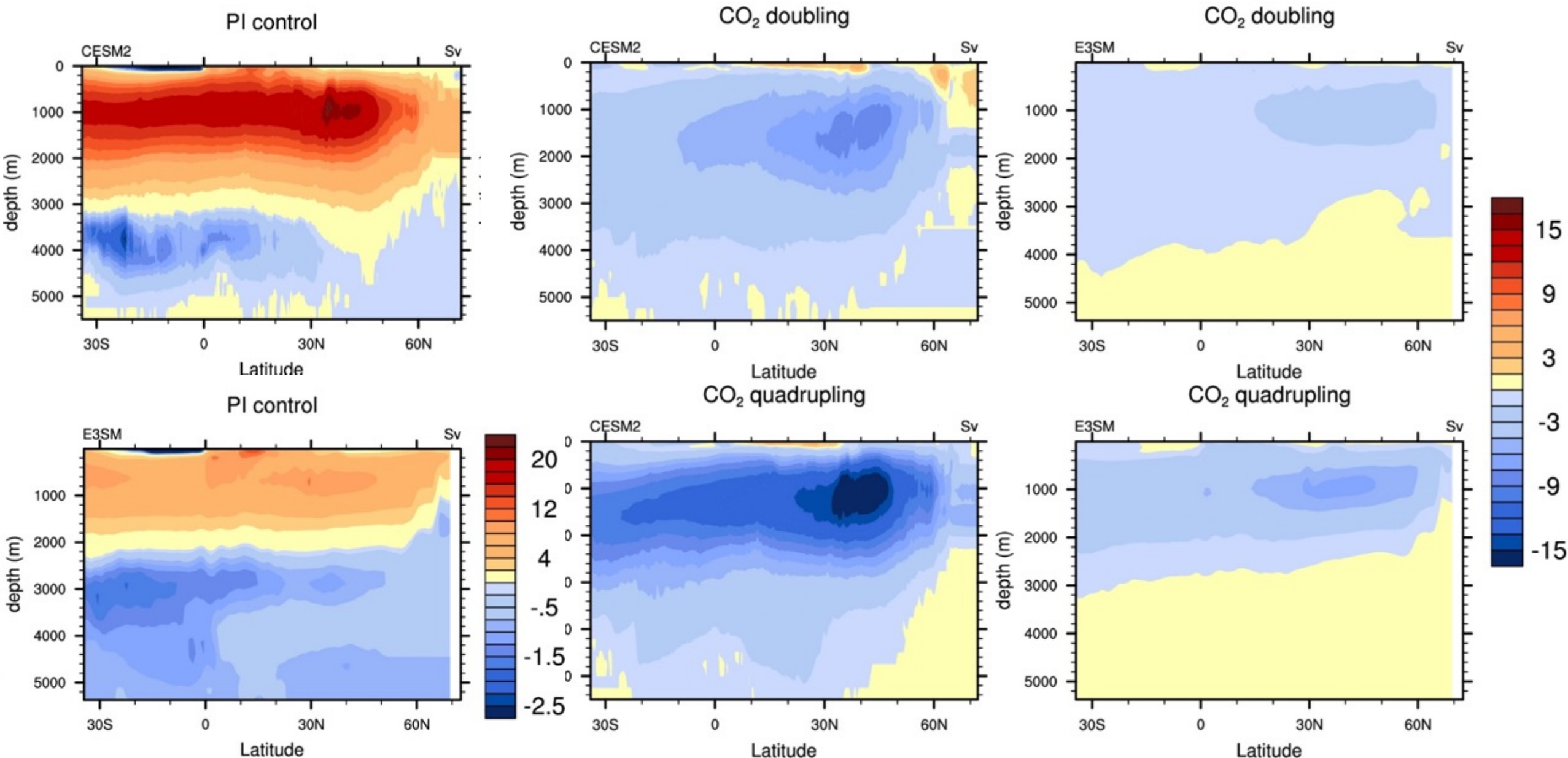
Historical simulations (1850-2014): CESM2 – 11 ensemble members and E3SM1 – 5 ensemble members; CESM2 also includes SSP1-2.6, SSP2-4.5, SSP3-7.0, SSP5-8.5 (2015-2100)

AMOC index:

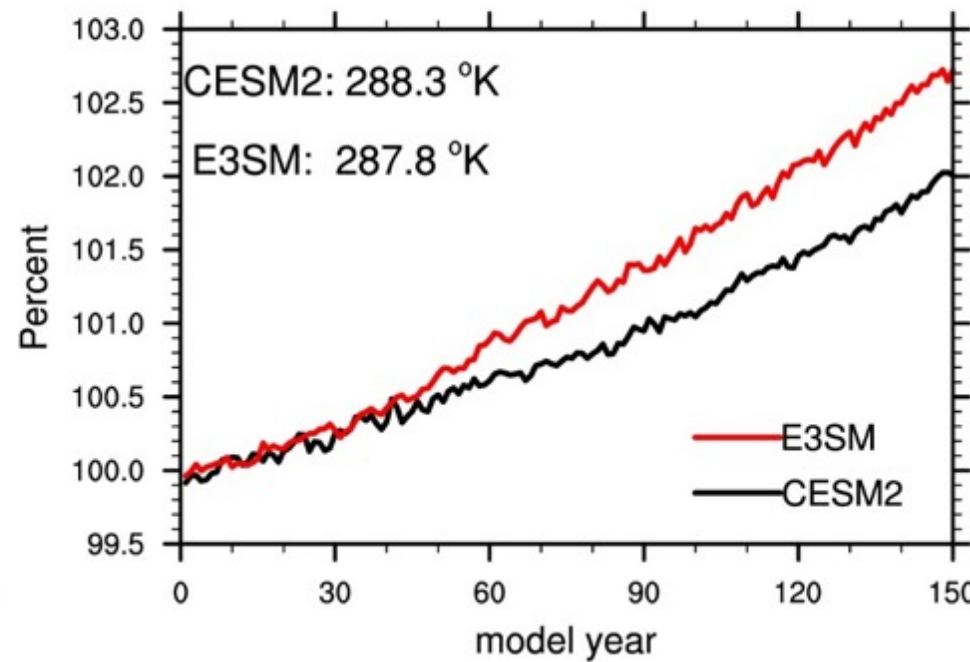
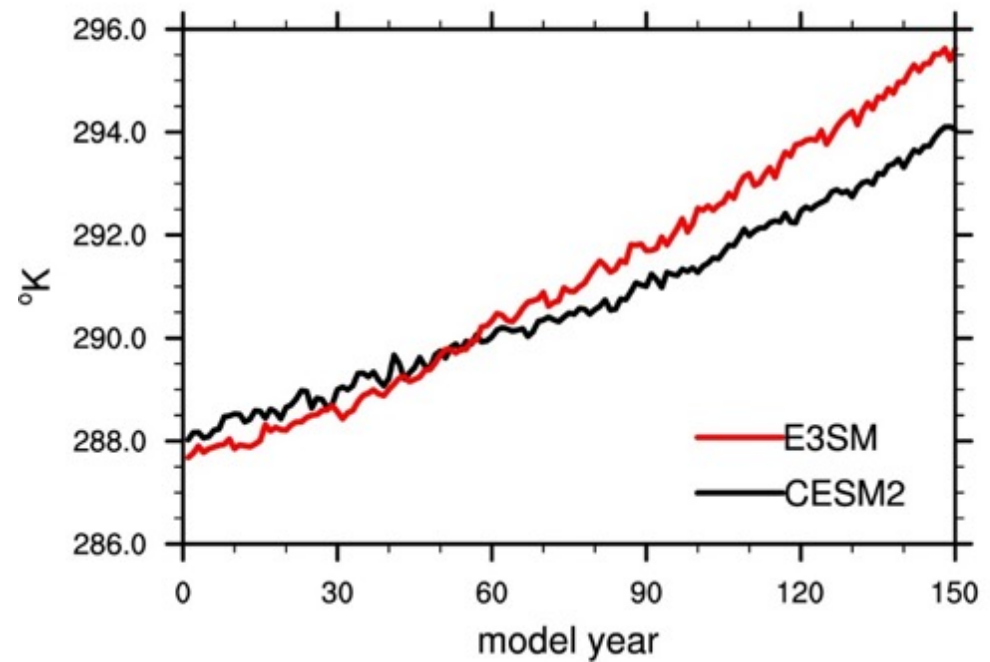
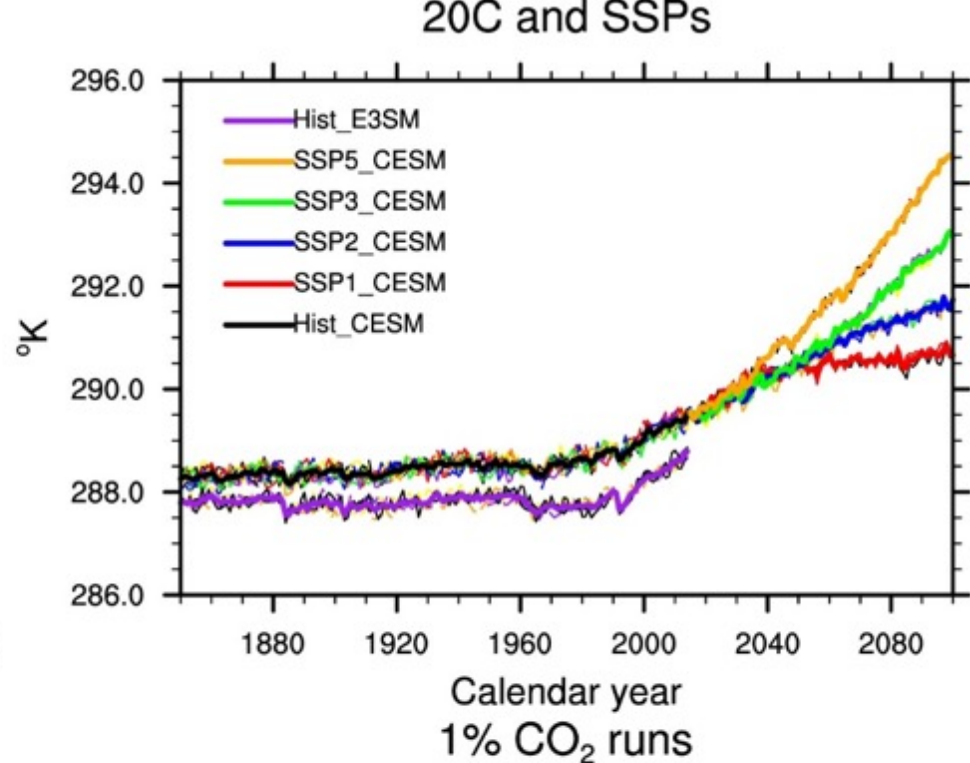
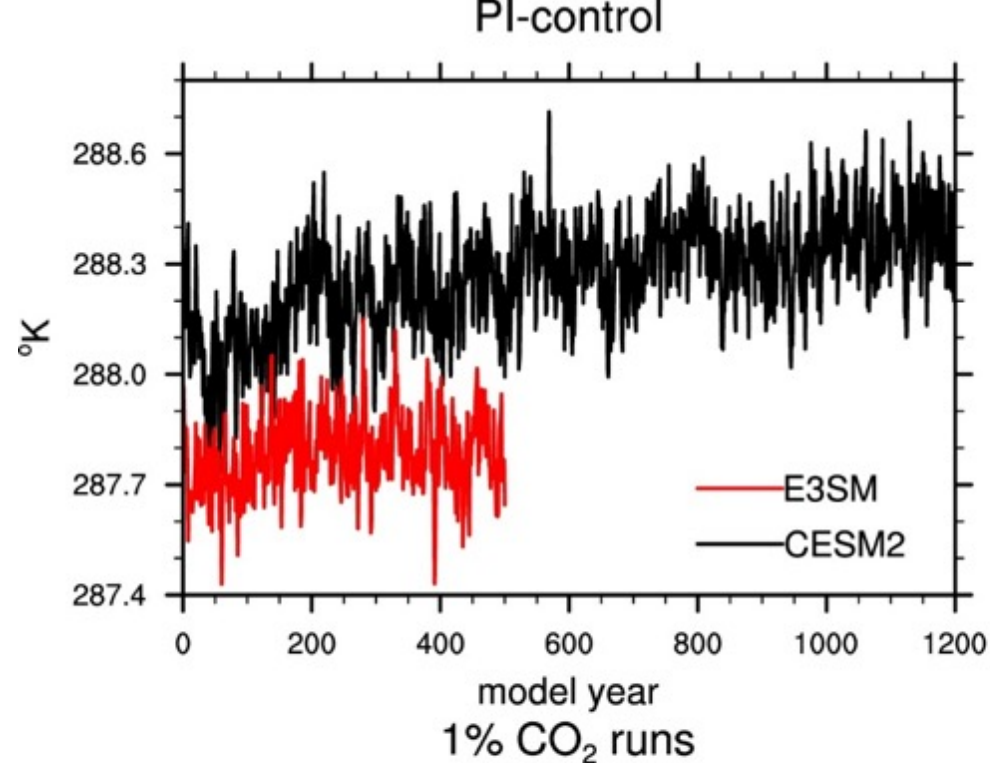
defined as the maximum of the Atlantic Meridional Streamfunction below 500 m depth.



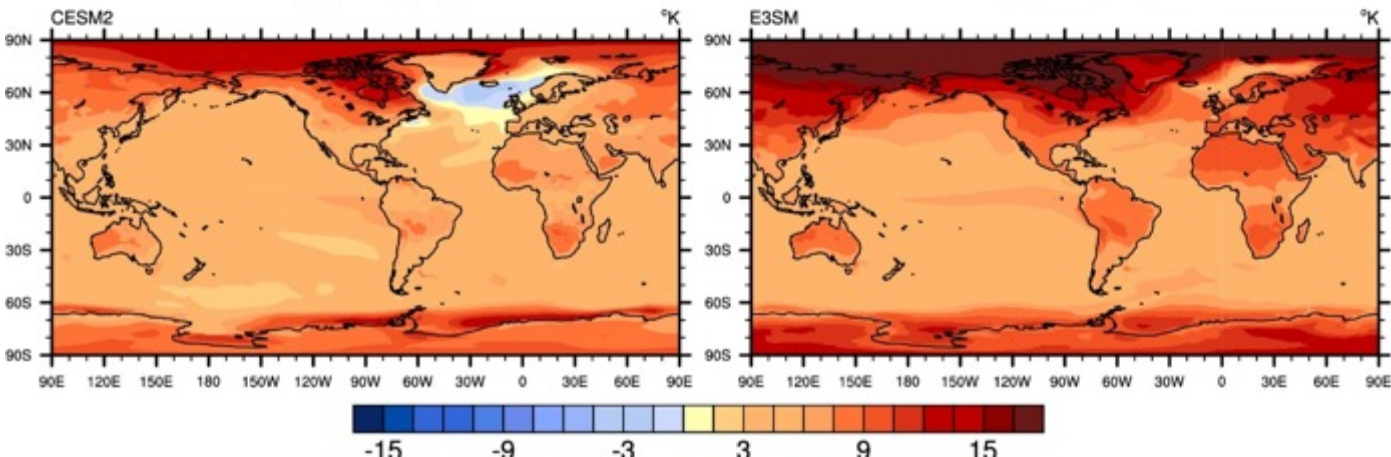
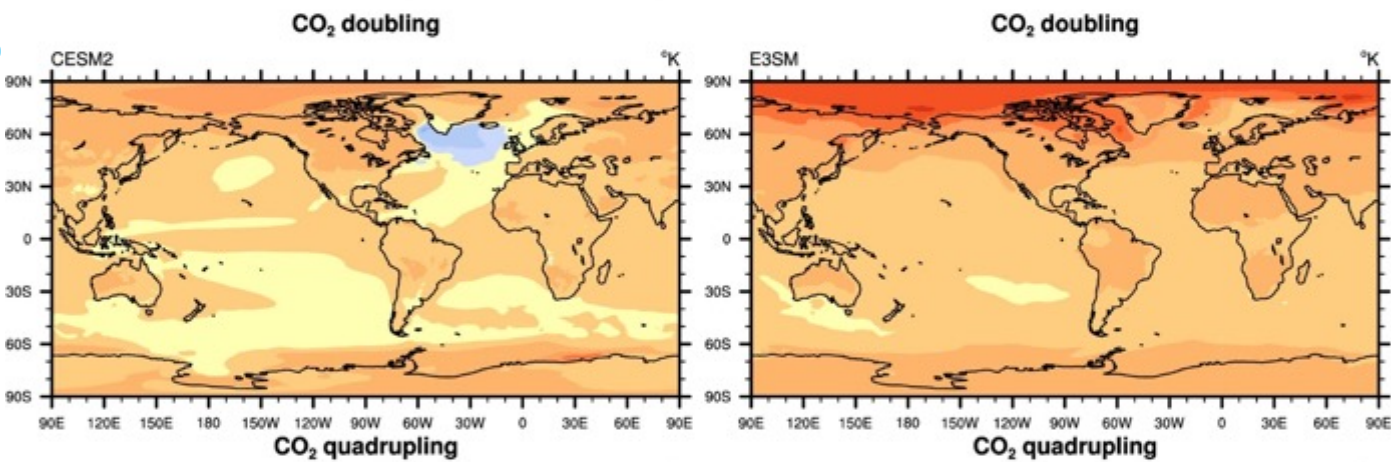
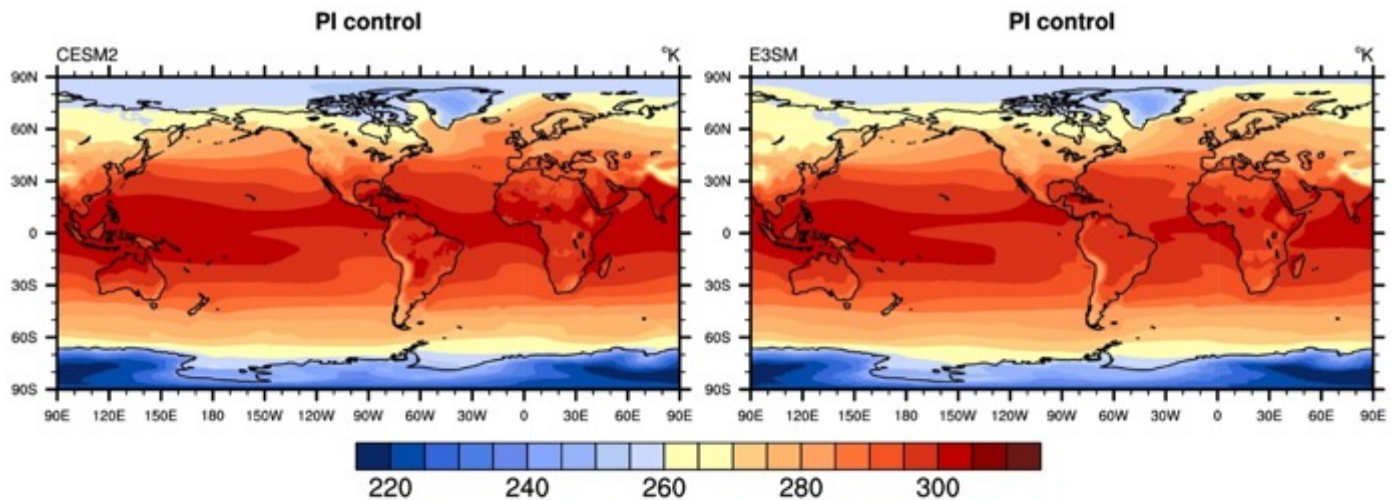
Atlantic meridional streamfunction and its anomaly



Time evolution of the global annual mean surface air temperature

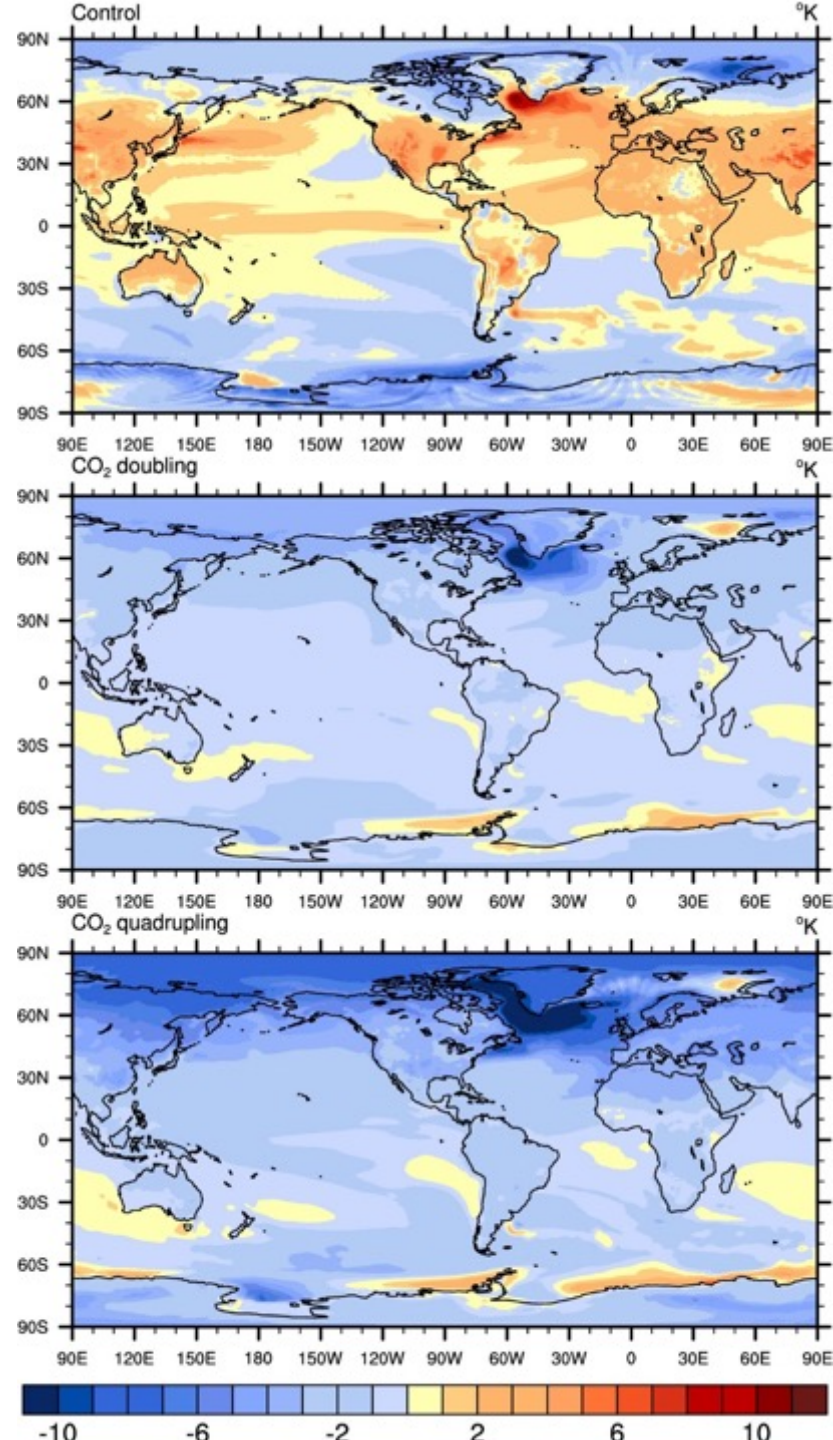


Surface air temperature



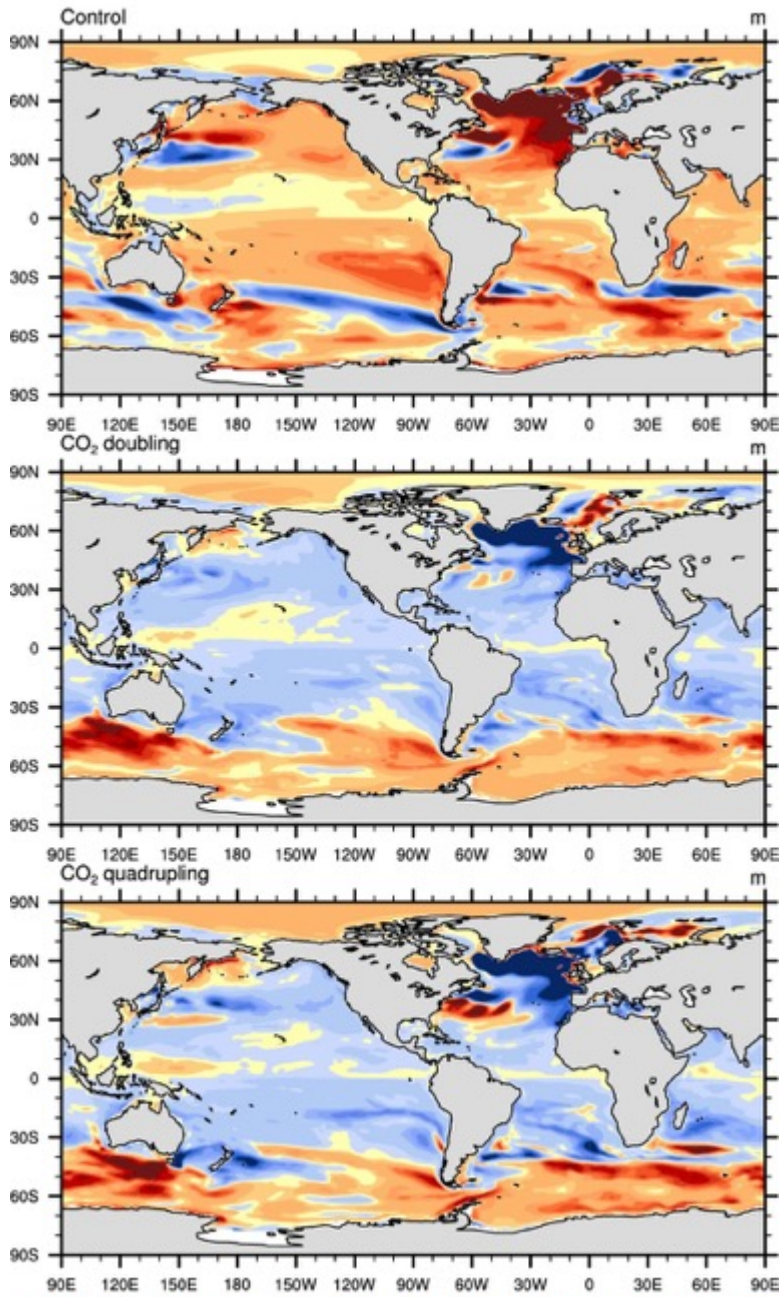
Surface air temperature anomaly

between CESM2 and E3SM1

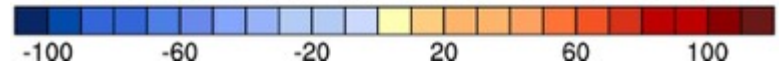
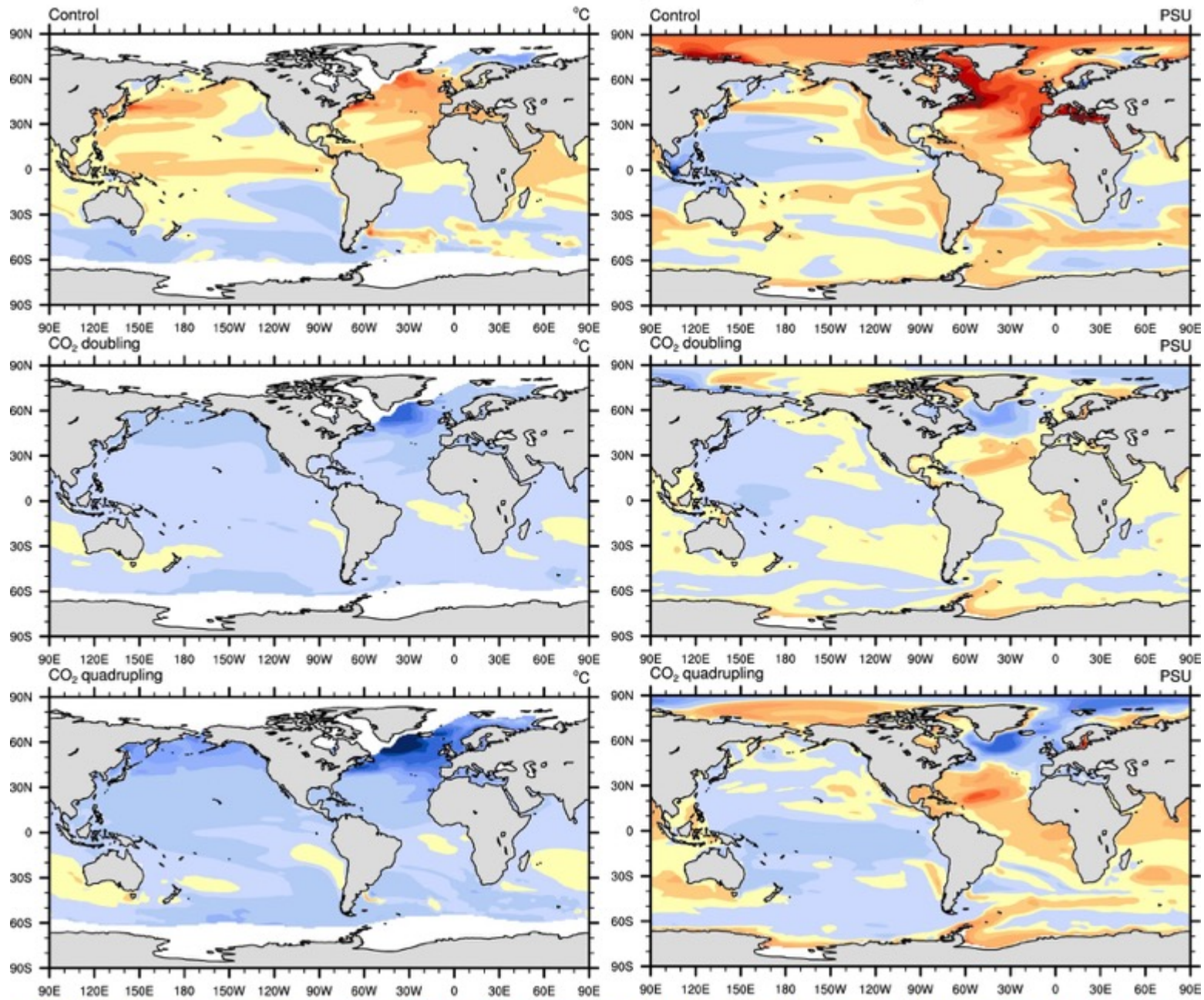


CESM2 minus E3SM1

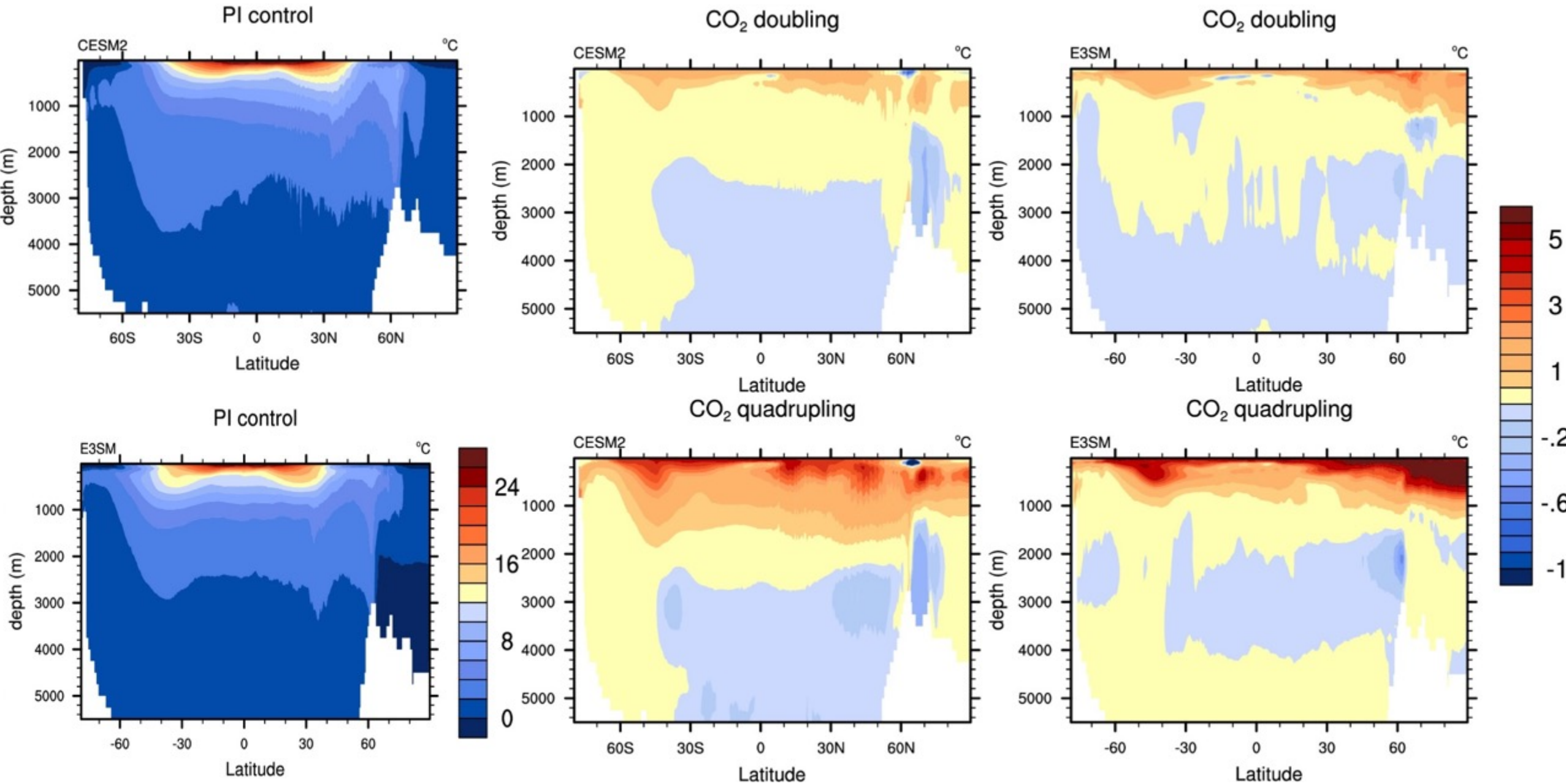
March/Sept mixed layer depth difference



Annual mean sea surface temperature/salinity difference



Global zonal mean temperature and the anomaly



Summary

- Although the ECS is the same for CESM2 and E3SM1 (5.3K), the AMOC mean state is quite different (24.6 vs. 14.3 Sv).
- The weaker AMOC in E3SM1 is associated to a fresher subpolar North Atlantic leading to an absence of deep convection there.
- In response to rising CO₂ concentration, AMOC weakens more in CESM2 than in E3SM1. As a result, the upper/deeper ocean warms slower/faster in CESM2 than in E3SM1 in association to the overall weaker upper ocean



DOE/UCAR Cooperative Agreement

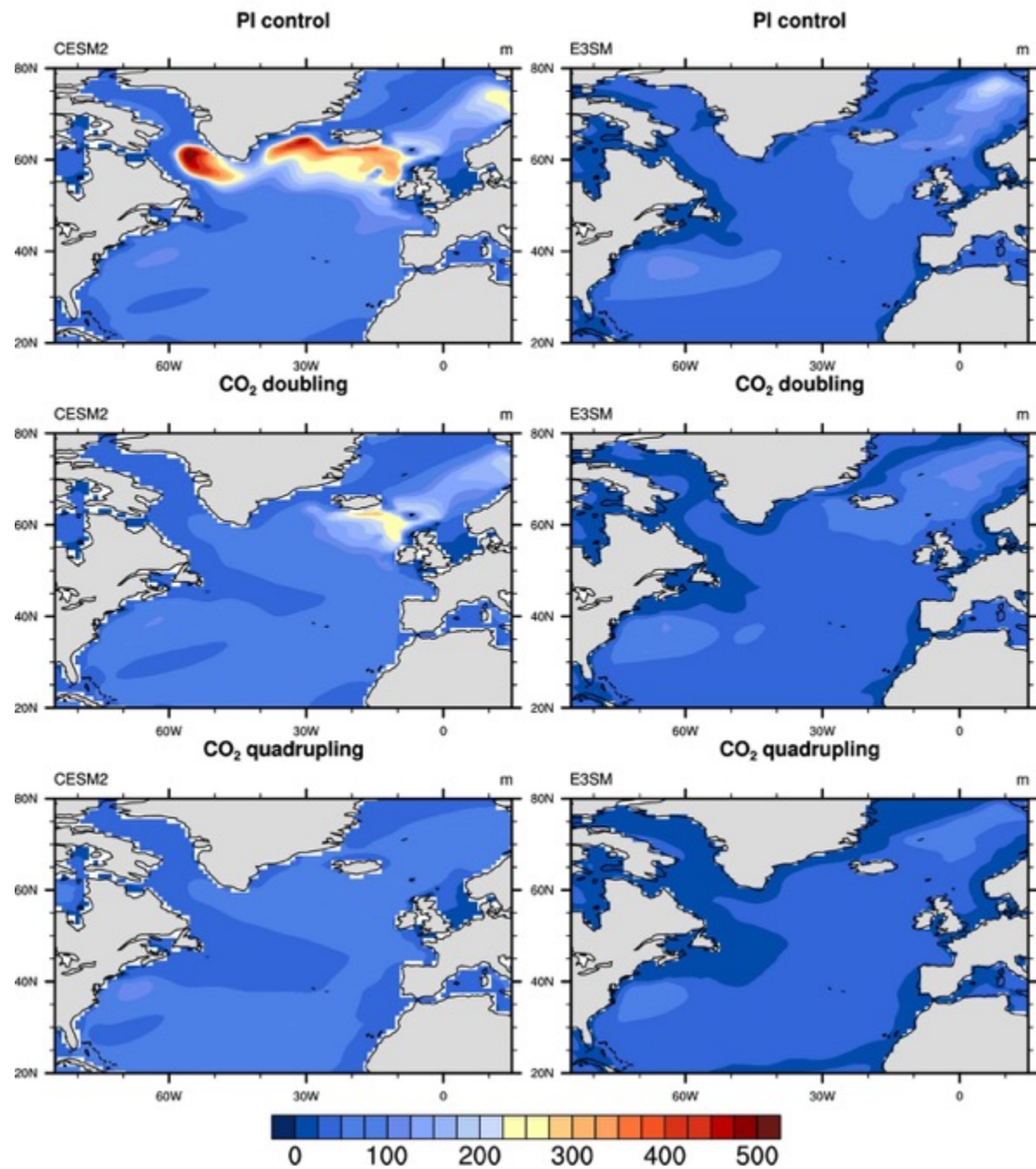
Regional and Global Climate Modeling Program



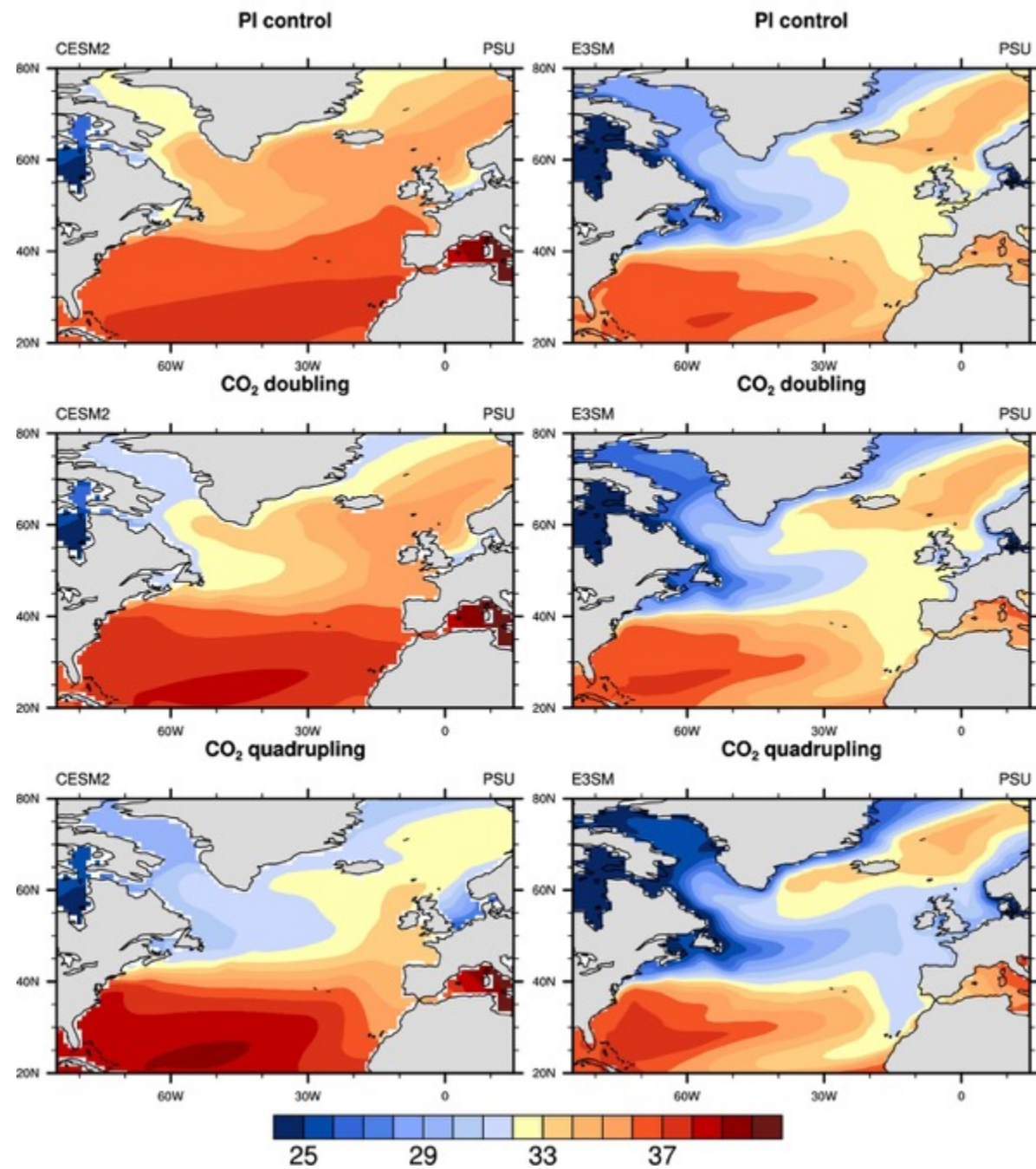
Thank you!

Questions?

Annual mean mixed layer depth



Annual mean sea surface salinity



Atlantic zonal mean salinity

