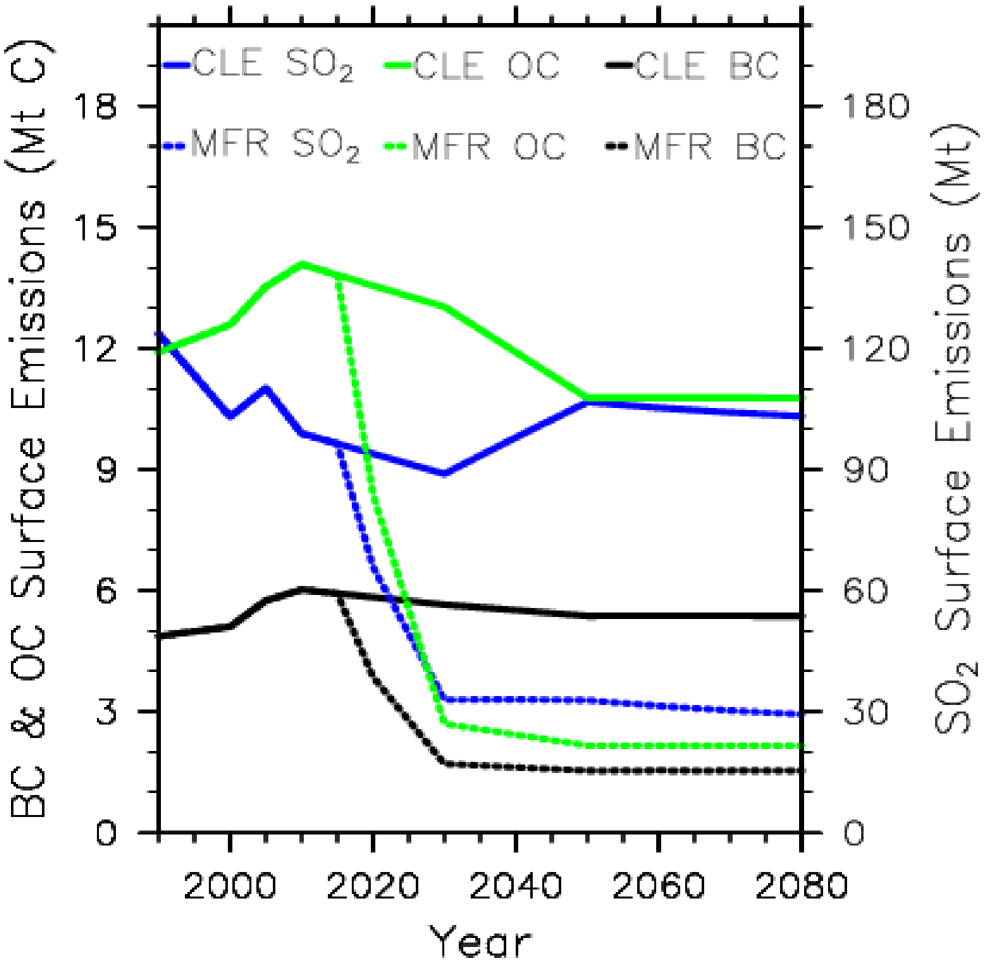
Stockholm University

Future Arctic and European climate response to air pollution scenarios

Juan Camilo Acosta, Øyvind Seland, Annica Ekman, Vidya Varma, Michael Gauss, Ilona Riipinen, HC Hansson

Aerosol and aerosol precursor emissions scenarios (IIASA)



SO_2 Emissions (Mt/yr.)	OC Emissions (MtC/yr.)	BC Emissions (MtC/yr.)
2.1	16.5	1.9

Mean 2005-2010 GFED biomass burning emissions.

Year	CO_2 (ppm)	CH_4 (ppb)	N_2O (ppb)
1990	354	1694	309
2005	379	1754	319
2010	389	1770	324
2030	435	1830	337
2050	487	1833	351

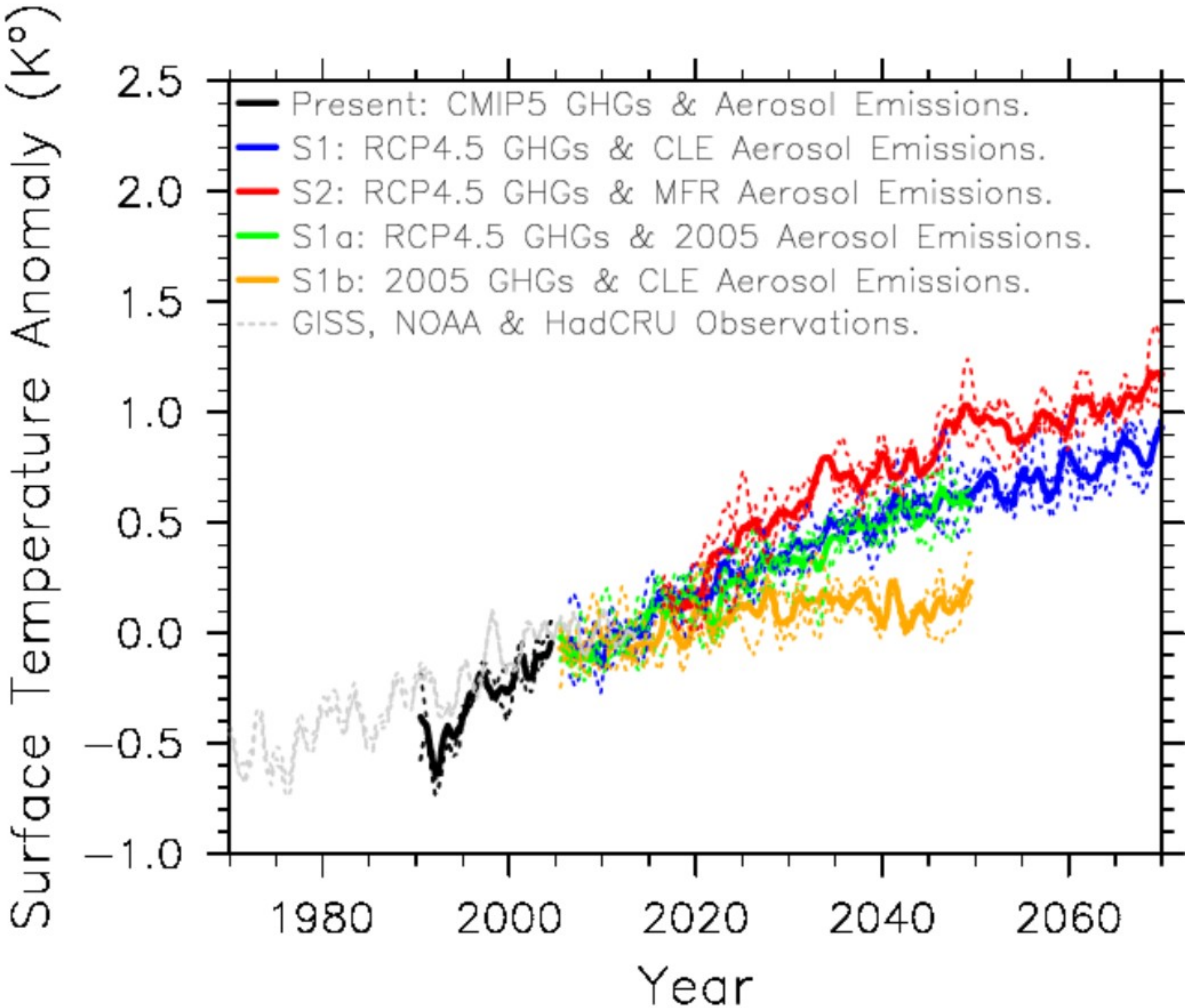
GHGs concentration in RCP4.5

Temporal evolution of fossil fuel Black Carbon (BC), Organic Carbon (OC) and SO_2 global emissions under CMIP5 scenario between 1990-2000 and ECLIPSE V4a CLE and MFR scenarios from 2005-2080. Between 2000 and 2005 a linear interpolation was applied. Note the difference in scales for BC/OC and SO_2. Klimont et al. (manuscript in prep)

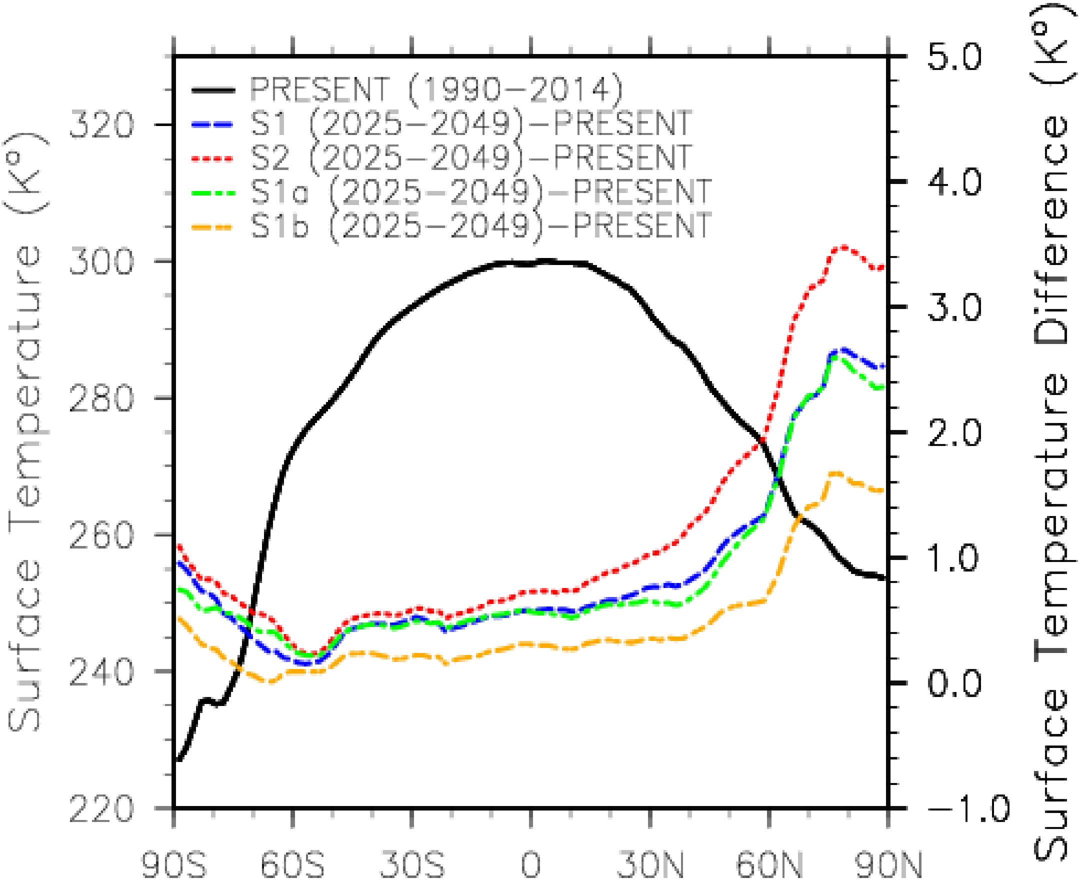
Description of the transient simulations

Ensemble simulatiuons (1 ensemble = 3 runs started at 1990 from independent CMIP5-type runs)	GHG emission scenario	Primary aerosol & precursor emissions from fossil fuels ***	Biomass burning (wild & human-induced fires) ***
S1 (1990-2070) 	CMIP5/RCP4.5*	CMIP5/Interp/CLE**	Mean 2005-2010 GFED
S1a (1990-2050) 	CMIP5/RCP4.5*	CMIP5/Fixed 2005 Emissions**	Mean 2005-2010 GFED
S1b (1990-2050) 	CMIP5/Fixed 2005* Emissions	CMIP5/Interp/CLE**	Mean 2005-2010 GFED
S2 (1990-2070) 	CMIP5/RCP4.5*	CMIP5/Interp/MFR**	Mean 2005-2010 GFED

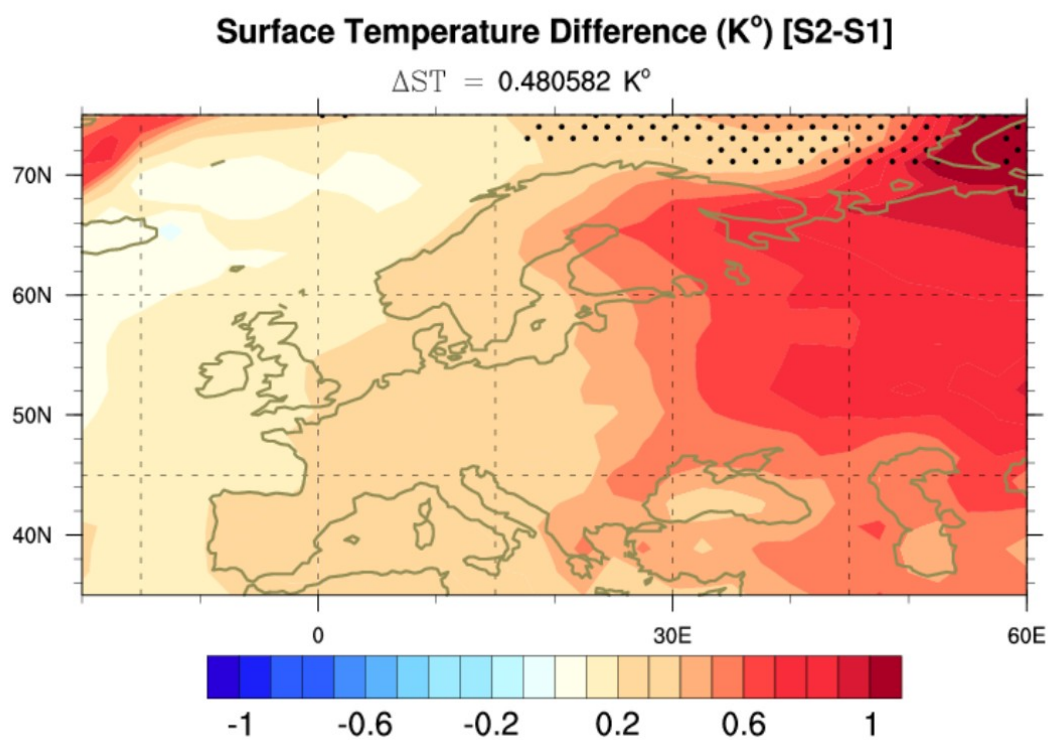
Surface Temperature change under the different emission scenarios

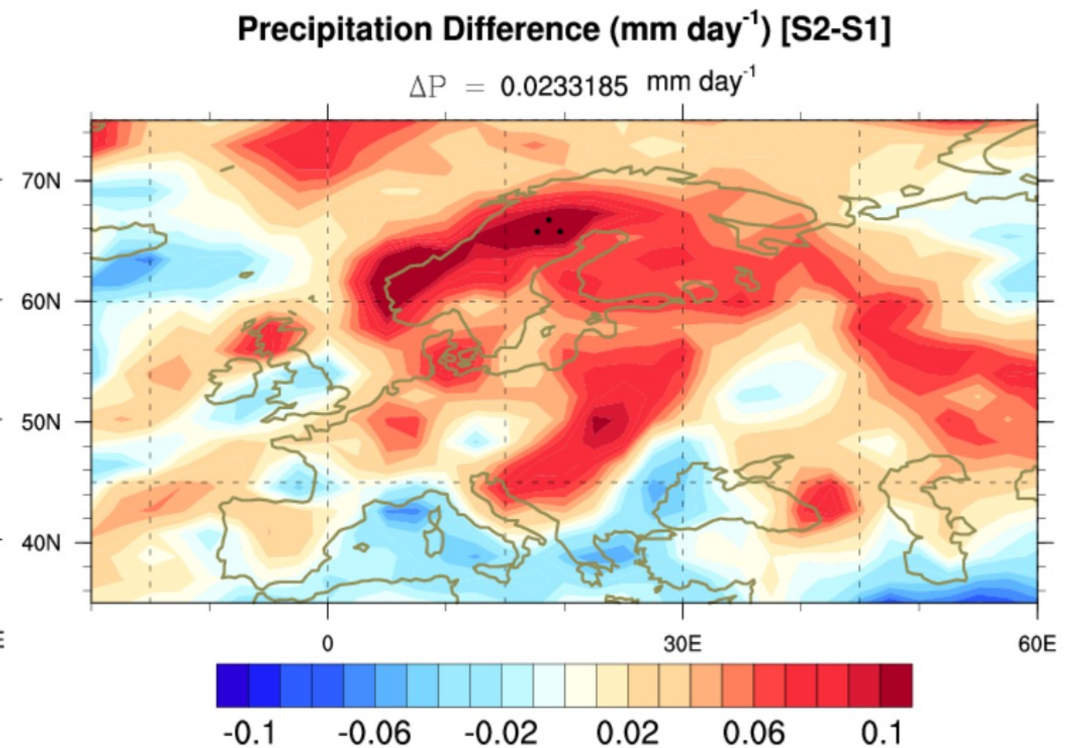


Surface Temperature difference under the different emission scenarios

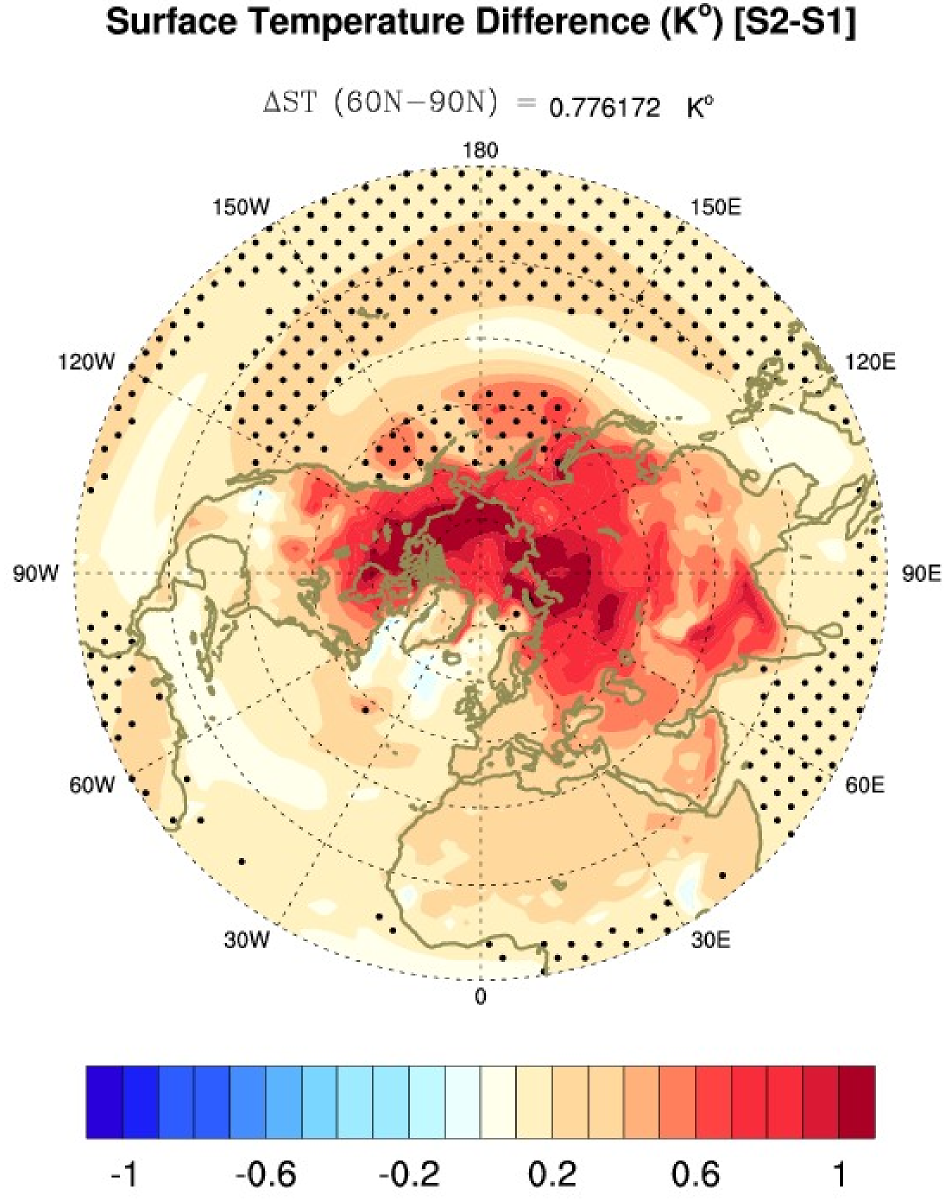


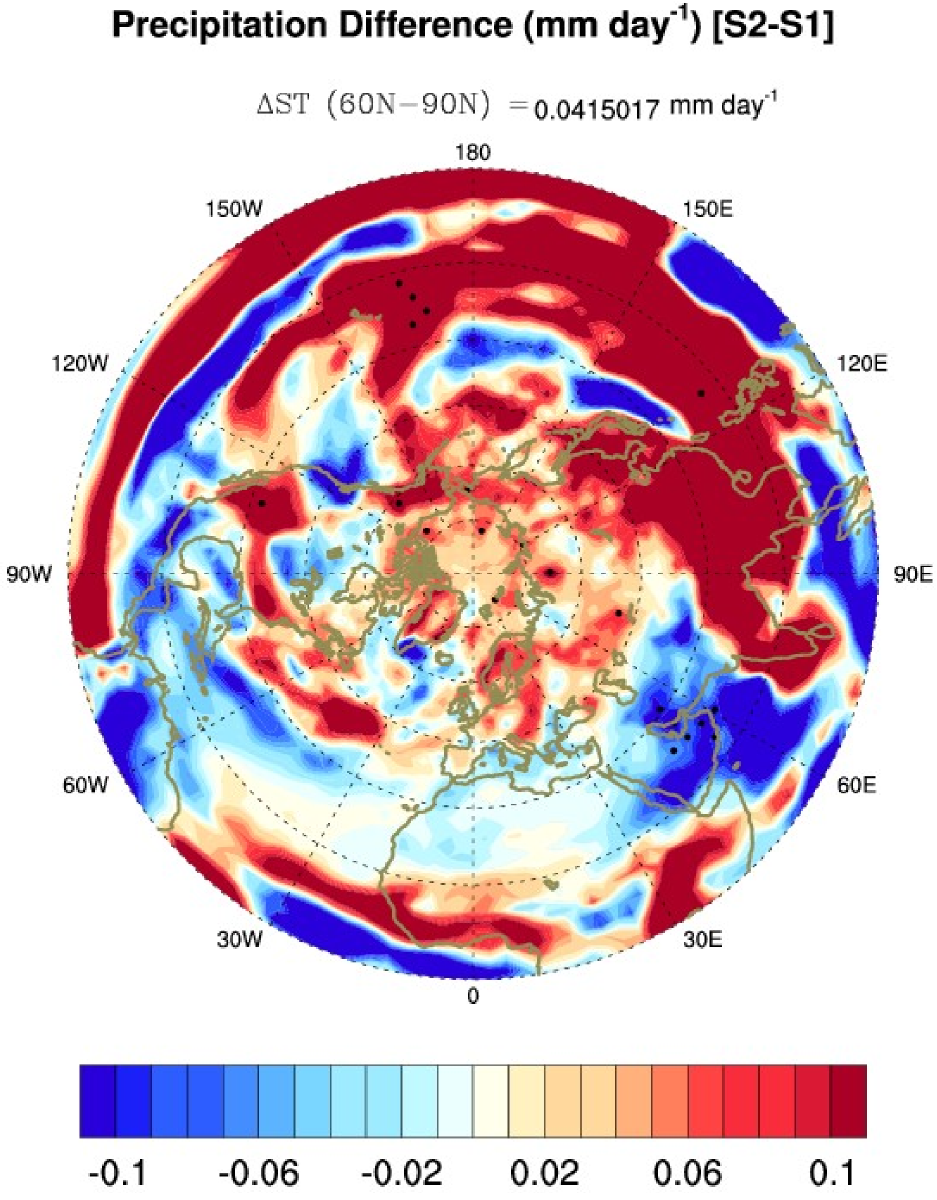
Surface temperature and total precipitation difference between S2 (MFR) and S1 (CLE) (2025-2049)



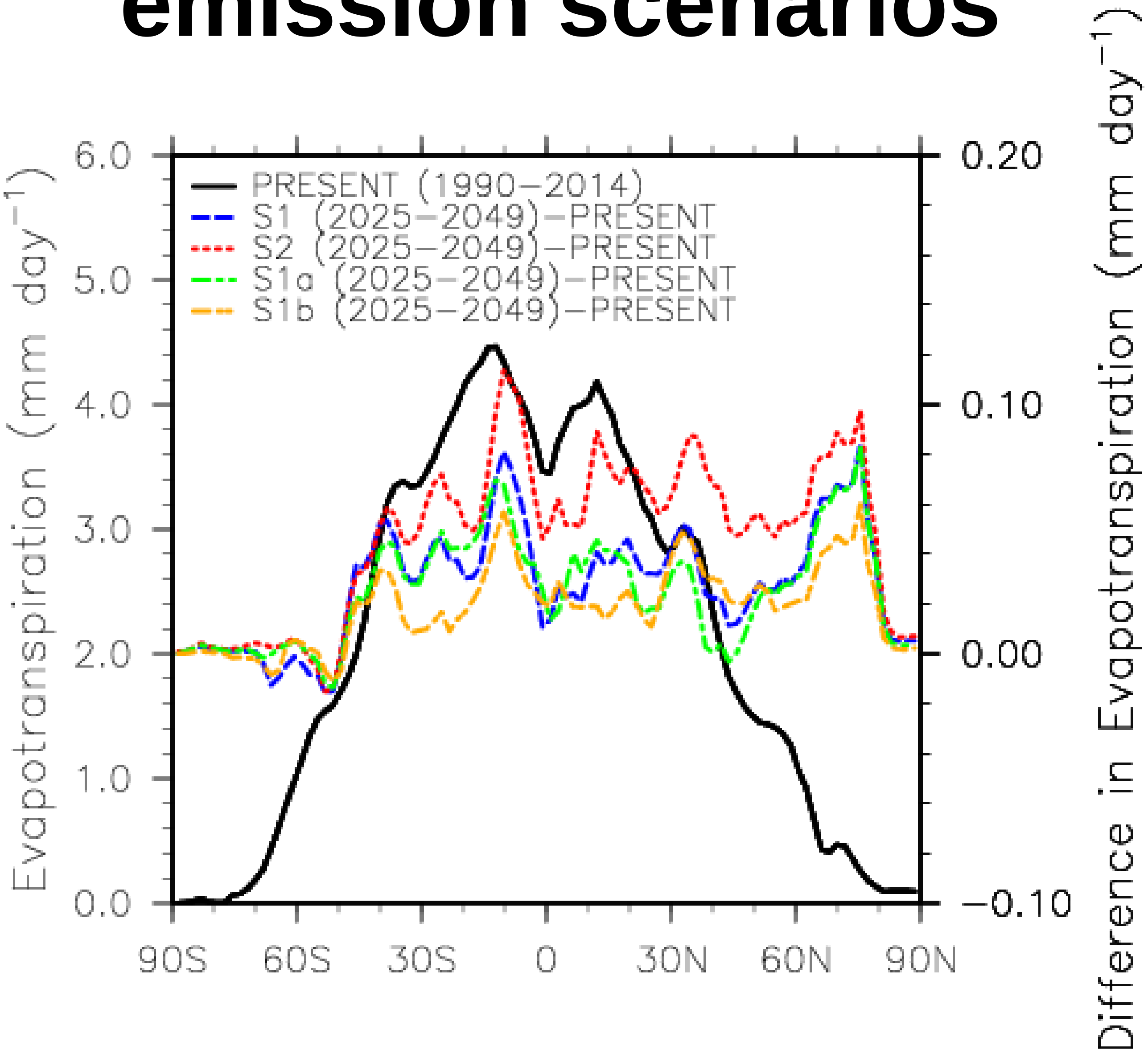


Surface temperature difference between S2 (MFR) and S1 (CLE) (2025-2049)

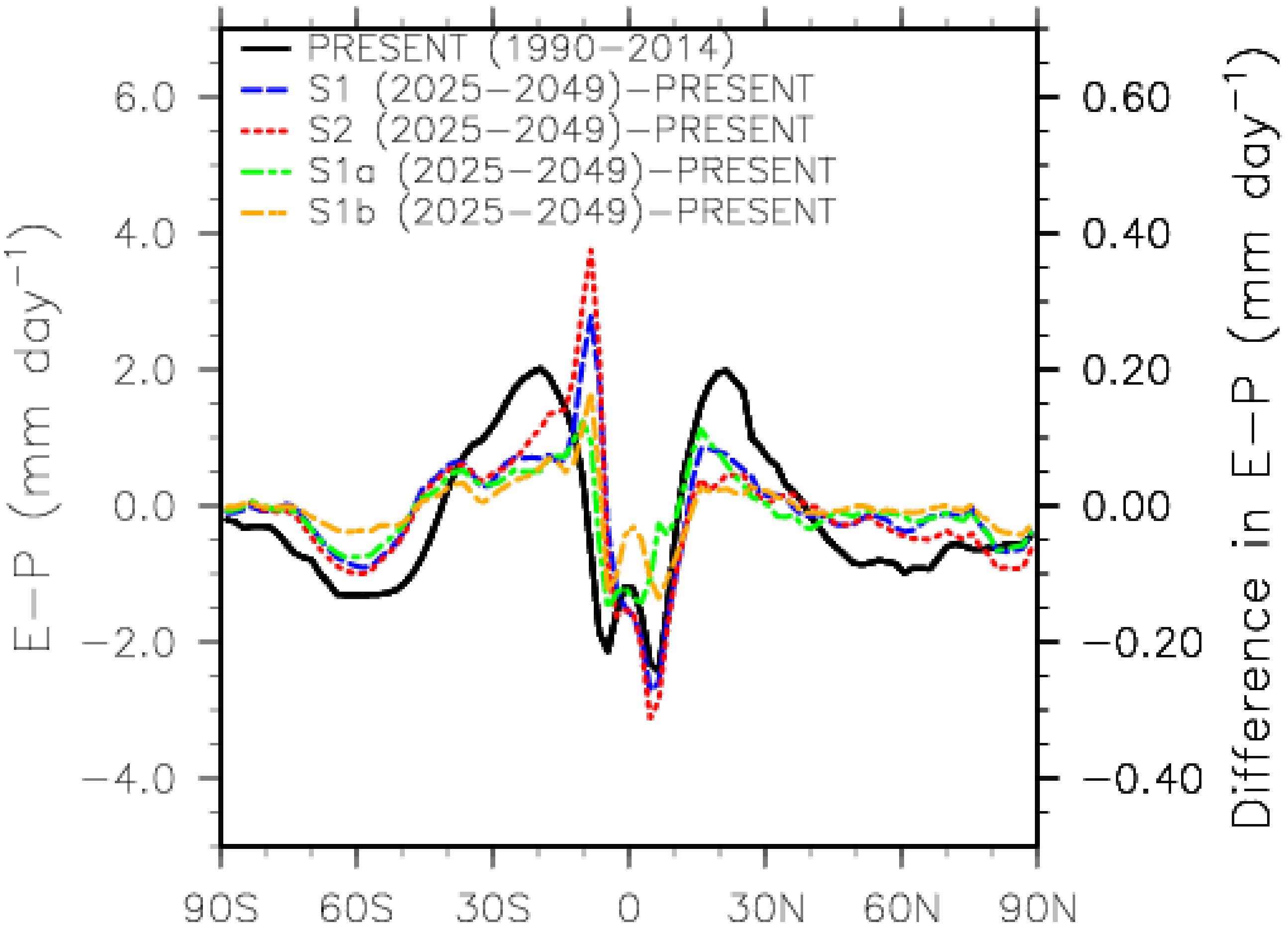




Evapotranspiration (Ocean+Land) difference under the different emission scenarios

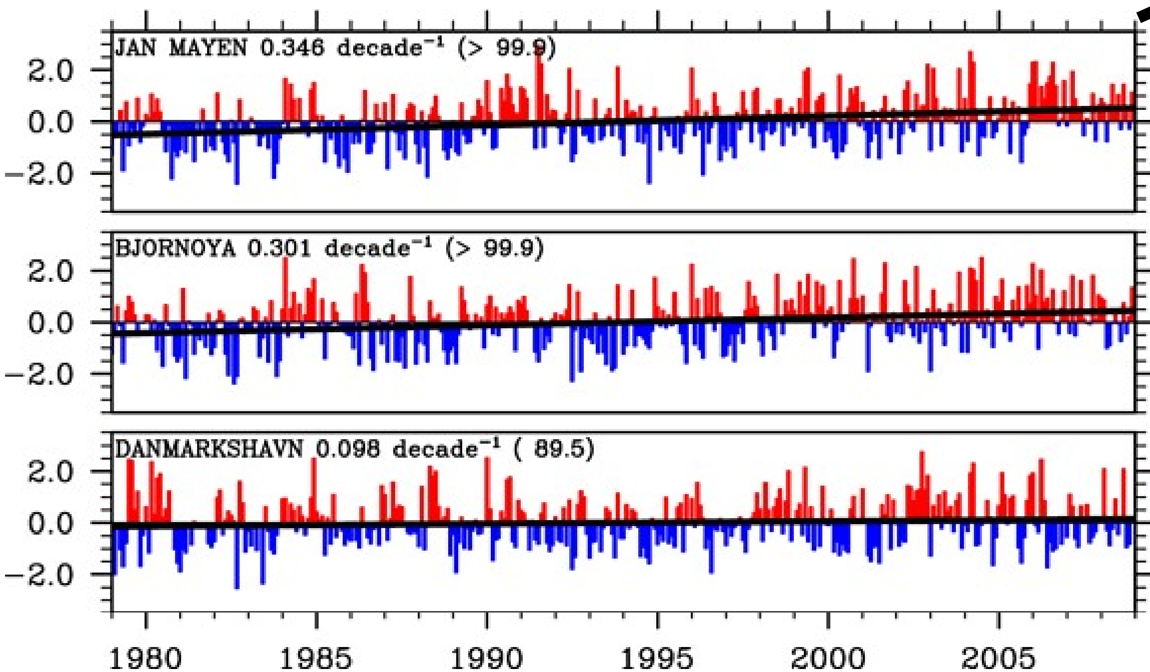


Evapotranspiration - Precipitation (Ocean+Land) difference under the different emission scenarios

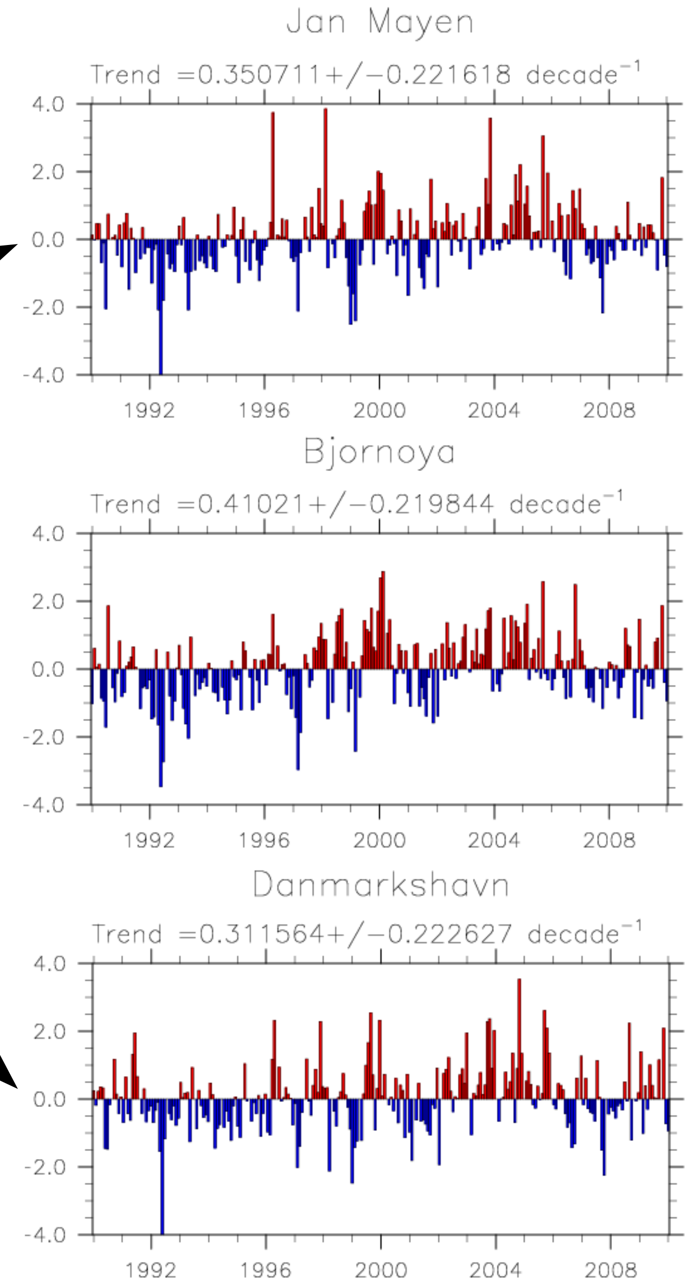


Model vs observed trends in normalized precipitable water from ground to 500 hPa

Observed

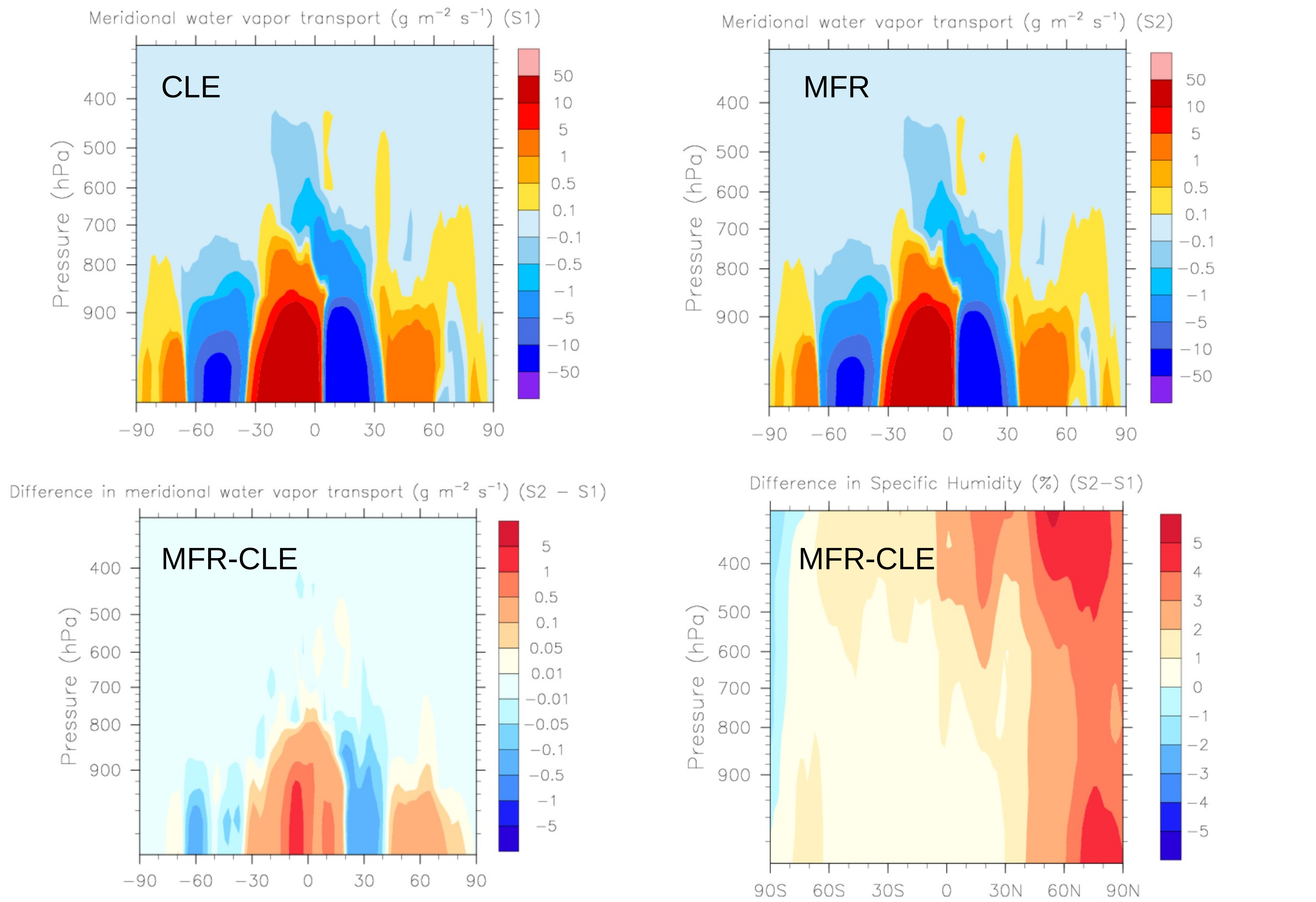


Modelled



Serreze et al. 2012, JGR

Meridional water vapor transport (2025-2049)



Conclusions

- Strong global reductions on aerosol emissions (MFR) would have an important short term (~20 years) effect on climate warming in Europe & the Arctic region.

- Warming in the Arctic would be ~0.8C, Eu warming would be ~0.5C. The global warming would be about one third of the Arctic warming.

- The aerosol reductions cause overall less severe drying in dry areas and wetter patterns in wet areas in the Northern hemisphere.

Conclusions (continuation)

- Global reduction of anthropogenic aerosols would increase precipitation in the Arctic region and over most of Eu. However, most of the Mediterranean basin would receive less precipitation.

Take home message

- Cleaning the air would bring undeniable improvements in terms of health, but could induce an important warming in the Arctic and Eu in addition to the dominant warming caused by GHGs emissions.