

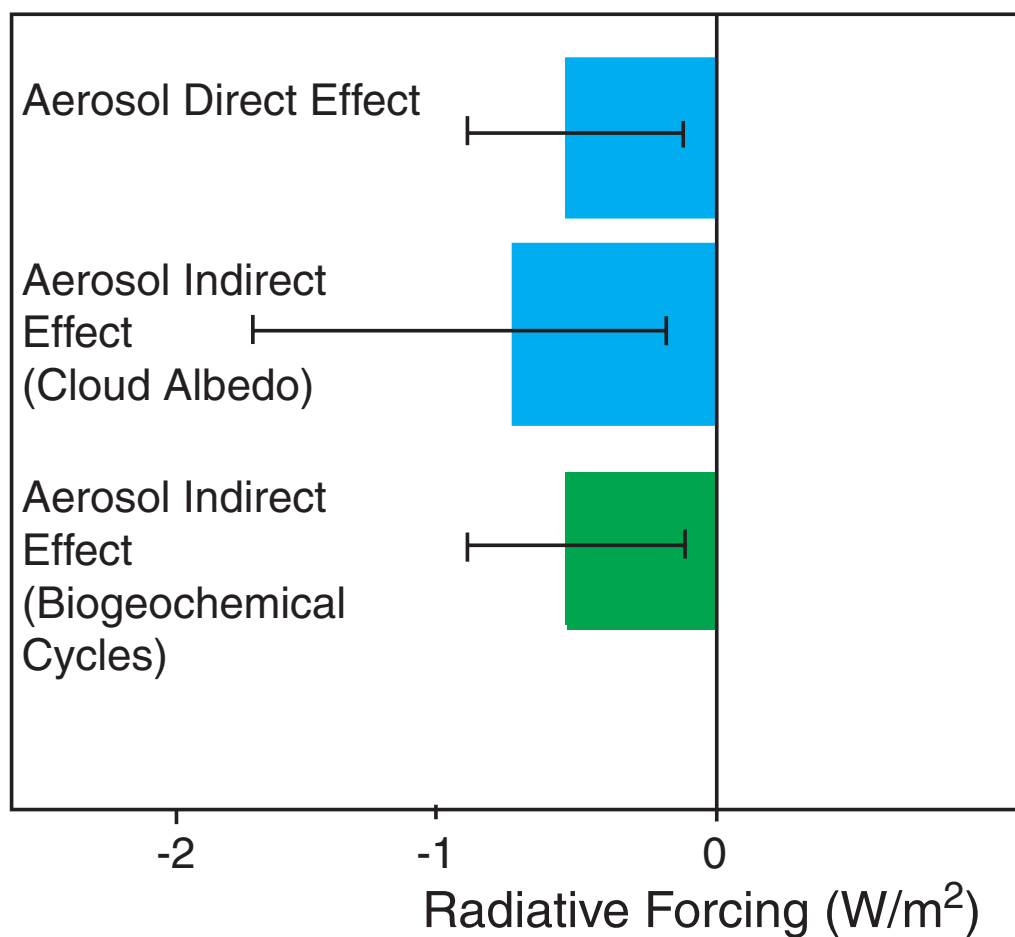
The impact of SO₂ emissions reductions on US carbon uptake

Gretchen Keppel-Aleks (U. Michigan),
Rebecca Washenfelder (NOAA CSD)

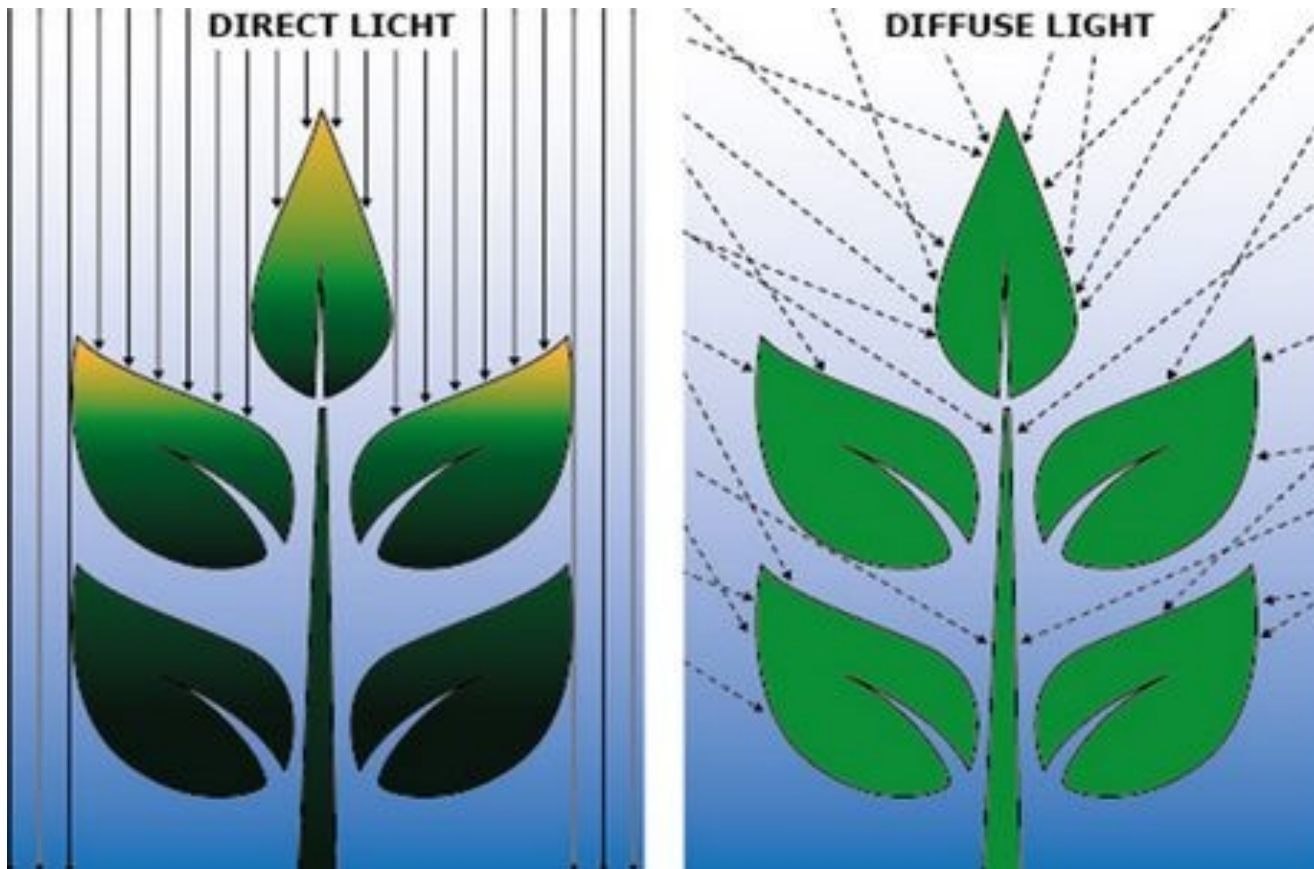
CESM BGC Working Group Meeting 2016

Partial support DOE RGCM program — Biogeochemistry – Climate Feedbacks
Scientific Focus Area (SFA)

Aerosols impact climate via radiative forcing and biogeochemical cycling

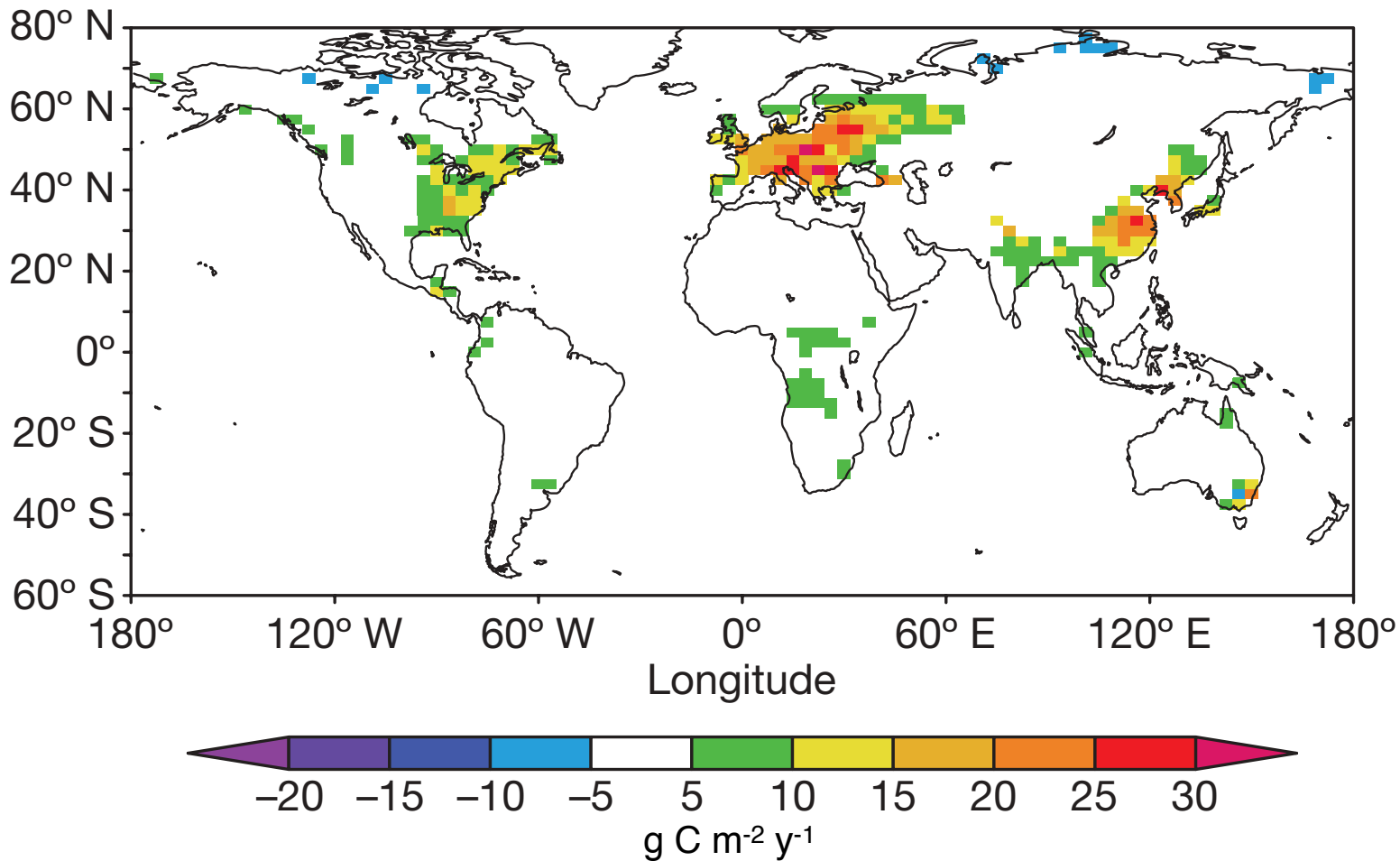


Aerosol impact climate via radiative forcing and biogeochemical cycling



Simulations show a large increase in ecosystem carbon uptake due to diffuse PAR

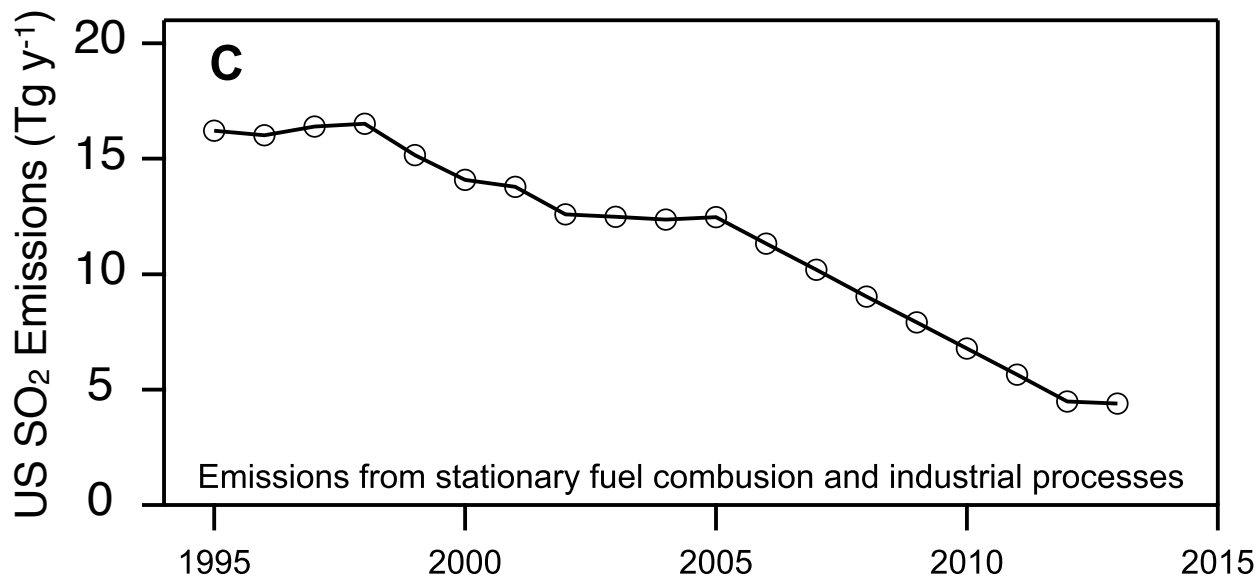
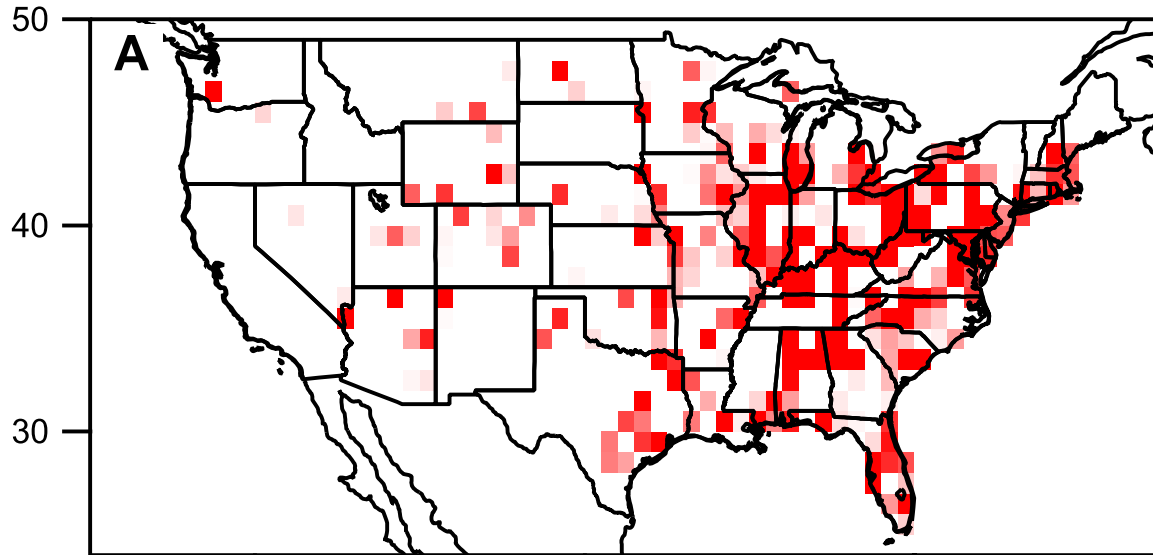
NEE due to Diffuse PAR: 1950-1980



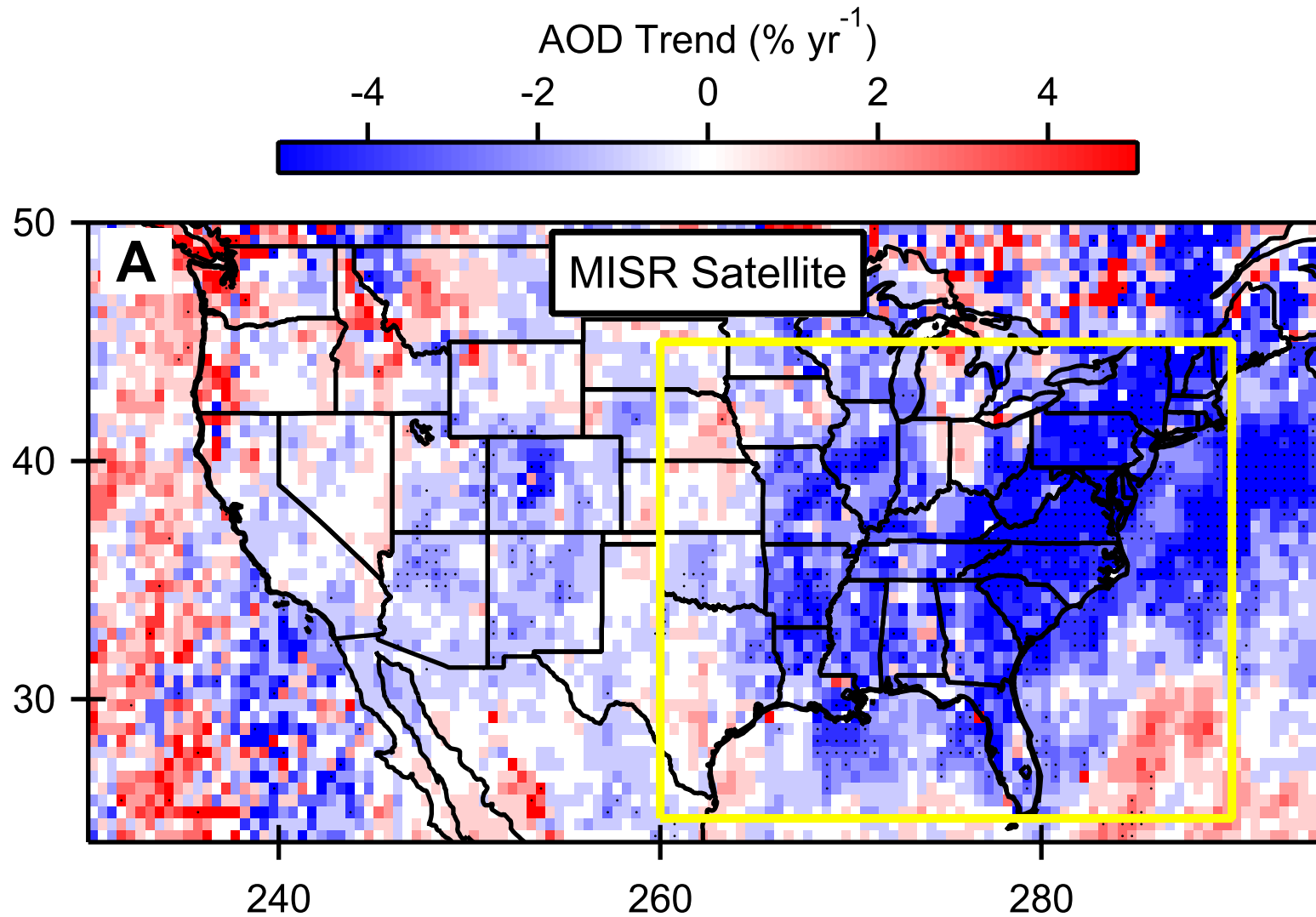
Most aerosols over the United States are secondary aerosol from gas-phase emissions

SO₂ Emission in 1995 (kg km⁻² yr⁻¹)

0 1000 2000 3000 4000 5000

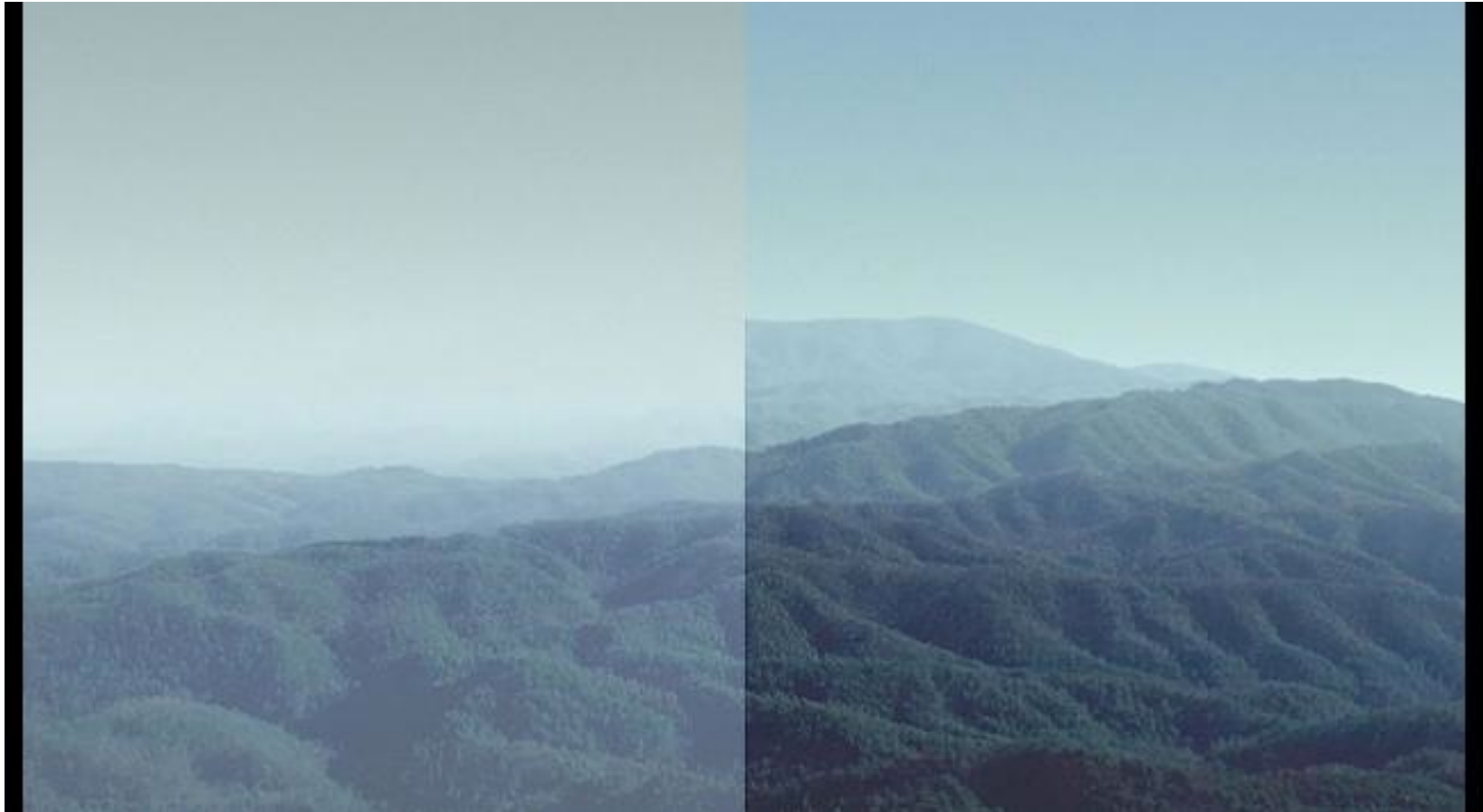


Aerosol Optical Depth (AOD) has decreased over the eastern US



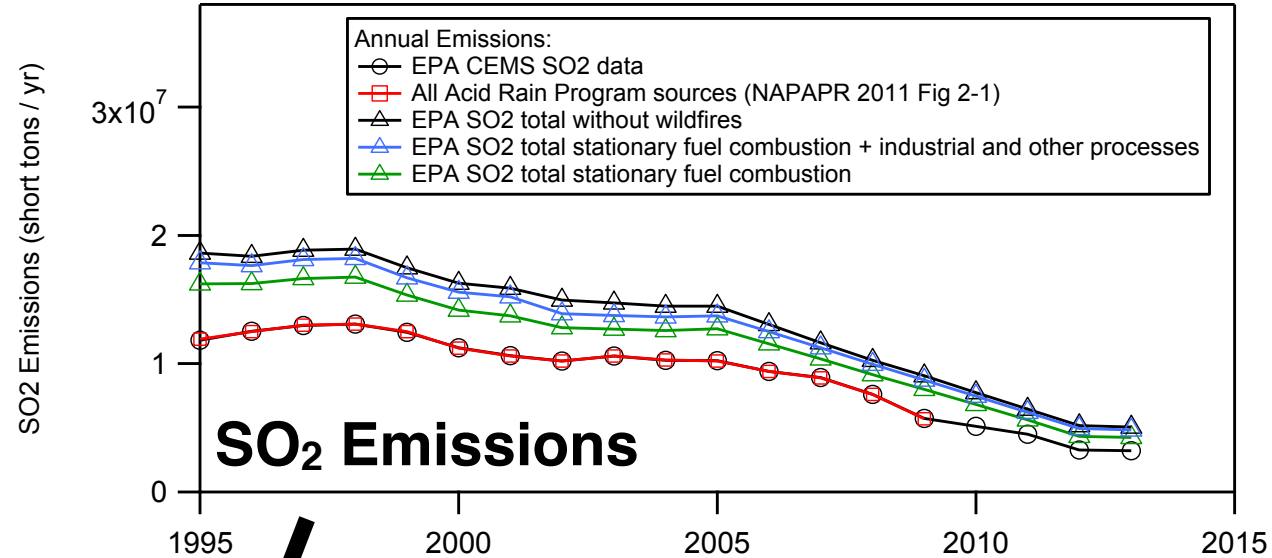
Data: NASA MISR

Visibility in Great Smoky Mountains 1990 vs 2010

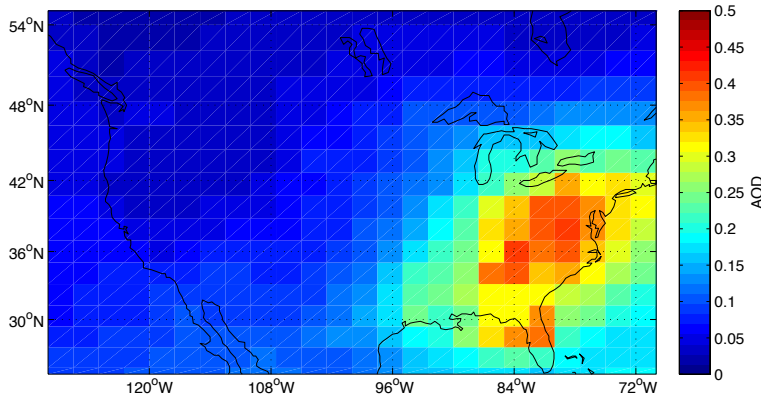


Dr. Jenny Hand, CIRA

Testing photosynthesis responses to AOD in CLM

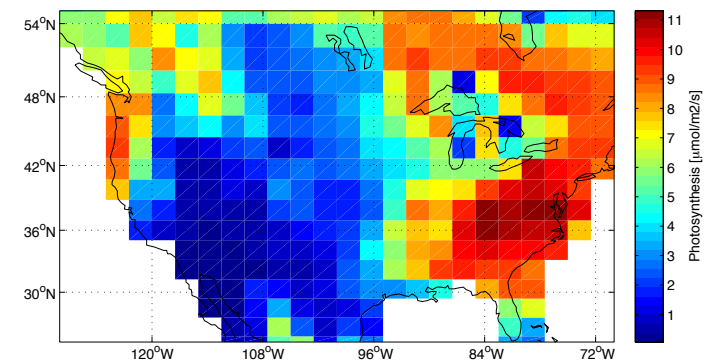


CAM4 with BAM

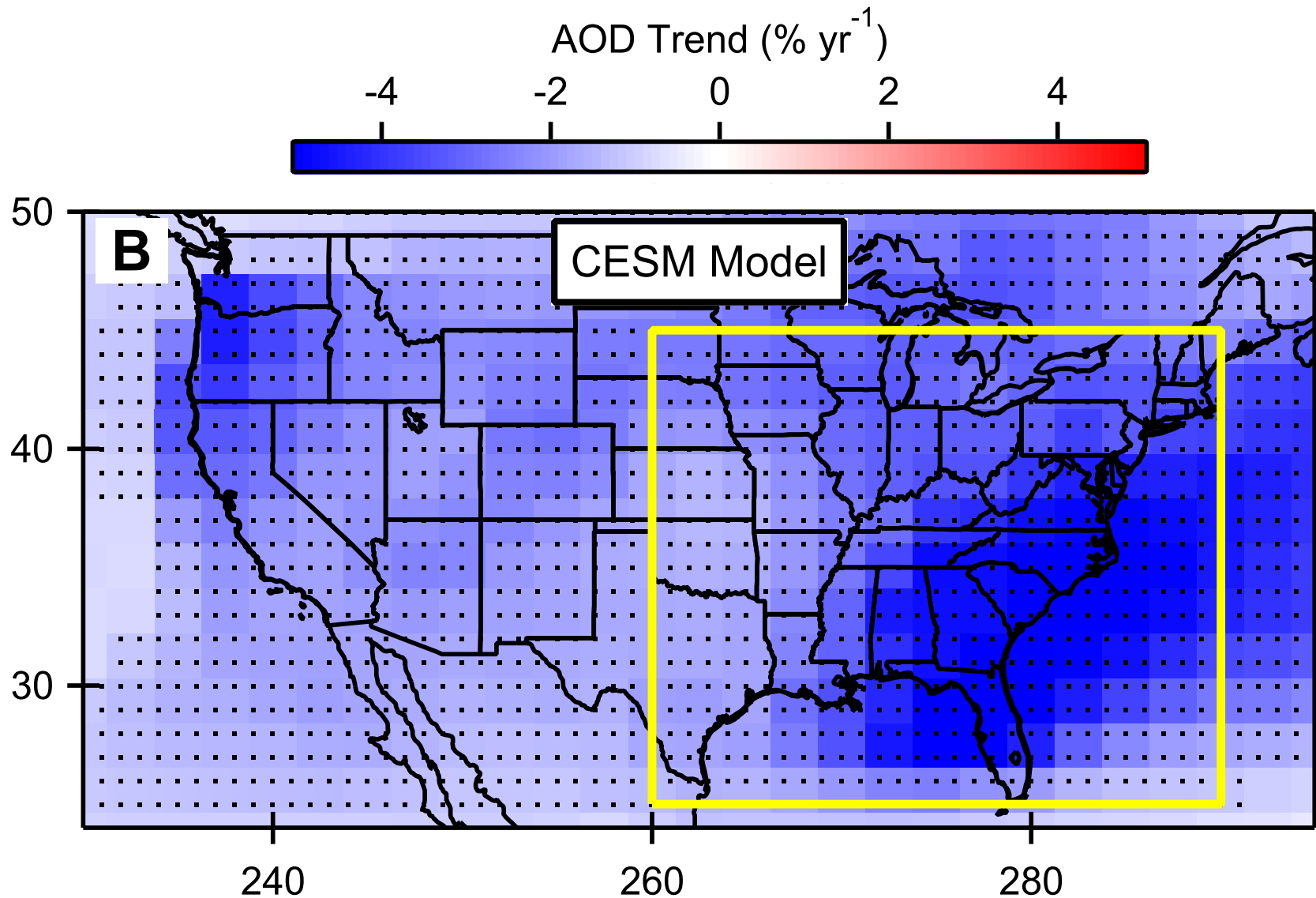


diffuse and
direct radiation

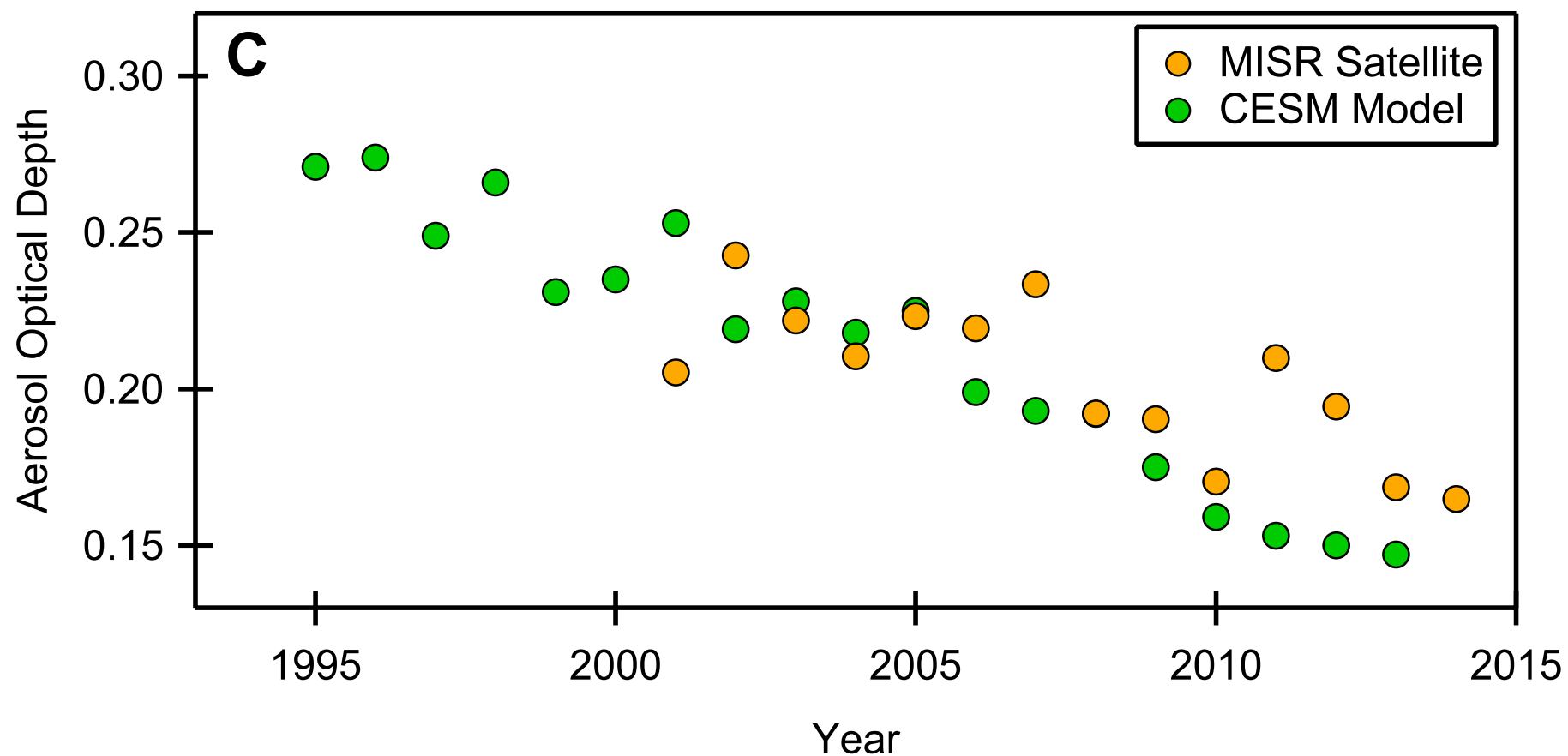
CLM4.5 (satellite phenology)



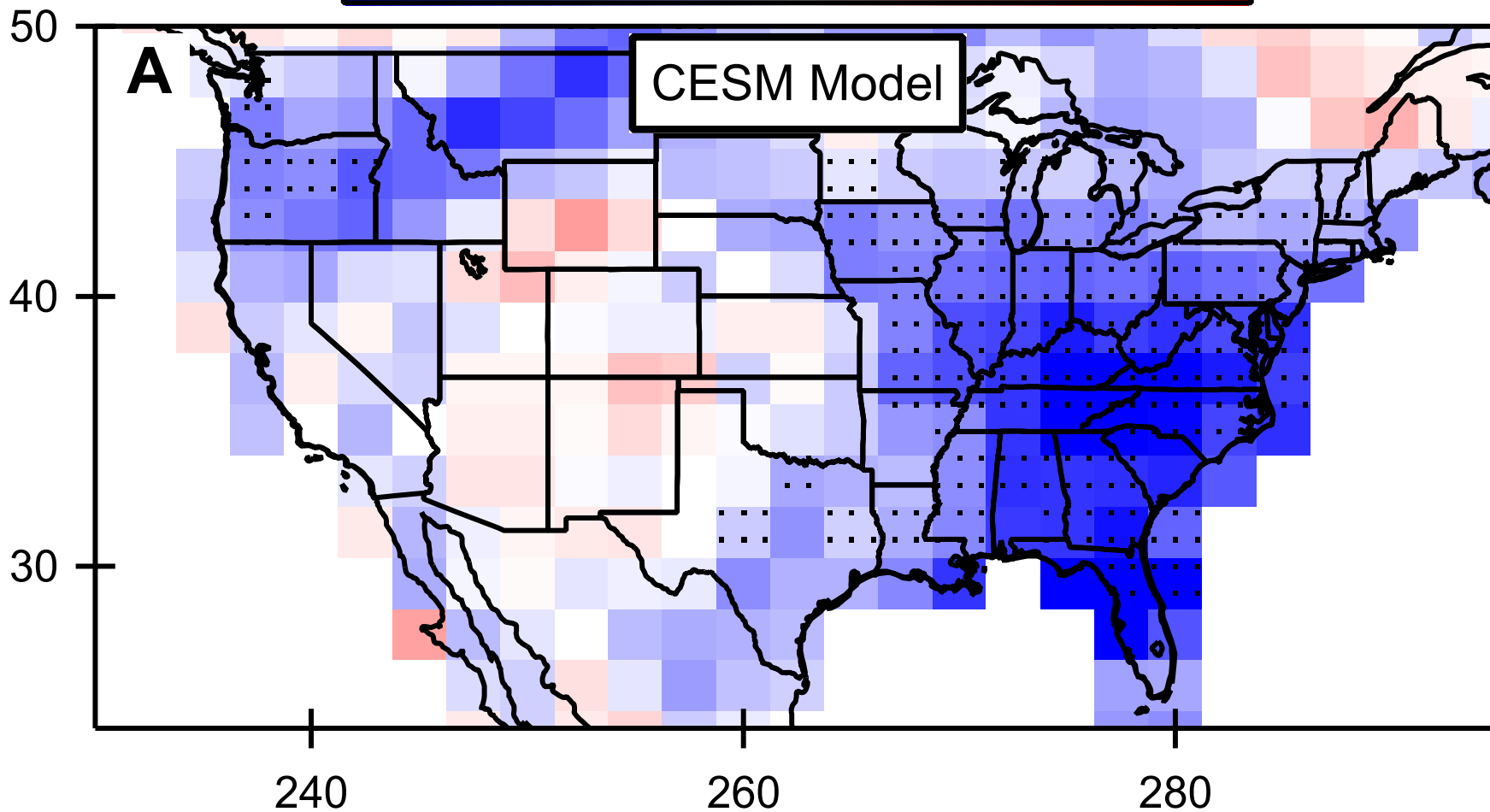
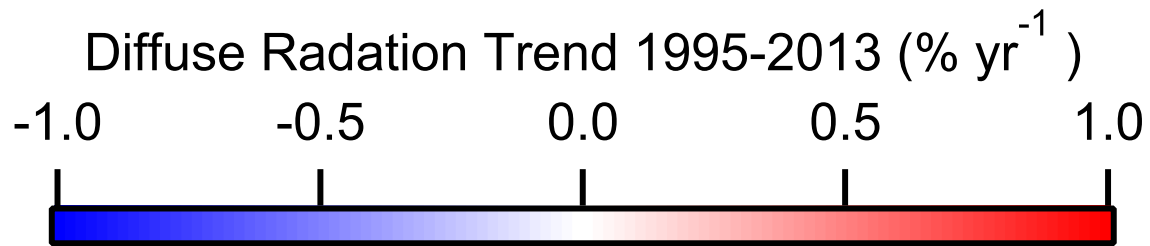
CAM4 with Bulk Aerosol Model (BAM) simulates decrease in AOD over US with EPA SO₂ emissions



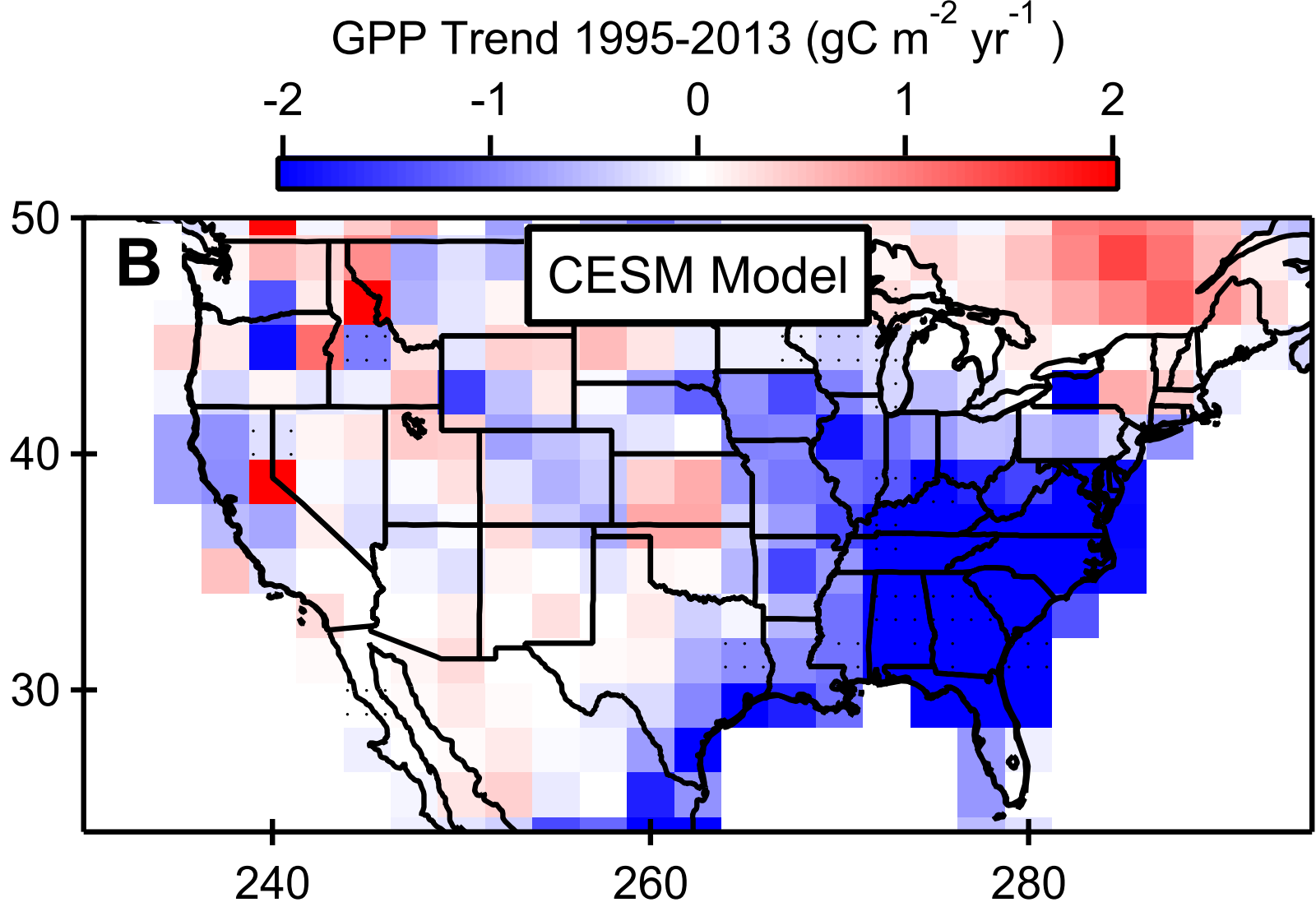
Trend in AOD over eastern US comparable to observed trend from MISR



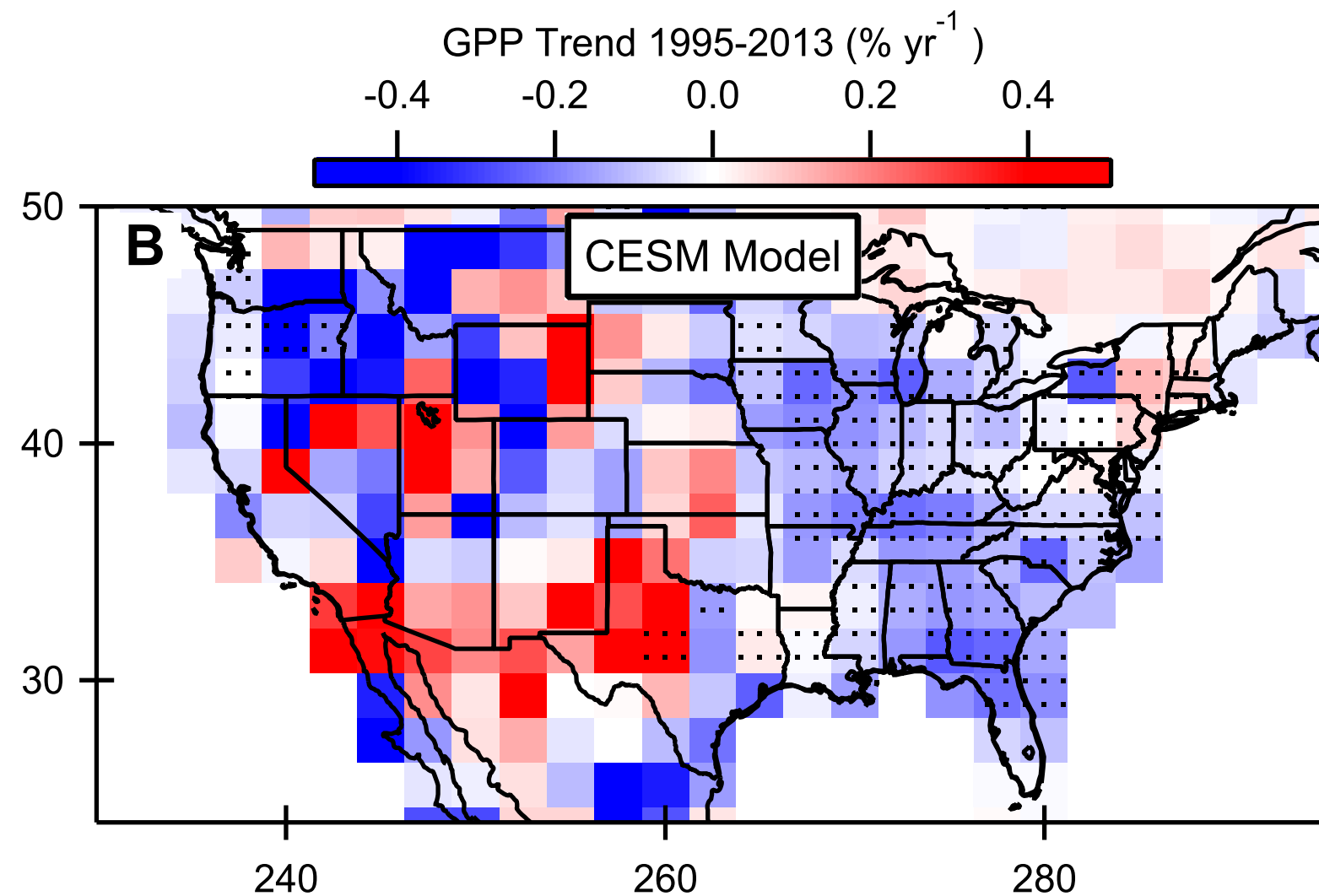
Diffuse solar radiation shows statistically significant increase over eastern US



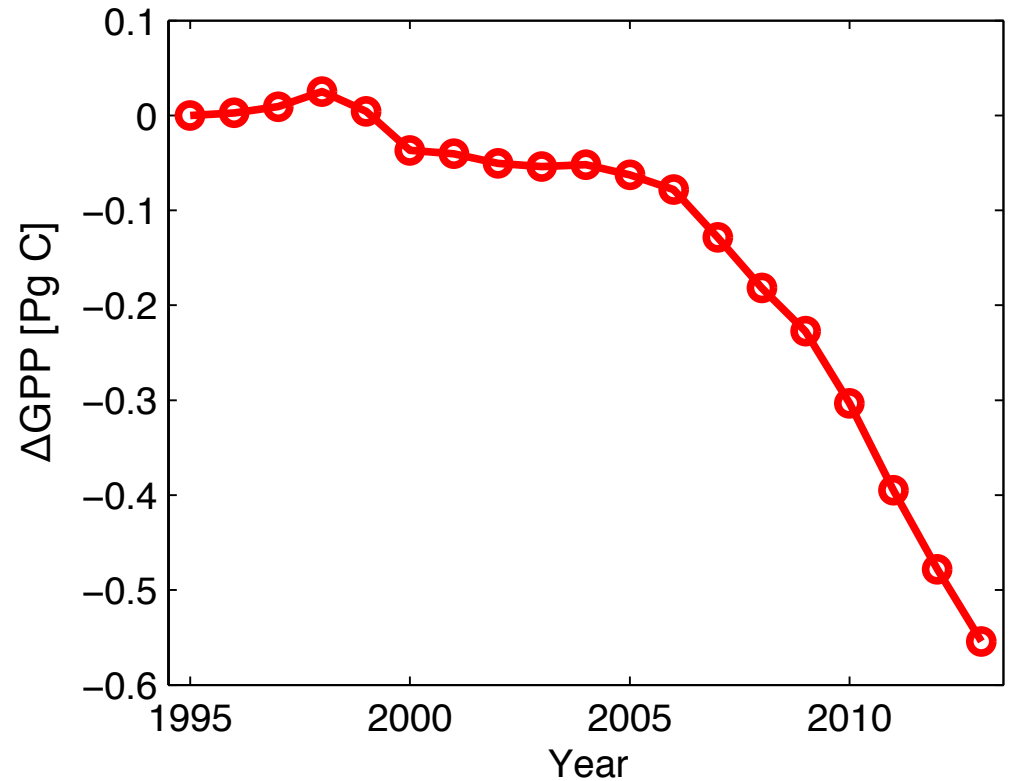
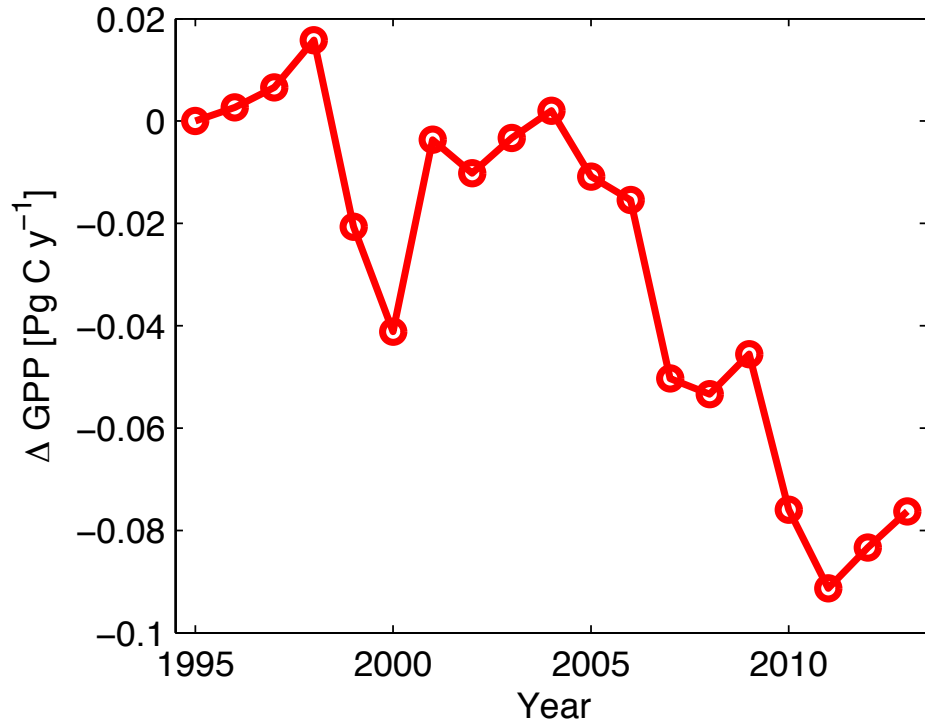
CESM simulates a reduction of 0.5 Pg C per year



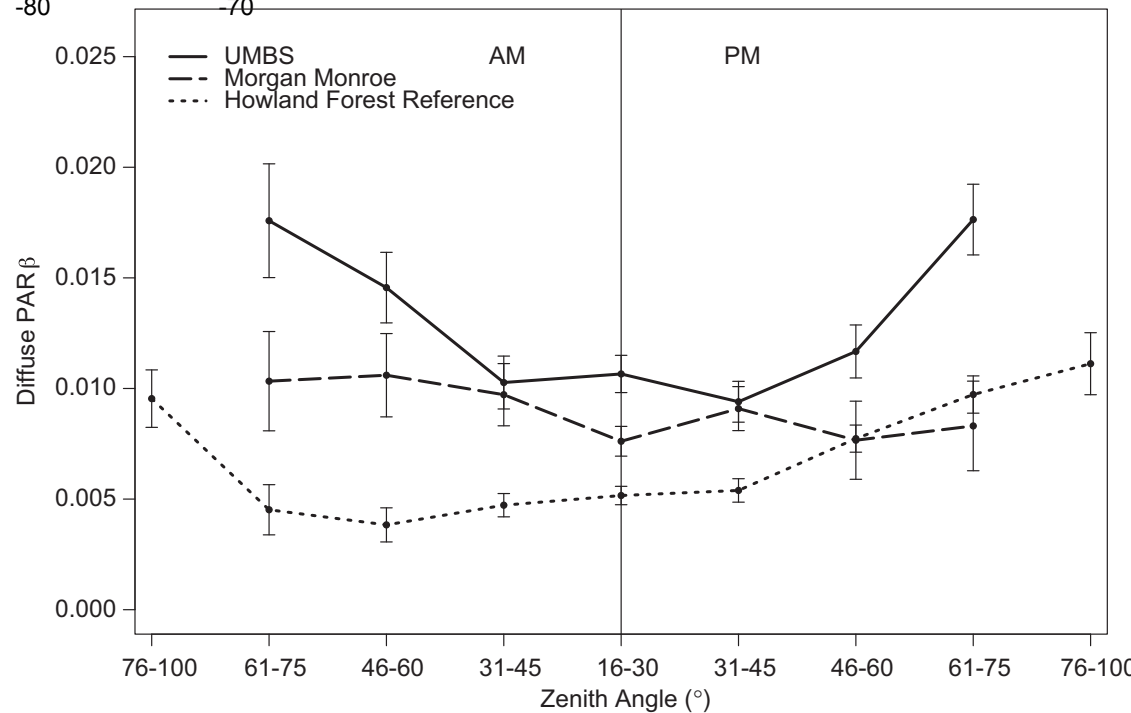
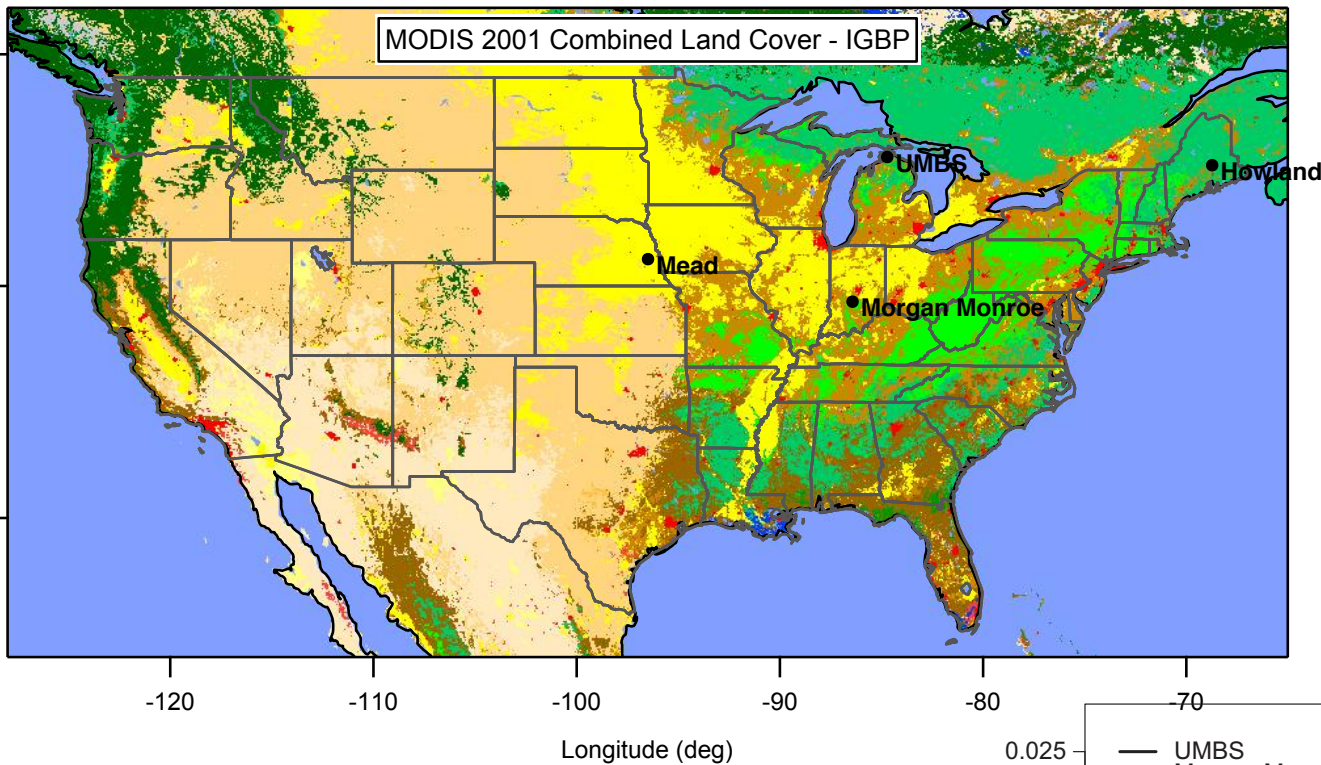
Photosynthesis in CLM4.5 decreases where diffuse solar radiation declines



Photosynthesis in CLM4.5 decreases where diffuse solar radiation declines

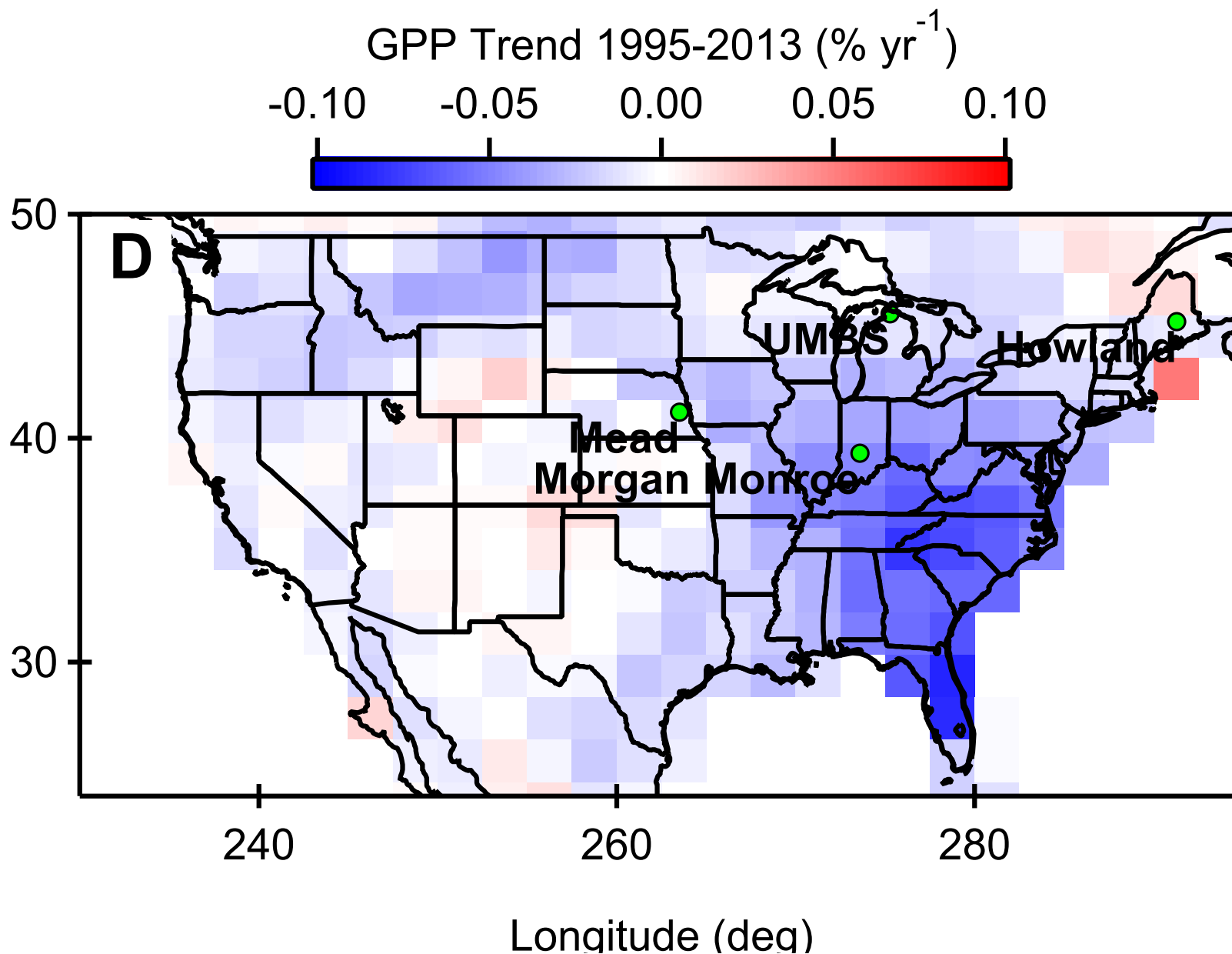


Can we evaluate CESM simulations?

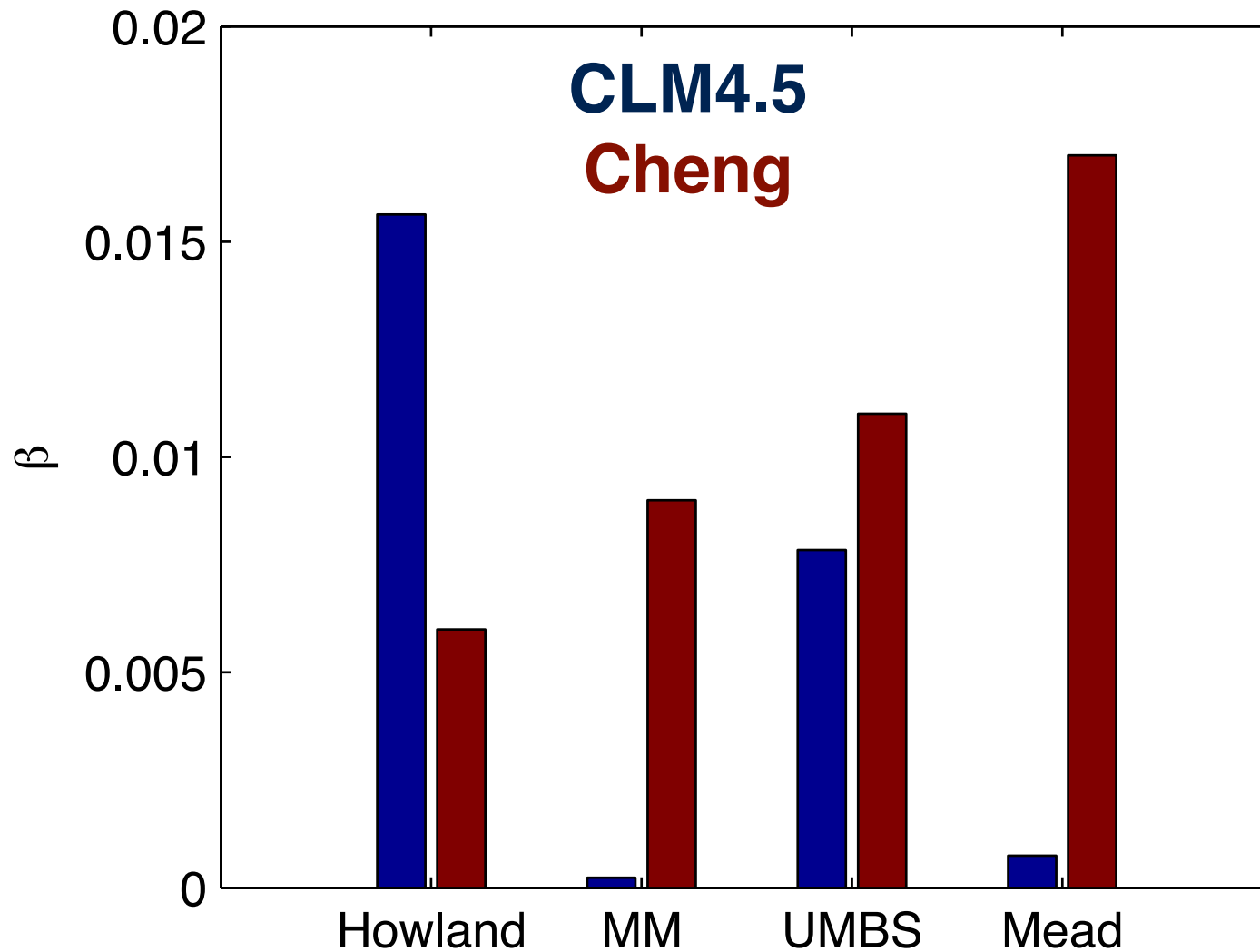


Cheng et al., 2015

Relative trend in GPP from upscaling observational constraints is ~4x weaker than CLM4.5



CLM4.5 shows different sensitivity to diffuse light than FLUXNET sites with observational constraints



Discussion

CLM4.5 shows reduction in photosynthesis in response to SO₂ emissions reductions, albeit a larger decrease than FLUXNET

Response of CLM4.5 to diffuse radiation reductions is significantly smaller than previously reported values

Continuing to develop an upscaling approach for observed sensitivities that accounts for errors on drivers

