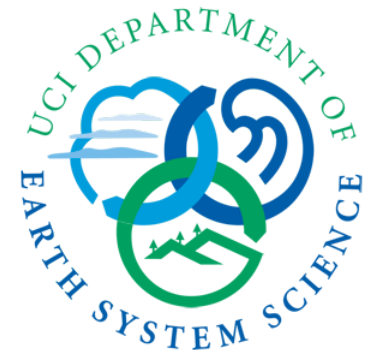


Evaluating the strength of the land-atmosphere moisture feedback using global satellite observations



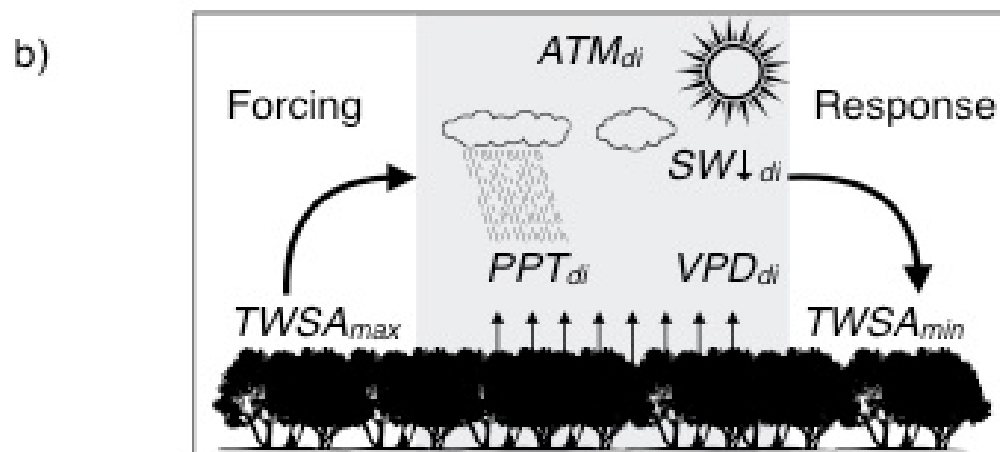
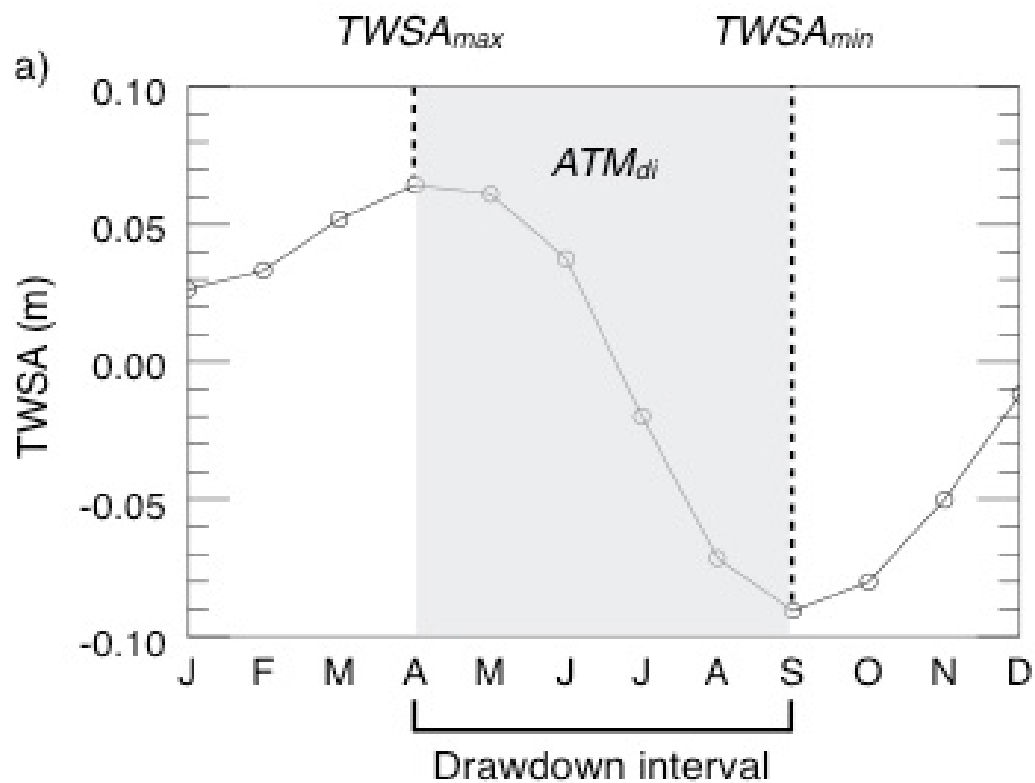
Paul Levine, Jim Randerson,
Sean Swenson, and Dave Lawrence

February 10, 2016

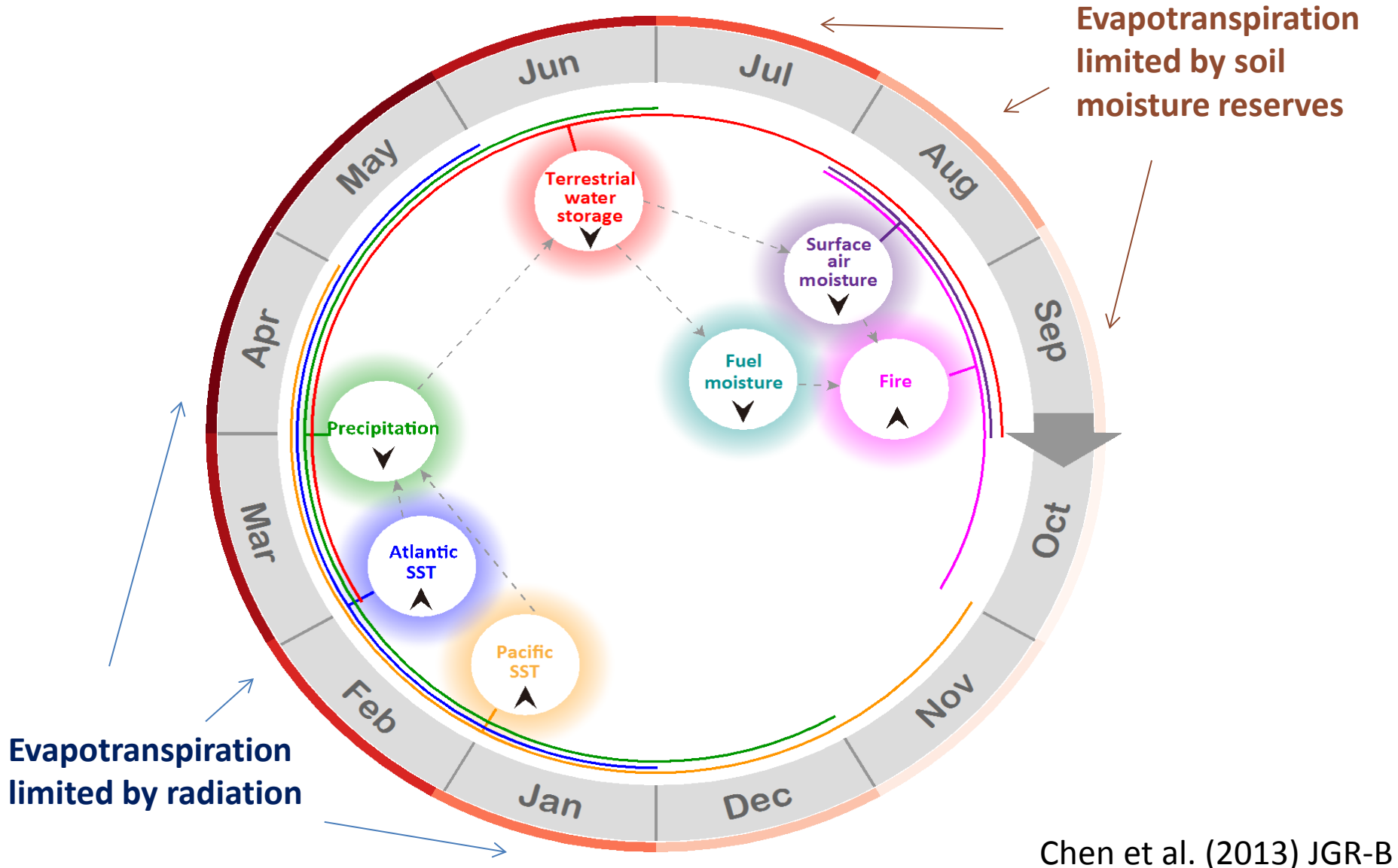


NCAR BGC-Land-SD Working Group meeting
Support from the DOE Office of Science BGC SFA

n = 13 (2002-2015)

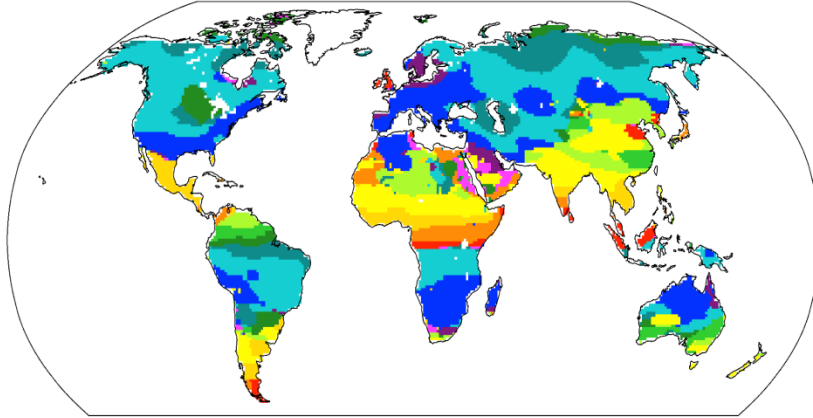


A conceptual model for fire predictability in the Amazon is based on a forest soils capacitor mechanism

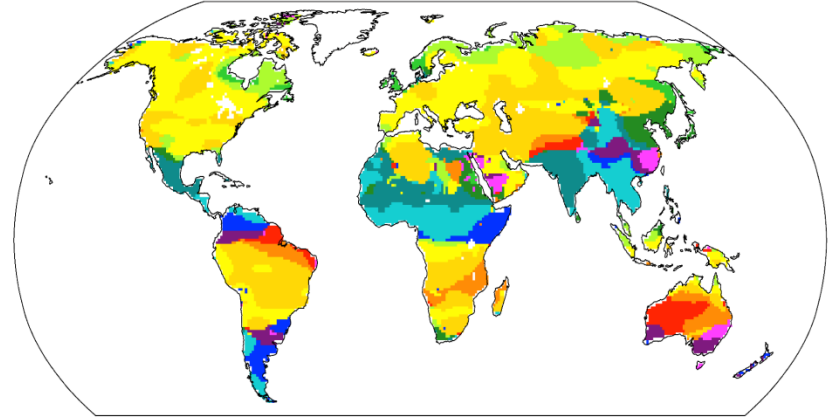


Seasonal dynamics of terrestrial water storage

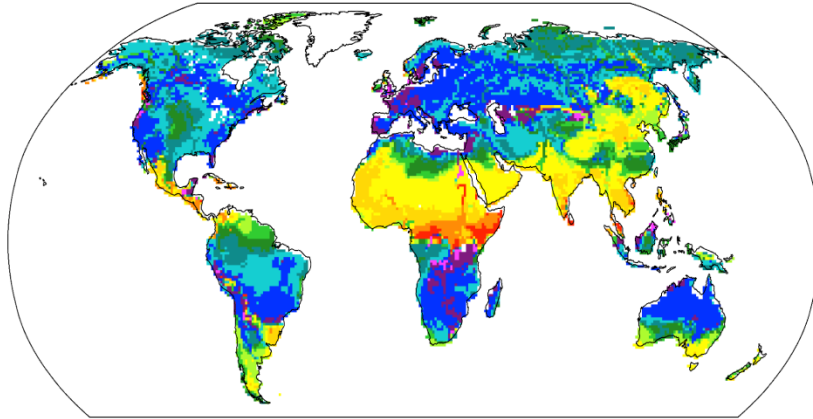
a) Month of maximum TWSA from GRACE-CSR



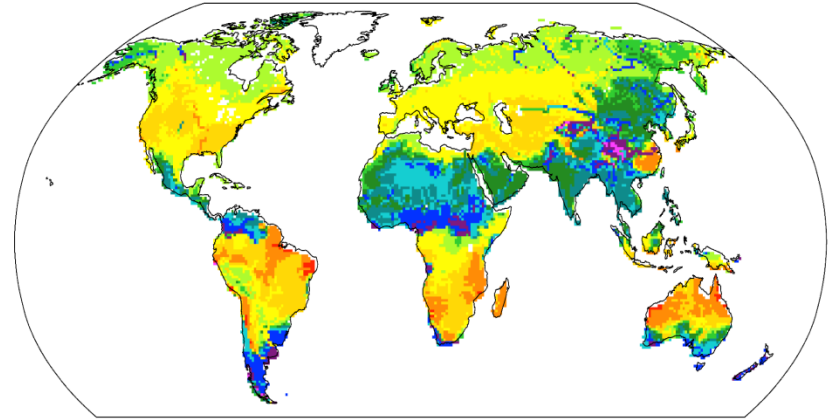
b) Month of minimum TWSA from GRACE-CSR



c) Month of maximum TWSA from CESM-LE



d) Month of minimum TWSA from CESM-LE



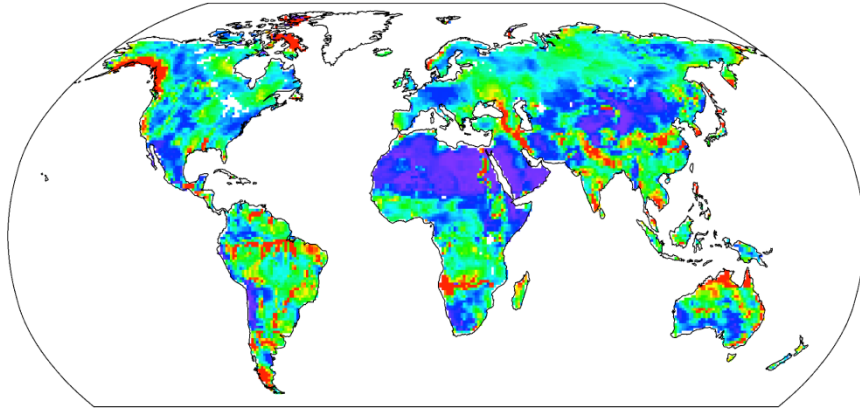
J F M A M J J A S O N D



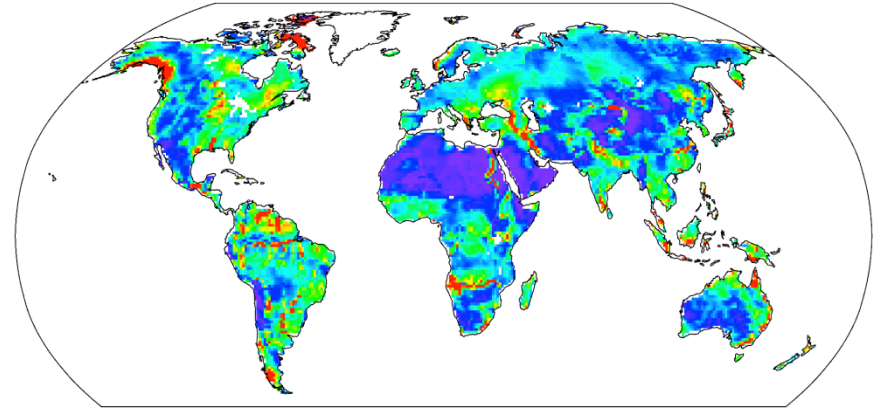
Month of year

Interannual variability in terrestrial water storage

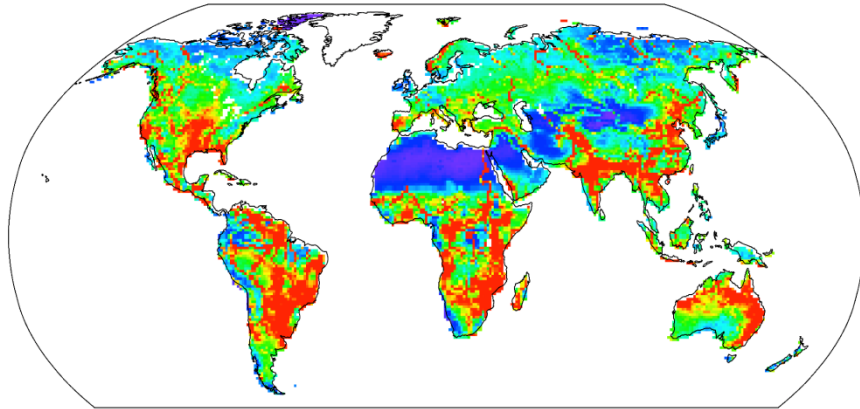
a) σ TWS_{max} (GRACE)



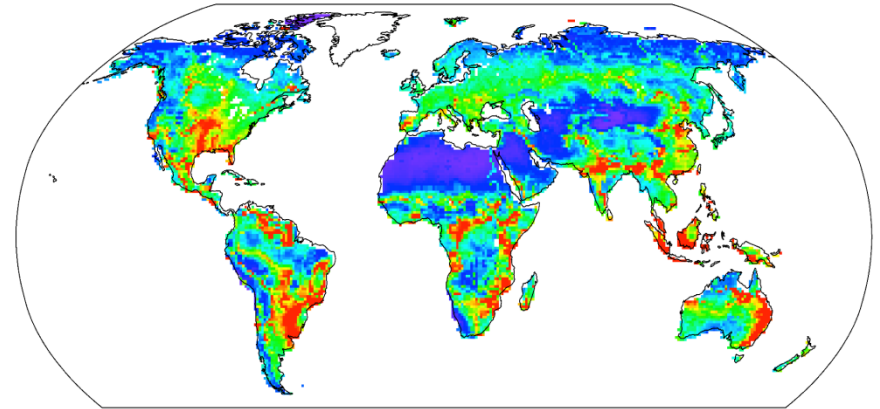
b) σ TWS_{min} (GRACE)



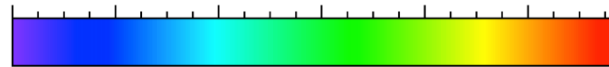
c) σ TWS_{max} (CESM-LE μ)



d) σ TWS_{min} (CESM-LE μ)



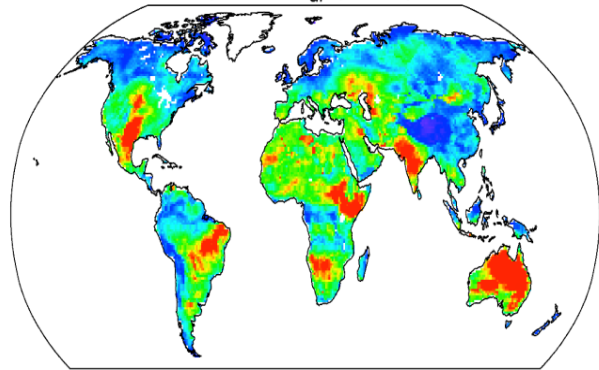
0 20 40 60 80 100



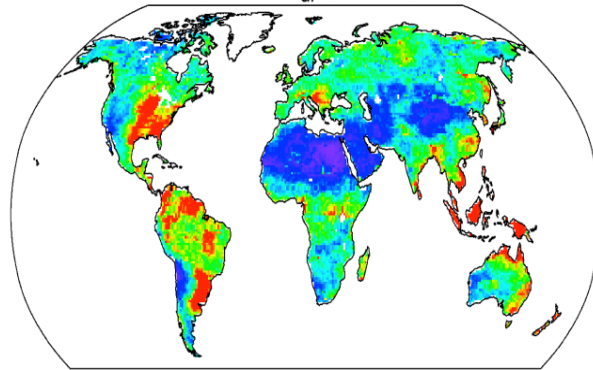
σ TWS_{min} (mm)

Interannual variability in atmospheric state during the drawdown interval

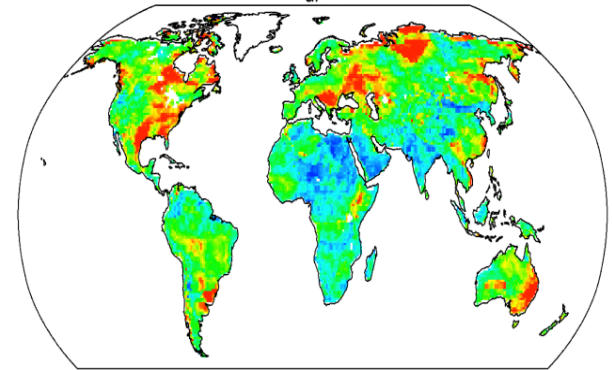
a) σ VPD_{di} (AIRS)



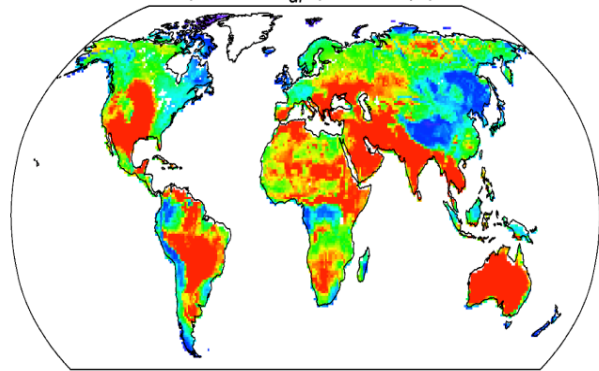
b) σ PPT_{di} (GPCP)



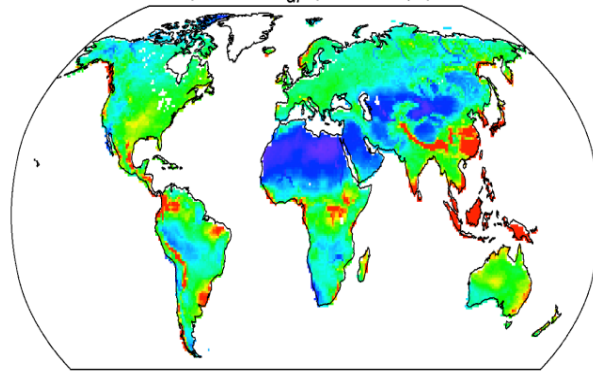
c) σ SWD_{di} (CERES)



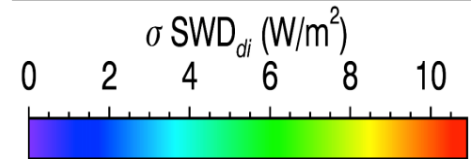
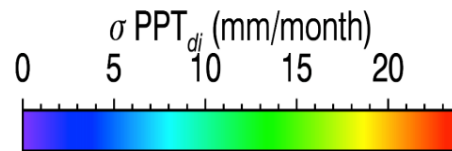
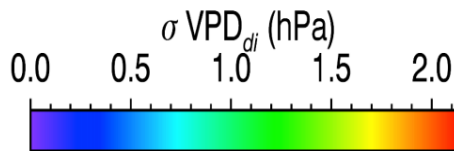
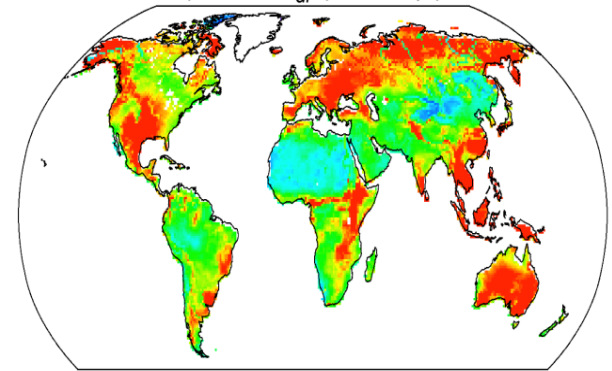
d) σ VPD_{di} (CESM μ)



e) σ PPT_{di} (CESM μ)



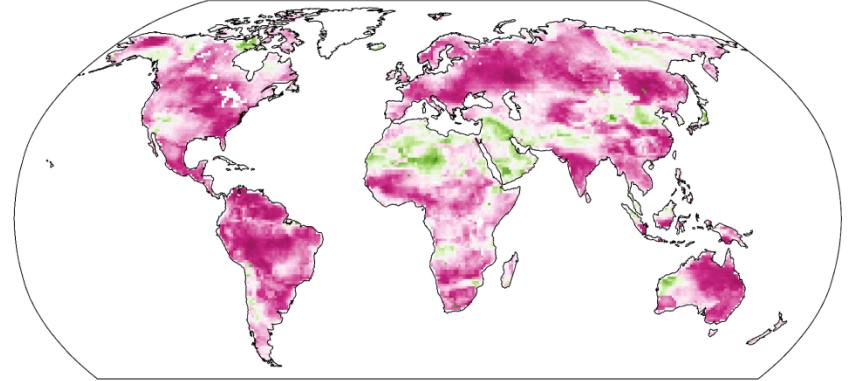
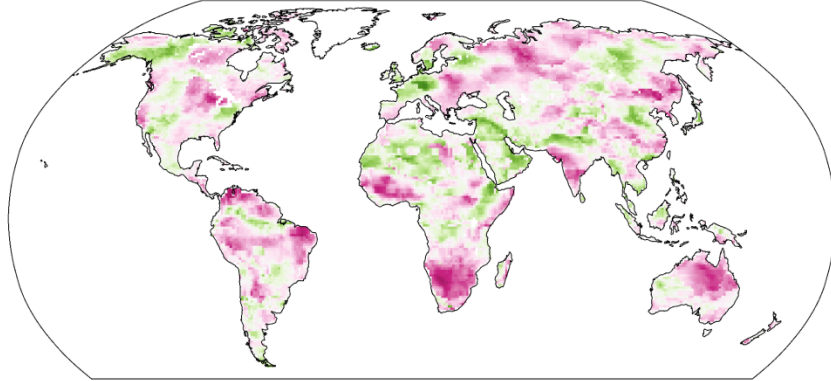
f) σ SWD_{di} (CESM μ)



Forcing and response metrics for VPD

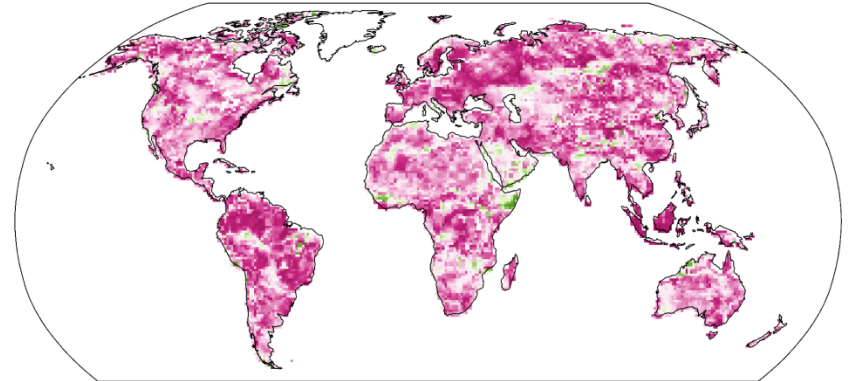
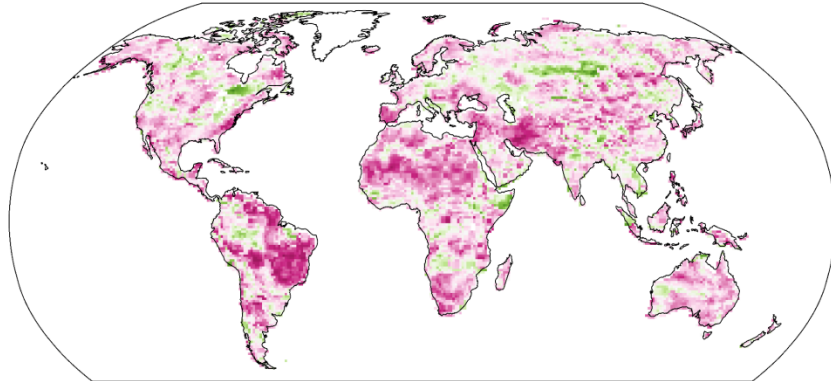
a) VPD forcing metric (GRACE-AIRS)

b) VPD response metric (GRACE-AIRS)



c) VPD forcing metric (CESM-LE 001)

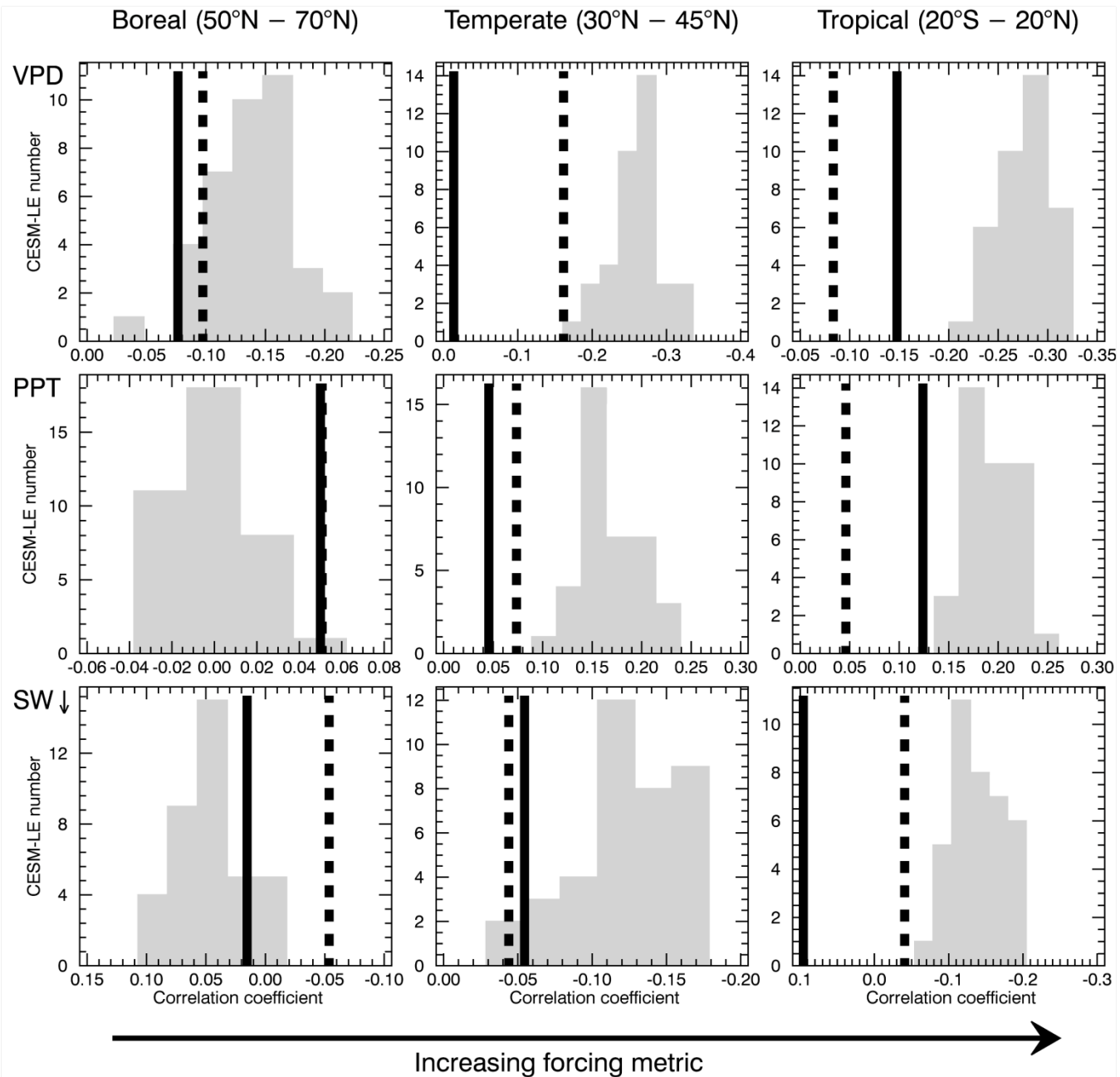
d) VPD response metric (CESM-LE 001)

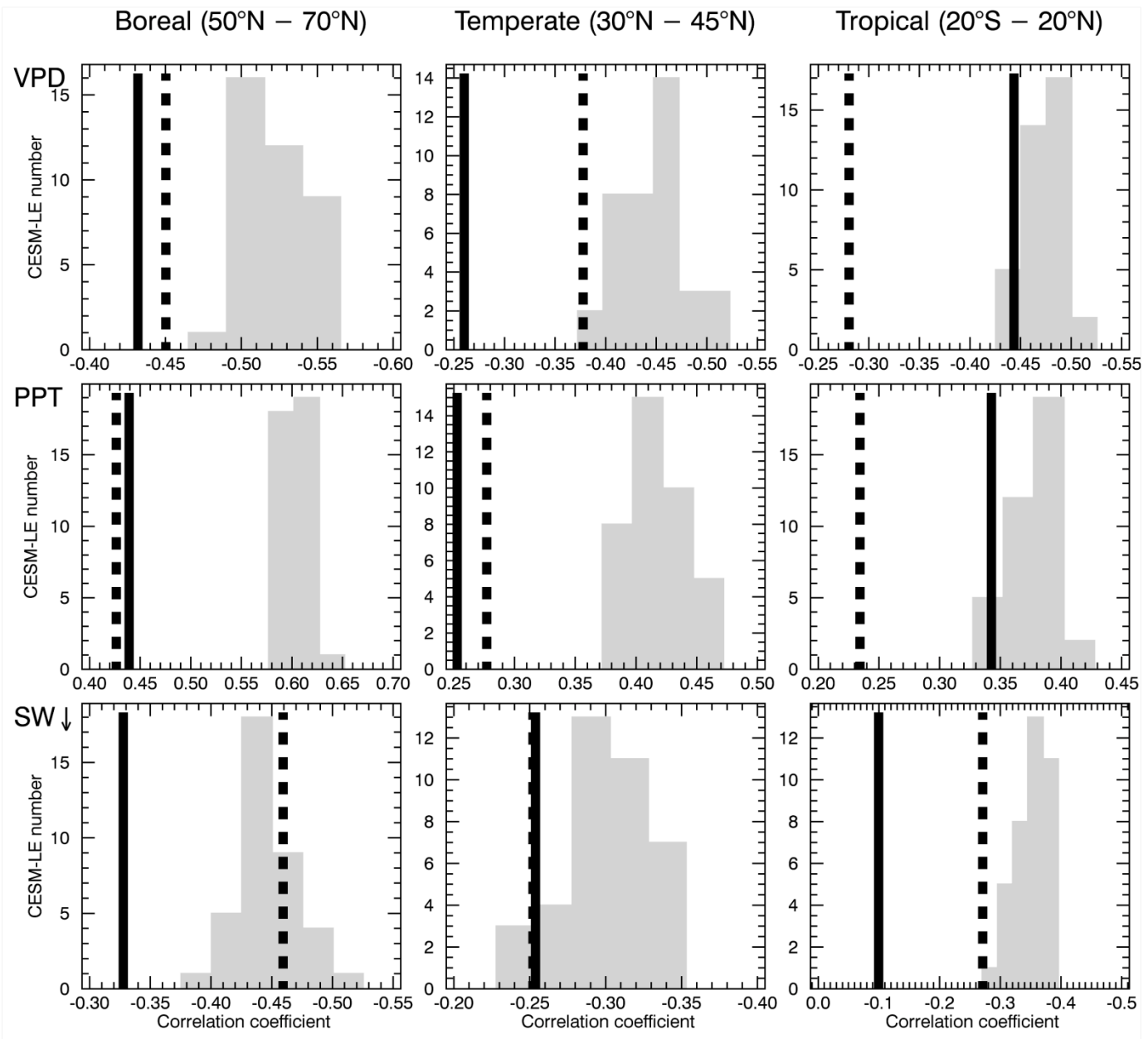


-1.0 -0.5 0.0 0.5 1.0

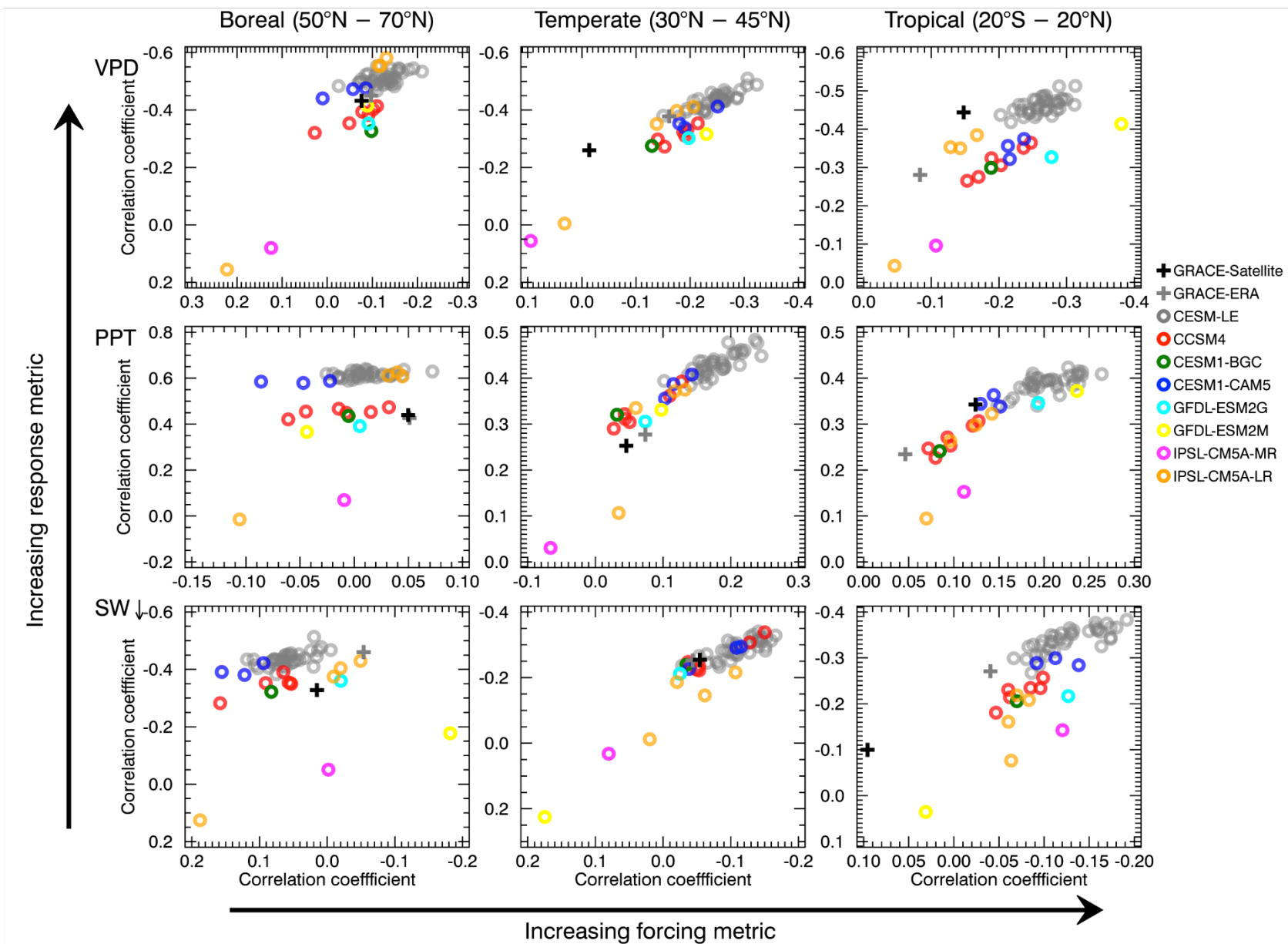


Correlation coefficient





Increasing response metric



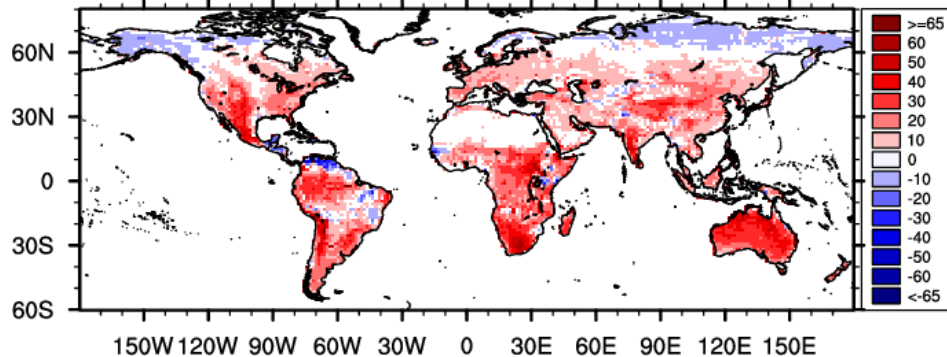
Findings I

- CESM1 and many CMIP5 ESMs may have stronger land-atmosphere coupling than the observations on the seasonal-interannual time scales examined here
- Why?
 - Canopy interception and drizzle may yield ET that is too high
 - Landscape heterogeneity, bare soil coupling with runoff too small
 - Stomatal conductance coupling with VPD too strong
 - Subsurface drainage too slow
- Implications
 - Coupling between drought and heat waves may be too strong in the models
 - Projections of land surface warming during the 21st century from the multi-model mean may be too high

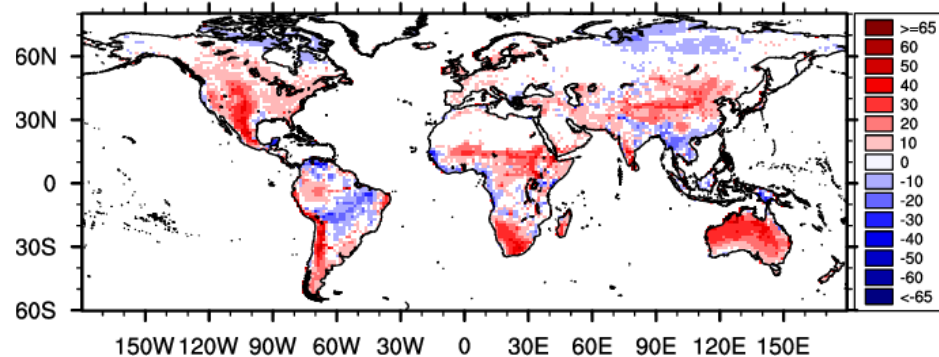
Findings II

- ET fluxes are in closer agreement with observations in CESM1.5

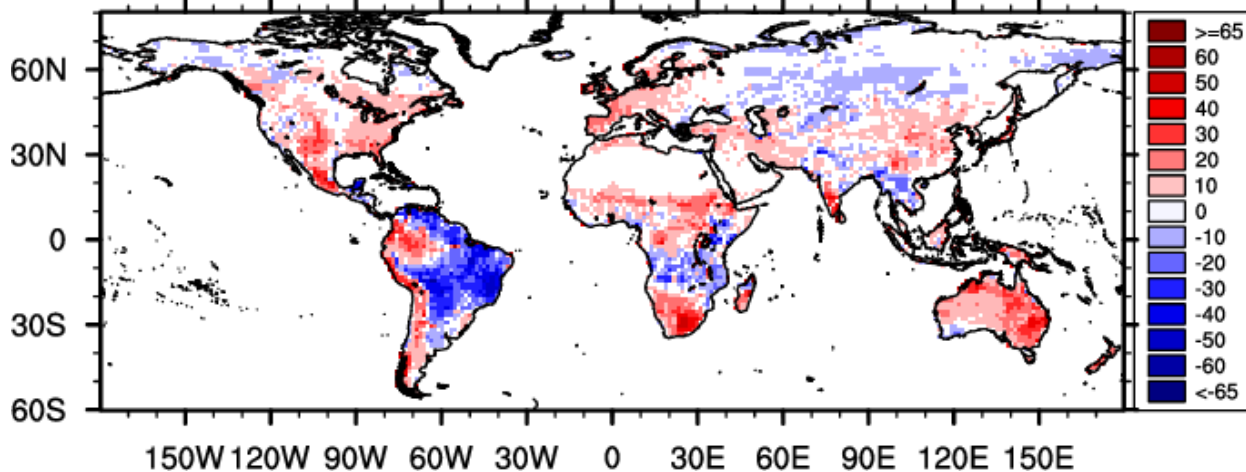
Bias for LE (W/m²): CESM1-BGC against FLUXNET-MTE, 1982-2005



Bias for LE (W/m²): cesm1_2bgc against FLUXNET-MTE, 1982-2005



Bias for LE (W/m²): cesm15_28 against FLUXNET-MTE, 1982-2005

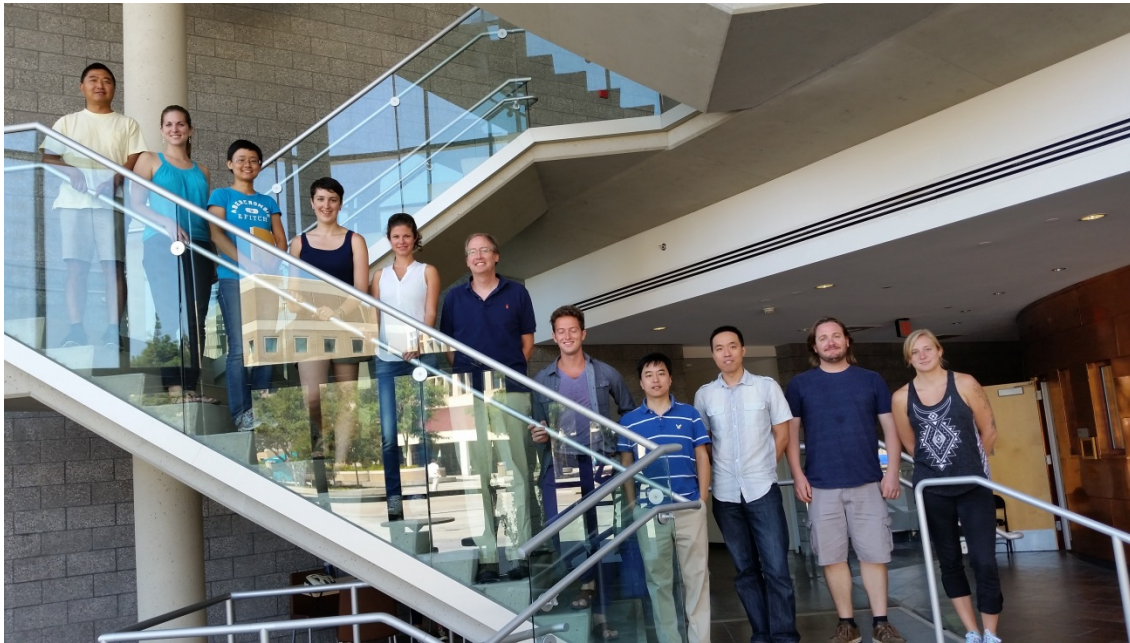


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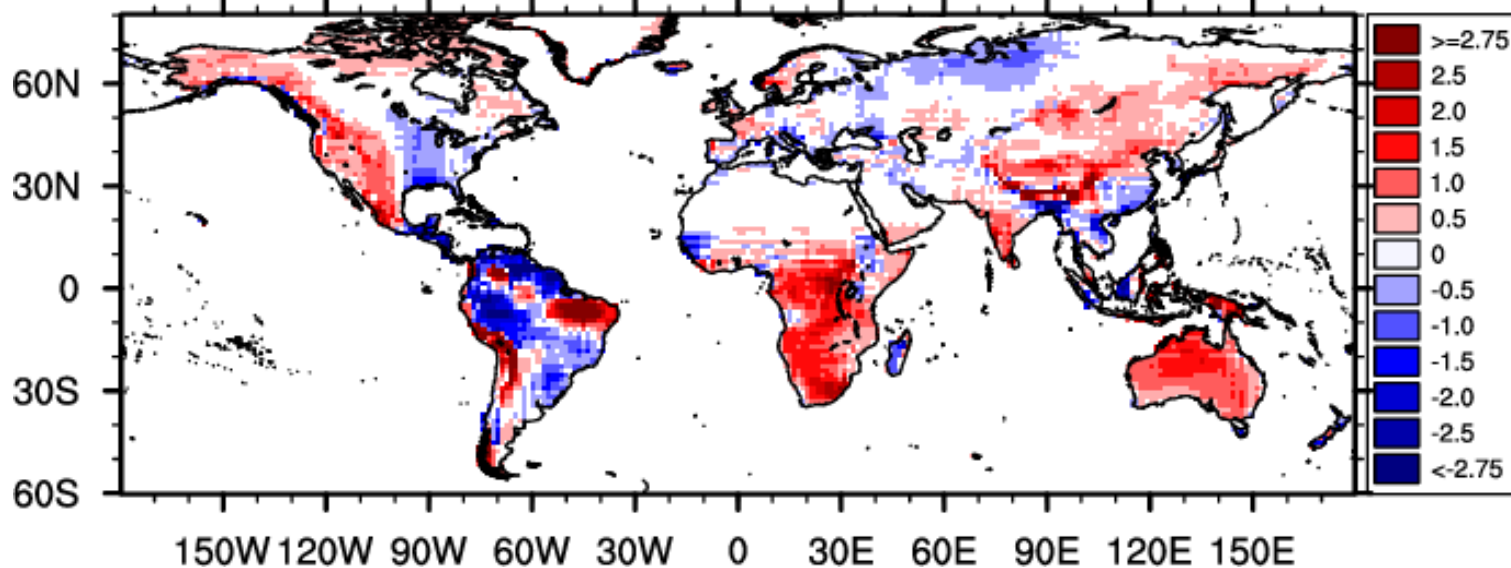
<http://sites.uci.edu/randersonlab/>



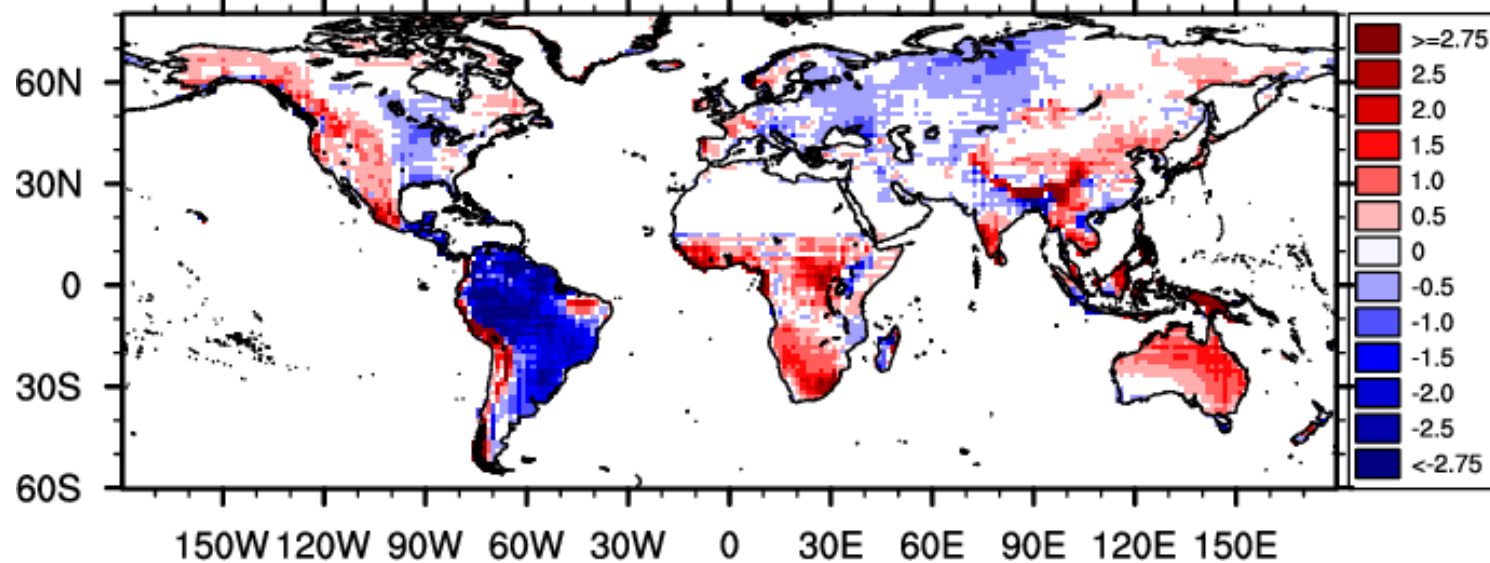
Funding support from DOE Office of Science Biological and Environmental Research to the Biogeochemical Cycles Feedbacks Project, the National Science Foundation, NASA, and the Gordon and Betty Moore Foundation

Backup Slides

Bias for PR (mm/day): CESM1-BGC against GPCP2, 1980-2005



Bias for PR (mm/day): cesm15_28 against GPCP2, 1980-2005



Annual Mean for PR (mm/day): GPCP2, 1980-2005

