



Last millennium simulations at GISS including water isotopes

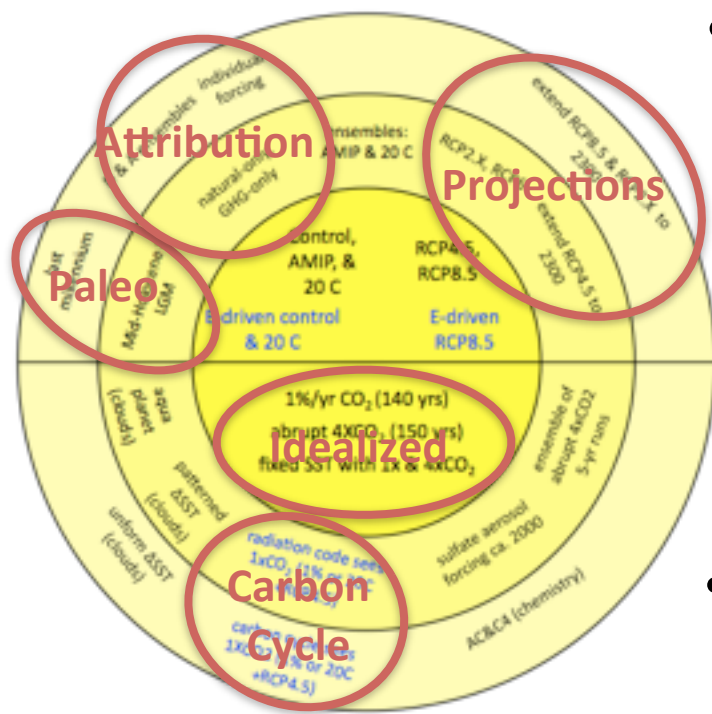
Presented by: Gavin Schmidt

Work done by: Allegra LeGrande +
Chris Colose



Goddard Institute for Space Studies

GISS Contributions to CMIP5

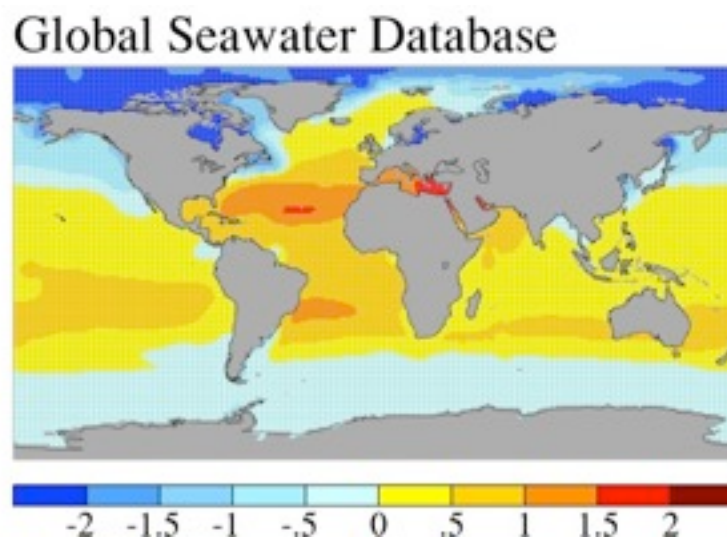
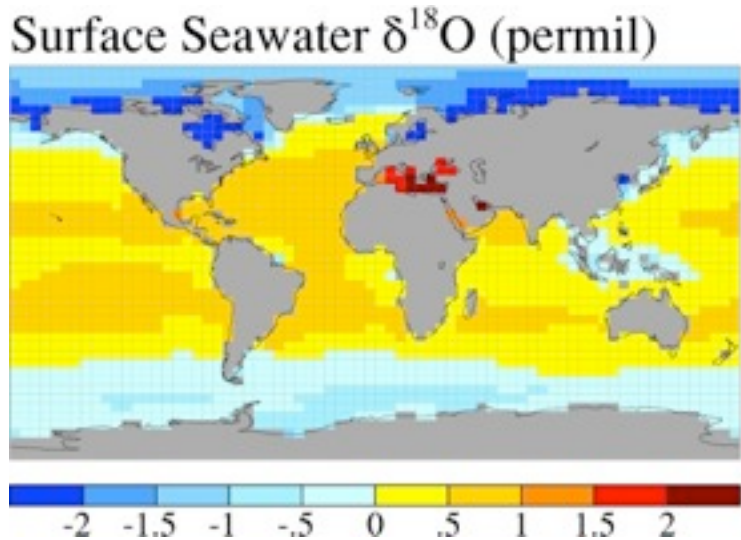
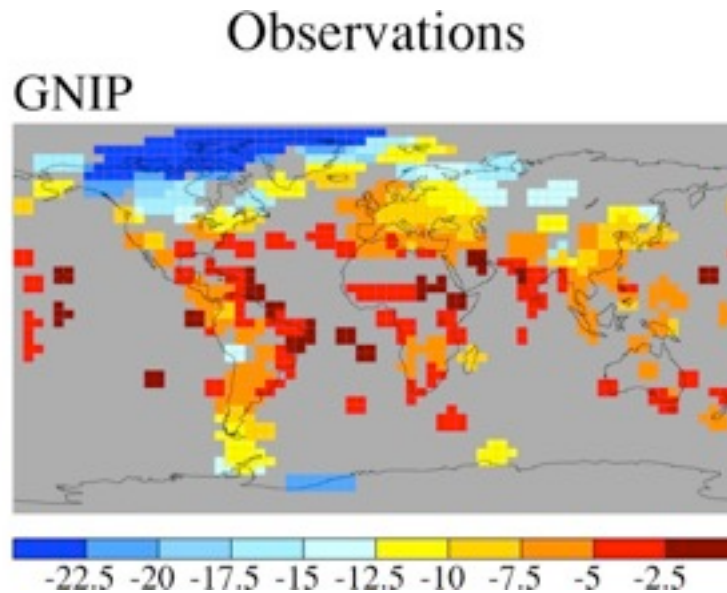
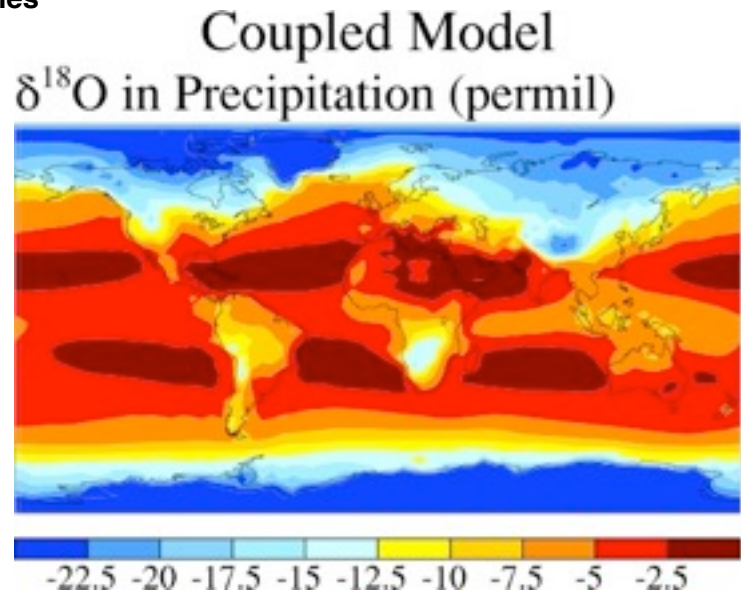


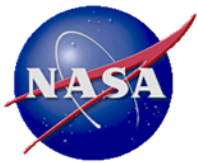
- 6 model configurations:
 - 2 oceans: Russell + HYCOM
 - 3 treatments of chem/aerosols/AIE
 - NINT: Non-INTERactive (tuned AIE)
 - TCAD: Tracers Chem/Aer/Direct Eff
 - TCADI: TCAD + first AIE
- 80,000+ model yrs; ~400 distinct simulations
- ~70 TB contributed to archive (internally ~500 TB)
- Extensive ensembles: forcings + IC



Coupled water isotopes

Goddard Institute for Space Studies

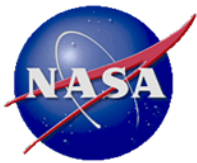




GISS past1000 ensemble

Goddard Institute for
Space Studies

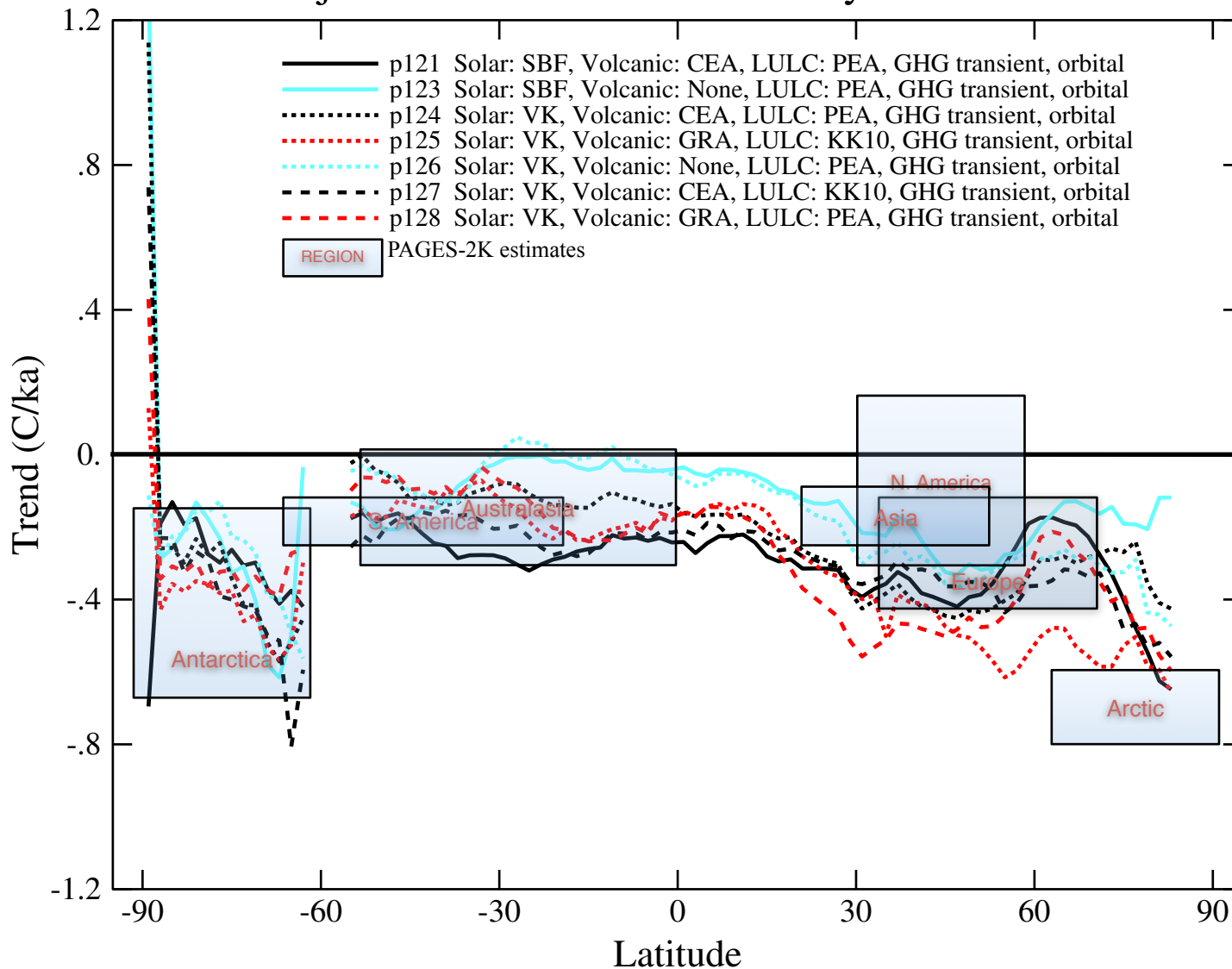
Run	Solar	Volcano	Crops	GHGs
E4rjh_850gy3	SBF(850)	CR(mean)	P(850)	850
E4rhLMhC	SBF(850)	CR(mean)	P(850)	850
E4rhLMgTcs	SBF	CR	P	Transient
E4rhLMgTgs	SBF	GRAx2	P	Transient
E4rhLMgTck	VK	CR	P	Transient
E4rhLMgTck	VK	CR	P	Transient
E4rhLMgTgk	VK	GRAx2	P	Transient
E4rhLMgTKck	VK	CR	K	Transient
E4rhLMgTKgk	VK	GRAx2	K	Transient
E4rhLMgTs	SBF	None	P	Transient
E4rhLMgTk	VK	None	P	Transient
E4rhLMgTKk	VK	None	K	Transient
E4rhLMgTnck	VK	None	None	Transient
E4rhLMgTncgk	VK	GRAx2	None	Transient
E4rhLMgTnckk	VK	CR	None	Transient

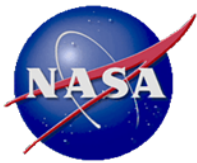


Regional trends: GISS-E2 Models

Goddard Institute for Space Studies

Drift-Adjusted Zonal Mean Land-Only trends 1000-1850

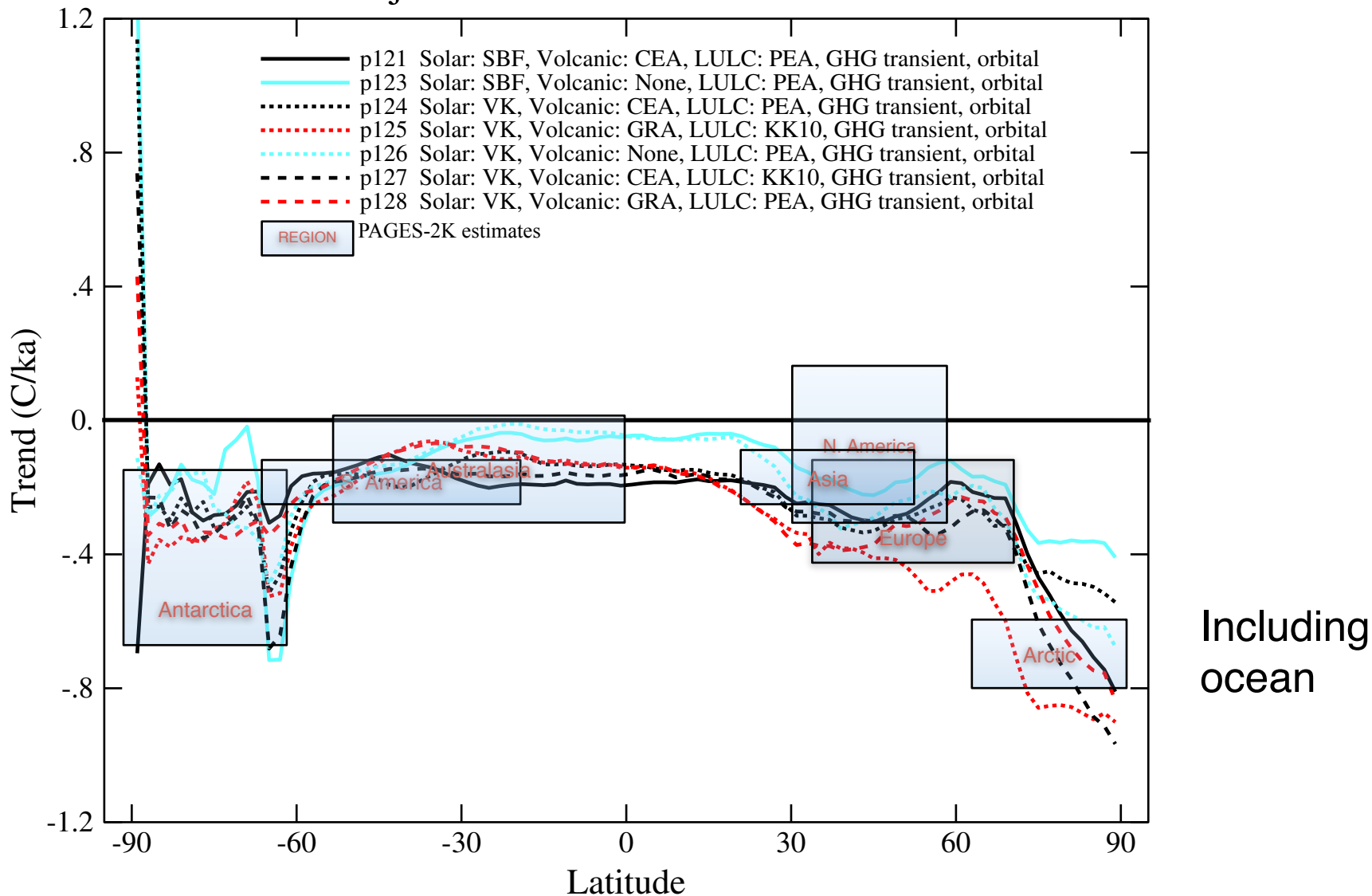




Regional trends: GISS-E2 Models

Goddard Institute for Space Studies

Drift-Adjusted Zonal Mean trends 1000-1850

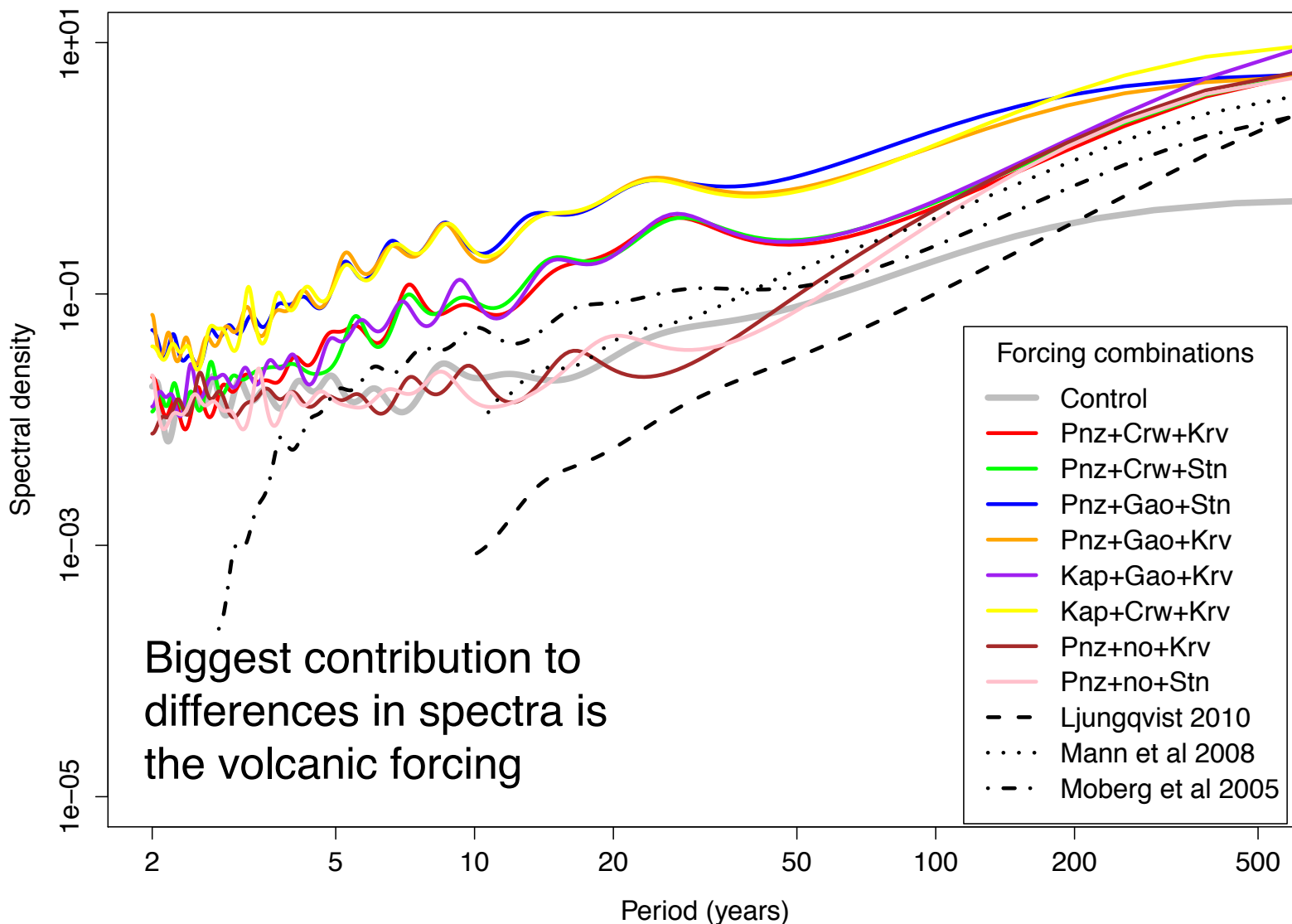


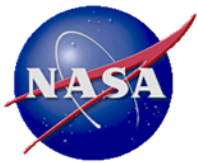


Spectral estimates: GISS-E2 Model

Goddard Institute for Space Studies

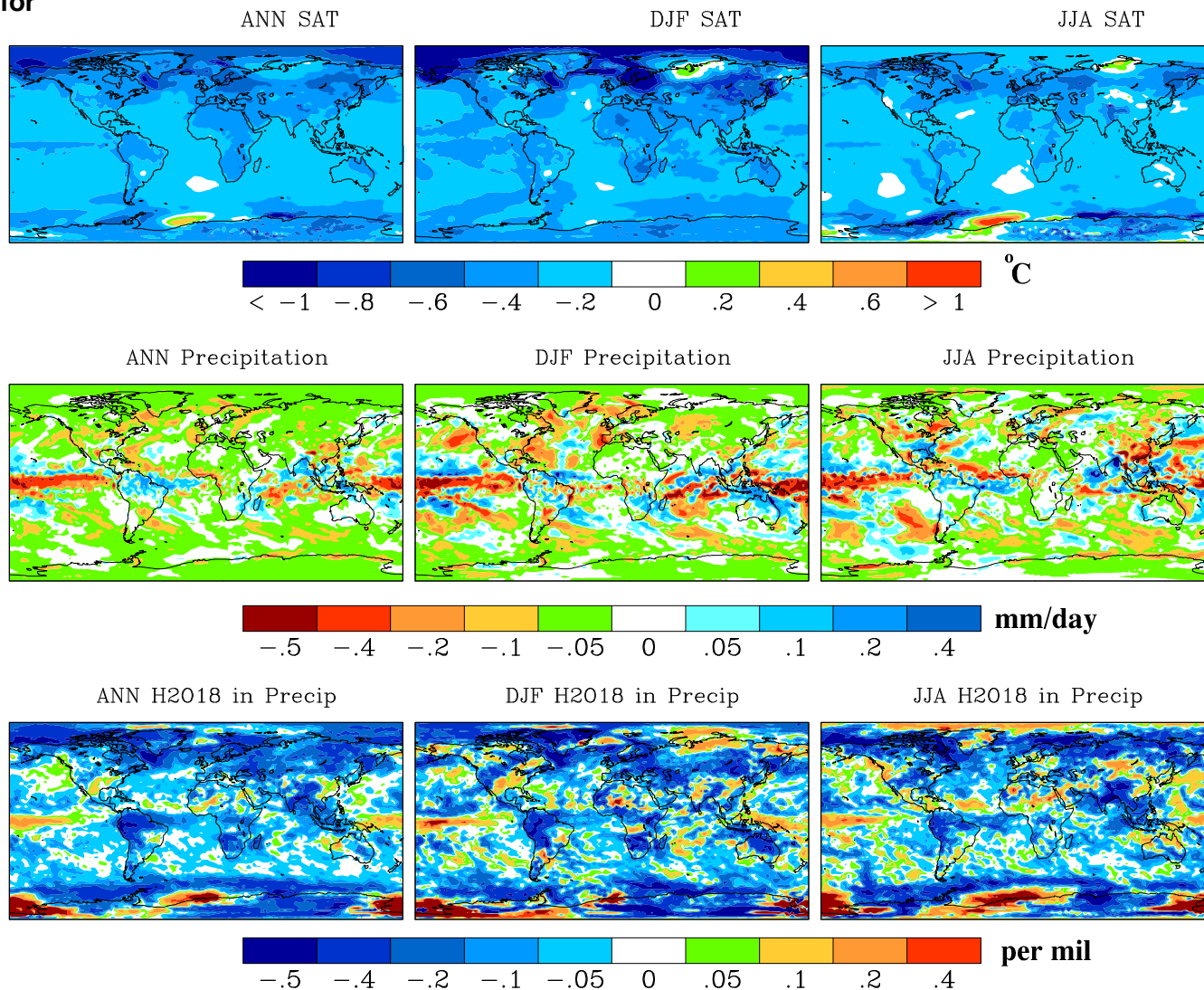
Spectra of NH Land Surface Temperatures for the Last Millennium



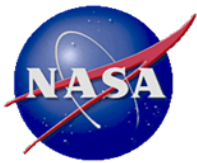


Goddard Institute for Space Studies

LIA-MWP differences in T, P, $d^{18}O_p$

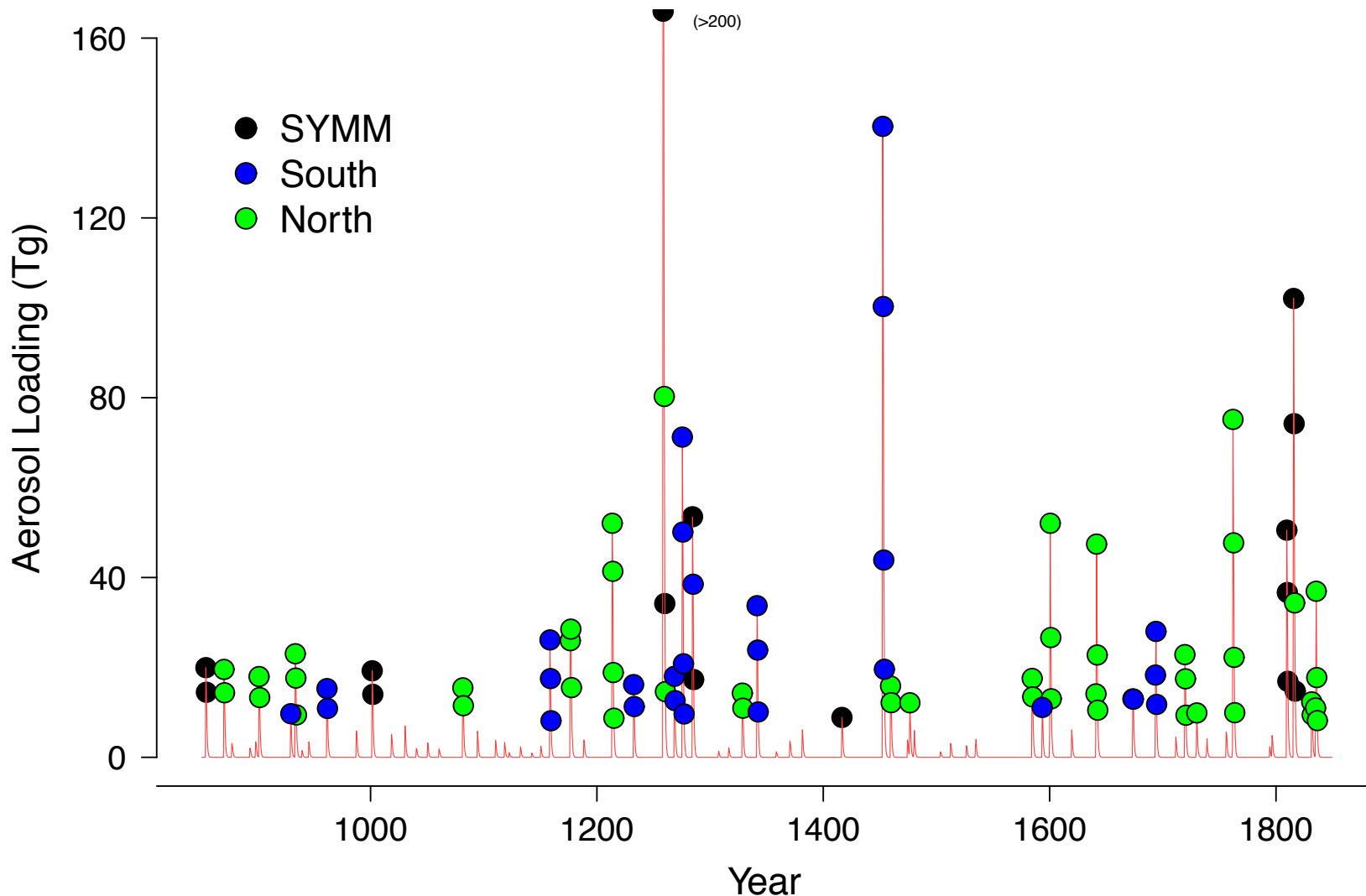


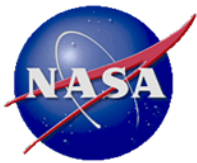
LIA=1600-1730 AD
MWP=1000-1200 AD



Goddard Institute for Space Studies

Most volcanoes in Last Millennium exhibit hemispheric asymmetry

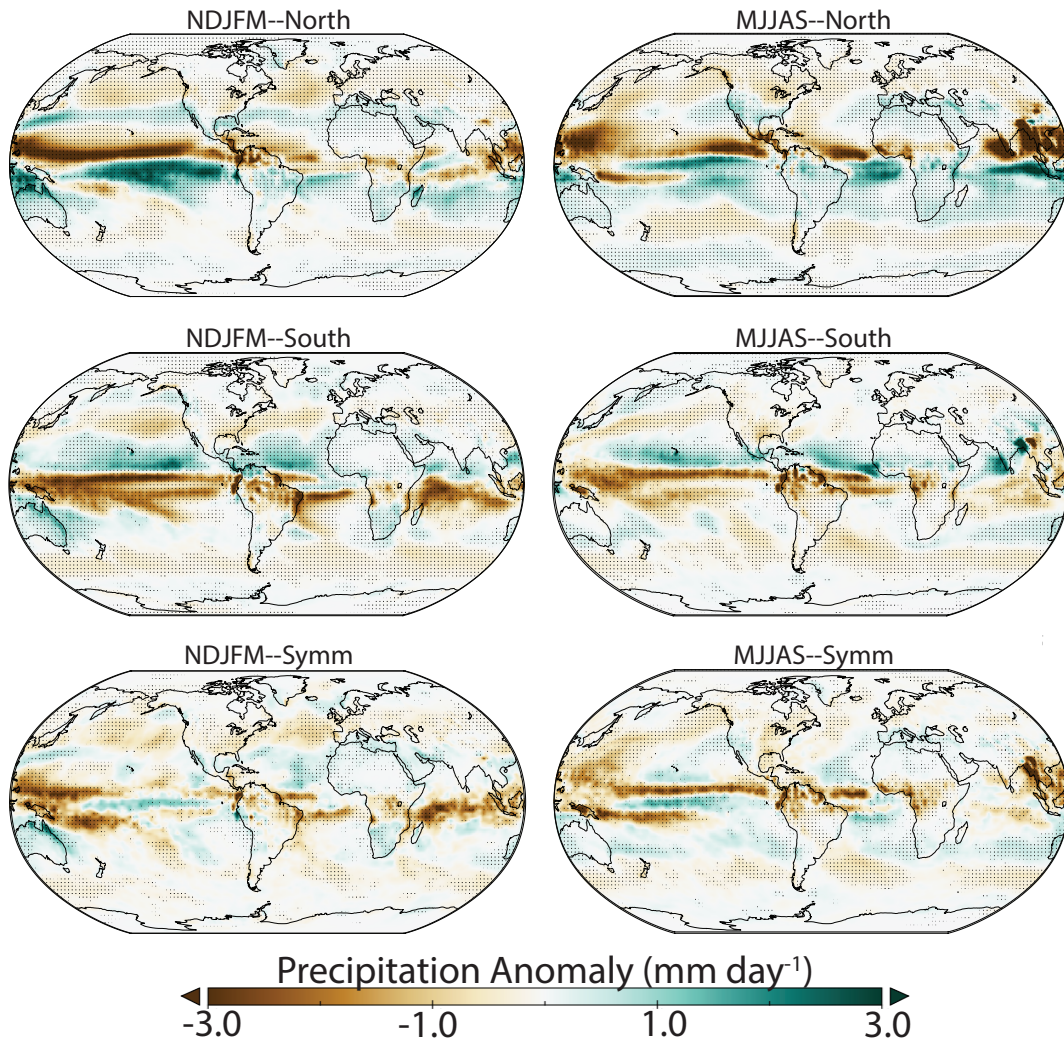




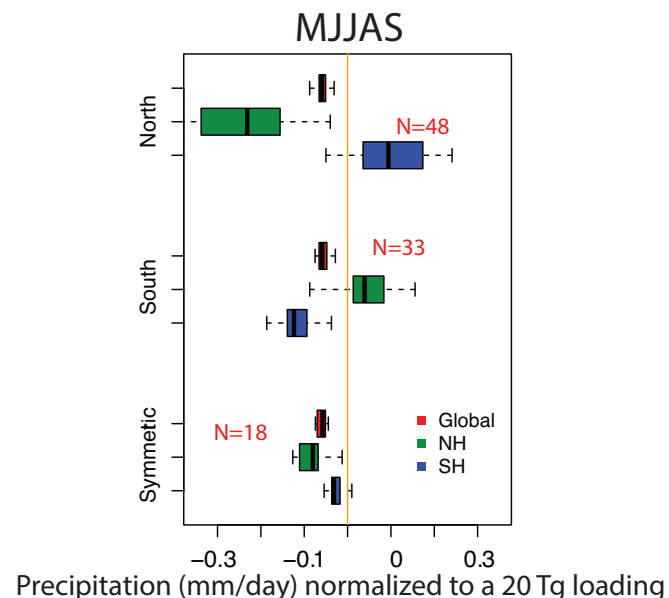
Precipitation response varies by NH/SH

Goddard Institute for Space Studies

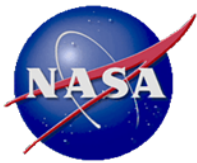
Precipitation (Ensemble/Event Mean)



Pronounced ITCZ shift away from forced hemisphere. Increase in 'other' hemisphere precipitation.



Colose et al. (2016, ESDD)

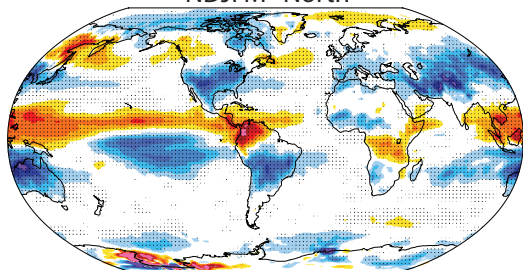


Water isotope fingerprint?

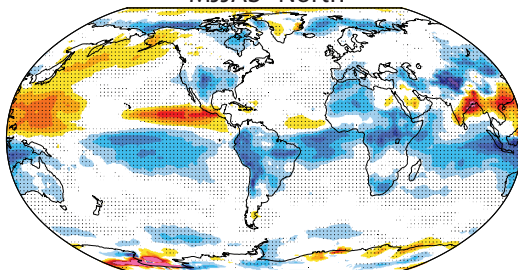
Goddard Institute for Space Studies

GISS $\delta^{18}\text{O}_p$ (Ensemble/Event Mean)

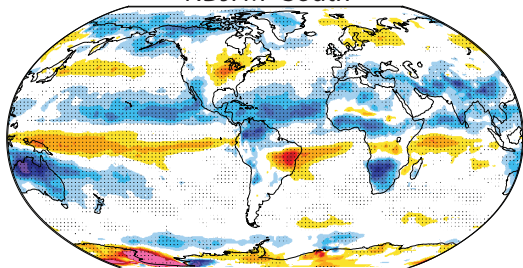
NDJFM--North



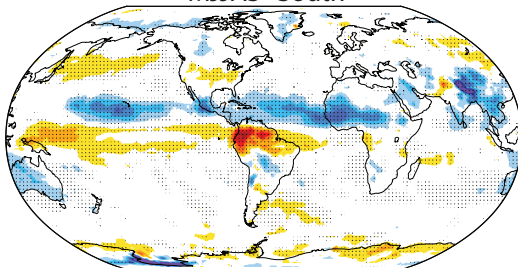
MJJAS--North



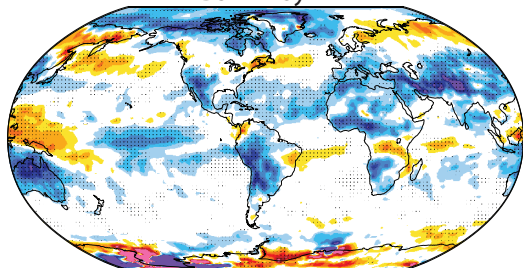
NDJFM--South



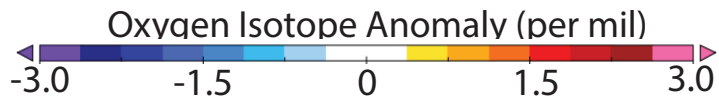
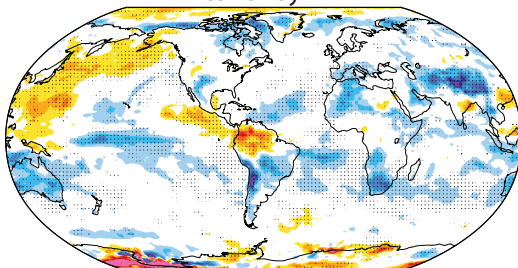
MJJAS--South



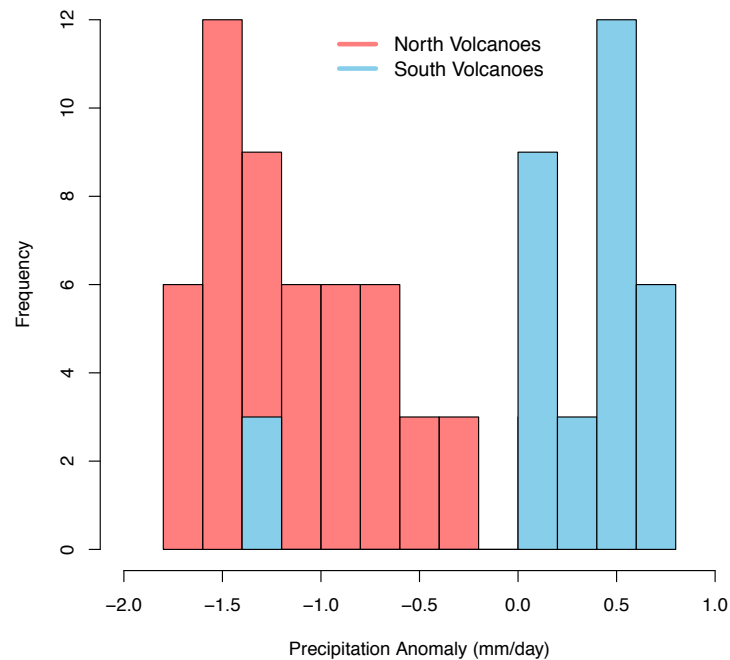
NDJFM--Symm



MJJAS--Symm



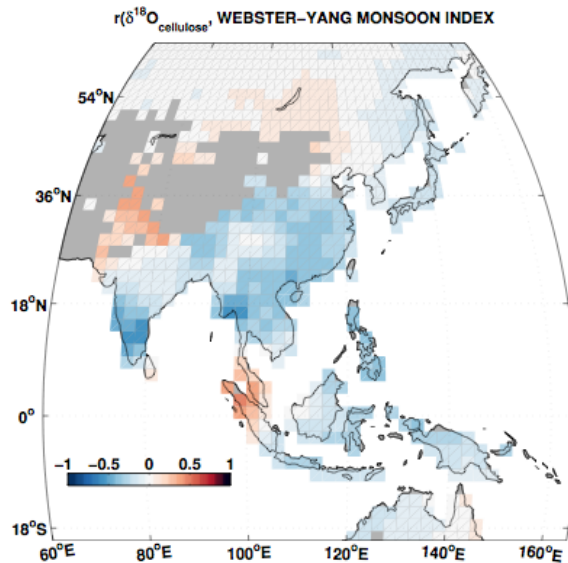
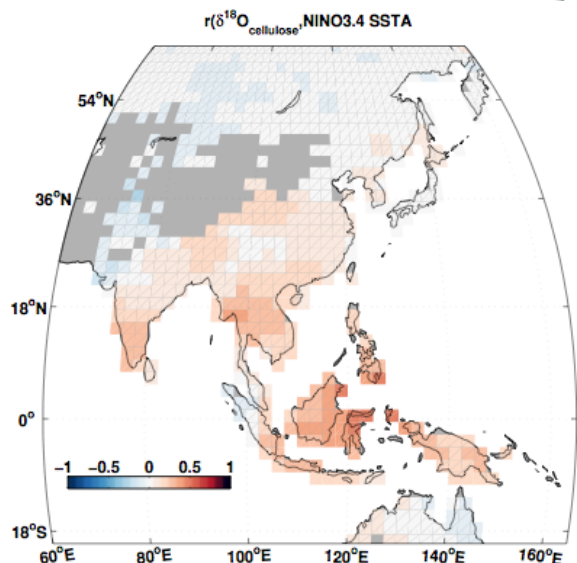
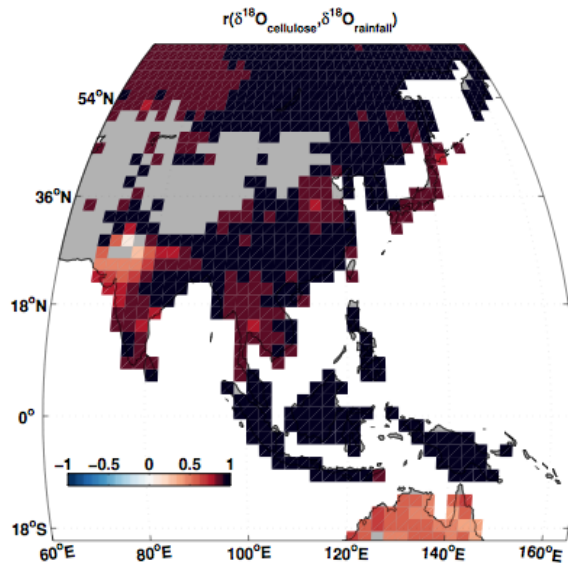
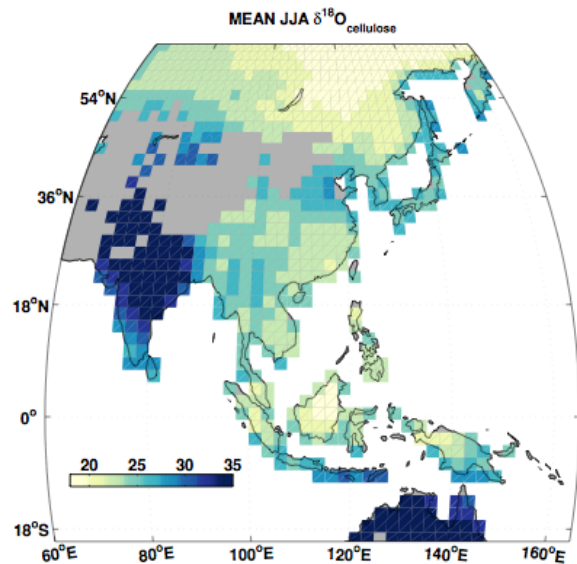
MJJAS East Asian Monsoon sector





Goddard Institute for
Space Studies

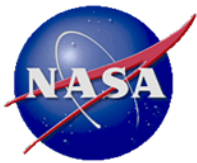
Forward modeling of $\delta^{18}\text{O}_{\text{cellulose}}$?



Simple forward
model of tree
cellulose growth.

High correlation to
 $\delta^{18}\text{O}_{\text{precip}}$, ENSO
index in West Pacific
and Webster-Yang
Monsoon Index.

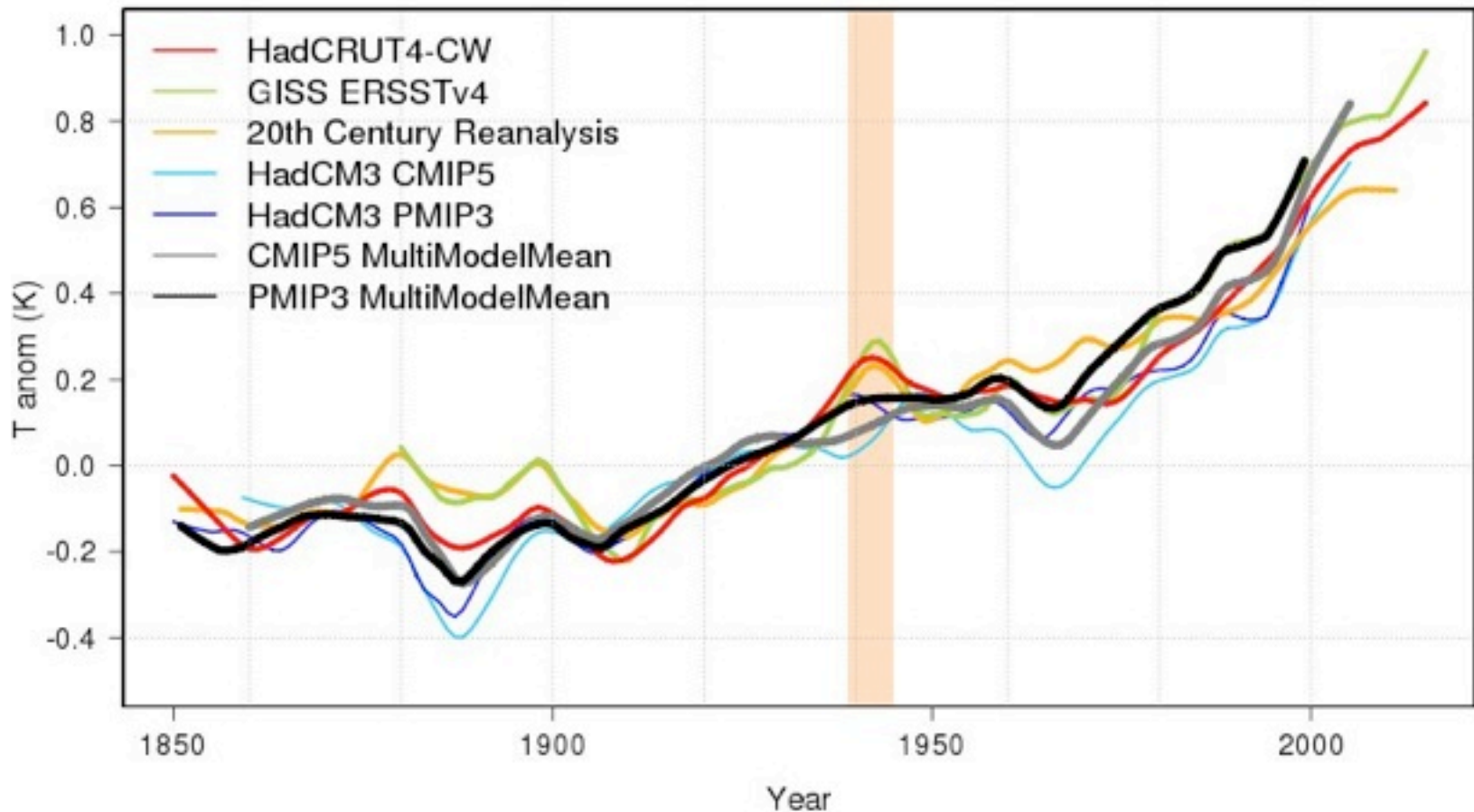
Mariel Herzog, Allegra LeGrande &
Kevin Anchukaitis



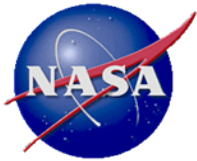
Goddard Institute for
Space Studies

Are the past1000 simulations different from historical runs after 1850?

PMIP3 Last1000 vs CMIP5 Historical vs OBS (1901-1950 baseline): Global



Graph via Twitter from Karsten Haustein @khaustein



Conclusions

Goddard Institute for
Space Studies

- LM simulations for CMIP5 were a whole new ball game:
Multi-model, Initial condition, Forcing ensembles
- Coherence with historical and future simulations
- Important uncertainties in all aspects:
Forcings, sensitivity, data/reconstructions
- Big potential for model/paleo-data comparisons to connect model skill and prediction uncertainty
- Improvements in CMIP6:
 - Volcanoes by emissions (not specified AOD)
 - Improved solar
 - Extended land-use (incl. irrigation)