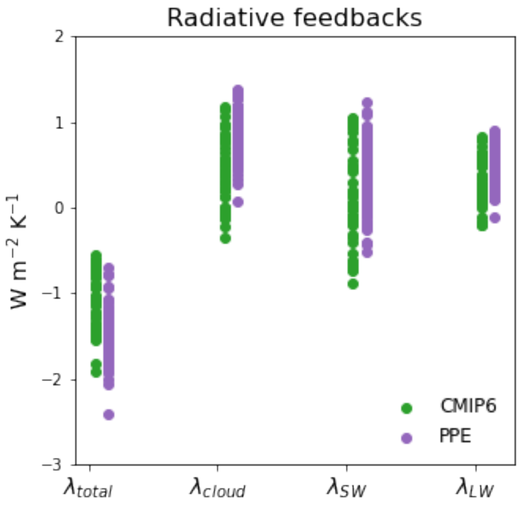
Investigating the spread in cloud-radiative feedbacks in a perturbed physics ensemble

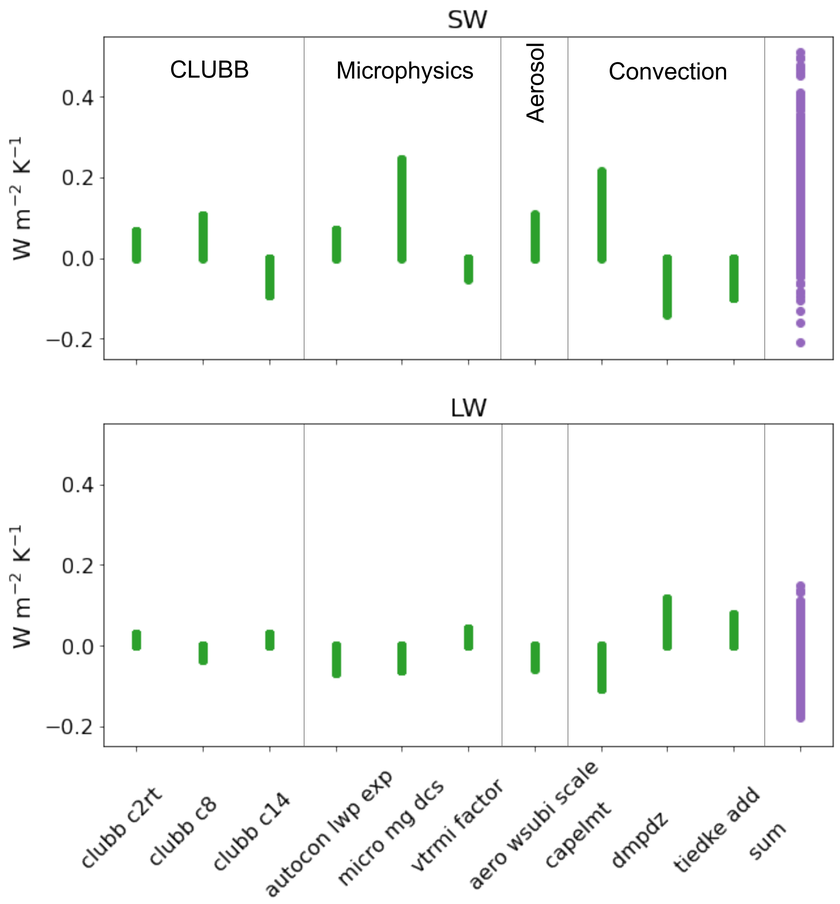
Margaret L. Duffy, Brian Medeiros, Andrew Gettelman, Trude Eidhammer
mlduffy@ucar.edu

Funded by NOAA MAPP Climate sensitivity taskforce

Cloud-radiative feedbacks dominate spread in total radiative feedbacks



Microphysics and convection scheme parameters contribute most to spread

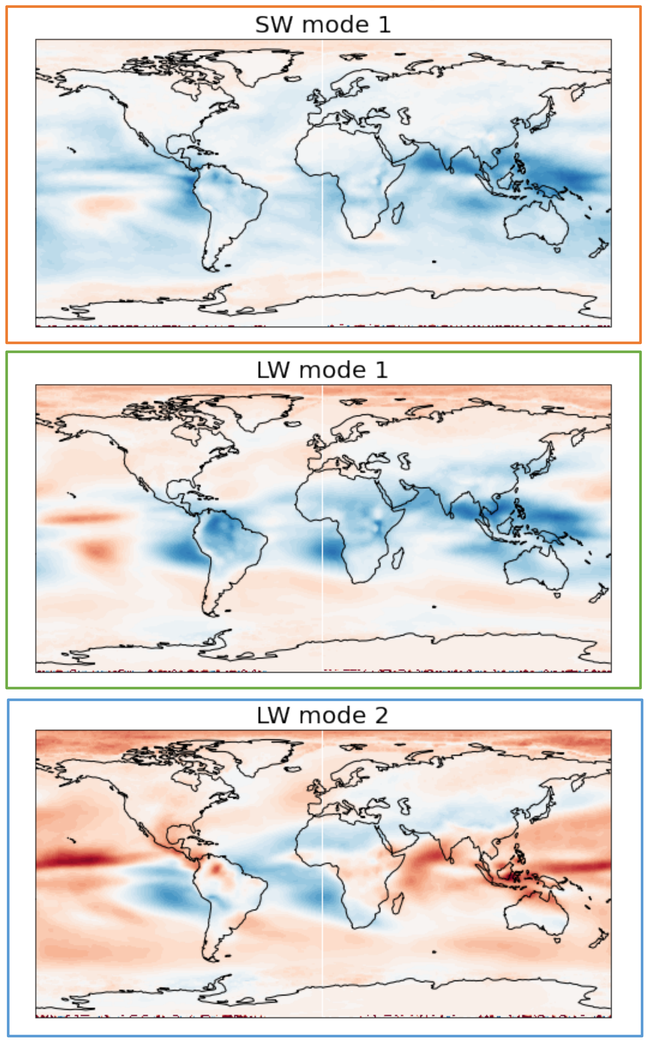


Abstract: The spread in cloud-radiative feedbacks across a perturbed physics ensemble (PPE) is substantial. We find that convection scheme and cloud microphysics parameters tend to have large contribution to the total spread in feedbacks. We further investigate this spread using an empirical orthogonal function (EOF) analysis, which reveals that the first mode of SW variability and first two modes of LW variability dominate the spread in total feedbacks. These modes of variability all represent tropical and subtropical behavior.

PPE experiments:

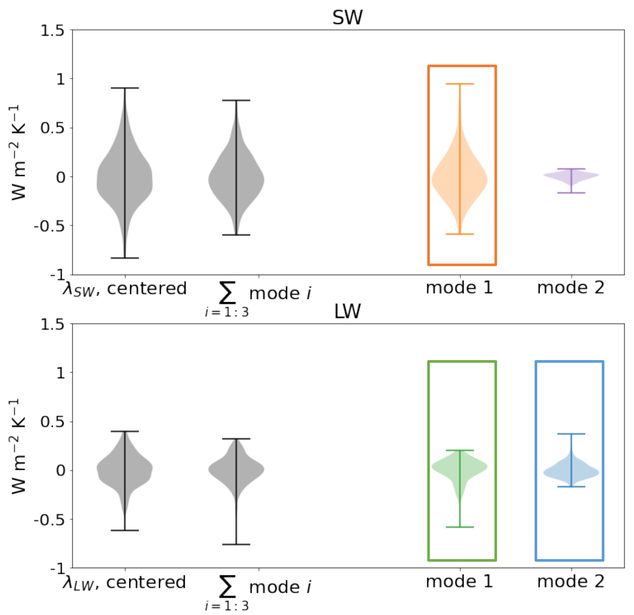
- CAM6 – atmosphere only
- Fixed SST
- 262 simulations
- 45 atmospheric parameters vary
- PD: Present day simulation
- SST4K: Uniform 4K warming simulation

Tropical and subtropical variability dominates spread



All three dominant modes are highly correlated with various ice and convection parameters

Parameter name	Description	SW 1	LW 1	LW 2
clubb c2rt	Damping on scalar variances		-0.25	
clubb c8	Coefficient in C8 skewness equation			-0.23
clubb c14	Constant for u'^2 and v'^2 terms	-0.24		
autocon lwp exp	Liquid water path exponent	0.21		-0.22
micro mg dcs	Ice-snow autoconversion size threshold	0.41		
vtrmi factor	Ice fall speed scaling		-0.42	-0.34
aero wsubi scale	Subgrid velocity for ice activation scaling	0.28	0.37	
capelmt	Triggering threshold for convection	0.35	0.30	-0.21
dmpdz	Convective entrainment parameter	-0.32	-0.30	0.26
tiedke add	Convective parcel temperature perturbation			0.31



Spread in SW feedbacks dominated by first mode of variability

Spread in LW feedbacks dominated by first two modes of variability

SW mode is dominated by changes in scattering

1st LW mode is correlated with PD topical cloud ice

2nd LW mode is correlated with PD NH Hadley circ strength