

# Perturbed parameter experiments with CESM2

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# CESM2 on a shoestring budget

10x10 degree land/atmosphere CAM6, CLM5

Slab ocean model

40 years per day on 24 CPUs [100 times faster than FV1]

Preliminary ensemble - 60x20 year simulations@NERSC

# Sampling the CAM6 parameter space

Latin hypercube sample of 37 parameters in:

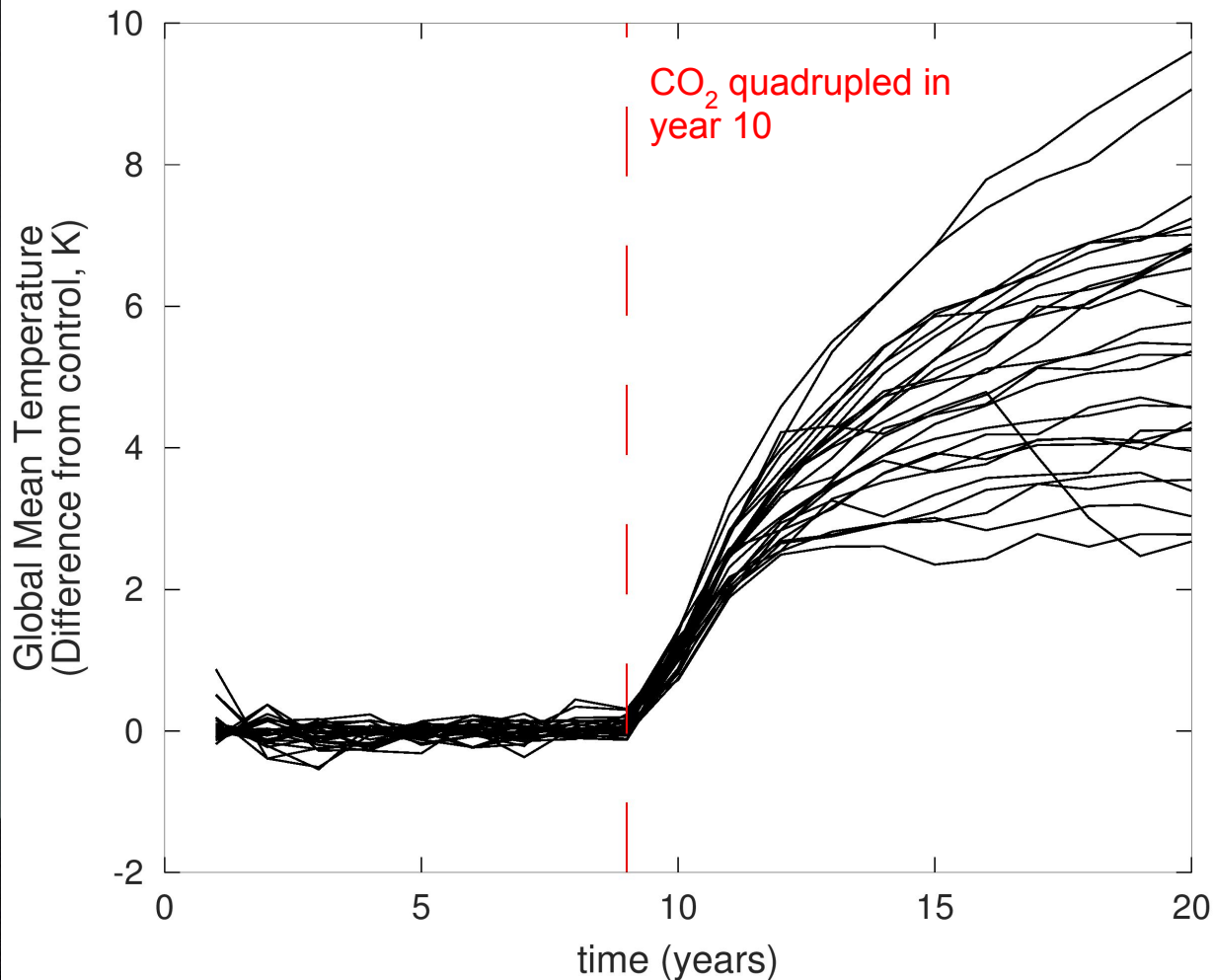
MG2 microphysics

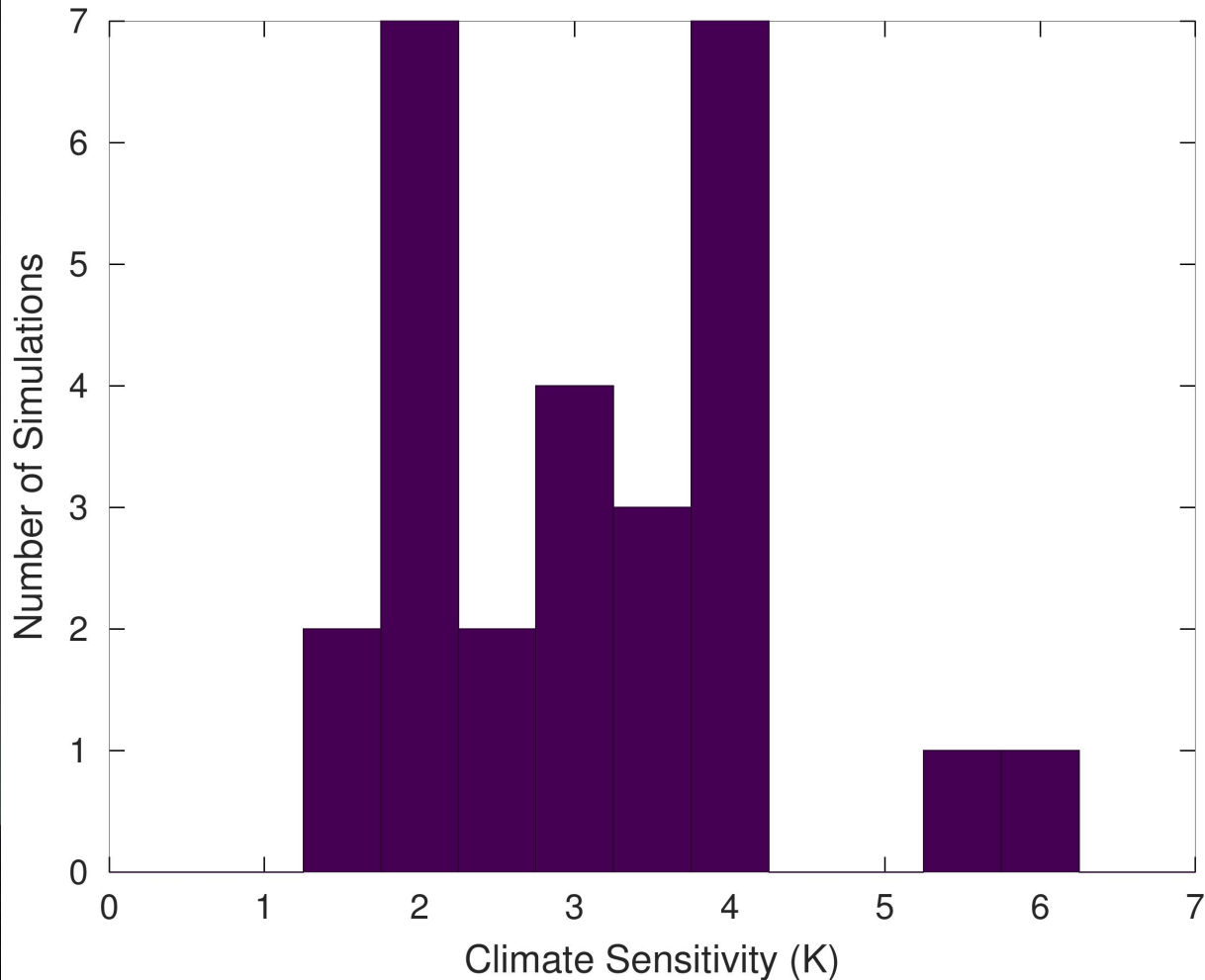
MAM4 aerosol scheme

CLUBB moist turbulence and cloud macrophysics

# CO<sub>2</sub> quadrupling experiments

- 33 simulations were successful (27 crashed)
- Slab equilibration drift removed



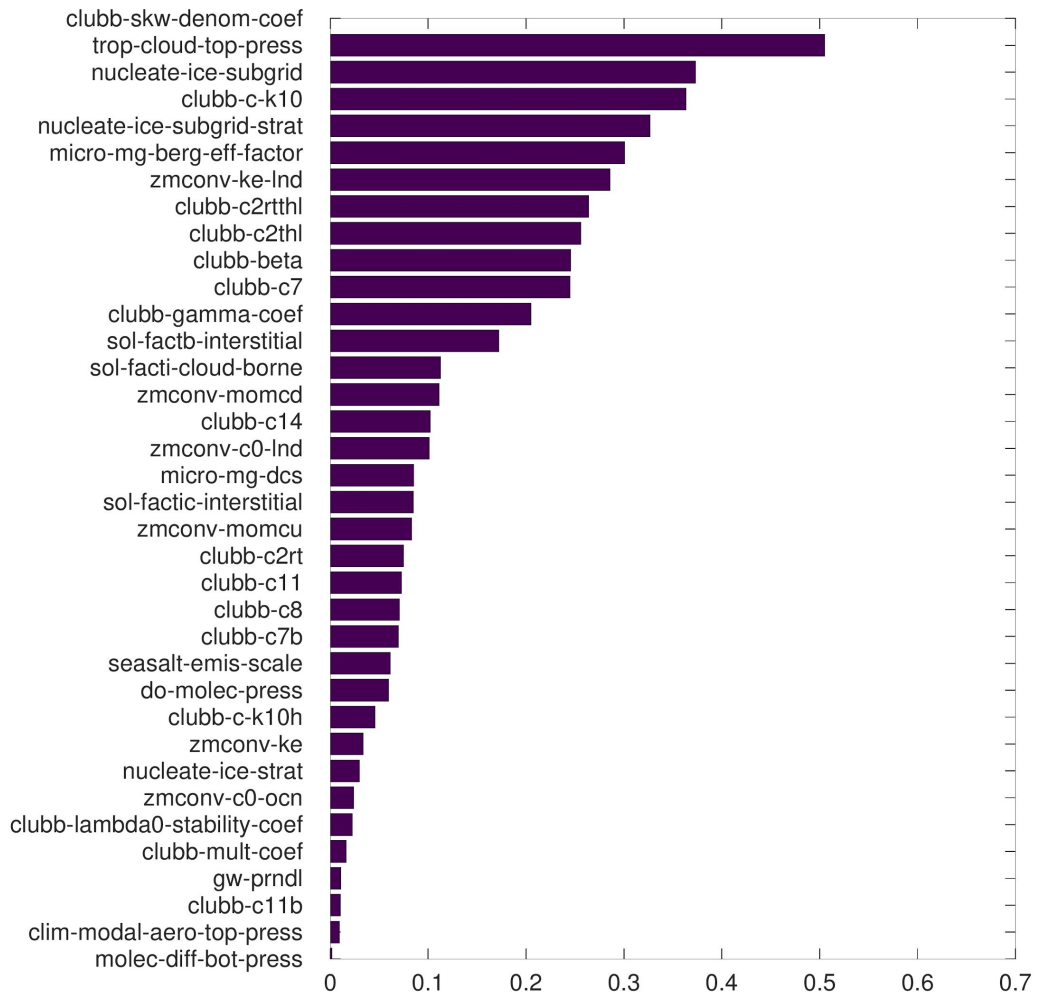


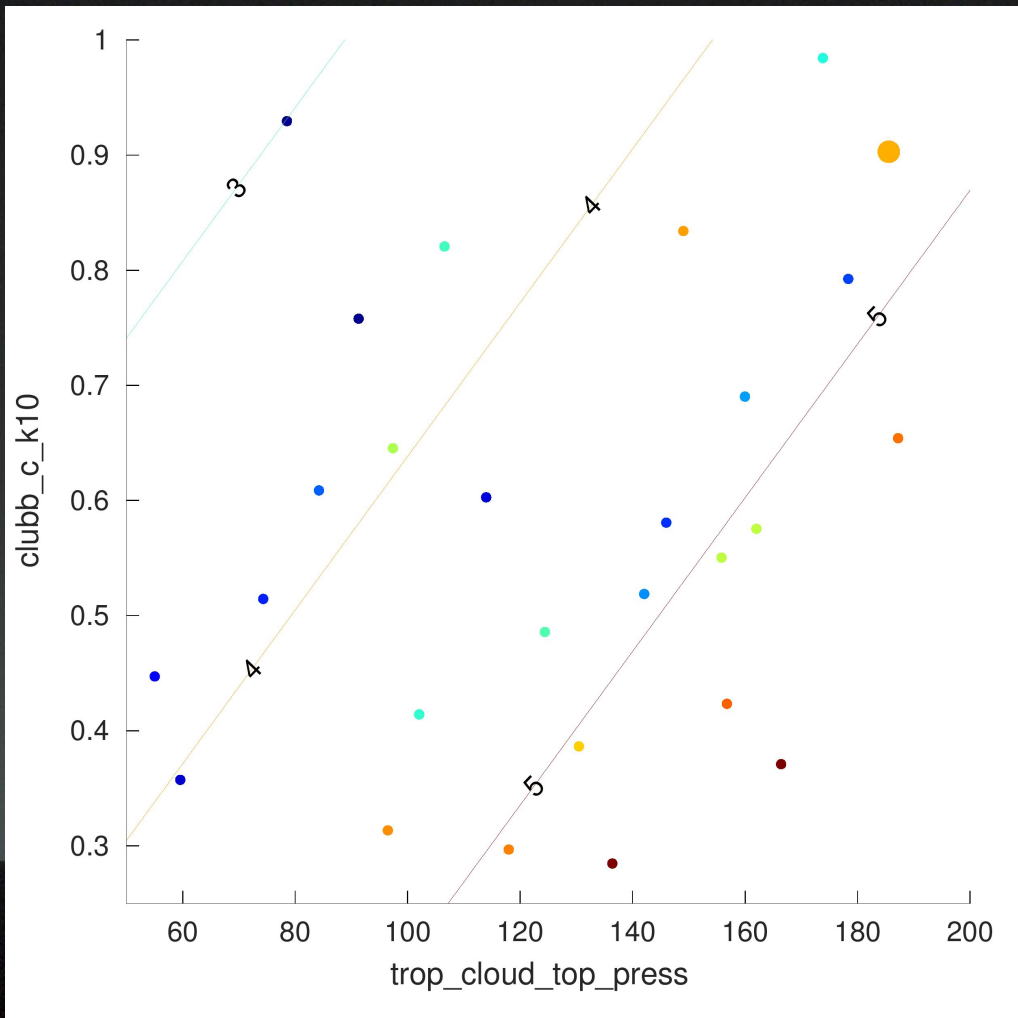
## Climate sensitivity range

- CSM2 Climate sensitivity ranges from 1.5 to 5.9K, depending on parameter selection

# Parameter correlations

- Parameters dominating sensitivity correlation:
  - Pressure level top for tropospheric clouds
  - Subgrid scaling factor for relative humidity in ice nucleation code (both trop and strat)
  - CLUBB's eddy diffusivity for momentum

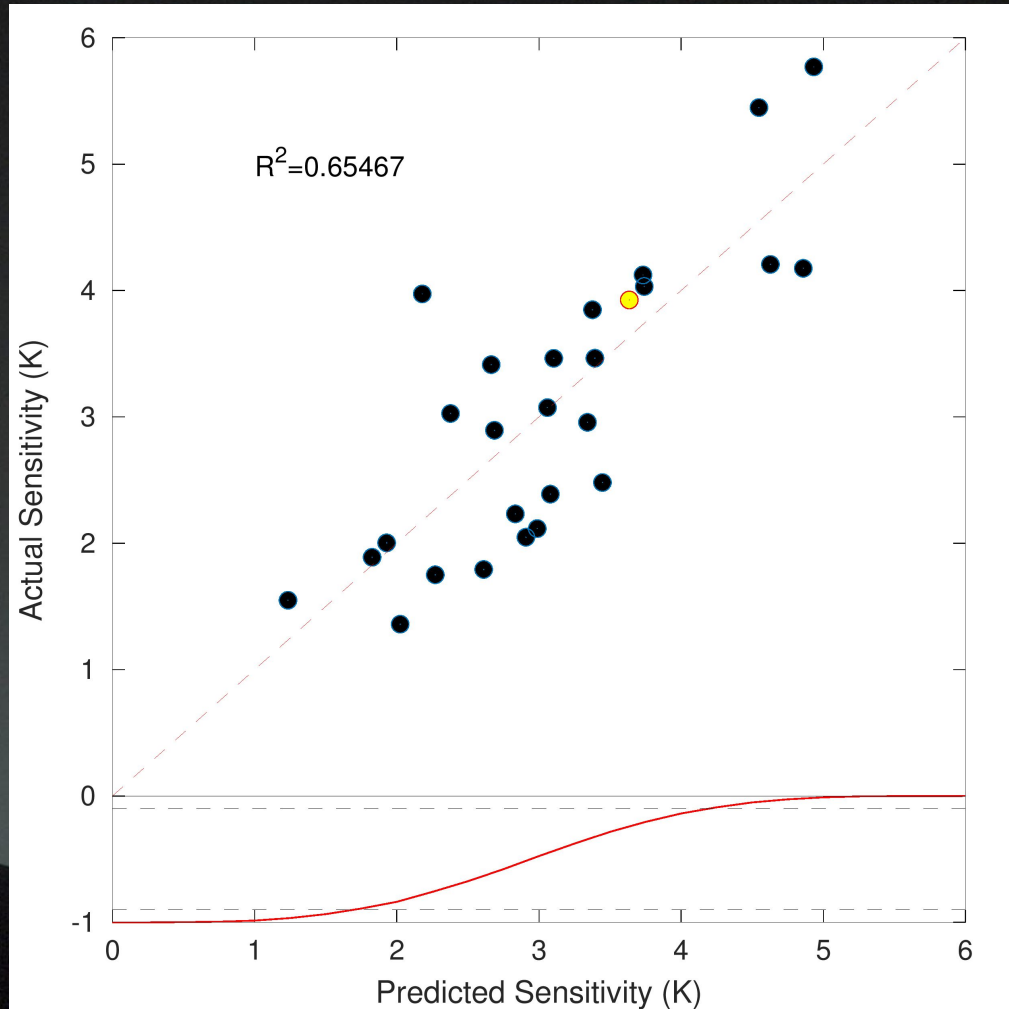




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# Regression model

- Sensitivity can be modeled as a function of 5 leading parameters
- Likelihood distribution for  $S$  between 1.6K and 4.2K implied, with uniform parameter prior





## Next steps

Second iteration of low-res ensemble: limited parameters, fully equilibrated slab

Targeted 2 degree test cases to test consistency of climate sensitivity at low and high resolution

COSP/Cloud feedback analysis to provide mechanistic understanding of sensitivity relationship and model adequacy