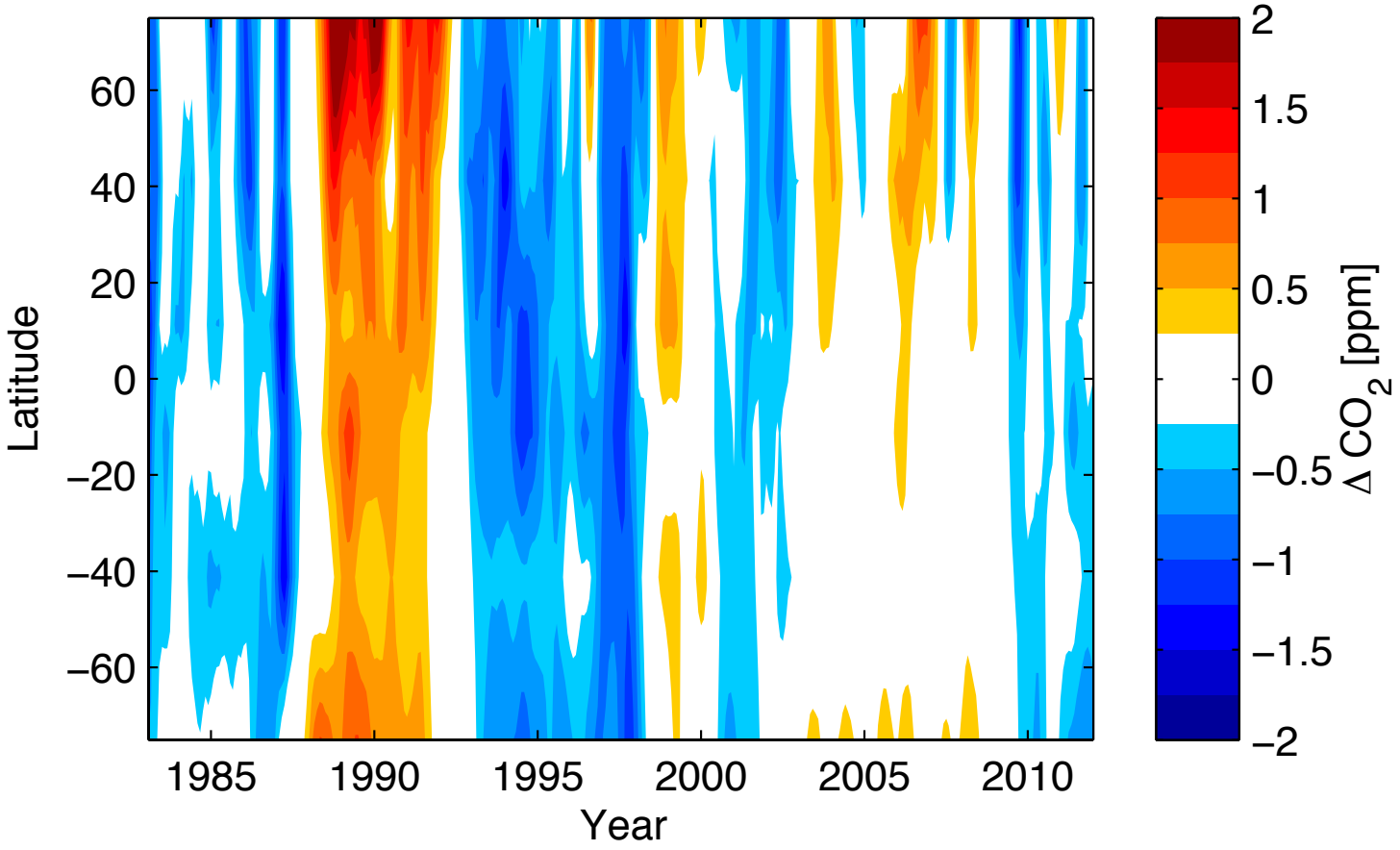
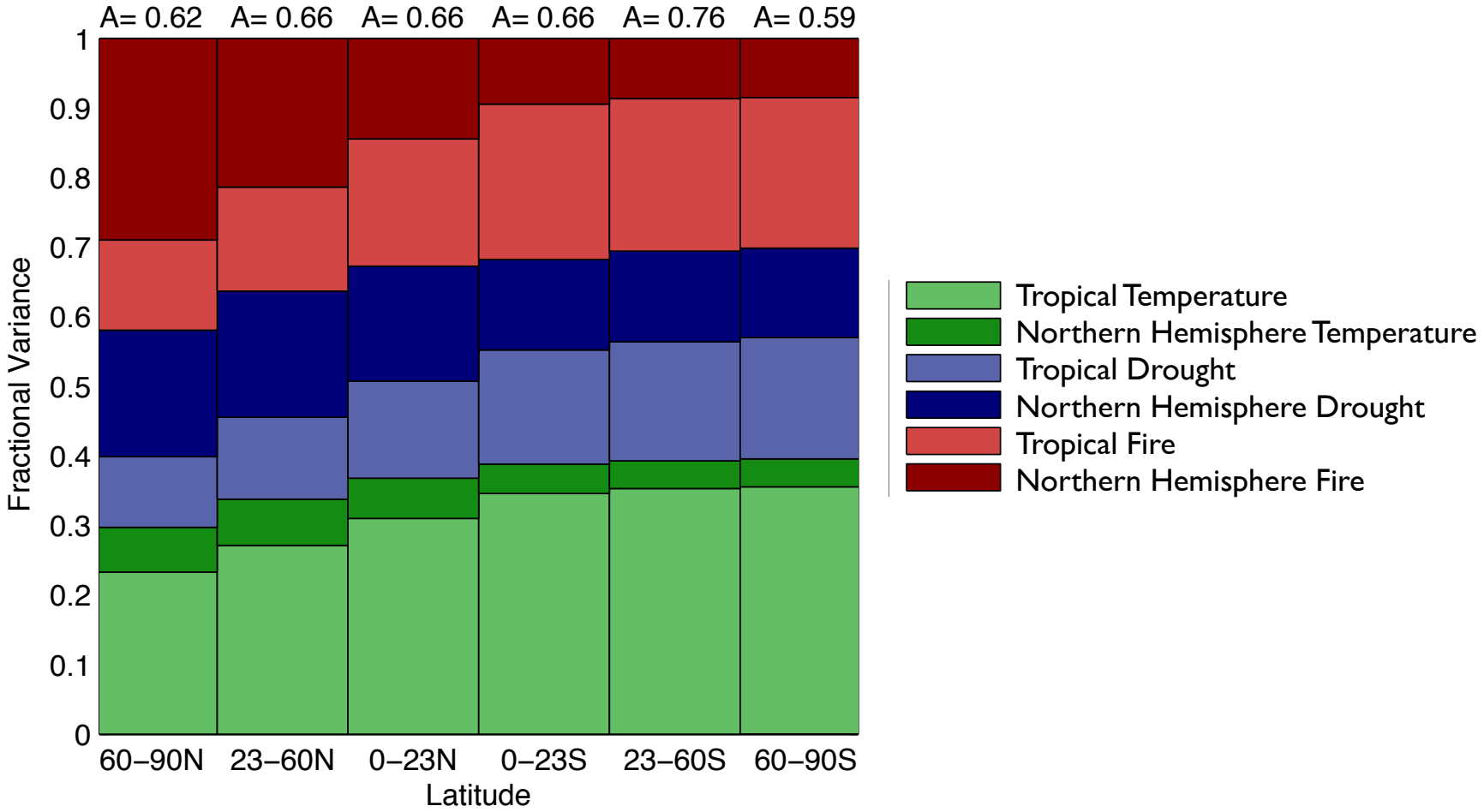
Drivers of interannual variability in atmospheric CO_2 across CMIP5 and implications for future feedbacks



Gretchen Keppel-Aleks
University of Michigan
gkeppela@umich.edu

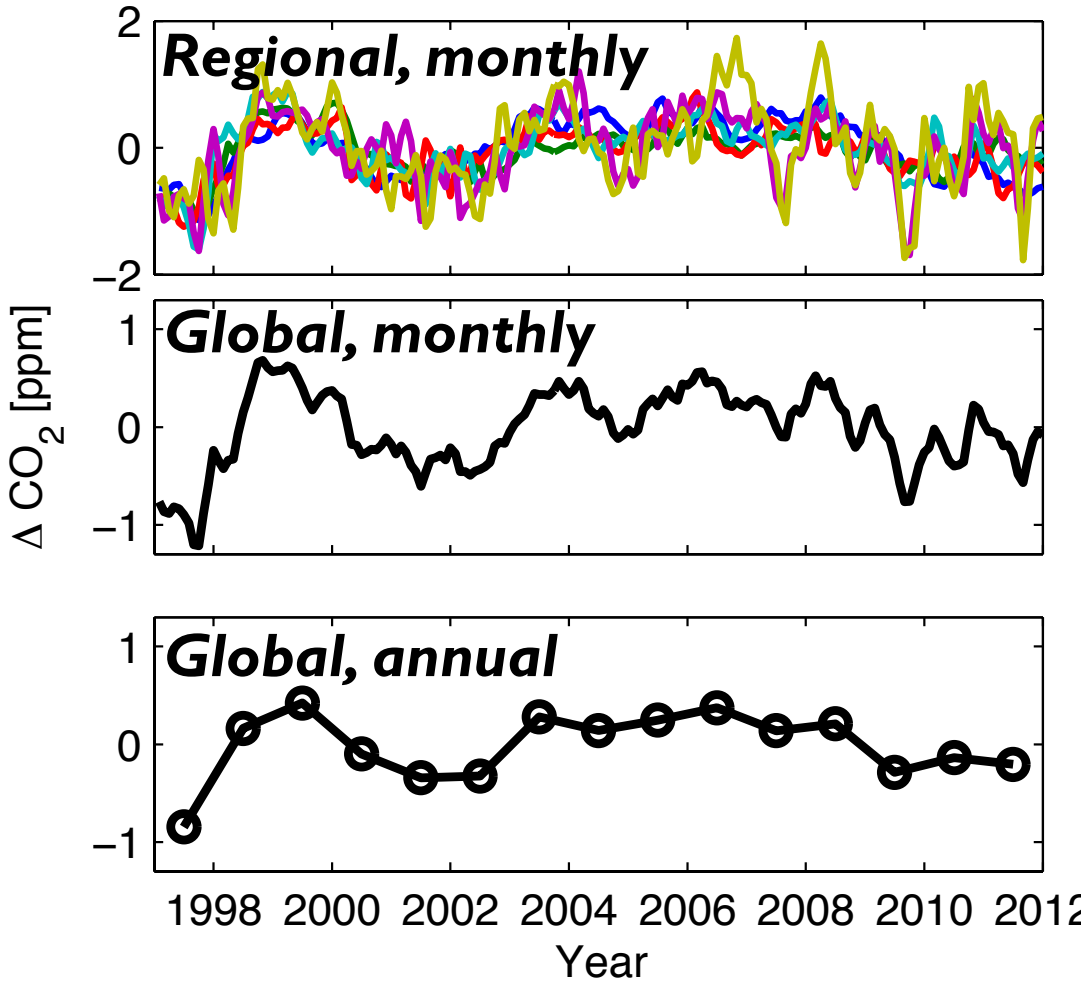
CLM and BGCWG meeting
March 2015

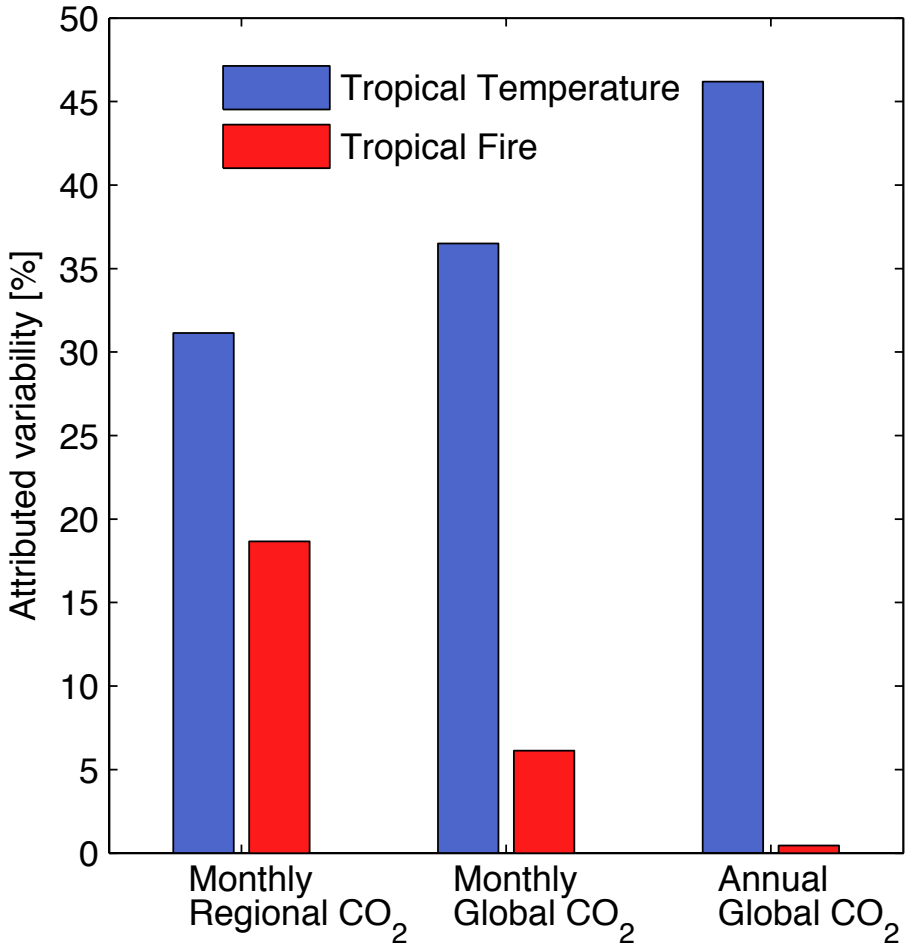
Variations in CO_2 owe to a combination of tropical and northern hemisphere climate and human drivers.



Keppel-Aleks et al., 2014

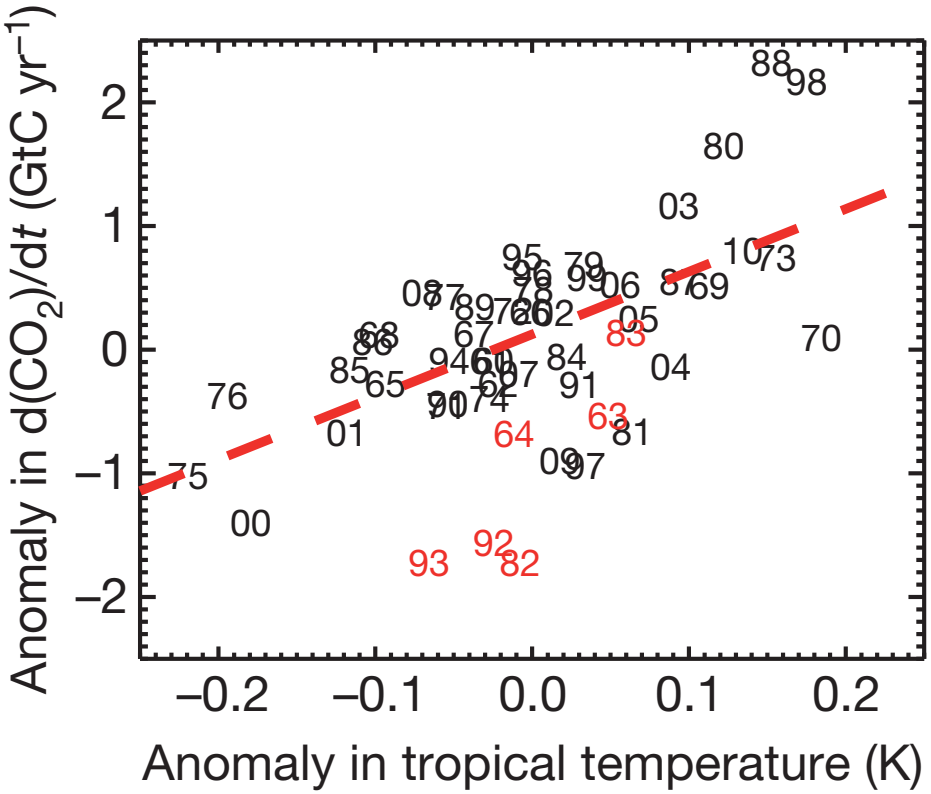
Variability is preferentially attributed to temperature, as CO_2 observations are aggregated in time and space

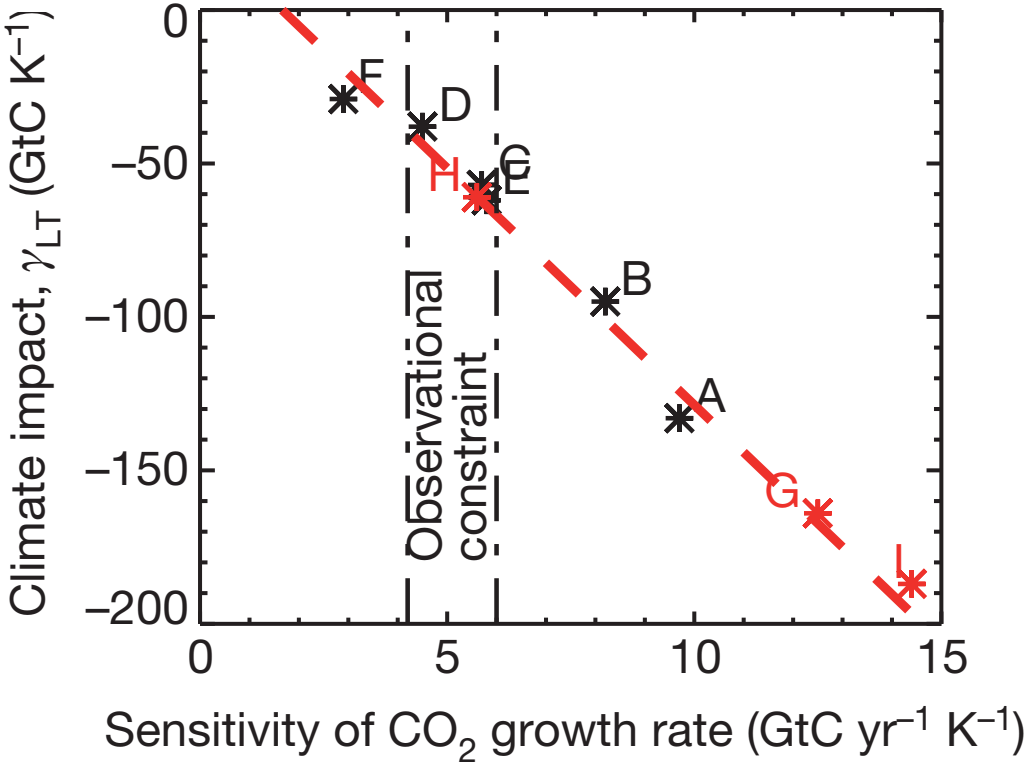




Keppel-Aleks et al., 2014

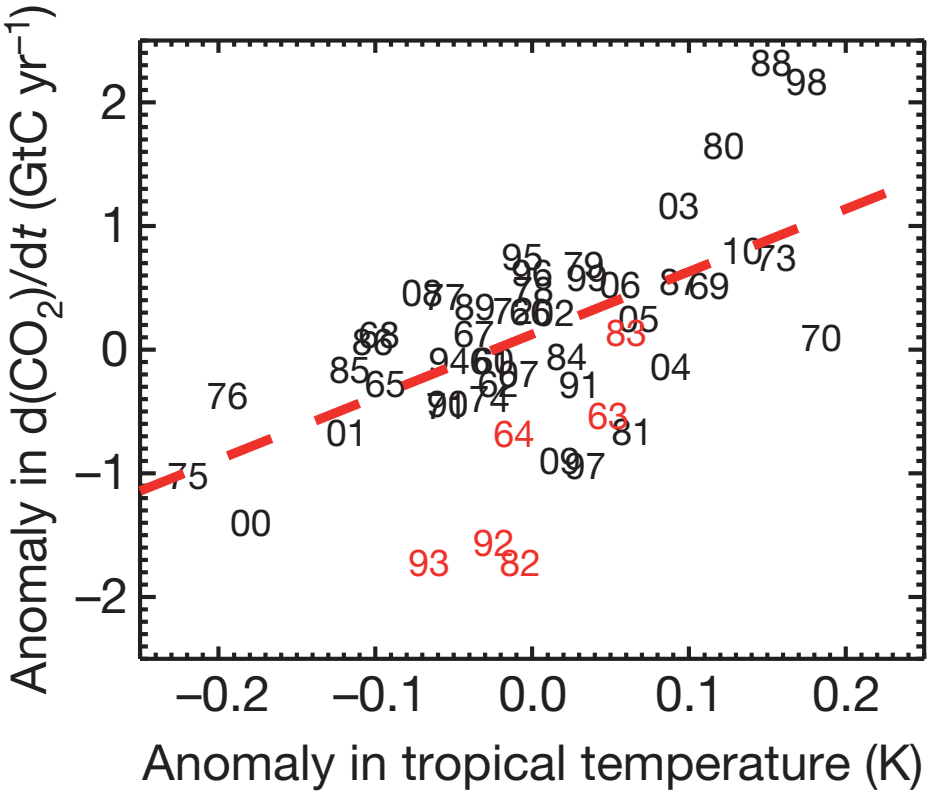
Short term carbon cycle variability may constrain predictions of long-term feedbacks



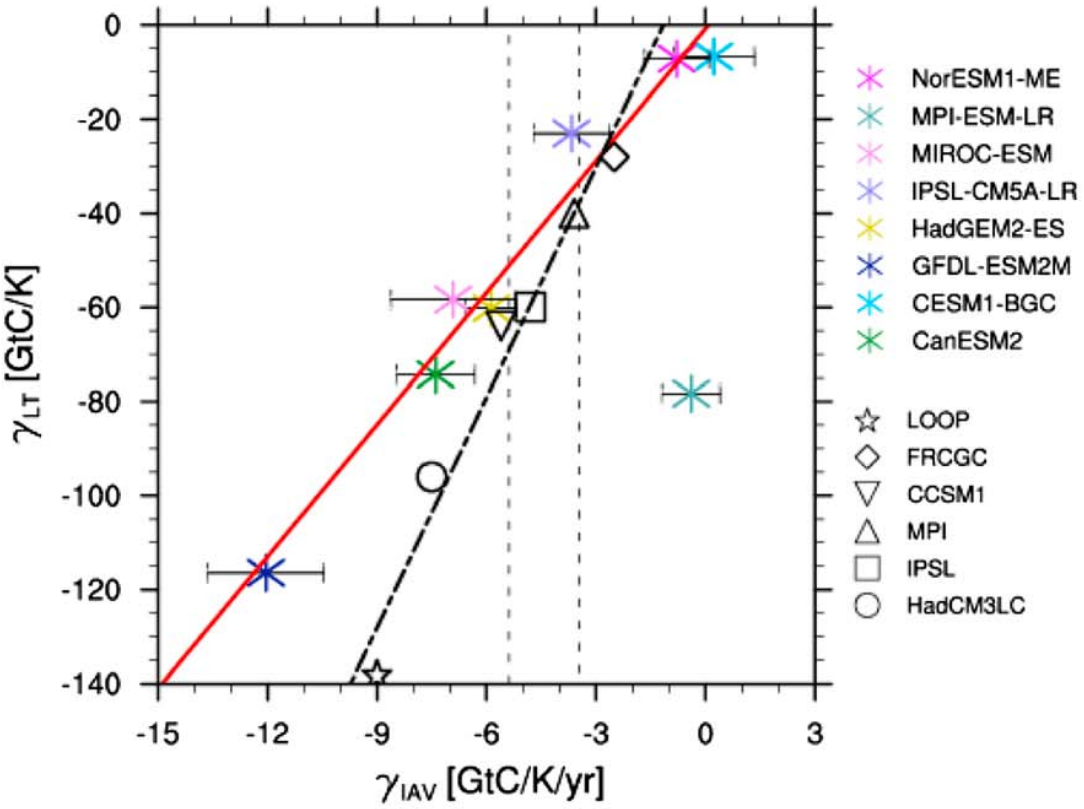


Cox et al., 2013

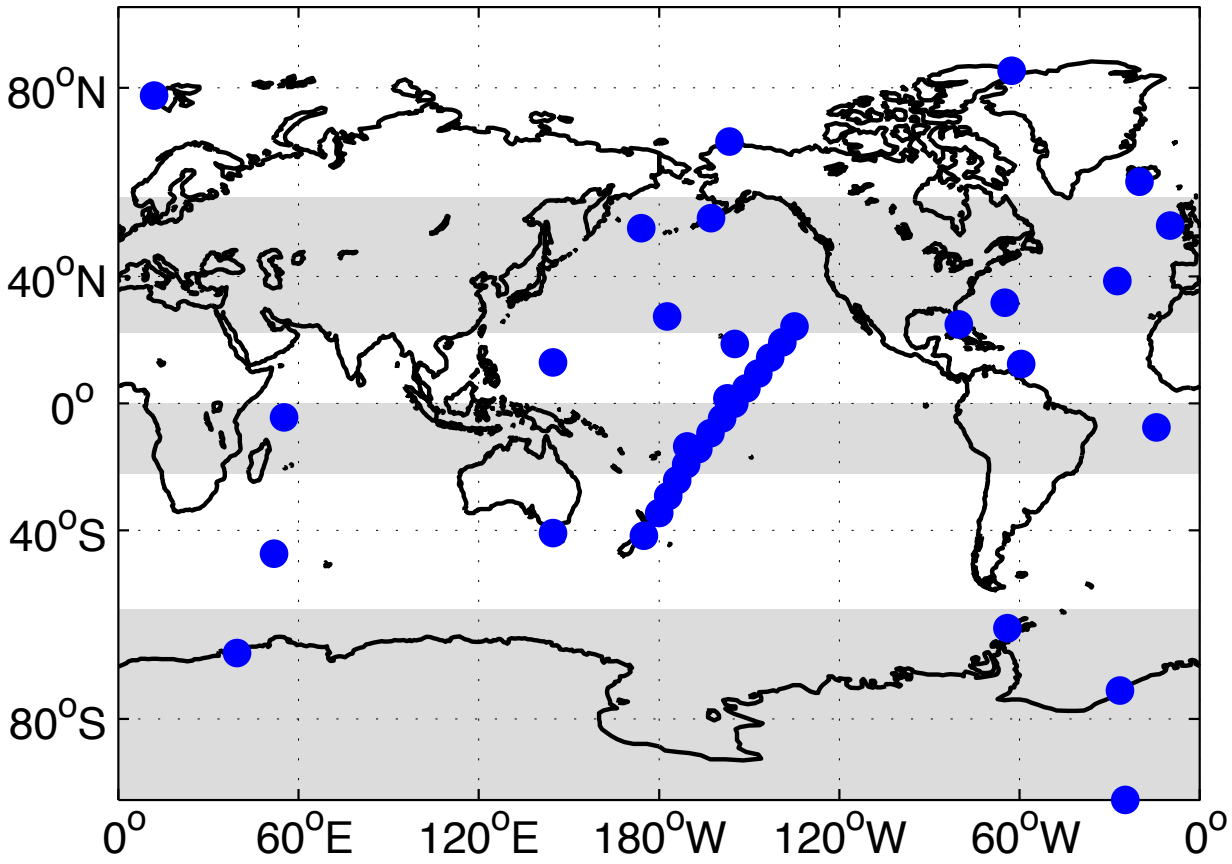
Short term carbon cycle variability may constrain predictions of long-term feedbacks



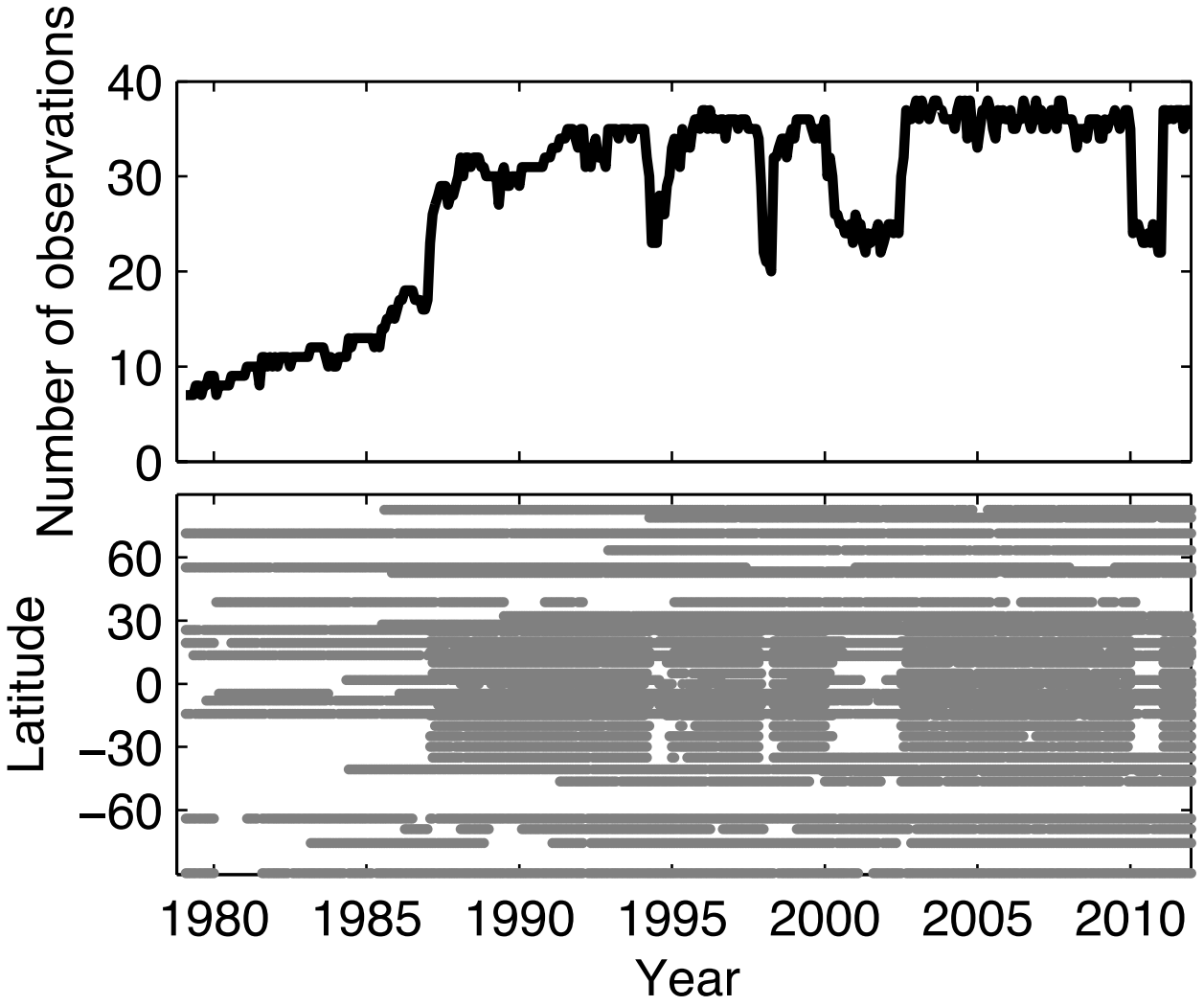
Wenzel et al., 2014



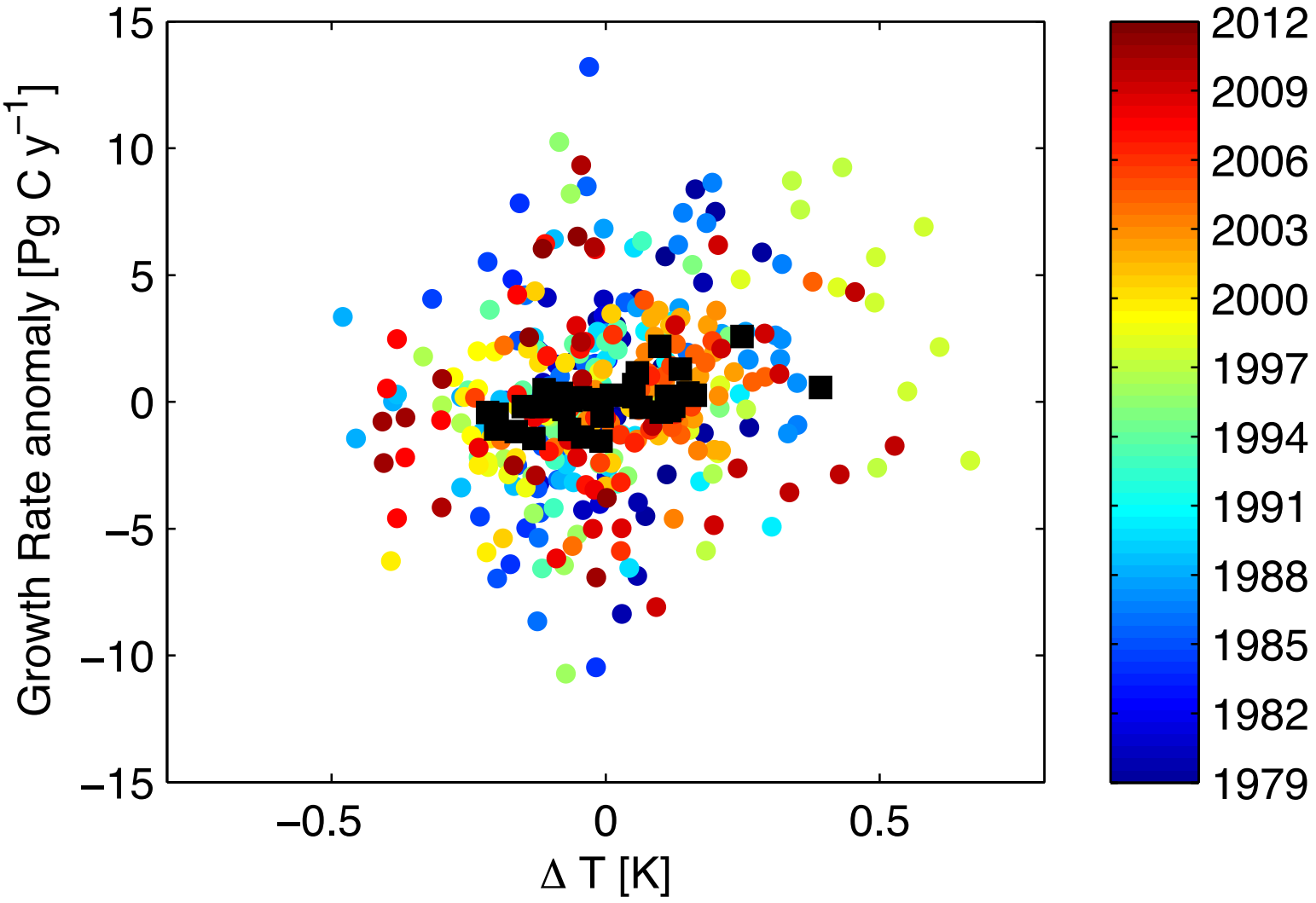
Coverage by the NOAA cooperative sampling network has expanded with time



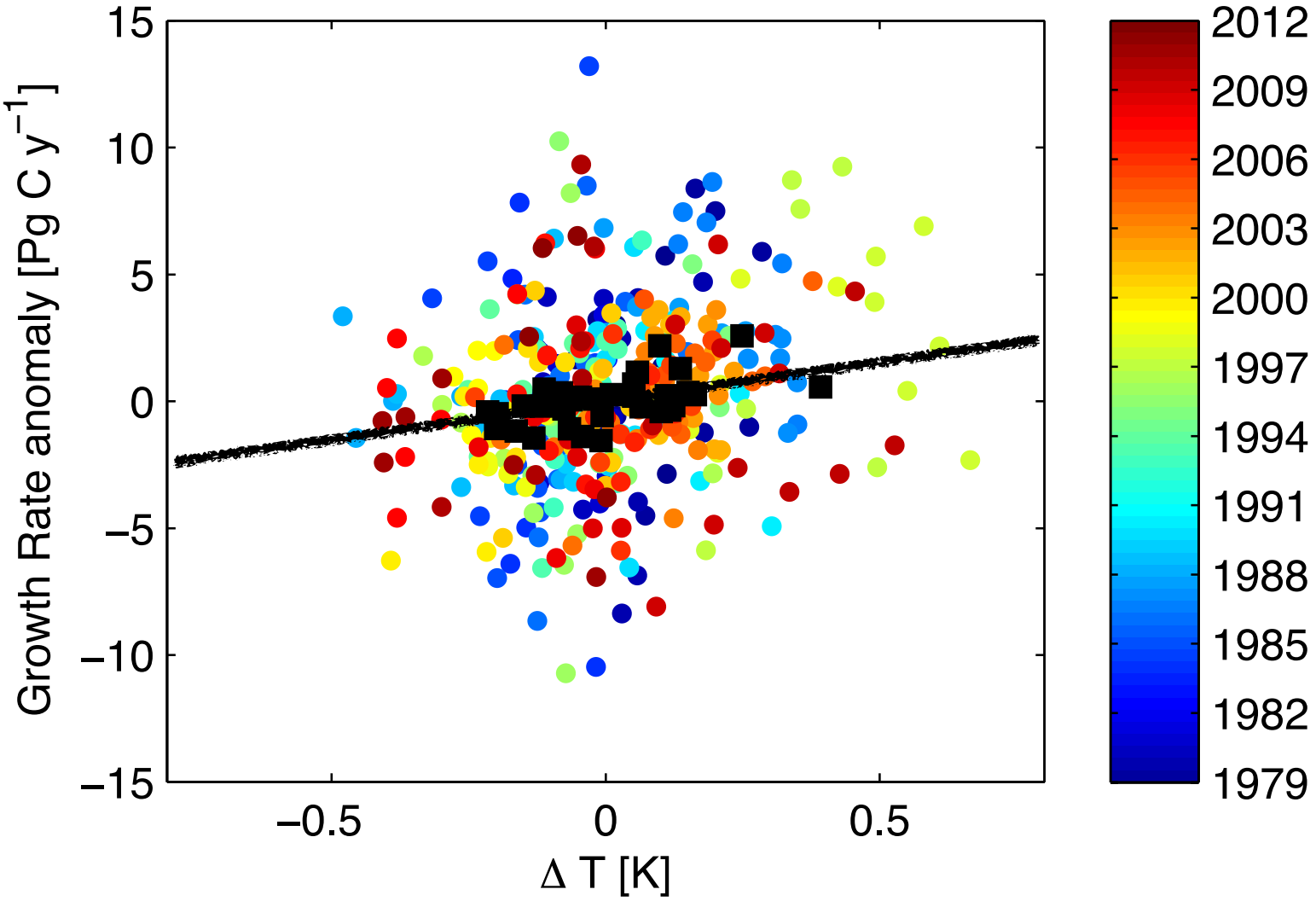
Observational density has increased, yielding improved meridional coverage



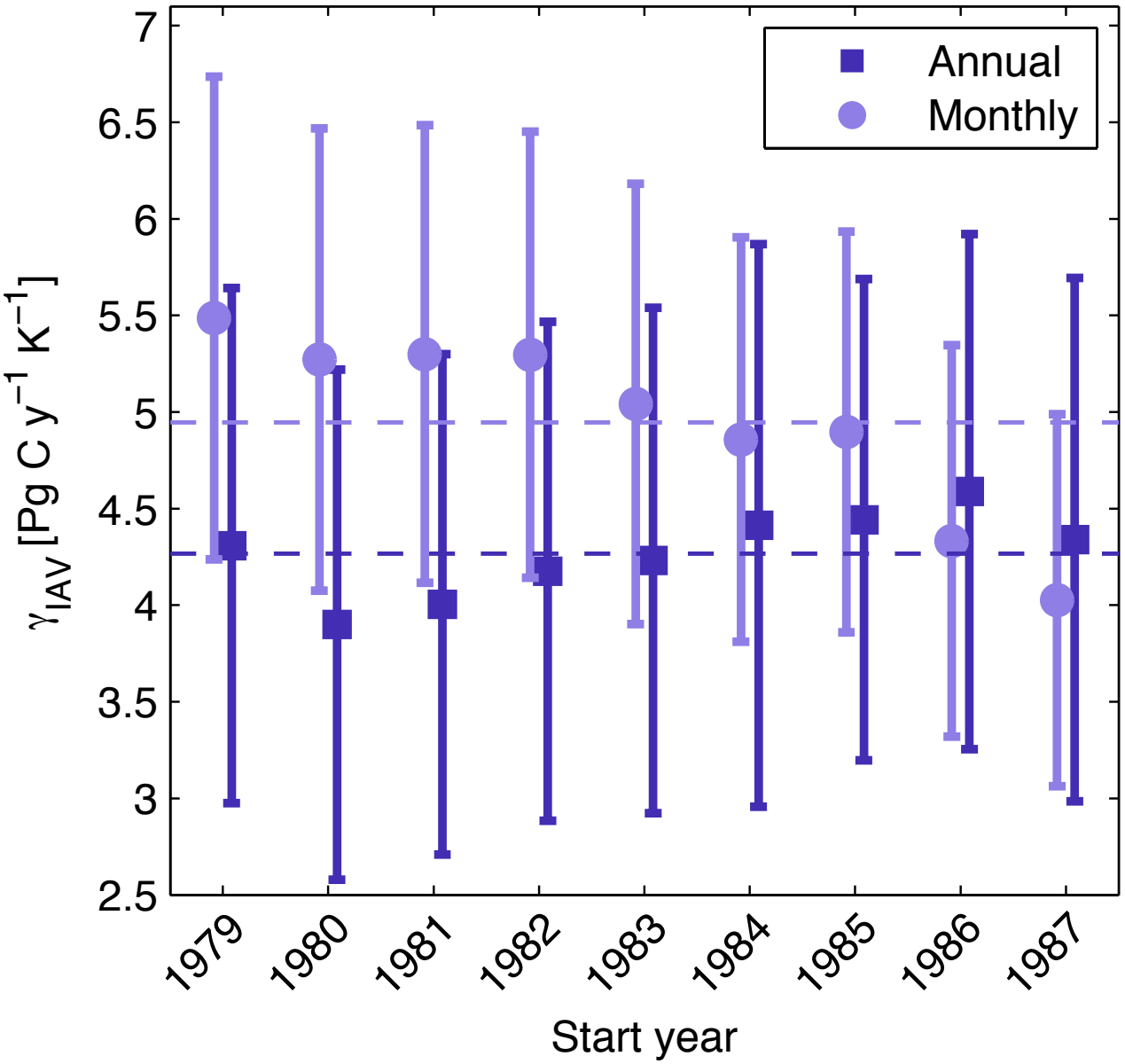
Interannual variability in the CO_2 growth rate can be calculated at annual or monthly timescales

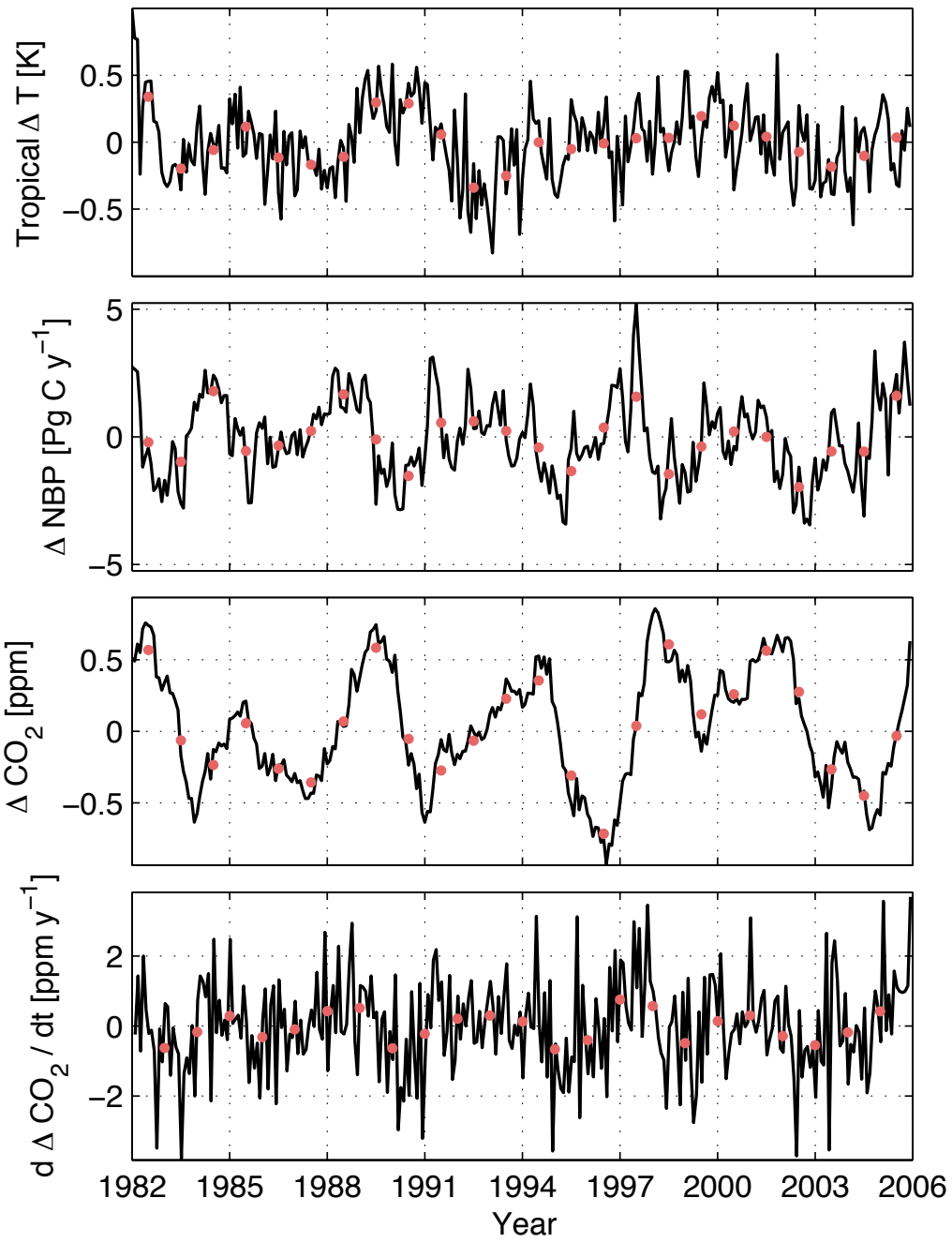


Interannual variability in the CO_2 growth rate can be calculated at annual or monthly timescales



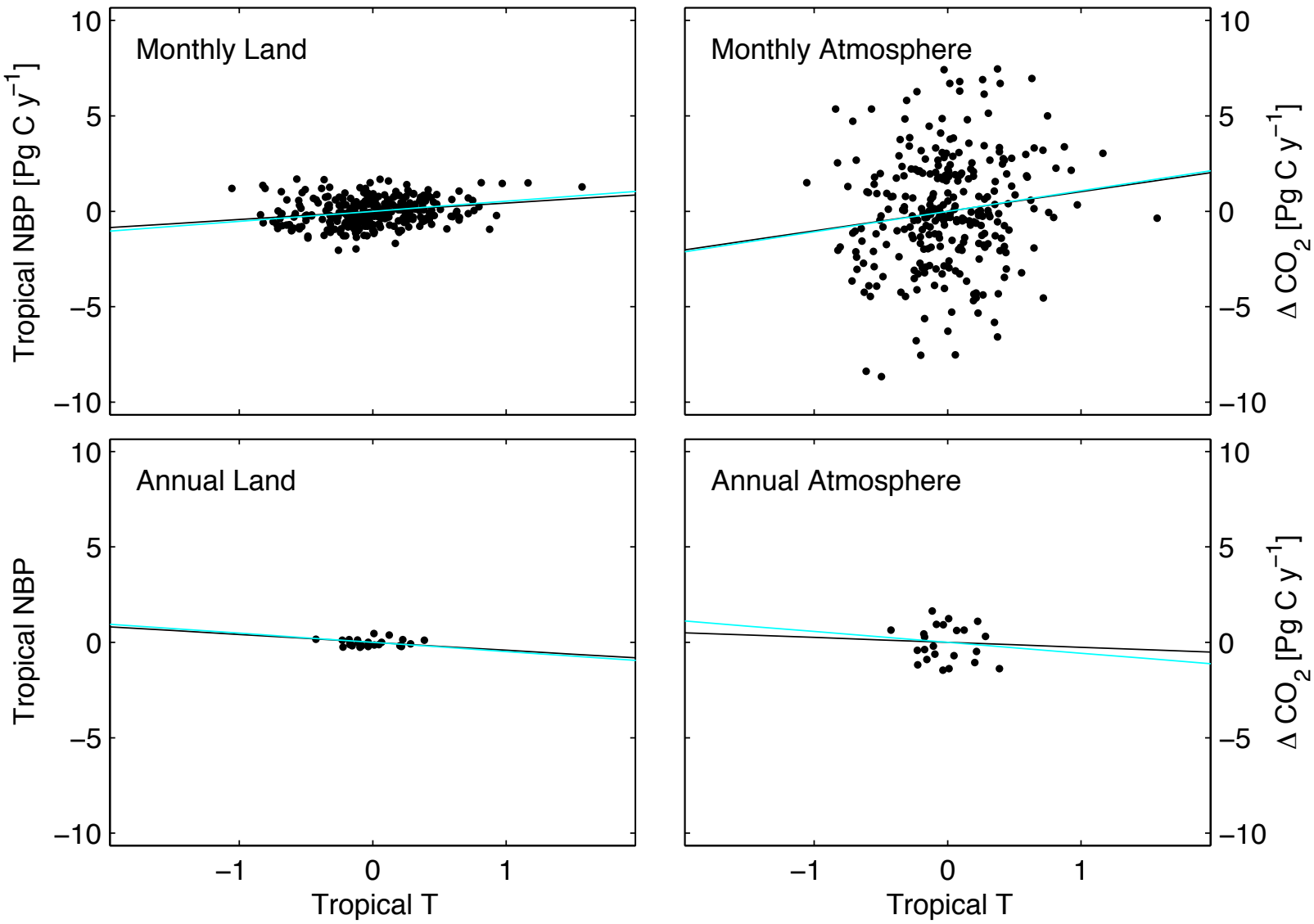
The temperature sensitivity of the CO_2 growth rate depends on period sampled



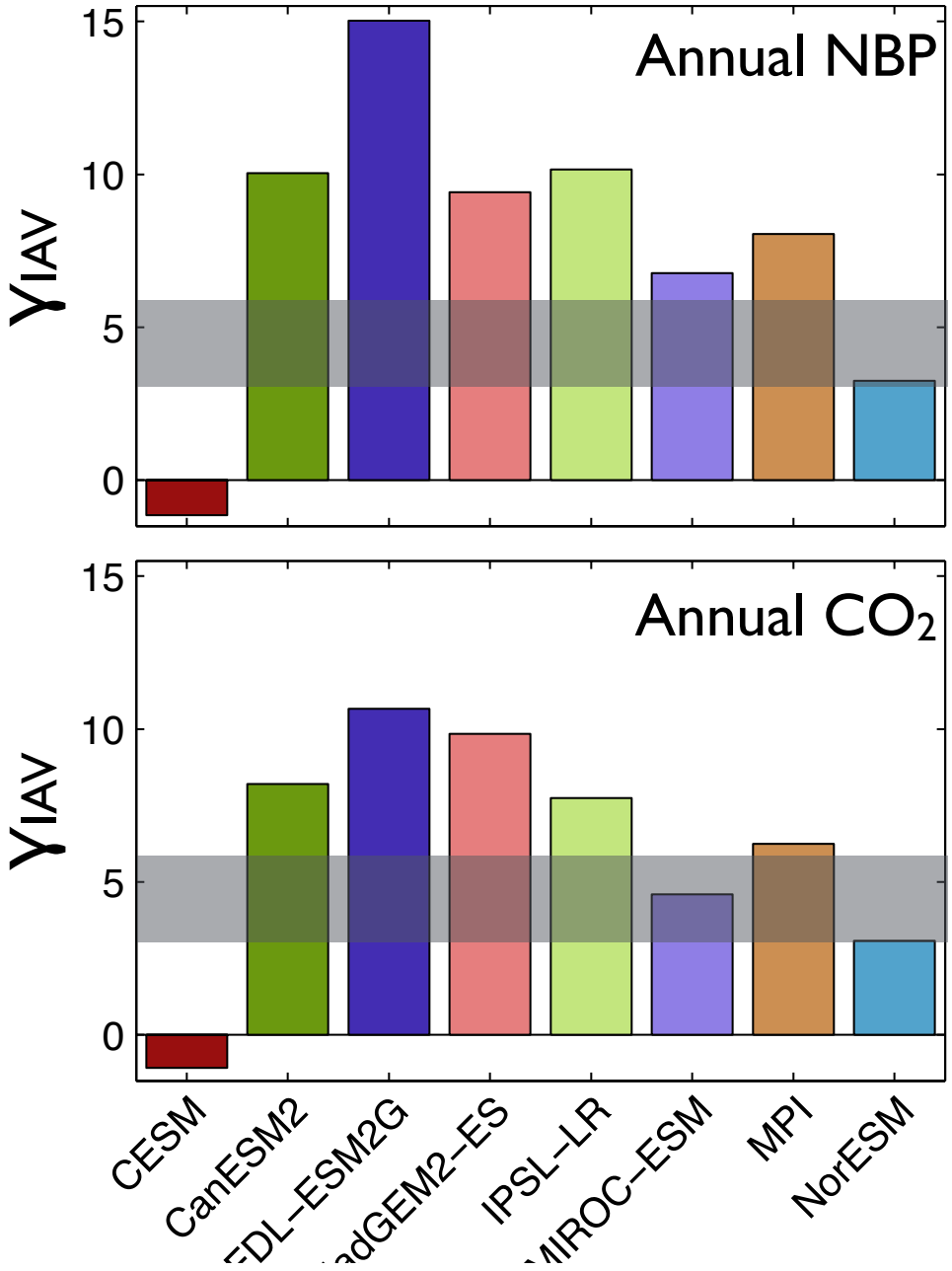


In the real world, we cannot observe carbon fluxes at global or regional scales

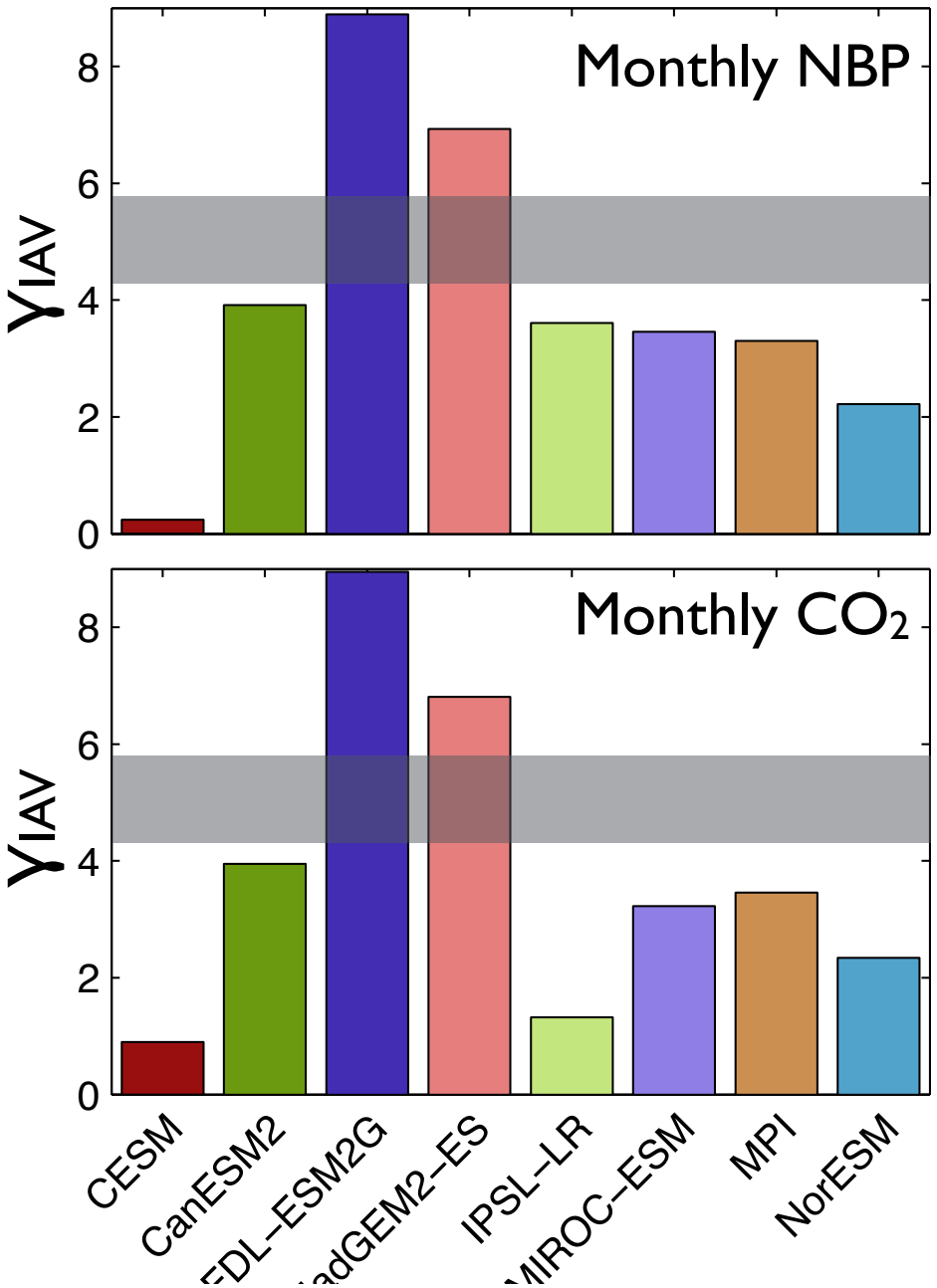
Interannual variability in the CO_2 growth rate inferred from models is sensitive to method of computation



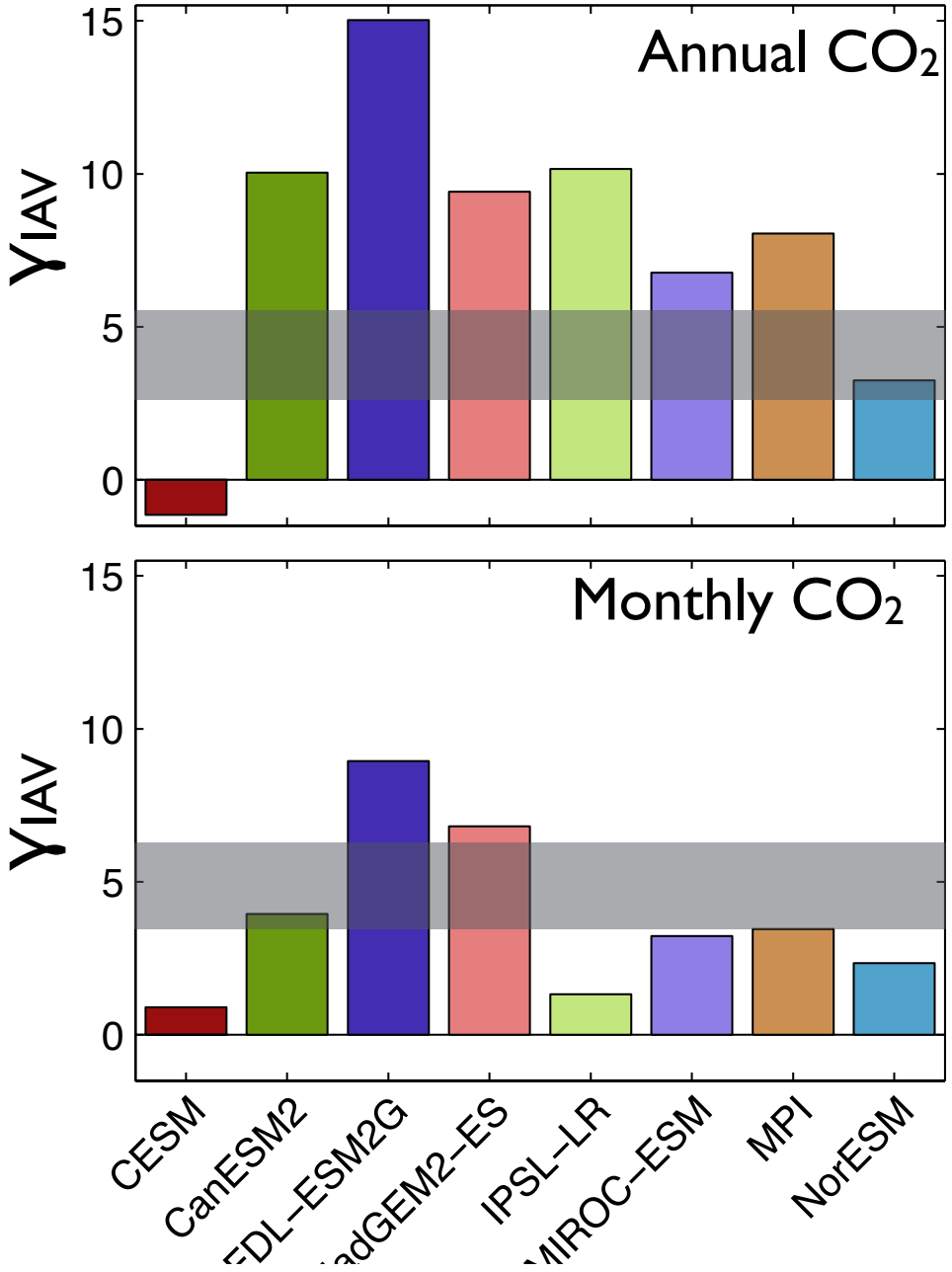
Atmospheric transport damps γ_{IAV} values when estimated from annual CO_2 rather than directly from land fluxes



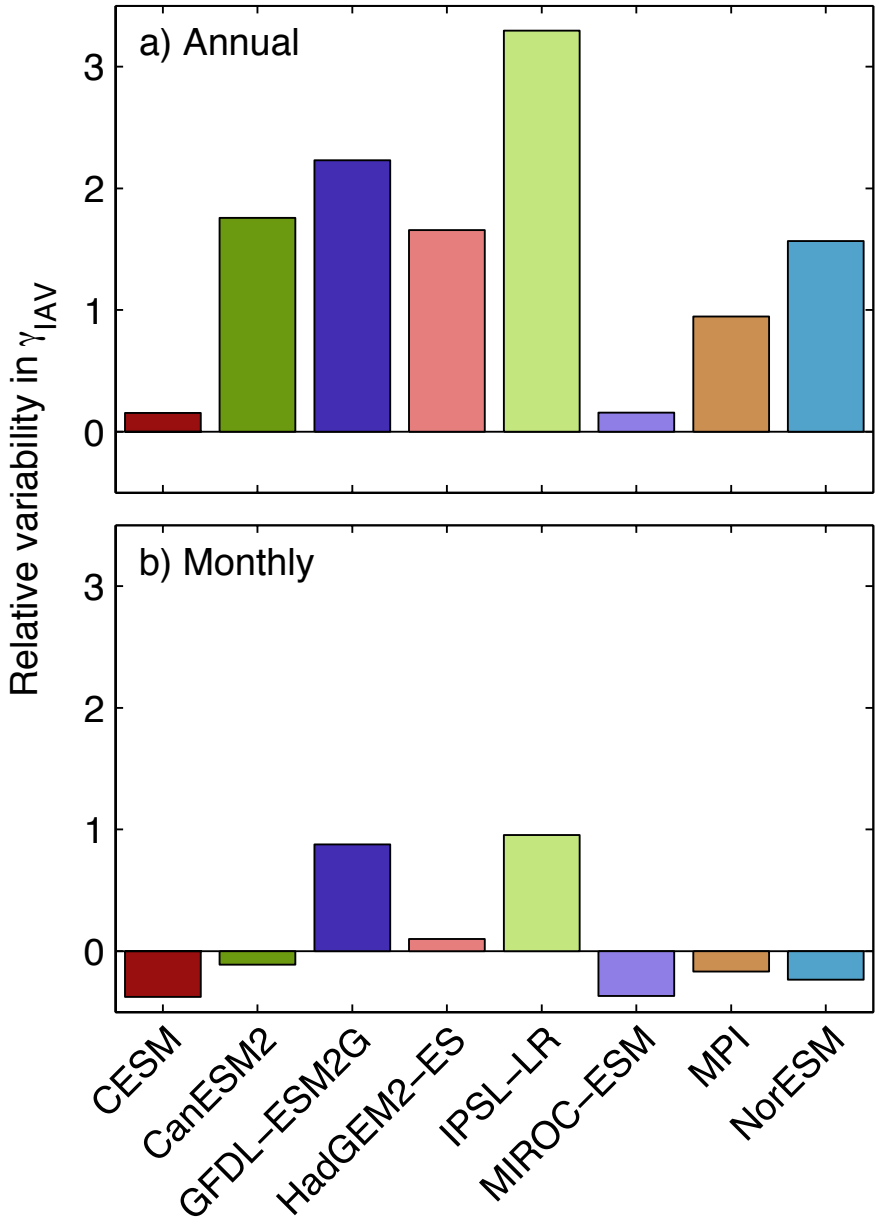
The use of monthly land and atmospheric diagnostic yields largely consistent γ_{IAV} values



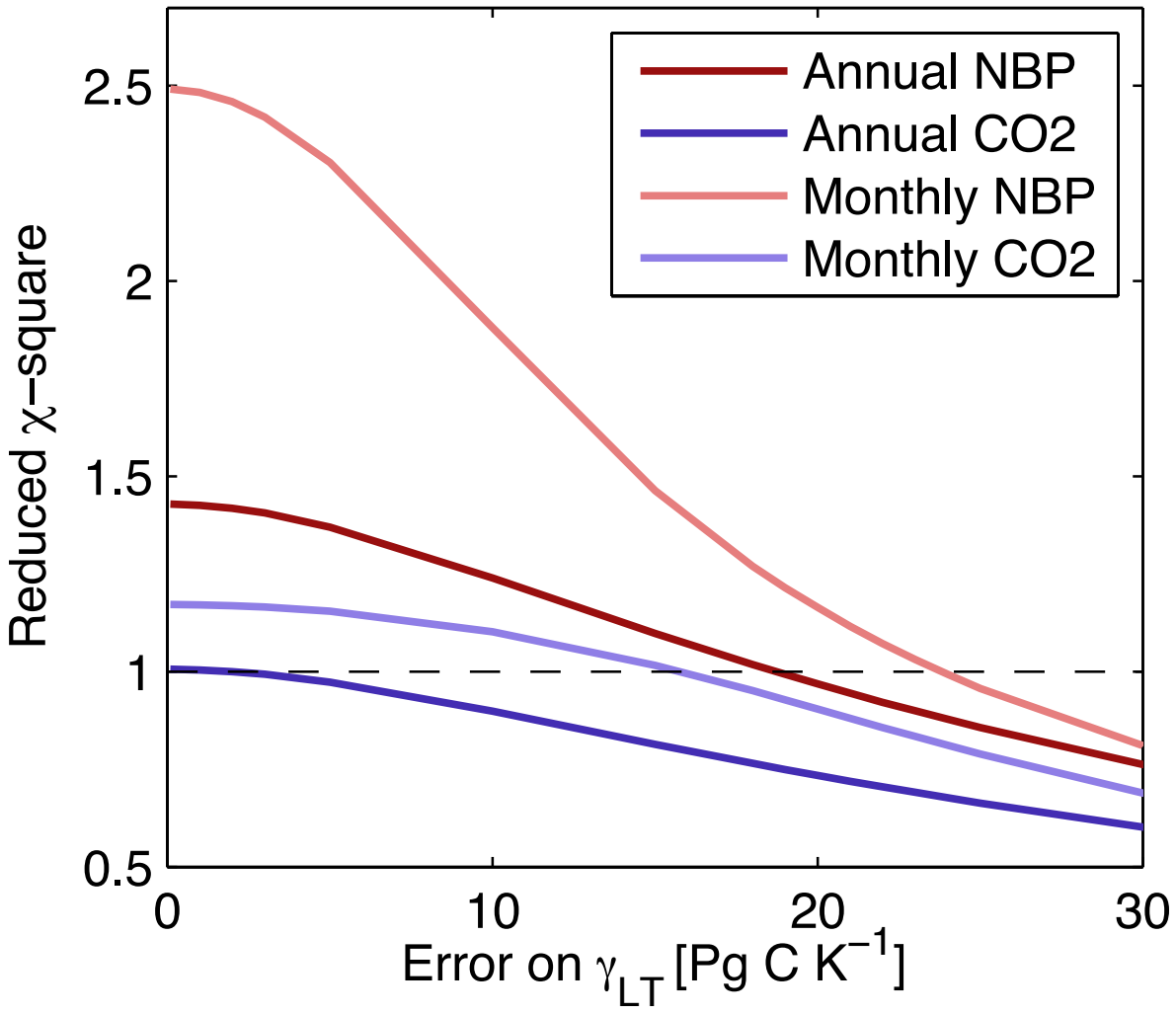
The choice of annual vs monthly diagnostics has the largest impact on the calculated γ_{IAV} values



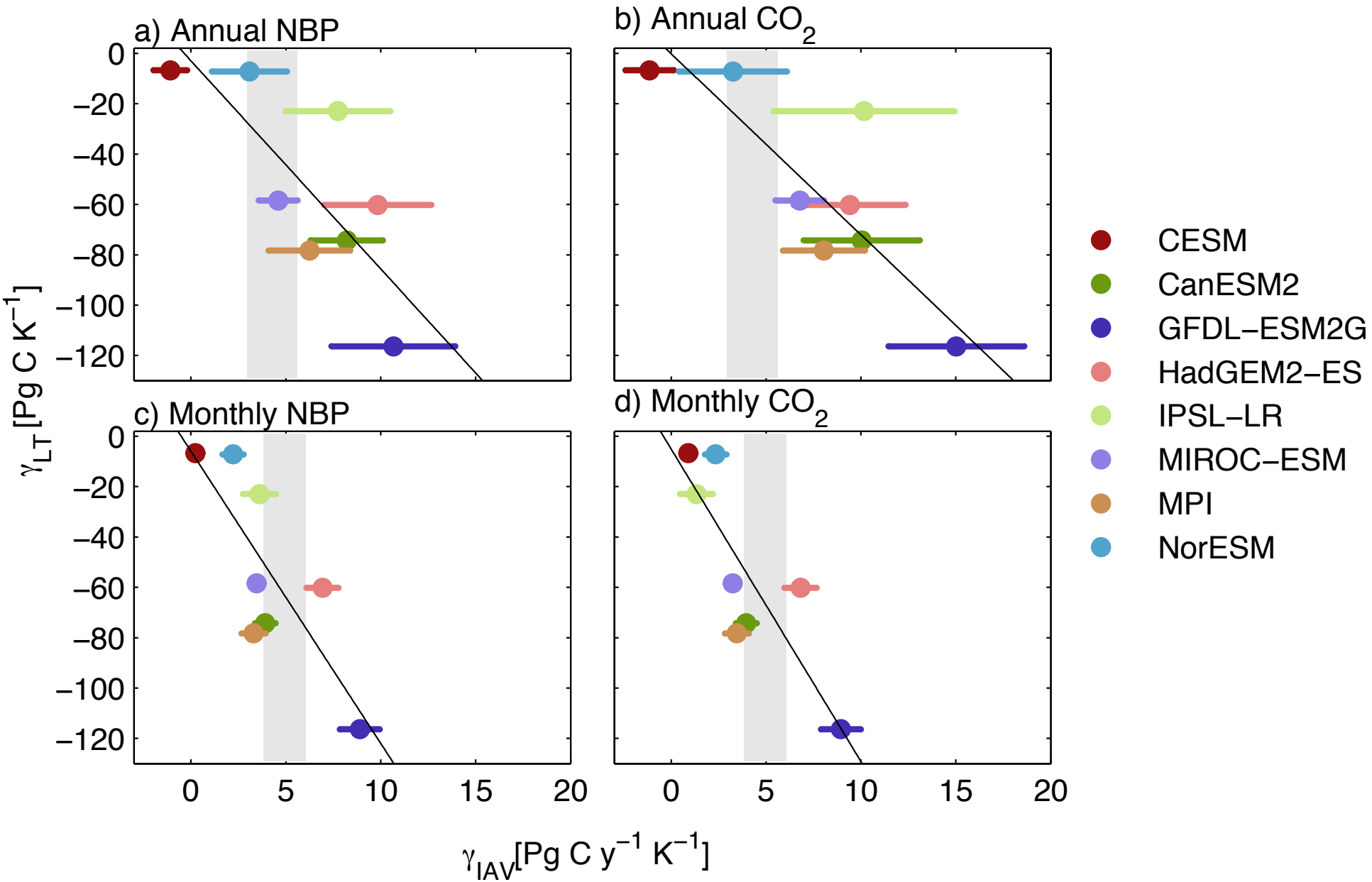
The uncertainty on γ_{IAV} from annual observations exceeds that from monthly observations



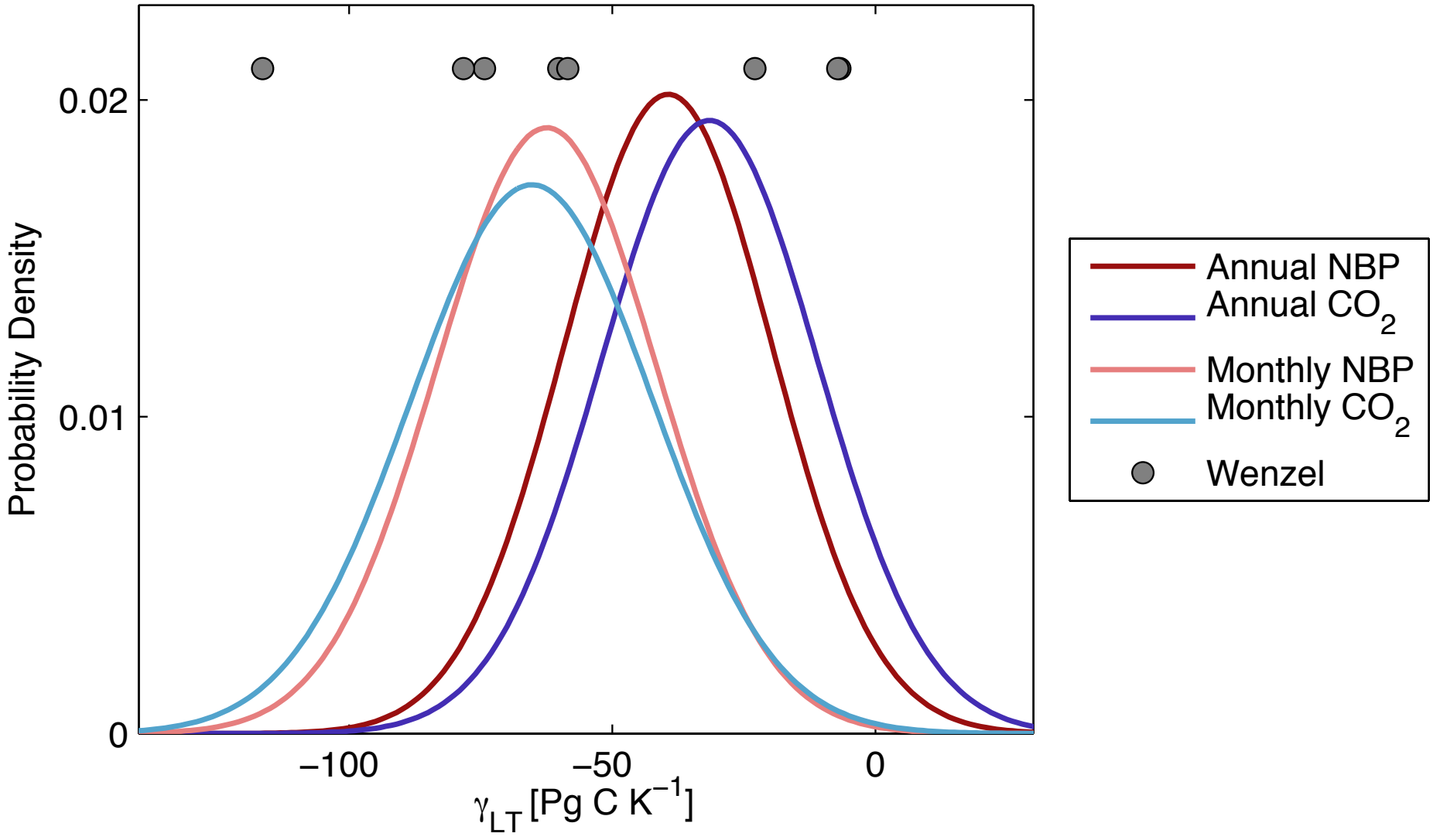
The uncertainty on the long-term γ required to produce a χ^2 value of one is larger for land data



A different subset of CMIP5 models are consistent with the observational constraint across four methods



The constraint on γ_{LT} depends on whether model data are averaged monthly or annually



The emergent constraint from a multi-model ensemble is highly dependent on the choice of observational constraint and the treatment of model output

The most likely γ_{LT} value increases by at least 50% when monthly, rather, than annual values are used

No set of models are consistent with observations across four sensitivity tests

Model output should be compatible with observations where possible

Acknolwedgements: NOAA GMD, CMIP5 Archive