

ATS/CIRA Colloquium

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Hosted by Chris Kummerow

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ATS 101 and Microsoft Teams

The implications of time varying climate feedbacks for precipitation

Climate sensitivity varies on multiple timescales with different magnitudes as climate feedbacks evolve over time. This timescale dependence of climate feedbacks can be understood through the radiative fluxes at the top of the atmosphere. If TOA fluxes respond on multiple timescales, then surface fluxes may as well, which would lead to timescale dependence of global mean precipitation. We investigate whether it does in millennial-length simulations of the response to abrupt increase in carbon dioxide from LongRunMIP.

In order to compare the slope of precipitation versus temperature (also known as "hydrologic sensitivity") among timescales, we must first calculate this slope. Ordinary least squares, the most common regression technique often used by default for calculating a slope, provides (on average) the correct slope of a trend over time. But, when regressing against an independent variable with internal variability, such as temperature, it systematically underestimates the slope (called "regression dilution"). This is well known to statisticians, and at least beginning to be appreciated in the context of calculating climate sensitivity. But what has not yet been addressed is the effect of internal variability in both the independent and dependent variables that is correlated. We introduce a new framework to quantify and understand the biases in regression slope arising from both of these factors in the climate context, which reveals that biases from correlated internal variability can either add additional bias or mask the bias due to regression dilution. We then use a method that accounts for both regression dilution and correlated internal variability and apply the framework to understand these effects on the time-dependence of climate sensitivity and hydrologic sensitivity.