

ATS/CIRA Colloquium

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Hosted by Maria Rugenstein

3 p.m. Thursday, May 5
ATS 101 or Microsoft Teams

Incorporating nonlinearities into the climate forcing and feedback framework

In this talk, I use a series of coupled and atmosphere-only simulations of the HadCM3 GCM to illustrate how the traditional climate forcing and feedback framework can be extended to incorporate the climate nonlinearities needed to forecast warming in the coming century. Studies of global warming often employ an energy balance model in which perturbations to the net planetary energy flow are called forcings, and the processes by which subsequent surface warming counters these perturbations are called feedbacks. Traditionally, these studies have assumed that the global energy balance model is zero-dimensional and linear, implying both that the equilibrium warming response to a constant forcing is proportional to that forcing (“equilibrium linearity”), and that feedbacks are constant across time, allowing the equilibrium outcome to be forecasted early on (“transient linearity”). Over the last decade, evidence from observations, paleoclimate, and simulations have shown that neither linearity truly holds, and that the global energy balance model must be subsequently extended. While most focus has been on how spatial variation in feedback strength can break transient linearity (while preserving equilibrium linearity), changes in feedback strength in the presence of forcing agents and increased temperatures can break both assumptions, and could become relevant if CO₂ levels were to more than double with respect to the preindustrial concentration, as may happen by 2100. We use comprehensive experiments to measure these different phenomena in HadCM3, and show the surprising role that cross-terms between spatial feedbacks can play in affecting projected warming.

Colloquia page: atmos.colostate.edu/colloquia