M.S. Defense Announcement
Luke Davis
Thursday, February 14 at 1:00pm

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M.S. Defense

February 14, 2019
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Defense
ATS West Seminar Room (121 ATS West)

Post Defense Meeting
ATS West Seminar Room (121 ATS West)

Committee:
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Thomas Birner (co-advisor)
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Connections between climate sensitivity and large-scale extratropical dynamics

The response of the extratropical storm tracks to anthropogenic forcing is one of the most important but poorly understood aspects of climate change. The direct, thermodynamic effects of climate change are relatively well understood, but their two-way interactions with large-scale extratropical dynamics are extremely difficult to predict. There is thus continued need for a robust understanding of how this coupling evolves in space and time.

The dry dynamical core represents one of the simplest possible numerical models for studying the response of the extratropical storm tracks to climate change. In the model, the extratropical circulation is forced by relaxing to a radiative equilibrium profile using linear damping. The linear damping coefficient plays an essential role in governing the structure of the circulation. But despite decades of research with the dry dynamical core, the role of the damping coefficient in governing the circulation has received relatively little scrutiny.

In this thesis, we systematically vary the damping rate and the equilibrium temperature in a dry dynamical core in order to understand how the amplitude of the damping influences extratropical dynamics. Critically, we prove that the damping rate is a measure of the climate sensitivity of the dry atmosphere. The key finding is that the structure of the extratropical circulation is a function of the climate sensitivity. Larger damping timescales -- which are equivalent to higher climate sensitivities -- lead to a less dynamically active extratropical circulation, equatorward shifts in the jet, and a background state that is almost neutral to baroclinic instability. They also lead to increases in the autocorrelation and relative strength of the annular modes of climate variability. It is argued that the climate sensitivity of the atmosphere may be identifiable from its dynamical signatures, and that understanding the response of the circulation to climate change is critically dependent on understanding its climate sensitivity.