Speaker: Elizabeth A. Barnes

Title: Influence of meridional constraints and eddy feedbacks on low-frequency variability and its response to climate change (Ph.D. defense)

Abstract:
Two aspects of the internal variability of the atmosphere are examined. The first concerns the interactions and feedbacks between synoptic-scale Rossby waves (eddies) and the large-scale mean flow. We study the variability of the midlatitude jets in observations, comprehensive global circulation models and a barotropic model on the sphere and quantify the persistence of this variability and the corresponding strength of the feedback between the eddies and the mean flow. We demonstrate that factors such as the strength of the subtropical jet and spherical geometry play important roles in modulating the eddy-mean flow feedback and thus the resulting jet variability. The results predict a reduction in eddy-mean flow feedback strength with human-induced climate change, which implies a reduction in the time scale of the leading mode of variability in the troposphere.

The second addresses the behavior of the eddies themselves. Rossby waves play a crucial role in modulating the low-frequency variability of the atmosphere, and changes in their characteristics such as size, speed and momentum fluxes have been put forth as possible explanations for general circulation trends under human-induced global warming. We contribute to the understanding of synoptic, midlatitude eddies by introducing a Rossby wave identification algorithm that looks for overturning of absolute vorticity contours on pressure surfaces to quantify wave breaking in the observations and general circulation models. The results suggest that the meridional constraints of wave breaking identified in the barotropic model are also present in more realistic atmospheres and the implications for future climate predictions is explored.