ATS/CIRA Colloquium

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Hosted by Christine Chiu

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ATS 101 and Zoom

Quantifying How Cloud Morphological Changes Contribute to the Interannual Cloud Feedback Based on MODIS and ISCCP Satellite Observations

The surface temperature-mediated change in cloud properties, referred to as the cloud feedback, continues to dominate the uncertainty in climate projections. A larger number of contemporary global climate models (GCMs) project a higher degree of warming than the previous generation of GCMs. This greater projected warming has been attributed to a less negative, i.e. less damping cloud feedback in the Southern Ocean. Here, we apply a novel "double decomposition method" that merges the traditional "cloud radiative kernel" method and the "cloud regime" method, to two datasets of satellite observations to decompose the interannual cloud feedback into contributions arising from changes within cloud morphologies, shifts between cloud morphologies and their covariance. Our results show that shifts between cloud morphologies generally shape the global spatial distribution and magnitude of the cloud feedback in general agreement with GCMs. We then focus on interpreting how both changes within and between cloud morphologies impact the shortwave cloud optical depth feedback over the Southern Ocean in light of additional observations. Results from the across-regime analysis reveal that shifts from thick, high stratus clouds to thinner oceanic storm-track clouds contribute to a positive, i.e. amplifying feedback over the Southern Ocean. Results from the within-regime analysis reveal that the wind response to warming increases low- and mid-level cloud optical thickness over the Southern Ocean. Our novel methods and results can be applied to evaluate GCMs and diagnose shortcomings pertaining to their physical parameterizations of particular cloud morphologies.

Colloquia page: atmos.colostate.edu/colloquia