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Atmospheric rivers: A global climatology based on Reanalyses and CAM

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Atmospheric rivers are thin horizontal plumes of elevated moisture transport that can extend from the tropics poleward through the subtropics and into the midlatitudes. Understanding their role in the global climate system can allow one to determine how the humidity in the subtropics might change as global warming changes, which is important to know for radiative fluxes. It also might allow one to determine how extratropical cyclones and other systems might change if atmospheric rivers provide more moisture and latent heating for their development. Atmospheric rivers can also have a large impact on precipitation over land, and could potentially be responsible for changes in the distribution of floods and droughts in certain regions. However, the exact large-scale dynamical mechanisms that control atmospheric rivers and their characteristics is not well understood. As a first step towards tackling this issue, a global climatology of atmospheric rivers was created in this study using several quantitative definitions that can be easily applied to gridded data. These definitions, or detection methods, were first applied to the NCEP-NCAR and MERRA reanalyses, to provide a good estimate of the current state of atmospheric rivers globally. Statistical analyses were completed on these data to see how atmospheric rivers change in relation to the seasonal cycle, ENSO, and the MJO. Finally, the Community Atmosphere Model version 5 (CAM 5) was run for several years at different resolutions and with two different dynamical cores (Eulerian and Finite-Volume). The atmospheric river detection methods were then applied to the model data, in order to determine if the model could capture atmospheric rivers accurately, and if this accuracy depends on the resolution and dynamical core.