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## **On the importance for modeling the general circulation of closure theory for cumulus parameterizations**

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Closures for cumulus parameterizations remain a key theoretical challenge in meteorology. Unresolved questions include the extent to which convection is in equilibrium with the large-scale flow in which it develops, the nature of the putative equilibrium, interactions of deep convection with shallow convection and the planetary boundary layer, and the distributions of mass fluxes and vertical velocities among the clouds in a cumulus ensemble. This paper examines the importance of these closure aspects for large-scale flows in a general circulation model. They will be shown to be important for the tropical wave spectra, interannual variability, storm intensity distribution, diurnal cycle, and troposphere-stratosphere exchange of water vapor.