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# Mechanisms for Annual Cycle Changes in Monsoons in a Warming Climate

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Analyses of phase 5 of the Coupled Model Intercomparison Project (CMIP5) experiments show that the global monsoon is expected to increase in area, precipitation, and intensity as the climate system responds to anthropogenic forcing. Concurrently, detailed analyses for several individual monsoons indicate a re-distribution of rainfall from early to late in the rainy season. This presentation will further examine CMIP5 projected changes in the annual cycle of precipitation in monsoon regions, and use a moist static energy framework to evaluate competing mechanisms identified to be important in precipitation changes over land. In the presence of sufficient surface moisture, the local response to the increase in downwelling energy is characterized by increased evaporation, increased low-level moist static energy, and decreased stability with consequent increases in precipitation. A remote mechanism begins with warmer oceans and operates on land regions via a warmer tropical troposphere, increased stability, and decreased precipitation. The remote mechanism controls the projected changes during winter, and the local mechanism appears to control the switch to increased precipitation during summer in several monsoon regions. During the early summer transition, regions where boundary layer moisture availability is reduced due to decreases in evaporation and moisture convergence experience an enhanced convective barrier. This enhanced convective barrier leads to a redistribution of rainfall from early to late summer, and is robust in the American and African monsoons but not seen in Asia.