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Dynamics and thermodynamics of the regional response to the Indian monsoon onset

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The regional influence of the Indian Monsoon onset is examined though observational analysis focusing on the Rodwell-Hoskins "Monsoon-Desert" hypothesis, which proposes that the strong diabatic heating associated with the monsoon produces a Gill-like Rossby wave response that thermodynamically interacts with the mid-latitude westerly jet to produce subsidence and reduced rainfall to the west of the monsoon. Here we analyze this proposed mechanism in terms of changes to the thermodynamic energy equation, regional circulation, and precipitation between the 10-day periods before and after the monsoon onset, for all onset dates 1958-2000. A Rossby-like response to the monsoon onset is clear in the observational data and is associated with horizontal temperature advection at mid-levels as the westerlies intersect the warm temperature anomalies of the Rossby wave. Analysis of the thermodynamic equation verifies that the horizontal temperature advection is indeed balanced by subsidence over areas of North Africa, the Mediterranean, and the Middle East, and there is an associated decrease in precipitation over those regions. Despite the increased subsidence, diabatic heating changes are small in these regions so diabatic enhancement does not appear to be a primary factor in the response to the onset. This analysis also shows that the same processes that favor subsidence to the west of the monsoon also force rising motion over northern India, and appear to be an important factor for the inland development of the monsoon. Comparison of strong and weak onsets further validates these relationships.