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Atmospheric dynamics of hot Jupiters

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The stellar flux incident on hot Jupiters is expected to drive an atmospheric circulation that shapes the day-night temperature difference, infrared lightcurve, spectra, albedo, and atmospheric composition. In our previous work, we performed three-dimensional numerical simulations to explore the dynamics of hot Jupiters with an emphasis on HD209458b (Showman and Guillot 2002; Cooper and Showman 2005, 2006; Fortney et al. 2006). These simulations showed that winds of several km/sec and day-night temperature differences reaching 500-1000 K are possible at and above the photosphere; the simulated circulation takes the form of a broad superrotating (eastward) equatorial jet with superposed eddy activity. Here we extend these simulations to cover a much broader range of physical parameters relevant to a diversity of close-in planets. The gravity, rotation rate, and radiative time constant are systematically varied to determine the effect of these parameters on the strength, geometry, and vertical structure of the circulation. Radiation is parameterized with a simple Newtonian cooling scheme that relaxes the temperature toward radiative equilibrium over the radiative timescale. We will discuss the implications of our parameter variations for specific planets including HD189733b, TrES-1, and Ups-And b, which differ from HD209458b in mass, radius, gravity, rotation rate, and distance from the host star. The goal is to aid in interpreting existing and near-future observations of these planets.