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Consistent Dynamics Equations for Extrasolar Planet Neutral Atmospheres

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The equations that govern the dynamics of large-scale, neutral atmospheric motions on Solar System planets are reanalyzed for the extrasolar planet context. As in the traditional setting, the set of hydrostatic primitive equations presents a good starting point for extrasolar planet study. However, several modifications and reinterpretations are necessary – particularly for close-in planets. A careful scaling analysis, performed to ensure consistency of the different forms of the dynamical equations and to identify plausible constraints on the expected flow and temperature structures, is presented. Implications for current simulations and observations are also discussed.