



Reduced asymptotic models for planetary and synoptic motions in the atmosphere

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Reduced model equations valid for two different planetary scale regimes are presented. The models are derived using an unified multiple scales asymptotic approach and account in a systematic way for the planetary-synoptic interactions. The first regime includes the planetary geostrophic equations and a new two scale closure condition in the form of an evolution equation for the vertically averaged pressure. The influence of the synoptic scale on the planetary scale dynamics is represented by the planetary scale divergence of the synoptic momentum fluxes in the closure equation. In the second asymptotic regime only planetary variations in the zonal direction are allowed. This regime describes a coupling between the planetary evolution of the leading order synoptic PV field and the synoptic dynamics of higher order PV corrections. The analysis of experiments with a primitive equations model shows that the asymptotic models capture the leading order balances in the planetary scale vorticity transport.