Geophysical Research Abstracts
Vol. 17, EGU2015-7256, 2015
EGU General Assembly 2015

Superrotation in Held & Suarez-like flows with weak surface temperature gradient

Inna Polichtchouk (1,2) and James Y-K. Cho (2)

(1) Department of Meteorology, University of Reading, Reading RG6 6BB, United Kingdom (i.polichtchouk@reading.ac.uk),
(2) School of Physics and Astronomy, Queen Mary University of London, London E1 4NS, United Kingdom

Using a global general circulation model which solves the dry primitive equations, we investigate the generation of equatorial superrotation in Earth-like planetary atmospheres under zonally-symmetric thermal forcing. In the classic Held and Suarez (1994) setup, which normally does not exhibit equatorial superrotation, a robust transition to superrotation occurs when the equator-to-pole surface equilibrium temperature gradient is weakened. Such a reduced temperature gradient setup can be relevant to Earth-like exoplanets or past and future climates of the Earth. Two factors contribute to the transition in this situation: 1) reduction of equator-ward propagating mid-latitiude Rossby waves that break in the tropics and decelerate the equatorial flow and 2) presence of barotropic instability in the equatorial region that provides stirring to accelerate the equatorial flow. The instability also excites Kelvin waves important for generation and maintenance of superrotation. In addition, we find that superrotation can be artificially enhanced in under-resolved and/or over-dissipated simulations. By achieving numerical convergence, we quantify the roles of the Kelvin waves and the diffusion on superrotation.