

Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

Diabatic vortices: a simple framework for tropical cyclones and the martian polar vortex RICHARD SCOTT, University of St Andrews — The formation and subsequent evolution of annular distributions of potential vorticity, forced by the combination of diabatic heating and the angular momentum transport of secondary, transverse circulations, is investigated in the framework of the forced shallow water equations at various levels of complexity. Annular potential vorticity is found to develop under a range of forcing conditions depending on the radial location of diabatic heating and the structure of secondary circulation; the simplest, axisymmetric formulation of the model allows the effect of the two forcings to be examined in isolation. Further eddy permitting calculations allow the nonlinear transient evolution to be studied, where the competition of forcing and shear instability can give rise to quasi-regular vacillation cycles. The framework is applied to two very distinct geophysical systems, the terrestrial tropical cyclone and the martian winter polar vortex, where diabatic heating is due to the condensation of water vapor or carbon dioxide, respectively, and where eddy transience gives rise to such effects as eye-wall replacement cycles and controls the polar transport of dust and ice aerosols.

Richard Scott
University of St Andrews

Date submitted: 01 Aug 2019

Electronic form version 1.4