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Spontaneous transitions between sub- and superrotation in dry and moist shallow-water turbulence on the sphere

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We run a moist shallow water model with stochastic mesoscale forcing, to simulate the effects of mesoscale forcing on exciting large-scale flow structures. In previous work, we showed how the mesoscale forcing excites a classical -5/3 eddy kinetic energy upscale cascade to planetary scales where the linear tropical modes such as Rossby, Yanai, Intertial Gravity, and Kelvin waves form. In this work, we focus on the arising zonal mean flow.

We present results from ensembles of a few hundred simulations indicating multiple-equilibria in the tropical flow, once latent heat release passes a certain threshold in the first 1000 days. Runs up to one hundred thousand days confirm these results and show abrupt transitions in the dry and moist shallow-water turbulence lasting several thousand days. We will discuss the transient nature of the mean flow and suggest a possible new mechanism for the transition of the wind at the equator to super-rotation in a moist environment.