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LARGE-SCALE EXPERIMENTAL STUDY OF THE FORMATION OF ZONAL JETS IN CONVECTIVELY-DRIVEN GEOSTROPHIC TURBULENCE ON A BETA-PLANE

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One of the most striking aspects of the appearance of the gas giant planets in the outer solar system is the persistent and stable organisation of their upper cloud decks into zonal-oriented belts and zones, in association with a pattern of strong latitudinally-alternating zonal winds. Since the early numerical model simulations of Williams (1978), it has been suggested that this zonal organisation of the atmospheric circulation on these planets arises from highly nonlinear interactions between convectively-driven eddies in the background potential vorticity gradient produced by the rotation and spherical curvature of the planet (the so-called Rhines effect), leading under some circumstances to strongly anisotropic spectra and transfers of energy and enstrophy. Until recently, however, experimental confirmation of this effect in the laboratory has been sparse, owing mainly to the extreme conditions needed to access the relevant flow regimes. In a new set of experiments, carried out on the 13m diameter Coriolis Platform in Grenoble, convective geostrophic turbulence was driven by a uniform buoyancy flux introduced at the free surface of the rapidly-rotating tank by a continuous spray of dense, salty water. The resulting flow was allowed to develop in the presence of a conical lower boundary and was visualised and measured over periods of up to 5-6 hours. In this talk, we describe the experimental setup and report on new results which demonstrate the formation of up to 5 alternating zonal jets across the domain, depending on the strength of background rotation, topographic slope and strength of buoyancy forcing.