Laboratory experiments of multiple zonal jets in rotating fluids

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Abstract

In this work we investigate experimentally the formation and evolution of a system of alternating zonal jets in rotating fluids; the focus is therefore on the self-organization of persistent, geometrically defined flow patterns from a turbulent background subjected to a β-effect. Systems of alternating east-west jets are commonly observed in geophysical and planetary environments, indeed these structures play a prominent role in the transfer of both momentum and scalars and, more in general, in the overall dynamics of the atmospheres of Gas Giants as well as of the terrestrial oceans [1].
We perform a set of laboratory experiments in a rotating tank in which turbulence is generated by electromagnetically forcing a shallow layer of saline solution and the flow is measured using image analysis [2]; the measurement campaign is carried out by widely varying the main experimental control parameters, *e.g.*, the fluid thickness, the rotation speed of the tank, the forcing intensity, and analyzing how the system modifies accordingly. On the base of the collected data, we characterize and quantify the observed flow features in both the Eulerian and the Lagrangian frame of reference and in particular we focus on the geometry of the simulated jets [3] and on their diffusion properties [4, 5].

References

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