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Strong Vortex Insteractions in Quasi-Geostrophic Flows

Jean N. Reinaud, David G. Dritschel, Ross R. Bambrey

University of St Andrews, St Andrews, UK

We examine the strong interaction between two quasi-geostrophic vortices. The interaction depends on 6 parameters: the volume ratio, the potential vorticity ratio, the height-to-width aspect ratios, and the vertical and horizontal offsets. The parameter space is huge and highly efficient methods are needed to cope with the size of the problem. We primarily use a novel solution method, the Ellipsoidal Model (ELM), which models vortices as ellipsoids and filters higher-order deformations. It proves to be highly accurate and allows us to determine steadily rotating equilibria for both like-signed and opposite-signed vortices. We next determine the margin of linear stability of these states which we associate with the critical distance for strong vortex interactions. We complete the description of the interactions by illustrating the nonlinear evolution of selected unstable interactions here using the full dynamical equations (including non-ellipsoidal deformations).

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