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Jet sharpening by turbulent mixing. (English) Zbl 1219.85007

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Summary: Jets or localized strong currents in planetary atmospheres, as well as in the Earth's oceans, are often associated with sharp potential-vorticity gradients owing to the inherent balance exhibited by these flows. Here, we explore and quantify jet sharpening in a simple idealized single-layer quasi-geostrophic model on a mid-latitude β -plane. The advantages of this idealization are that just two parameters control the flow development (the Rossby deformation length and the amplitude of the initial random flow perturbation), and that numerical experiments can comprehensively and accurately cover the parameter space. These experiments, carried out at unprecedented numerical resolution, reveal how an initially broad jet is sharpened, and the role played by coherent vortices in the vicinity of jets.

MSC:

85A20 Planetary atmospheres

76F99 Turbulence

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Keywords:

jets; turbulent mixing; potential vorticity

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