Khatri, Hemant; Berloff, Pavel

Tilted drifting jets over a zonally sloped topography: effects of vanishing eddy viscosity. (English) Zbl 1430.86003

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Summary: Oceanic multiple jets are seen to possess spatio-temporal variability imposed by varying bottom topography resulting in jets that can drift and merge. The dynamics of multiple jets over a topographic zonal slope is studied in a two-layer quasi-geostrophic model. The jets tilt from the zonal direction and drift meridionally. In addition to the tilted jets, other large-scale spatial patterns are observed, which are extracted using the principal component analysis. The variances of these patterns are strongly influenced by the values of eddy viscosity and bottom friction parameters. The contribution of the tilted jets to the full flow field decreases with decreasing friction and viscosity parameters, and purely zonal large-scale modes, propagating in the meridional direction, populate the flow field. Linear stability analysis and two-dimensional kinetic-energy spectrum analysis suggest that the zonal modes gain energy from ambient eddies as well as from the tilted jets through nonlinear interactions. However, viscous dissipation and bottom friction tend to suppress the nonlinear interactions, which results in the inhibition of the upscale energy transfer from eddies to the zonal modes. These simulations suggest that, in the presence of topography, alternating jet patterns may be sustained through interactions among various large-scale modes. This is different from the classical zonal jet formation arguments, in which direct eddy forcing maintains the jets.

MSC:

86A05 Hydrology, hydrography, oceanography
76U05 General theory of rotating fluids
76F05 Isotropic turbulence; homogeneous turbulence

Keywords:

quasi-geostrophic flows; jets; topographic effects

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