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Spontaneous generation and reversals of mean flows in a convectively-generated internal gravity wave field[1] LOUIS-ALEXANDRE COUSTON, CNRS, Aix Marseille Univ, Centrale Marseille, IRPHE, DANIEL LECOANET, Princeton Center for Theoretical Science, Princeton University, BENJAMIN FAVIER, MICHAEL LE BARS, CNRS, Aix Marseille Univ, Centrale Marseille, IRPHE — We investigate via direct numerical simulations the spontaneous generation and reversals of mean zonal flows in a stably-stratified fluid layer lying above a turbulent convective fluid. Contrary to the leading idealized theories of mean flow generation by self-interacting internal waves, the emergence of a mean flow in a convectively-generated internal gravity wave field is not always possible because nonlinear interactions of waves of different frequencies can disrupt the mean flow generation mechanism. Strong mean flows thus emerge when the divergence of the Reynolds stress resulting from the nonlinear interactions of internal waves produces a strong enough anti-diffusive acceleration for the mean flow, which, as we will demonstrate, is the case when the Prandtl number is sufficiently low, or when the energy input into the internal wavefield by the convection and density stratification are sufficiently large. Implications for mean zonal flow production as observed in the equatorial stratospheres of the Earth, Saturn and Jupiter, and possibly occurring in other geophysical systems such as planetary and stellar interiors will be briefly discussed.

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