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Instability driven relaxation of an anticyclone EUNOK YIM, Laboratory of Fluid Mechanics and Instabilities, EPFL, Lausanne, CH-1015, PAUL BILLANT, LadHyX, Ecole polytechnique, Palaiseau, 91120, France, FRANCOIS GALLAIRE, Laboratory of Fluid Mechanics and Instabilities, EPFL, Lausanne, CH-1015 — We study the nonlinear evolution of the centrifugal instability appearing in a columnar anticyclone using a semi-linear approach to model the transient unsteady flow evolution in a self-consistent manner. For anticyclones in a homogeneous viscous flow, the fastest growing instability is without oscillation in time but with a finite axial wavenumber. Hence, the self-consistent model is developed around the spatially averaged time dependent meanflow and the fluctuation, which reduces the problem from 2D nonlinear to 1D semi-linear. The two linear meanflow and fluctuation equations are coupled via the Reynolds stress of the fluctuations. At a given rotation ratio between the vortex angular velocity and the background rotation, only the most linearly unstable mode is considered for Reynolds numbers $Re = 800$ and 2000 defined with the maximum angular velocity and the radius of the vortex. For both values of Re, the model predicts well the nonlinear evolution of the meanflow and the fluctuation amplitude. Higher harmonics are non-negligible only at the highest value of Re. The results show that the angular momentum of the meanflow is homogenized to a stable state via the action of the Reynolds stresses of the fluctuation.

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