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Near-inertial damping of geostrophic flows

Recent work examining balanced-to-unbalanced energy transfers in the low to moderate Rossby number regimes typical of the atmosphere and ocean have suggested that, although spontaneous loss of balance is weak, balanced-to-unbalanced energy transfers can nonetheless be significant when near-inertial (unbalanced) motion is either externally forced or present in initial conditions. Here, we review recent literature and attempt to disentangle the messy jargon that it has introduced. Further, we present examples from a range of numerical settings: i) an unstratified wind-driven primitive equation ocean basin, ii) a wind-driven primitive equation (ocean) channel and iii) decaying turbulence near an idealized, Boussinesq tropopause. In all cases, the total flow includes geostrophic and near-inertial components, and our interest is in describing energy exchanges between the two. We will also comment on idealisations in which the total flow is considered to be the sum of geostrophic and weakly nonlinear near-inertial components (e.g., as in recent models by Xie and Vanneste (2015) Wagner and Young (2016)). We find this idealization to be reasonable at large horizontal scales, and that it is at these scales where the bulk of the energy transfer occurs.