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3D Vortices in Stratified, Rotating Flows - Secondary Circulations and Changes in Aspect Radio Due to Dissipation PHILIP MARCUS, PEDRAM HASSANZADEH, UC Berkeley — The aspect ratio of a 3D vortex in a rotating, stratified flow is defined as the ratio of its vertical half-thickness H to its horizontal scale L. We recently showed that due to hydrostatic and geo/cyclostrophic balance, an anticyclone has an equilibrium scaling law of $H/L = Ro(1 - Ro)f/(\bar{N} - N_{in})$, where Ro is the Rossby number of the vortex, f is the Coriolis parameter, and $\bar{N}$ and N_{in} are the Brunt-Väisälä frequencies of the local ambient fluid and of the vortex interior, respectively. Introduction of a viscous or thermal dissipation (the latter being much more rapid and therefore much more relevant in atmospheric, astrophysical, and planetary vortices) forces a vortex that was initially in equilibrium to decay through a series of quasi-stationary states. Both viscous and thermal dissipation rapidly induce secondary circulations within the vortex, but the circulations created by the two types of dissipation differ qualitatively from each other. Moreover, thermal dissipation rapidly changes the values of Ro and N_{in}, so although the equilibrium scaling law above is still satisfied, the aspect ratio of the vortex changes rapidly. We show how the resulting aspect ratio of the vortex, and the magnitude and geometry of the secondary circulation are both strong functions of the vertical dependence of $\bar{N}$.

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