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Inertia-gravity waves associated with a vortex dipole

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Vortex dipoles provide a simple representation of localized atmospheric jets. We consider a dipole in surface potential temperature in a rotating, stratified fluid with uniform potential vorticity. Following an initial period of adjustment, the dipole propagates along a slightly curved trajectory at a nearly steady rate and with nearly fixed structure for more than 20 days. The flow also contains upward propagating inertia-gravity waves that are stationary with respect to the dipole and form elongated bows concentrated near and roughly aligned with the leading edge of the dipole. The persistence of the waves for tens of days strongly suggests the waves are inherent features of the dipole itself, rather than being remnants of imbalances in the initial conditions. The wavelength of the waves decreases and their vertical velocity increases as they near the stagnation point at the leading edge of the dipole, and we show that the wave vector tends to assume a preferred orientation determined by the local horizontal deformation and vertical shear. These simulations are consistent with wave emission by the balanced flow.