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The Equations for Geostrophic Motion in the Ocean

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ABSTRACT

A multiple-scale approach is used to develop the quasi-geostrophic dynamics for synoptic oceanic scales. This new approach allows the buoyancy frequency N and the Coriolis parameter f to be slowly varying functions of horizontal position. No series expansion of f about some arbitrary central latitude is required. Nor is there a limitation on the geographic extent of the synoptic-scale domain.

Simultaneously, the equation for large-scale geostrophic flow on a gyre, or planetary, scale is derived as a solvability or consistency condition on the synoptic-scale dynamics. Thus a single derivation suffices to develop both sets of dynamical equations. In addition, the multiple-scale analysis explicitly describes the interaction terms between the synoptic-scale and gyre-scale fields of motion.

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