

12.803

Quasi-balanced Circulations in Oceans and Atmospheres

Fall 2008

I. Fundamental Conservation and Balance Principles for Large-scale Flow

Hydrostatic balance
Conservation of potential vorticity
The invertibility principle
The shallow water equations
The Rossby number and the quasi-geostrophic equations
Geostrophic adjustment
The superposition principle
Higher-order balance systems
Separation of flow into balanced and unbalanced parts
The “omega equation”

II. Generation and Dissipation of Quasi-balanced Eddies

Rossby waves
Barotropic instability
The Rayleigh and Fjørtoft theorems
The Eady model
The Charney model
The Charney-Stern theorem
Surface friction and Ekman Layers
Western Boundary Currents
Effects of phase change of water
Effects of orography: topographic waves
Observed modes of eddy development
Generation and dissipation of ocean eddies

III. Equilibrated Quasi-Balanced Systems

The Eliassen-Palm theorem
Two-dimensional and Quasi-geostrophic turbulence and inverse cascades
The Rhines scale and quasi-balanced jets
Equilibration of baroclinic eddies in the ocean