GEF3450/GEF4450: Geophysical Fluid Dynamics (Fall 2015)

I. Introduction
- Lagrangian/Eulerian description (GFD 1.1)
- Mass conservation (GFD 1.2)
- Momentum conservation, with rotation and friction (GFD 1.3)
- Equations of state (GFD 1.4)
- Thermodynamics (GFD 1.5)
- Vertical variation of density in atmosphere and ocean (KCH 13.2, GFD 1.5)

II. GFD: Simplifications and dominant balances
- Incompressbility and the Boussinesq approximation (GFD 2.4)
- f-plane and Beta-plane approximations (KCH 13.4 and GFD 2.2)
- Equations of motion for the ocean (KCH 13.3, 13.4)
- Geostrophic balance (KCH 13.5 and GFD 2.1)
- Other momentum balances (GFD 2.1)
- Hydrostatic balance (GFD 4.5)
- Thermal wind (KCH 13.5 and GFD 2.5)
- Pressure coordinates (GFD 2.4.2)
- Equations of motion and balances for the atmosphere (GFD 2.7)

III. Vorticity
- Flow lines, stream tubes (KCH 3.3)
- Strain and rotation (KCH 3.4, 3.5)
- The vorticity equation, in 3D and 2D
- Circulation and Kelvin's theorem (KCH 5.1-5.3)
- The vorticity equation for quasi-2D motion

IV. Shallow water flows
- Taylor-Proudman theorem (KCH 13.5)
- Shallow water equations (GFD 3.1, KCH 13.8)
- Volume conservation (GFD 3.2.1)
- Vorticity conservation (GFD 3.2.2, KCH 13.13)
- Potential vorticity conservation (GFD 3.2.3)
- Linear system, f-plane (GFD 3.4-3.5)
- Gravity waves without rotation (GFD 3.6, KCH 13.10)
- Gravity waves with rotation (GFD 3.7, KCH 13.11)
- Geostrophic adjustment (GFD 3.8)
- Kelvin waves (GFD 3.9, KCH 13.12)
- Barotropic QG vorticity equation (GFD 4.1, KCH 13.15)
- Barotropic Rossby waves (GFD 4.4, KCH 13.15)
- Mountain waves (GFD 4.6)

V. Ekman layers
- Boundary layer equations (GFD 2.6)
- Surface Ekman layer (GFD 2.6, KCH 13.6)
- Bottom Ekman layer (GFD 2.6, KCH 13.7)
- Spin down (GFD 4.5)
- Mountain waves with friction (GFD 4.6)

VI. Baroclinic flows
- The QG equations (GFD 5.1-5.3)
- Baroclinic Rossby waves (KCH 13.5, GFD 5.5)
- Mountain waves and sudden stratospheric warming (GFD 5.6)
- Topographic waves (GFD 5.7)
- Baroclinic instability (KCH 13.17, GFD 5.8, 5.9)

GFD: *Geophysical Fluid Dynamics*, LaCasce (http://folk.uio.no/josepl/publications.html)
KCD: *Fluid Mechanics*, Kundu, Cohen, Dowling