

MPO/OCE 750: Coastal Ocean Circulation

Spring 2018,
M/W 3:00-4:20,
MSC 329

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Office Hours: 1:30-3:00 M/W
MSC 367

Description:

The oceanography of the continental margins are where tides, winds and waves interact on a spectrum of temporal and spatial scales in driving the shelf circulation from the shelf break to the inner shelf. The effects of barclinity, topography (and bottom stresses) will be explored in this course. We will highlight fundamental differences between wide versus narrow shelves, and those where boundary currents impact the shelf circulation such as the Loop Current on the west Florida shelf; Florida Current and Gulf Stream along the east coast; and the weaker and broader California Current along the US west coast.

1. Introduction: Basic Processes and Observational Techniques (Weeks 1-2)

- A. Definitions
- B. Governing Equations/Laws
- C. Moorings and Buoys
- D. Remote Sensing Techniques

2. Surface Winds (Weeks 3-4)

- A. Friction velocity and surface layer
- B. Log layer
- C. Methods of determining wind stress
- D. Nondimensional Scaling/Buckingham Pi Theorem

3. Sea Level Variations and Barotropic Tides (Weeks 5-6)

- A. Tidal Constituents
- B. Harmonic Analysis of Tides
- C. Tidal Currents

4. Responses to Wind (Weeks 7-8)

- A. Steady State-Ekman Response (Upwelling/Downwelling)
- B. Wind Setup Along the Coast
- C. Seiche Effects in Narrow and Rectangular Basins
- D. Along-Shelf Wind Stress and Sea Level
- E. Transient Responses to Winds
- F. Coastal Kelvin and Rossby Waves

5. Stratification Effects (Weeks 9-10)

- A. Normal Modes (Barotropic and Baroclinic)
- B. Projection of Wind Stress onto Modes
- C. Ekman Layer (Stratification-Limited)

D. Ventilation of the Pycnocline
E. Effects of Riverine Outflows

6. Bottom Topography Effects (Weeks 11-12)

A. Winds over Variable Depth
B. Topographic-Induced Gyres
C. Seiches over Variable Bottom Depth
D. Variable Depth and Rotation
E. Vorticity Effects (Taylor-Proudman Theory)
F. Stratified Shear Flows over Topography

7. Transient versus Steady Flows (Weeks 13-15)

A. Frictional and Frontal Adjustments
B. Parameterization of Interior Currents and Bottom Stress
C. Circulation along a Straight Coast
D. Inclined Beach Model
E. Circulation Features of the Loop Current, Florida Current and Gulf Stream (e.g., Eddy Variability)
F. Cross-Shelf Exchanges

Books: On Reserve

Bowman, M. J., and W. Esaias, 1977: Oceanic Fronts in Coastal Processes. Springer-Verlag, New York, New York, 115 pp. (Reference)

Csanady, G., 1982: Circulation in the Coastal Ocean. D. Reidel, London, England, 279 pp. (Reference)

Garratt, J. R., 1992: The Atmospheric Boundary Layer, Cambridge University Press (Reference)

Gill, A. E., 1982: Atmospheric-Ocean Dynamics, Academic Press, Inc., London, 662 pp. (Reference)

Kraus, E. B., and J. A. Businger, 1994: Atmosphere-Ocean Interaction, 2nd edition, Oxford University Press, Oxford, 362 pp. (Reference).

Mooers, C. N. K., 1986: Baroclinic Processes on Continental Shelves, Coastal and Estuarine Sciences 3, American Geophysical Union, Washington DC, 130 pp. (Reference)

Phillips, O. M. and K. Hasselman, 1986: Wave Dynamics and Radio Probing of the Ocean Surface, Plenum Press, 681 pp.(Reference)

Richards, F. A., 1981: Coastal Upwelling, Coastal and Estuarine Sciences 1, American Geophysical Union, Washington DC, 529 pp. (Reference)

Selected manuscripts as assigned.

Grading:

1. Homework/Lab Assignments: 33%
2. Mid Term Exam: 33%
3. Final Exam: 33%