SCRIPPS INSTITUTION OF OCEANOGRAPHY UC San Diego

Falk Feddersen: Class Nearshore Physical Oceanography (SIO 261, Spring 2020)

Nearshore Physical Oceanography

SIOC 261
Professor Falk Feddersen
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Meetings
Class: Zoom Monday/Wed 2:00-3:20pm
Office Hours: Zoom, TBD

Course Requirements Completing of all the problem sets and projects. The final grade will be based 1/3 on problem sets and 2/3 on projects Students should enroll in four (4) units as either letter (1st year students) or S/U.

Description This course, *Nearshore Physical Oceanography*, will cover the basic physics of the nearshore and coastal regions spanning the surfzone to the outer shelf. Topics covered will include how surface gravity waves, winds, and tides force circulation and its intrinsic response across this region. Additional topics are also possible.

Syllabus

Overview

- What is the nearshore? The range of processes, time-scales, length-scales that occur in the nearshore

Surface Gravity Waves : Sea/Swell

- Review of linear surface gravity waves: plane waves
- Random directionally spread waves
- Flux-conservation equations, wave energy, energy flux, and mass flux (Stokes drift)
- Wave momentum flux: Radiation Stresses (Chapter 4, Longuet-Higgins & Stewart, 1964, read first 8 pages)
- Cross-shore wave transformation - shoaling and breaking (Chapter 9)

Depth-Averaged Processes, Setup, Alongshore Currents

- Wave-induced setdown and Setup
- Depth-integrated models for nearshore circulation: Inviscid (Chapter 10, Smith 2006)
- Bottom stress and Lateral Mixing (Chapter 11)
- Local Alongshore Uniform Dynamics: Surfzone (setup + alongshore currents, Ch 5, 13, & 14)
- Local Alongshore Uniform Dynamics: Inner-shelf (Chapter 15, Lentz et al. 1999 JGR)

Infragravity Waves

- Edge Waves and Shelf waves (Chapter 12)

Nonlinear wave interaction and wave modeling

- Boussinesq wave models
- Nonlinear wave interaction, bispectra, and infragravity wave generation

Depth-Resolving Processes

- Wave and Tidal boundary layers + steady streaming
- Current Boundary Layers
- Sediment, Fall Velocity, Sediment mobilization, Bedload and suspended load transport.

Other

- Rip currents
- Inner-shelf internal waves

Lecture notes will be posted here.

- Lecture Notes and HW as of 13 April 2020

Books
There are some books that have relvant material in them. These include

- Kundu, Cohen, Dowling, *Fluid Mechanics:* Chapter 7 on Gravity Waves (same book as SIOC 214 - denoted KUNDU)
- Mei, CC, The Applied Dynamics of Surface Gravity Waves (in CCS basement). Note that this book is also available electronically

from UCSD library: E-BOOK
- Kamphuis, J.W., Introduction to coastal engineering and management 2000 (EBOOK: need to be on UCSD network).
- Dean and Dalrymple, Coastal processes: with engineering application 2002. (EBOOK: need to be on UCSD network)
- Svendsen, IA, Nearshore Hydrodynamics
- Dean and Dalrymple, Water Wave Mechanics for Scientists and Engineers

Papers to be discussed in class
Sea-swell Surface Gravity Waves

- Kuik et al. A Method for the Routine Analysis of Pitch-and-Roll Buoy Wave Data, JPO, 1988.
- Longuet-Higgins M.S. and R.W. Stewart, Radiation stress in water waves: A physical discussion with application, *Deep Sea Research*, Vol 11, 529-563, 1964. LINK
- Longuet-Higgins and Stewart, Radition stress and mass transport in gravity waves, with application to 'surf beats', JFM, 1962.
- Duncan, J. H., An experimental investigation of breaking waves produced by a towed hydrofoil, Proc. Royal Society A, 1981.
- Thornton E.B., and R. T. Guza, Transformation of Wave Height Distributions, *J. Geophys. Res.*, **88**, 5925--5938, 1983.

Depth-averaged processes: Setup, setdown, circulation, edge waves

- Bowen, Inman, and Simmons, Wave Set-Down and Set-Up, *JGR*, Vol 73, N8, 2569-2577, 1968.
- Raubenheimer, Elgar, Guza, Field observations of wave-driven setdown and setup, JGR, 2001.
- Apostos, Raubenheimer, Elgar, Guza, Smith, Effects of wave roller and bottom stress on wave setup, JGR, 2001.
- Longuet-Higgins, M.S., Longshore Currents Generated by Obliquely Incident Sea Waves 1., *JGR*, Vol 75, 33, 6778-6789, 1970
- Feddersen, F., R. T. Guza, S. Elgar, and T. H. C. Herbers, Alongshore Momentum Balances in the Nearshore, *J. Geophys. Res.*, **103**, 15,667-15,676, 1998.
- Ruessink, B.G, J.R. Miles, F. Feddersen, R. T. Guza, and S. Elgar, Modeling the Alongshore Current on Barred Beaches, *J. Geophys. Res.*, **106** 22,451-22,463, 2001.
- Lentz S. J., R. T. Guza, S. Elgar, F. Feddersen, and T. H. C. Herbers, Momentum Balances on the North Carolina Inner Shelf, *J. Geophys. Res.*, **104**, 18,205-18,226, 1999. link

Infragravity Waves

- Munk, Snodgrass, Gilbert, Long waves on the continental shelf: an experiment to separate trapped and leaky modes , JFM, 1964
- Mysak, L. 1980, Topographically Trapped Waves, Annual Reviews Fluid Dynamics, LINK
- Oltman-Shay and Guza, Infragravity Edge Wave Observations on Two California Beaches , JPO, 1987
- Bertin et al., Infragravity Wave Review, Earth Science Reviews, 2018 - LINK

Nonlinear wave-wave interactions

- Peregrine, D.H. Long waves on a beach *J. Fluid Mech.* **27** 815-827. 1967.
- Freilich, M. and R. T. Guza
- Elgar, Herbers

Bottom boundary layer proceses and sediment transport

- Gallagher EL, Elgar S, Guza RT, Observations of sand bar evolution on a natural beach *J. Geophysical Research*, **103**, 3203-3215 FEB 15 1998.
- Hoefel F, Elgar S, Wave-induced sediment transport and sandbar migration *Science*, **299**, 1885-1887, MAR 21 2003.

If you have any questions or comments, please contact me at falk@coast.ucsd.edu.
