Special Topics in Marine Turbulence
3 credits

Instructor: Robert Hetland
Office: O&M Building Room 618d Phone: 458-0096
E-mail: hetland@tamu.edu

Description:
This course is an overview of turbulent mixing in the ocean, with a focus on how turbulent mixing is approximated in modern numerical models of ocean circulation. The course comprises of three components: theory, numerical modeling, and literature review. The theory section focuses on the Reynolds averaged equations of motion, and introduces many important non-dimensional numbers important in quantifying turbulent mixing. The numerical modeling component focuses on the General Ocean Turbulence Model (GOTM), a program that contains a number of one-dimensional turbulent mixing parameterizations. Finally, recent literature on observations and simulations of turbulent mixing in the ocean will be reviewed.

Prerequisites: OCNG 609, or instructor permission.

Learning outcomes:
Students will be able to read and critically evaluate scientific papers on turbulent mixing in the ocean. Students will be able to configure the numerical model GOTM for simple standard cases, such as boundary layer mixing, and analyze and plot numerical results. Students will be able to define standard parameters used in characterizing turbulent mixing, and explain the physical meaning of these parameters.

Course Outline:

Introduction to turbulence: Characterization of turbulent flows, mathematical scaling, fundamental concepts and assumptions, Kolmogorov scales, energy cascade.

Fluid / continuum dynamics: Tensors; Einstein notation; deformation, shear, and stress; Reynolds decomposition

Classic examples of unstratified turbulence: Wall-bounded turbulence, the law of the wall, turbulence in a jet, entrainment

Stratified turbulence: Buoyancy, available potential energy, the Richardson number, the Taylor-Goldstein equation, Kelvin-Helmholtz instabilities

Two-equation models of turbulence: The $k$-$\varepsilon$ model, other common models used in oceanography, using GOTM

Grading:
Homework will be assigned approximately every other week; there will be no exams. Students are expected to actively take part in class discussions. Students will be expected to work on a project, with
results presented in class in the final weeks of the course. Homework will account for 50% of the grade, class participation 25%, and the group project 25%.
The grading scale for all students is 90-100% = A, 80-89% = B, 70-79% = C, etc.

Text:
*Turbulence: an Introduction for Scientists and Engineers* by P. A. Davidson

Attendances:
Excused absences will be based on Student Rule 7 (http://student-rules.tamu.edu/rule07). Please inform me before any planned absences, and I will try to be accommodating.

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