

Syllabus

OCN 760 Dynamics and Probability

The course will cover the basic dynamical and probabilistic concepts that underlie oceanography and climate sciences. Emphasis will be on the concepts, with oceanographic applications used as illustrations. Specifically, the course will cover the following subjects:

1. **Deterministic dynamical systems:** stability, long-time behavior, chaos, control parameters, bifurcations, and structural stability.
2. **Probability theory:** probability spaces, independence, the law of large numbers, the central limit theorem, stochastic processes.
3. **Time evolution of broadened initial conditions:** ergodic, mixing and exact systems.
4. **Statistical mechanics:** micro and macrocanonical ensemble, entropy, BBGKY hierarchy and Boltzmann equation.
5. **Stochastic dynamical systems.** autoregressive processes, Langevin equation, and stochastic differential equations.
6. **Reduced descriptions:** coarse graining, averaging, partitioning and traces.
7. **Probability in scientific reasoning:** estimation, hypothesis testing, and Bayesian inference.

The class will consist of lectures by the instructor, classroom discussions, and presentations by students. Handouts with technical details will be provided.

Grading will be based on student presentations, homework assignments, and participation in classroom discussions.

Student learning outcomes:

By the end of the class the student should have a proper understanding of terms like chaotic, ergodic, random, stochastic and statistical when she/he encounters these in applications.