Course title: Physical and Chemical Oceanography

Instructor: Taka Ito

Text (required): *Ocean Dynamics and the Carbon Cycle*, By R. G. Williams and M. J. Follows, Cambridge University Press, 2011.

Reference text (optional): *Atmosphere, Ocean and Climate Dynamics*, by J. Marshall and A. Plumb, Academic Press, 2008

Course Overview: The objective of this course is to provide a broad view of the oceans for advanced undergraduate and graduate students interested in marine sciences. The course material covers fundamental principles of physical, chemical and biological oceanography, focusing on the basic processes and mechanisms at work in the oceans including equation of motion in rotating frame of reference, carbonate chemistry, air-sea gas transfer, photosynthesis and respiration. These concepts are applied to illustrate large-scale ocean circulation and biogeochemical cycling of gas and nutrient tracers. Physical demonstrations and observational data are used to develop physical insights.

Evaluation: Graduate students will have additional homework and are expected to lead in-class discussion on reading assignments. Undergraduate evaluation: Homework (20%), 2 mid-term exams (25% each), final exam (30%); Graduate evaluation: In-class paper discussion (10%), Homework (20%), 2 mid-term exams (20% each), final exam (30%)

Outline

Week 1-3: *Observational backgrounds*, kinematics, tracer transport fundamentals
Week 4-5: *Fluid dynamics fundamentals*, equation of motion in rotating frame

Midterm exam 1

Week 6-7: *Biogeochemical fundamentals*, photosynthesis and respiration, nutrients and carbon cycling, gas transfer, chemical equilibrium
Week 8-10: *Atmosphere-ocean climate system*, atmospheric gen circ, Ekman, gyres, Sverdrup, WBCs, subduction, ACC, ocean eddies.

Midterm exam 2

Week 11-14: *Large-scale physical-biogeochemical processes*, seasonal bloom, nutrient cycles in oligotrophic gyres, polar ecosystem, HNLC, iron
Week 15-16: *Global synthesis*, thermohaline circulation, carbon pump theory, the fate of anthropogenic carbon, glacial CO2 problem

Final exam