This course provides an introduction to physical phenomena in the Indian Ocean, covering observations, theories, and models. Most talks will be presented by Jay McCreary, but additional presentations will be given by guest speakers (Dr Wenju Cai, Professor Matthew England, Dr Susan Wijffels and Professor Gary Meyers).

Lectures will cover Indian-Ocean phenomena at a variety of time scales: the climatological annual cycle, intraseasonal variability, interannual variability, and long-term trends. For most topics, a hierarchy of models will be presented, beginning with idealized analytic solutions whenever possible: The analytic solutions clearly reveal fundamental processes at work in the Indian Ocean (and elsewhere), and provide the building blocks necessary for understanding solutions to more complex, ocean general circulation models (OGCMs). The course requires a knowledge of basic physical oceanography. Although focused on physics, it also involves the solution of partial differential equations. The necessary mathematics tools will be presented in one lecture.

See next page for an overview of lectures.
PROPOSED TOPICS TO BE COVERED IN LECTURES

Ocean models: An overview of the hierarchy of models to be considered in the course.

Climatological phenomena and processes: An overview of the processes that are active in the Indian Ocean in the mean and at the annual cycle. Talks will cover both the surface circulation and the shallow overturning cells that, among other things, provide the cool water that upwells.

Modeling building blocks: A suite of analytic solutions will be presented that illustrate wind-forced responses to idealized models in the interior, coastal and equatorial oceans.

Tsuchiya Jets: This talk introduces the concept of LPS dynamics, in which the propagation of baroclinic Rossby waves is impacted by mean currents. The theory is applied to the “Tsuchiya Jets” in the Pacific Ocean, a pair of currents that lie on either side of, and at somewhat deeper depths, than the Equatorial Undercurrent. Aspects of LPS theory that may be at work in the Indian Ocean are noted in the lecture on the Indonesian Throughflow.

Indonesian Throughflow: The Indonesian Throughflow significantly impacts Indian Ocean circulations. This talk focuses on describing and understanding those impacts.

IO intraseasonal variability: Yanai and Kelvin waves are prevalent along the equator at intraseasonal time scales. In the western ocean, they appear to be generated by unstable currents, whereas in the interior of the basin they are wind-driven.

Biophysical processes: Biological activity is controlled by the physical environment. Major biological regimes in the Indian Ocean are reviewed, as well as the physical processes that control them.

Impacts on climate: During the past decade, the climate community has realized that the Indian Ocean significantly impacts climate. (ENSO doesn’t control all tropical climate after all!). Some of these recent studies are reviewed.

GUEST LECTURES

Dr Wenju Cai, CSIRO
The Supergyre in a changing climate

Professor Matthew England, UNSW
Interannual variability in Indian Ocean heat content and links to regional climate

Dr Susan Wijffels, CSIRO
Indonesian Throughflow

Professor Gary Meyers, IMOS
Ocean Observing System (IndOOS), development and recent scientific results.