Wave & Stability in Fluids & Geofluids

The propagation of waves represents one of the fundamental mechanisms for the transport of energy in a moving fluid. Two of the most familiar examples are sound waves and surface water waves. Waves can also appear due to flow instabilities, as an onset to the complexity of fluid turbulence. The theme of this course will be the development of analytical methods for the understanding of waves and instabilities — in specific contexts taken from fluid models.

The theory of acoustics begins from the demonstration that weak variations in flow, density and pressure result in the linear wave equation. Beyond simple translation, linear wave propagation can display richer behaviours due to the effects of spatial dimensionality, dispersion and refraction. When the background flow has stronger spatial variation, as for jet and shear flows, the possibility arises for nonlinear instability. Finally, variations in background density can be addressed under the Boussinesq assumption, which is the foundation for the modelling of thermal convection and geophysical flows. Many of the new types of waves and instabilities introduced through these buoyancy effects are particularly relevant to the dynamics of the atmosphere and ocean.

In addition to focussing on model development and analysis, assigned work will also emphasize proficiency in the use of research tools for searching the scientific journal literature. Computer visualization and numerical computing will involve the use and modification of Matlab scripts.

Professor: David Muraki, office K10538, phone 778.782.4814

Lectures: Tuesday & Thursday at 9:30-11:20am in AQ 5006

Office Hours: Tuesday 3:00-5:00pm, or by special arrangement (phone/e-mail)

Readings: *Introduction to Hydrodynamics Stability*, P.G. Drazin, Cambridge (2002)
Waves in the Ocean and Atmosphere, J. Pedlosky, Springer (2003)

Webpages: class link from *www.math.sfu.ca/∼muraki*
updated weekly — assignments, computing demos & announcements
student-maintained course wiki page
updated weekly — notes, discussions & resource lists

Communication: wiki-page discussion postings as class broadcast
muraki@sfu.ca: private class-related e-mail correspondence only
muraki@math.sfu.ca: urgent correspondence only please

Computing: Matlab is the baseline computing environment
lecture & homework scripts will be posted on web/wiki pages
Matlab accessible via campus network & labs

Responsibilities: weekly assignments, midterm
presentation & final projects
active participation: including note-taking & wiki-management