

Possible Projects

In collaboration with colleagues at UVic and the Institute of Ocean Sciences, the Ocean Physics Group has a significant number of projects suitable for graduate students at the MSc or PhD levels. MSc projects involve either numerical modelling/theory or data analysis, PhD topics ideally will involve both.

Applying

I am jointly appointed in SEOS and Physics and Astronomy. Students have the option of applying through either department. The physics degrees require more physics courses to be taken, the SEOS degree more earth-system-science courses.

- Physics Grad Program: [Calendar](#), [Department](#)
- SEOS Grad Program: [Calendar](#), [Department](#)

While I want grad students, I *strongly* advise students to cast a wide net and discuss projects with other potential supervisors. There is a wide variety of approaches and methods and finding a good match for your personal tastes is important.

Applying for an NSERC is always a good idea, particularly if you are an A-student with research experience. Applications are usually due in early October, the year before you apply for grad school.

All students should **apply to UVic by Feb 15th** to be considered for a UVic award.

Observational projects

These are opportunistic, in that when we can get ship time or participate in a project a data set is made available. Currently, I have datasets from:

- internal wave and turbulence data from the continental shelf
- dye dispersal, and tidal dynamics, in Saanich Inlet.
- Velocity time series at the sill in Saanich Inlet.

Other data sets will be collected in the near future.

Observational theses are less specified than numerical theses, as the ocean does not always yield observational results in a predictable manner. The steps are usually:

- characterize what phenomena are present in the observations
- quantify the phenomena
- understand what drives the phenomena
- attempt to parameterize the phenomena

where the last integrative step usually requires many observations and often benefits from theoretical and numerical insight.

Observational projects are challenging, but extremely rewarding.

Numerical Projects

I believe numerical process studies motivated by observations are a very powerful tool to improve our understanding of the ocean. Student projects are a little easier to specify in advance, and I do so here.

Eddy separation around headlands

Grad student Wendy Callendar found that the tides produce headland vortices around Cape St. James in the Queen Charlotte Islands. Interestingly, on certain tidal phases these eddies coalesced into larger mesoscale eddies that then spun off into the interior of the ocean. A project would be to idealize Wendy's work and

- explore what tidal parameters set whether the eddies coalesce
- explore the propagation of eddy dipoles from the shelf to the deep ocean.

Effect of bottom-enhanced mixing on large-scale flows

Turbulent mixing impacts the strength of the global overturning circulation and the density stratification of the ocean. However, the turbulent mixing also depends on the stratification. So there is a potential climate feedback that has not been explored. The goal here would be to

- understand how a stratification-dependent dissipation should be entered into a simple model
- how the simple model responds to changes in atmospheric heat forcing

Ray tracing through non-canonical wavefields

In the open ocean, away from topography, the dominant way that turbulence is generated is via the somewhat random breaking internal waves. The problem is analogous to whitecapping on the sea surface, but without the wind's direct forcing. Our understanding of the *rate* of this process is arrived at by tracing "test waves" through an empirical continuum of internal waves, modifying the waves until they are of a small enough scale to break. The continuum for these waves, however, often excludes well-known frequency peaks such as those driven by the tides. The question here is how does the ray tracing of the waves change as these peaks are made more prominent (if at all).

Applying

The Uvic Ocean Physics Group is actively looking for new graduate students to start as early as Sep 2017. If you have a strong aptitude for physics and mathematics, and the desire to apply it to important environmental problems, please contact us with a current CV, unofficial transcript, and a short statement of interest.