**Research Interests**

Our group collects and analyzes seagoing data, and create numerical experiments designed to help us understand small scale ocean flows, and their impacts on large scale flows. Important processes include waves, turbulence, fronts and eddies. These processes are what ultimately dissipate energy from the ocean circulation and mix momentum, heat, salt, and passive tracers.

**Current Projects**

**GEOTRACES CCAR**

Aims to map the cycling of trace elements in the Canadian Arctic in order to better understand their distribution and their effect on the functioning of the ocean as a whole. Expedition scientists from 14 institution aboard the *Amundsen* also do research in multiple other areas of ocean science, such as phytoplankton, climate-active gasses, ocean acidification, and climate change. The chief scientists of the expedition are Dr. Philippe Tortell and Dr. Roger Francois, both from the University of British Columbia.

**VITALS CCAR**

The VITALS (Ventilation, Interactions and Transports Across the Labrador Sea) research network will answer fundamental questions about how the deep ocean exchanges carbon dioxide, oxygen, and heat with the atmosphere through the Labrador Sea. New observations and modelling will determine what controls these exchanges and how they interact with varying climate, in order to resolve the role of deep convection regions in the Carbon Cycle and Earth System.

VITALs is a pan-Canadian initiative involving scientists from 11 Canadian universities as well as multiple federal government laboratories (Fisheries and Oceans Canada, as well as Environment Canada), industrial and foreign partners.

**Tasmanian Internal Tide Experiment**

The Tasman Sea Internal Tide

Surface tides supply about 1 TW of power to internal tides as tidal currents attempt to flow over undersea mountains. Most this internal-tidal energy propagates away from its generation region in the form of low-mode internal tides. The ultimate fate of this energy is unknown. The specific geography of energy dissipation has a large impact on the overall circulation of the ocean, its biological functioning, and our climate.

One of the most energetic and focused beams of internal-tide energy is generated south of New Zealand. It propagates 1,500 km across the Tasman Sea, and strikes the Tasman continental margin. The goal of the NSF-funded Tasman Tidal Dissipation Experiment (T-TIDE) is to see what happens next.

T-TIDE and companion experiments T-Beam and T-Shelf will together examine the dissipation of the internal tide as it shoals on the Tasmanian continental slope. T-Shelf will focus on the shallow Tasmanian continental shelf, and the costal consequences of the incoming tidal energy. T-Beam will enhance T-TIDE by providing synoptic measurements of the incident internal-tide energy flux , providing the initial conditions for the dissipation experiments.

A decade ago, the Hawaiian Ocean Mixing Experiment (HOME) provided a comprehensive look at the internal tide generation process. Together, T-TIDE, T-Beam and T-Shelf will complete that life cycle by providing the first comprehensive observations of an internal-tide beam as it propagates through the open ocean and dissipates and/or reflects from a continental slope.

The T-Teams will be out at sea from January 9 to March 11, 2015 on the R/V Revelle and the R/V Falkor deploying mooring, using state of the art instruments all to measure the internal waves in the Tasman Sea!

Support for this research is provided by the National Science Foundation (OCE-1434722, OCE-1129763, & 1129782) and by the Schmidt Ocean Institute, providing ship time aboard the RV Falkor.

**Flow Encountering Abrupt Topography**

The scientific goal of the FLEAT research initiative is to determine the effects (process-wise) when major current systems encounter topography. Little is known about the interaction dynamics and the consequent results. Preliminary data, theory indicate that these topographic interactions influence the structure of major current systems, internal wave climates and highly-energetic down-slope flows. There are indications that ocean current interactions with major ocean ridges and island archipelagos are not properly represented in large scale models and the modeling science of “downscaling” need to be used to achieve realistic results. Multiple papers have been written on implementing the “island rule” but this concept has only ever been tested in quasi-geostrophic models and never has been evaluated with an appropriate data set.

An integrated modeling and observational program is proposed to first map and determine the dynamic response of flows to abrupt topography and second, to test ocean models nested across a wide range of scales in the context of a western Pacific, low latitude system. The goal of the proposed program is to develop the understanding necessary to quantify and predict the correct circulation in the western Pacific and its vertical structure. The critical study area follows a major subsurface ridge (the west Mariana Ridge –extending from Guam, past the Micronesian Islands, to the Mariana Trench). Few studies have been conducted in this area and the projected circulation is largely from large scale ocean models. The program will jointly address, through observation and models, circulation dynamics on scales ranging from the vertical and horizontal structure of the topographic ridge (3000m high, 10-100 km width, to 1000’s miles long) to flows near island boundaries. Establishing the linkage between these scales, which have traditionally been studied separately, will lead to fundamental advances in the science of island circulation, boundary layers, and downscaling, and subsequently, will advance our ability to accurately model the relevant processes.