

## Recent Science Highlights using Air-Sea Underway Observations in Drake Passage

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In the Southern Ocean, upper-ocean processes and air-sea fluxes play a critical role in transforming water at the ocean surface by changing its density and thus shaping the characteristic properties of many globally important water masses. These processes control the meridional overturning circulation, and lead to the formation of Intermediate and Mode Waters that carry with them evidence of their contact with the atmosphere that may indicate changes in forcing on time scales of relevance to climate.

Drake Passage has long provided a convenient chokepoint to observe and study these processes in the Southern Ocean. Over the past decade or so, underway *in situ* measurements within Drake Passage from XBT, XCTD and ADCP instrumentation, along with concurrent shipboard meteorological and pCO<sub>2</sub> sampling, have been routinely acquired aboard the U.S. Antarctic Supply and Research Vessel, the R/V *Laurence M. Gould* (LMG). The LMG is the principal supply ship for the U.S. base of Palmer Station, Antarctica, and crosses Drake Passage on average twice a month, thus providing concurrent air-sea along-track measurements at high temporal and spatial resolution on a near year-round basis.

This talk will highlight results from some recent analyses of the *in situ* underway shipboard observations from the LMG transects in Drake Passage. Our motivation is to demonstrate the significant benefits and synergy of air-sea observations when they are measured at similar time and space scales along near-repeating transects from the same platform. The multi-year high-resolution measurements are used to examine seasonal and spatial variability in upper ocean diapycnal eddy diffusivities, eddy heat and momentum fluxes, and upper ocean heat content. Long-term trends in Drake Passage upper ocean temperature, pCO<sub>2</sub> concentration, winds and shifts in the Polar Front are related to large-scale climate modes of variability such as ENSO and the Antarctic Oscillation. Automated underway observations on research vessels and supply ships provide a cost-effective method for obtaining high-quality synergistic data at the air-sea interface that has benefits for a broad range of climate-related research questions in the data poor Southern Ocean.