**Case Study: Eddy Covariance Flux Measurements in the Coastal Ocean**

**Contacts:**

* Clare E. Reimers, CEOAS OSU, creimers@coas.oregonstate.edu
* H. Tuba Özkan-Haller, CEOAS OSU, ozkan@coas.oregonstate.edu

**Topics:**

* Can eddy covariance measurements of fluxes at benthic interfaces be improved by detailed analysis and new filtering approaches to separate transient advection events from turbulent flux estimations?
* Can a new rotating disc microelectrode sensor resolve very small oxygen fluctuations at a high sampling acquisition frequency and thereby measure high-frequency oxygen fluxes that are not captured with fixed microelectrodes or optodes commonly in use?
* How variable are benthic oxygen fluxes on the Oregon continental shelf temporally and spatially?
* Are there periods on the Oregon Shelf and in Saanich Inlet BC when turbulence is too weak to drive a steady oxygen flux through the bottom boundary layer?

**Background:**

Eddy covariance (EC) measurements of underwater scalar fluxes, especially dissolved oxygen (DO), are new to studies of coastal ecosystems. The theoretical and methodological foundations of aquatic EC are rooted in analogous studies of meteorological gas fluxes between a surface and the boundary layer of the atmosphere. In practice, aquatic EC relies on simultaneous high-resolution measurements of the three-dimensional current velocities of water, **u**=(*u,v,w*), and DO concentration, *C,* at a fixed position ~10-30 cm above a benthic surface or apart from other aquatic interfaces (e.g., sea ice or the air-sea interface). From such time-series, the instantaneous velocity and concentration are decomposed into mean and fluctuating components by Reynolds decomposition:and , and estimates of the flux of oxygen are derived for discrete time intervals (typically 15 min) as:

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The oxygen flux between benthic systems and the water above is a widely used proxy for benthic primary production and organic carbon mineralization. We started studying benthic oxygen fluxes on the Oregon shelf and elsewhere in 2009 to understand regional causes of hypoxia.

Now we seek groups of students to work together to tease out the physical processes at work in the benthic boundary layers where we have measurements, and to assess how these processes drive (or introduce errors) into benthic flux determinations of oxygen and heat. The dynamics of the benthos and the effects on commercial species that live there are not well documented, and new research is needed to guide the management of coastal resources under climate change. We also seek students to help develop and test our idea for a new rotating disc microelectrode, and to statistically evaluate its performance compared to commonly used Clark-type microelectrodes and optodes.

**Existing Data:**

* EC measurements collected between 2009 and 2013 at 11 Oregon shelf stations at water depths of 40-100 m with repeat measurements at different times of the year at 7 of the stations. Ancillary data includes sediment properties, *in situ* microprofiles of dissolved oxygen at the sediment-water interface, bottom water concentrations of DO, nutrients, pigments, and POC/N, as well as full water column CTD profiles.
* Seven months of continuous EC measurements at the Ocean Networks Canada (ONC)- Victoria Experimental Network Under the Sea (VENUS) node in Saanich Inlet, BC with ancillary observatory data. <http://www.oceannetworks.ca/installations/observatories/venus-salish-sea>.

**Data Needs:**

* Ongoing sensor development, tests and data sets that provide comparisons between sensors under dynamic conditions.

**Desired Areas of Expertise for Students:**

* Chemical, Physical and Biological Oceanography
* Electrochemistry
* Marine Resource Management
* Computer Science
* Statistics