Hidden currents
What drives flow beneath the surface waters of Coos Bay?

More than Tides, Winds, and Waves
Tides, winds, and waves are the familiar forces that move water around. We see their effect each time we visit the estuary or ocean. But what happens beneath the surface? Estuaries are dynamic systems where fresh river water meets salty ocean water. Over time periods of days to weeks, a net movement of water is driven by the mixing of the river and ocean waters, due to the difference in density between them. River water is less dense and wants to float on top of denser ocean water. Scientists call this the estuary exchange flow, as it delivers fresher waters to the ocean via a surface layer, while bringing in saltier ocean water along the bottom.

The estuary exchange flow is responsible for bringing in ocean water to the estuary, regulating changes in Coos Bay water properties, such as nutrient and dissolved oxygen levels. Since this flow occurs over days to weeks, it is hard to see with your eye! But we know it exists due to long-term scientific observations. And, we know it changes dramatically over the seasons: in winter, with high river runoff, the estuary is flushed rapidly, while in summer when runoff decreases, the estuary brings in less ocean water.

Why do we need to understand these currents?
Monitoring our bays and coastal waters is vital for protecting Oregon’s natural marine resources that sustain recreational, tourism, and fishing industries. Many of our coastal areas now experience low oxygen water, or hypoxia, during the summertime that causes stress to organisms and can be lethal. Scientists want to know if these low oxygen waters flow into Coos Bay. Oxygen levels not only change because of water flow, but also due to biological processes, such as photosynthesis (increases oxygen) and respiration (decreases oxygen).

How do we monitor the estuary?
Monitoring is done by the University of Oregon, the South Slough National Estuarine Research Reserve, and the Coos Watershed Association, along with numerous community stakeholders.

Water quality sensors and underwater moorings are left in the estuary to continuously record data. River gauges monitor the flow and temperature of fresh river water as it enters the estuary. Scientists lower instruments from boats to measure temperature, salinity, and dissolved oxygen. These water properties are not constant! They change in time and they change in space, both across the estuary and in depth from the surface waters to the seafloor. Thus, long term observations are critical to assess the impact of future changes, due to climate or human alterations, on the Coos Bay Estuary.

What have we learned?
In winter, both ocean and estuarine waters are oxygen-rich due to strong winds and little biological activity. During spring, southward winds start that upwell low oxygen waters from the deep ocean into the estuary. As summer progresses, oxygen levels continue to decrease in the bottom waters of the estuary due to respiration. However, low river runoff shuts down the estuary exchange flow, limiting the amount of ocean water input into the estuary from the shelf, where hypoxia can occur.

The future
A narrow offshore shelf, a dredged ship channel, and fresh river water combine to keep the bay relatively well-oxygenated, even in summer, but that could change as the climate warms. We will continue to monitor the estuary flow and its water properties.

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Where do we go from here?
In the future, other factors will change. As global ocean conditions warm, so will the ocean surface. The ocean, like the atmosphere, is warming. We expect sea surface temperatures to rise in the future, and the upper ocean to become more stratified, just like the atmosphere is. This will make it harder to mix fresh water from rivers into the ocean and will affect how the estuary exchanges water with the ocean. We will continue to monitor how this process changes over time.