Science Brief

Salinity Changes in N. Channel of Columbia River

ISSUE

Regions that have high gradients in properties (e.g., salinity "wedge" intrusions into the Columbia River estuary) are of vital ecological importance. Existing technology to observe the salt wedge has problems:

- point sensors –(cannot give areal coverage)
- maintaining sensors in strong currents
- biofouling and sedimentation
- fish attack and damage by debris
- damage from fishing and vessels, and
- costly sensors and batteries.

OBSERVATIONS AND APPROACH

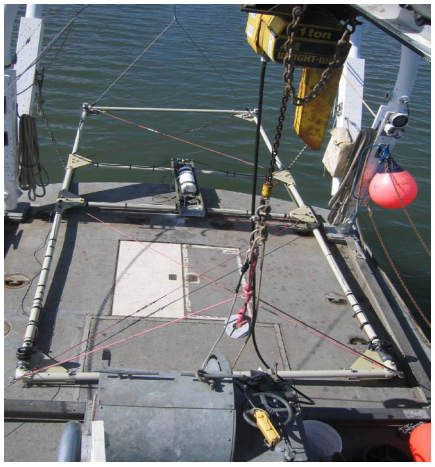
There is a tight correlation between the electrical conductivity of water and its salinity. One can measure water's conductivity and convert that to salinity. Conductivity is measured by injecting electric current (AC) at one point and simultaneously measuring the electric field at some other point. An important factor is how salinity changes with depth – the salinity profile. To get this, we use multiple frequencies. The penetration of AC electric currents into the water is inversely proportional to the square root of (conductivity x frequency). This is called the "EM skin depth": in seawater it is 25 m at 100 Hz and 2.5 m at 10 kHz. One can exploit this dependence on frequency to calculate electrical conductivity averaged over the skin depth. Those calculations then give us the salinity profile, but without moving the sensor through the water column.

IMPLEMENTATION

Tom Sanford and his group at the University of Washington's Applied Physics Lab developed an EM sounder (the "Sigma Profiler" – σ is the symbol for electrical conductivity). It has no moving or delicate parts. The first device is shown in the photo. A current dipole source (an antenna) is at the far end of the 6-m long PVC frame: a receiver dipole is at the near end. In the middle is the electronics package. A second version with 6 and 20-m source-receiver separations was also built and tested.

DEPLOYMENTS

Versions 1 and 2 of the Profiler were deployed in the Columbia River, first off Tansy Point and then near the Astoria-Megler Bridge in the North Channel.



FINDINGS

Version 2 was deployed in the North Channel for 14 days in 20m of water. The Saturn01 autonomous profiler on the bridge provided calibration profiles of conductivity and temperature. The figure below shows the salinity profiles inferred from the Sigma Profiler for the whole 14-d long deployment. Note the differences between neap and spring tides.

IMPLICATIONS

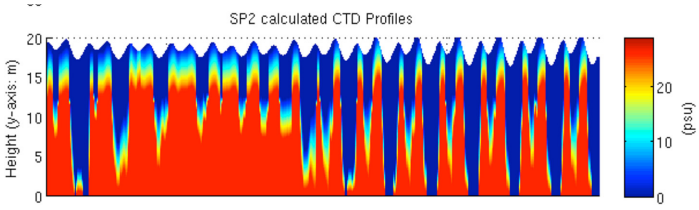


Figure 1. Salinity profiles 14-27 May 2009

Long duration salinity profile observations in hostile environments are possible in the Columbia River estuary. This method is suitable marine estuaries that have good correlation between electrical conductivity and salinity.

MORE

Sanford et al. are preparing a manuscript describing this work for submission to the *J. At-mos. Oceanic Technol*. This project is part of CMOP's *Enabling Technologies* effort.