An investigation of the subsurface freshwater/saltwater distribution in an estuarine environment using Towed Time Domain electromagnetic methods

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Time-domain electromagnetic (EM) datasets were collected using a FloaTEM system (Aarhus GeoInstruments, ApS) along the Yaquina River to map the spatial distribution of subsurface freshwater and saltwater in the vicinity of Newport, Oregon. Understanding coastal subsurface freshwater/saltwater distribution and dynamics is important for the prevention of freshwater aquifer contamination caused by rising sea levels. Overpumping of coastal aquifers can draw in surface saltwater (intrusion) and up from deeper in the subsurface (upconing). Saline contamination can be difficult to reverse, creating long-term water resource problems. For this investigation, EM data was collected while towing the transmitter and receiver behind an aluminum boat. Data was collected over 3 days in October 2022 starting from the mouth of the Yaquina River in Newport, Oregon upriver to Elk City, Oregon where the salinity of the water is tidally influenced by sea water. The specific conductance of the surface water varied from 49.2 mS/cm (~seawater) near Newport to 593 µS/cm (~freshwater) at Elk City. Data were georeferenced using an AtlasLink Smart antenna H10 global positioning system, and water depth was recorded using a Cee Echo sounder. EM measurements collected in water with a specific conductance close to sea water provided shallow sensitivity less than or equal to 2m, but as the specific conductance declined moving upstream, the depth of investigation (DOI) increased substantially. At some locations, EM coupling was observed from adjacent infrastructure and the data affected was filtered. In total, about 65 line-kilometers of data were collected and inverted using Aarhus Workbench to produce 2D tomograms of subsurface electrical resistivity. These distributions were used to interpret for subsurface salinity in regions where DOI was sufficiently deep. These results provide baseline conditions against which future datasets may be compared to identify areas along the Yaquina River were saltwater intrusion may be a concern to local freshwater supplies.