Extended Abstract

FRESHWATER/SEAWATER INTERFACE DYNAMICS IN THE INTERTIDAL ZONE AT WEST NECK BAY, SHELTER ISLAND, NY.

Durand JM, Wong T-f

Submarine groundwater discharge (SGD) is now widely recognized as a important contributor to surface waters as it provides a pathway for nutrients and contaminants that can significantly impact coastal ecosystems. Field measurements in the vicinity of the freshwater/seawater interface (FSI) have shown that the spatio-temporal distribution of SGD can be highly heterogeneous. Some numerical models have identified 3 regions (a density-driven circulation cell offshore, an upper saline plume and a freshwater tube in the intertidal zone) which seem to persist over time, such that the distinct regions can be recognized in simulations that average the numerically predicted salinity profiles over the tidal phases. The size and shape of each region are influenced by factors such as the tidal and wave loading, inland hydraulic gradient, beach geometry and aquifer properties. There is a paucity of field data at the FSI on the evolution of the salinity profile during a tidal cycle.

To characterize the spatio-temporal heterogeneities of the FSI and compare with numerical predictions, we used electrical resistivity as a proxy for salinity. Electrical resistivity surveys were acquired during a 12-hour cycle in a tidally dominated environment. On September 12 2012, at West Neck Bay (Shelter Island, NY), a 33.4 m long stationary cable with 56 electrodes was extended over land and sea to image the intertidal zone. Hourly measurements were conducted over a full tidal cycle. Additional data were collected along the survey line to provide ground-truthing information (Fig. 1).

Our resistivity measurements indicate fundamentally different scenarios during high and low tide. At low tide, our resistivity data suggest a strong influx of freshwater from land, forming a plume that rises up and contributes significantly to SGD in the intertidal zone. We also observed the occurrence of 3 regions somewhat analogous to the numerical predictions. However, at high tide, instead of these distinct regions, we observed a diffuse mixing zone that extended along the water/sediment interface and overlaid the freshwater from land. Point measurements of seepage rates and salinity are in basic agreement with the two scenarios. It should also be noted that the phase-averaged section obtained with the resistivity surveys resembles the high tide scenario and therefore differs from the phase-averaged simulations.

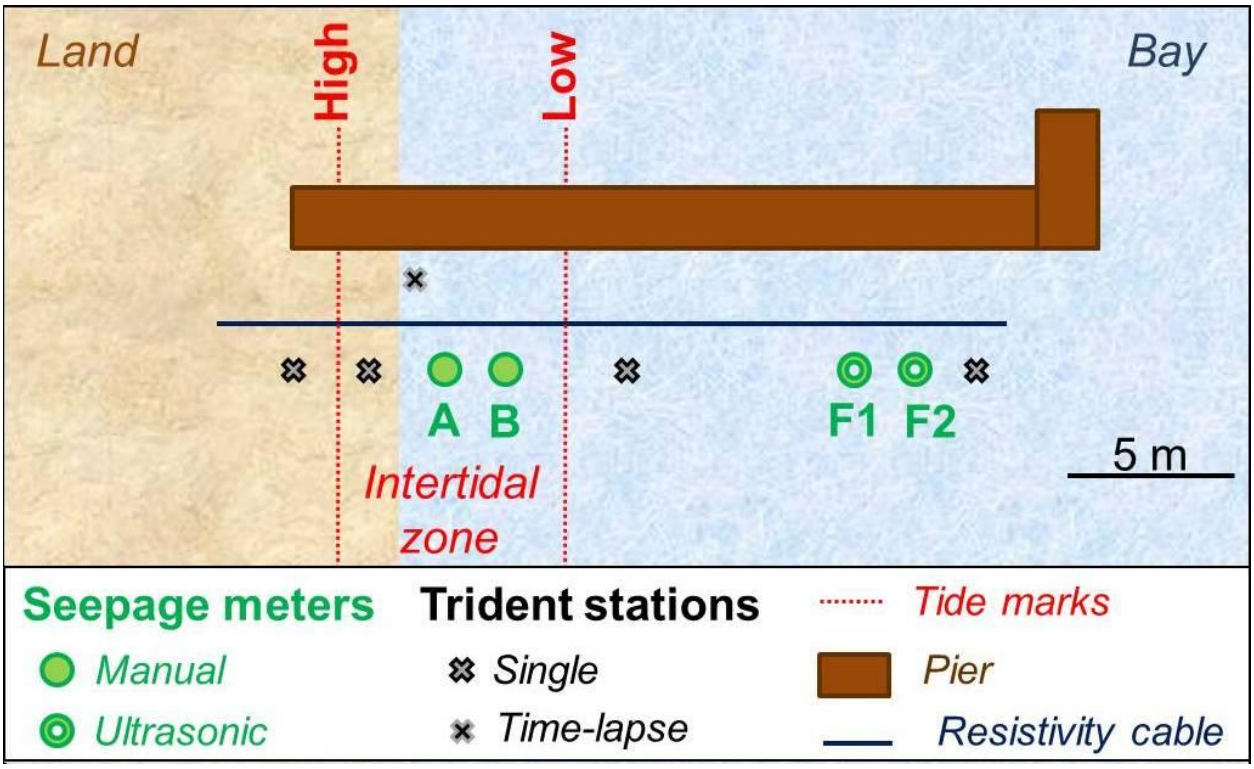

Fig. 1: Map of data acquisition combining electrical resistivity surveys, manual and ultrasonic seepage meters and conductivity/temperature point measurements.