Water Resources Research

Supporting Information for

Seasonal and Tidal Variations in Hydrologic Inputs Drive Salt Marsh Porewater Nitrate Dynamics

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Introduction

Here we provide supplementary figures and tables. Figures provide (1) an example of nitrate (NO_3^-) and ammonium (NH_4^+) time series for the 2021 calendar year from surface water in Elkhorn Slough National Estuarine Research Reserve; (2) an exceedance probability graph used to delineate salt marsh positions; (3) photography of the sampling cups used to sample point NO_3^- concentrations in combination to a manifold pump in the salt marsh subsurface; (4) a plot of modeled vs lab measured nitrate concentrations; (5) an example of smoothed versus unsmoothed predicted NO_3^- concentrations; (6) a time series of precipitation, terrestrial water level and hysteresis indices; (7) HI versus surface water temperature, pH, salinity, turbidity, and dissolved oxygen (DO); and (8) FI versus surface water temperature, pH, salinity, turbidity, and DO.

The table provides (1) a summary of the manifold pump-spectrolyser probe deployment schedule.

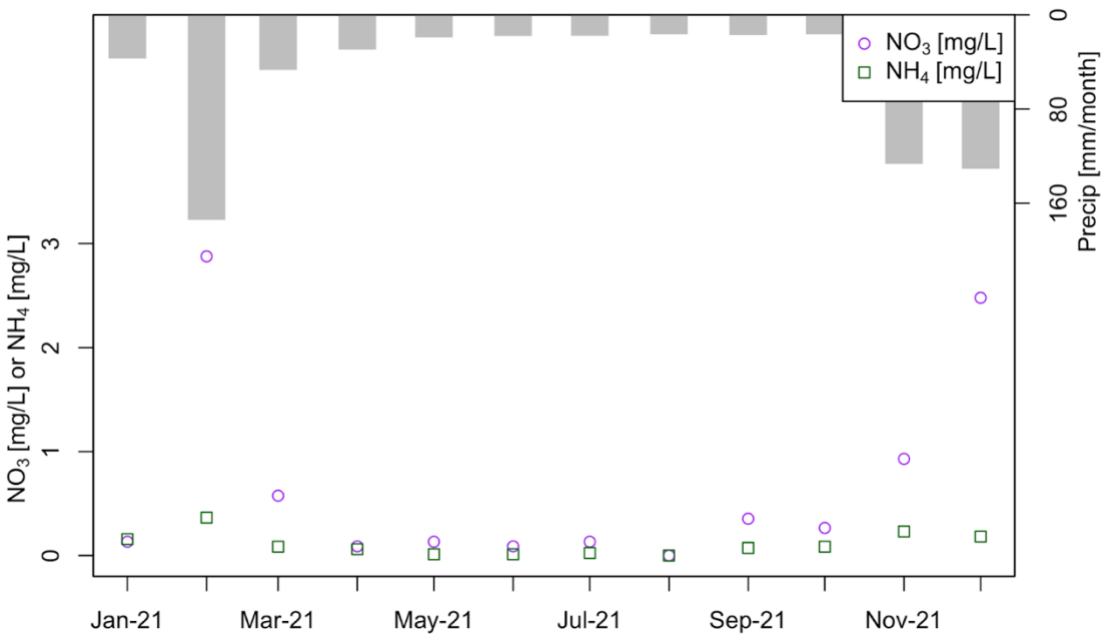

Figure S1. Time series of nitrate ($\boldsymbol{NO_3^-}$) and ammonium ($\boldsymbol{NH_4^+}$) measured by ESNERR at the Kirby Park Station (Nearest ESNERR sampling station to our experimental transect) corresponding to the 2021 calendar year. The figure also shows an inverted hyetograph for the same period. This figure highlights the strong relationship between precipitation and nutrient concentration in Elkhorn Slough. Storm events draining several acres of agricultural areas around ESNERR are the principal source of nutrients to the estuary during the wet season.

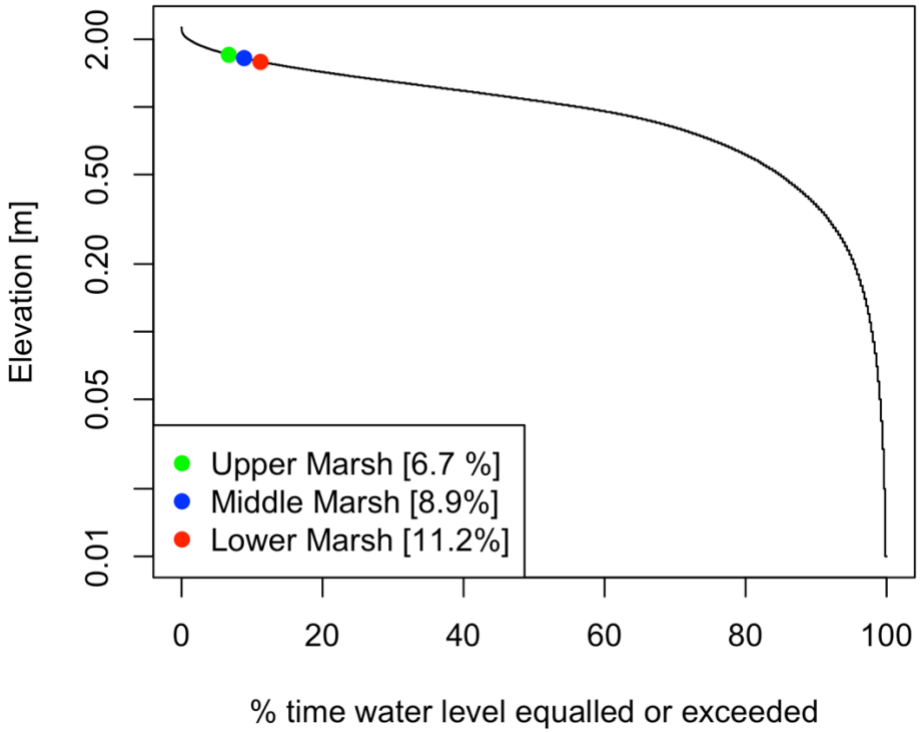

Figure S2. Exceedance probability used to differentiate between the different marsh positions. The exceedance probability was calculated from a tidal gauge installed at the study site. Water levels at 5-minute intervals from February 2019 to November 2021. The elevations amsl of each marsh position are 1.79 m, 1.65 m, and 1.55 m for the upper marsh, middle marsh, and lower marsh, respectively.

Figure S3. Photographs of sampling cups used in combination with a manifold pump and a field-base spectrophotometer to continuously measure NO_3^- concentrations in salt marsh porewater.

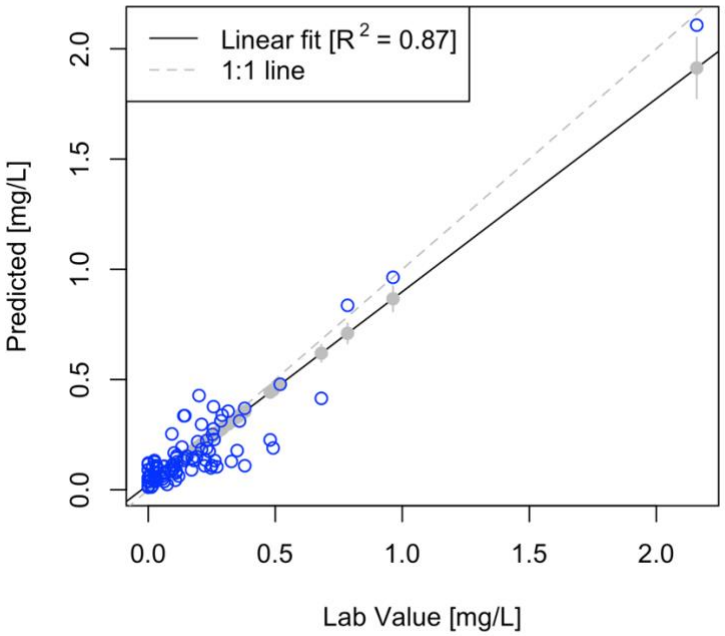

Figure S4. Plots of sensor predicted vs lab measured nitrate. The error bars represent the 95% confidence intervals.

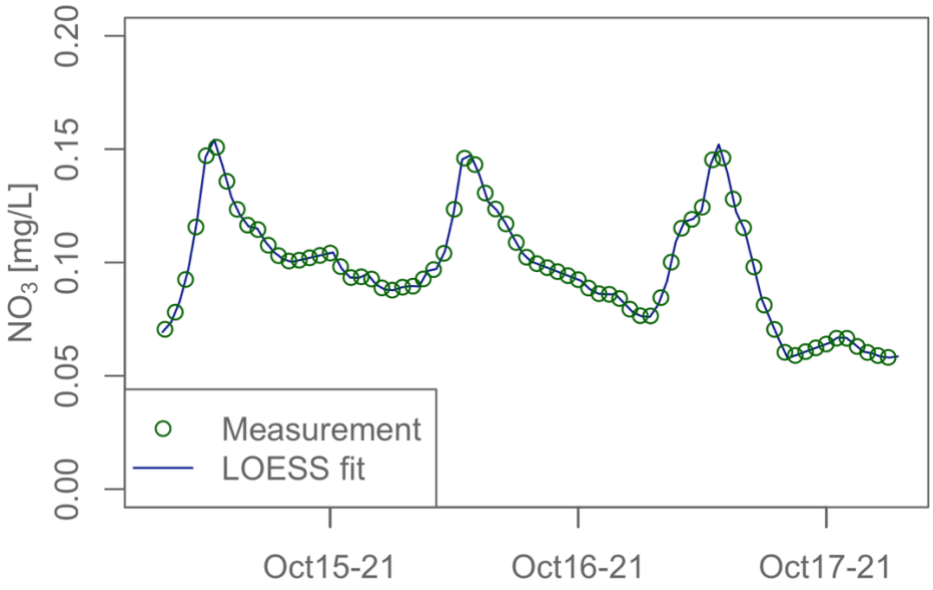

Figure S5. Example of a LOESS function fitted to the data. Notice that the function closely conforms with the data.

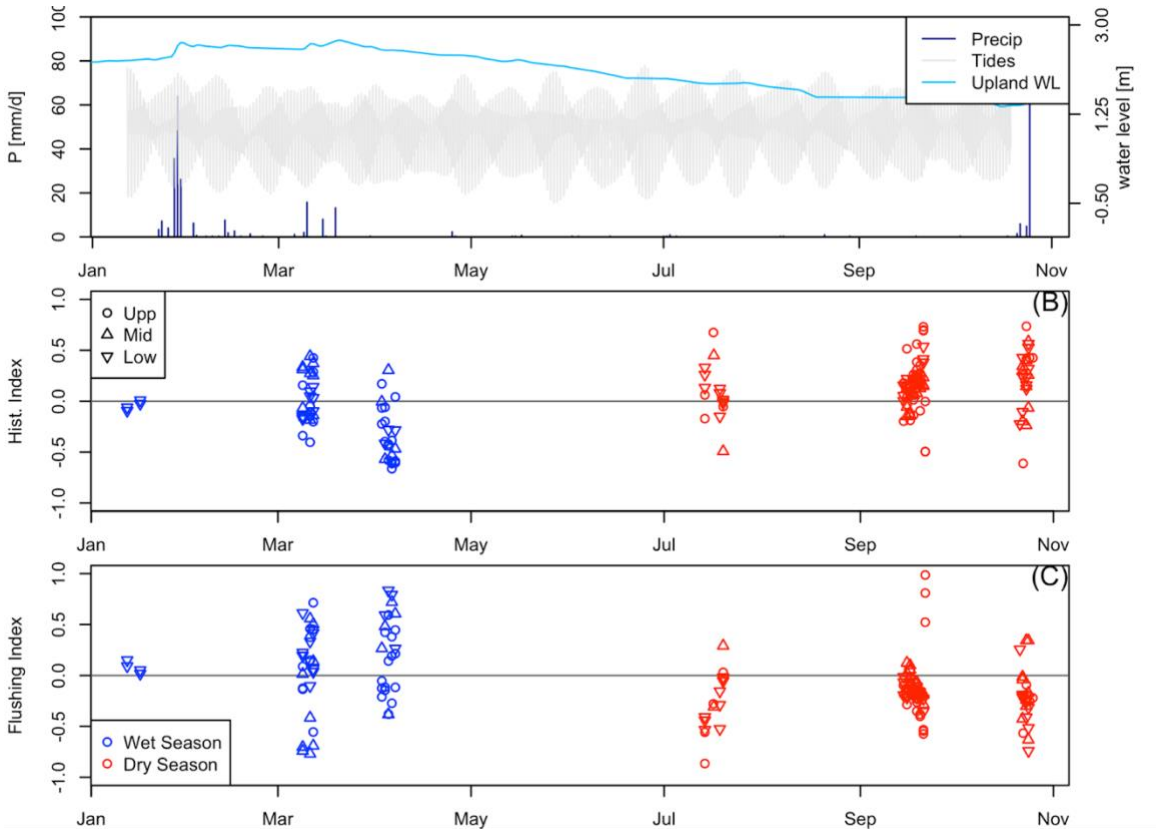

Figure S6. (A) Time series of precipitation, upland water level, and tidal water level over the study period. (B-C) Hysteresis Indices divided by wet (blue) and dry (red) seasons. This figure illustrates the variability of the hysteresis indices over time, particularly for "wet" tidal events, when we do not see a clear grouping of either positive or negative hysteresis indices, and the variability is not driven by precipitation events, terrestrial water level, or differences in the tidal cycles (A).

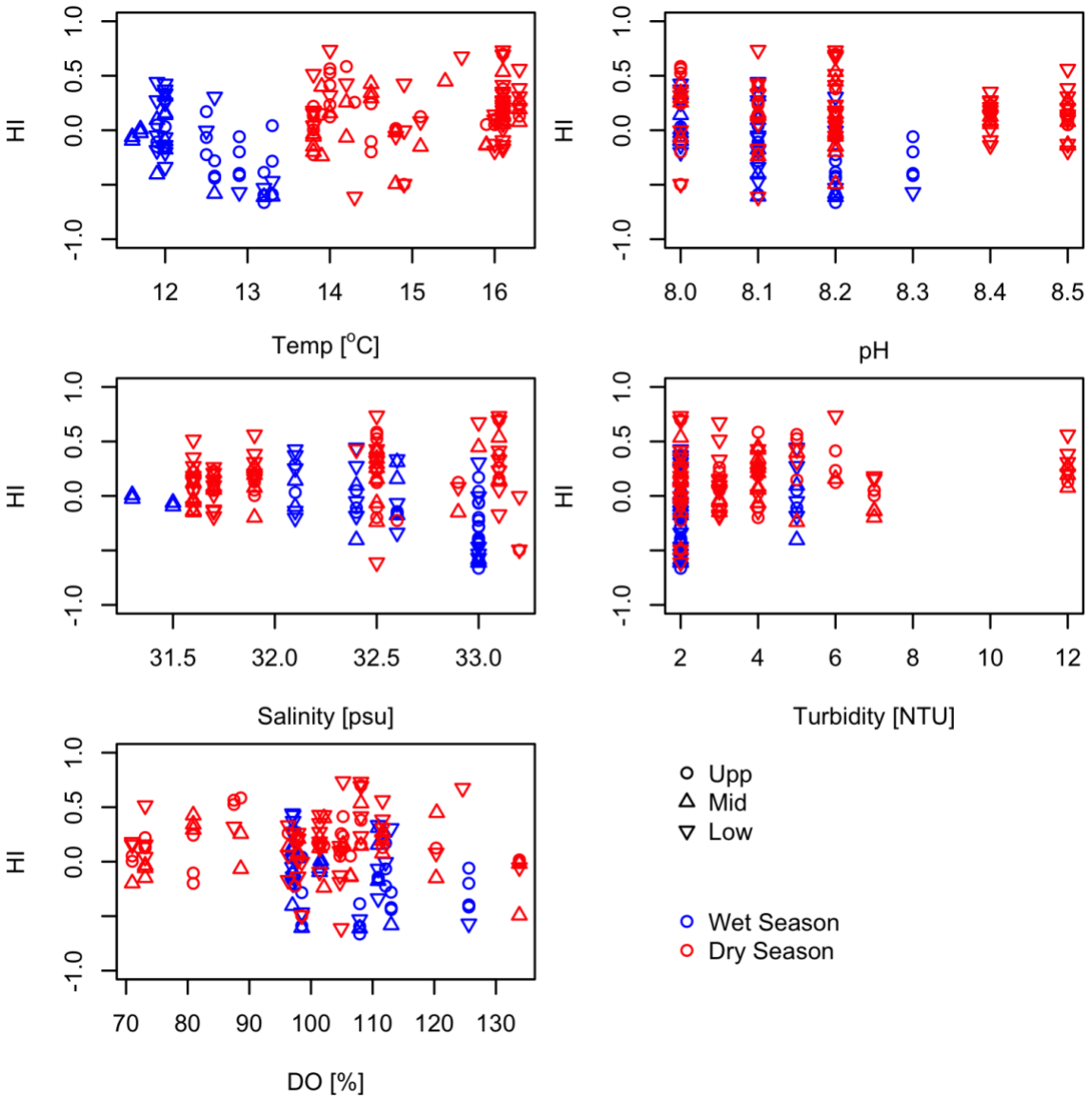

Figure S7. Relationship between HI and surface water temperature, pH, salinity, turbidity, and dissolved oxygen. The figure illustrates that none of these parameters explain the scattering in HI.

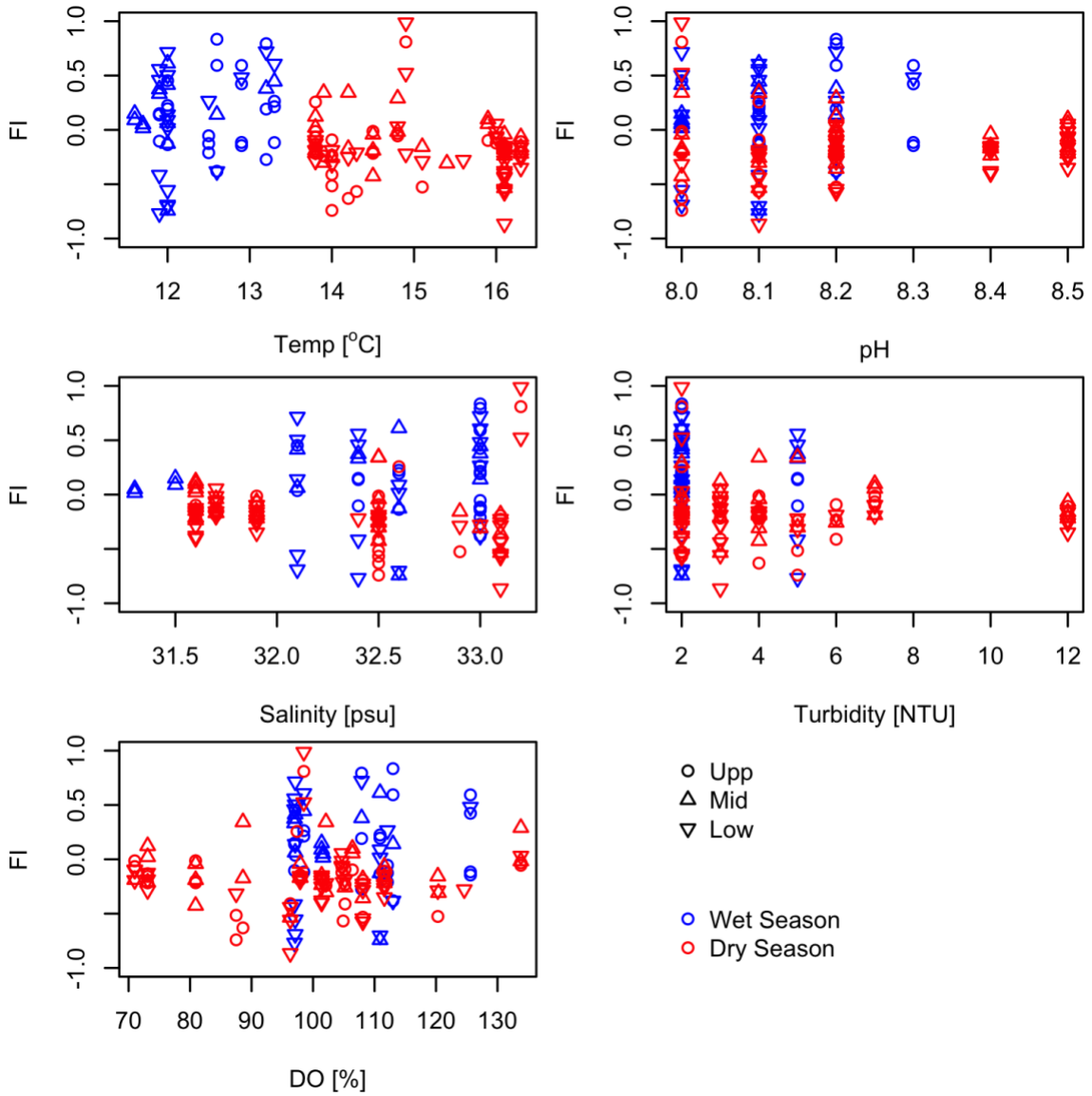

Figure S8. Relationship between FI and surface water temperature, pH, salinity, turbidity, and dissolved oxygen. The figure illustrates that none of these parameters explain the scattering in FI.

Marsh Position and Depth	Jan (10-20)	Mar (6-16)	Apr (1-10)	May* (3-9)	Jul (13-22)	Sep (14-22)	Oct (12-26)
Lower Marsh- 10 cm	no	yes	yes	no	some	yes	yes
Lower Marsh- 30 cm	no	yes	yes	no	no	yes	yes
Lower Marsh- 50 cm	no	yes	yes	yes	yes	yes	yes
Middle Marsh- 10 cm	some	yes	no	no	no	yes	yes
Middle Marsh- 30 cm	no	yes	yes	yes	yes	yes	yes
Middle Marsh- 50 cm	no	yes	no	no	no	yes	yes
Upper Marsh- 10 cm	no	yes	yes	yes	some	yes	no
Upper Marsh- 30 cm	some	yes	no	no	yes	yes	yes
Upper Marsh- 50 cm	some	yes	yes	yes	yes	yes	yes

Table S4. Summary of the optical probe's deployment schedule. All dates correspond to the 2021 calendar year."Yes" means that a relatively complete time series was collected. "Some" means that at least 15 % of the data was collected. "No" means that no data was collected.

*No tidal events were analyzed during this deployment as there were no tidal inundation in this period. However, the short-term dynamics in NO_3^- concentrations were included in the analysis.