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Physical and Biogeochemical Observations within a Tidally Restricted Estuary in Central California

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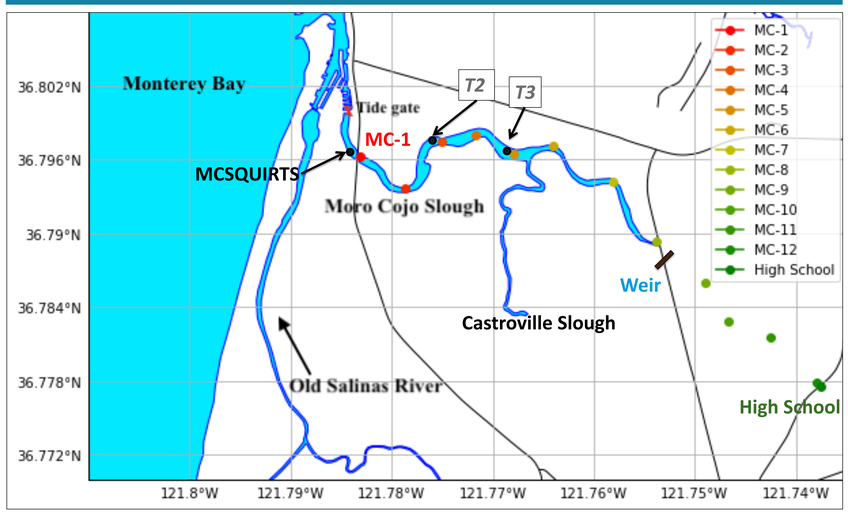
Background

Historic hydrology changes and land use alterations have severely impaired the Moro Cojo Slough (MCS). Nutrient enrichment from agricultural runoff and tidal control infrastructures are the two major disturbances affecting organism inhabitance and ecosystem health. Established monitoring programs provide spatial coverage of temperature, salinity, nitrate, and dissolved oxygen (DO) but lack temporal variability. Long term data collection in this vulnerable marine protected area has been a vital component in monitoring water quality and the impacts of restoration efforts.

Objectives

- Observe seasonal and spatial trends in salinity, DO, and nitrate for 2017-2021 to understand local biogeochemical cycling.
- Compare high resolution DO data from stationary sensors (T2/T3) to monthly transects and an existing sensor array located at the mouth (MCSQUIRTS).
- Monitor spatial and temporal variability to determine effects of flow restriction (tide gate, weir) on hydrologic connections to upstream regions of the system.

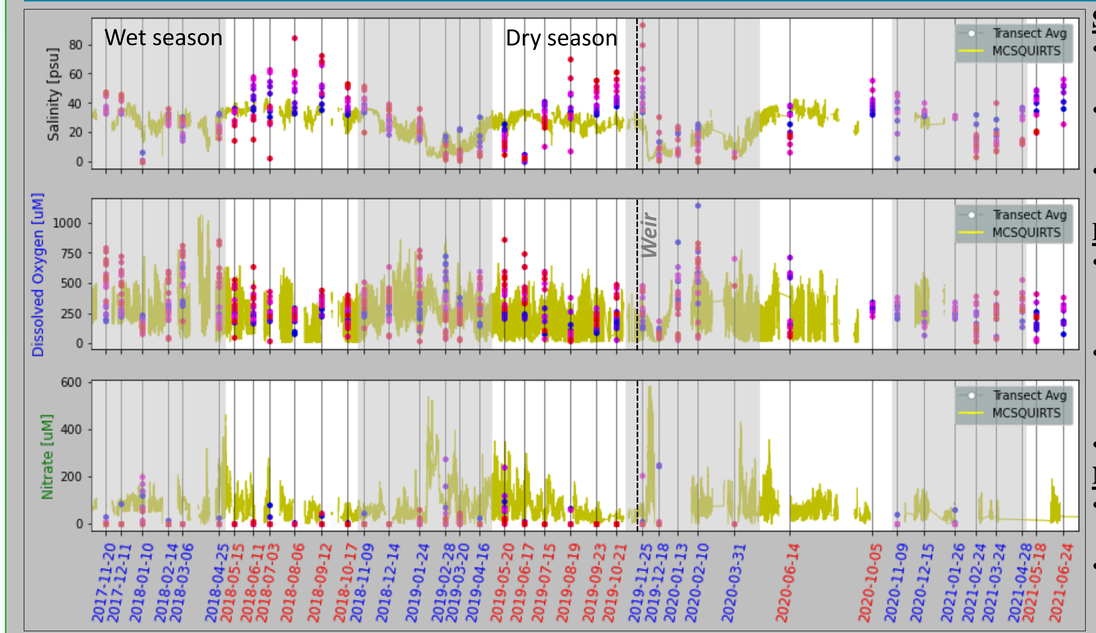
Study Site



Stations:

- *"MC-1"…"High School": transect sampling points*
- *"MCSQUIRTS": floating sensor array*
- *T2/T3: Feb.– May 2021 deployment locations*

High resolution temporal data (MCSQUIRTS) vs. monthly transects



Blue dates – wet season (November – April)
Red dates – dry season (May – October)

MC-1 → High School
- - - = weir installation (Nov. 2019)

Salinity:

- Spatial variance increases during dry seasons and decreases during wet seasons.
- A seasonal pattern of high salinity (dry season) and low salinity (wet season) is observed.
- Higher concentrations are mostly observed farther upstream during dry seasons.

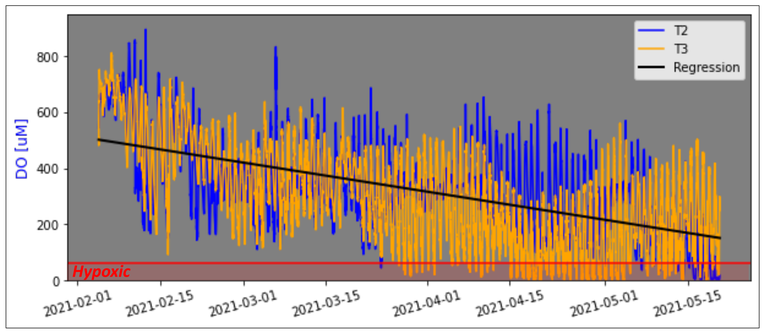
Dissolved Oxygen:

- A seasonal pattern of higher daytime DO (wet season) and lower daytime DO (dry season) is observed.
- Monthly transects fail to observe diurnal variability seen at the MCSQUIRTS station and T2/T3 deployments.
- Stronger DO variability observed upstream.

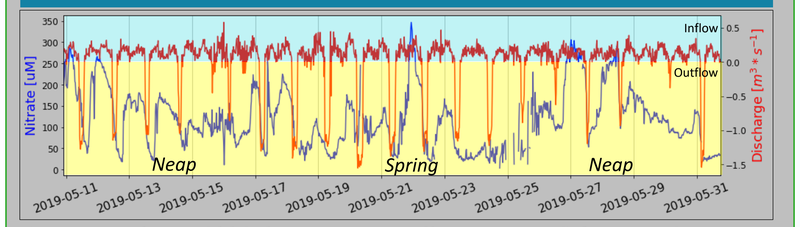
Nitrate

- High concentration pulses were generally observed during the wet seasons.
- In-situ samples (transects) reflect only up to half (up to 274 uM) of what is recorded by MCSQUIRTS (up to 578 uM).
- Hot spots in the spatial distribution are located around the Castroville Slough input.

Decreasing DO as Winter shifts towards Summer



High nitrate pulses during inflow



**Nitrate spikes = Old Salinas River runoff + Monterey Submarine Canyon*

Conclusions

- Flow restriction inhibits flushing of waters upstream, resulting in hypersaline conditions during the dry season.
- Fewer hypersaline conditions in upstream sites were observed after the installation of a weir in November 2019.
- Introduction of nitrate-rich waters collectively derived from the adjacent Old Salinas River and the Monterey Submarine Canyon into MCS well exceed the TMDL allowable threshold of ~70 uM nitrate.
- A combination of limited flushing and high nutrient transport lead to increased assimilation and nighttime hypoxic conditions.
- Long term water quality monitoring proved to estimate a seasonal pattern in salinity, DO, and nitrate, but lacks the resolution to capture short term biogeochemical cycling that occurs on a diurnal/fortnightly cycle.

Acknowledgments

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