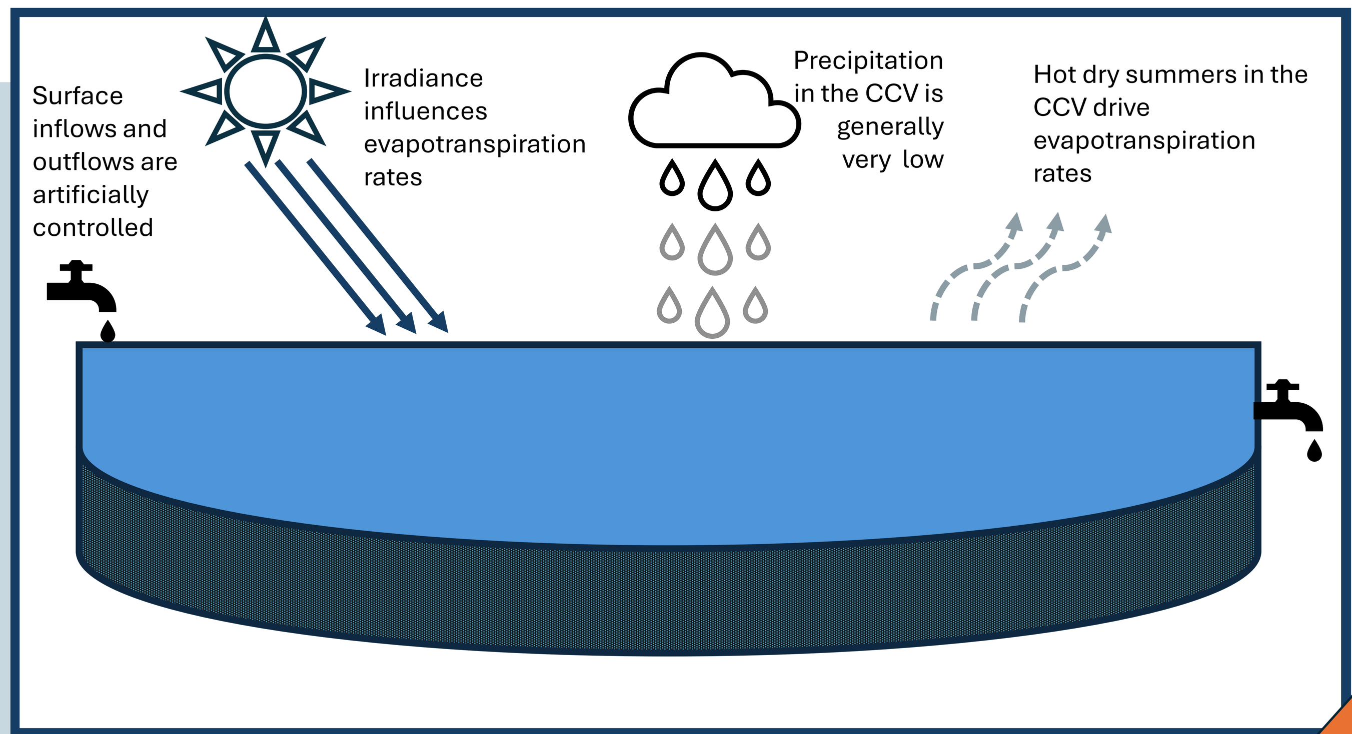
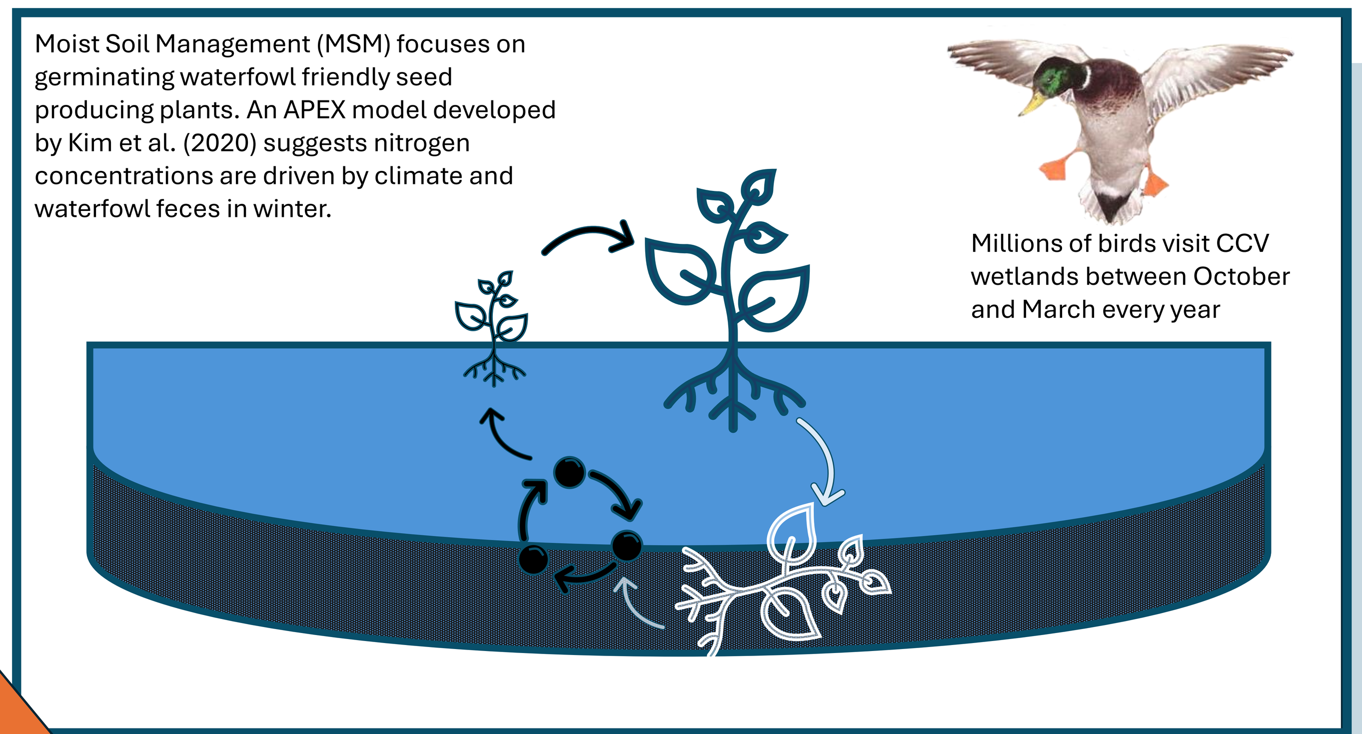
Hydrology and Nutrient Dynamics in Restored Wetlands of California's Central Valley

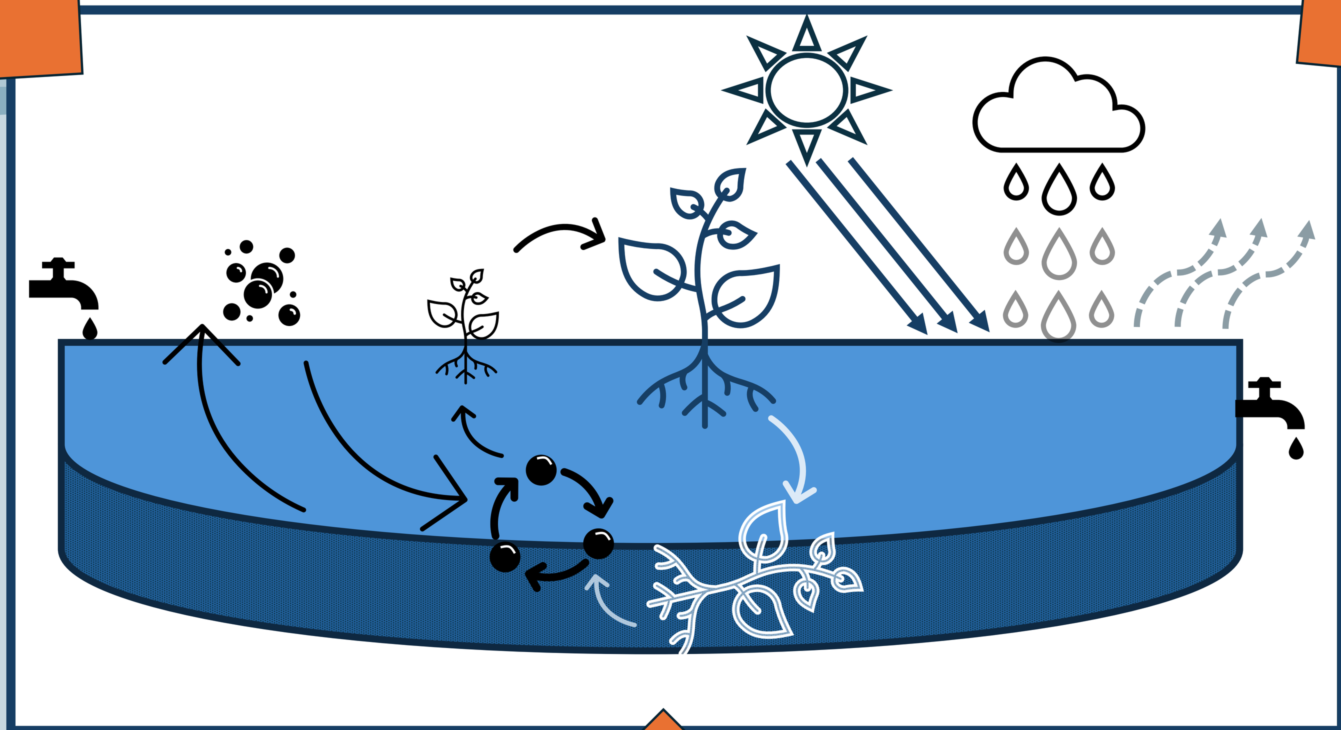
Sharon N. Kahara[1,2], Buddhika Madurapperuma[2], Breana K. Hernandez[2], Luke Scaroni[2] & E. Joseph Paredes[2]

1) University of New Haven, West Haven, CT, 2) California Polytechnic State University, Humboldt, Arcata, CA

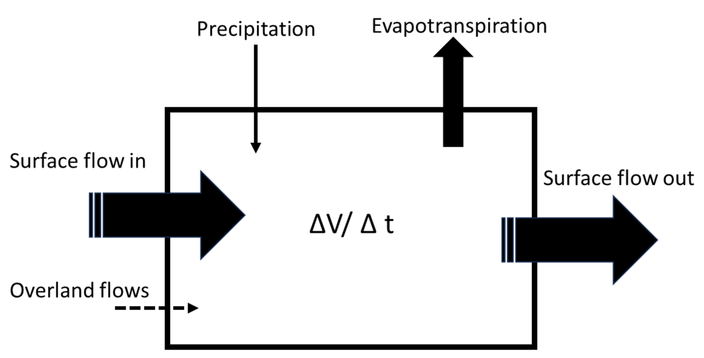


About two-thirds of restored wetlands in California's Central Valley (CCV) are on private land where most are managed under the moist soil management (MSM) regime (CVJV 2006, Duffy et al. 2011, Kahara et al. 2012). MSM involves a series of carefully planned practices to promote growth of waterfowl friendly plants for food and cover. The study aimed to understand the impact of MSM management practices on nutrient dynamics and optimize ecosystem services in the region. Using the program STELLA®, a dynamic process modeling platform, we simulated wetland hydrology, vegetation growth, and nitrogen dynamics. The model considered factors such as nutrient loading and vegetation uptake. The hydrology model incorporated climate data, precipitation, evapotranspiration, and flow rates to accurately represent wetland conditions. The nitrogen dynamics sub-model accounted for nitrogen loading, assimilation in vegetation, and transformation processes within the wetlands. We drew assumptions about factors such as transformation rates and carbon availability from literature. Simulated and empirical hydrology of irrigated and unirrigated wetlands aligned well but more is needed to understand the impacts of overland flows in wet years. The study explored the influence of early and late successional vegetation on nitrogen concentrations in wetland outflow.

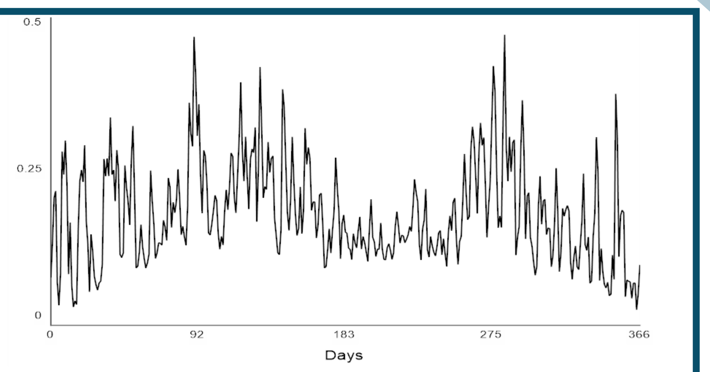




Hydrology Sub-model

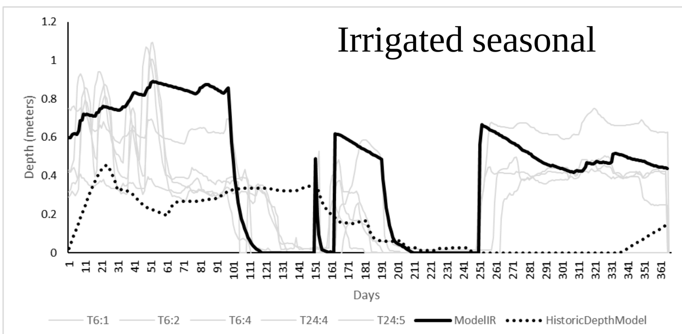


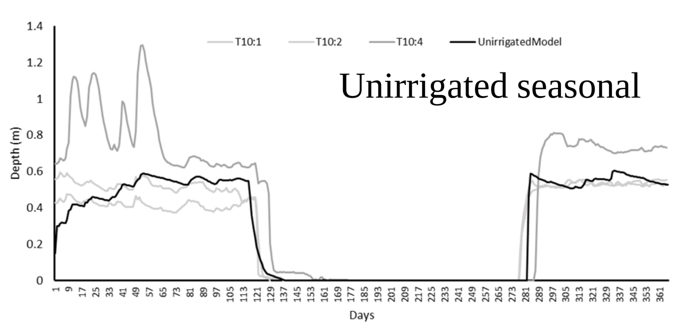
Restored wetland hydrology was modelled as a simple budget of inflows and outflows. Surface and overland flows were based on information from wetland managers as well as water depth loggers that recorded every two hours.
We modelled two wetland types irrigated seasonal and unirrigated seasonal from climate and empirical flood day and volume information from managers.



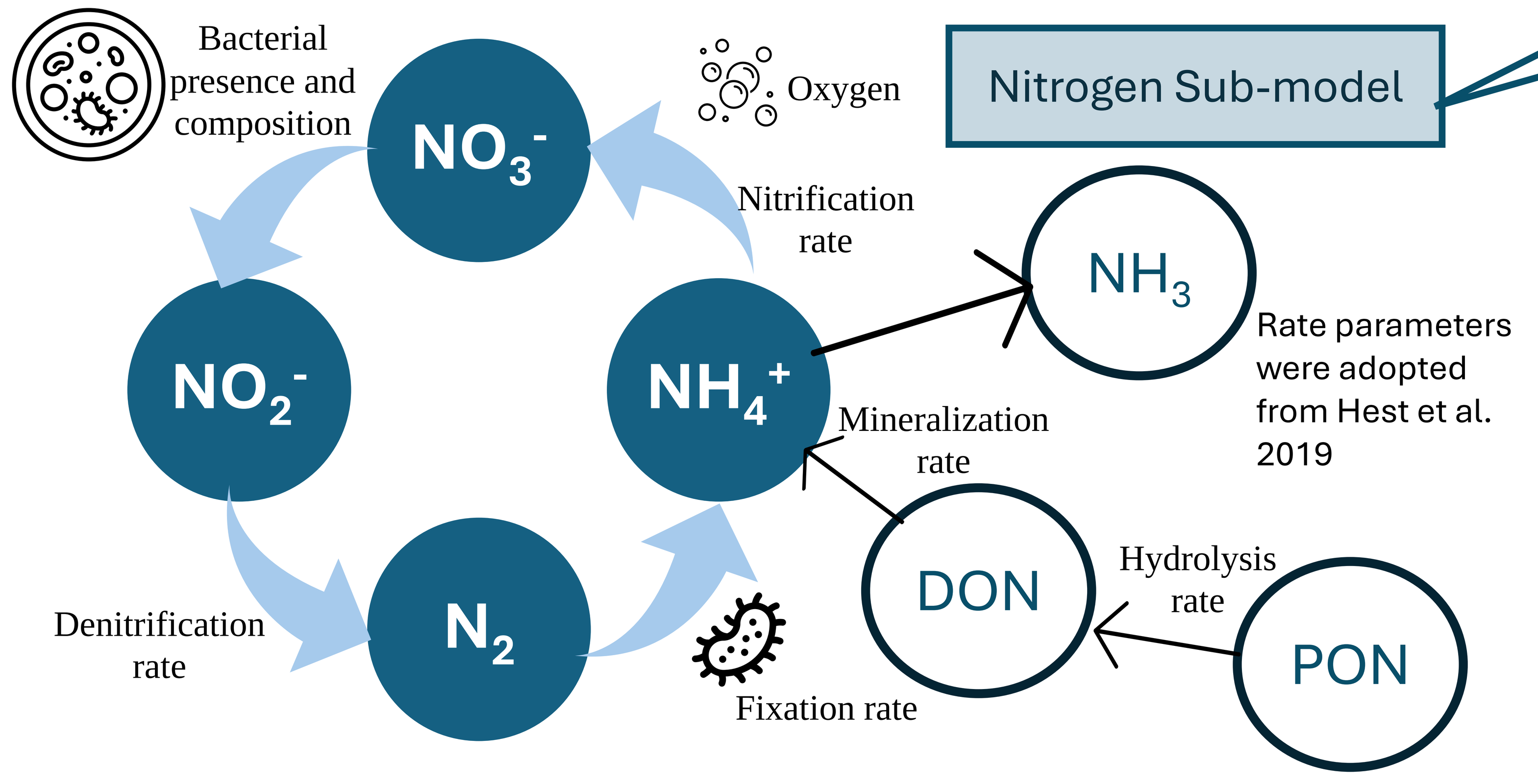
Daily precipitation data were derived from local weather stations. Evapotranspiration was calculated using the Pennman-Montieth equation:

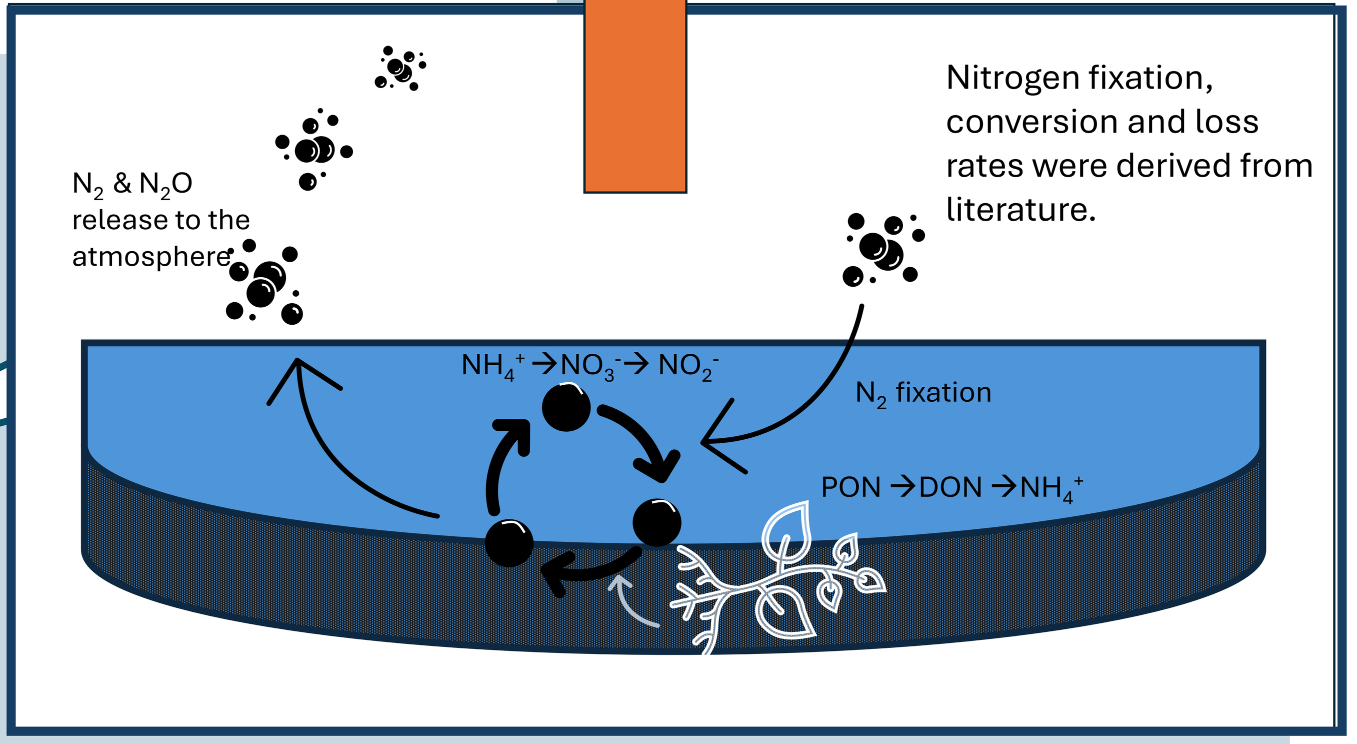
$$ET_0 = \frac{0.408\Delta(R_n - G) + \gamma\frac{900}{T+273}u_2(e_s - e_a)}{\Delta + \gamma(1 + 0.34u_2)}$$





Nitrogen Sub-model





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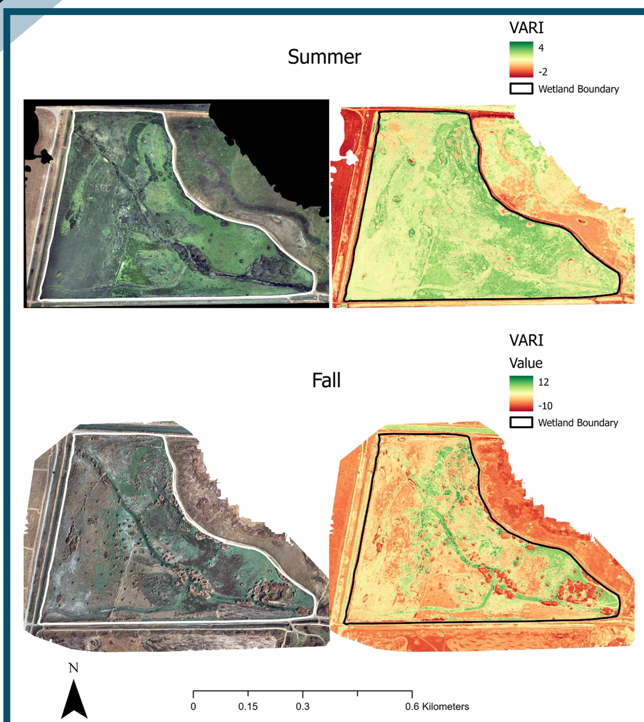
Vegetation Sub-Model



Average vegetation growth rates were based on empirical data collected over the growing season between 2016-2017 from restored CCV wetlands focusing on dominant species –hardstem bulrush (*Schoenoplectus acutus*), cattail (*Typha latifolia*), jointgrass (*Calamagrostis* spp.) and watergrass (*Echinochloa crus-galli*).

Initial biomass was calculated for each site based on empirical data and drone imagery to estimate coverage.

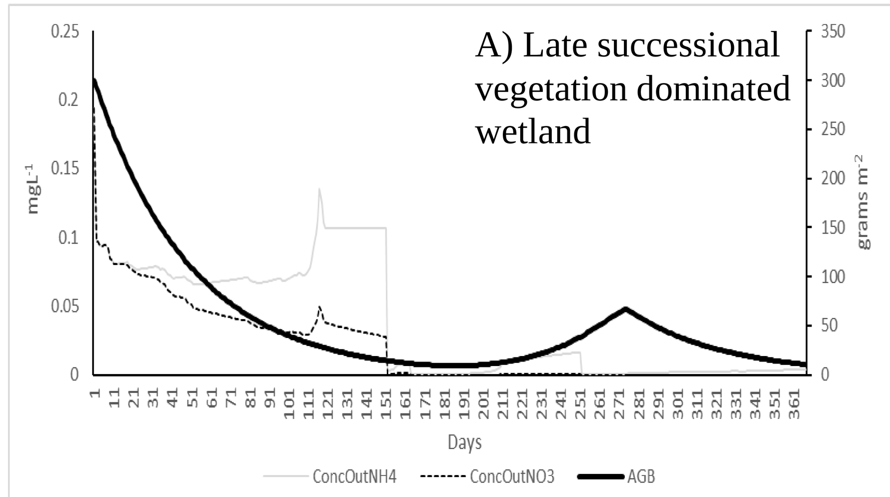
Ammonium and nitrate uptake by wetland vegetation was estimated based on based on literature values using equation

$$NH_4\_uptake = max\_NH_4\_uptake \times N\_veg \times \left(1 - \frac{N_{veg}}{N\_max}\right) \times \frac{conc\_NH_4}{(conc\_NH_4 + kNH_4)}$$

Results, Discussion and Next Steps

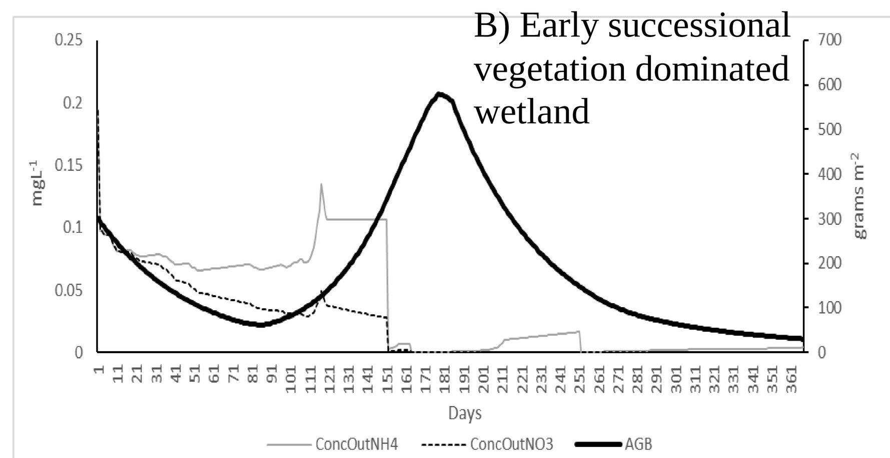
Model predicted daily nitrogen (mg/L) discharged from irrigated seasonal wetlands dominated by:

a) Late successional plant species (irrigated seasonal wetlands)
b) Early successional plant species (unirrigated wetlands)



More work is needed to ensure important processes are captured adequately. For instance, plant growth and nutrient uptake require additional verification and calibration. Many parameters were sourced from the literature, but empirical data is needed due to the unique climatic conditions CCV wetlands experience. Microbial composition and associated rates need to be included and parameterized.

Sensitivity analysis is yet to be completed to identify the primary drivers of hydrology.



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