

Field study of multi-year biomass production through the attached periphytic algae flow-ways utilizing non-point source nutrient in the estuary at Corpus Christi, TX

Sungwhan Kim¹, Carlos Quiroz-Arita¹, Eric A. Monroe¹, Anthony Siccardi², Jacqueline Mitchell³, Nathan Huysman⁴, Ryan W. Davis¹

¹Department of Bioresource and Environmental Security, Sandia National Laboratories, 7011 East Ave, Livermore, CA 94550, United States

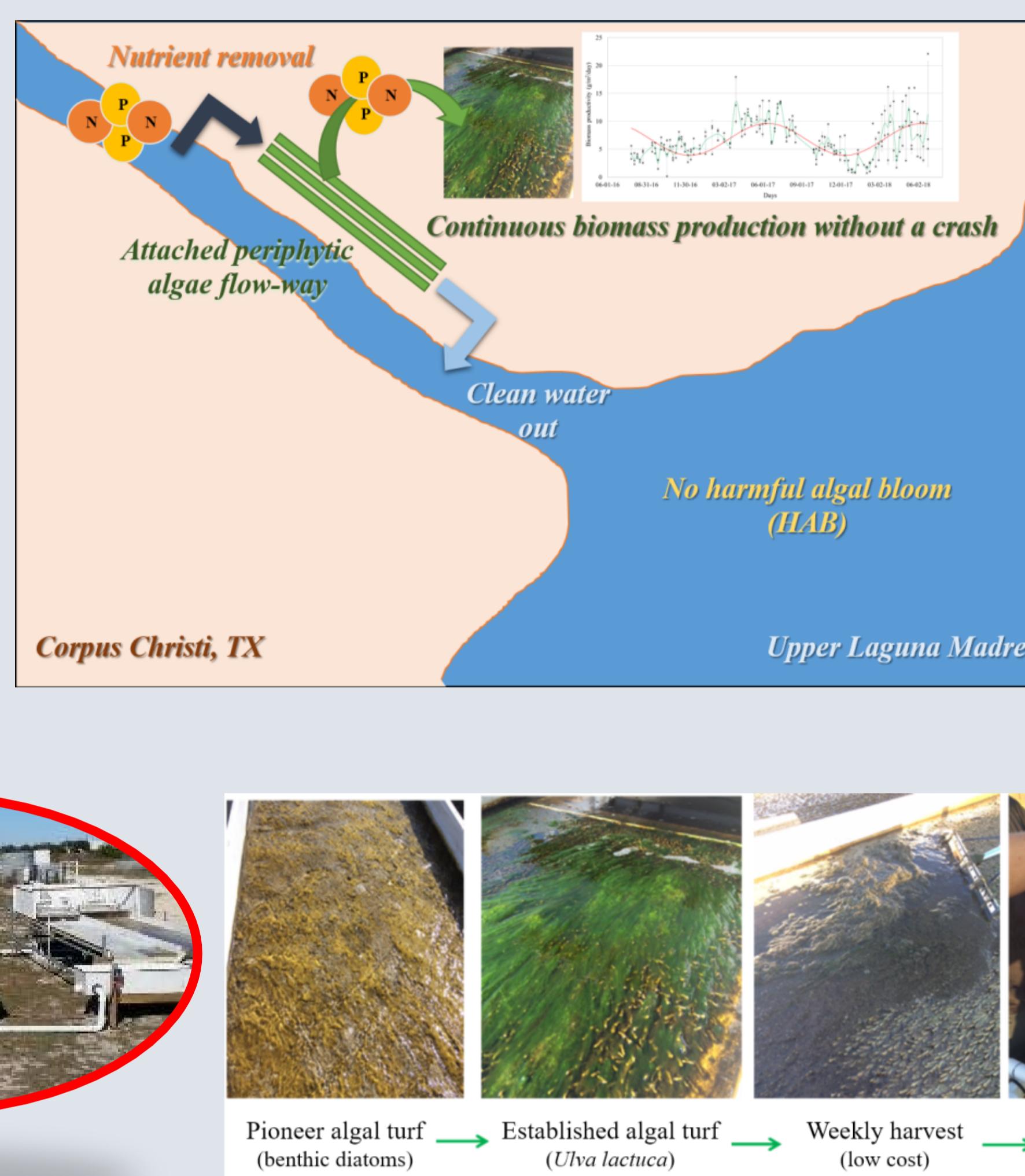
²Department of Biology, Georgia Southern University, 4324 Old Register Road, Statesboro, GA 30460, United States

³Department of Fisheries and Mariculture, Texas A&M-Corpus Christi, 6300 Ocean Dr., Corpus Christi, TX 78412, United States

⁴Texas A&M AgriLife Research, 100 Centeq Building A, 1500 Research Parkway, College Station, TX 77843, United States



Energy Efficiency & Renewable Energy



➤ Long-term outdoor operation of attached algae flow-way in Upper Laguna Madre, TX.

➤ Persistent algal ash-free biomass production at 4 to 10 g/m²/day over two years.

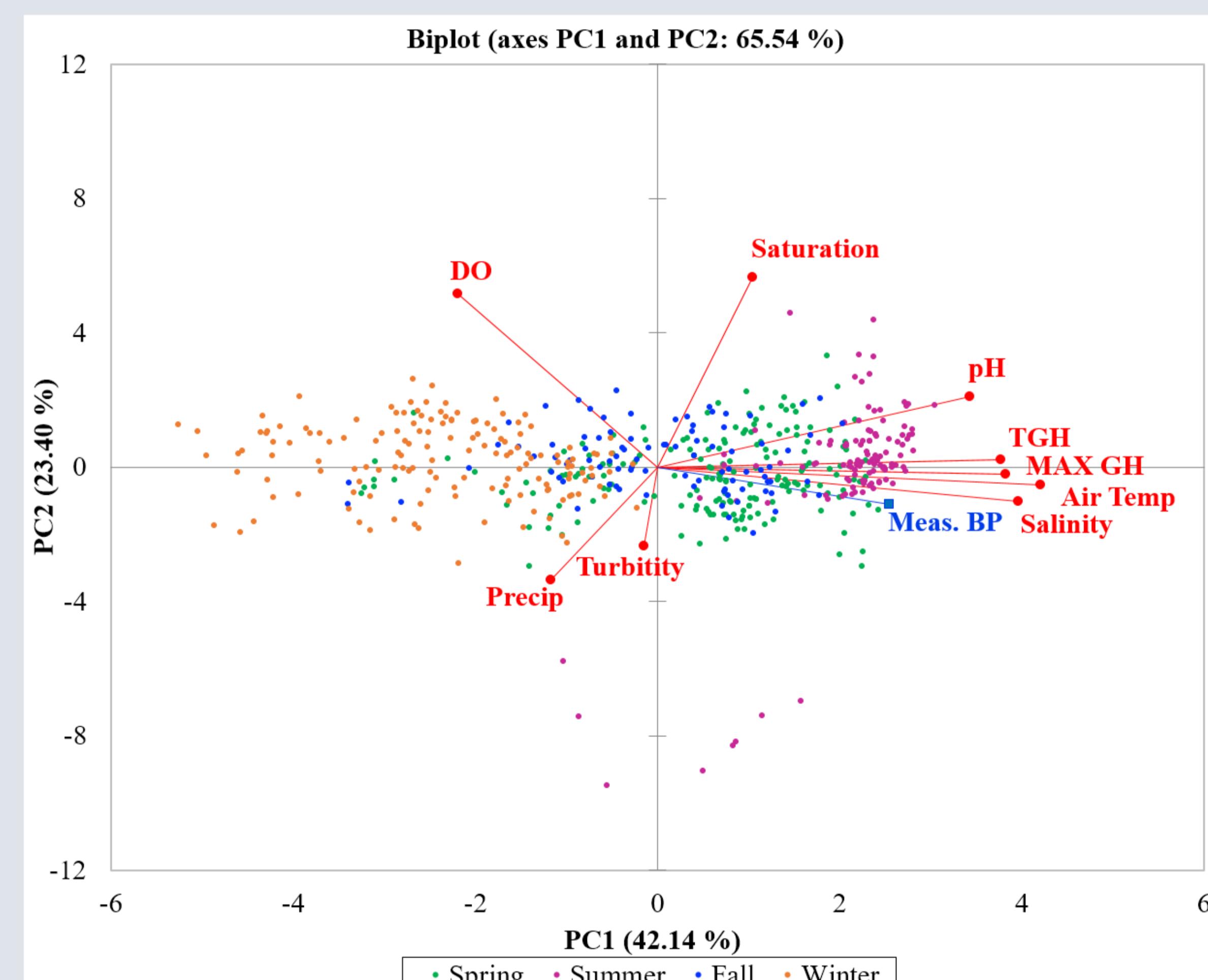
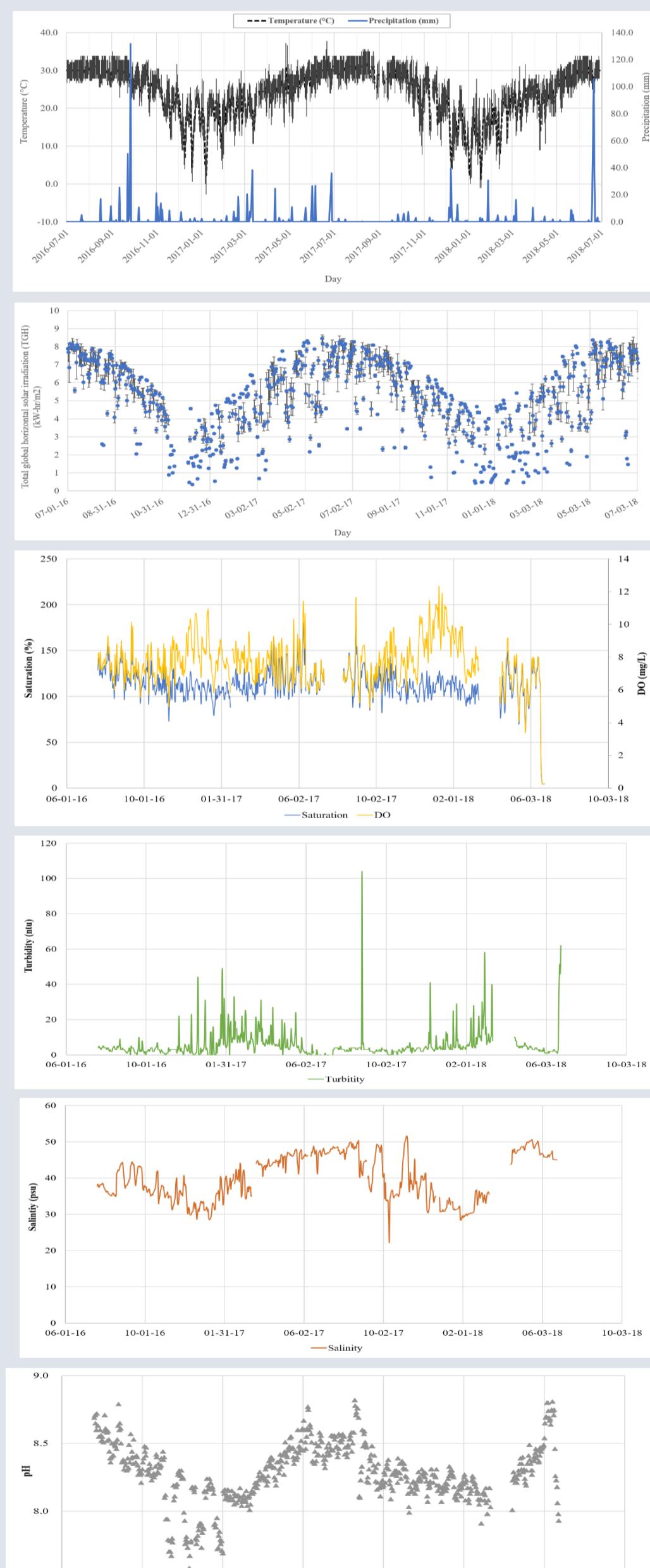
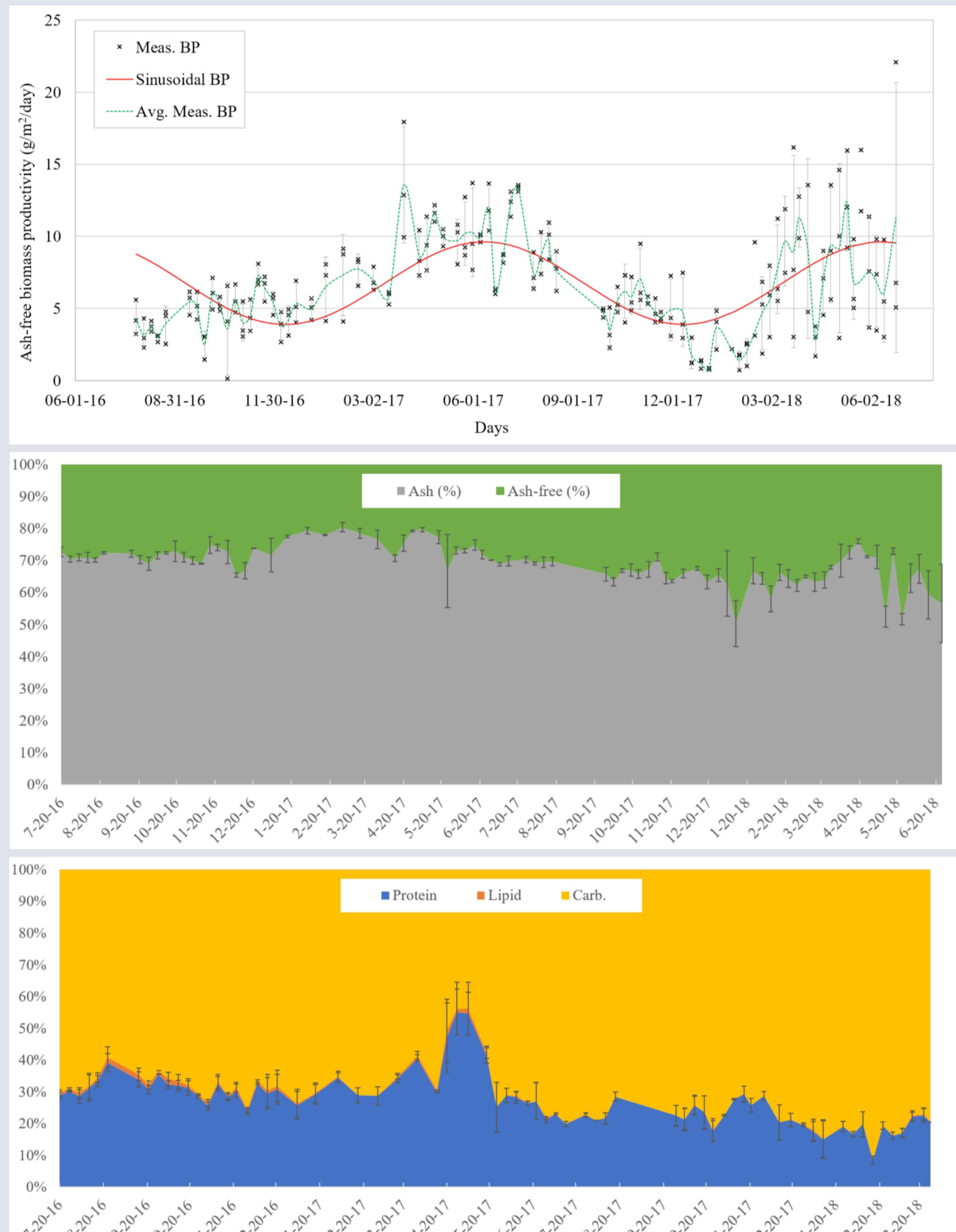
➤ TN and TP recovery at 300~500 mg/m²/day and 15~30 mg/m²/day, respectively.

➤ Total solar irradiation was a key factor for biomass productivity of the flow-way.

➤ Developed the machine learning models have predictive capability ($R^2 = 0.67\sim0.75$).

➤ Upon start-up, a latency period was observed which indicates roles for species succession from relatively low productivity, high ash content pioneer periphytic culture composed primarily of benthic diatoms from the source waters to higher productivity, reduced ash content, and more resilient culture mainly composed of filamentous chlorophyta, *Ulva lactuca*.

Multi-year biomass productivity and compositional variation & Effect of environmental factors (PCA)



➤ Persistent biomass productivity of 4 to 10 g/m²/day (with the highest: 22 g/m²/day in summer 2018; the lowest: 0.2 g/m²/day in winter 2016)

➤ Biomass productivity has positive correlation with Salinity (strongest), air temperature, pH, and maximum (MAX GH) and total solar irradiation (TGH).

Machine-learning predictive capability for biomass productivity

- Training, validation, and testing results of three ML methods, regression tree, ensemble tree, and Gaussian process regression (GPR) model, to investigate their predictive capability of biomass productivity at Corpus Christi, TX.
- The regression tree (RMSE=1.94g/m²/day, $R^2=0.66$) and ensemble of tree (RMSE=1.93g/m²/day, $R^2=0.66$) are more consistent in their metrics and appear to have more predictive capability of biomass productivity in the algae flow-way.

