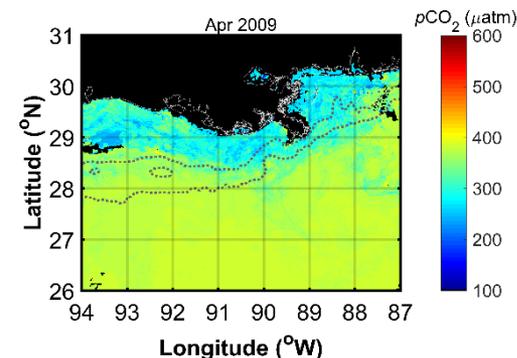


Satellite estimation of coastal $p\text{CO}_2$ and air-sea flux of carbon dioxide in the northern Gulf of Mexico

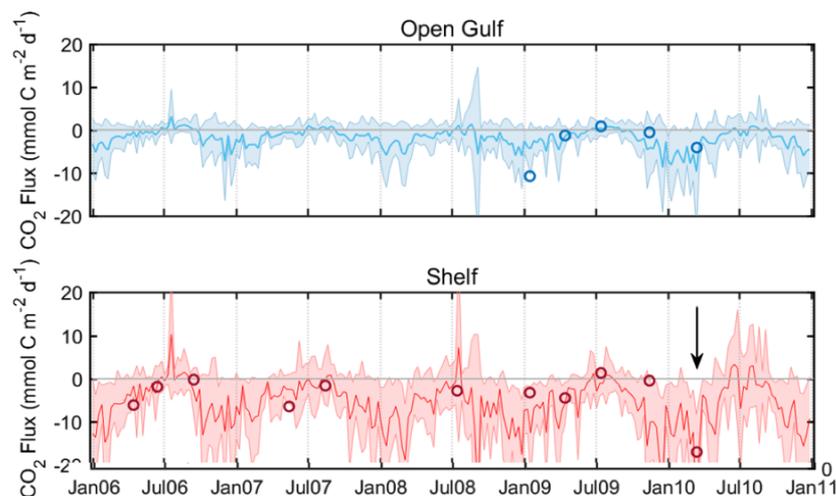
Challenge: A contributing factor in uncertainties in coastal carbon fluxes stems from the under sampling of seasonality and spatial heterogeneity. Our objectives were to i) assess satellite-based approaches that would expand the spatial and temporal coverage of the surface ocean $p\text{CO}_2$ and sea-air CO_2 flux for the northern Gulf of Mexico, and ii) investigate the seasonal and interannual variations in CO_2 dynamics and possible environmental drivers.

Methods: Regression tree analysis was effective in directly relating surface ocean $p\text{CO}_2$ to satellite-retrieved (MODIS Aqua) products including chlorophyll, sea surface temperature, and dissolved/detrital absorption. Satellite-based assessments of sea surface $p\text{CO}_2$ were made spanning the period from 2006-2010 and were used in conjunction with estimates of wind fields and atmospheric $p\text{CO}_2$ to produce regional-scale estimates of air-sea fluxes.

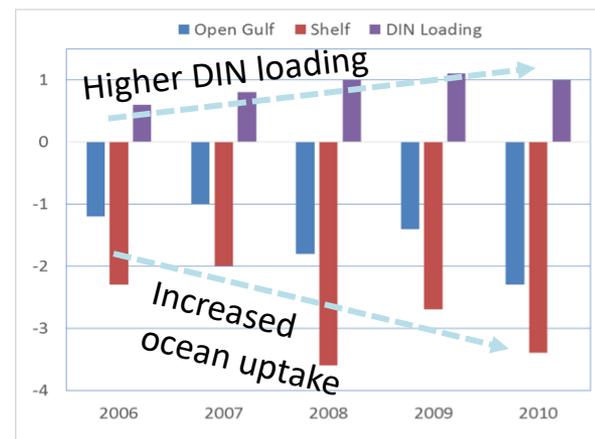
Key Findings: Seasonality was evident in air-sea fluxes of CO_2 , with an estimated annual average CO_2 flux for the study region of $-4.3 \pm 1.1 \text{ Tg C y}^{-1}$, confirming prior findings that the Gulf of Mexico was a net CO_2 sink. Interannual variations in fluxes were evident and related to Mississippi River dissolved inorganic nitrogen (DIN) loading.



Satellite-derived $p\text{CO}_2$ image for April 2009.



Satellite-based estimates of sea-to-air flux of CO_2 (shaded areas represent plus or minus one standard deviation). The circle symbols are results from ship-based estimates. Arrow indicates strongest negative fluxes (ocean uptake) during March 2010.



Annual CO_2 flux (Tg C y^{-1}) and DIN loading (Tg N y^{-1}) for the region.

Significance: This is the first multi-year assessment of $p\text{CO}_2$ and air-sea flux of CO_2 using satellite-derived environmental data for the northern Gulf of Mexico. Interannual variability in fluxes was related to Mississippi River DIN inputs, an indication that human- and climate-related changes in river exports will impact coastal carbon budgets.

NASA Publication from NACP Projects Lohrenz-04, Lohrenz-05:

Lohrenz, S. E., W.-J. Cai, S. Chakraborty, W.-J. Huang, X. Guo, R. He, Z. Xue, K. Fennel, S. Howden, and H. Tian (2018), Satellite estimation of coastal $p\text{CO}_2$ and air-sea flux of carbon dioxide in the northern Gulf of Mexico, *Remote Sensing of Environment*, <https://doi.org/10.1016/j.rse.2017.12.039>

Supported by funding from NASA (NNX10AU06G, NNX12AP84G, NNX14AO73G, and NNX13ZDA001N)