SEASONAL VARIABILITY IN AIR-SEA FLUXES OF CO2 IN A RIVER-INFLUENCED COASTAL MARGIN

Steven E. Lohrenz 1, Wei-Jun Cai2, Feizhou Chen3, Xiaogang Chen4, and Merritt Tuel5

1Dept. of Marine Science, The University of Southern Mississippi, Stennis Space Center, MS 34529, U.S.A. (Steven.Lohrenz@usm.edu)
2Dept. of Marine Sciences, The University of Georgia, Athens, GA 30602, U.S.A. (wcai@uga.edu)

INTRODUCTION

A major objective of the U.S. Global Change Research Program Climate Change Science Program Strategic Plan and the North American Carbon Program is the application of satellite ocean color to characterize the spatial variability of air-sea CO2 flux in the oceans adjacent to the North American continent. Recent studies (Lohrenz and Cai, 2006) in the northern Gulf of Mexico and elsewhere (Tsunogai et al., 1999; Ternon et al., 2000; Cai, 2003) demonstrate that enhanced biological production in large river plumes may influence surface pCO2 levels resulting in a net surface influx of atmospheric CO2. However, such systems deliver large amounts of terrestrial carbon into continental margin waters, and hence, the potential for large and variable signals in carbon flux exist in these regions.

A series of recent syntheses highlight the lack of information about the northern Gulf of Mexico (e.g., SOCCR, 2006) highlight the need for additional data regarding carbon fluxes in the Gulf of Mexico.

Satellite-based regional approaches (e.g., Lefevre et al., 2002; Ono et al., 2004; Lohrenz and Cai, 2006) can be used to extend the spatial and temporal coverage for broad scale assessments of pCO2 distributions and air-sea fluxes of CO2.

Here, we use a satellite-based approach to assess air-sea fluxes of CO2 in the central northern Gulf of Mexico under different seasonal and river discharge conditions.

METHODS

We have successfully developed and applied an algorithm for assessment of areal distributions of pCO2 from MODIS imagery in the northern Gulf of Mexico based on empirical relationships of in situ measurements of surface pCO2 to environmental variables (T, S, chlorophyll). We applied principal component analysis to the T, S chlorophyll data and regressed the derived orthogonal components against pCO2 to produce an empirical algorithm for the estimation of pCO2.

To derive estimates of pCO2 from the satellite imagery, products for T, S and chlorophyll were required. MODIS-Aqua L1B data were processed using SeaDAS and sea-surface temperature (SST), chlorophyll (OC4 algorithm) and dissolved-dissolved absorption (Garve-Siegel-Mariotena version 1, aCDOM_process) products were retrieved. To provide an estimate of salinity, we used previously determined relationships between CDOM absorption (aCDOM) and salinity for the Mississippi delta region (Fig. 2). The algorithm to predict pCO2 from T, S and chlorophyll was applied using the MODIS-derived products to generate regional distributions of pCO2 (Fig. 3).

RESULTS

In contrast to the net uptake of CO2 in June, air-sea flux estimates revealed a net release during all other cruises. October 2005 followed two major storm events accompanied by coastal flooding. Fluxes were also high during April 2006, due to a combination of high pCO2 in the nearshore waters and high winds. Winds during both the October and April surveys were high (~12-15 m s\(^{-1}\)).

ACKNOWLEDGEMENTS

MODIS image data were provided by the NASA-GSFC DAAC. Funding was provided from NASA (NNG04GA02G) and NOAA.

REFERENCES