The Johns Hopkins University APPLED PHYSICS LABORATORY On the use of ocean color remote sensing to measure the transport of dissolved organic carbon by the Mississippi River Plume

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Abstract

We investigated the use of ocean color remote sensing to measure the transport of dissolved organic carbon (DOC) by the Mississippi River to the Gulf of Mexico. From 2000 to 2005 we recorded surface measurements of DOC, colored dissolved organic matter (CDOM), salinity, and water-leaving radiances during five cruises to the Mississippi River Plume. These measurements were used to develop empirical relationships to derive DOC, CDOM, and salinity from monthly composites of SeaWiFS imagery collected from 1998 through 2005. The CDOM algorithm uses a simple empirical relationship between ag 412 and Rrs 510/ Rrs 670. We compared our remote sensing estimates of river flow and DOC transport with data collected by the United States Geological Survey (USGS) from 1998 through 2005. Our remote sensing estimates of river flow and DOC transport correlated well ($r^2 \sim 0.70$) with the USGS data. Our remote sensing estimates and USGS field data showed low variability in DOC concentrations in the river endmember (7-11%), and high seasonal variability in river flow (~50%). Therefore, changes in river flow control the variability in DOC transport, indicating that the remote sensing estimate of river flow is the most critical element of our DOC transport measurement. We concluded that it is possible to use this method to estimate DOC transport by other large rivers if there are data on the relationship between CDOM, DOC, and salinity in the river plume.



Figure 1. Flow chart showing the method and rational of this work. Boxes represent empirical relationship, plain text represent the outputs of these relationships. DOC_p and DOC_0 are the concentrations of DOC in the river plume and river end-member respectively.



Figure 2. Relationship between [DOC] and CDOM, and CDOM and salinity. Data are from surface samples collected during 5 cruises to coastal waters of Louisiana between 2000 and 2005.



Figure 4. Relationship between ag 412 and Rrs 510/ Rrs 670. The least square linear regressions for the *Acadiana* I data only (dashed line), and all the data (solid line) are: R = -1.04 ag + 2.51, $r^2 = 0.94$, n=10; and R = 1.07 ag + 2.47, $r^2 = 0.60$, n=21. respectively. The lines are not statistically different.



Figure 5A. Modeled salinity vs. monthly river flow averaged from daily measurements collected by the USGS at St. Francisvile, LA. The least square linear regression equation is: salinity = -8.33×10^{-7} (river flow 1 s^{-1}) + 33, $r^2 = 0.71$, n = 82., Figure 5B shows the comparison between modeled and measured river flow (USGS). $r^2 = 0.70$, n = 82.



Figure 6A. Temporal variability in modeled and measured DOC transport by the Mississippi River. The data include the period between January 1998 and December, 2005. Figure 6B. Modeled vs. measured DOC transport. The line represents the 1-to-1 relationship. $r^2 = 0.70$, n = 67.