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Sea Surface Salinity and Ocean Color Observations in the Northern Gulf

J.C. Wesson (1), D.M. Burrage (1), D.W. Wang (1), and S.D. Howden (2)

(1) Oceanography Division, Naval Research Laboratory, Stennis Space Ctr, USA (wesson@nrlssc.navy.mil), (2) Department of Marine Sciences, University of Southern Mississippi, Stennis Space Ctr, USA (stephan.howden@usm.edu)

Airborne mapping of Sea Surface Salinity (SSS) has been performed using L-Band radiometers for over 15 years, and has been operationally practical for over a decade. Ocean scale L-band observations
of SSS are now obtained by satellite. ESA's SMOS has been operational for over two years and NASA's Aquarius satellite, launched in Jun, 2011, for over 6 months. Aircraft SSS complements satellite measurements by measuring nearer to coasts and with finer (∼1 km) spatial resolution. Due to the large effective pixel size of the satellite L-Band SSS measurements(∼35-80km), SMOS measurements do not reach the coast. Land microwave brightness signal in a given pixel contaminates the measurement of sea surface brightness temperature. However, the high signal to noise ratio (salinity contrast of 7-15 psu over 10km in some cases) of the coastal salinity signal, due to large freshwater sources, may dominate land contamination effects, to allow closer than usual SMOS SSS observations of strong coastal salinity patterns.

An additional method to estimate SSS near coasts is using ocean color. Very near to coasts, freshwater sources such as rivers are relatively rich in Colored Dissolved Organic Matter (CDOM).
As freshwater mixes with saltwater, salinity increases and CDOM concentrations fall. For conservative mixing, there is an inverse linear relation between CDOM and salinity, allowing estimates of SSS based on CDOM. The airborne sensors we use during STARRS flights include 2 SeaWifs airborne simulator sensors, one upward looking and one downward looking, as well as digital cameras, which we have used to identify color fronts. These provide ocean color measurements in addition to the STARRS microwave SSS measurements.

We present results from an airborne campaign in the northern Gulf of Mexico, June 2-13, 2011. We made four types of flights. 1) Underflights of SMOS tracks at times coincident with SMOS passes. 2) Zig-zag flights along the coast, between Texas and Mississippi. 3) Flights over NOAA buoys (which record in situ winds, waves, and temperature) in star-shaped patterns, for roughness studies. 4) Mapping flights to map salinity near a ship or buoy. Observations of high salinity gradient conditions near the coast allow us to evaluate SMOS SSS measurements near to shore under optimal conditions.

The campaign was conducted at a time when the Mississippi River had been diverted into the Morganza spillway due to record high river levels (flow rate exceeding 42,500 m^3/s), in order to reduce flooding risk for Baton Rouge and New Orleans, LA. The Morganza spillway had last been used for flood diversion in 1973. The diverted flow went into the Atchafalaya river and Atchafalaya Bay, west of the Mississippi River outlet. In this paper we concentrate on the near coastal observations (see also Burrage, Wesson, Wang, Hwang, and Howden, "Coincident Retrieval of Sea Surface Salinity from the Northern Gulf of Mexico Using SMOS and STARRS During the 2011 COSSAR Airborne Campaign") of ocean color and SSS, to map the extent of the freshwater plumes of the Atchafalaya and Mississippi outflows. We evaluate the effectiveness of the ocean color measurements as a proxy for SSS, in comparison with the airborne L-band SSS measurements, and also assess the SMOS nearshore salinity measurements.