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Coincident Retrieval of Sea Surface Salinity from the Northern Gulf of Mexico Using SMOS and STARRS During the 2011 COSSAR Airborne Campaign.

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Airborne mapping of Sea Surface Salinity (SSS) using L-band radiometers has been practiced for over a decade. However, aircraft range has limited mapping to coastal regions with occasional extended offshore transects. With 2-years of successful SMOS operation and the launch of NASA's Aquarius mission on 10 June 2011, open ocean SSS remote sensing has become an operational reality. The spatial resolution of the L-band radiometers is limited by deployable antenna size, but the relatively fine (35 km) resolution of SMOS at nadir, provides unprecedented opportunities to study SSS variations in marginal seas. Here, the relatively high signal to noise ratio produced by freshwater inflows at the coast allows the averaging period needed to map open ocean SSS variations to be reduced; improving temporal resolution without significantly compromising sensitivity.

We describe an airborne campaign that combined the high-resolution coastal mapping capabilities of NRL's airborne Salinity Temperature and Roughness Remote Scanner (STARRS) with the open ocean mapping capabilities of SMOS. The Color Surface Salinity and Roughness (COSSAR) airborne campaign was conducted under summertime conditions, by flying STARRS over the Northern Gulf of Mexico during 2-13 June, 2011. Campaign objectives were to map SSS over the continental shelf and fly offshore transects coincident with SMOS overpasses. The campaign started immediately following a record flood crest in the Mississippi River, with flows exceeding 42,500 m̂3/s. This necessitated large diversions into the Atchafalaya River and Lake Ponchartrain, to avoid catastrophic flooding of New Orleans and Baton Rouge. The flood, and its diversion, produced large plumes from both rivers, which were observed by STARRS. Line transects crossing the plumes were flown along three ascending SMOS groundtracks and a descending one, at times coincident with satellite overpasses. Shorter zig-zag transects were flown along the coast. Intensive mapping surveys were conducted over an oceanographic research vessel that was collecting in situ temperature and salinity data, and star-shaped patterns were flown over NOAA buoys recording in situ winds, waves and temperatures. The coincident ship, STARRS, SMOS and NOAA buoy data are being used to assess the performance of alternative roughness correction models for the SSS retrievals, including one based on Hwang's new wind-wave spectrum.

Analysis of data from the STARRS L-band radiometer reveals large freshwater plumes from the Mississippi and Atchafalaya Rivers, separated from offshore regions with quite subtle SSS variations by sharp salinity and color fronts (see also Wesson, Burrage, Wang and Howden, "Sea Surface Salinity and Ocean Color Observations in the Northern Gulf of Mexico Using SMOS and STARRS"). The salinity fronts exhibited SSS contrasts of 7-15 psu over 10 km spans. The buoy data and aerial photographs show the low wind speeds produced only weak to moderate wind-wave development, so that roughness influence on SSS retrieval was modest. This situation will be contrasted with observations from the Virginia Offshore (VIRGO) STARRS airborne campaign, to be conducted during wintertime off Chesapeake Bay and across the Gulf Stream in Feb., 2012. This will also overfly NOAA buoys and underfly SMOS.