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Linking the Presence of Surfactant Associated Bacteria on the Sea Surface and in the Near Surface Layer of the Ocean to Satellite Imagery

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Several genera of bacteria residing on the sea surface and in the near-surface layer of the ocean have been found to be involved in the production and decay of surfactants. Under low wind speed conditions, these surfactants can suppress short gravity capillary waves at the sea surface and form natural sea slicks. These features can be observed with both airborne and satellite-based synthetic aperture radar (SAR). We have developed a new method for sampling the sea surface microlayer that has reduced contamination from the boat and during lab handling of samples. Using this new method, a series of experiments have been conducted to establish a connection between the presence of surfactant-associated bacteria in the upper layer of the ocean and sea slicks. DNA analysis of in situ samples taken during a RADARSAT-2 satellite overpass in the Straits of Florida during the 2010 Deepwater Horizon oil spill showed a higher abundance of surfactant-associated bacterial genera in the slick area as compared to the non-slick area. These genera were found to be more abundant in the subsurface water samples collected as compared to samples taken from the sea surface. The experiment was repeated in the Straits of Florida in September 2013 and was coordinated with TerraSAR-X satellite overpasses. The observations suggest that the surfactants contributing to sea slick formation are produced by marine bacteria in the organic matter-rich water column and move to the sea surface by diffusion or advection. Thus, within a range of wind-wave conditions, the organic materials present in the water column (such as dissolved oil spills) can be monitored with SAR satellite imagery. In situ sampling was also performed in the Gulf of Mexico in December 2013 during RADARSAT-2 and TerraSAR-X satellite overpasses. Areas near natural oil seeps identified from archived TerraSAR-X imagery were targeted for in situ sampling. A number of samples from this location have been analyzed to determine the presence and relative abundance levels of one genus of surfactant-associated bacteria. Determining the effect of surfactant-associated bacteria on the state of the sea surface may help provide a more complete global picture of biophysical processes at the air-sea interface and uptake of greenhouse gases by the ocean.