Electrical Properties of Ocean Water at Mississippi Gulf Coast and Development of Electromagnetic Algorithms to Predict Sea Surface Salinity (SSS)

K. Brooke Grantham*, Tutku Karacolak, Robert J. Moorhead, and Erdem Topsakal

Department of Electrical and Computer Engineering and GeoResources Institute
Mississippi State University, Mississippi State, MS 39762, USA

Salinity plays an important role in ocean circulation (*David M. Le Vine and Saji Abraham, "The Effect of the Ionosphere on Remote Sensing of Sea Surface Salinity From Space: Absorption and Emission at L Band" IEEE Trans. on Geoscience and Remote Sensing, vol. 40, no.4, April 2002*) and fluctuations in salinity are mainly due to changes in freshwater (evaporation, precipitation, melting ice, or river input). Microwave remote sensing techniques have been often applied to the remote sensing of ocean surfaces. Microwave remote sensing from space provides the necessary temporal and spatial information needed to understand the role of salinity in oceans. For instance, the NASA Aquarius mission scheduled to launch in 2009 will be flying an integrated L-band microwave radar and radiometer (*http://aquarius.nasa.gov/*). In order to validate the data collected through current and future NASA missions, and to provide data for calibration of the current instruments, there is a need to develop fast and very accurate (<0.1psu) microwave remote sensing methods to predict the ocean salinity.

The first step in remote sensing of sea surface salinity is to understand the direct electromagnetic scattering from the sea surface and develop accurate models to predict the sea surface impedance. Figure 1 shows the pictorial electromagnetic scattering scenario. In order to solve the direct electromagnetic scattering problem, ocean water samples were collected from Mississippi Gulf Coast. The dielectric properties, ε and σ were measured using Agilent's 85070E dielectric probe kit and Agilent's E8362B PNA Network Analyzer (10 MHz – 20 GHz). Based on these measurements, we have developed a computational model of the sea. We have then calculated the sea surface impedance for L, S, C, X and Ku -bands (1 GHz–18 GHz). The direct scattering problem was analytically solved using these surface impedance values and the scattered fields were compared with the simulations. In house Finite Element Boundary Integral Based Electromagnetic simulation tools were used for numerical analysis.

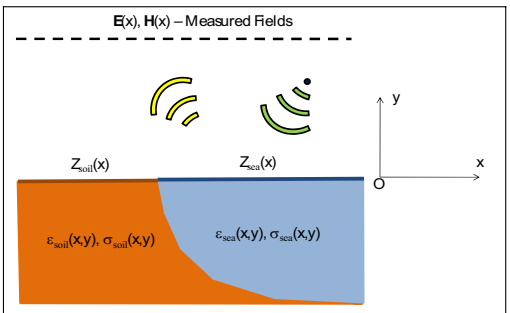

Figure 1. Microwave Remote Sensing Scenario for Determining Sea Surface Impedance