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Measurement of SSS and SST Using Multiple Frequencies in the Range 0.3 – 3.0 GHz

David M. Le Vine[1] and Emmanuel P. Dinnat[1,2]
(1) Goddard Space Flight Center, Greenbelt, MD 20771, e-mail: david.m.levine@nasa.gov
(2) CEESMO, Chapman University, Orange, CA 92866, e-mail: emmanuel.dinnat@nasa.gov

The radiometers on SMOS [1], SMAP [2] and Aquarius [3] have demonstrated the feasibility of monitoring surface salinity from space [4]. They also have demonstrated the need for better accuracy in cold water [5, 6]. These radiometers operate in a narrow, 27 MHz wide, spectral window at 1.413 GHz protected for passive use only. While this is nearly ideal (protected spectrum and near a null in sensitivity to SST), the actual peak in sensitivity to SSS is closer to 800 MHz and moves to even lower frequency as the water temperature drops [7]. Simply moving to a frequency closer to the sensitivity peak is not feasible because of the lack of spectrum protected from radio frequency interference (RFI). One way to improve accuracy and mitigate the impact of RFI is to make observations at several frequencies simultaneously, for example using a wide bandwidth radiometer and dividing the signal into multiple frequency channels [8]. Typical frequencies under consideration are in the range 0.3 – 3.0 GHz. The sensitivity to SST also has a peak in this frequency range [7], and this paper examines the possibility of retrieving both SSS and SST together. The approach adopted for assessing the potential for retrieving SSS or SST is to start with an idealized radiometer system (i.e. calibrated with an error free retrieval algorithm). Then the retrieved SSS or SST is expanded in a Taylor series about the error-free value and examined as function of the input variables, in this case SSS, SST, radiometric noise and wind speed (surface roughness). The potential accuracy of the retrieval (i.e. standard deviation of the error) is examined as a function of the error in these input parameters. Only random error is considered. Systematic error such as calibration bias, or bias in the retrieval algorithm are not considered. The analysis gives an idea of the potential accuracy of the retrieval, although clearly an optimistic estimate (i.e. lower limit). The results are encouraging for SSS but not so for SST. The problem for retrieving SST in this frequency range is a null in the sensitivity of brightness temperature to changes in SST in the vicinity of 1-2 GHz where the sensitivity changes sign. Low values of the sensitivity to changes in SST make the retrieval highly susceptible to radiometric noise and errors in the input parameters (SSS and wind speed in this case). The situation is much better above 3 GHz.

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