MODELING L-BAND EMISSIVITY OF A WIND-DRIVEN SEA SURFACE

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In this study, we develop a new multiparametric microwave emission model to compute L-band (1.4 GHz) emissivity for a wind-driven sea surface. In hydrodynamic part, the surface is characterized by a number of dimensionless variables associated with wave spectrum, fetch, and whitecapping. The electromagnetic part is based on our models reported in [1], [2], [3], and [4]. In a view of remote sensing the sea-atmosphere interface can be represented by a statistical ensemble of environmental factors, having different electromagnetic properties and brightness characteristics (Fig. 1). We combine both parts analyzing, first, individual microwave contributions due to surface roughness, foam/whitecap, subsurface bubbles, and spray on L-band emissivity. Then, considering their joint impacts on sea surface emissivity, we compute L-band radiation-wind dependencies (RWD) parameterized by sea surface temperature (SST) and sea surface salinity (SSS). As a result, we define variations in the brightness temperature induced by SST and SSS separately (i.e., the relevant signatures) at variable sea surface conditions. So, for the fetch-limited situations estimated brightness-temperature gradients by SSS lie in the range 0.1-0.3 K/ psu (at 35° incidence angle).

We predict that the observed (measurable) L-band signatures are produced due to a spatially temporal *intermittency* of the listed microwave contributors. We found that the sensitivity of computed RWD to SST and SSS is good enough for low and moderate winds (< 7 m/s); at high winds (>10-12 m/s) it is difficult or even impossible to distinguish the contributions from environmental factors (shown in Fig. 1) on the brightness temperature. Our understanding is that variations of sea surface emissivity at L-band are induced mostly by vertical and horizontal nonuniformities of the sea electromagnetic skin layer responsible for the formation of thermal microwave emission. Radiometric signals in such situations depend on observation process and an instrument resolution significantly. This fact should be taken into account in the retrieval algorithms. We assume that for adequate analysis of radiometric data it is necessary to employ a comprehensive physics-based model operated with many parameters.

The suggested task is considered in the context with upcoming missions: NASA-Aquarius [5] and ESA-SMOS [6] dedicated for the global monitoring of SSS and SST from space using L-band radiometers. Our results also can be used for a quantitative interpretation of field remote sensing experiments and laboratory tests. As an example, we perform the comparison of our model RWD with L-band observations [7], [8].

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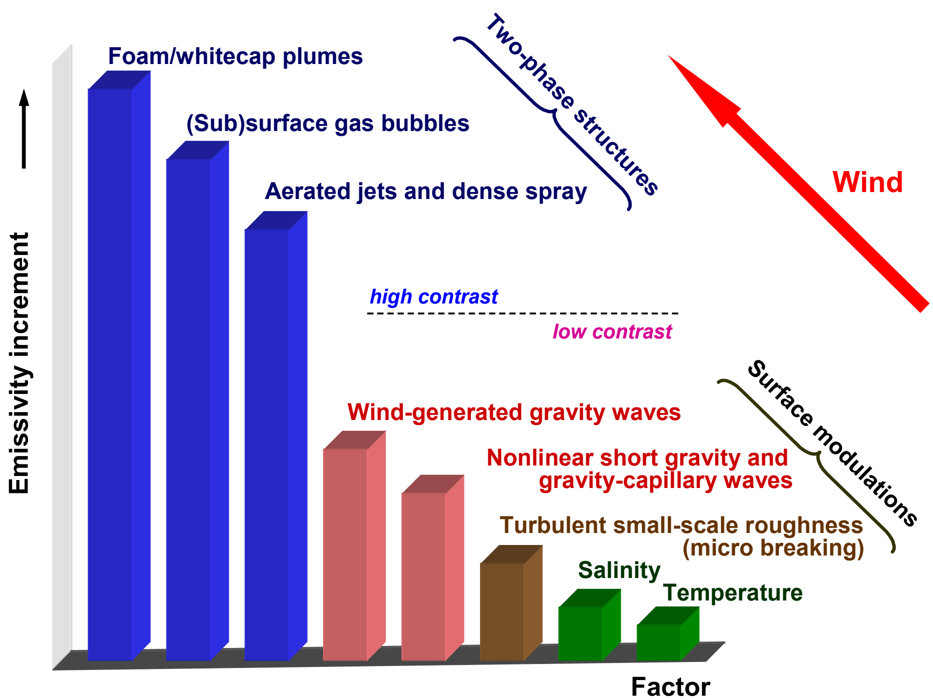

Figure 1. Environmental factors affected on sea surface emissivity.