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Title: SMAP's Decadal View of L-band Ocean Surface Emissivity

Abstract: Accurate retrieval of SSS from L-band radiometer observations requires careful correction for the effects of wind stress and swell on the roughness of the ocean surface. This has been particularly challenging at high wind speeds due to limited sampling in sensor measurements used to determine surface roughness model functions (Yueh et al. 2013, 2016, Meissner et al. 2014). Now that systems like SMAP and SMOS have been in orbit for >10 years, enough observations have been obtained to enable a careful assessment of how ocean surface emission covaries with wind speed and direction, sea temperature, and wave height.

We have performed a matchup analysis of SMAP ocean surface emissivity using radiometer observations from 2016-2025. Our process for flagging and calibrating SMAP brightness temperatures, defining validation exclusion regions, and matching observations with ancillary data (Argo SSS, NCEP winds, WaveWatch III wave heights, optimally interpolated SST) are detailed in the JPL L2 product document and prior studies (Yueh et al. 2016, Saïd et al. 2024), with the following additional steps. (1) Rather than the hybrid Klein-Swift/Meissner-Wentz GMF currently employed in the product, we use the dielectric constant model of Boutin et al. (2023) (2) Rather than masking based on instantaneous rain rate, we use a diffusive rain impact model (Jacob et al. 2019) to flag regions with potential surface stratification. (3) We mask outliers in ocean surface stability/instability by using near-surface parameters to estimate the ocean surface bulk Richardson number.

Using the matchup data, we subtract model functions currently employed for the JPL L2 salinity product and bin the residual. A model for this residual (in the zero-harmonic component) is fit by training a neural network on the binned data weighted by the logarithm of the number of counts. This achieves a precise fit where counts are high while maintaining smoothness towards the edges of the sampling distribution. We will present our analysis of the effects of our revised excess emissivity model on SSS and ocean surface wind speed retrievals and discuss other activities towards the development of Version 6 of the JPL SMAP salinity product.

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