**Title**

Characterising the marine atmospheric boundary layer with spaceborne SAR

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**Abstract**

Oceans play a vital role in the regulation of Earth's intricate climate system. The majority of gas and energy exchanges occurring at the ocean-atmosphere interface are driven by small-scale, O(1 km), coupled processes. Despite its importance, too few observations have been able to capture the ocean-atmosphere coupling at scales smaller than O(10 km). This has led to poor parameterisation in climate models. In an effort to enhance our understanding of the ocean-atmosphere coupling, this study aims to test and improve upon two separate Marine Atmospheric Boundary Layer (MABL) characterisation methodologies (called algorithm 2A and algorithm 2B) put forward by Young et al., (2000). Algorithms 2A and 2B relate processed Synthetic Aperture Radar (SAR) image properties to a specific atmospheric state through use of surface-layer similarity theory and a combination of surface-layer and mixed-layer similarity theory respectively. Results of both methods indicate significant inherent limitations. Algorithm 2A's utility is curbed by uncertainty introduced during the estimation of Convective Boundary Layer depth Zi and spectral power-law extrapolation. Algorithm 2B suffers from uncertainty introduced by the dimensionless energy dissipation rate psi. As a result of these (and other) uncertainties, the estimated atmospheric instability can be off by a factor 2 or more. Further analyses suggest shortcomings in the applicability of the Geophysical Model Function (GMF). It is hypothesised that both employed GMFs underestimate the horizontal wind-field variance at scales relevant to turbulent convection, which subsequently manifests itself as (part of) the observed average 50% overestimation of absolute Obukhov length and subsequent 33% underestimation of the atmospheric instability. Additional research is required to support and quantify the GMF-induced underestimation hypothesis. Inspired by algorithm 2B, a third method (algorithm 2C) is developed which circumvents major uncertainties inherent to both algorithm 2A and 2B. However, due to limitations of its own, algorithm 2C is incapable of replacing algorithms 2A or 2B for a large range of atmospheric instabilities. If improved upon and successfully employed, spaceborne characterisation of the MABL could benefit climate studies by providing a wealth of continuous and global atmospheric-state measurements on scales previously unavailable.