Themes: Earth Observation and Atmosphere

Characterization of the Marine Atmospheric Boundary Layer using wide-swath SAR imagery

Synthetic Aperture Radar (SAR) provides all-weather monitoring of the ocean surface roughness with an effective resolution (after speckle filtering) in the order of 100 m. On the atmospheric side of the air-sea interface, wind fields forced by atmospheric phenomena locally enhance ocean roughness, leaving behind a projection of their wind field onto the ocean surface. These patterns are in turn visible in the roughness-sensitive SAR observations. Through this mechanism, SARs are capable of observing the intricate variations of atmospheric boundary layer wind fields. Information contained in these wind-field projections is sufficient to identify specific atmospheric conditions, e.g. Sikora et al. (1995), Young et al. (2000), Vandemark et al. (2001).

Recent efforts by Wang et al. (2019) have enabled a classification of Sentinel-1 wave-mode observations into categories containing specific ocean-surface signatures, including those induced by organized wind fields contained within the boundary layer. Follow-up work (Stopa et al. (2022), O'Driscoll et al. (2023)) has shown that the image texture can be used to qualitatively and quantitatively characterize the state of the Marine Atmospheric Boundary Layer.

The aforementioned research is limited to small SAR vignettes of approximately 20 by 20 km^2. In order to observe the transition of atmospheric states, one ought to consider a larger domain, such as provided by Sentinel-1 IW acquisitions of approx 170 by 250 km. This simultaneously enables the comparison with atmospheric predictions from the ECMWF operational model.

This project will focus on tracing atmospheric transitions on the larger IW scenes. Firstly, this will require the identification of IW SAR scenes of interest adapting existing classification algorithms. Then the images will be segmented in areas of similar texture after which the atmospheric state will be estimated and compared to atmospheric models run by ECMWF.

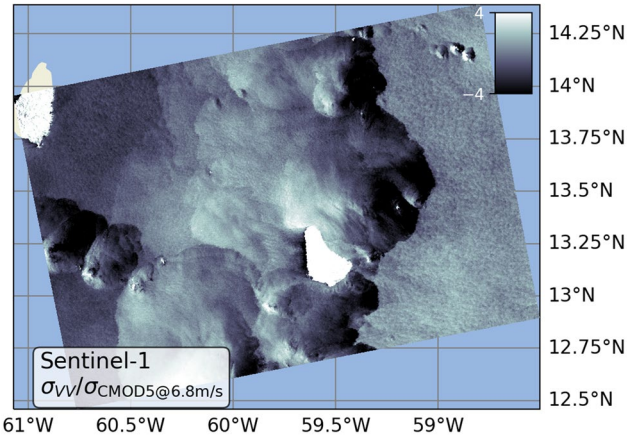

Figure 1 Sentinel-1 IW image showing a range of atmospheric phenomena and MABL states over Hawaii

Research questions:

- Can we identify atmosphere-induced textures from large-scale IW observations?
- Are atmospheric parameters extractable from textures visible in IW scenes?
- Are the textures and derived atmospheric parameters consistent with the spatial transition of the atmosphere as predicted by ECMWF?

Students profile

The candidate should have an interest in Earth Observation. The work involves working with satellite and ECMFW data sets and the develoment of algorithms, which requires some affinity for (Python) coding.

involved in the mission across Europe

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