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Combining satellite and in situ data to investigate the marine atmospheric boundary-layer structure and trade-wind cumuli organization

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Studying the marine atmospheric boundary layer (MABL) processes through satellite products is challenging. Here, we propose an innovative approach to investigate the MABL turbulent structures thanks to the spaceborne Synthetic Aperture Radar (SAR) images combined with the Geostationary Operational Environmental Satellite (GOES) images.

Due to access difficulties, the number of field campaigns carried out over the sea is limited. In this framework, the intensive EUREC4A field campaign that took place over the Western Tropical Atlantic Ocean, in Jan-Feb 2020, provides a relevant context with reference in situ measurements to evaluate the spaceborne observations. Especially the turbulence measurements of the French ATR-42 research aircraft, which include fine scale measurements of air motion, provide a valuable support to validate the hypothesis of a sea surface roughness signature of atmospheric coherent structures in the SAR images.

The February 13, 2020 day was chosen as a case study, given the good spatial and temporal colocalization between the airborne measurements and the satellite overpass. Two types of atmospheric processes are investigated: convective rolls in clear sky regions and cold pools characterizing the convective activity areas. The size and the orientation of the convective rolls has been characterize through the correlation function of the surface roughness and provides a very good correlation with the characteristics deduced from the airborne in situ data. Also, an object identification method is used to segregate the cold pools within the SAR image. Their characteristics such as their size, age and spreading rate can then be estimated with respect to the cloud field evolution provided by the GOES data.