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Variability of satellite Sea Surface Salinity under rainfall

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Two L-Band (1.4GHz) microwave radiometer missions, the Soil Moisture and Ocean Salinity (SMOS) and the Soil Moisture Active and Passive (SMAP) missions, currently provide salinity measurements in the first centimeter below the sea surface. At this depth, salinity variability at hourly temporal scales is dominated by the impact of precipitation. The dependency of the salinity freshening with the instantaneous rain rate (RR) observed between 50°S and 50°N, with SMOS and SMAP salinities, is very similar.

We investigate the influence of rain history on salinity anomalies. By using rain rates retrieved from several microwave satellites measurements including Advanced Microwave Scanning Radiometer 2 (AMSR-2), and Special Sensor Microwave Imager Sounder 17 (SSMIS-17 and SSMIS-16) and by taking advantage of their different crossing times, we estimate the temporal cross-correlation function between salinity freshening and rain rate for different time lags in various tropical and high latitudes regions. Whatever the region, the magnitude of the salinity anomaly associated with precipitation is dominated by the instantaneous RR for each area. The apparent correlation between salinity anomaly and rain history can be explained by RR auto-correlation.

The relationship between salinity anomaly (ΔS) and RR is then investigated in different regions, with RR provided using three different algorithms (the Unified Microwave Ocean Retrieval Algorithm (UMORA), the Goddard profiling algorithm (GPROF) and Integrated MultisatellitE Retrievals for GPM (IMERG)). Differences in RR distribution between the various algorithms lead to differences of up to a factor 2 in ΔS versus RR slopes. For a given RR product, we also observe that part of the variability in ΔS versus RR relationships is related to the variability in wind speed regimes as detected by SMAP wind speed.

These results are compared with Sea Surface Salinity (SSS), rain and wave measured in-situ during field campaign as SPURS-2 2017 cruise and Mirai 2018 cruise using collocation methods. Preliminary investigations considering the effect of rain heterogeneity and wind speed on freshening using a prognostic model (Bellenger et al, 2017) will be presented.