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Upper Oean Salinity Stratification and Rain Induced Fresh-Water Lensing Effects in the Tropics Observed from Aquarius

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Our presentation is based on the latest Aquarius Level 2 ocean surface salinity product. The CO-NAE Microwave Radiometer (MWR) on board of the Argentinean SAC-D spacecraft, which also host the Aquarius instrument, supplies brightness temperatures at K/Ka-band that are exactly spatially and temporally collocated with Aquarius. The MWR measurements can be used to obtain a value for the surface rain rate at the instant and location of the Aquarius observation.
The main goal of our study is to analyze the strength and duration of rain driven fresh-water events in the tropics and how they affect the ocean surface layer. An important question in this context is if it is possible to make a meaningful comparison between salinity observations from Aquarius and the ARGO drifting buoy network, which is used as the major validation source for the Aquarius product. Aquarius measures salinity within a few centimeters of the ocean surface, whereas the ARGO buoys measure at least at 5 m depth.
We use the MWR to filter out any rain event at the instant of the Aquarius measurement, which would result in an obvious rain freshening effect. Even after applying this rain filter, Aquarius is sig-nificantly fresher than ARGO in most of the tropical regions, the difference reaching up to 0.4 psu in the Indian Ocean and near the ITCZ. It appears that there is a clear spatial correlation between the fresh bias of the rain-filtered Aquarius – ARGO salinity and the monthly TMI rain rate at the location of the Aquarius measurement. The monthly TMI rain rate at a certain location serves as a proxy for the probability that rain occurs there. This suggests that at least a large part of the observed freshwater bias is real and due to the fact that Aquarius sees rain induced freshwater lensing close to the ocean surface, which is not captured by the ARGO buoys at 5 m depth. In order to confirm this hypothesis, we have analyzed the Aquarius – ARGO salinity difference as function of the rain rate that is meas-ured by TMI in a certain time interval before the Aquarius observation occurs. A correlation between Aquarius – ARGO bias and TMI rain rate becomes evident. If the time difference between the rain-free Aquarius observation and the TMI rain events is less than 1 hour, a rain rate of 1 mm/h results roughly in a 0.1 psu freshening effect. Even if the time difference is 12 hours there is still a noticeable freshening of about 0.05 psu per 1 mm/h rain rate. This demonstrates that rain induced freshwater lensing can persist for at least half a day before complete mixing of the upper layer occurs.
Finally, we show that there is better agreement between salinities from Aquarius and moored buoys (TAO, PIRATA, TRITON, RAMA), which measure at a depth of 1 m and are therefore a better proxy to the Aquarius observation than the ARGO buoys at 5 m depth.