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Assessment of the performance of coastal and open-water buoys for application to satellite SST validation

Sandra Castro[†]; William Emery; Gary Wick
[†] University of Colorado/CCAR, USA
Leading author: sandrac@colorado.edu

Drifting and moored buoys have played an essential role in enabling development of satellite sea surface temperature (SST) products and for routinely monitoring the stability of the retrievals once such products become operational. In particular, SST measurements from global drifting and tropical moored buoys have been utilized to derive the algorithm coefficients in regression-based methods employed with AVHRR SSTs since its inception. These buoys are also the basis for evaluating the accuracy of the different satellite SST products and for diagnosing possible bias corrections for existing satellite SST products. It is important to emphasize, however, that even though the global buoy network has been the frame-of-reference for comparisons with SST measurements estimated from satellites, the buoys themselves have not been deployed with this specific purpose in mind and, therefore, are not optimized for satellite SST calibration/validation applications. In this study we examined the performance of drifting and moored buoys relative to reference satellite SST products. Buoys were segregated into coastal (within 200 km from the coast) and open-water (outside the 200 km boundary) zones, and were further stratified by buoy manufacturer (drifters) and by buoy program (moorings). Global differential mean biases and standard deviations of drifting and moored buoys from the NCEP-GTS were computed with respect to both the AMSR-E SSTs and the NAVOCEANO K10 SST analysis. The drifting buoys exhibited no systematic difference as a function of manufacturer. Open-water drifting buoys typically showed biases of less than 0.1 K with standard deviations of less than ~0.7 K relative to AMSR-E SSTs and less than 0.6 K relative to the K10 analysis. Coastal drifting buoys showed slightly greater standard deviations but similar biases, with the exception of the daytime AMSR-E comparisons for which biases were occasionally greater than 0.2 K. The tropical moored buoy arrays showed similar standard deviations (~0.45 K for AMSR-E and 0.40 K for K10), albeit with bigger biases, particularly for the AMSR-E nighttime comparisons. Coastal moored buoys, however, showed significant differences relative to the satellite SST reference products, and required case-by-case analysis. It has been customary to exclude coastal moorings from satellite calibration and validation procedures. It is known that these buoys behave differently, although the reason as to why, has largely been a matter of speculation to this point. As a result, most operational agencies and SST data producers have opted for excluding moored buoys from their matchup databases entirely. Although they constitute a smaller portion of the GTS catalog, these buoys provide valuable information in regions where there is no other source of in situ data, as well as in coastal regions where satellite SST algorithms are not well characterized, as is the case with the microwave SST sensors. Additional work targeted understanding the sources of the differences in behavior for the coastal moorings. Mean bias differences were subsequently binned in terms of geophysical parameters such as wind speed, water vapor, and SST for both drifting and moored buoys in order to understand potential differences in behavior by buoy hull type, season, and geographic region.