Are Wave Measurements Actually Ground Truth?

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Abstract:

In the wave modeling world, there has always been a need to evaluate the performance of the technology. Use of either point-source measurement sites or satellite based altimeter (or SAR) provide valuable insights into the quality of a forecast, hindcast, or used to improve the modeling technology. We have taken for granted wave data are *ground* truth and our modeling technologies are inherently required to approximate these conditions. We understand wave data are bounded by confidence limits generally set by statistical relationships.

The wave measurement providers are for the most part bounded by operational time constraints. Attempts have been made to Quality Control the data prior to releasing. Some spurious data does become public and are used without knowledge of the inaccuracies. We also base nearly all of wave model evaluations on integral parameters (H_{mo}, T_p, T_m, θ_{mean}). These variables tend to mask errors that would have a significant impact on an error metric. For example, a negative bias in the low frequency range and a large positive bias in the high frequency range of a spectrum would integrate to a net zero bias in significant wave height. This gives a false positive result in a wave model evaluation. It could also create unwarranted modifications in the modeling technology.

Over the past five years under the Joint Technical Commission for Oceanography and Marine Meteorology (JCOMM) we have been performing intra-measurement analyses of various buoy platforms. Our original hypothesis entering into this study was that most directional estimates (and high-order moments) would result in the largest differences between platforms. What we have found is that the energy spectra distributions significantly differ. Durrant et al. (2009) found a 10% difference in results derived from Environment Canada and National Data Buoy Center wave estimates compared to altimeter estimates. This observation also supports findings by Bender et al. (2010) where strapped down accelerometers (or tri-axial motion sensors) in a high wind and wave environment will over-estimate H_{mo} by as much as 3-m (in an 11-m wave state). Bender et al. (2010) indicated the error could be rectified numerically removing the heel in the times series. We are presently investigating this correction based on results from buoys containing a HIPPY and strapped down accelerometers positioned in the Atlantic and Pacific Ocean basins.

The ramifications of these differences can and will have an impact on the work performed in the wave modeling community. This talk will summarize the findings of the work performed to date and identify the steps to understand and rectify these inherent errors.