# HURRICANE HINDCASTS ARE MISSING THE PEAKS

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## 1. ABSTRACT

Hurricanes produce the most intense wind speeds over Earth's oceans, resulting in extreme sea states. Understanding ocean wave development under hurricane conditions is important for safety and operations offshore, yet operational hindcasts tend to under-predict the highest sea states [1–3].

Following [4], ref. [2] combined hurricane track information in the North Atlantic [5, 6] and observations of significant wave height from satellite altimeter [7, 8]. Using a coordinate transformation based on hurricane radii and orientation [9–14], ref. [2] produced spatial maps of wave heights, amalgamating 1,286 altimeter passes. Ref. [2] showed the variation of wave height as a function of hurricane intensity and translation speed that revealed evidence of extended fetch [15].

Comparing to the hindcast from the Institut français de recherche pour l'exploitation de la mer (Ifremer), which was forced by the Climate Forecast System Reanalysis (CFSR) produced by the U.S. National Oceanic and Atmospheric Administration (NOAA) National Center for Environmental Prediction (NCEP)[16], ref. [2] showed a pattern of bias in the estimated wave heights under hurricane conditions. Figure 1 a) reproduces the wave height bias map along with contours of wave height as observed by altimeter. Fig. 1 a) shows that although wave heights tend to be overestimated in the right sector, the highest wave heights are underestimated near the hurricane eye. This is the spatial analog to missing the peak of a time series [1].

Here we extend the work of ref. [2] by looking directly at wind speeds that drove the hindcast. altWIZ[1], a system for pairing altimeter measurements with models, point observations, and storm tracks [17], was updated to include wind speed. Fig. 1 b) shows percent bias of model wind speed with contours of observed wind speed overlaid. Wind speed is overestimated except for an area of severe underestimation within 2R. The low winds around the eye explain the under-generation of peak swell waves that dominate dominate the eye region and left and rear sectors. Ongoing work extends this analysis to extra-tropical cyclones[18].

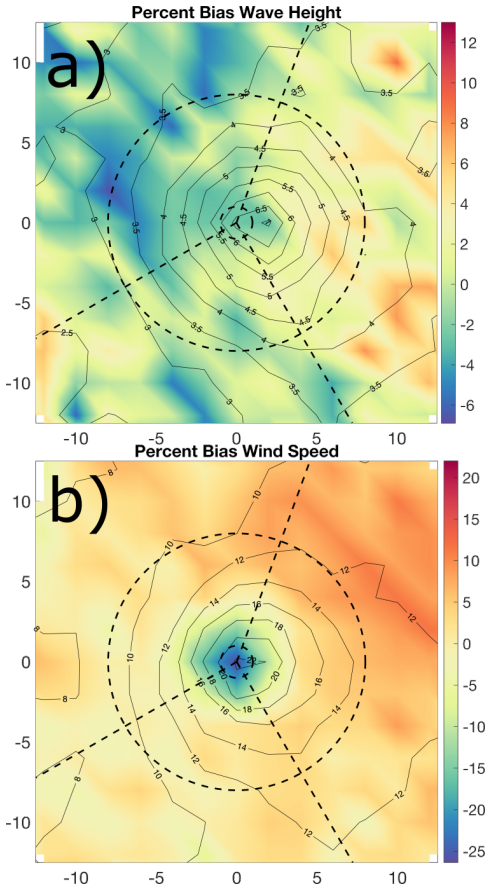


**FIGURE 1: PERCENT BIAS OF (A) WAVE HEIGHT AND (B) WIND SPEED FROM IFREMER HINDCAST COMPARED TO OBSERVATIONS BY ALTIMETERS IN A HURRICANE-CENTERED REFERENCE FRAME AVERAGED IN 2R X 2R BINS. R IS THE DISTANCE NORMALIZED BY RADIUS OF MAXIMUM WINDS. ALL DATA ARE FROM HURRICANE CONDITIONS (MAXIMUM WIND SPEED ≥ 33 M/S). CONTOURS SHOW THE ALTIMETER OBSERVATIONS OF (A) WAVE HEIGHT AND (B) WIND SPEED. SMALL DASHED CIRCLE IS R = 1; LARGER DASHED CIRCLE IS R = 8. DASHED LINES SHOW HURRICANE SECTORS. THE ORIENTATION IS SUCH THAT THE HURRICANE IS MOVING FORWARD UP THE PAGE. NOTE THE CHANGE IN COLOR SCALES.**

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[1]https://github.com/Tripphysicist/altWIZ.git

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