EVALUATION OF WIND AND WAVE FORECASTING ON THE SOUTHWEST ATLANTIC OCEAN

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ABSTRACT

Predicting waves in the ocean is extremely important for various activities, such as navigation and for mitigating risks in offshore structures. With that in mind, one should consider that wave forecasting is quite sensitive to fluctuations in wind speed and direction, modeled at 10 m from the sea surface. This is even more critical in extreme events such as cyclones, which occur frequently near the southern and southeastern regions off Brazil. Considering this, the present work is aimed to analyze the accuracy of predicted sea surface wind (SSW) and significant wave height (HS), with special attention to those generated by subtropical and extratropical cyclones in the Southwest Atlantic Ocean. The models used are the ones currently operational at CPTEC/INPE: the WaveWatch III® (WWIII) and the Global Forecast System (GFS) atmospheric model (used to feed WWIII), both with a horizontal 25 km resolution, and for forecasts running up to 120 h (5 days). To evaluate the modelled SSW and HS we compared the predicted fields with *in situ* buoy data at coastal stations and at open ocean maintained by the PNBOIA and SIMCOSTA programs in the west South Atlantic Ocean, between 10° S to 55° S and 20° W to 70° W, within the period of 2018-2023 (i. e., last 6 years). The scatterometer and altimeter data were merged and 'colocated' in the model grid in order to obtain an equivalent data set for future evaluation. The Root Mean Squared Error (RMSE), bias, Pearson Correlation Coefficient (ρ) and Determination Coefficient (R^2) were used to characterize the uncertainty of the predicted fields. The validation results of wind prediction with coastal buoys showed that the bias was oscillating between positive and negative values, with a minimum of -0.938 m and maximum of 1.857 m. The RMSE was found to be ranging from 3.761 m to 1.760 m and the correlation was ranging from 0.217 to 0.864. In the offshore region the bias was predominantly negative reaching -2.087 m, indicating an underestimation of the model. The RMSE was ranging from 2.182 m to 3.737. The correlation was predominantly above 0.5, reaching 0.902. The results of the comparisons between wave prediction and buoy data in coast, showed RMSE ranging from 0.84 m to 1.05 m, and a positive bias ranging from 0.51 to 0.87 m, indicating that the model tends to overestimate HS over the continental shelf. The correlation was under 0.51 and the scatter was high with R2 predominantly under 0.30. For the offshore regions, a better performance of the model was evident with RMSE ranging from 0.18 m and 0.51 m, bias near 0 m, ρ predominantly over 0.90, and a lower scatter of the data, with R^2 over 0.70. This is expected since the WWIII is an open ocean model, and its performance deceases on shelf waters. Nonetheless, recent works have shown improvements on predicted HS near coastal regions,

especially for extreme weather events, using biased corrected SSW fields, combining weather forecast and satellite scatterometry. The next steps of the present work are to (i) apply a bias correction method to the GFS SSW using operational scatterometers; (2) apply the corrected GFS SSW to the WWIII hindcast, and (3) compare with the observed *in situ* buoy and satellite data, over the same region and period previously analyzed. Detailed analysis of the model performance with and without the SSW bias correction will be made for selected study cases with extreme weather events caused by subtropical and extratropical cyclones.

Key-words: Wave prediction. Sea surface wind. Bias correction. Satellite data. Cyclones.