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Steps towards a consistent Climate Forecast System Reanalysis wave hindcast (1979-2016)

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Surface gravity waves are being increasingly recognized as playing an important role within the climate system. Wave hindcasts and reanalysis products of long time series (>30 years) have been instrumental in understanding and describing the wave climate for the past several decades and have allowed a better understanding of extreme waves and inter-annual variability. Wave hindcasts have the advantage of covering the oceans in higher space-time resolution than possible with conventional observations from satellites and buoys. Wave reanalysis systems like ECWMF's ERA-Interim directly included a wave model that is coupled to the ocean and atmosphere, otherwise reanalysis wind fields are used to drive a wave model to reproduce the wave field in long time series. The ERA Interim dataset is consistent in time, but cannot adequately resolve extreme waves. On the other hand, the NCEP Climate Forecast System (CFSR) wind field better resolves the extreme wind speeds, but suffers from discontinuous features in time which are due to the quantity and quality of the remote sensing data incorporated into the product. Therefore, a consistent hindcast that resolves the extreme waves still alludes us limiting our understanding of the wave climate.

In this study, we systematically correct the CFSR wind field to reproduce a homogeneous wave field in time. To verify the homogeneity of our hindcast we compute error metrics on a monthly basis using the observations from a merged altimeter wave database which has been calibrated and quality controlled from 1985-2016. Before 1985 only few wave observations exist and are limited to a select number of wave buoys mostly in the North Hemisphere. Therefore we supplement our wave observations with seismic data which responds to nonlinear wave interactions created by opposing waves with nearly equal wavenumbers. Within the CFSR wave hindcast, we find both spatial and temporal discontinuities in the error metrics. The Southern Hemisphere often has wind speed biases larger than the Northern Hemisphere and we propose a simple correction to reduce these features by applying a taper shaped by a half-Hanning window. The discontinuous features in time are corrected by scaling the entire wind field by percentages ranging typically ranging from 1-3%. Our analysis is performed on monthly time series and we expect the monthly statistics to be more adequate for climate studies.