Geophysical Research Abstracts
Vol. 21, EGU2019-13681, 2019
EGU General Assembly 2019

Discrepancies in modern wave climate projections based on different atmospheric reanalyses

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Ocean surface waves are an important component of the climate system affecting momentum, heat and mass exchange between the ocean and the atmosphere. The main source of uncertainty in the results of wind wave modeling is forcing wind fields. However, wave climate can demonstrate different regional climate signals from those observed in winds due to influence of both local meteorological conditions and swell generated in remote areas. Here our aims are (1) to investigate regional discrepancies between wind and wave climate signals and (2) to assess the discrepancies between wind and waves themselves. Here we use MERRA2 and ERA-Interim atmospheric reanalyses that suggest sufficient homogeneity in time and reliable representation of extratropical cyclone activity. Using them as atmospheric forcing we performed two sets of experiments with the spectral wave model WAVEWATCH III (WW3) for the period 1980-2017. Both wind wave hindcasts have been validated against buoy and satellite altimetry data and demonstrated a good agreement everywhere except high southern latitudes in the partially ice-covered area.

In midlatitudes the largest differences between MERRA2 and Era-Interim is observed in the Southern Ocean. Surface winds are lower in MERRA2 by up to 1 ms^{-1} in mean and 1.5 ms^{-1}in extreme values. However, in equatorial and subtropical regions MERRA2 demonstrates higher wind speed especially in summer of each hemisphere and the difference amounts up to 1 ms^{-1} in mean and 2 ms^{-1} in extreme wind speeds. In climatological characteristics MERRA2-WW3 hindcast in general demonstrate lower wave heights with the largest difference in tropics (up to -0.5 m) and the almost zero difference in mid-latitudes. The only region where MERRA2-WW3 waves exceed ERA-Interim-WW3 is along the Greenland coast (up to 0.4 m in mean and 0.6 in extreme values) and high latitudes in the Southern Ocean. In this way, discrepancies in winds in tropics do not lead to wave anomalies of the same sign in swell pools in the eastern part of the basins. The only region where wind and wave anomalies are in kind is the area to the south from Greenland effected by the local influence of katabatic winds and polar lows. In conclusion, understanding the discrepancies between wind and wave signals in present climate simulations can be useful in providing a stepping stone to interpretation of the future wind and wave climate projections.

Key Words: wind wave hindcasts, wave climate, WAVEWATCH, MERRA-2, ERA Interim