

EVLUATION AND BIAS CORRECTION OF MARINE SURFACE WINDS IN THE WESTERN NORTH PACIFIC FROM CMIP5 AND CMIP6 GCMs FOR WAVE CLIMATE MODELLING

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INTRODUCTION

For over years, fundamental component and dataset in climate projection had been covered by general circulation models (GCMs) output mainly from the Coupled Model Inter-comparison Project (CMIP). Marine surface winds are an important output of GCMs and they provide input to marine forecasts and warning systems. Their accuracy have direct implications for marine safety, air-sea fluxes, and wave and ocean modellings. Western North Pacific (WNP) is known as a highly vulnerable region to oceanic and atmospheric hazards, such as storm surges, waves and typhoons. Therefore, this study aims to examine the quality of marine surface winds from CMIP5 and CMIP6 GCMs in the WNP and its sub-regions with respect to a reference data, and presents bias correction of marine surface winds for contributing to wave and ocean modelling communities.

DATA AND METHOD

Monthly marine surface winds for 30 years from January 1979 to December 2008 of the historical datasets from CMIP5 and CMIP6 GCMs are retrieved from the IPCC (Talyor et al, 2012). 60 ensembles from 21 GCMs for CMIP5 and 32 ensembles from 7 GCMs for CMIP6 are considered in the analysis. The monthly surface winds for the same 30-yr period from the ERA-Interim reanalysis data are retrieved and considered as the reference surface winds. The WNP region (110° - 170°E and 10° - 60°N) is divided into 4 sub-regions in the analysis (not shown here): Southern Japan (SJ), Southeast Japan (SEJ), Eastern Japan (EJ) and Japan Sea (JS), to investigate the marine surface winds and their characteristics. Due to the different resolutions of GCMs and ERA-Interim considered, the surface winds are regridded onto the same resolution (1° x 1°) over the domain. Then, zonal and meridional winds over the study domain and sub-regions are investigated. Moreover, the multi-model ensemble mean (MME) is calculated and compared with the reference winds. The results of comparisons are summarized with statistical values such as bias, coefficient of determination (R^2), root mean square deviation (RMSD), standard deviation (std), and index of agreement (d). In addition, surface winds bias for each ensemble is investigated and corrected by using three bias correction method such as variance scaling correction (VC), quantile mapping correction based on cumulative distribution (QMC), and QM based on Weibull distribution (WBC).

RESULTS AND CONCLUSIONS

Due to the page limitation, we shows two results. Figure 1 shows comparisons of surface wind speed components in the WNP and sub-regions. Taylor diagram (not shown here) depicts the comparison of each GCM and MME from CMIP5 and 6. Figure 2 exhibits the results of surface wind bias correction with three methods. From

the monthly surface winds, the annual and seasonal variations are well presented, and the MME results show good agreements with the reference winds in the WNP and sub-regions. In the Taylor diagram, the MMEs from CMIP5 and 6 clearly indicate the improved results with the reduced RMSD, std and R values. In the bias correction results in Figure 2, the wide spreading bias in relative frequency are improved to the narrow banded distribution (Figure 2(c)).

Based on the results, it can be concluded that the use of individual ensemble use from CMIP GCMs could result in serious bias, and recommended to use MME values in coastal and ocean applications.

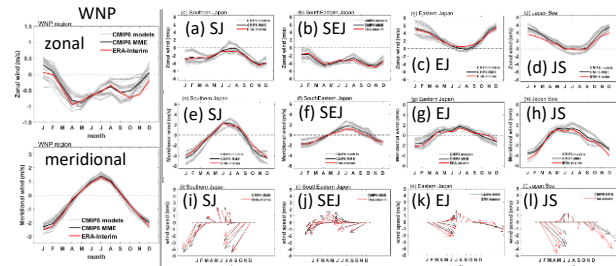


Figure 1 - Monthly averaged surface wind components in the WNP region (left) and sub-regions named SJ, SEJ, EJ, and JS for 1979-2008. (a-d) Zonal wind speeds with positive (negative) to east (west) direction and (e-h) meridional wind speeds with positive (negative) to north (south) direction. (i-l) shows monthly averaged wind vectors. Grey line indicates the each ensemble value from CMIP5, black line is the MME values, and red line depicts the reference data.

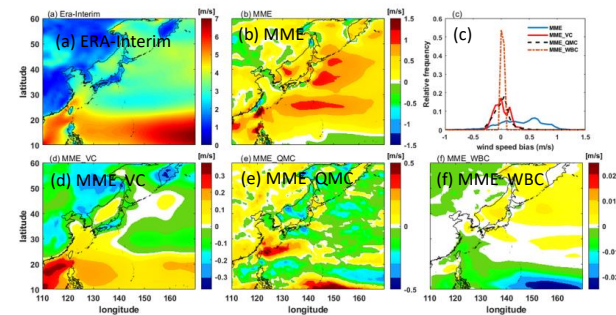


Figure 2 - (a) monthly mean wind speed (m/s) of ERA-Interim over 1979-2008 in WNP region. (b) Bias (m/s) of MME wind speed against reference data. Bias (m/s) of corrected MME against reference data using (d) VC, (e) QMC, and (f) WBC methods, respectively. (c) Relative frequency distribution of wind speed bias.

REFERENCES

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