A Performance Evaluation of CMIP6 wind fields for robust forcing in Indian Ocean Wave climate studies

The Coupled Model Intercomparison Project Six (CMIP6) lacks wave climate projections, emphasizing the critical need to select the most accurate CMIP6 model winds for projecting wave climate. This study focuses on evaluating and selecting the optimal CMIP6 model wind fields for the Indian Ocean wave climate projections. A 35-year (1980-2014) wind-wave climate simulation of the Indian Ocean (IO) using the third-generation wave model WAVEWATCH-III (WW3), forced with seven CMIP6 Global Climate Models ((BCC-CSM2-HR, EC-Earth3, CMCC-CM2-SR, GFDL-ESM4, CNRM-CM6-1-HR, HadGEM3-GC31-MM, and MPI-ESM1-2-HR), is generated and validated against in-situ buoy observations and ERA5 reanalysis data. Statistical analyses revealed that MPI, BCC, EC, and CNRM are the most accurate in representing wave characteristics in the IO, exhibiting strong correlations with observations, and effectively capturing inter-annual variability. Extreme wave analysis shows that MPI, BCC, and EC model wind-forced wave simulations match well with ERA-5 data (>220 rough days south of the equator and <150 rough days north of it). The top three models (MPI, BCC, and EC) are then selected for the composite analysis to assess their capability to reproduce the climate mode impacts on IO wave climate. EC performs best in capturing wave fields under El-Nino Southern Oscillation, Southern Annular Mode, and Indian Ocean Dipole influences, followed by BCC and MPI. Thus, the study identifies EC, BCC and MPI as the optimal CMIP6 models for the Indian Ocean wave projections.

Meenakshi Sreejith1,2, Remya P G1, Sreelakshmi S1, B Praveen Kumar1 Malavika Sudhakaran1 and T M Balakrishnan Nair1 1. MoES-Indian National Centre for Ocean Information Services, Hyderabad, India 2. Kerala University of Fisheries and Ocean Studies (KUFOS), Kochi, India