Abstract

Wind-waves generated over the ocean surface can directly impact coastal sediment transport, vessel manoeuvring characteristics, design of coastal and offshore facilities etc. Proper understanding of climate change impact on the wind-wave climate is therefore very crucial to plan adaptation and efficient mitigation strategies for coastal communities. Only limited studies were performed in the recent past on the variability on wind-waves induced by changing climate patterns, in particular for the Indian Ocean region. It is crucial to understand the futuristic projections of wind and waves under different changing climate scenario which has inherent uncertainty in the climate model simulations. The work carried out in this thesis addresses specific objectives that investigated the performance of Global Climate Models (GCMs) under CMIP5 and CMIP6 family for the Indian Ocean region. It examined the skill level of 33 different GCMs developed under the CMIP5 project for near-surface wind speeds over the Bay of Bengal (BoB). Statistical measures of CMIP5 projections indicate that RCP 4.5 wind speed holds good for the BoB region. Further, the validation exercise of GCMs with observations could provide better representation of wind speed for few cyclone cases that developed over BoB, whereas some GCMs showed under-estimation. Findings from the analysis indicate increased probability of moderate wind speeds in BoB during the study period. The study also verified the relative skill level of CMIP5 models with the recent CMIP6 GCMs for BoB region, and clearly demonstrated the improved quality in CMIP6 compared to CMIP5 models. Analysis also signifies that multimodal ensemble for projected wind speed in the head BoB region are expected to increase by 20% under the high-end scenario (SSP 8.5) by the end century. The wind-wave climate projections were constructed using the best-performing models to investigate extreme waves for the Indian Ocean. Projections collectively highlight on the maximum extreme winds and waves for the South Indian Ocean region. Future projected change in the extreme waves are maximum for the South China Sea, even in the RCP 4.5 scenario indicating a maximum of 23% rise under RCP 8.5 pathway by the end 21st century. The thesis analysed near-surface wind speed and significant wave height and also explored the projected changes in large-scale environmental drivers including SST (Sea Surface Temperature) and SLP (Sea Level Pressure) affecting the wind and wave climate.

Key Words: Wind speed, Wave height, CMIP5, CMIP6, COWCLIP