3rd International Conference on Earth System Modelling
Vol. , 3ICESM-91, 2012
3rd International Conference on Earth System Modelling

Climate Change Impact on Typhoon Affecting Taiwan Using MRI 20-km Mesh AGCM Time Slice Simulations

C.-T. Chen (1), T.-P. Tzeng (1), C.-T. Cheng (2), and A. Kitoh (3)

(1) National Taiwan Normal University, Department of Earth Sciences and Institute of Marine Science and Technology, Taipei, Taiwan (chen@rain.geos.ntnu.edu.tw, 886-2-29333315), (2) National Science and Technology Center for Disaster Reduction, (3) Japan Meteorological Agency, Meteorological Research Institute

Hurricane and Typhoon are the major contributors to the annual damage and economic lost due to natural disaster around the world. How the characteristics of these high-impact weather extremes will change in a warming climate have attracted considerable interests from research community. Currently the assessment on the future projected change in tropical cyclone from modeling study concluded that the global frequency of tropical cyclones will likely either decrease or remain essentially unchanged in the future. The projected changes in individual basins, on the other hand, are less certain. Despite the number reduction of tropical cyclones, the mean intensity and associated rainfall near cyclone center are likely to increase with anthropogenic greenhouse warming.

For climate change impact study, the previous global or basin-wise projected changes in tropical cyclone frequency and intensity have only limited usefulness. It would require regional and local information on the detailed changes in the tropical cyclone activities for impact analysis and adaptation planning, and national assessment on storm-related socioeconomic loss. Nevertheless, the reliability of simulated tropical cyclone tracks and intensity distribution for a specific region is much less than the whole basin and uncertainty much higher. In this study, the present day simulation of Taiwan landfalling typhoon was investigated using a 20-km mesh, very-high-resolution Meteorological Research Institute (MRI) atmospheric general circulation model. Realistic rainfall distributions associated with typhoon during a Taiwan landfall event were found for simulated tracks that resemble observed tracks. The maximum wind speed and minimum surface pressure relationship along the simulated typhoon tracks is also resemble to the observation. The climatology, seasonal evolution, and interannual variability for typhoon track density distribution are reasonably captured after considering the stochastic nature of regional tropical cyclone track statistics. However, one should be cautious about the untypical overestimate of intensive typhoon (major hurricane, greater than Saffir-Simpson scale category 3) number by the climate model might restrain the utility of model projected typhoon intensity change.

The future (2075–99) projection for typhoons affecting Taiwan by MRI 20-km mesh climate model indicates a significant reduction (by about 20%) in typhoon frequency of occurrence except for super typhoon (wind speed high than 130 knots). Although the typhoon frequency changes at individual grids are typically insignificant for statistical test, the data aggregation to a larger region that typhoons affecting Taiwan showed a significant reduction using bootstrapping method. For the rainfall associated with Taiwan landfall typhoons, projected future change is about 30-40% within the 200km radius from storm center. The corresponding change in precipitable water amount are typically less than 20%. It implied that there should be considerable contribution to these extreme precipitation changes from changes in dynamical process. By sampling the grid rainfall over Taiwan when typhoon passing, despite the general reduction of occurrences in the future, the number of heavy rainfall events increase significantly.