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学位論文題名	Numerical study on the climate over the western Philippines by a convection-permitting model: Role of local sea surface temperature （積雲対流解像モデルによるフィリピン西部の気候に関する数値的研究：局所的海面水温の役割）
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【論文の内容の要旨】

The Asian summer monsoon significantly impacts the climate of the western Philippines. In particular, rainfall variability in this region is determined by the dynamics and interactions of the Asian summer monsoon. These complex and highly-coupled dynamics, in addition to availability of observation data, prove to be a challenge in studying this region. With recent developments in regional climate models (RCMs), numerical simulations can fill the gap, both in terms of providing non-observed meteorological variables for analysis and in isolating physical processes that are otherwise difficult from observation analysis alone. In this study, a regional climate model, Advanced Research Weather Research and Forecasting Model (WRF-ARW), is used to analyze the role of local sea surface temperature (SST) in the western Philippines. This will provide insight on the extent of air-sea coupling in rainfall variability over this region.

The reproducibility of rainfall is first evaluated over the western Philippines at different spatial resolutions of RCM using WRF-ARW. Four sets of experiments with distinct horizontal resolutions were done for the summer monsoon period of June to August from 1982–2012. The spatial distribution of monthly rainfall amount improved for higher resolution simulations. Further

downscaling from a coarser initial domain performed better in capturing the monthly rainfall distribution than the single domain setup, however the spatial distribution at 12.5km-single domain run has the closest distribution compared with observed values. In addition, high rainfall amount was simulated over an offshore area apart from the coastline in the windward direction of the Asian summer monsoon westerlies. This offshore rainfall was also observed in other regions of monsoon Asia.

In the western North Pacific region, atmospheric forcing dominates over ocean conditions, which results to seemingly hidden effects of SST on rainfall. To determine the impact of SST west of the Philippines on summer monsoon rainfall in the northwestern coast of the country, the numerical experiments are devised as follows. A set of control simulations (CTL) driven by ERA-Interim reanalysis data and the monthly National Oceanic and Atmospheric Administration Optimum Interpolation SST dataset was performed for the months of June to August of 1982–2012. A second set of simulations driven by climatological SST values was performed for the same period. The difference between these two simulation sets is analyzed to determine the sensitivity of rainfall to interannual variations in local SST. The results showed that positive SST anomalies west of the Philippines induced positive rainfall anomalies in the northwestern Philippines via an increase in latent heat flux from the sea surface, implying that summer monsoon rainfall in the northwestern Philippines is modulated by interannual variations in SST west of the Philippines. The impact of SST on latent heat flux and rainfall were 20–40%, greatly exceeding the 7% approximation from the Clausius-Clapeyron equation, which can be explained by the enhancement of low-level winds and a weak warming of surface air temperature over the ocean.

In summary, this study was able to show the reproducibility of rainfall over the western Philippines using a convection-permitting model. The impact of SST was also isolated and quantified by analyzing numerical experiments with different SST forcing.