

Future changes of Asian monsoon simulated by the improved 20km MRI/JMA AGCM

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There are increasing demands for simulations by high-resolution climate models, which can provide detail and localized information about the climate change by global warming. We have developed the MRI/JMA 20km AGCM (Mizuta et al., 2006) and introduced a new cumulus parameterization scheme for the improvements. The new model improves in simulating the present-time climatology such as heavy monthly-mean precipitation around tropical Western Pacific, tropical precipitation variability, global distribution of tropical cyclones and their strength, seasonal march of East Asian summer monsoon, and inter-annual variability of tropical precipitation. The improvements of 25-year mean climatology are confirmed numerically with Taylor Diagram for 30 elements including precipitation, wind, temperature and others in the Asian region. Time-slice experiments using the CMIP3 ensemble SST changes are made for the near future and the end of 21st century. World-scale features of precipitation changes in the new 20km AGCM experiment are similar to those in the previous 20km model experiment and also to the CMIP3 multi-model ensemble result. However, we found that the improved climatology in the new model experiment gives significant influences on future regional changes in Asian monsoon. Dry future is dominant over the whole maritime continent in the new model experiment, being different from the previous 20km model experiment simulating wet future in the northern maritime continent. Over the Philippines and the Indochina Peninsula where drier future climatology is simulated by the previous model, the new model simulates more rainfall in the future. These differences between the models are partially attributed to the differences in the cumulus responses to increased equatorial Pacific SST changes, indicated from the differences in the present-time inter-annual variability of tropical precipitation. The improved seasonal march of East Asian summer monsoon also makes the difference in future East Asian climatology. The new model simulates the strengthened Meiyu and Baiu precipitation bands in the future similarly to the previous model, but the new model indicates precipitation bands tend to shift southward in the future. The future tendency of the precipitation bands is consistent with the southward shift and strengthening of upper subtropical jet over East Asia simulated by the new model and found in the CMIP3 ensemble projection. Increased future monsoon precipitation in Southeast Asia in the new model experiment leads to drier future in central Asia and southern Europe more than in the previous model experiment. High-resolution models are able to simulate future changes of fine scale climatology and extreme weather events. The result indicates their climatological states and variances also have to be simulated well. The output of the experiments will be open as one of CMIP5 experiments.