A study on future projections of precipitation characteristics around Japan in early summer combining GPM DPR observation and CMIP5 large-scale environments

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In this study, we estimate future changes in precipitation characteristics around Japan in early summer, by combining Global Precipitation Measurement (GPM) satellite-borne Dual-frequency Precipitation Radar (DPR) observation and Coupled Models Intercomparison Project Phase 5 (CMIP5) climate model large-scale projections. We first classify rainfall events (REs) observed with the GPM DPR during May-July 2014-2017 into “small”, “organized”, and “midlatitude” types according to their characteristics. Environments favorable for these three types of REs differ from one another in terms of the lower-tropospheric convective instability and the subtropical jet (Yokoyama et al. 2017). Based on this knowledge, we relate precipitation in each type of REs to the large-scale environment. Two environmental fields are chosen to determine the large-scale conditions of the precipitation: the sea surface temperature and the mid-level large-scale vertical velocity. Using these precipitation-environment relationships, we then reconstruct precipitation distributions for each type with reference to the large-scale environmental indices in climate models for the present and future climates.

As a result, future changes in the reconstructed precipitation are found to vary widely between the three types in association with the large-scale environment. In more than 90% of models, the region affected by organized-type precipitation will expand northward, leading to a substantial increase in this type of precipitation in areas where its present amount is relatively small. An increase in organized precipitation suggests an elevated risk of heavy rainfall, because the maximum precipitation intensity is more intense in organized-type precipitation than in the other two types. Validity of the method to reconstruct precipitation of each type of REs with large-scale environments is also discussed.

Key words: precipitation characteristics, future change, GPM, CMIP5

References

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