Future projections of precipitation characteristics around Japan in early summer combining GPM DPR and CMIP5 data

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Early-summer precipitation around Japan has a variety of characteristics, and it is an urgent issue to obtain information on its future change as accurately as possible. While current climate models have difficulties in predicting detailed precipitation characteristics, they have skills in predicting large-scale environments to some extent. In this study, we estimate future changes in precipitation characteristics by combining Global Precipitation Measurement (GPM) Dual-frequency Precipitation Radar (DPR) observation and Coupled Model Intercomparison Project Phase 5 (CMIP5) large-scale projections.

We first relate characteristics of rain events (REs) observed by the GPM DPR with large-scale environments. Rain events during May-July 2014-2017 are classified into “mid-latitude”, “organized”, and “small” types, which are identified by Yokoyama et al. (2017). These three types exist associated with different environments in terms of the subtropical jet and lower-tropospheric convective instability (Yokoyama et al. 2017). Based on this knowledge, we make look-up tables for three RE types with two indices; ascent at 500 hPa and sea surface temperature (SST). Using the look-up tables, we then reconstruct precipitation with CMIP5 large-scale environments, and predict its future change.

Twenty-four CMIP5 model ensembles of reconstructed early-summer precipitation are examined in the current (1980-2005) and future (2075-2100) climates. It is shown that patterns of precipitation change are significantly different among three types. Notably, organized precipitation will increase in Kanto-region around Tokyo, the northeastern part, and the Sea of Japan side of the Japanese archipelago, where the present amount is relatively small. Since maximum intensity of REs is significantly more intense in organized systems than other two types, we should take appropriate action for those regions where organized systems increase in future.

[Acknowledgment]: This study is supported by JSPS KAKENHI Grant 15H02132, the Environment Research and Technology Development Fund (2-1503) of Environmental Restoration and Conservation Agency, and the 8th RA of the Japan Aerospace Exploration Agency Precipitation Measuring Mission science.

キーワード：GPM DPR、CMIP5、降水特性、将来変化
Keywords: GPM DPR, CMIP5, precipitation characteristics, future change

