Future projection of Baiu precipitation from multi-GCM/RCM dynamical downscaling ensemble experiments

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Dynamical downscaling (DDS), whereby regional climate models (RCMs) is driven by outputs from ocean-atmosphere coupled general circulation models (GCMs), is a useful approach to provide climate change projection at fine spatiotemporal scales. The usefulness of DDS in future projection of Baiu (Meiyu) precipitation is unequivocal considering the observed topographic effect in Baiu precipitation from Japanese complex terrain. However there are indisputable uncertainties in DDS approach; those arising from GCMs, internal processes in RCMs, and their combined effects.

This talk presents projected future change of Baiu precipitation and its sources of uncertainties from an ensemble of multi-GCM and RCM DDS experiments. The ensemble DDS experiments are composed of three GCMs (MIROC3.2-hires, MIROC5, and MRI-CGCM3) and three RCMs (NHRCM, NIED-RAMS, and Tsukuba-WRF), yielding a total of nine ensemble members. 20-year simulation is conducted for each of current (1981-2000) and future (2081-2100) climate. Here, downscaling from MIROC3.2-hires is based on IPCC-AR4 20C3M and A1B scenarios, whereas downscaling from MIROC5 and MRI-CGCM3 is using AR5 20C and RCP4.5 scenarios. The target region is Japan and its vicinity, and the horizontal resolution is 20km. GCM outputs are directly used as initial and boundary conditions for RCMs in these experiments.

As an ensemble average, Baiu precipitation is projected to increase in Japan, whereas a reduction is projected over ocean south of Japan. This pattern indicates a northward shift of Baiu rainband in future climate. However, this shifting pattern is not unanimous among the ensemble members (Fig. 1). Downscaling results from MIROC3 and MIROC5 project the above noted northward shift of Baiu rainband, no matter what RCM is used. On the other hand, downscaling from MRI-CGCM indicates a reduction of precipitation in Japan and an increase in south of Japan, showing a reversed spatial pattern of downscaling from MIROC3 and MIROC5. These results indicate that forcing GCM is a major source of uncertainty in dynamical downscaling for future projection of Baiu rain band.

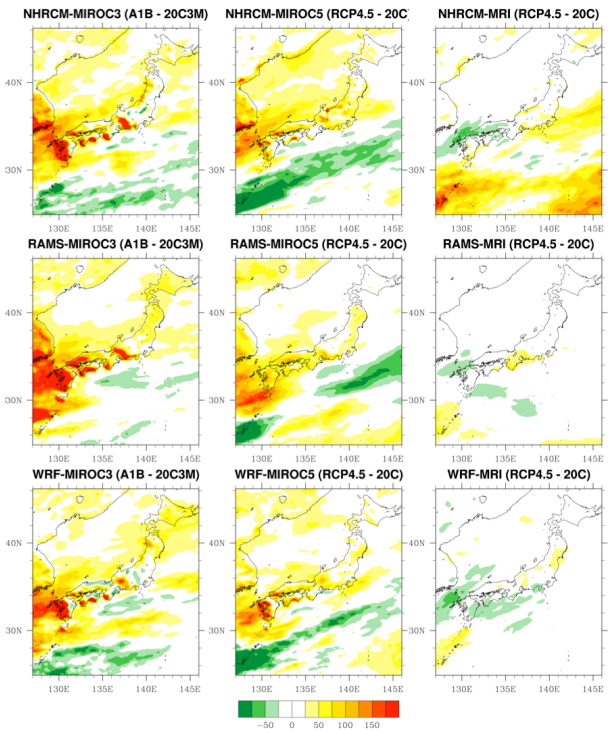

Figure 1: Projected future change of Baiu season (June) monthly accumulated precipitation [mm/mo].

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