Future Climate Simulations by IPCC AR4 Coupled Climate Models and MRI/JMA Global 20-km Mesh Atmospheric Model

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1. Introduction

In this report, we compare the future precipitation change obtained by 19 coupled atmosphere-ocean general circulation models (AOGCMs) under the SRES A1B scenario, whose horizontal resolution is about 200 km, and that obtained by a time-slice experiment with the MRI/JMA 20-km mesh atmospheric GCM.

2. IPCC AR4 model result

Figure 1 shows the present-day observed annual precipitation based on GPCP, and Fig. 2a shows the ensemble averaged annual precipitation of 19 AOGCMs corresponding to the 1981-2000 period. In Fig. 2, data are interpolated to common 2.5 degree grids as the models' horizontal resolution varies between 500 km and 100 km. See Nohara et al. (2006) for details of the models used. The model ensemble reproduces large-scale characteristics of annual precipitation distributions with north-south contrast within this region and large precipitation at the northeastern part of Turkey, but orographic rainfall pattern is not visible.

Figure 2b shows the changes in annual precipitation between the end of the twenty-first century and the end of the twentieth century, where

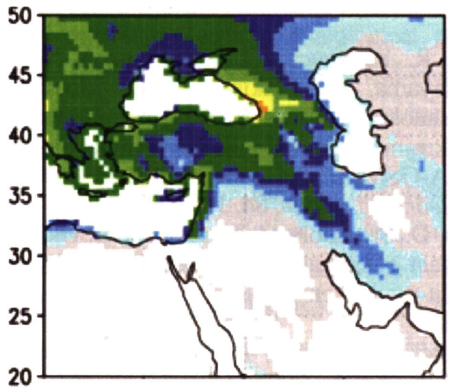

Fig. 1 Observed annual precipitation based on GPCP.

lightly and heavily hatched region denotes the grid point where the ensemble mean precipitation change is larger than 0.5 times or 1 times of inter-model standard deviation of the changes, i.e., consistency among model projections. It is noted that future precipitation will significantly decrease over the Mediterranean and the surrounding region including Middle East.

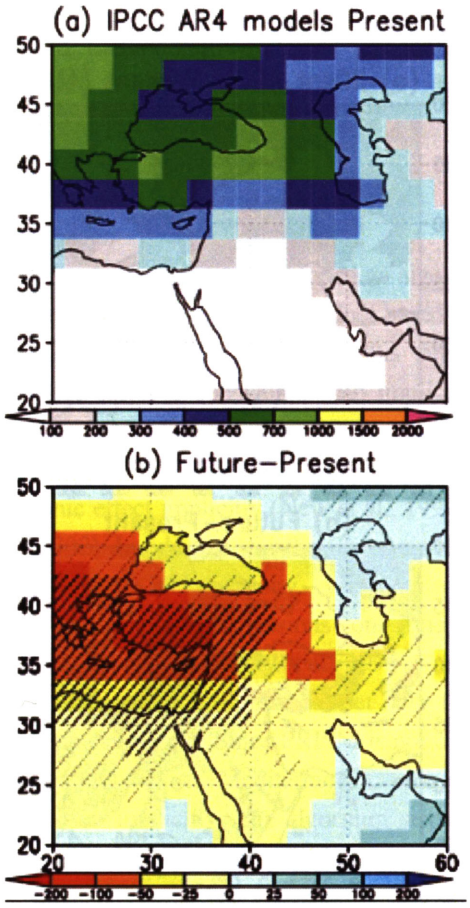

Fig. 2 (a) Annual precipitation using 19 IPCC AR4 models for the present (1981-2000). (b) Annual precipitation difference between the future (2081-2100) and present based on SRES A1B scenario.

3. MRI/JMA 20-km AGCM result

Here, we use an AGCM with a horizontal resolution of about 20 km (TL959 linear Gaussian

grid) developed at MRI/JMA (Mizuta et al. 2006). We have conducted two "time-slice" 20-year simulations. One is a present-day and the other is a global warming simulation that uses the sea surface temperature (SST) corresponding to the 1981-2000 and 2081-2100 period, respectively, by the MRI-CGCM simulations (Yukimoto et al. 2006).

Figure 3a shows the present-day annual precipitation, which clearly depicts orographic rainfall along the Mediterranean and the Black Sea coast, as well as over the Zagros mountains. Precipitation maximum over the Adana region is also well reproduced.

In the future (Fig. 3b), a decrease in precipitation is concentrated along the Mediterranean coast. Contrary to the IPCC model ensemble result, the 20-km mesh AGCM shows an increased annual precipitation over the Caucasas and the Zagros mountains as well as Mesopotamia region.

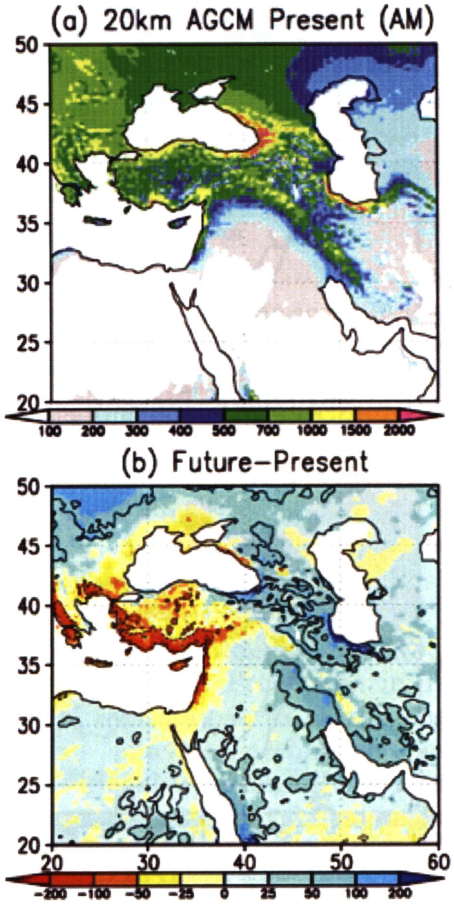

Fig. 3 (a) Annual precipitation with the MRI/JMA 20-km mesh AGCM for the present. (b) Annual precipitation difference between the future and present.

4. Concluding remarks

Changes in streamflow depend on changes in precipitation and evaporation. As evaporation increases more than precipitation does by global warming over most of the regions, the runoff and, eventually, streamflow decreases over larger areas than found in precipitation. We plan to compare streamflow changes in the 20-km mesh AGCM with the IPCC AR4 model results (Nohara et al. 2006).

There is a discrepancy between low-resolution AOGCM results and high-resolution AGCM results on the sign in future precipitation change in some areas. Whether this discrepancy comes from different resolution, i.e. how orographic rainfall is resolved in the model, or stems from other reason should also be investigated in the future.

5. Acknowledgements

We acknowledge the international modeling groups for providing their data for analysis, the Intercomparison (PCMDI) for collecting and archiving the model data, the JSC/CLIVAR Workin Program for Climate Model Diagnosis and g Group on Coupled Modelling (WGCM) and their Coupled Model Intercomparison Project (CMIP) and Climate Simulation Panel for organizing the model data analysis activity, and the IPCC WG1 TSU for technical support. The IPCC Data Archive at Lawrence Livermore National Laboratory is supported by the Office of Science, U.S. Department of Energy. The 20-km mesh model calculations were made on the Earth Simulator performed by global warming group under the framework of the "Kyosei Project 4: Development of Super High Resolution Global and Regional Climate Models" supported by the Research Revolution 2002 (RR2002) of the Ministry of Education, Sports, Culture, Science and Technology of Japan (MEXT).

6. References

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