Comparison of the model climate of various horizontal-resolution

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A unified NWP-Climate model for operational weather forecasts, seasonal prediction, global warming experiment and for related studies has been developed at Japan Meteorological Agency (JMA) and Meteorological Research Institute (MRI). The unified model is used with different horizontal resolution for various purposes. The recent progress in the high-speed large-memory computer enables us to run the models with very high resolution. However, since a long time-integration with high-resolution model requires a large computer resource, an optimum resolution has to be chosen depending on the purpose. An important question is, therefore, how much the performance of a model is improved by increasing resolution. To investigate the impact of increasing horizontal resolution on the simulated model climate, we conducted an experiment using the JMA operational global atmosphere model (JMA-GSM0103). In the experiment, the model has been integrated for three years with four different horizontal resolutions ranging from T42 to T213 with prescribed climate sea surface temperature.

The distributions of 3-yr averaged seasonal mean precipitation are basically similar among the models with different resolution (Figure 1). The precipitation over equatorial area of the Indian Ocean and the Pacific Ocean in DJF-season tends to be overestimated, particularly in the winter Hemisphere. This error pattern becomes more distinct as the resolution increases. But the differences in seasonal mean precipitation pattern among the models with different resolution are much less than the difference between the model simulation and the observation.

In contrast, smaller scale phenomena are represented better in the high-resolution models as expected. The precipitation band corresponding to Baiu front is seen in the 3-yr averaged monthly mean precipitation pattern for June in the models at all resolution. But the precipitation band of T42 model is located southward of the observation and the amount of precipitation at the peak is less than the observation. The representation of Baiu front is better in the higher resolution models.

Although smaller scale phenomena are represented better in the higher resolution models, the large-scale error patterns of seasonal mean fields are similar among the

models with different resolution. This suggests that the cause of these systematic errors is mainly inadequate representation of physical processes in the model, particularly the tropical precipitation, rather than inadequate resolution. To improve the model climate and its variability, it seems to be more important to improve physical parameterizations, especially convection scheme, than increasing resolution.

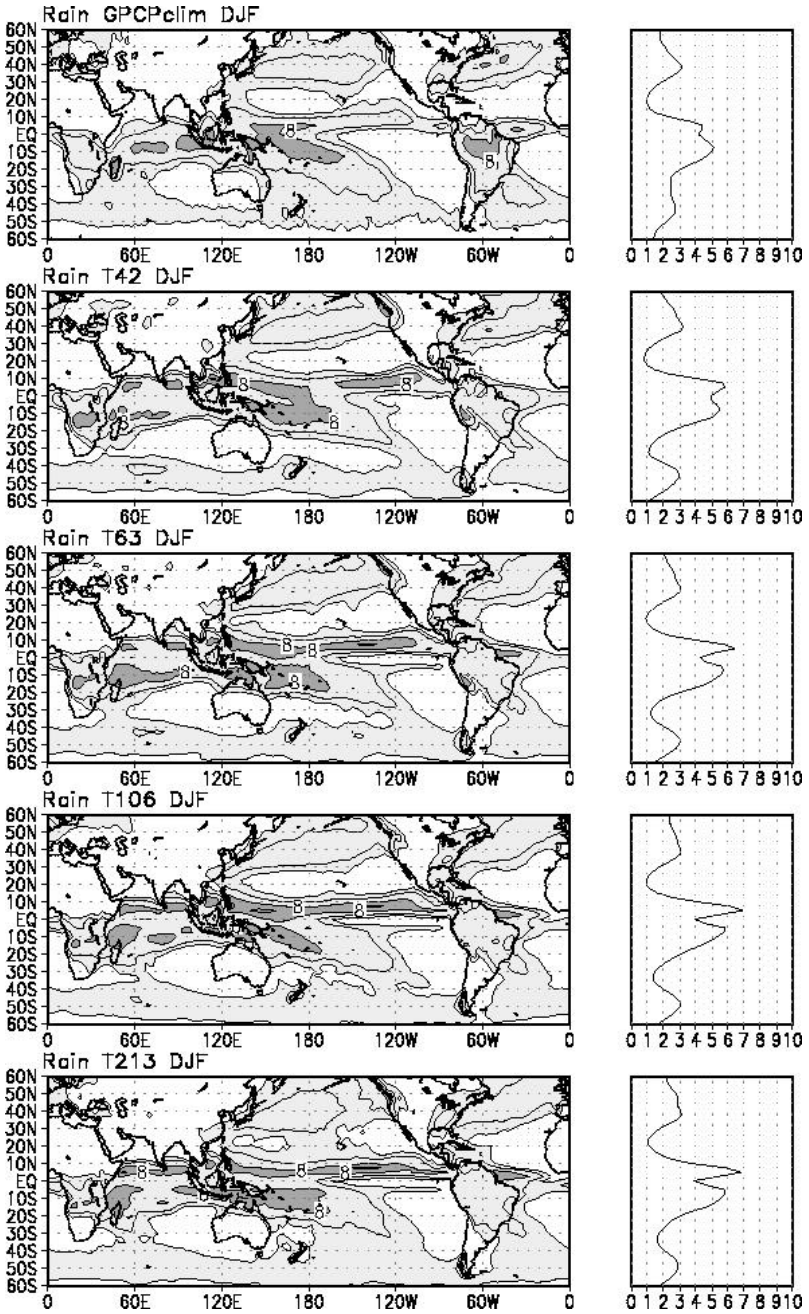

Figure 1 Seasonal mean precipitation in DJF

From top to bottom: GPCP, T42, T63, T106 and T213. Contours : 2,4,8,12 mm/day. Shading: light gray > 2mm/day, dark gray > 8mm/day