1. Introduction

Dynamic Downscaling (DDS): Useful to investigate the effects of climate change in detail for a specific region. However, the global warming outputs do not completely reproduce the current climate conditions. Is it appropriate to use them as initial/boundary condition?

I. Investigating Reproducibility of CMIP3 20th Century Experiments

The results of 20th Century Climate in Coupled Models (20C3M) runs by multiple GCMS in Coupled Model Inter-comparison Project 3 (CMIP3) are investigated. Spatial patterns and seasonal variations of air temperature and precipitation of CMIP3 20C3M are compared with a reanalysis product, especially for summer in Asia.

II. Developing a DDS Method using a NWP Model

A DDS method is developed using the Weather Research Forecast (WRF) system. In this work, the downscaling results for current climate in Asia (around Japan) are shown and discussed.

2. Data and Method

2.1 Data

CMIP3 data
- CMIP3 data is the output from CGCMs by 18 groups in the world.
- In CMIP3 CGCMs, the runs are made for several different scenarios.
- In this study, 20C3M outputs are used to examine their reproducibility.
- In this study, the outputs from the following 24 models are used.

Table 1 Spatial resolutions of CGCM outputs in CMIP3

<table>
<thead>
<tr>
<th>Model</th>
<th>Res. (A)</th>
<th>Res. (O)</th>
<th>Model</th>
<th>Res. (A)</th>
<th>Res. (O)</th>
</tr>
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<tbody>
<tr>
<td>BCCR_BCM2_0</td>
<td>2.8x2.8</td>
<td>1.0x1.0</td>
<td>INMCM1_0</td>
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<td>2.5x2.1</td>
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<tr>
<td>CCCMA_CCCGCM3_1</td>
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<td>1.9x1.9</td>
<td>INGV_ECHAM4</td>
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<tr>
<td>CCCMA_CCCGCM3_1_T63</td>
<td>2.8x2.8</td>
<td>1.4x0.9</td>
<td>IPSL_C4</td>
<td>3.8x3.8</td>
<td>2.0x2.1</td>
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<td>CNRM_CM3</td>
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<td>2.0x1.1</td>
<td>MIPRO3_2_HRES</td>
<td>1.1x1.1</td>
<td>1.1x0.5</td>
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<tr>
<td>CSIRO_MK3_0</td>
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<td>1.9x1.0</td>
<td>MIPRO3_2_MEDRES</td>
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<td>1.4x0.9</td>
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<td>1.9x1.0</td>
<td>MIUB_ECHO_G</td>
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<td>2.8x1.5</td>
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<tr>
<td>GFDL_CM2_0</td>
<td>2.5x2.0</td>
<td>1.0x0.9</td>
<td>MPI_ECHAM5</td>
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<td>1.3x0.5</td>
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<td>1.0x1.0</td>
<td>NCAP_PCML</td>
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<td>IAP_FGOALS_0_G</td>
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</tbody>
</table>

**Res.(A) and Res.(O) are resolution of atmosphere and ocean, respectively.**

*Japanese 25-year ReAnalysis (JRA25)*
- As a reference of current climate conditions and the initial and boundary conditions for DDS, JRA25 is used in this study.
- JRA-25 is a joint research of Japan Meteorological Agency and Central Research Institute of Electric Power Industry of Japan.
- An advantage of JRA25 is that SSM/I precipitable water and TOVS radiance are assimilated. Details are available in Onogi et al. (2007).

Global Precipitation Climate Project precipitation data
- As a reference of precipitation, GPCP daily data is used to compare with CMIP3 20C3M data and the downscaling results.

NCEP FNL (Final) Operational Global Analysis
- Because of several missing variable, JRA25 is not enough to run the WRF, and the NCEP FNL is used as supplementary data.

NOAA Optimum Interpolated Daily Sea Surface Temperature
- To downscaling climate data, a NWP should be run relatively longer period, however, the WRF cannot predict SST. To update and provide reasonable SST as a lower boundary condition, NOAA’s OSI SST is used.
- In this study, a new version of NOAA OSI SST. Spatial resolution of the new data is 0.25x0.25 degree. This product uses AVHRR and AMSR data. A description can be found in Reynolds et al. (2007).

2.2 Analysis System

The total amount of CMIP3 dataset is about 33 TB. To archive and analyze such a quite large volumetric earth science data, a research project “Data Analysis and Integrated System” (DIAS) has been launched. DIAS project is led by the University of Tokyo, JAMSTEC, JAXA, and other research institutes in Japan.

An analysis system is now under development. The analysis system is employed a browser-based interface, and it is easy to use and check the analysis results. The comparison results in this study are obtained through the system. In future, the system will be applied to the next climate change experiments (CMIP5).

3. Spatial Distribution of 20C3M Experiments in CMIP3

- Spatial distribution of CMIP3 outputs are compared with JRA25 and GPCP data. We focus on the Asian summer monsoon, and the target region is Asia (see figures), and period is summer (Jun.-Sep.) for 1979-2000 (1999 for several CMIP3 outputs).

3.1 Air Temperature averaged for summer

- Air temperature at 850 hPa (Fig 1) are relatively well reproduced.
- At 500 hPa, spatial patterns are similar to JRA25. But, in some models, clear difference in the warm core over the Tibetan Plateau (Fig. 2).
- The difference among models are very significant at 200 hPa and every model has one or more disparity between JRA25 (Fig. 3).

Figure-1 Distribution of air temperature at 850 hPa of JRA25 & CMIP3 20C3M. Spatial correlation and RMSE between JRA25 and CMIP3 results are shown.

Figure-2 Distribution of air temperature at 850 hPa of JRA25 & CMIP3 20C3M.