Projection of the future change in precipitation in the vicinity of Japan during the rainy season using a 5km-mesh regional climate model

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Outline of my talk

 Brief introduction of our experiments
 Reproducibility of daily precipitation over Japan by NHM5km: In comparison with an outer global 20-km-mesh atmospheric climate model

- 3) General characteristics of future changes of precipitation over Japan
- 4) Future changes of the rainy season, the Baiu/Meiyu, around Japan
- 5) Summary

Kakushin Team-Extremes (Team-3, Kitoh-san's group) Time-Slice Climate Change Experiments



Details were introduced by Kitoh-san.

AGCM/NHM are climate model versions of the JMA operational NWP models

JMANHM; Saito et al. 2001, 2006

Simulation status for the NHMs Main target: Changes in characteristics and extremes of precipitation in the vicinity of Japan

- NHM5km: June-October

 Present (1979-2003): (25 years)
 Near-future (2015-2039): (25 years)
 Future (2075-2099): (25 years)
- NHM2km: <u>June-October</u> <u>Still executing</u> – 25 years for present, near-future and future
- NHM1km: A/N (as needed)
 For chosen extreme events such as Typhoon

Descriptions of the NHM5km on the Earth Simulator

Horizontal resolution	NHM5km
Grid points	669x594x50
Cumulus parameterization	Yes (Kain-Fritsch)
Cloud physics	Simple 2-moment 3-ice bulk scheme
The spectral nudging (SN) method	Yes
Execution period	From 17 th May to 30 th October for each year for 25-year period in the present (1979-2003), near future (2015-2039), and future (2079-2099) climates, respectively.
Time step	20s
Output (2D)	1 hourly
Output (3D)	3 hourly

Details will be introduced by Nakano-san in next presentation.

Why do we need the NHM5km?

2) Reproducibility of daily precipitation over Japan by NHM5km: In comparison with an outer global 20-km-mesh atmospheric climate model

Data: Obs. (APHRO_JP: 0.05degree), AGCM20km (the previous version), NHM5km from Jun.-Oct. in 1990-1999

Data of NHM5km and obs. are averaged over the AGCM20km grid.

Characteristics of precipitation

Data of NHM5km and obs. are averaged over the AGCM20km grid.



Fig. 1. Horizontal distributions of 10-year mean precipitation amount from June to October (mm season⁻¹) by a) APHRODITE, b) AGCM20km and c) NHM5km between 1990 and 1999. d), e) and f), same as a), b), and c) but for numbers of wet days (day season⁻¹). g), h) and i), same as a), b) and c) but for SDII (mm day⁻¹). Data of APHRODITE and NHM5km are averaged over the AGCM20km grid. A c (Kanada et al. 2010. SOLA)

NHM5km reproduces more realistic characteristics.

Monthly variations of wet days over Japan



The biases of AGCM20km's precipitation has the seasonal variation. Who knows in the climate change experiments?

Mean top-3 daily precipitation



Why do we need the NHM5km?

Because, NHM5km provides more realistic characteristics of daily precipitation including precipitation extremes.

↓ Present climate (1979-2003) vs Future climate (2075-2099)

Future change of precipitation General characteristics from Jun. to Oct.





The Baiu -Mid-June to Mid-Jul. -A huge system extending from west to east -One of the most remarkable rainfall phenomena





Seasonal variations of rainfall during the Baiu



Changes in seasonal variations of rainfall around west Japan



Seasonal variations of domain-average rainfall amount around west Japan





The Composited Baiu front in early July when the front is detected in the analysis region (125-130E,30-35N)







Summary so far

In the future climate, some changes in precipitation during the rainy season, the Baiu/Meiyu, are projected. 1) June-July:

- 1) A delay of northward march of the Baiu
- 2) Remarkable increments of ratio of intense rainfall (>100mm/day) in the end of the Baiu.
- 2) August: Occurrence of the Baiu-like rainfall in the early period
- The early July change is characterized by the Baiu with
- \rightarrow Larger QV + more intense SN gradient of θe
- Intense precipitation are brought in a very narrow region near the front.
- The early August change is characterized by an appearance of the Baiu-like front around western Japan with
- \rightarrow Larger QV

→ Heavy precipitation are brought in the southern side of the front.



Fig. 2 Horizontal distribution of 10-yr mean RH(%) and EPT(K) in July: NHM5km

Figure 2. Horizontal distributions of monthly mean relative humidity at a 5km height (a) in the present and (b) in the future climates and monthly mean equivalent potential temperature at a 500m height (c) in the present and (d) in the future climates. Dotted-black rectangles show the averaging regions for Fig. 3.

Horizontal distribution of 10-yr mean RH(%) and WV(m/s) in July: NHM5km



25yr-mean monthly precipitation in Jun., Jul., and Aug. **Present**





With the high confidence level

100mm/day以上の雨量と回数の生値:0701-10

____Total_R(>100mm/day)(10day/year)_between_Jul1=10,1979=2003(L)|2075=99(R)



Domain-average EPT, QV and their SN-gradients for each year when the front is detected (125-130E,30-35N)



Top-3



Top-3



