Asian Summer Monsoon Simulation in Geophysical Fluid Dynamics Laboratory (GFDL) High Resolution Atmospheric Model (HiRAM)

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(Outline) Data / Model

1. Present-day monsoon simulations ; 2. Global warming impact

Case	Model / Simulation	Future climate projection (RCP8.5)
1.	HiRAM c384 (23km). <i>historical_1979-2008</i> MRI (20km). <i>historical_1979-2003</i>	
2.	HiRAM c192 (50km). <i>historical_1979-2008</i> CAM5/SOM f05 (50km). <i>preindustrial_Year23-42</i> HadGEM CGCM (50km). <i>historical_1976-2000</i> CAM5/SOM f05 (50km). <i>preindustrial_Year23-42</i>	 Note: GFDL global High Resolution Atmospheric Model AGCM from Meteorological Research Institute . Japan Meteorological Agency NCAR Community Atmospheric Model / coupled with Slab Ocean Model
3.	CAM5/SOM f09 (100km).preindustrial_Year51-70 CAM5 f09 (100km).preindustrial_Year3-12	
4.	MRI (20km). <i>historical_1979-2003</i> HiRAM c384 (23km). <i>historical_1979-2008</i> HiRAM c192 (50km). <i>historical_1979-2008</i>	MRI (20km) HiRAM c384 (23km) HiRAM c192 (50km) HiRAM c192 (50km) with different SST forcing

Observation and reanalysis data

Precipitation from GPCP (1 degree, 1997-2013) and TRMM (0.25 degree, 1998-2013)

Thermal and dynamical fields from NCEP R1 (2.5 degree, 1979-2013)







Precipitation (HiRAM) 5.16-6.15



Dots: (with 99% confidence level)

Precipitation (HiRAM)

7.16-8.15



Dots: (with 99% confidence level)

Overview of thermal and dynamical conditions controlling the monsoon

Surface Temperature (shadings) & Sea Level Pressure (contours)



Overview of thermal and dynamical conditions controlling the monsoon



Vertical circulation in (60E-110E)

Latitude-pressure distribution of zonal wind speeds (colors) and streamlines (constructed by meridional and vertical winds) in 60E-110E. Black shadings denote topography. Unit of zonal wind speed is m/s.

Seasonality



(blue lines: WNPSMI ; red line: EAJS, 30N-50N)



⁽blue lines: WNPSMI ; red line: EAJS, 30N-50N)

Seasonality (historical run)



Global Warming Impact on the Asian Summer Monsoon (RCP 8.5)

HiRAM (c192r minus c192) vs. (c384r minus c384) (also MRI precipitation)



HiRAM (23km)

MRI (20km)



Dots: (with 90% confidence level)

5.16-6.15



(u200 > 26m/s, blue contours)

(gph850 = 1515 and 1535 gpm, red-thick contours)

(precipitation > 6 mm/day, shadings)

7.16-8.15



(u200 > 26m/s, blue contours)

(gph850 = 1515 and 1535 gpm, red-thick contours)

(precipitation > 6 mm/day, shadings)





зом

15N

Eq.

155

305





120E

150E

Summary

The topographically-induced precipitation substantially influences the Asian summer monsoon circulation. A better performance of the monsoon simulation can be reasonably related to a more realistically simulated precipitation-windtopography interaction.

The GFDL HiRAM better simulated the pre-Meiyu/Baiu and the WNP monsoon at approximately 23km horizontal resolution than its 50km version. We also found considerable difference of the projected future monsoon climate between the two resolutions, in particular over the East Asia-WNP. Details remain unclear and warrant further study, whether the topographically-associated precipitation plays a major role or not.



Courtesy of hqscreen







Shadings: rcp85 minus amip







Seasonality (c192)



(blue lines: WNPSMI ; red line: EAJS)

Seasonality (c384)



(blue lines: WNPSMI ; red line: EAJS)



c192



40

20

0

-20

-40

-60

0.6

-0.6

-1.2

-1.8

-2.4

-3

12

9

6

3

-3

6

-9

-12

0





Black: NCEP (1979-2013) Red: RCP85 (2074-2100) Blue: Historical (1979-2008) Bars (light blue): rcp85 minus his

(test of significance will be added)

c192





HIRAM



(test of significance will be added)





Black: GPCP(1997-2013) Red: RCP85 (2074-2100) Blue: Historical (1979-2008) Bars (light blue): rcp85 minus his

HIRAM

Symmetry and asymmetry of Asian-Australian monsoon system

850hPa streamlines & precipitation (mm/d)

C384



prec,uv850(gpcp,cfsr)DJF

30N

EQ

prec,uv850(gpcp,cfsr)JJA

30N

EQ

30S

30N ·

EQ.

30S

30N

EQ.

30S

30N

EQ ·

30S -

60E

60E

60E

60E

Global monsoons



Global monsoons [200hPa streamlines, 850hPa wind vectors, OLR (Wm⁻²)]





