Sixth China-Korea-Japan Joint Conference on Meteorology (24-25 October 2013)

SOUSEI

Verification and Application of High-resolution AGCMs for Climatology

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Contents

- High-resolution AGCMs for Risk Assessment
- New 20km MRI-AGCM and Its Performance
- On-going Japanese Research Program for Risk Information on Climate Change (SOUSEI-C)

High Resolution AGCMs are helpful

in

Assessment of Risk due to Global Warming

Advantages of High Resolution AGCMs

- **Realistic Present Climatology**

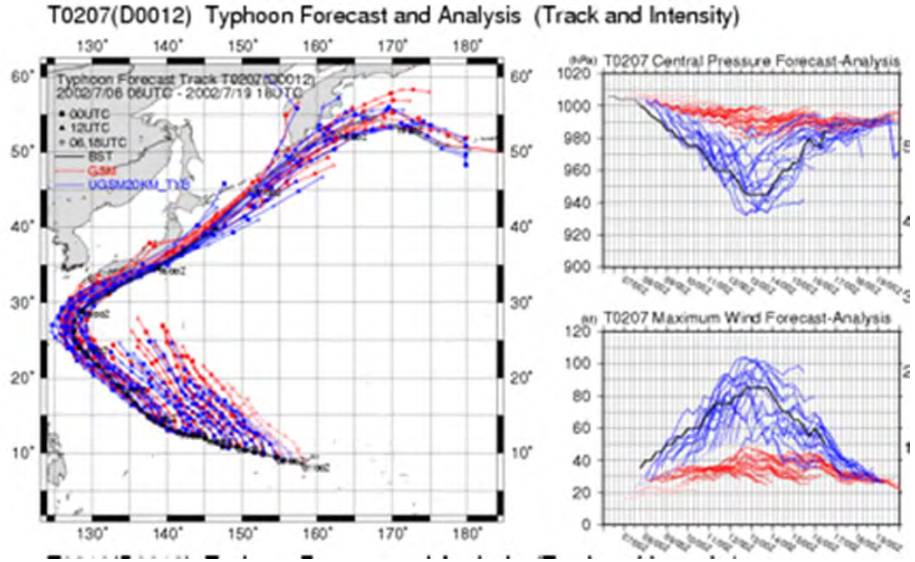
（Observed SST is specified）

- Fine geography
- **Realistic Extreme Events such as Typhoons**

- Experiments can be controlled well.
- SST and Model Ensembles are easily made.

Typhoon Prediction and Model Resolutions (20km and 60km)

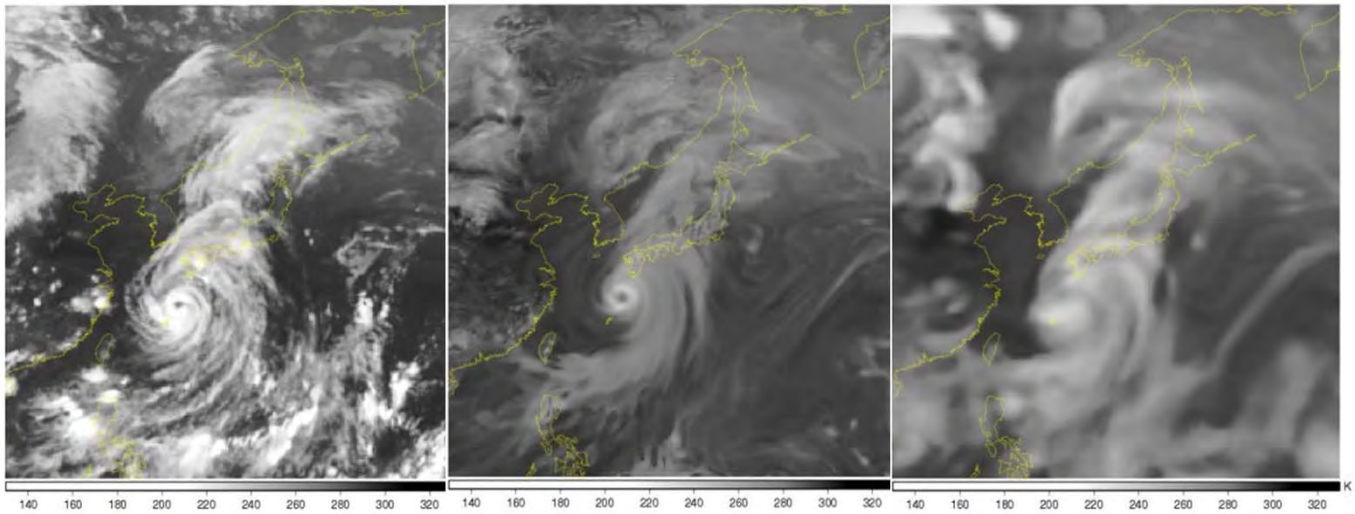
Track Prediction



Minimum Sea Level Pressure

Maximum Wind Speed

36-hour Prediction

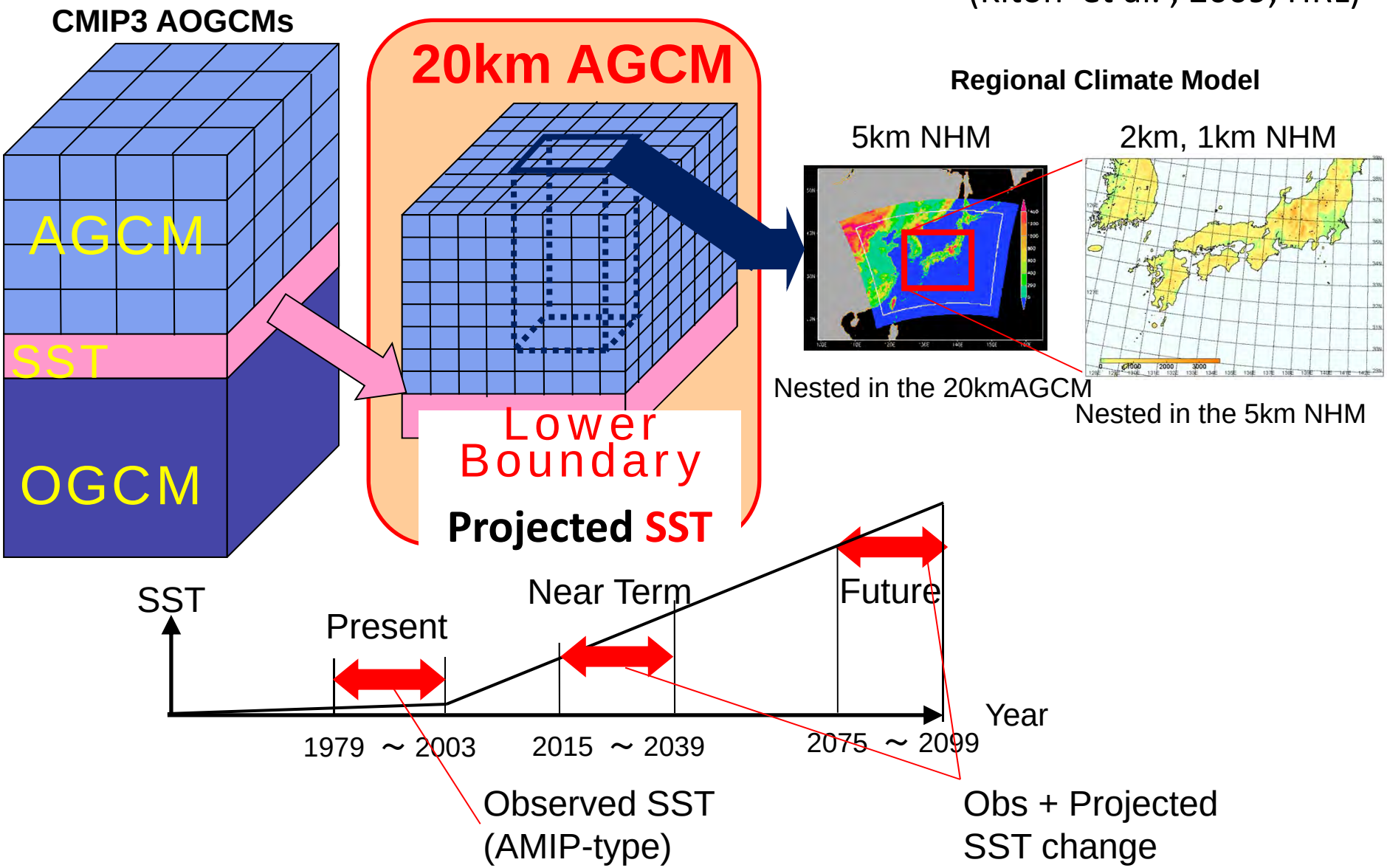


(Murakami et al., 2008)

KAKUSHIN-3 Time-Slice Future Projection

(FY2007-FY2011)

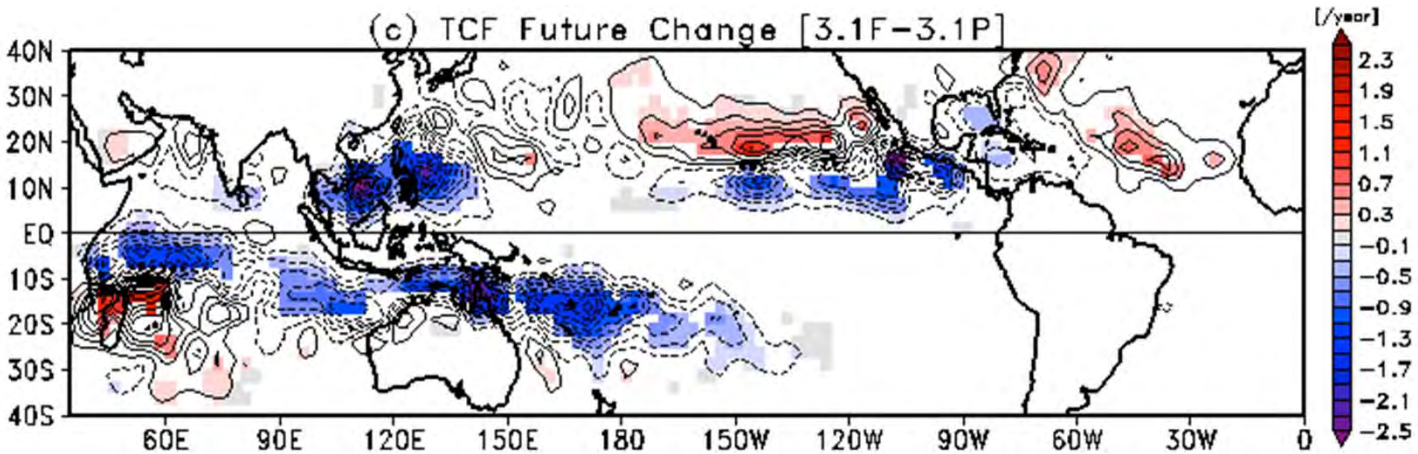
(Kitoh et al. , 2009, HRL)



A Result : Future Change of Tropical Cyclones

Murakami et al., 2012, J.Climate

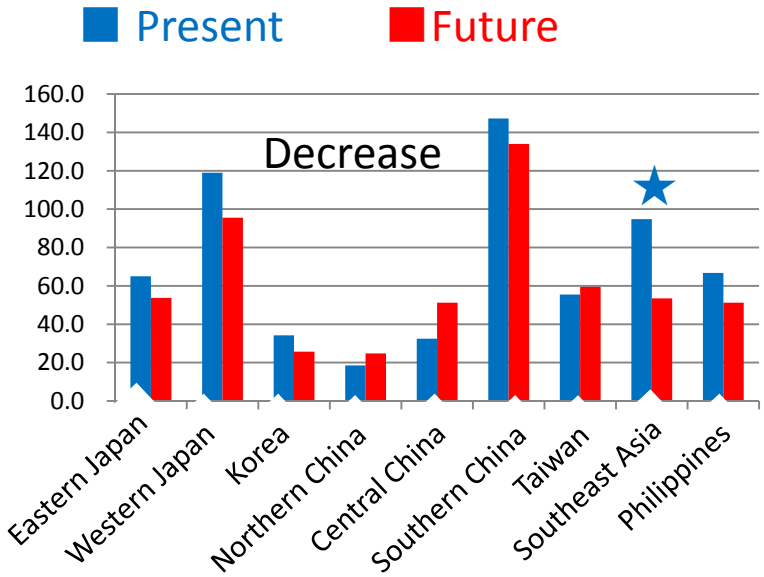
90% significance for Increase Decrease



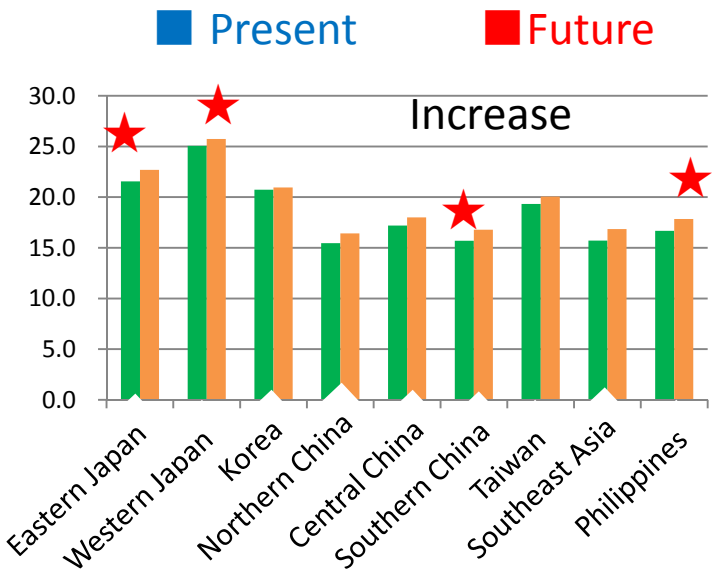
Murakami et al., 2011, J.Climate

★ 95% Significance

TC Frequency near Coasts



TC MaxWind mean near Coasts



New 20km AGCM (MRI-AGCM3.2S)

was developed

by

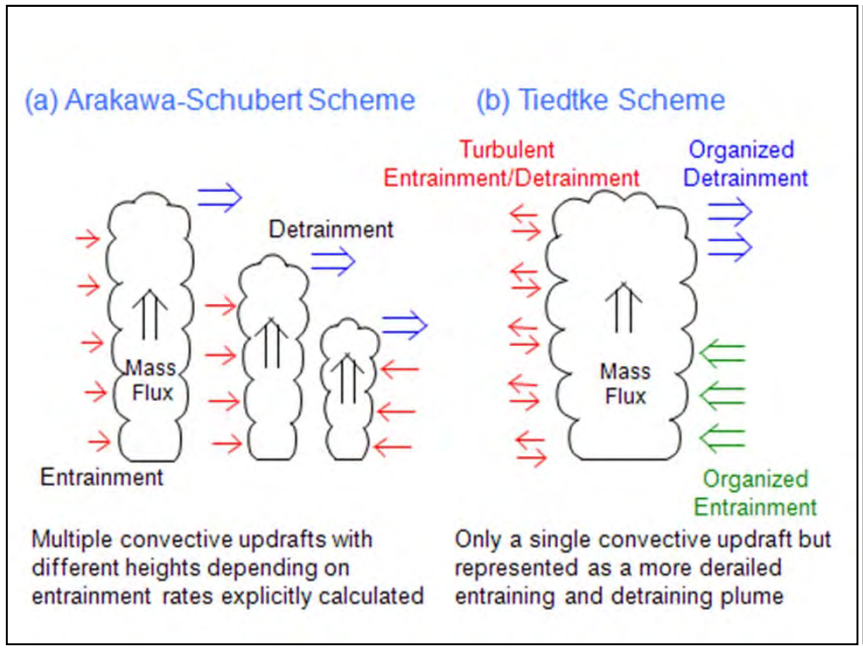
Mizuta et al (2012)

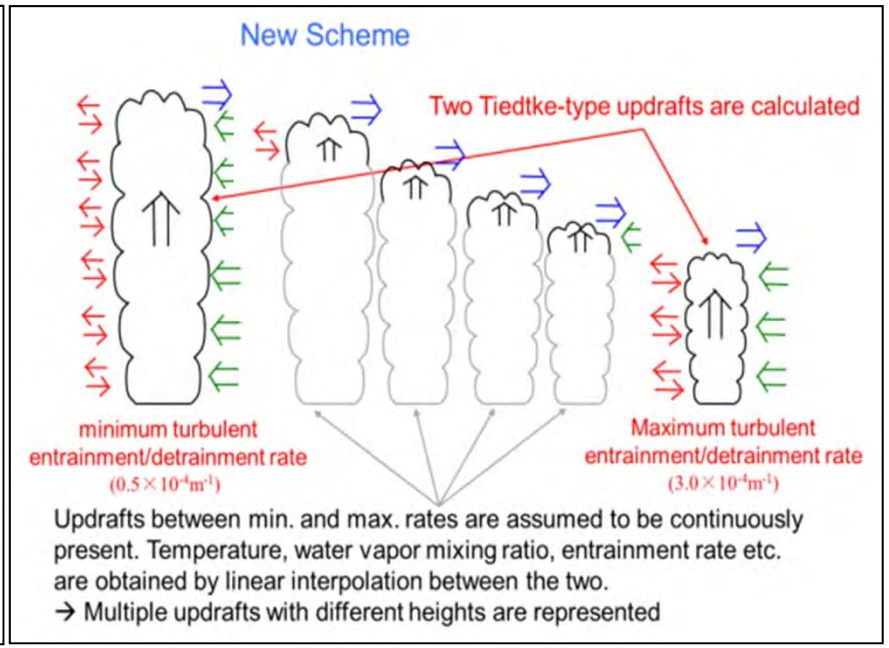
MRI-AGCM 3.1 vs 3.2

	Previous version (contributed to IPCC AR4)	New version (for IPCC AR5)
	MRI-AGCM 3.1 (Mizuta et al., 2006, *JMSJ*)	**MRI-AGCM 3.2** (Mizuta et al., 2012, *JMSJ*)
Horizontal resolution	TL959 (20km)	
Vertical resolution	60 levels (top at 0.1hPa)	64 levels (top at 0.01hPa)
Time integration	Semi-Lagrangian	
Time step	6minutes	10minutes
Cumulus convection	Prognostic Arakawa-Schubert	Yoshimura (Tiedtke-based)
Cloud	Smith (1990)	Tiedtke (1993)
Radiation	Shibata and Aoki (1989) Shibata and Uchiyama(1992)	JMA (2007)
GWD	Iwasaki et al. (1989)	
Land surface	SiB ver0109(Hirai et al.2007)	
Boundary layer	MellorYamada Level2	
Aerosol (direct)	Sulfate aerosol	5 species
Aerosol (indirect)	No	

New Cumulus Scheme

In Previous AGCM → **In New AGCM**



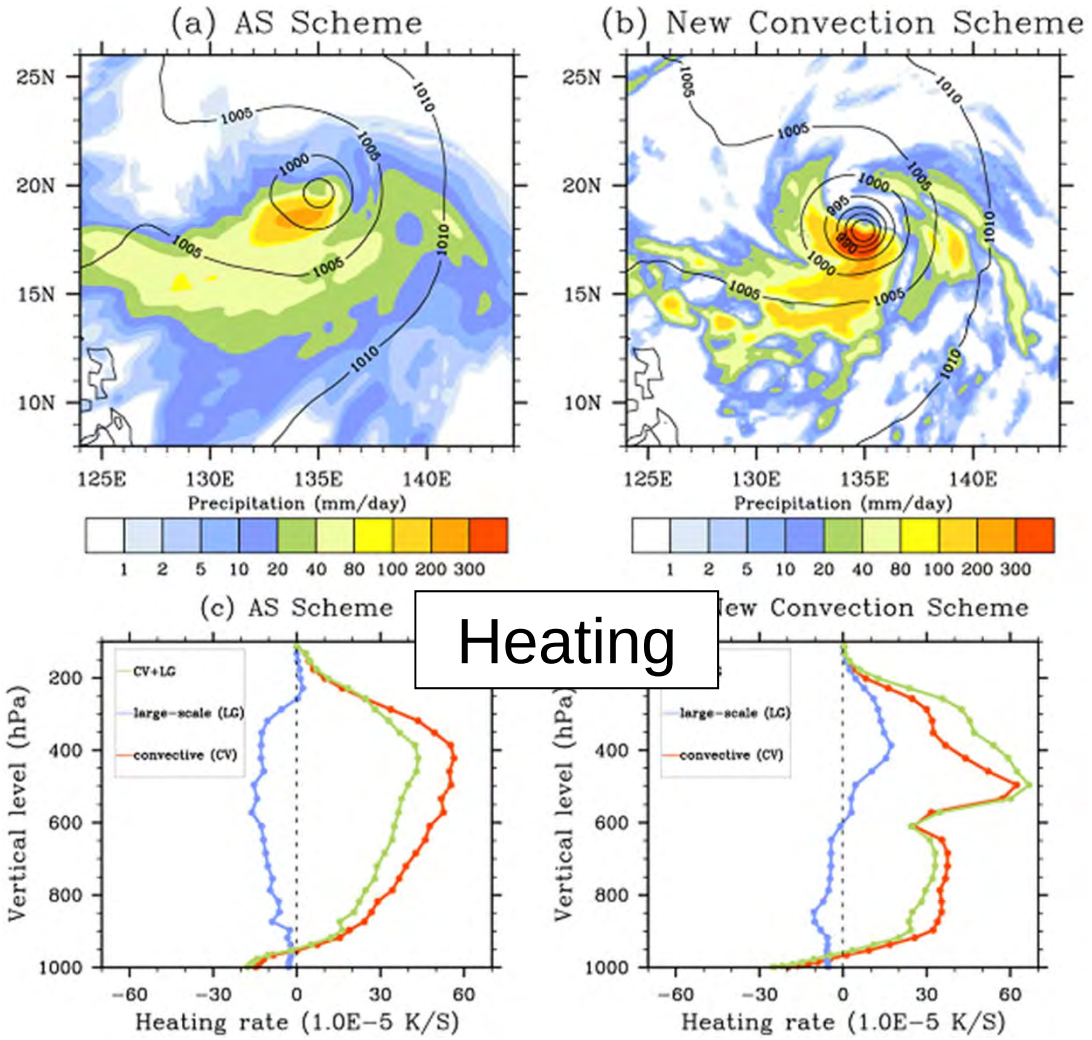


(Mizuta et al., 2012)

Precipitation by Tropical Cyclones

Previous AGCM

AS-type

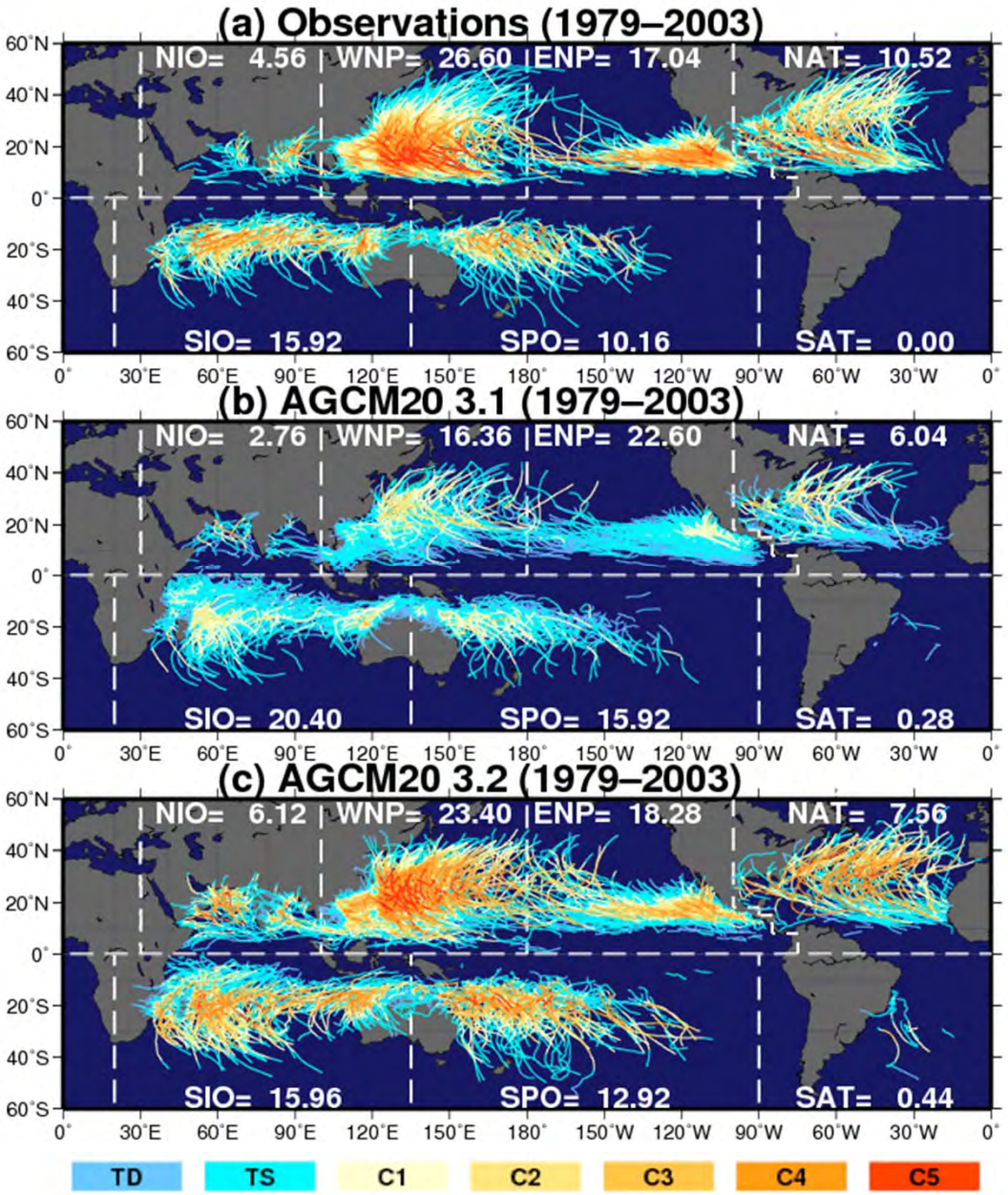


New AGCM

Yoshimura (2011)

Murakami et al., 2012, J.Climate

Tropical Cyclones (Weak -> Strong)



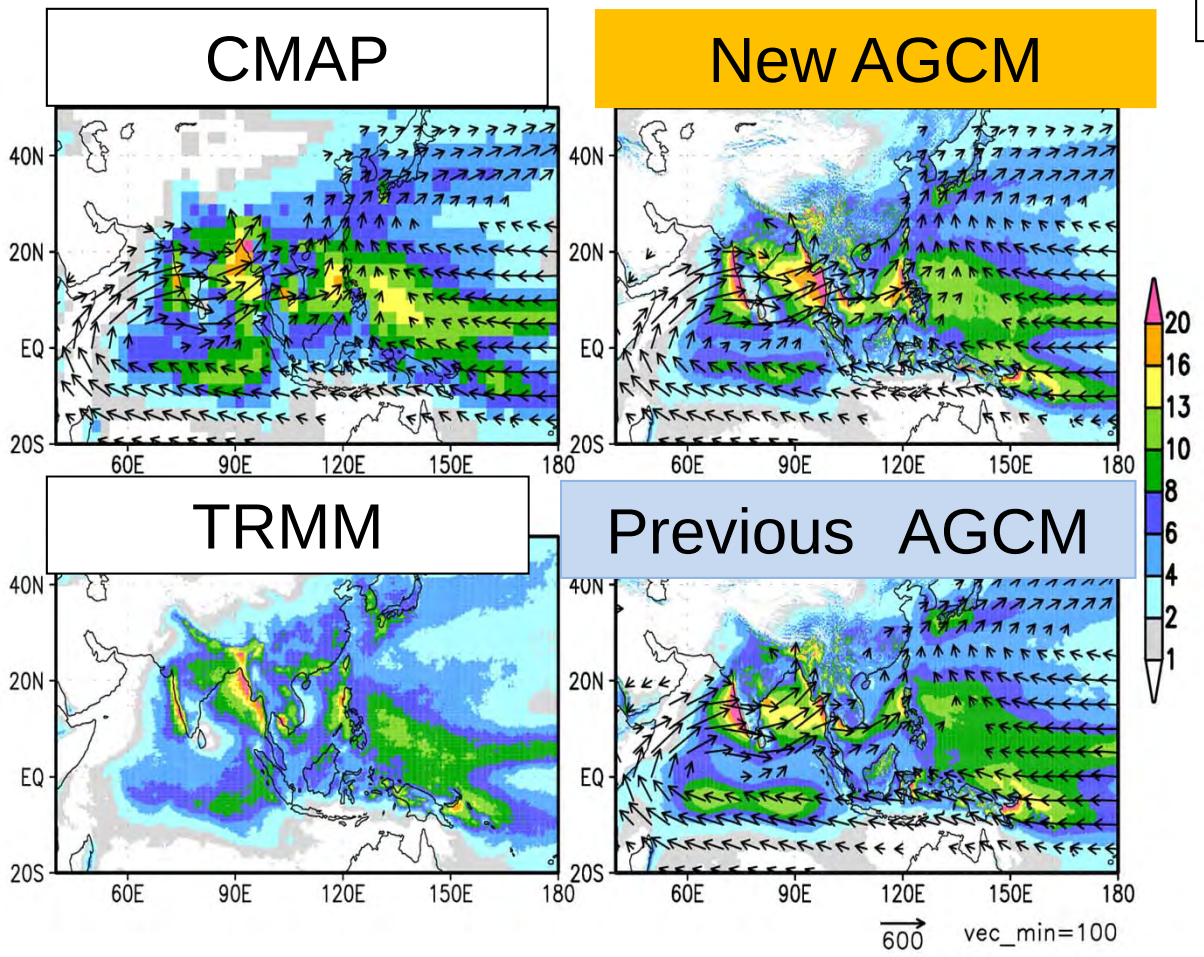
Observation

TL959L60
Previous AGCM

TL959L64
New AGCM

Murakami et al., 2012, J.Climate

Model Verification by Numerical Metrics

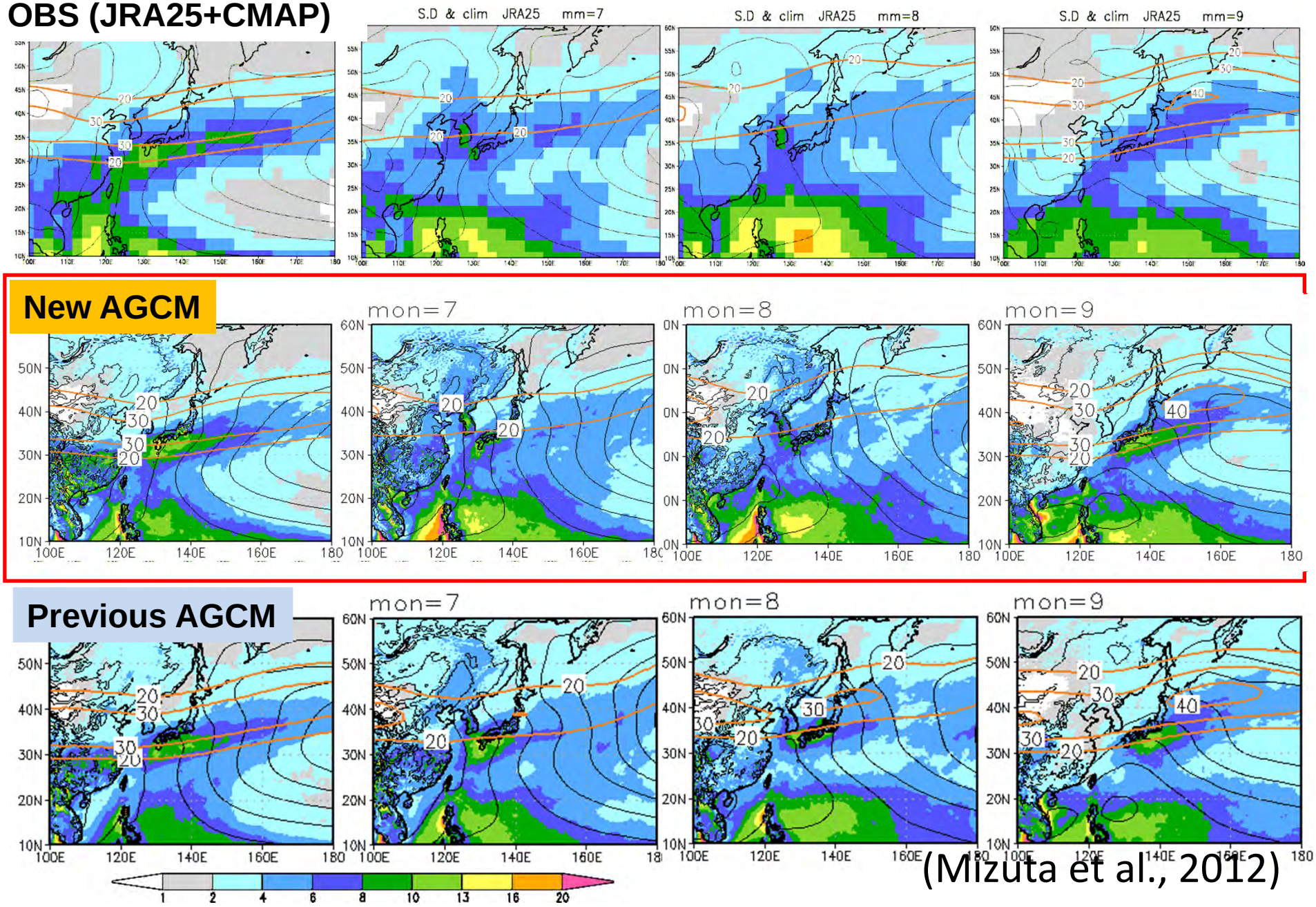


(Mizuta et al., 2012)

Metrics (60-150E,EQ-30N)
(New AGCM / Previous AGCM shows a high value)

Element(July)	OBS	Previous	New
Precipitation	TRMM	0.3886	0.497
Precipitation	CMAP	0.4523	0.5616
Precipitation	GPCP	0.3441	0.4088
500hPa Height	JRA25	0.7266	0.7813
Sea Level Pressure	JRA25	0.7894	0.8836
850hPa Temperature	JRA25	0.9195	0.9776
850hPa Zonal Wind	JRA25	0.8395	0.8547
200hPa Zonal Wind	JRA25	0.8866	0.9641
200hPaMeridional Wind	JRA25	0.7945	0.7923
500hPa Height Wave	JRA25	0.8161	0.868
SLP Wave	JRA25	0.8185	0.902
850hPa T Wave	JRA25	0.8785	0.936
850hPaZonalWind Wave	JRA25	0.8393	0.8833
200hPaZonalWind Wave	JRA25	0.7995	0.9217

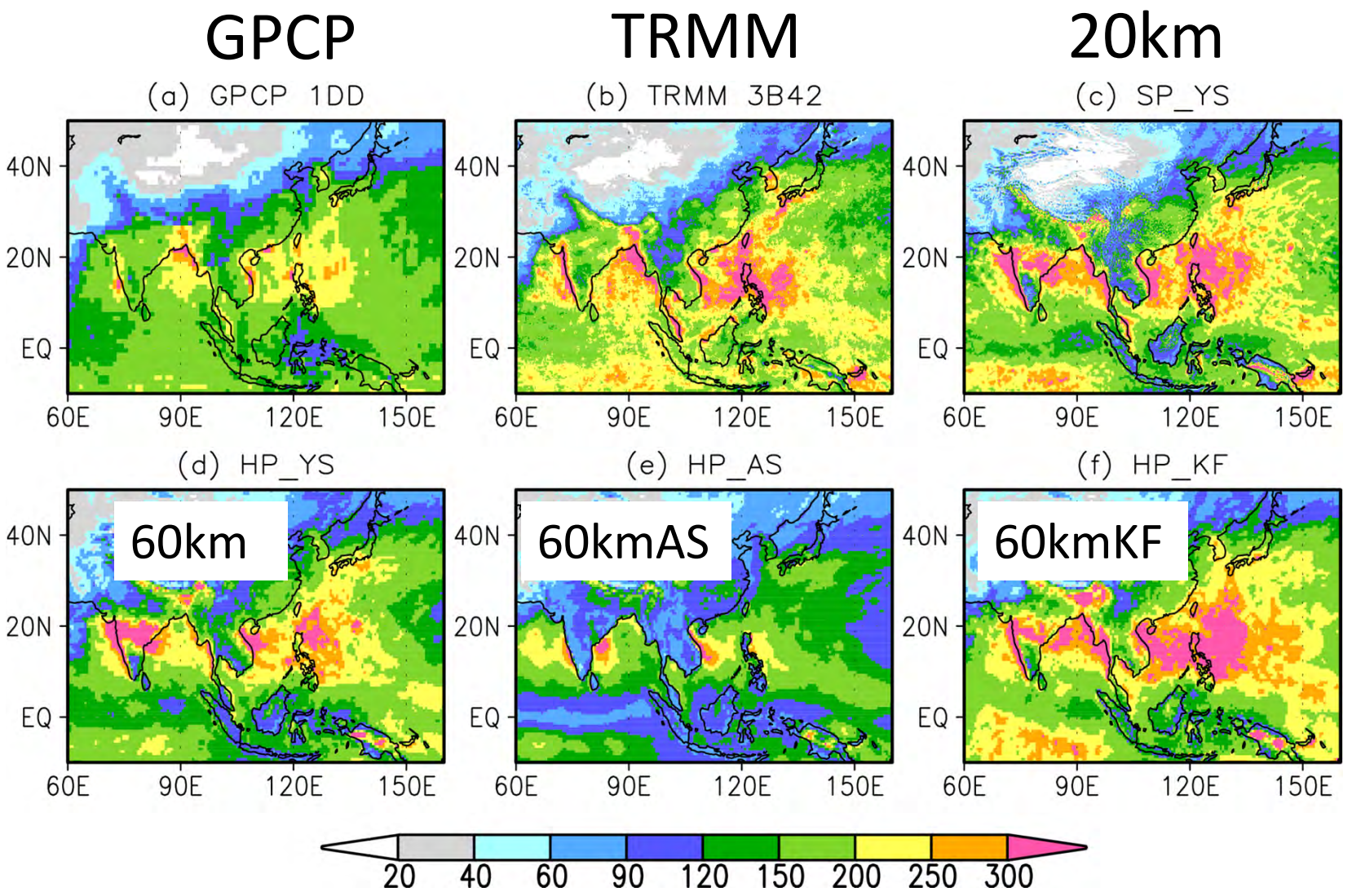
Jun-> Sep East Asia (Precipitation, Sea Level Pressure, 200hPa Jet)



(Mizuta et al., 2012)

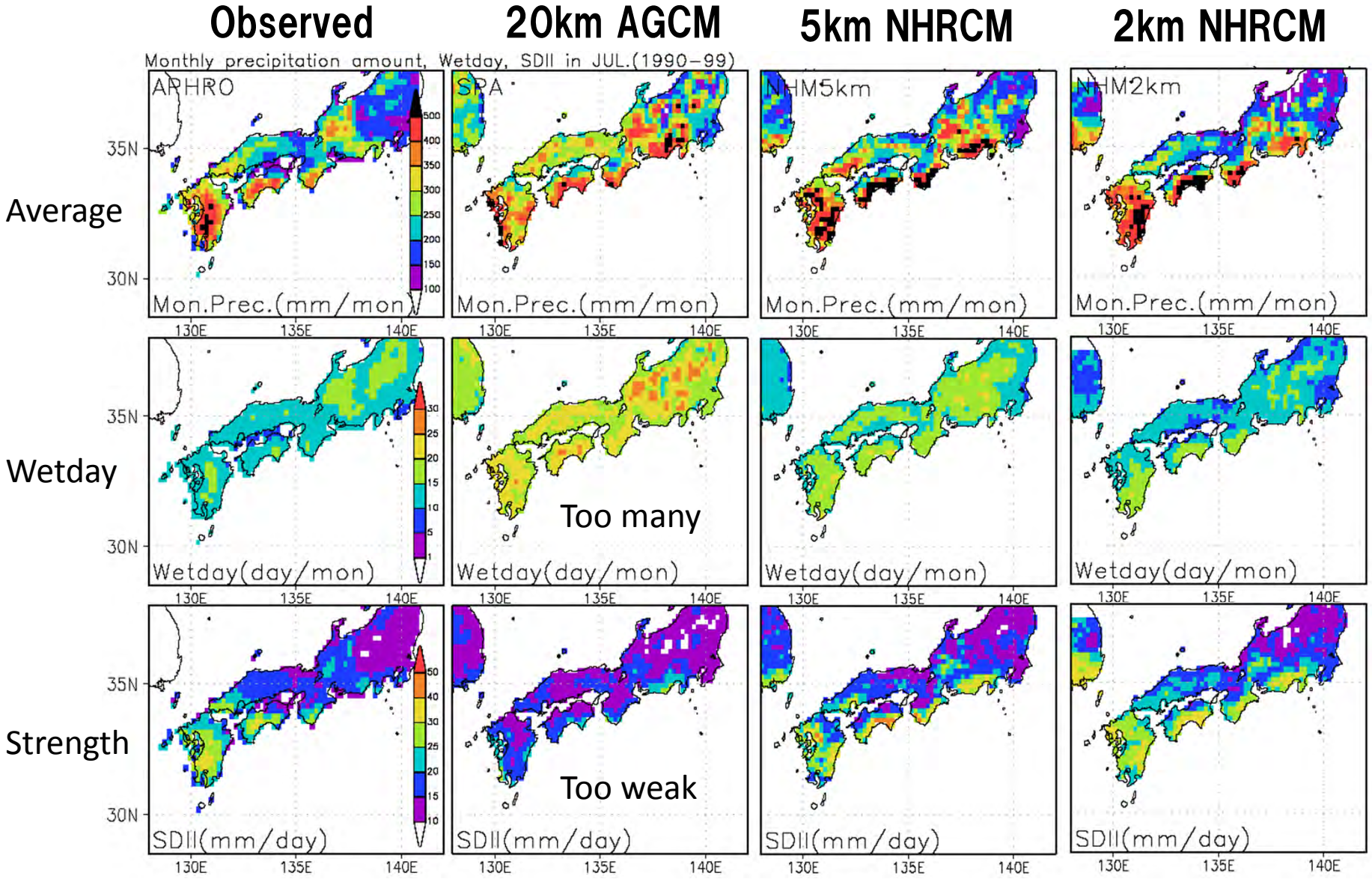
(Endo et al., 2012)

Annual Max 5-day Precipitation (GPCP, TRMM, Three schemes)



- New 20km AGCM is comparable with TRMM Observation

Precipitation Details (AGCM and NHRCM)



∗ All values are interpolated at 20km mesh grids

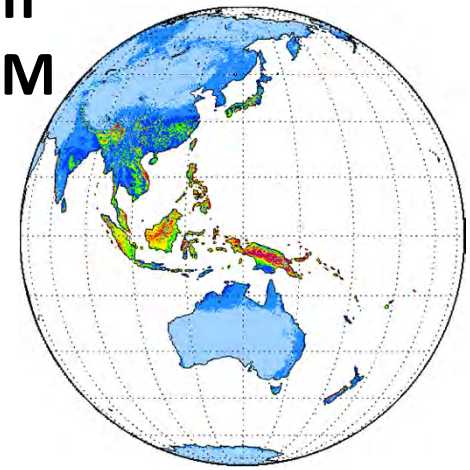
(Kanada et al. 2010)

New Japanese Program (SOUSEI-C)
Development of Basic Technology for Risk Information on Climate Change

by Izuru Takayabu (MRI/JMA)

(ii) Producing a standard climate scenario of Future projection by using super high resolution models

20km AGCM

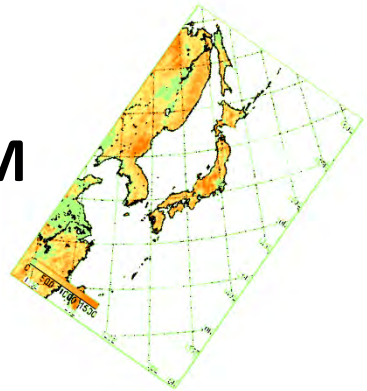


Projection Output

Boundary data for downscaling over any regions in the world

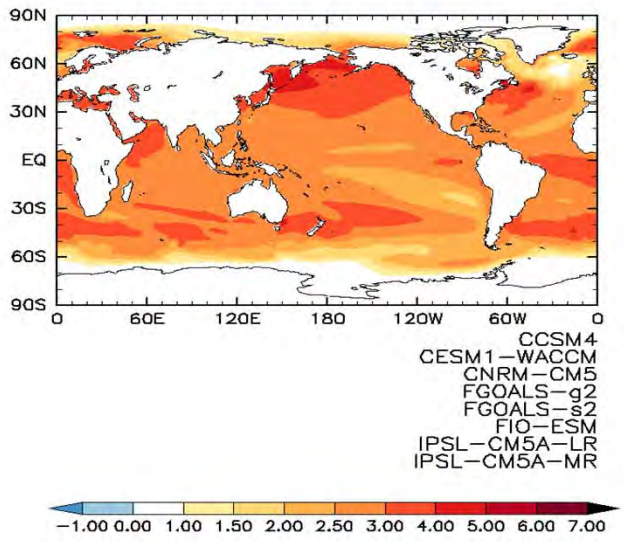
downscaling aruond Japan

5~2km NHRCM



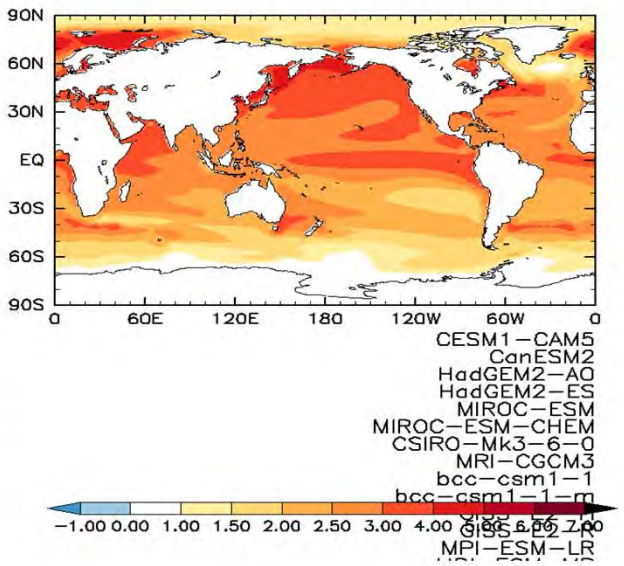
SST Change Ensemble for Future Projection

Based on Cluster Analysis of CMIP5-RCP8.5 Scenario Projections



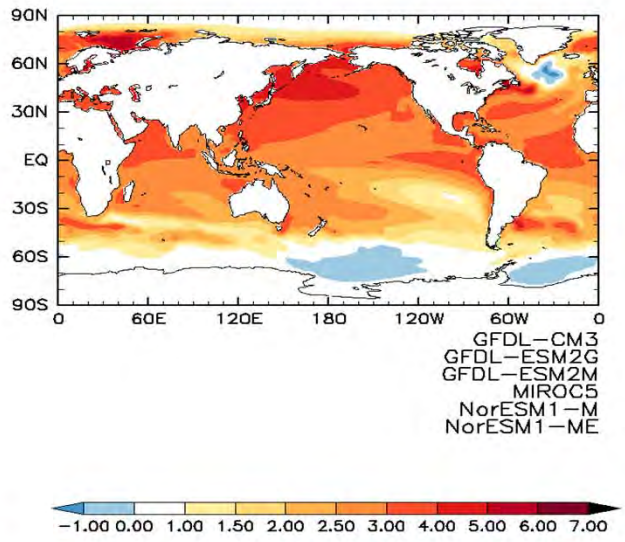
NCAR-Type

Flat



HadGEM2-Type

Warmer
Eastern Pacific



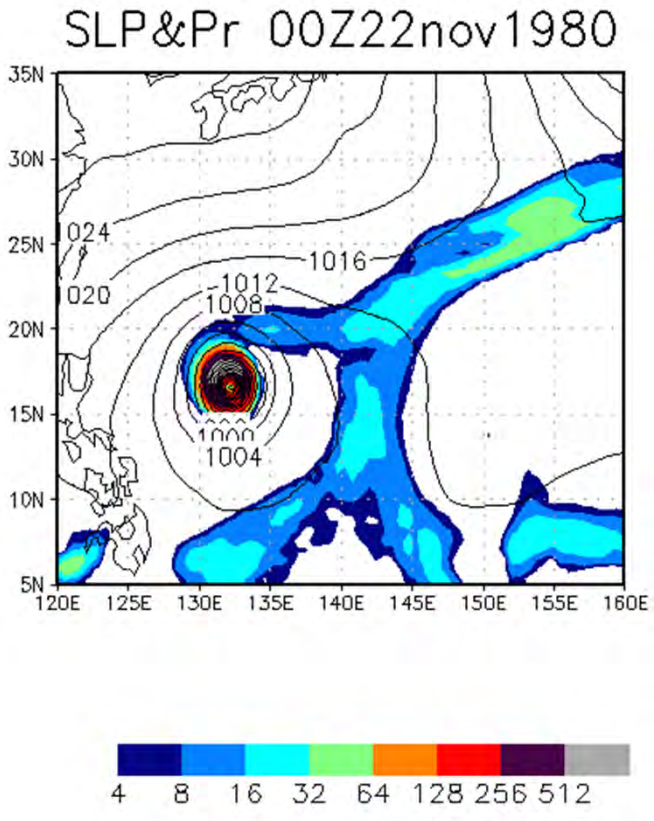
GFDL-Type

Warmer
Western Pacific
Indian Ocean

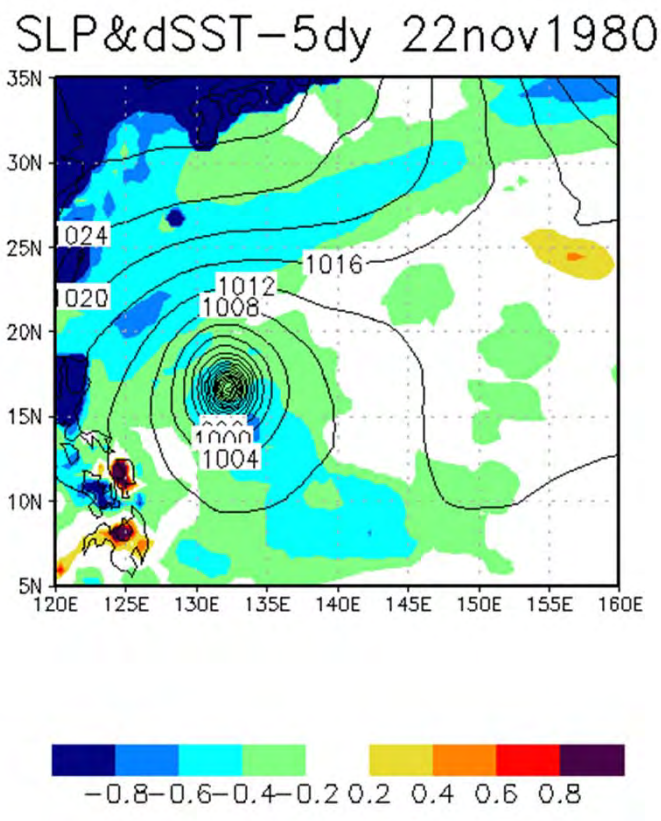
（by Mizuta (2012_SOUSEI Report）

AGCM Coupling with SST-Restored Ocean

Precipitation & SLP



SST Change from 5days before



Summary

- High-resolution AGCMs have advantages in simulating realistic climatology for Regional downscaling and realistic Extreme-events such as Tropical cyclones, as compared with CGCMs.

- 20km MRI-AGCM is improved so as to simulate climatology and tropical cyclones further realistically by introducing a new cumulus scheme.
- New Japanese research program for Risk Information on Climate Change (J-MEXT SOUSEI-C) started. The 20km-mesh AGCM ensemble prediction outputs for regional downscaling over any regions will be available as well as the outputs for analysis.

Acknowledgements

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