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High-Resolution Modeling in Japan

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Kakushin Team-Extremes Time-Slice Experiments

CMIP3 AOGCMs

Time slice experiments

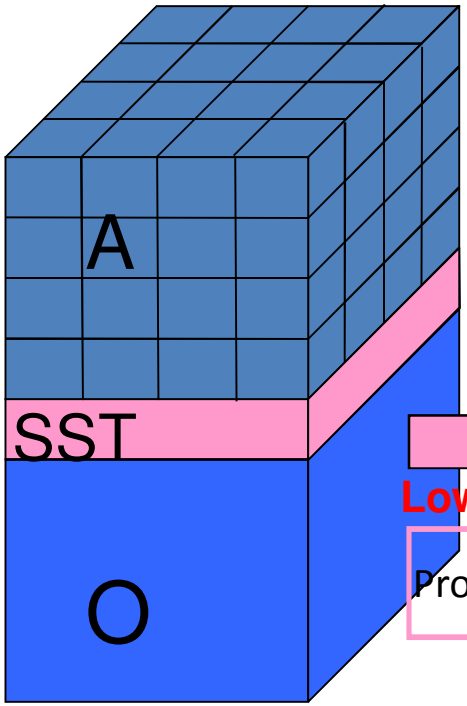
Projection of regional climate by one-way nested NHRCM

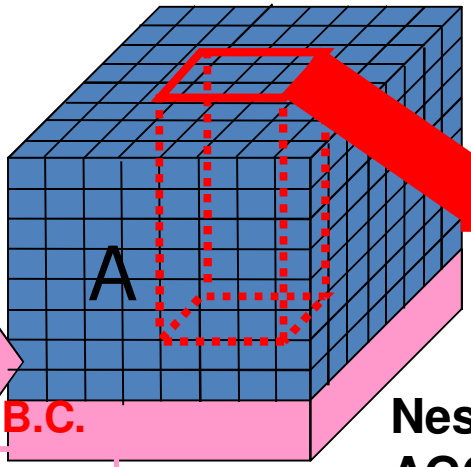
20km,60km MRI-AGCM3

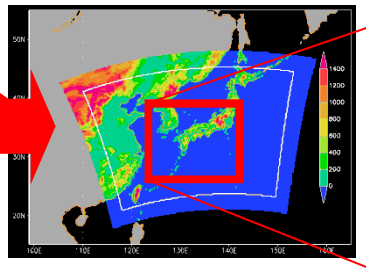
Regional Climate Model

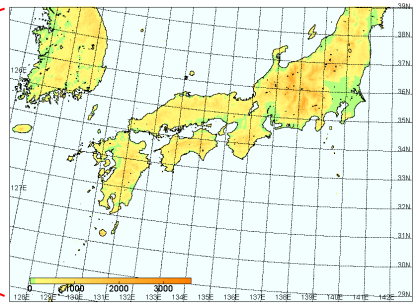
NHRCM5km

NHRCM2/1km







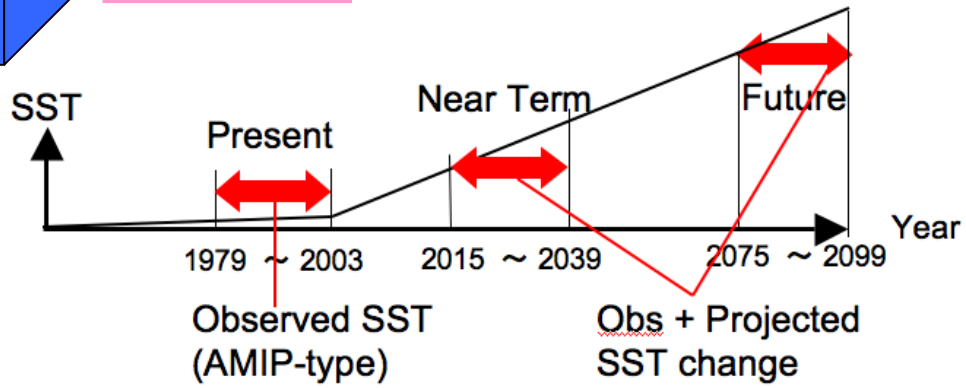


Lower B.C.

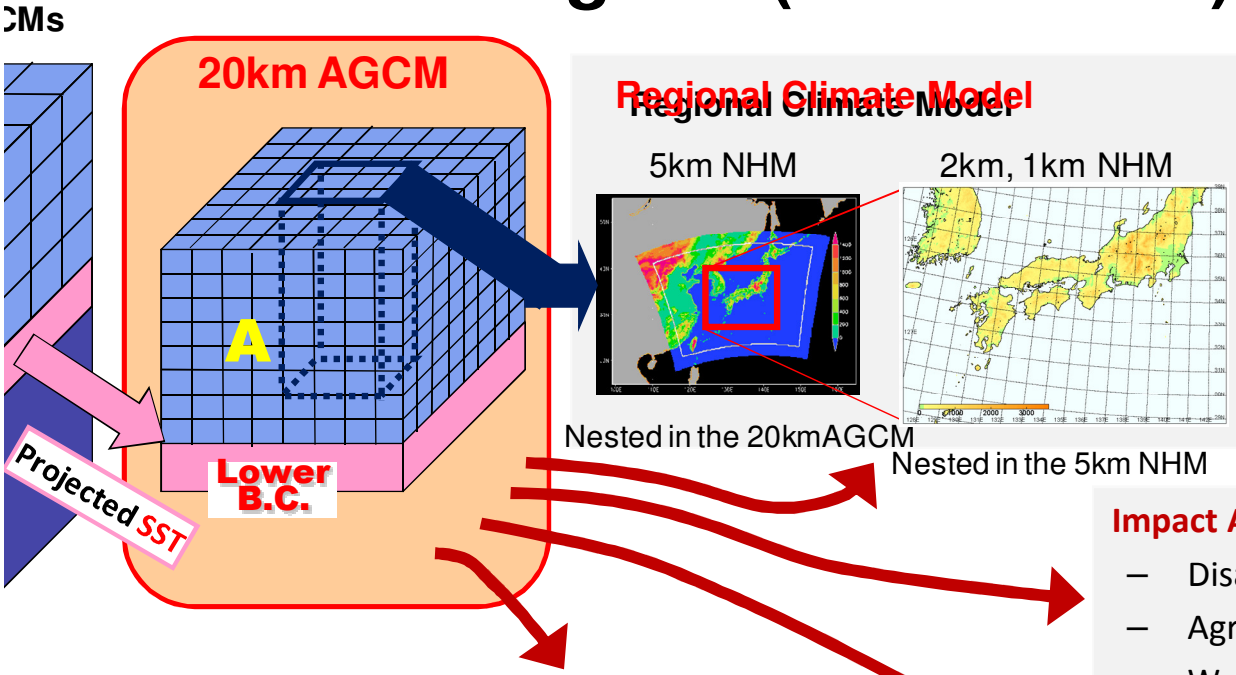
Projected SST

Nested in the AGCM20km

Nested in the NHM5km



KAKUSHIN Program (2007 – 2012) conducted by MRI



Detailed Projection around Japan

Impact Assessments

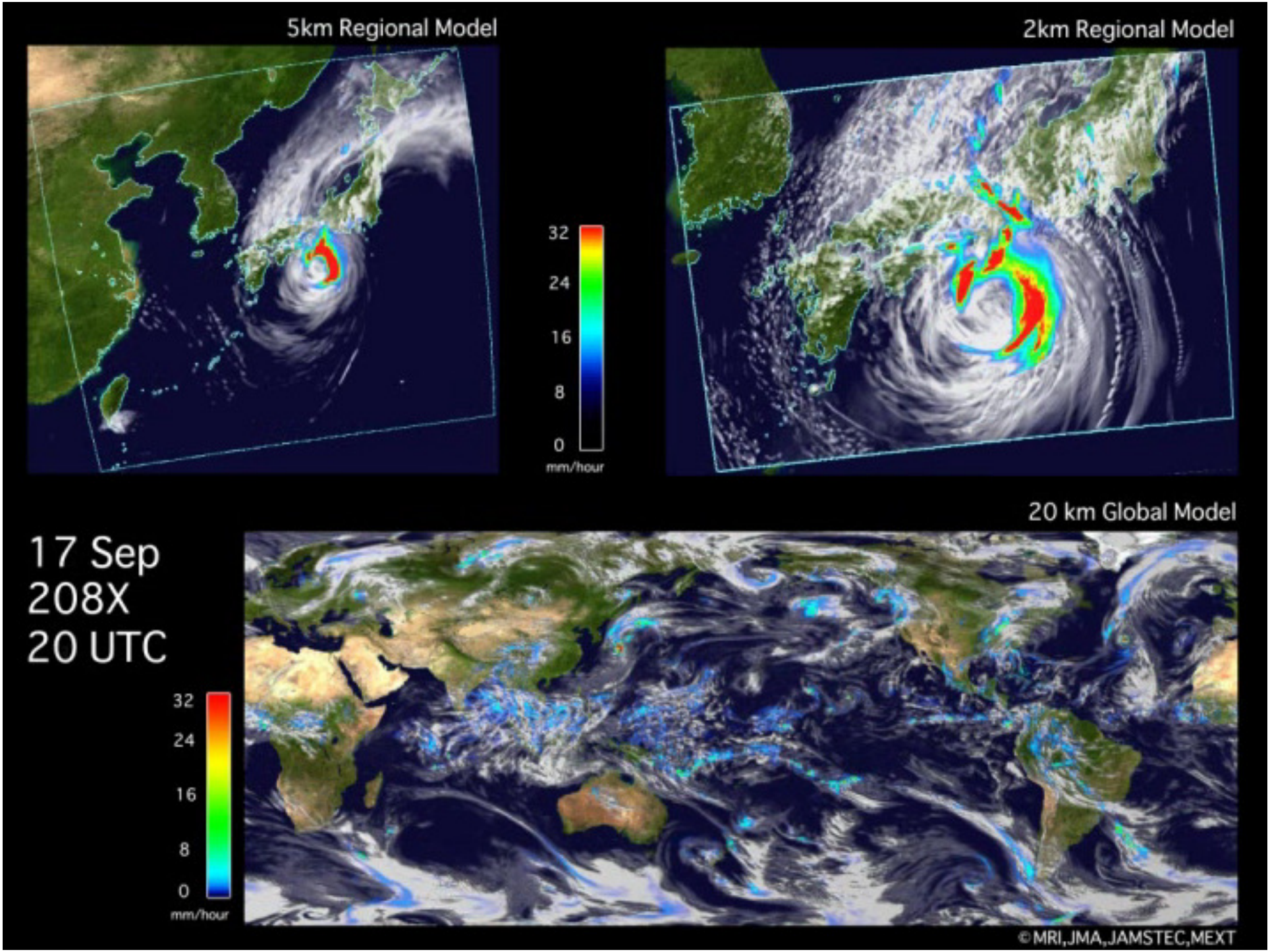
- Disasters
- Agriculture
- Water Resources

Study of Future Change in Extreme Events

Tropical Cyclones (e.g. Murakami et al. 2011)
→less number, more intense
East Asia Monsoon (e.g. Kusunoki et al. 2011)
→seasonal migration delayed
Extreme Rainfall (e.g. Kamiguchi et al. 2006)
→more frequent
Blockings (e.g. Matsueda et al. 2009)
→less frequent
Extratropical Cyclones (e.g. Mizuta et al. 2011)
→less number, more intense

Regional Climate Change

- Outputs provided to researchers of each region
  (Korea, China, Taiwan, Philippines, Thailand, Indonesia, Viet Nam, Bangladesh, India, Israel, Saudi Arabia, Senegal, Spain, Netherland, UK, Ireland, Denmark, Switzerland, Germany, USA, Mexico, Columbia, Barbados, Belize, Bolivia, Peru, Ecuador, Brazil, Argentina, Australia, Papua New Guinea)


5km Regional Model
2km Regional Model
32
24
16
8
0
mm/hour
20 km Global Model
17 Sep
208X
20 UTC
32
24
16
8
0
mm/hour
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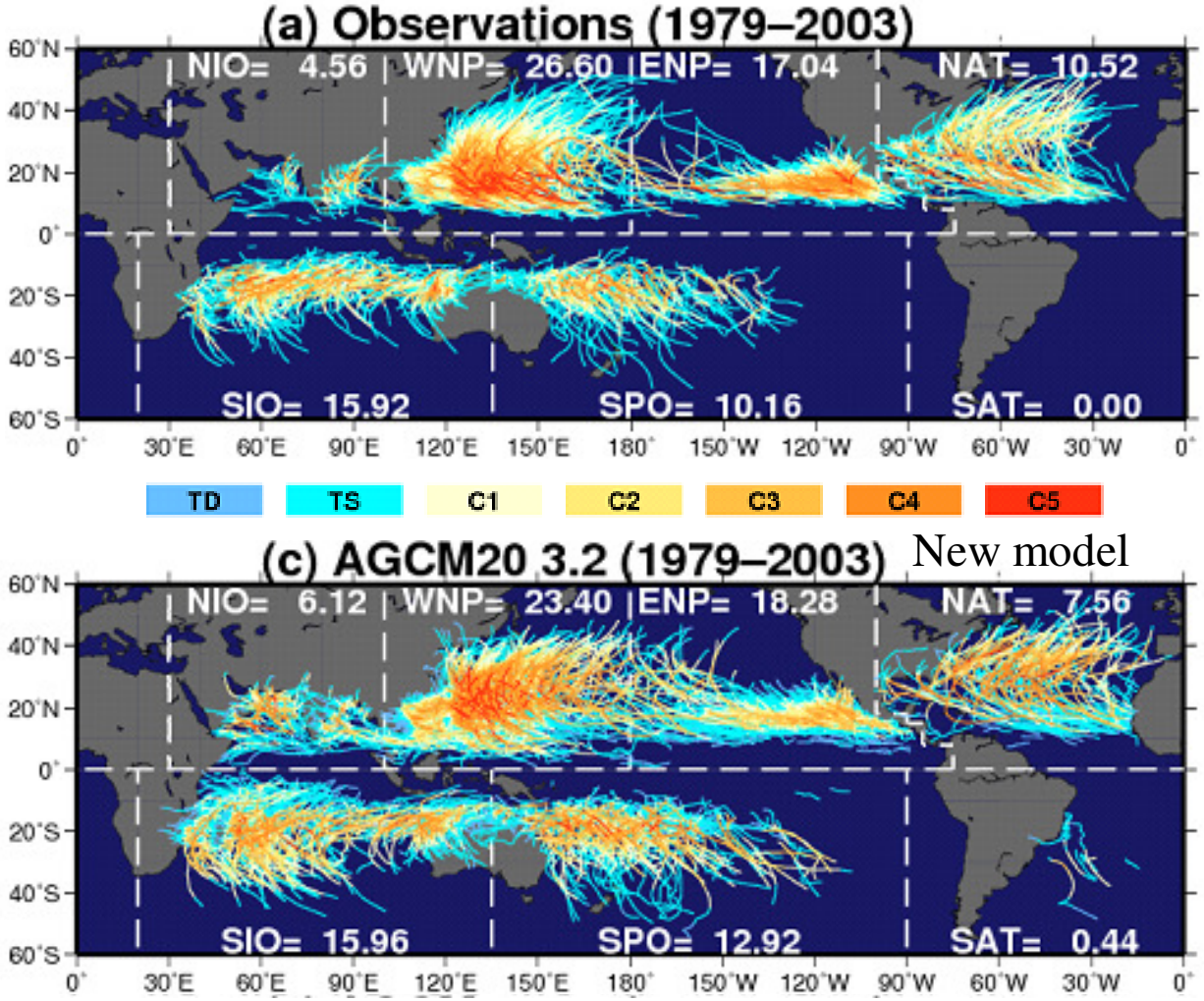
Problems with the previous 20-km mesh MRI-AGCM



Number for each basin denotes the annual mean number of TCs.

New model

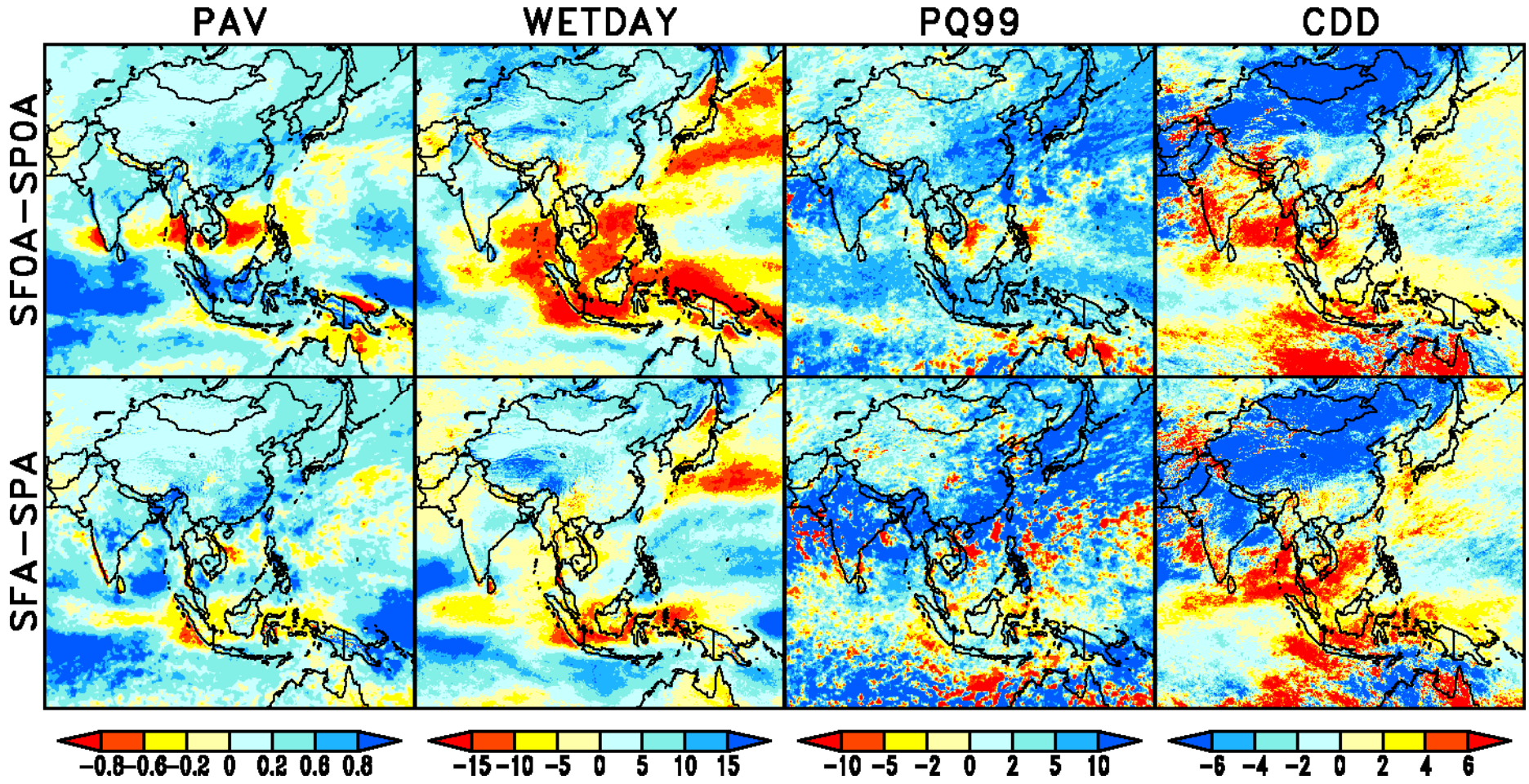
Predicted TC number in the WNP is underestimated — Improved

TC intensity is weak compared with observations — Improved

Murakami et al. (2011, submitted)

Future Changes in the Extremes indices

2 realizations by different versions of the 20-km MRI-AGCM



Precipitation amount increases over land

Heavy precipitation (pq99) notably increases India, Yangtze Basin (China) and Japan

Meteorological dryness (CDD) increases in Southeast Asia

Diagram of Kakushin Team-"Extreme"

Time-slice experiment

AGCM20

- 1979-2003
- 2015-2039
- 2075-2099

Typhoon
Asian monsoon…

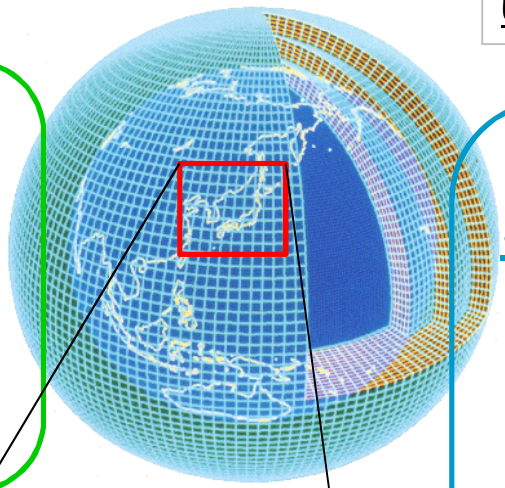
Downscaling

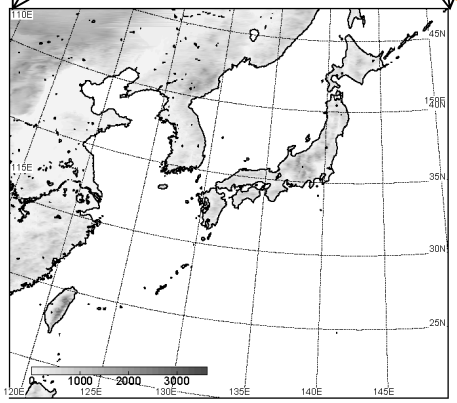
Many rainfall events

NHM5

- 1979-2003
- 2015-2039
- 2075-2099

Added-value?





Ensemble experiment

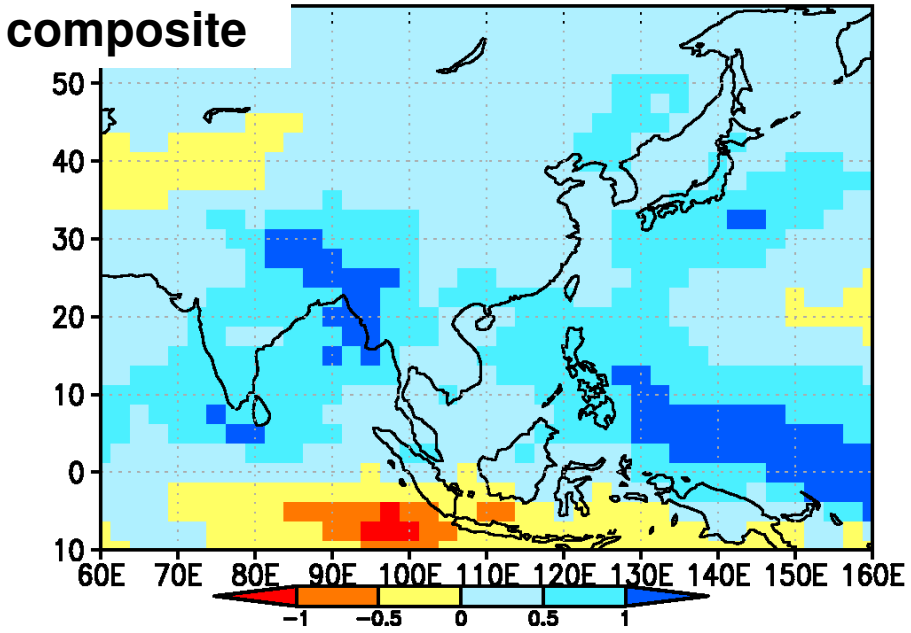
AGCM60

- 1979-2003: cntl
- 1872-2099:
  3-members of initial-value ensemble
- 2075-2099:
  4 members of different SST
  x 3 members of different cumulus parameterization

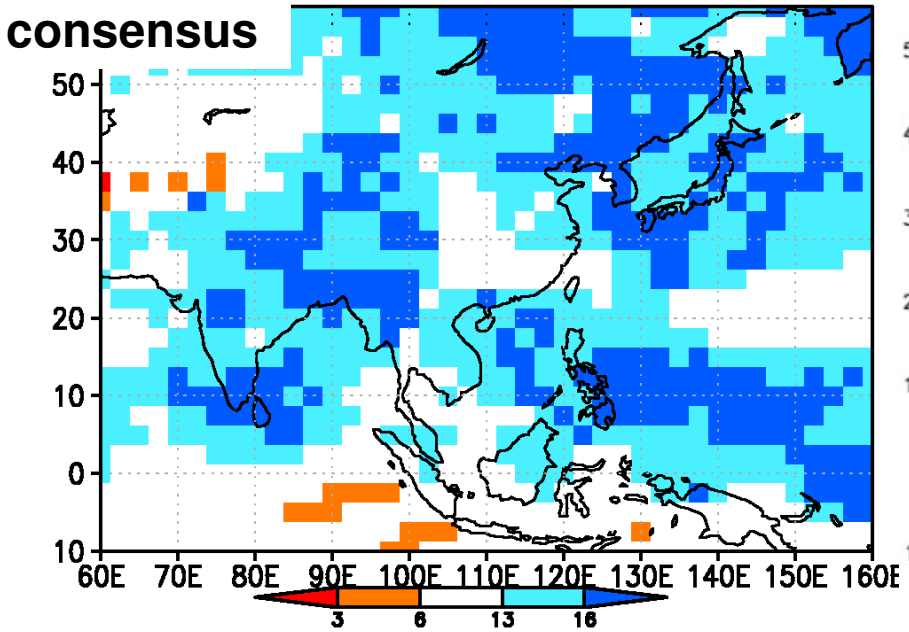
Uncertainties

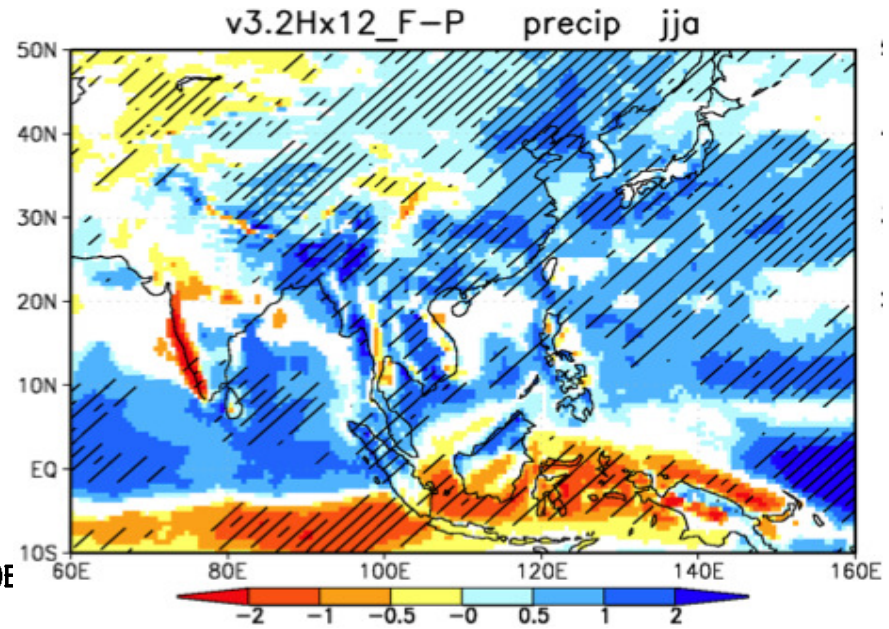
Global 20-km and 60-km model data are available

CMIP5 vs MRI-AGCM3.2H (JJA Precip change)



Differences appear around steep mountains





18 CMIP5 models

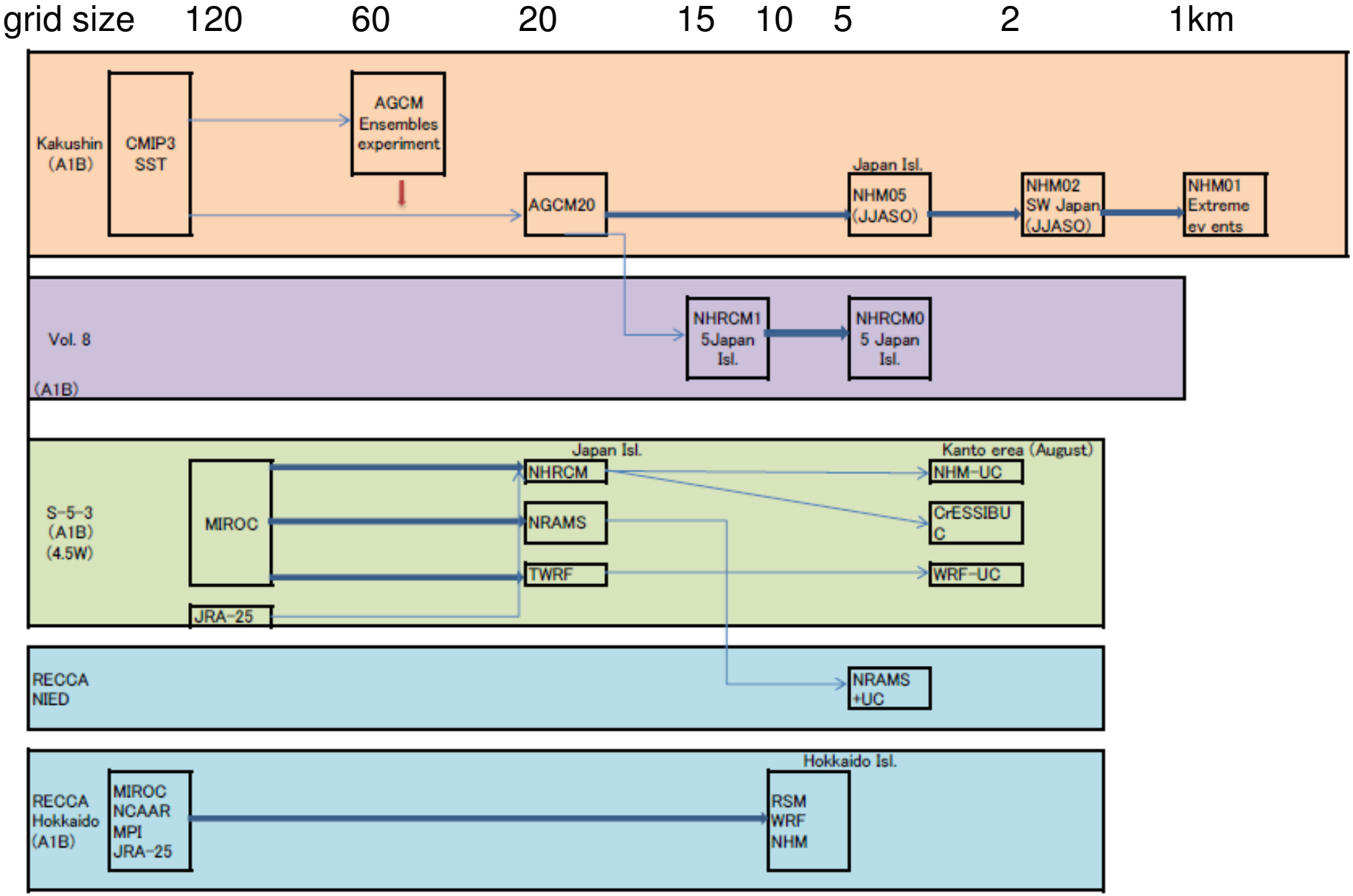
MRI-AGCM3.2H (60km, 12 members)

DDS projects in Japan (A1B)

Projects name	Model	Driven by	Grid int.	Convective scheme	Lateral Boundary	Area
Kakushin	NHM05	MRI	5km	K-F	AGCM20	Japan Isl.
	NHM	MRI	2km	Explicit	NHM05	SW Japan
	NHM	MRI	1km	Explicit	NHM05	SW Japan
Vol.8	NHRCM15	MRI	15km	K-F	AGCM20	Japan Isl.
	NHRCM	MRI	5km	K-F	NHRCM15	Japan Isl.
S-5-3	NHRCM	MRI	20km	K-F	MIROC	Japan Isl.
	NRAMS	NIED	20km	K-F	MIROC	Japan Isl.
	TWRF	Tsukuba	20km	K-F	MIROC	Japan Isl.
RECCA/ Hokkaido	RSM	Hokkaido	10km	Relax A-S	Multi GCM	Hokkaido
	WRF	Hokkaido	10km	K-F	Multi GCM	Hokkaido
	NHM	Hokkaido	10km	K-F	Multi GCM	Hokkaido

* Multi GCM = MIROC, NCAR, MPI, and JRA-25

DDS projects in Japan



* RECCA includes many smaller scale DDS approaches.

Future directions

- **KAKUSHIN Program ends March 2012, and a new project will begin this year.**
- **A flagship model we use is a revised version of MRI-AGCM3.2S (20-km) with air-sea coupling.**
- **DDS with multi-RCM will be performed for Japan.**
- **DDS with NHRCM will be extended into Asia: target region is to be decided depending on local interest and support.**