Added Value of reproduced precipitation by high resolved regional climate model simulation over CORDEX–East Asia
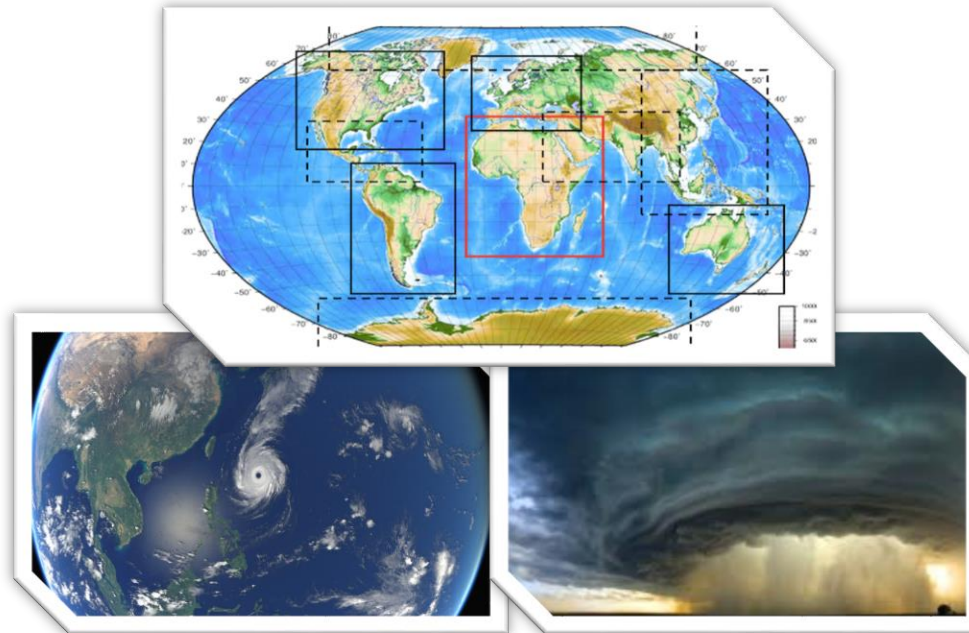
EGU 2020
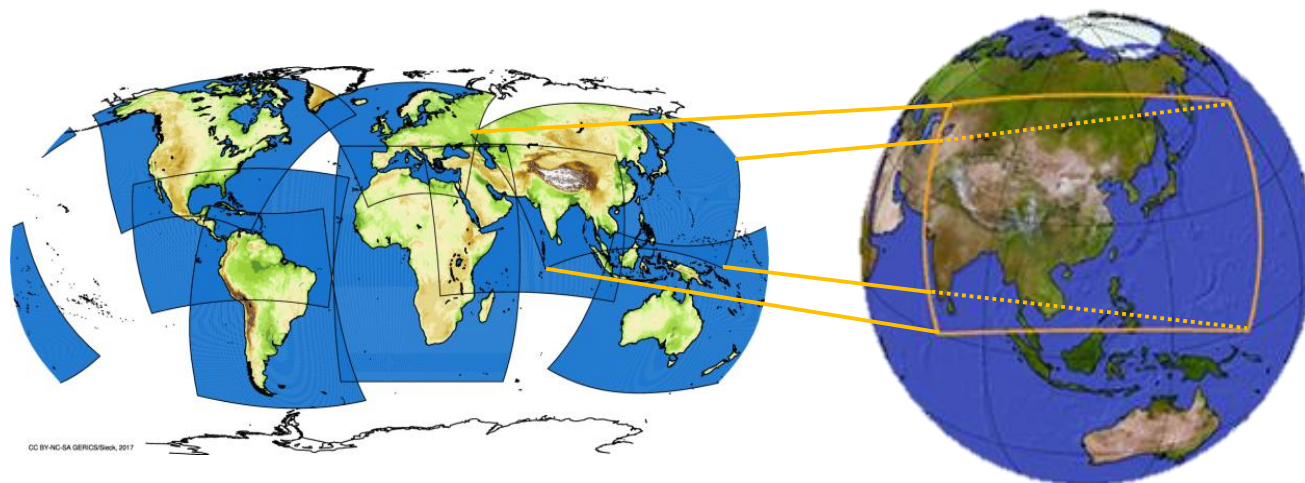
Taehyung Kim[1], **Dong-Hyun Cha**[1], **Gayoung Kim**[1], **Seok-Woo Shin**[1], **Changyong Park**[1], **Minkyu Lee**[1], **Young-Hwa Byun**[2], and **Hyun-Suk Kang**[2]

[1]Ulsan National Institute of Science and Technology

[2]National Institute of Meteorological Sciences

1. Introduction

- Can the higher-resolution RCMs generate added value in simulating precipitation ?

  ✓ Evaluation simulations in precipitation using RCMs which are participated in CORDEX-EA had been conducted, in order to understand the systematic error in advance

  ✓ Sets of Phase 1 and Phase 2 simulations of two RCMs are compared to observations in the East Asia region

2. Model, Data and Methods

● Model configuration

Forcing Data	ERA-INTERIM
Period	1989-2008(Evaluation)
Resolution	EAS-44 : 0.44° EAS-22 : 0.22°
Domain	See as below
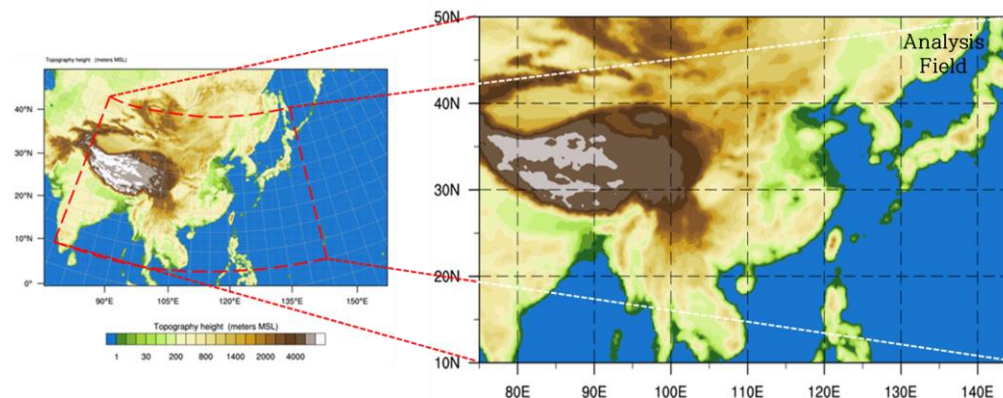
	SNURCM		HadGEM3-RA	
	EAS-44	**EAS-22**	**EAS-44**	**EAS-22**
Lat x Lon	197 x 233	260 x 405	183 x 220	254 x 396
Vertical Layers	24 sigma	24 sigma	38 hybrid	63 hybrid
Convection	Kain-Fritch II	Kain-Fritch II	Revised mass flux	Revised mass flux
Microphysics	Reisner II	Reisner II	Mixed Phase	Mixed Phase
Radiation	CCM2 package	CCM2 package	General 2-stream radiation	General 2-stream radiation
Land surface model	CLM3	CLM3	MOSES II	MOSES II
Spectral Nudging	Yes	Yes	No	No

2. Model, Data and Methods

● Observation Data

Observation Data	GPCP	APHRODITE	TRMM
Period	1989-2008(20y)	1989-2008(20y)	1999-2008(10y)
Resolution	2.5° x 2.5°	0.50° x 0.50° 0.25° x 0.25°	0.25° x 0.25°
Version	GPCP Ver. 2.3	MA_V1101, MA_V1101EXR	3B42

● Extreme Index - ETCCDI

Index	Descriptive name	Definition	Unit
Rx1day	Maximum 1-day precipitation	Yearly / Monthly Maximum 1-day precipitation	mm
Rx5day	Maximum 5-day precipitation	Yearly / Monthly Maximum consecutive5-day precipitation	mm

● Added Value Index

Added Value consists of the generation of small (spatial and temporal) scales by a high-resolution RCM driven by low-resolution GCM data

$$Added\ Value = \frac{(X_{RCM50} - X_{OBS})^2 - (X_{RCM25} - X_{OBS})^2}{Max((X_{RCM50} - X_{OBS})^2, (X_{RCM25} - X_{OBS})^2)}$$

Di Luca el al. (2012), Dosio et al. (2015)

3. Result

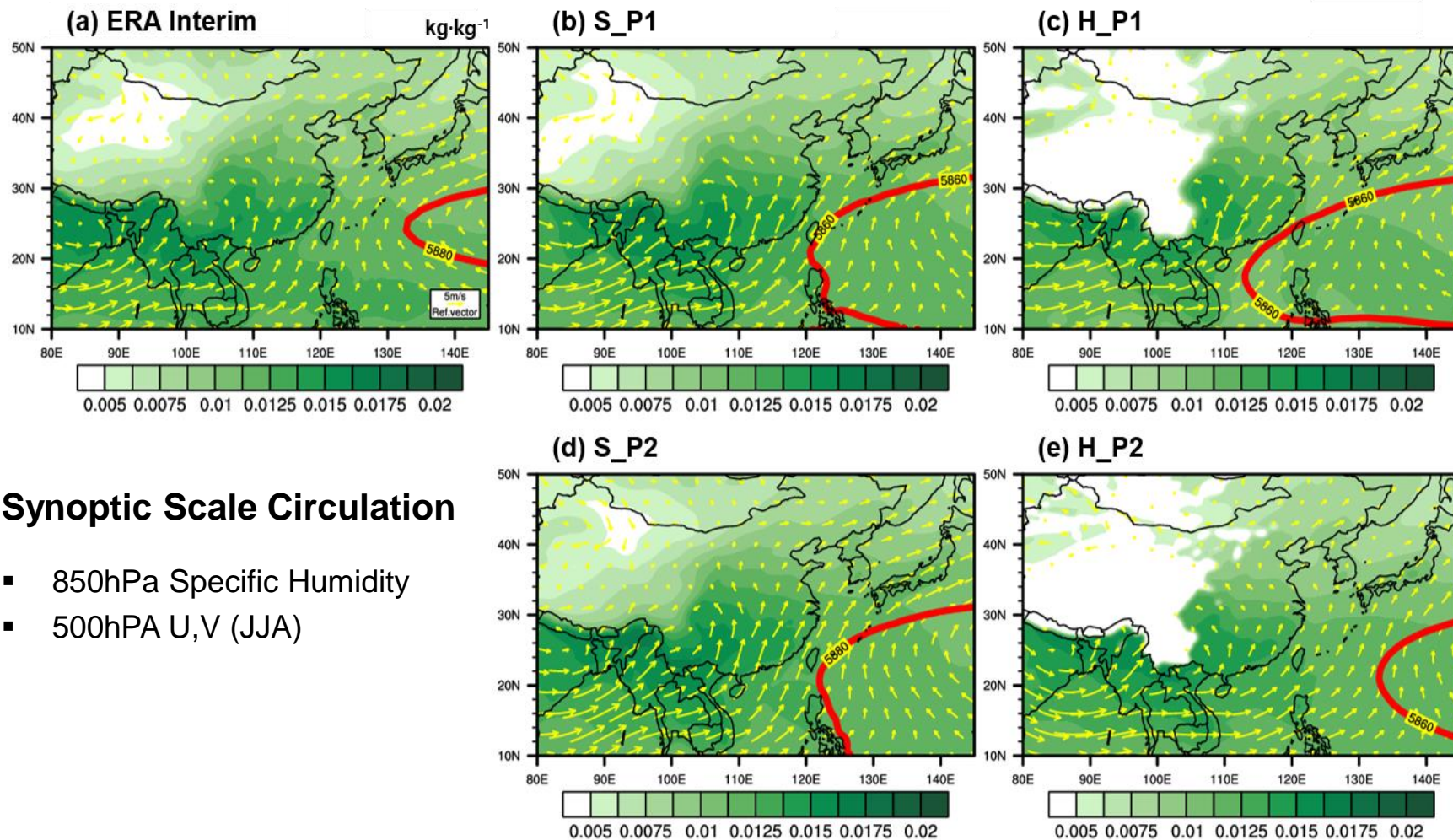● **Climatology_JJA**
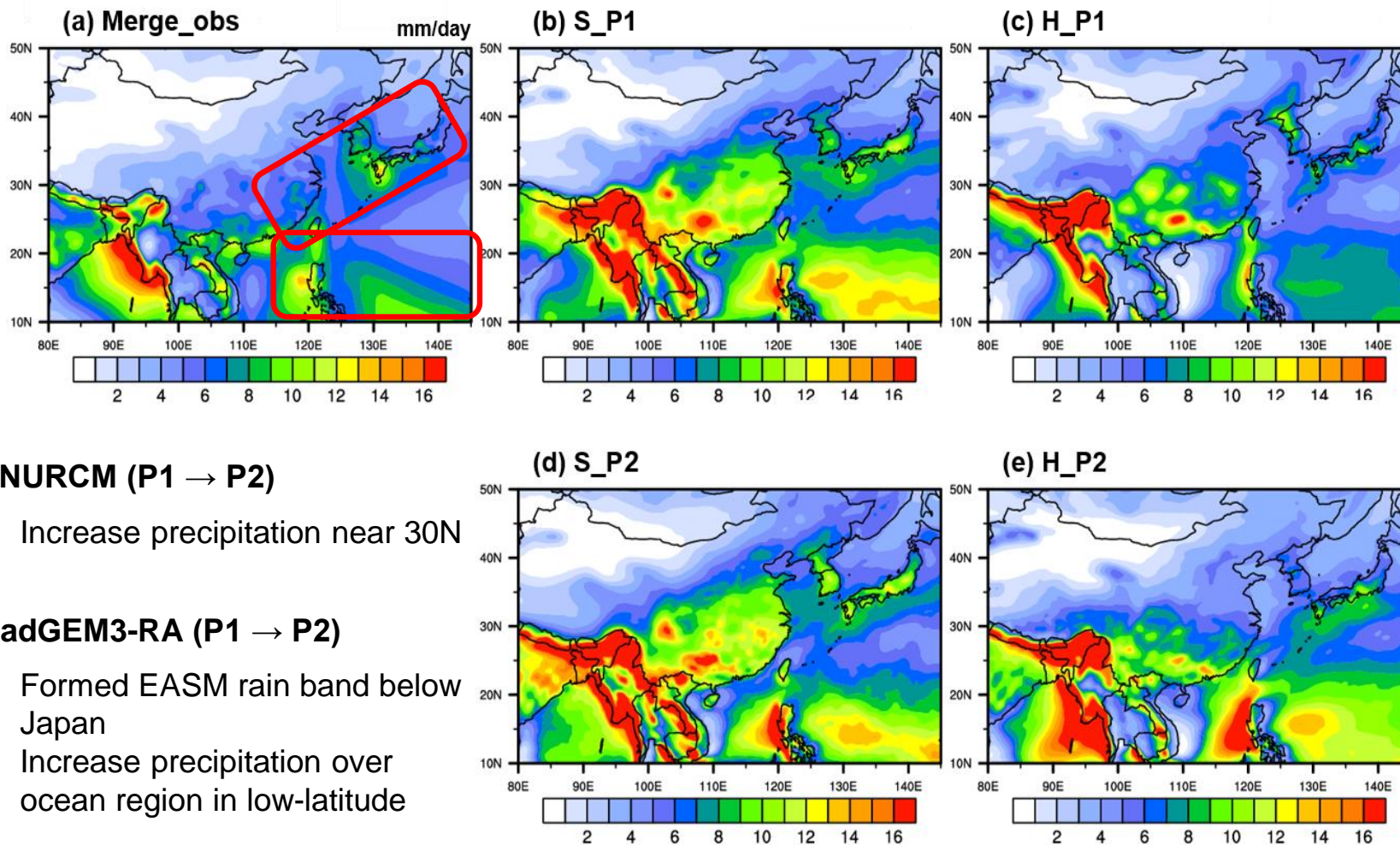
SNURCM (P1 → P2)

▪ Increase precipitation near 30N

HadGEM3-RA (P1 → P2)

▪ Formed EASM rain band below Japan
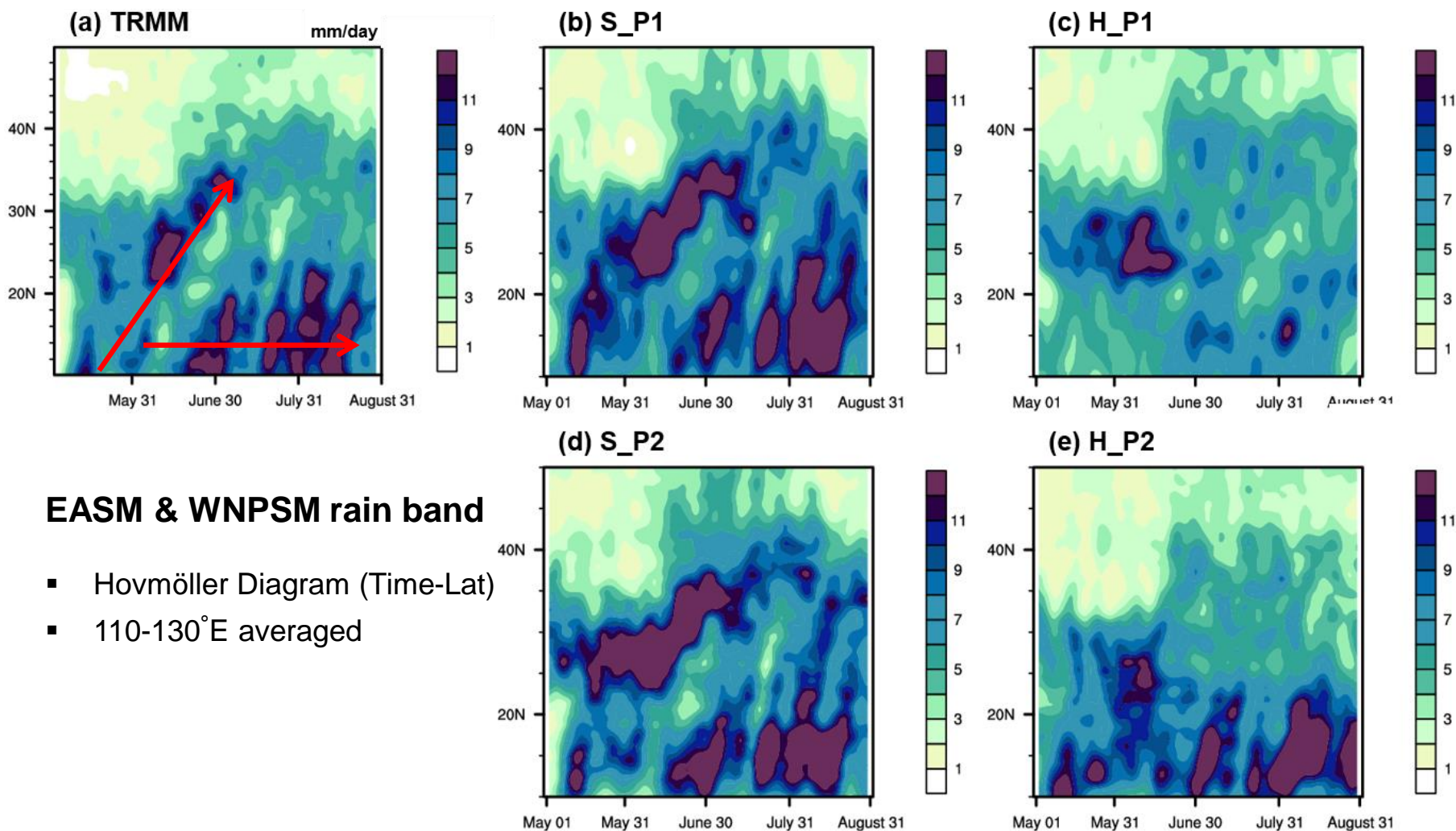▪ Increase precipitation over ocean region in low-latitude

3. Result
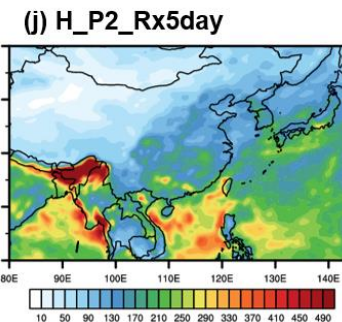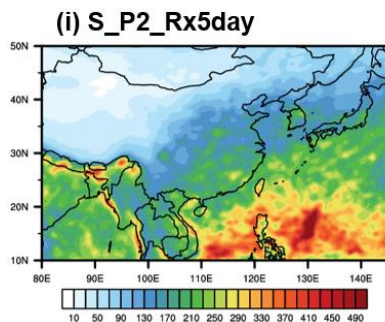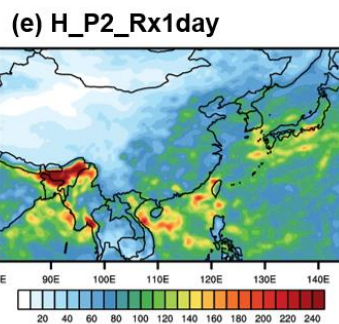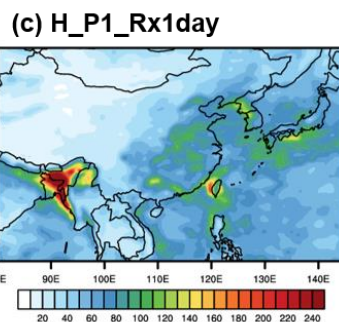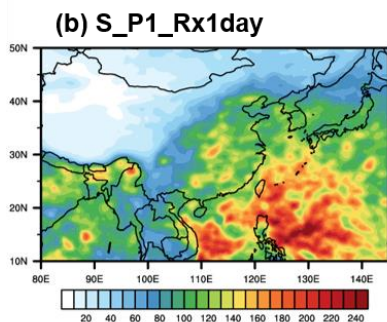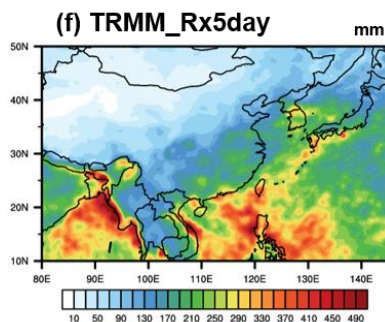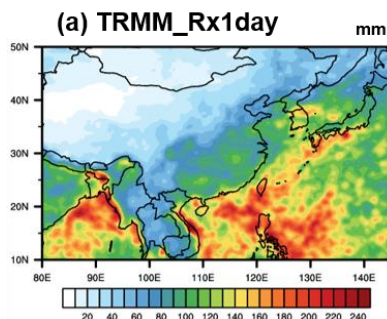

Synoptic Scale Circulation

- 850hPa Specific Humidity
- 500hPA U,V (JJA)

3. Result

(a) TRMM — mm/day

(b) S_P1

(c) H_P1

(d) S_P2

(e) H_P2

EASM & WNPSM rain band

- Hovmöller Diagram (Time-Lat)
- 110-130˚E averaged

3. Result

● Extreme Index – Rx1day / Rx5day

3. Result

● Added Value

(a) AV_S_JJA   (b) AV_H_JJA

(c) AV_S_Rx5day   (d) AV_H_Rx5day
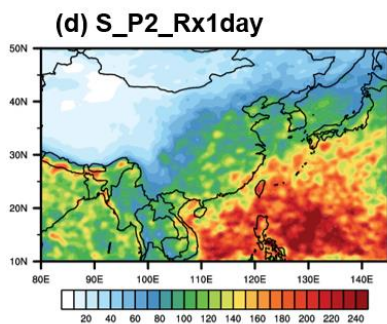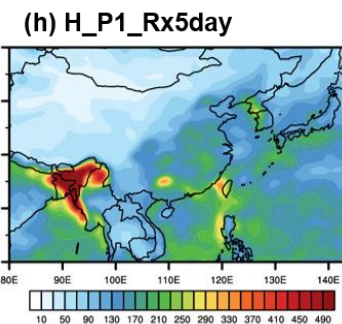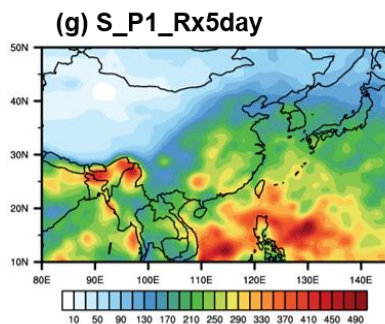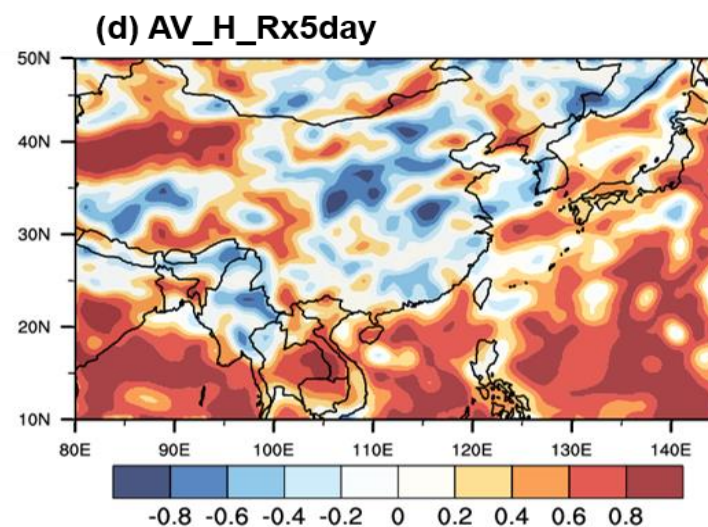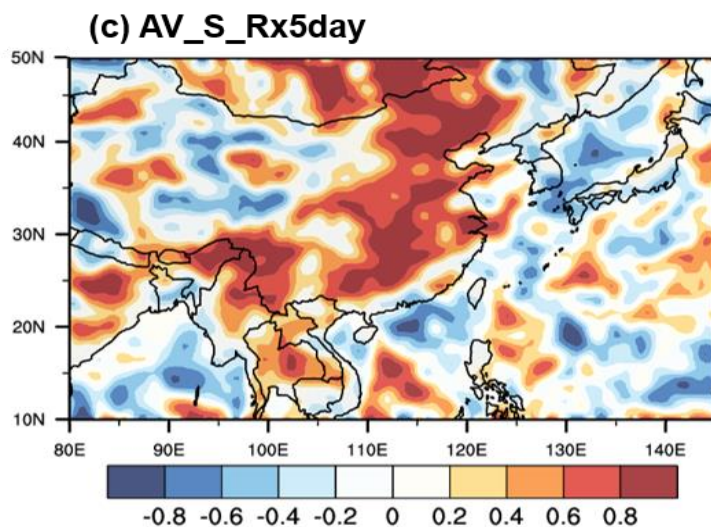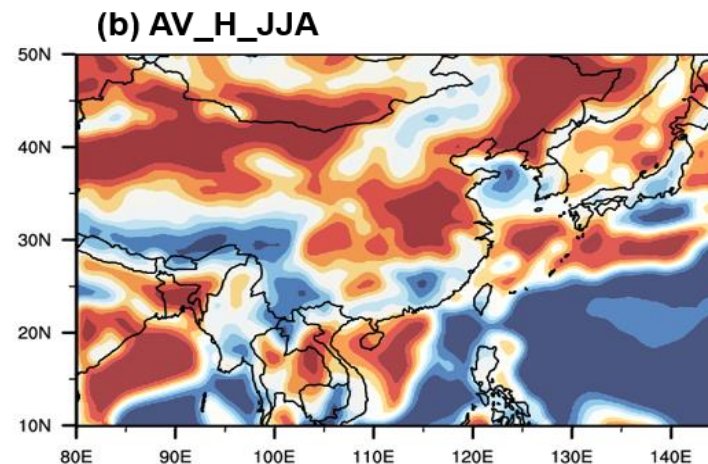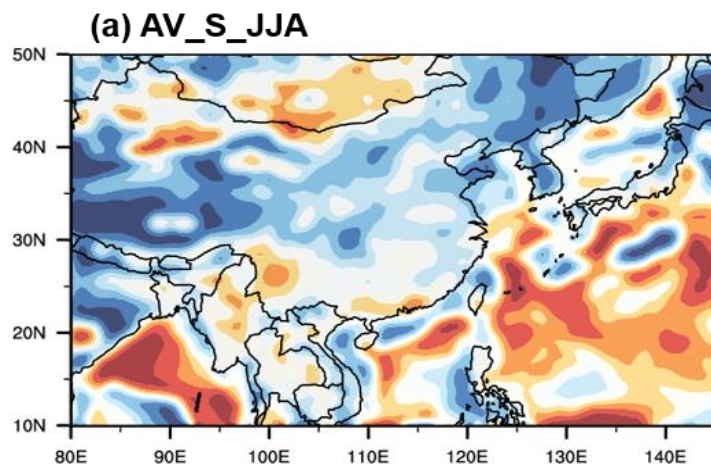
4. Summary

- Investigated whether the higher-resolution RCMs can generated Added Values for precipitation over CORDEX-EA domain

- Analyzed by Mean climatology precipitation, large-scale circulation, and extreme precipitation index

- In addition, the quantitative added value index is applied

- In SNURCM simulations, positive (negative) added value of summer mean precipitation is reproduced over most ocean (land) region of East Asia in fine-resolution simulation. Extreme precipitation over Korea and Japan is reasonably reproduced in Phase 2 simulations

- In HadGEM3-RA simulations, the results of summer mean precipitation over most East Asian regions above 25°N are improved in Phase 2, while worse results are reproduced below 25°N. But, extreme precipitation in fine-resolution simulation is adequately reproduced in most regions of East Asia except China and the Yellow sea

- Even the higher resolution was applied in phase 2, it still has the systematic error. Further study is necessary (more-higher resolution, Development physics scheme, etc.)