



## Projected Change in Seasonal Monsoon Precipitation over Southeast Asia under CMIP6 Climate Model

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# **1 INTRODUCTION** Why we should study?

- SEA is considered to be most vulnerable to climate extremes
  - High population density
  - Long coastline with exposure to tropical cyclones
  - Low-lying area
  - > 20,000 islands
  - Significant rainfall variability
- Limited number of Studies of CC over SEA (CMIP3, CMIP5)
- The present study uses CMIP6



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## 2 Data and methodology 2.1 Study region



Fig. 1 Study area SEA (Southeast Asia)

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## 2 Data and methodology 2.2 Observation and model datasets

- Observation datasets
  - SA-OBS

### Table 1 List of CMIP6 models used in this study

GCM	Research Center	Resolution
ACCESS-CM2	Australian Community Climate and Earth System Simulator	1.88×1.25
ACCESS-ESM1-5	Australian Community Climate and Earth System Simulator	1.88×1.25
BCC-CSM2-MR	Beijing Climate Center, China Meteorological Administration, Beijing, China	1.12×1.11
CanESM5	Canadian Centre for Climate Modelling and Analysis, Environment and Climate Change Canada, Canada	2.81×2.77
CNRM-CM6-1	National Center for Meteorological Research, France	1.41×1.39
CNRM-ESM2-1	National Center for Meteorological Research, France	1.41×1.39
EC-Earth3	EC-Earth Consortium (EC-Earth)	0.70×0.70
FGOALS-g3	LASG, Institute of Atmospheric Physics, Chinese Academy of Sciences, Beijing, 100029, China	0.70×0.70
GFDL-ESM4	NOAA Geophysical Fluid Dynamics Laboratory, USA	1.25×1.00
NM-CM4-8	Institute for Numerical Mathematics, Russia	2.00×1.50
NM-CM5-0	Institute for Numerical Mathematics, Russia	2.00×1.50
PSL-CM6A-LR	The Institut Pierre Simon Laplace, France	2.50×1.27
MIROC6	JAMSTEC (Japan Agency for Marine-Earth Science and Technology, Japan), AORI (Atmosphere and Ocean Research Institute, The University of Tokyo), NIES (National Institute for Environmental Studies), and R-CCS (RIKEN Center for Computational Science), Japan	1.41×1.39
MIROC-ES2L	JAMSTEC, AORI, NIES, and R-CCS, Japan	2.81×2.77
MPI-ESM1-2-LR	Max Planck Institute for Meteorology, Germany	1.88×1.85
MRI-ESM2-0	Meteorological Research Institute, Japan	1.12×1.11
NESM3	Nanjing University of Information Science and Technology, China	1.88×1.85
NorESM2-LM	NorESM Climate modeling Consortium consisting of CICERO (Center for International Climate and Environmental Research), MET-Norway (Norwegian Meteorological Institute), NERSC (Nansen Environmental and Remote Sensing Center, Bergen), NILU (Norwegian Institute for Air Research), UiB (University of Bergen, Bergen), UiO (University of Oslo) and UNI (Uni Research), Norway	2.50×1.89



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# 2 Data and methodology

## 2.3 Bias correction



Fig. 2 Taylor diagram of temperature and precipitation for CMIP6 models during the reference period



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## **3** Results and Discussion

## **3.2 Projected Changes in annual-mean precipitation**



Fig. 3 Spatial distribution of future changes in mean Precipitation



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# **3** Results and Discussion

# 3.3 Projected Changes in seasonal monsoon rainfall



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Fig. 4 Mean seasonal monsoon precipitation

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# 4 Conclusions

- Eighteen CMIP6 models are employed to assess future mean climate change for 3 periods (Near-future: 2015-2039, Mid-future: 2040-2069, and far-future: 2070-2099) under SSP2-4.5 and SSP5-8.5
- The spatial distributions in annual-mean temperature and precipitation of CMIP6 models generally produce similar pattern to SA-OBS.
  - Higher annual-mean precipitation is observed over the Maritime Continent than the mainland SEA.
  - The annual-mean temperature under SSP2-4.5 (SSP5-8.5) is projected to increase
  - The annual-mean precipitation is projected to increase

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# 4 Conclusions



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- There are robust increases in Southwest and Northeast monsoon rainfall (SWMR and NEMR) along the timeline of the 21<sup>st</sup> century
  - For SSP2-4.5, SWMR and NEMR are increased
  - For SSP5-8.5, SWMR and NEMR are increased
  - Both SSP2-4.5 and SSP5-8.5 scenarios display greater increases during the boreal summer than boreal winter.





# Thank you

