Evaluation of Southwest Monsoon Change over Thailand by High-resolution Regional Climate Model

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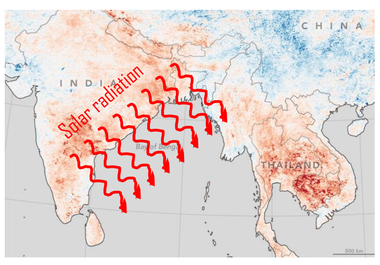
Abstract

The 5×5 km resolution of Non-Hydrostatic Regional Climate Model (NHRCM) developed by Meteorological Research Institute, Japan was used to evaluate the southwest monsoon season that affects to Thailand during mid-May until mid-October in each years. Bulk-type cloud microphysics, Kain-Fritsch convective scheme, Mellor-Yamada-Nakanishi-Niino level 3 PBL scheme, clear-sky radiation scheme and Hirai-Ohizumi land surface scheme are used as model configuration to simulate climate data under high emission scenario-RCP 8.5. This research was conducted for 2 time periods, i.e., baseline period (1981–2000) and future period (2080–2099), to estimate the southwest monsoon season onset and offset over Thailand by using average wind vector and cumulative precipitation in consecutive 5 days (pentad). Furthermore, the rain-break phase, less precipitation ranges during the southwest monsoon season, had also been analysed.

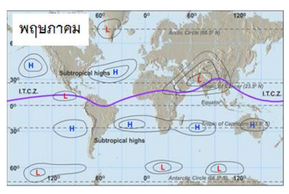
Introduction

Southwest monsoon

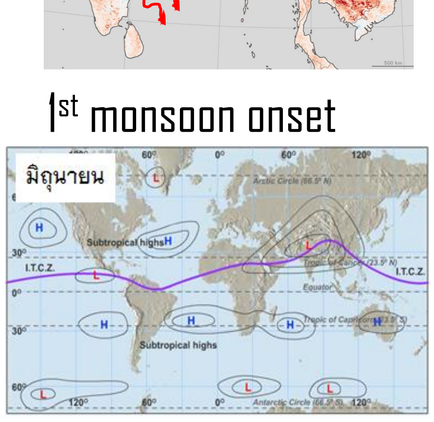
There are 4 phases of southwest monsoon season over Thailand.



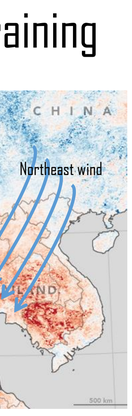
1st monsoon onset



2nd raining



3rd rain break



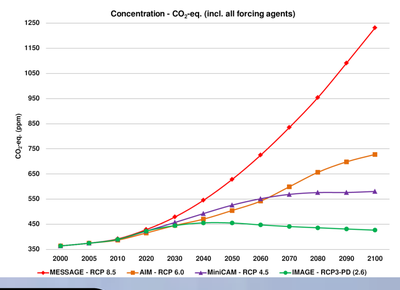
4th monsoon offset

Regional climate model

The Non-Hydrostatic Regional Climate Model (NHRCM) has been developed by Meteorological Research Institute, Japan, was set up by using the data in table as the configuration.

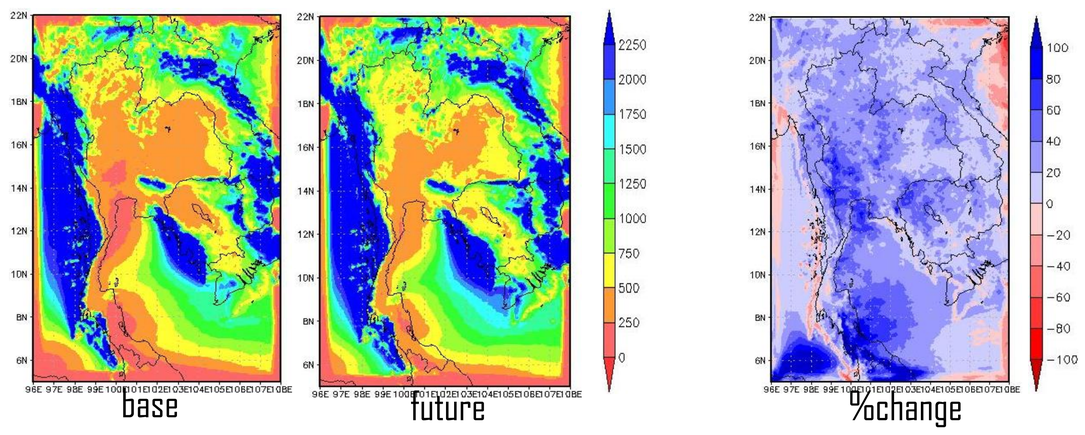
Physics options	Selected scheme
Cloud microphysics	Bulk-type Cloud microphysics (Ikawa et al. 1991)
Cumulus convective	Kain-Fritsch convective scheme (Kain and Fritsch 1990; Kato et al. 2010)
Planetary boundary layer	Mellor-Yamada-Nakanishi-Niino level 3 scheme (Nakanishi and Niino 2004)
Radiation	Clear-sky radiation scheme (Yabu et al. 2005) and cloud radiation scheme (Kitagawa 2000)
Land surface	Land surface scheme (Hirai and Ohizumi 2004)

And under RCP 8.5 CO_2 emission condition, the most increasing of CO_2 in exponential curve.



Results and discussion

Total precipitation in JJAS (monsoon season)



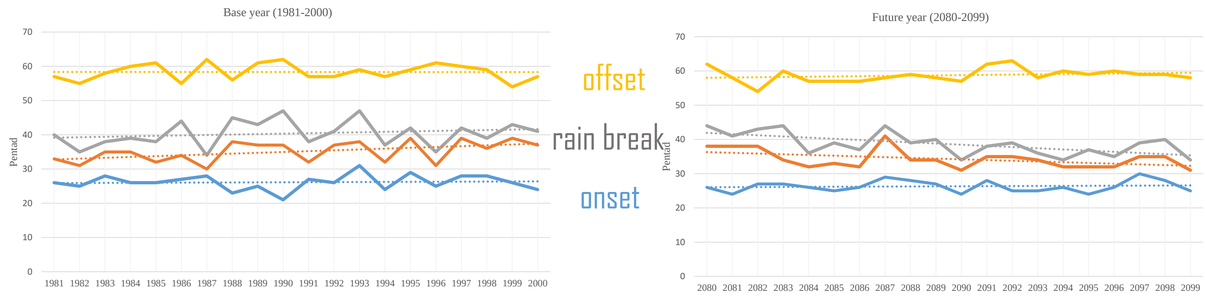
High precipitation amount was obviously detected in the same regions, for example, leeward side of western Thailand.

- Upper Malaysia and lower south part of Thailand increase 80-100%
- Central Thailand and the others increase 0-40%
- West coast of Thailand and south Myanmar decrease 0-40%

Results and discussion

Monsoon definition

- *Precipitation:* The cumulative precipitation in the onset pentad must be higher than 25 mm and lower than 25 mm in the offset pentad.
- *Horizontal wind:* The wind direction at upper layer (250 mb) and lower layer (850 mb) must be changed at least 120° from the previous pentad.



Average and SD

	Base year		Future year	
	Pentad	SD	Pentad	SD
Onset	26.15 (6 – 10 May)	2.1972	26.30 (6 – 10 May)	1.6462
Beginning of rain break	35.10 (20 – 24 June)	2.9309	34.30 (15 – 19 June)	2.6287
End of rain break	40.40 (15 – 19 July)	3.6932	38.65 (5 – 9 July)	3.2600
End of monsoon	58.35 (13 – 17 October)	2.3511	58.75 (13 – 17 October)	2.0218

Conclusion

The average southwest monsoon precipitation in JJAS over Thailand increases in the end of century. It might be concluded that wetter condition in the future would be influenced by the global warming conditions since higher greenhouse gas emission had been included in model simulations. The southwest monsoon onset, offset and duration would remain the same as the baseline but there would be less variation. The monsoon break would become one pentad earlier and slightly shorter than baseline period.

Acknowledgment

The authors would like to express our sincere to MRI for providing the NHRCM data and boundary conditions and facility to conduct the research.