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# Climate change impact on rainfall pattern in Bangkok Metropolitan region

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## Climate change impact on rainfall pattern in Bangkok Metropolitan region

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# Introduction

The extreme rainfall trends in Thailand frequently occurred during the past decades. The climate change problems have caused extreme monsoons and tropical cyclones, with heavier rainfall leading to floods and inundations in cities (DMR, 2012).

Bangkok Metropolitan region is cover Bangkok and five adjacent provinces: Nakhon Pathom, Pathum Thani, Nonthaburi, Samut Prakan and Samut Sakhon.

This research will focus on the comparison of rainfall pattern maps, between both the observed rainfall (1981 – 2017) and the modelled rainfall (2006 – 2050), are supported on Arc GIS software version 10.3.

The comparison between observed and modelled rainfall values are presented from 2006 to 2017.

This study seeks to analyse how rainfall trend in Bangkok Metropolitan regions will respond under modelled future emissions of greenhouse gases as indexed by IPCC emission scenarios RCP 8.5.

## The past of flood occurrences in Bangkok

- In 2006, floods occurred in the eastern part of Bangkok. These incidents occurred due to approximately 110 mm of rainfall values because the southwest monsoon and low air pressure winds dominated the northern part of Thailand.
- In 2011, the maximum daily rainfall was approximately 243 mm in the northern part because of the low air pressure and the southwest monsoon. It affected 23 districts in Bangkok, especially in economic areas such Pathumwan, Sathorn, Din Daeng, Phaya Thai districts and so on. The World Bank has estimated 1,425 trillion baht (US\$46.5 billion) in economic damages and losses due to flooding and the transportation system was disrupted, causing migration to secure areas.



## Present-day condition



- Rainfall pattern was described by interpolation using seventeen rain stations covering eighteen provinces of the central part of Thailand from 1980 to 2017
- The interpolation is used for this case because there are only six rain stations in Bangkok Metropolitan region.
- Both observed daily rainfall and three-hourly rainfall during 1981-2010 are used to calculate the standard hours of daily rainfall for the seventeen rain stations covering eighteen provinces
- Three hourly observed rainfall values obtained at the times: 1am, 4 am, 7am, 10am, 1pm, 4pm, 7pm and 10pm

## Present-day condition

- Calculating the daily rainfall hours (hr) in each rain station (1981-2010), using three hourly rainfall data (mm) from 1981 to 2010
- Calculating the number of three hourly rainfall (time) in each rain station covering seventeen rain stations covering eighteen provinces
- Using the hours of daily rainfall each rain station to calculate the hours of rainfall (hr) per year
- The number of days rain per a year (day rain: accumulated rain within 24 hr)
- Calculating annual rainfall values at each rain station (1981-2010) and the number of day rains (1981-2010) in each year at each rain station
- Calculating rainfall values rate (mm/24hours) at each rain station in seventeen rain stations
- (e.g. (168 times x 3 hr)/24 hr)

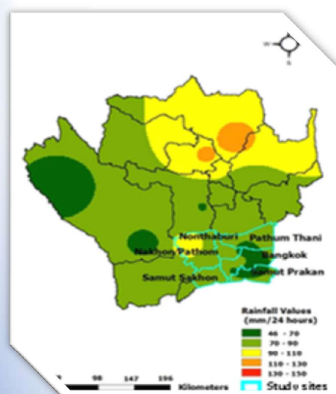
Rainfall values (1980-2010)	Bangkok	Ayutthaya	Nakhon Sawan	Chai Nat	Pathum Thani	Ratcha Buri	Lopburi	Samut Prakan	Kanchanaburi	Nakhon Pathom	Suphan Buri
Average annual rainfall	1,499.2	1,131.4	1,309	1,127.1	1,239.8	1,098.6	1,113.5	989.6	1,412.7	1,010.0	1,027.5
Days rain per a year	21	8	13	9	10	9	13	18	18	9	14
Average rainfall (mm/24 hours)	71.4	141.4	100.7	125.2	124.0	122.1	85.6	55.0	78.5	112.2	73.4



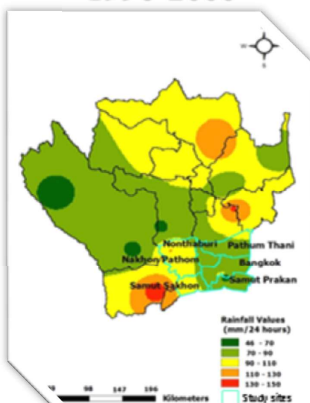
## The interpolated map covering eighteen provinces in the central part of Thailand



1981-1990



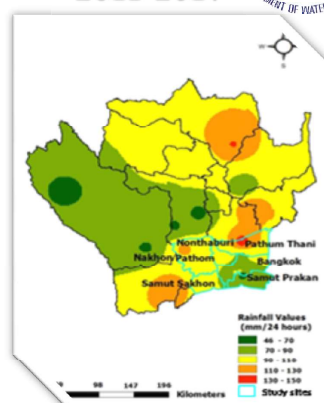
1990-2000



2001-2010



2011-2017



The rainfall values analysis focuses on Bangkok and five adjacent provinces: Nakhon Pathom, Pathum Thani, Nonthaburi, Samut Prakan and Samut Sakhon, the strongly intense rainfall present in Bangkok and Samut Prakan province : 46-90 mm/24 hours, while Nonthaburi, Samut Sakhon and Nakhon Pathom provinces are 70-130 mm/24 hours, and between 70 - 150 mm/24 hours in Pathum Thani province. The rainfall pattern showed significant increasing trends from 1980 to 2017.

## Rainfall pattern in the simulation scenario at local scale: downscaling

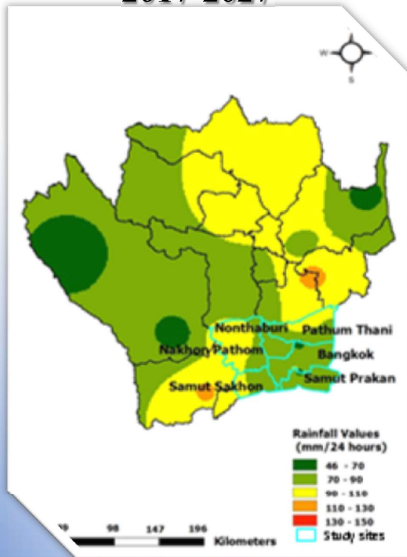


- The prediction of daily rainfall is obtained by Southeast Asia Climate Downscaling Experiment (SEACLID) from 2018 to 2050 under simulation scenario RCP 8.5, which is only 365 days per year. In this study, the rainfall data is downscaling in the central part of Thailand.
- The average three-hourly rainfall from 1981 to 2010 are used for the standard of days of rain per year for each rain station covering eighteen provinces.
- The days of rain per year and annual rainfall were used to calculate rainfall in mm/24 hours
- The modelled rainfall intensity values will be averaged by the interpolation approach and represented by the rainfall intensity rate on the map

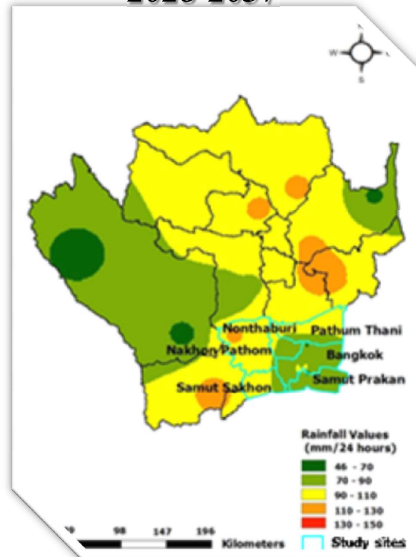
# The interpolation map from 2018 to 2050



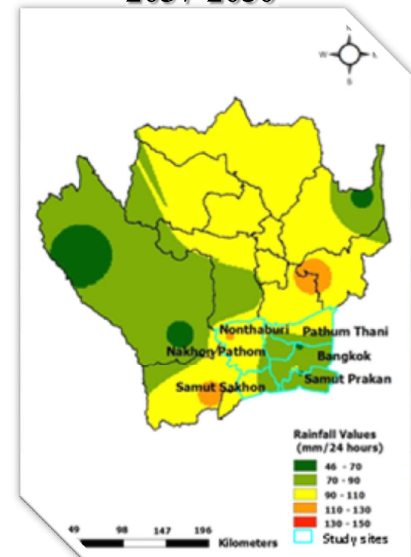
2017-2027



2028-2037



2037-2050



## The interpolation map from 2018 to 2050



- The rainfall values analysis focused on Bangkok Metropolitan region, the strongly intense rainfall present in six provinces:
- Bangkok, Samut Prakan: 70-90 mm/24 hours,
- Pathum Thani Samut Sakhon and Nakhon Pathom are 70-110 mm/24 hours from 2018 to 2027, while between 90 - 110 mm/24 hours in Nakhon Pathom and Pathum Thani,
- 90 and 130 mm/24 hours in Nonthaburi from 2037 to 2050 respectively.
- The trend of rainfall pattern slightly increased from 2018 to 2050.

## The comparison of rainfall pattern maps, between both the observed rainfall and the modelled rainfall (2006 – 2017)

- The modelled annual rainfall of SEACLID RCP 8.5 in each year is averaged: 1,345 mm from 2006 to 2017, while the observed rainfall in each year is averaged: 1,301.2 mm from 2006 to 2017, covering eighteen provinces . The comparison between observed and modelled rainfall are presented approximately 6.6 % difference from 2006 to 2017.

## The comparison of rainfall pattern maps, between both the observed rainfall (1980 – 2017) and the modelled rainfall (2006 – 2050)

- The rainfall values analysis focused on Bangkok Metropolitan region, the strongly intense rainfall present in six provinces during five periods: 1981-1990, 1991-2000, 2001-2010, 2011-2017, 2018-2027, 2028-2037 and 2037-2050
- 90-110 mm/24 hours of rainfall values areas will increase, while 70-90 mm/24 hours of rainfall values areas decrease, covering Pathum Thani Samut Sakhon and Nakhon Pathom provinces during 1981 - 2050. The rainfall pattern showed significant increasing trends from 2018 to 2050 Therefore, the increase of rainfall pattern affects the flooding in low land.

The rainfall pattern in the future has been predicted for Bangkok Metropolitan regions. This is useful for land use urban planning because there has been a lot of infrastructure and economic areas. It would be good for future research to know the rainfall pattern and use it in the model for disaster assessment such as the zonation of flood risks.





Thank you for your attention