Hydrological Responses to Climate Variability and Change and Promotion of the Use of Climate Information by Water Managers for adaptation of climate change in the context of climate variability in hydrological cycle in Vietnam

Changes in Climate Extreme and Impact on Water Resources in Viet Nam

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Contents

A. Introduction

B. Methodology

C. Results and Discussion

D. Conclusion

A. Introduction

- Viet Nam is one of the most countries affected by natural disasters and climate change.
- Storms and floods are the most frequent and severe natural disasters affecting Viet Nam.
- Extreme disasters annually cause negative effects on natural environment, habitat and socio-economic development in Viet Nam.
- Recent studies show that climate extreme events are likely added more complex in the future due to climate change.
- Climate change led to increase in surface temperatures, causing the appearance of unusual climate extreme events.
- In addition, climate change is a cause of altering climate variations, resulting in extreme events.

A. Introduction

- In 1/2015, Vietnam announced the “Viet Nam Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation (SREX Viet Nam).”
- In 2016, Vietnam will announce the report: “Updating Climate Change and Sea level rise Scenarios for Viet Nam”.

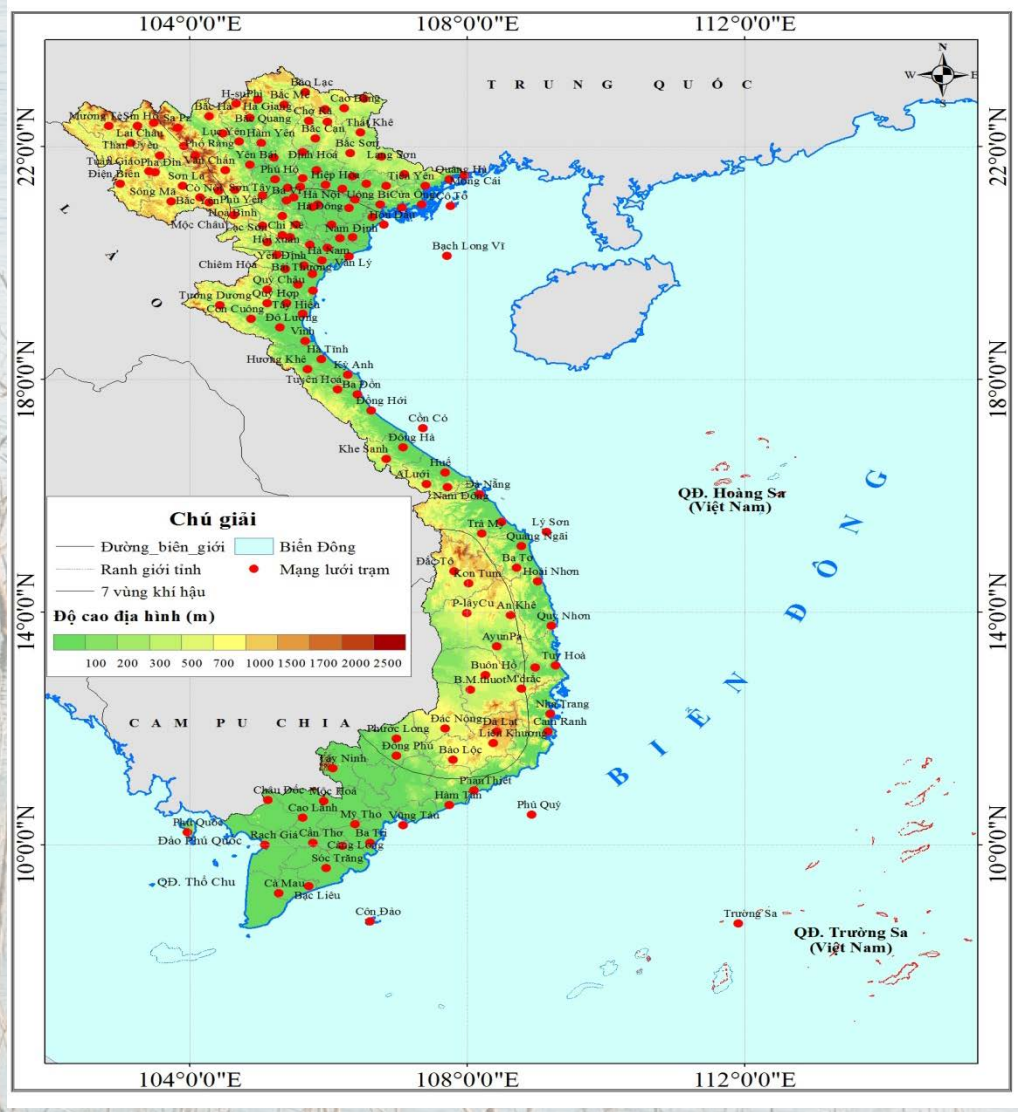
A. Introduction

- To assessment of the recent changes of climate extremes and future change would benefit for managing environment, socio-economic development and decision-makers.
- This study has contributed reliable information for the national reports “Updating on climate change and sea level rise scenarios for Viet Nam” and “SREX Viet Nam”

B. Methodology

Data

- Using 174 meteorological observation stations (1961 – 2014);
- Using 15 oceanographic stations (1960 – 2014);



B. Methodology

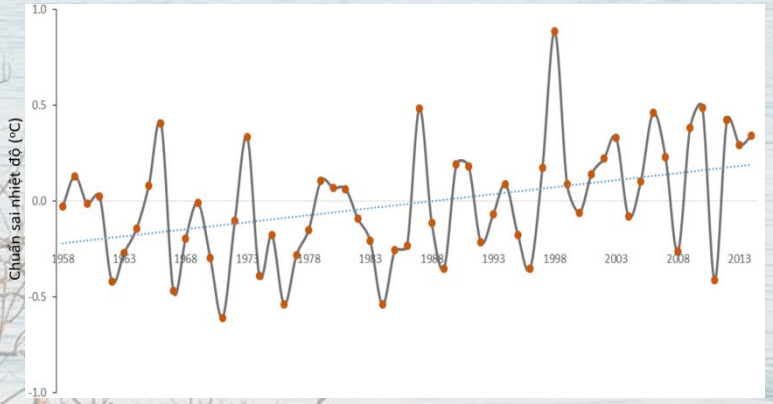
Data

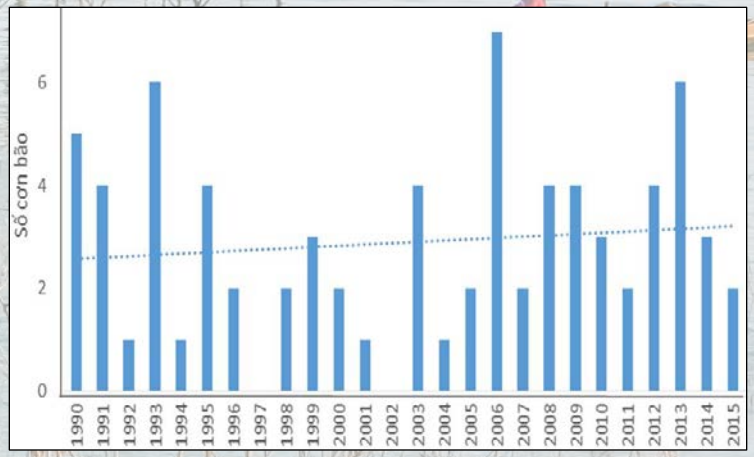
- AGCM/MRI model from the Japan Meteorological Agency (JMA)
- PRECIS from the Met Office Hadley Centre – UK,
- CCAM model from the Commonwealth Scientific and Industrial Research Organization (CSIRO) – Australia
- RegCM models from the International Centre for Theoretical Physics (ICTP) – Italy
- clWRF model from the Santander Meteorology Group – Spain.

B. Methodology

Methodology

- The linear regression was used to identify the trends and variations of climate extremes in a month, season or year based on daily observed data.





B. Methodology

Methodology

The climate extreme indices

Indices	Definition	Unit
Number of very hot days (SU39)	Count of days with daily maximum temperature >=39°C	days
Number of hot days (SU35)	Count of days with daily maximum temperature >=35°C	days
Highest maximum temperature (Txx)	Maximum value of daily maximum temperature	^{o}C
Lowest minimum temperature (Tnn)	Minimum value of daily minimum temperature	^{o}C
Number of cold days (CD15)	Count of days with daily mean temperature <=15^{o}C	days
Number of extreme cold days (CD13)	Count of days with daily mean temperature <=13^{o}C	days
Number of heavy rainfall days (R100)	Count of days with daily precipitation > 100 mm	days
Maximum 1-day rainfall (Rx1day)	Maximum value of daily precipitation	mm
Maximum 5-day rainfall (Rx5day)	Maximum value of 5-day accumulated daily precipitation	mm

B. Methodology

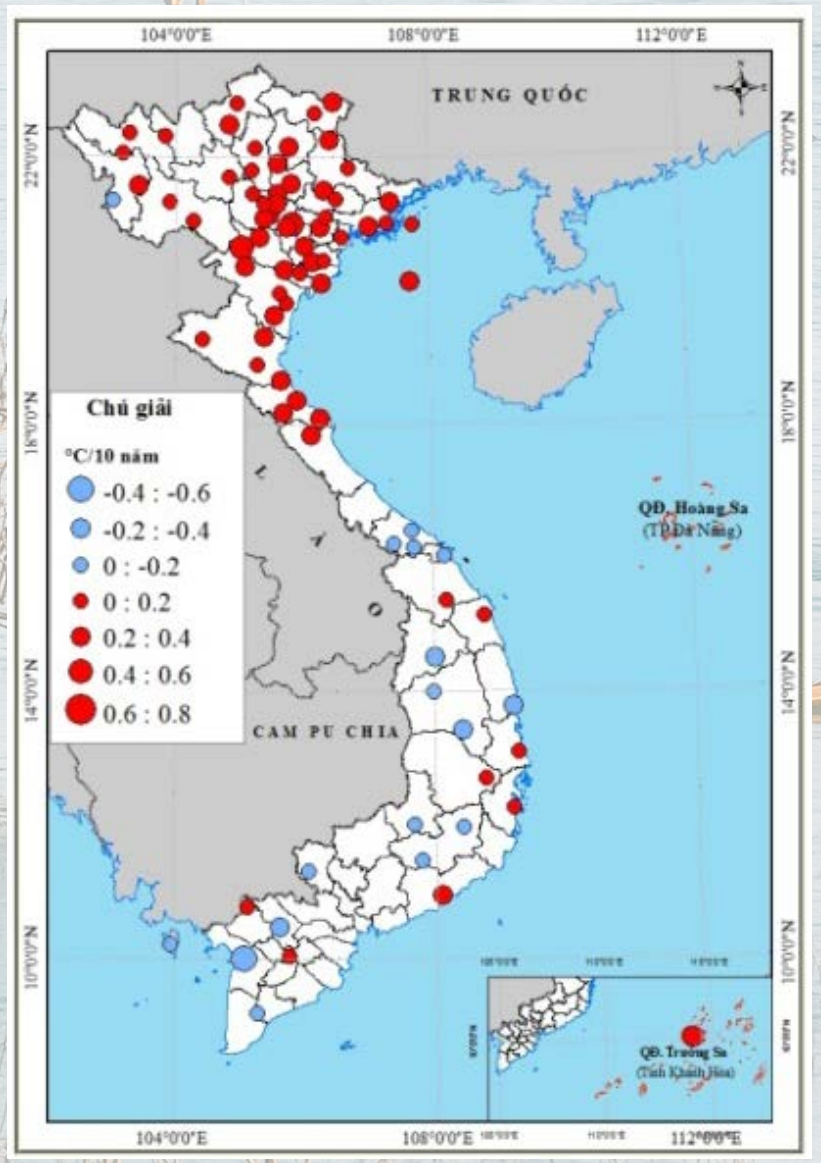
Methodology

- Using simulated models to assess the changes of climate extremes.
- The changes of climate extremes were assessed by comparing the future trends and variations of climate variables (2046-2065, 2080-2099) with the trends and the variations in the reference period (1986-2005) (referred to as baseline).

C. Results and Discussion

Observation

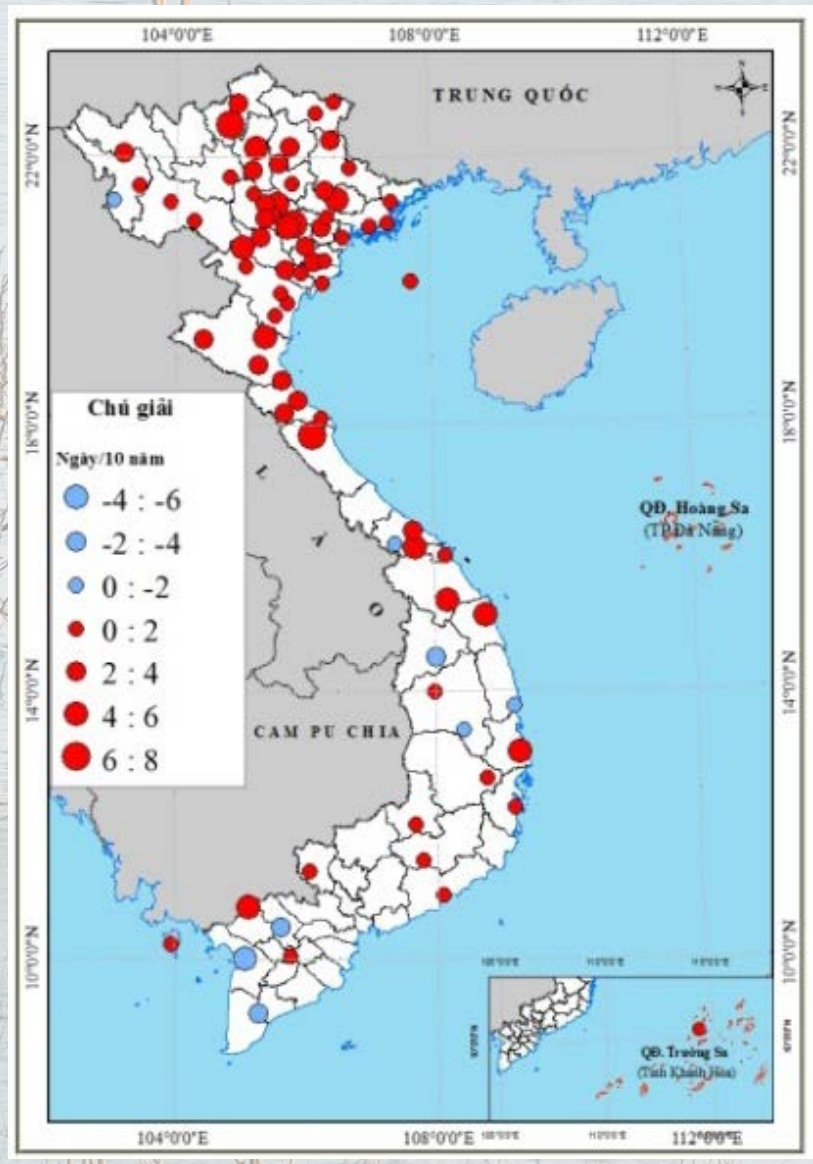
- The highest maximum temperature increased at most stations in the North and decreased in most stations in the South.
- The highest increase rate of about 0.9°C/decade was observed in some stations of the Northwestern and Northeastern Viet Nam.
- The highest decreased rates of about 0.8°C/decade were found in some stations of the North Central Viet Nam, North Central Viet Nam.



C. Results and Discussion

Observation

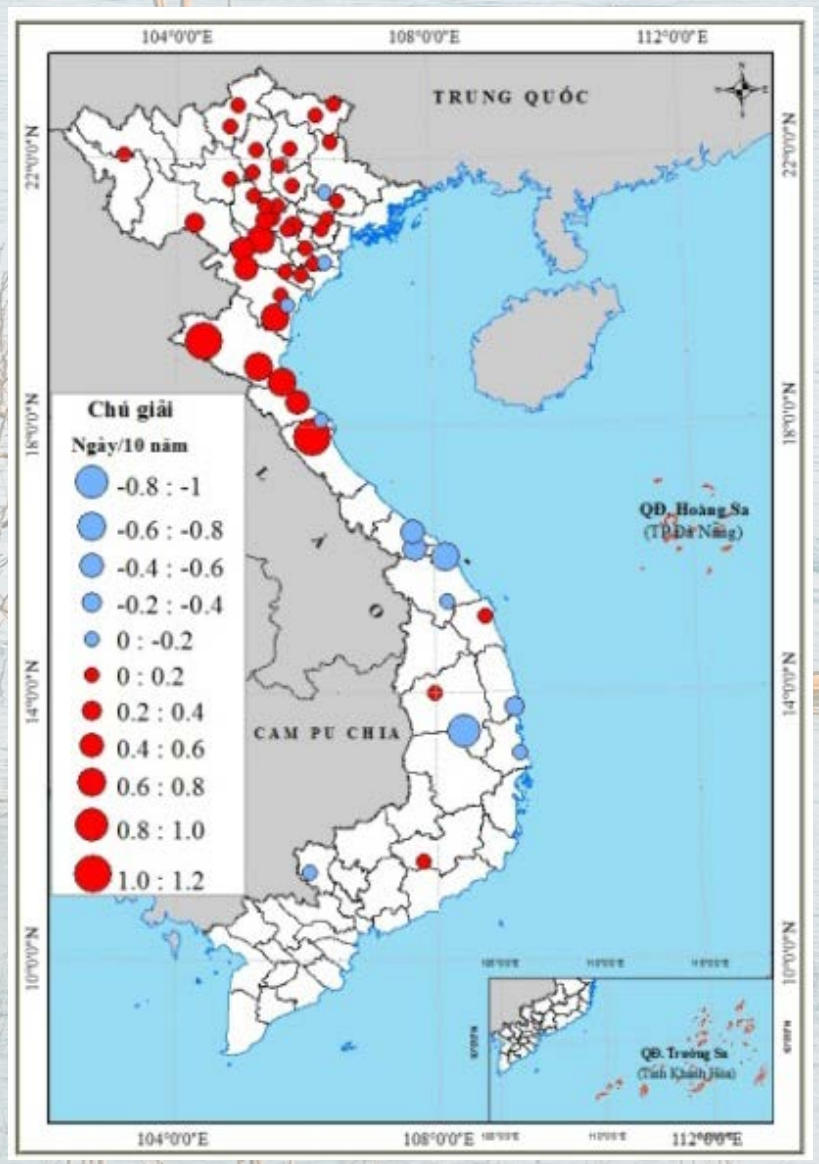
- The SU35 increased in most stations of the Northern Viet Nam (North, North Central Coast, and Center Central Coast) with a regular increase of about 2-6 days/decade.
- The decreased trends were found in most stations of the Southern Viet Nam (South Central Coast, Central Highlands and Mekong River Delta) with a regular decrease of about 2-4 days/decade



C. Results and Discussion

Observation

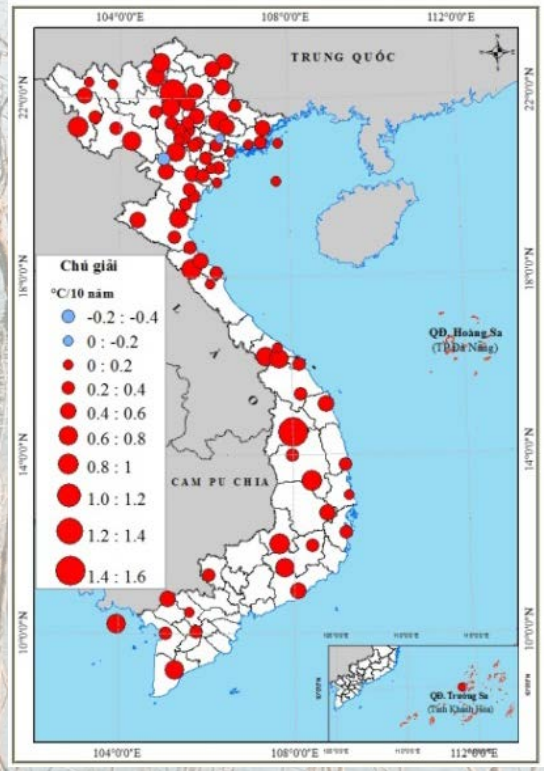
- SU39 had increased trends with regular increases of about 0.2-0.6 days/decade in most stations in Northern Viet Nam (Northwest, Northeast, Red River Delta and North Central Coast).
- SU39 decreased in most stations of the Southern Viet Nam with a regular decrease of about 0.4-0.8 days/decade .

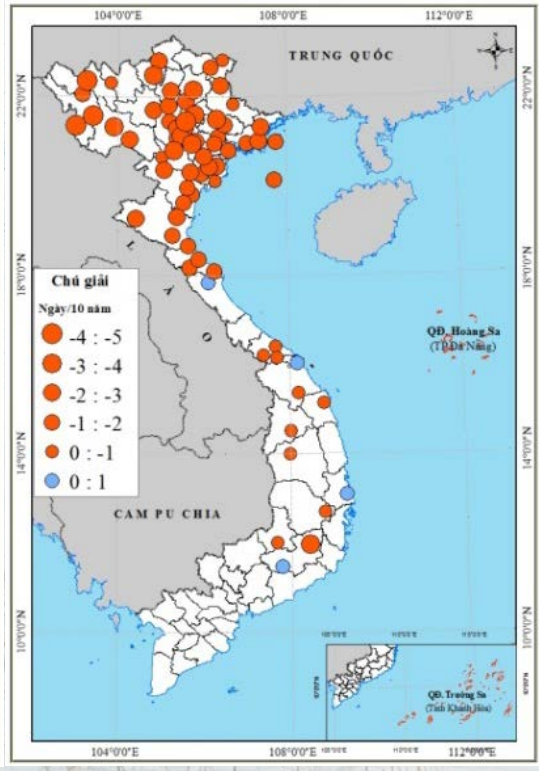


C. Results and Discussion

Observation

- Lowest minimum temperature increased in most stations over the country
- The number of cold days had an obviously decreased trend at the stations of Northern, Central Highlands with regular decrease of about 2-4 days/decade

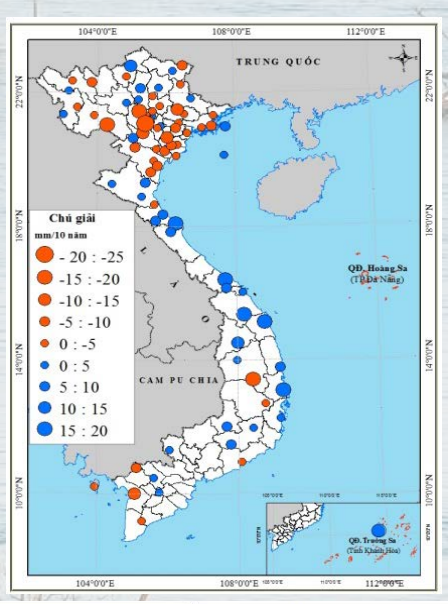


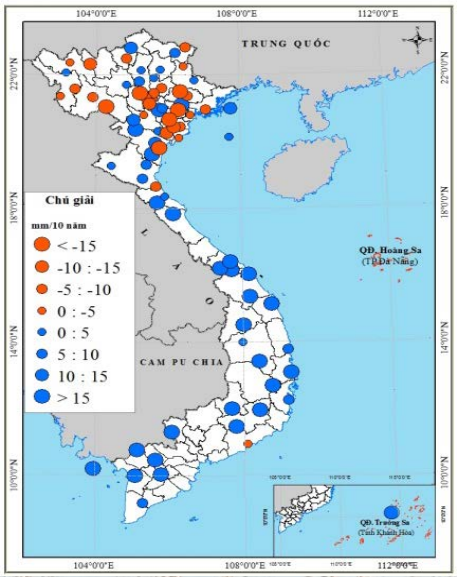


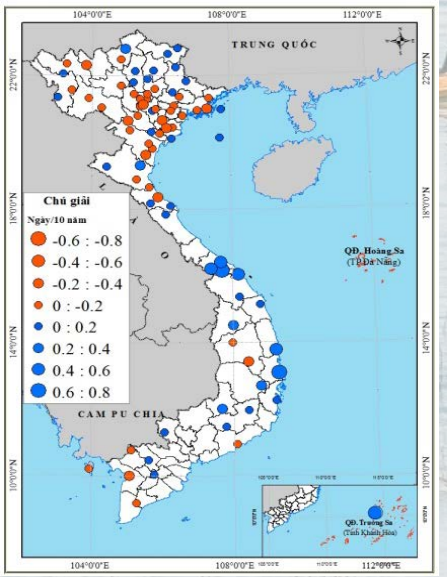
C. Results and Discussion

Observation

- Rainfall extremes had contradictory trends between regions.
- The observed data exhibited an obvious relation of the trends in a climate region.
- the trends of Rx1day, Rx5day and R100 decreased in most stations in the Northern Viet Nam, especially in Red River Delta; and increased in most stations in the Central Viet Nam







C. Results and Discussion

Observation

- The highest sea water levels tend to fluctuate at a higher rate in most stations, the highest rate being at stations in Cua Ong, Hon Dau and Con Dao, which is about 5mm/year; some stations such as Phu Quy witnesses a lower rate.
- No tendency of fluctuation of the annual lowest sea water levels has been concluded from the data available in the oceanographic stations along the coastline of Viet Nam.

C. Results and Discussion

Observation

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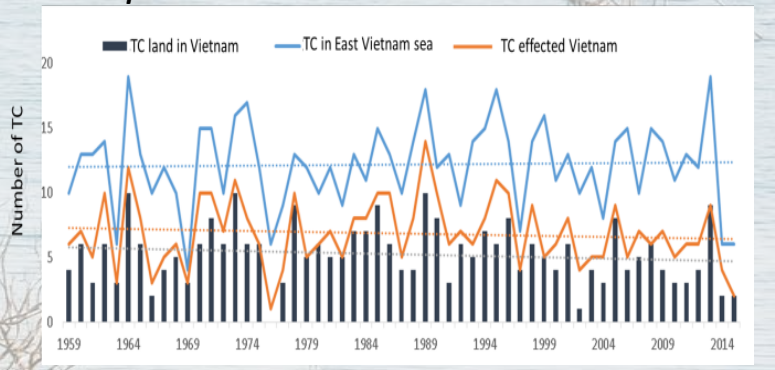
- No tendency of fluctuation of the annual lowest sea water levels has been concluded from the data available in the oceanographic stations along the coastline of Viet Nam.

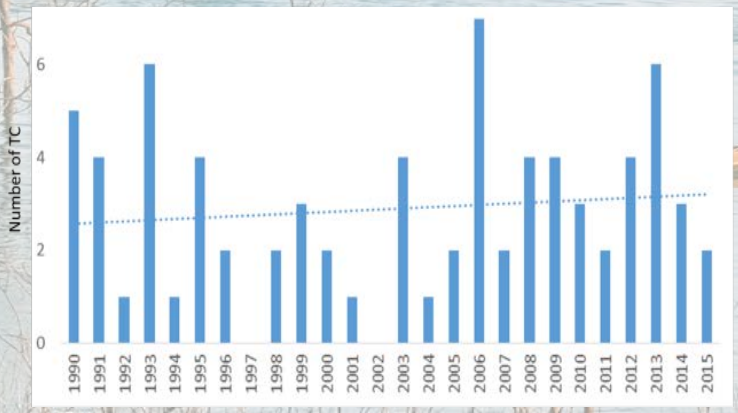
C. Results and Discussion

Observation

- The trend of tropical cyclones affecting and landing to Viet Nam was no significant change.
- The number of strong typhoons (over level 12) had a slightly increased trend in recent years (1990-2015).

The number of tropical cyclones in the period 1959-2014.





The number of typhoons over level 12 in the East Sea in the period 1990-2015.

C. Results and Discussion

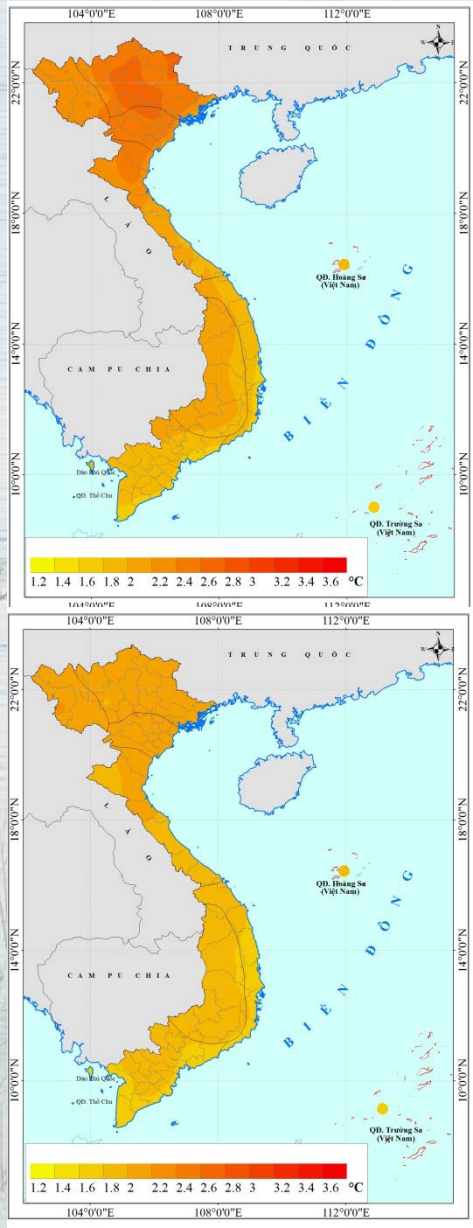
Observation

- The number of frigid days decrease
- The number of cold spells has been quite complex variations and fluctuations from year to year.
- Ice phenomenon seems to appear with more frequency in the high mountain regions
- The average number of days with hoarfrost in the North-West region decrease lightly

C. Results and Discussion

Projection

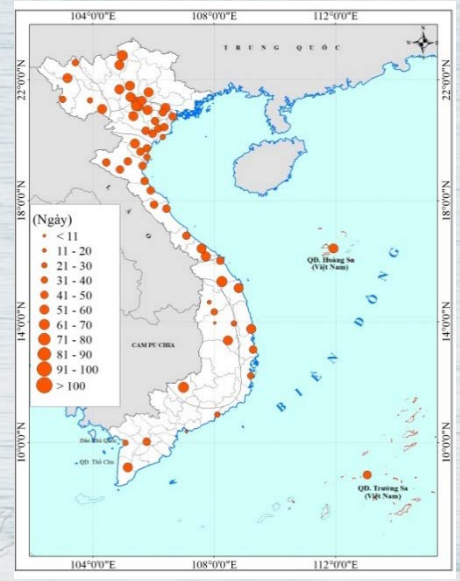
- RCP4.5 scenario: Maximum temperature increases on the order of 1.7 ÷ 2.7°C; minimum temperature increases on the order of 1,8 ÷ 2.2oC by the end of the century.
- RCP8.5 scenario: Mean maximum temperature will increase on the order of 3.0 ÷ 4.8°C and mean minimum temperature will increase on the order of 3.0 ÷ 4.0°C by the end of the Century.

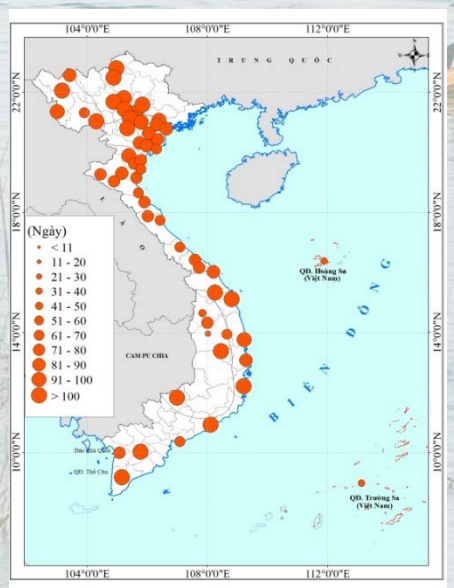


C. Results and Discussion

Projection

- The SU35 will increase by about 25÷35 days for the RCP4.5 scenario and 35÷45 days for the RCP8.5 scenario





C. Results and Discussion

Projection

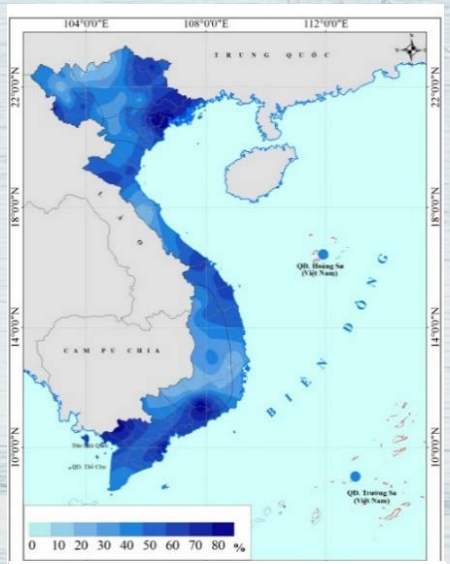
- RCP4.5 scenario: The trends of CD15 and CD13 tend to decrease of about 5÷10 days over the most of provinces in the North when compared to the baseline by the end of 21st century. The number of extreme cold days and damaging cold days tends to decrease from 10 to 20 days

C. Results and Discussion

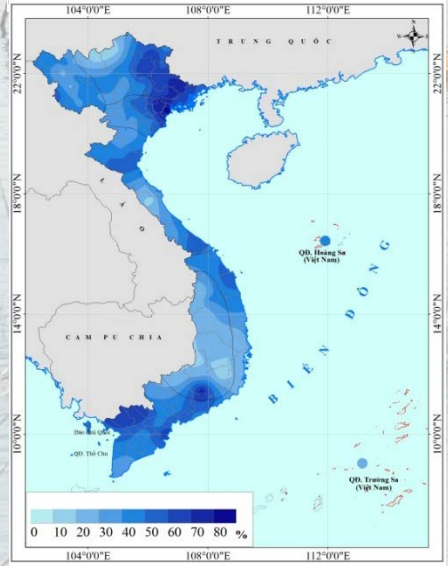
Projection

- Maximum 1-day Rainfall tends to increase in a range of 10 to 70% over the country
- Rx5day tends to increase in a range of 10 to 50% (RCP 4.5) and 10 to 60% (RCP 8.5)

Rx1day (mm) by the end of 21st century (RCP 4.5)



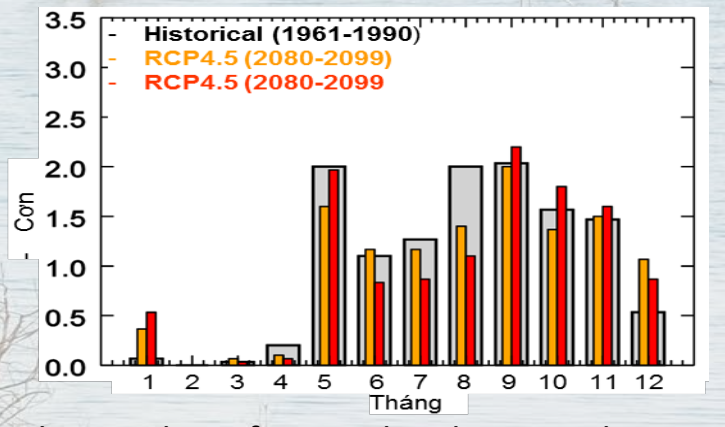
Rx5day (mm) by the end of 21st century (RCP 4.5)



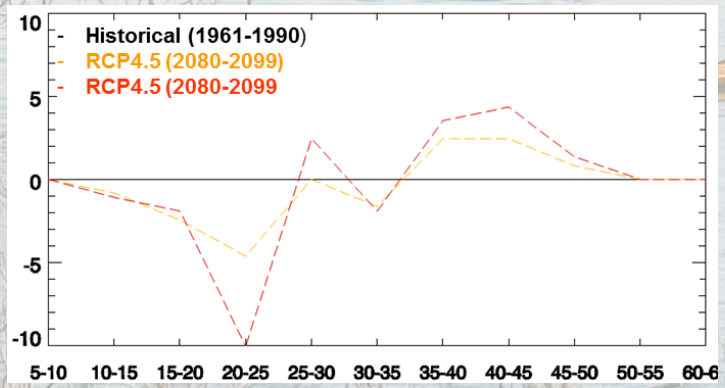
C. Results and Discussion

Projection

- Tropical cyclone tend to decrease in the early of typhoon season (Jun-August) in the East Sea
- Tropical cyclone increase in the last typhoon season
- Tropical cyclone activities will be shifted to the last of the typhoon season, which is the period of typhoons acting mainly in the South



The number of tropical cyclones at the end of the 21st century (PRECIS model)



The changes of TC with different intensity at the end of the 21st century (PRECIS model)

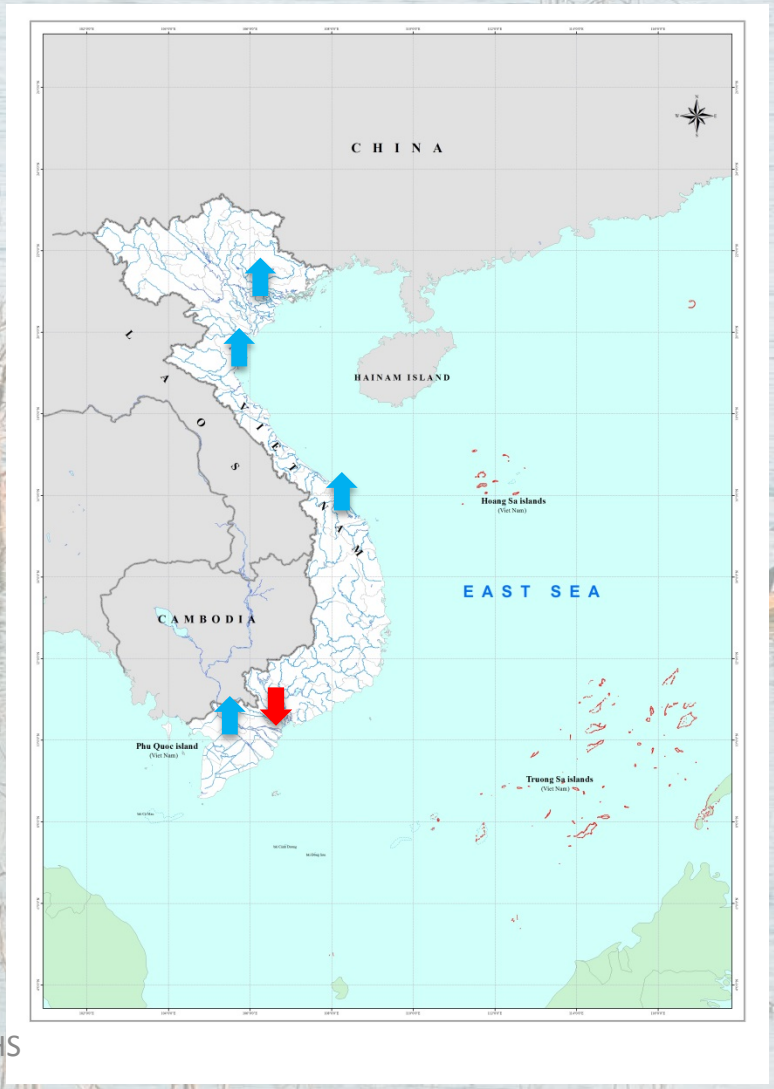
C. Results and Discussion

Impacts on Water Resources

Annual flow: Red River, Thai Binh River, Ca River rise about 5%; Mekong River increased 4-12%.

Flood flow: Red River, Thai Binh River, Ca River, Ba River, Thu Bon River increase 2-9%, Dong Nai River reduced 4-7%

Dry flow: Da River, Gam River, Hieu River decreased about 1.5%, Dong Nai River reduced 4-7%, Ba River decreased about 10%; other rivers decreased from 3.0 to 10%

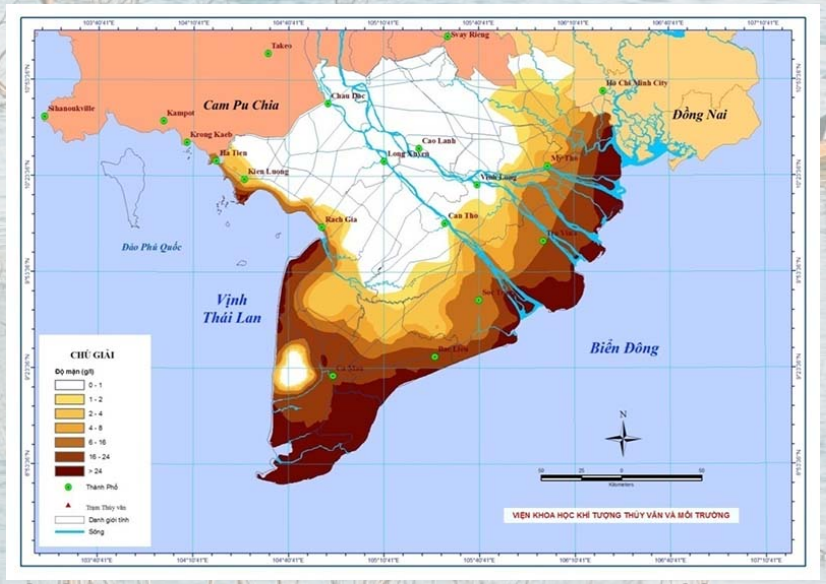


C. Results and Discussion

Impacts on Water Resources

- In context of climate change with changes in precipitation regimes and unpredictable, so the risk of floods and flash floods rising.

- Salinization with 1 ‰ salinity may deep to more than 20 km on the Dong Nai River, Tien River and Hau River; about 10 km on the Thai Binh River in 2100.



C. Results and Discussion

- In the future, the drought may appear more in many parts of Viet Nam.
- The drought will probably increase during the 21st century, with high speed in South Central, Highlands.
- In 2011-2050 period, drought can appear in many location with more frequently and more severity.
- In the mid-21st century, the drought will be able to happen to the increasingly higher levels.

D. Conclusion

- Over the past half-century (1961-2014), the highest maximum temperatures had an increased trend at most stations of the North and a decreased trend at most stations of the South.
- The trend of the lowest minimum temperatures decreased obviously over the whole country.
- The number of cold days had a decreased trend at stations of the North and Central Highlands.
- The trends of the maximum 1-day and 5-days rainfall decreased at most stations of the North whereas the trends increased in stations of the Central and the South.

D. Conclusion

- There was no obvious change in the frequency of tropical cyclones including typhoons and tropical depressions making landfall.
- The very strong typhoons are on the increase. The typhoon season at present tends to end later than the past and the typhoon occurs more frequently in the southern regions.

D. Conclusion

- By the end of the 21st century, the number of hot days will increase remarkably for both scenarios (RCP4.5 and RCP8.5).
- The number of cold days and extreme cold days will decrease over most provinces of the North and North Central Coast.
- The trends of the maximum 1-day and 5-days rainfall will increase over the whole country. In general, the trends at the middle and the end of the century will stay in the same level.

D. Conclusion

- The number of tropical cyclones in East Sea and impacts on Viet Nam does not show a clear trend and is uncertain, but the number of strong typhoon will likely increase in the future.
- Climate change impacts water resources, in the period from 2040 to 2059, the annual flow in almost river tends to rise. Due to changes in precipitation regimes and unpredictable, so the risk of floods, flash floods rising. The drought and salinity intrusion will probably increase in dry season.


Thank You !!