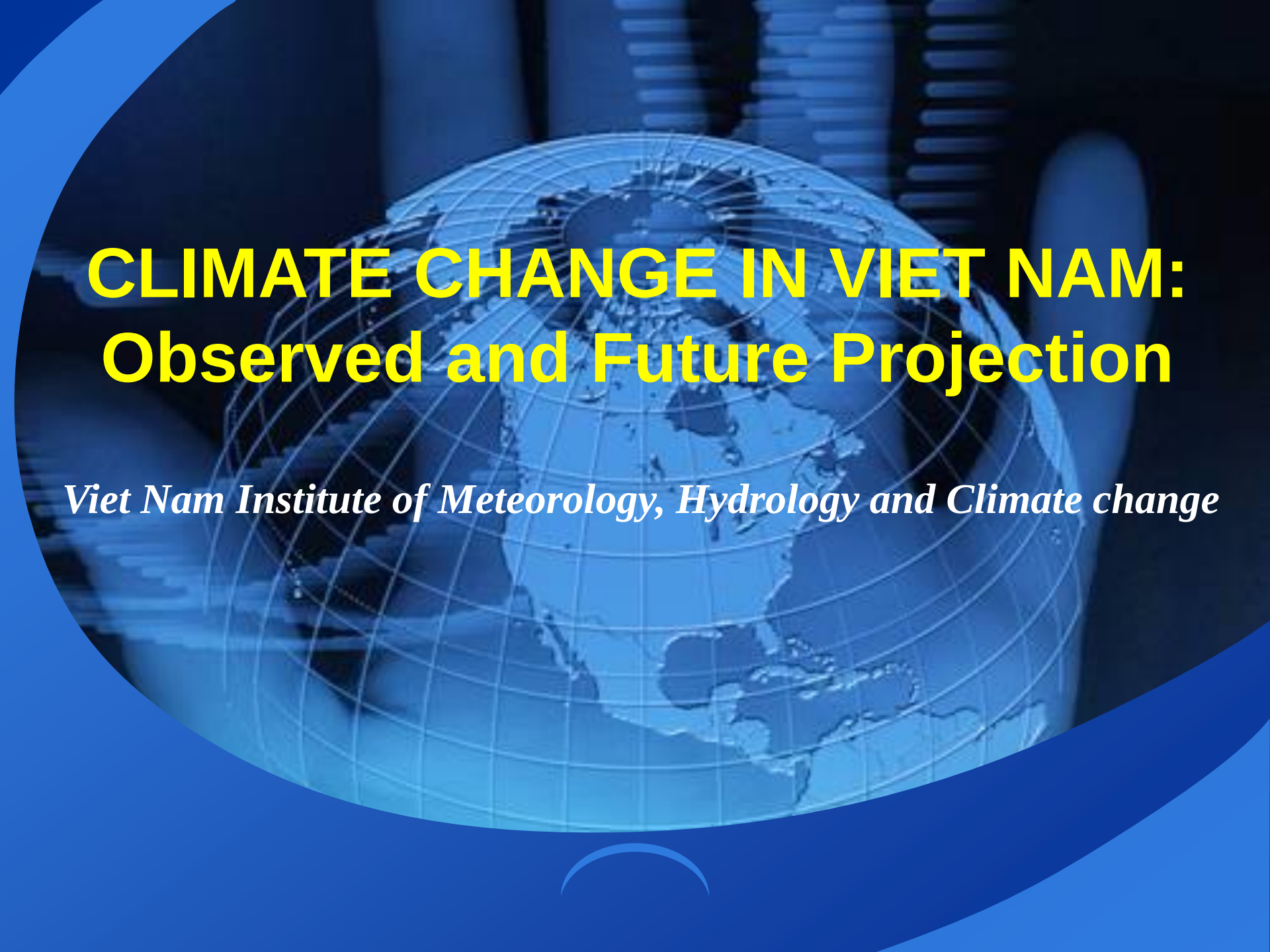


CLIMATE CHANGE IN VIET NAM: Observed and Future Projection

Viet Nam Institute of Meteorology, Hydrology and Climate change

FOUNDATION

2014 — Viet Nam Institute of Meteorology, Hydrology and Climate Change (IMHEN)

Total: 257

Prof., Assoc. Prof.: 8 PhD: 26

MSc.: 44 BSc., Engineers: 150

2003 — Viet Nam Institute of Meteorology, Hydrology and Environment (IMHEN) — Ministry of Natural Resources and Environment (MONRE)

1977 — Institute of Meteorology and Hydrology (IMH) — Vietnam Hydrometeorological Service of Viet Nam (HMS)

MAJOR ACTIVITIES AND ACHIEVEMENTS

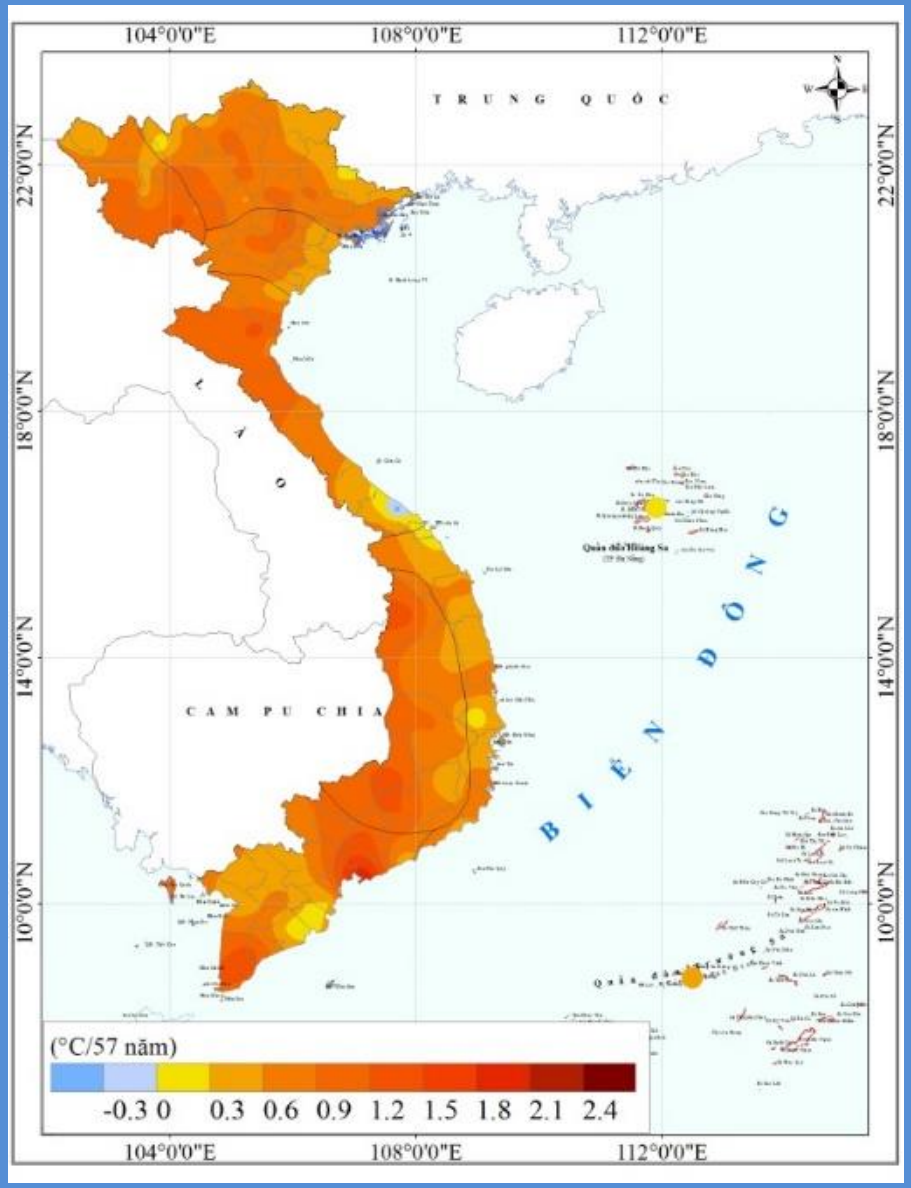
1. Meteorology, Climatology and Agro-Meteorology
2. Hydrology, Water Resources, Marine Hydrology
3. Environment
4. **Climate Change**

What has Changed?

How will it change?

What has changed?

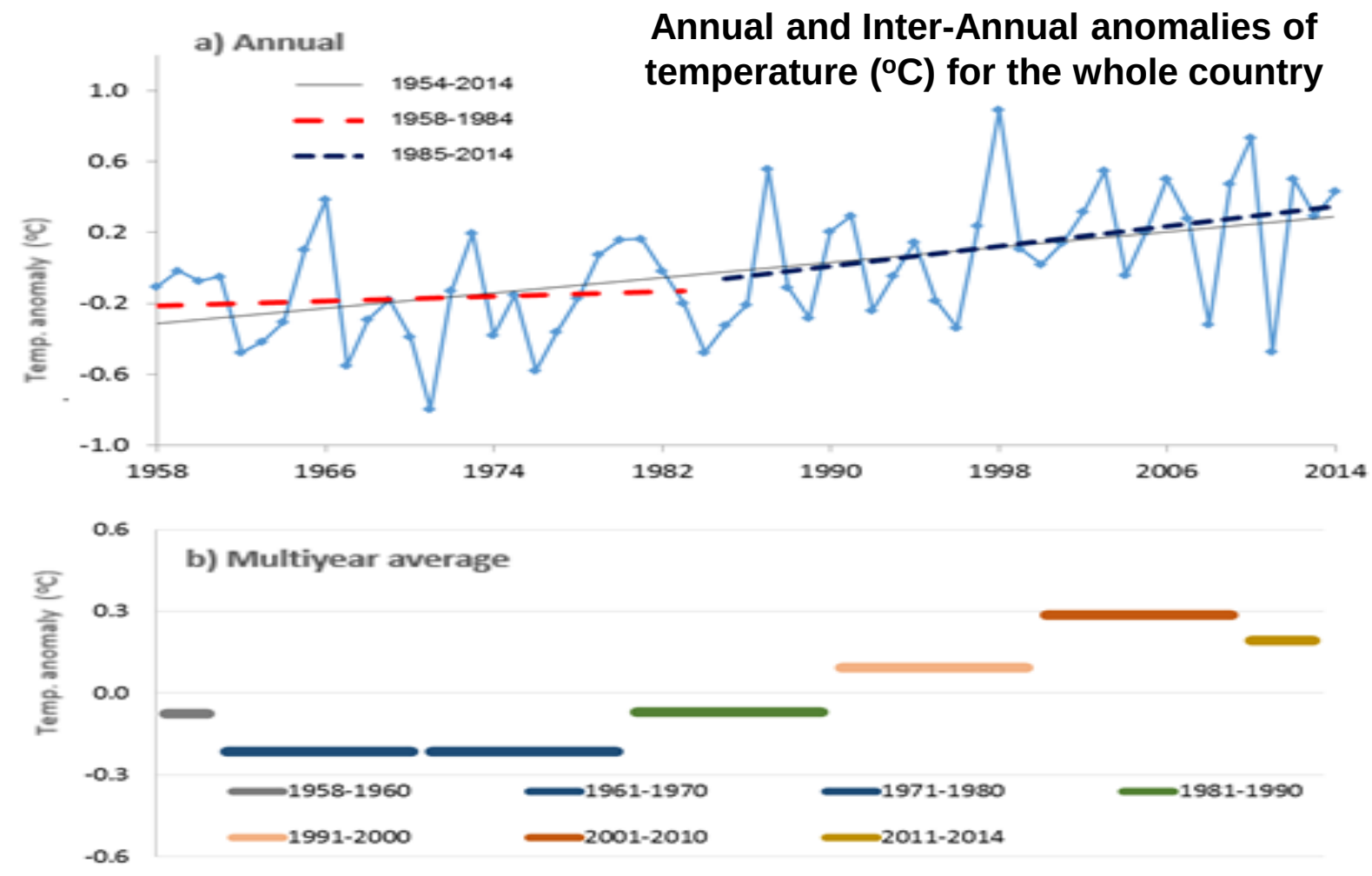
Change in temperature (°C)



Change of annual average temperature (°C) in 1985-2014

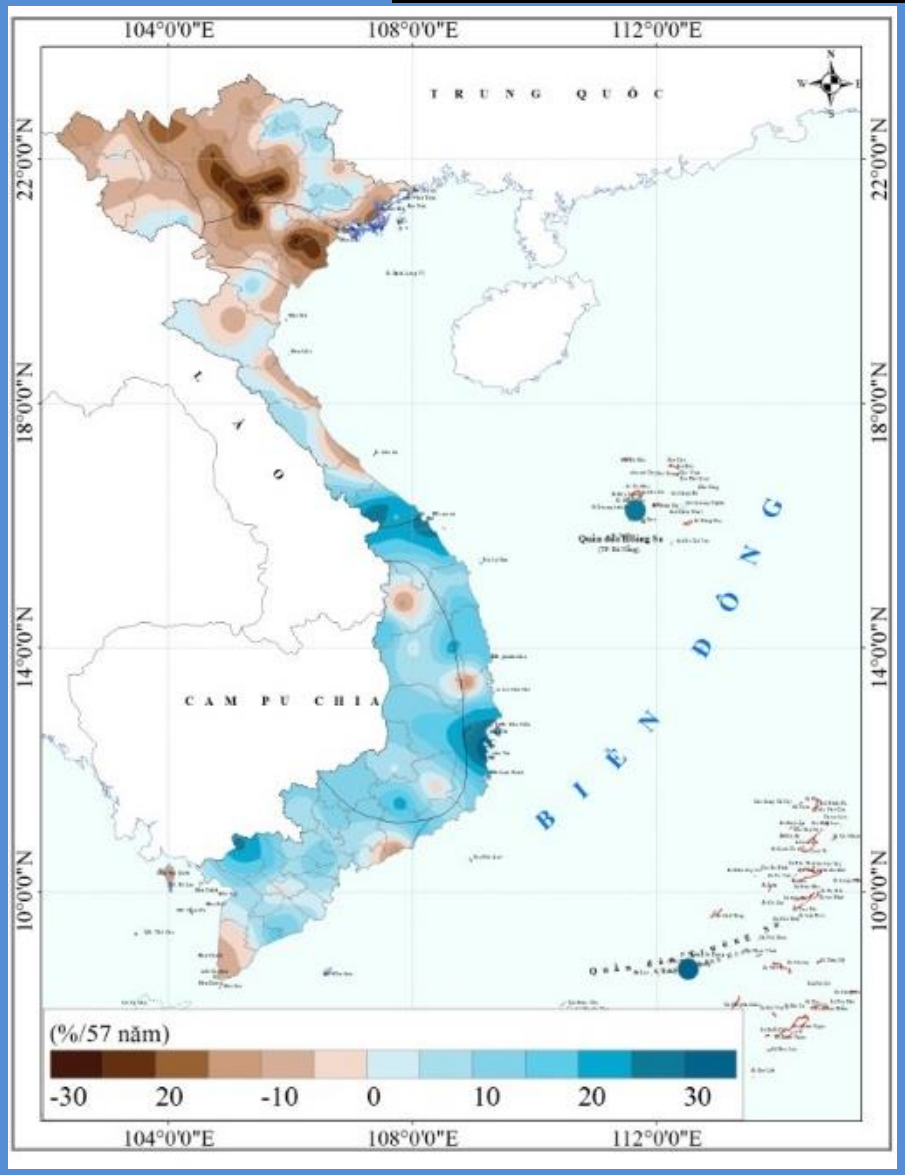
- In the period of 1958-2014, temperatures show increasing trends in most observed stations
- The annual average temperatures **increased by about 0.62°C** for the whole country

Change in temperature (°C)



- In average for the whole country, temperatures increased by 0.62ºC in the period 1958-2014. In particular, it increased 0.42ºC in period 1985-2014

Change in rainfall (%)

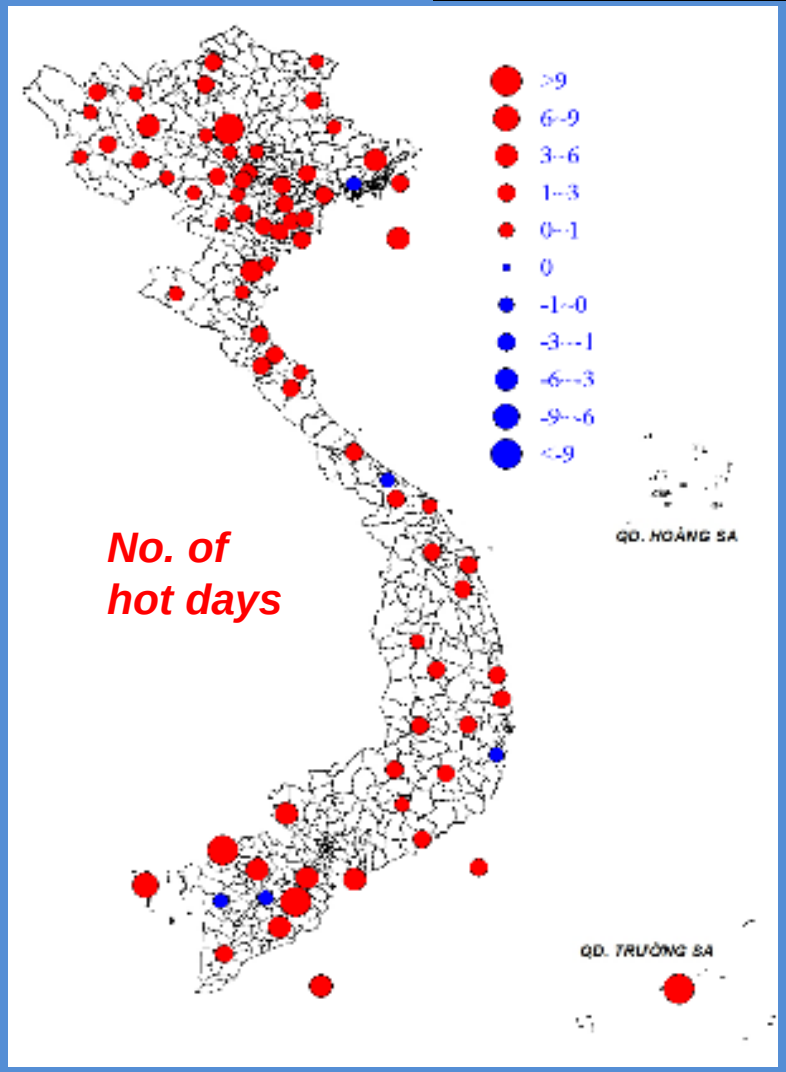


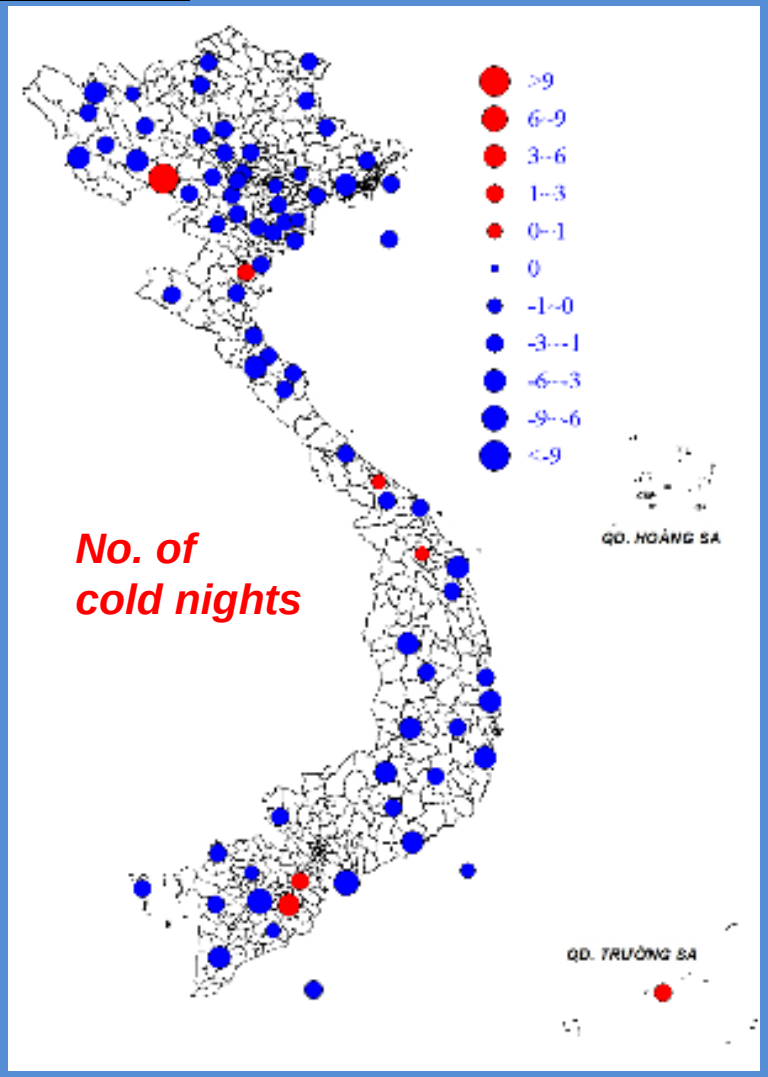
Change of annual total precipitation (%) in 1958-2014

Total Rainfall

- Decrease in the North (5,8 - 12,5%); Increase in the South (6,9 - 19,8%);
- Increase most in South Central and decrease most in Northern Delta.

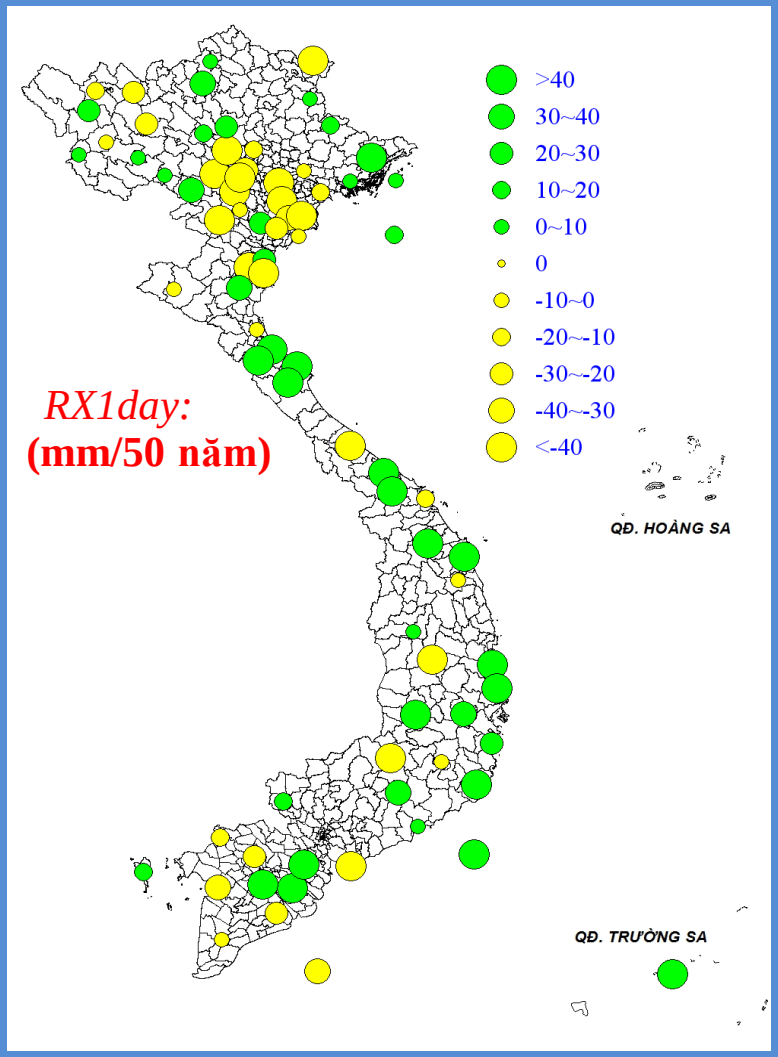
Climate extreme

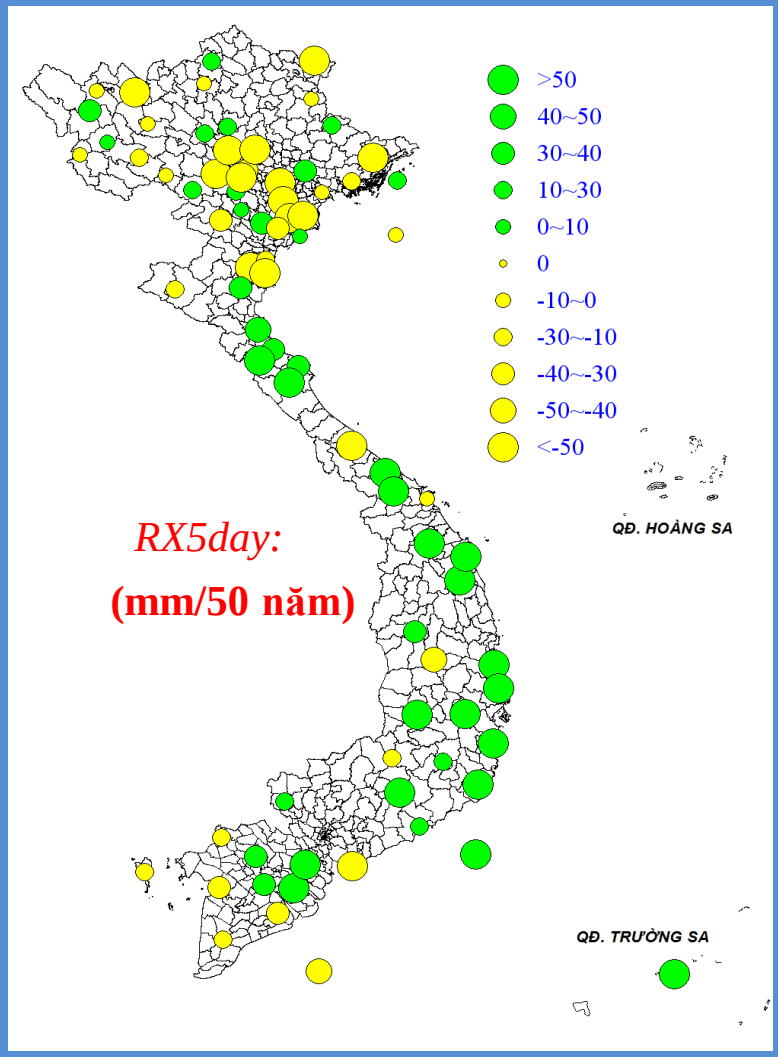




- No. of hot days increased (*34 days/decade*),
- No. of cold nights decreased (*11 night/decade*).

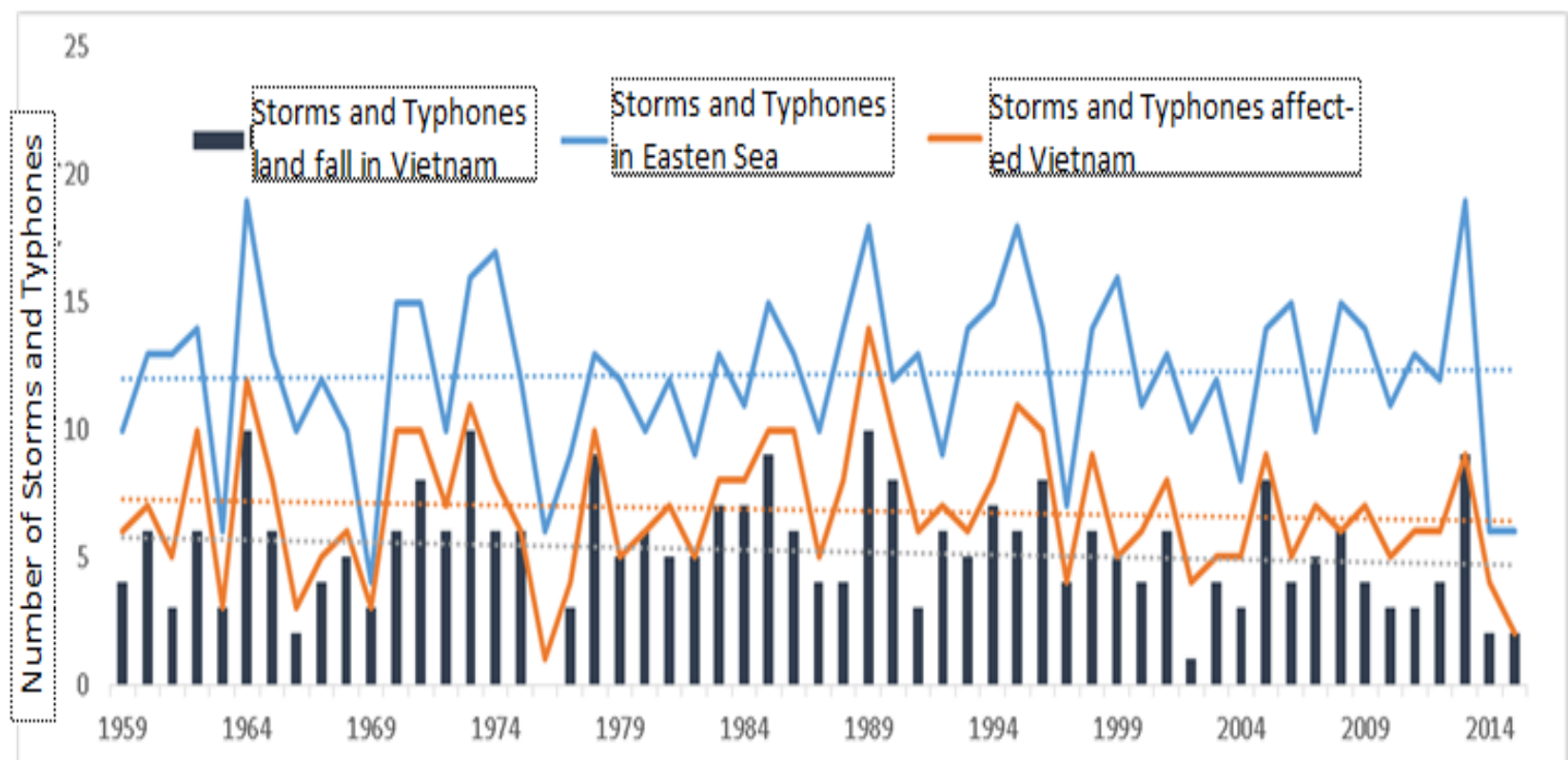
Climate extreme





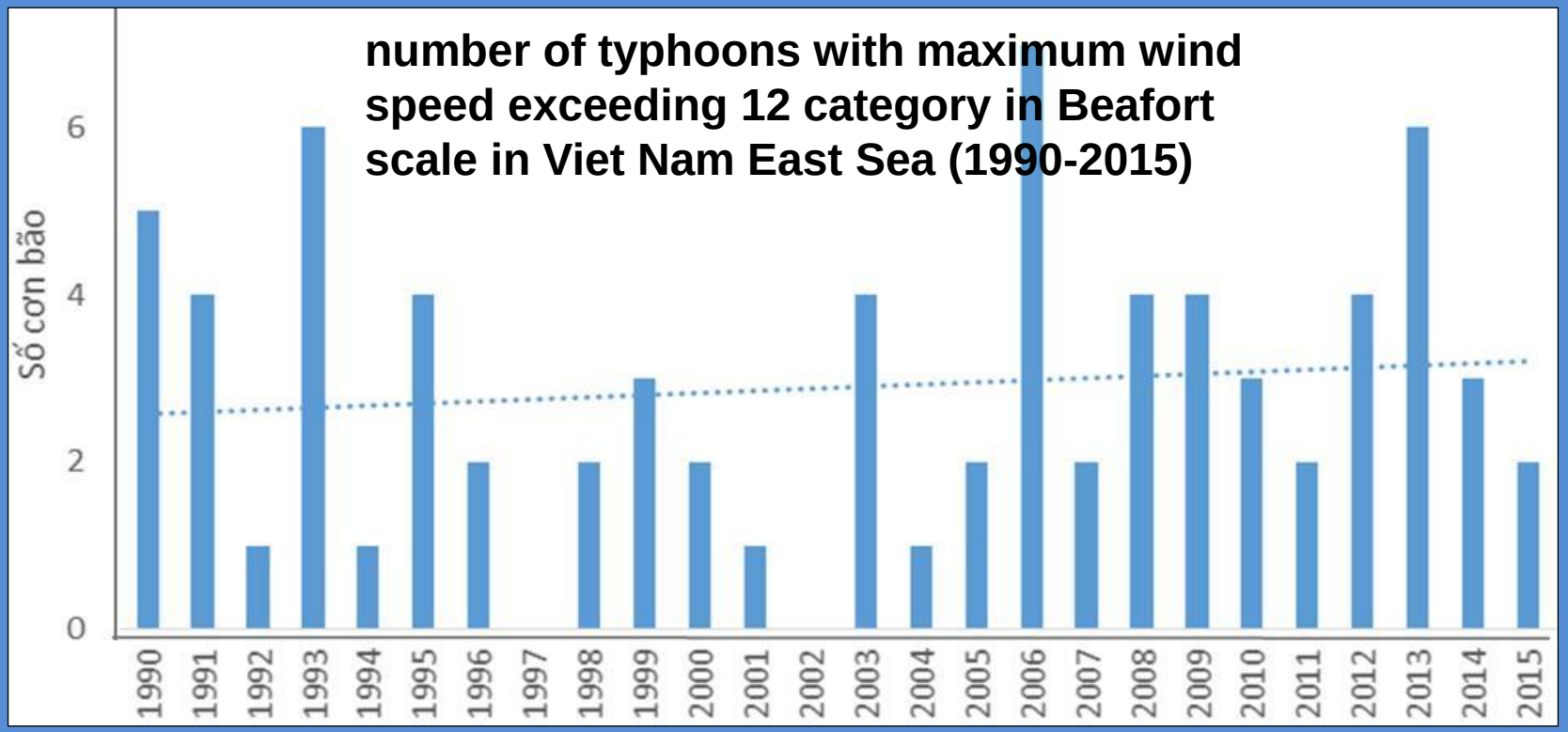
- Regional differences are obvious in **rainfall changes**, but **highly increase** in the South Central, Central Highlands, and Off-seaon rainfall and extreme rainfall occures more frequently

Climate extreme



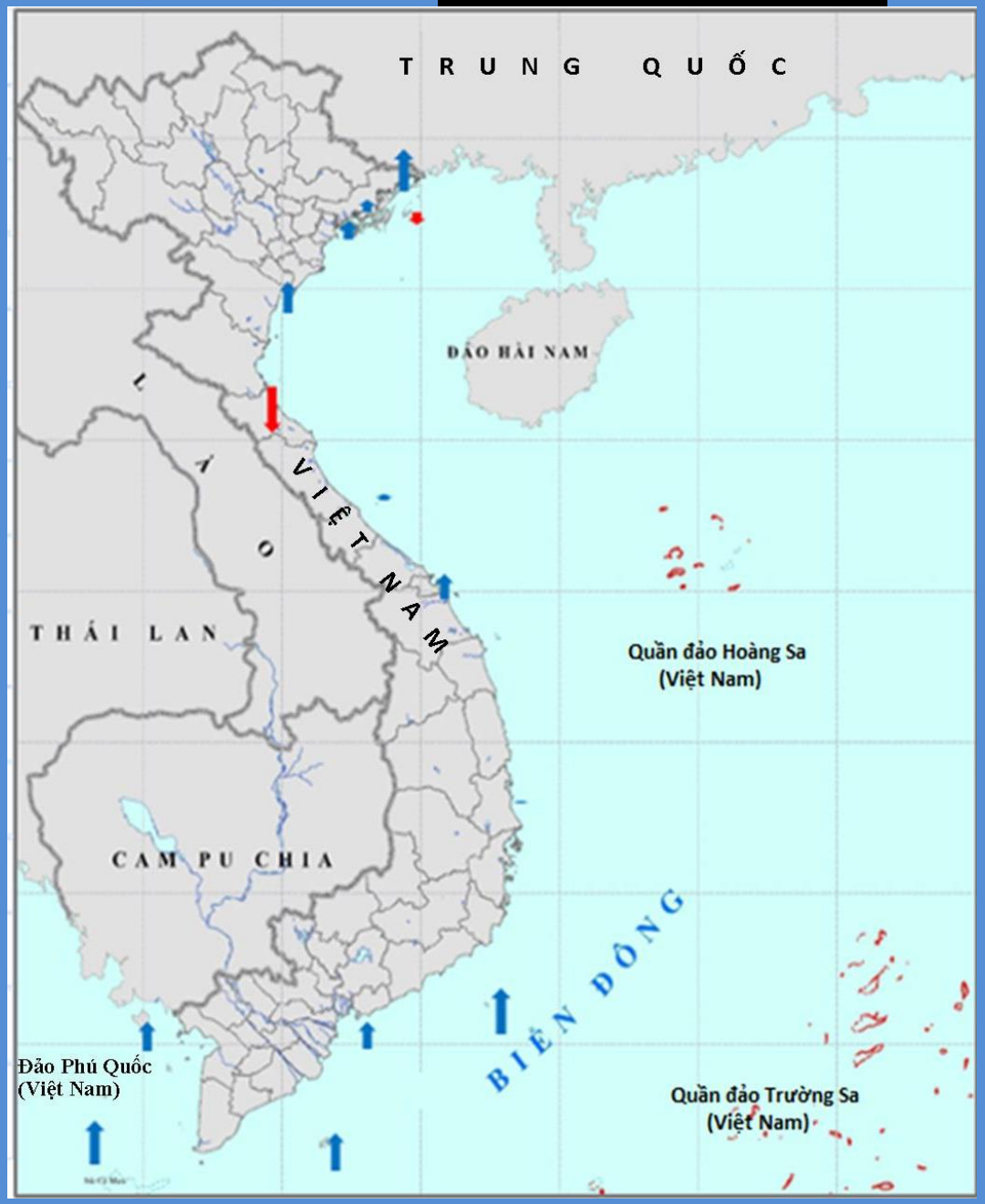
According to the data from 1959-2015, the change in the number of tropical depressions and typhoons in East Sea, influencing and making landfall to Viet Nam was slight. However, the inter-annual variation of number of tropical depressions and typhoons was substantial, sometimes up to 18÷19 storms (in 1964, 1989, 1995 and 2013), sometimes 4÷6 storms (1963, 1969, 1976, 2014, 2015)

Climate extreme



- No. of strong and very strong typhoon increase
- Typhoon season tend to last longer and typhoon tracks had a southward trend

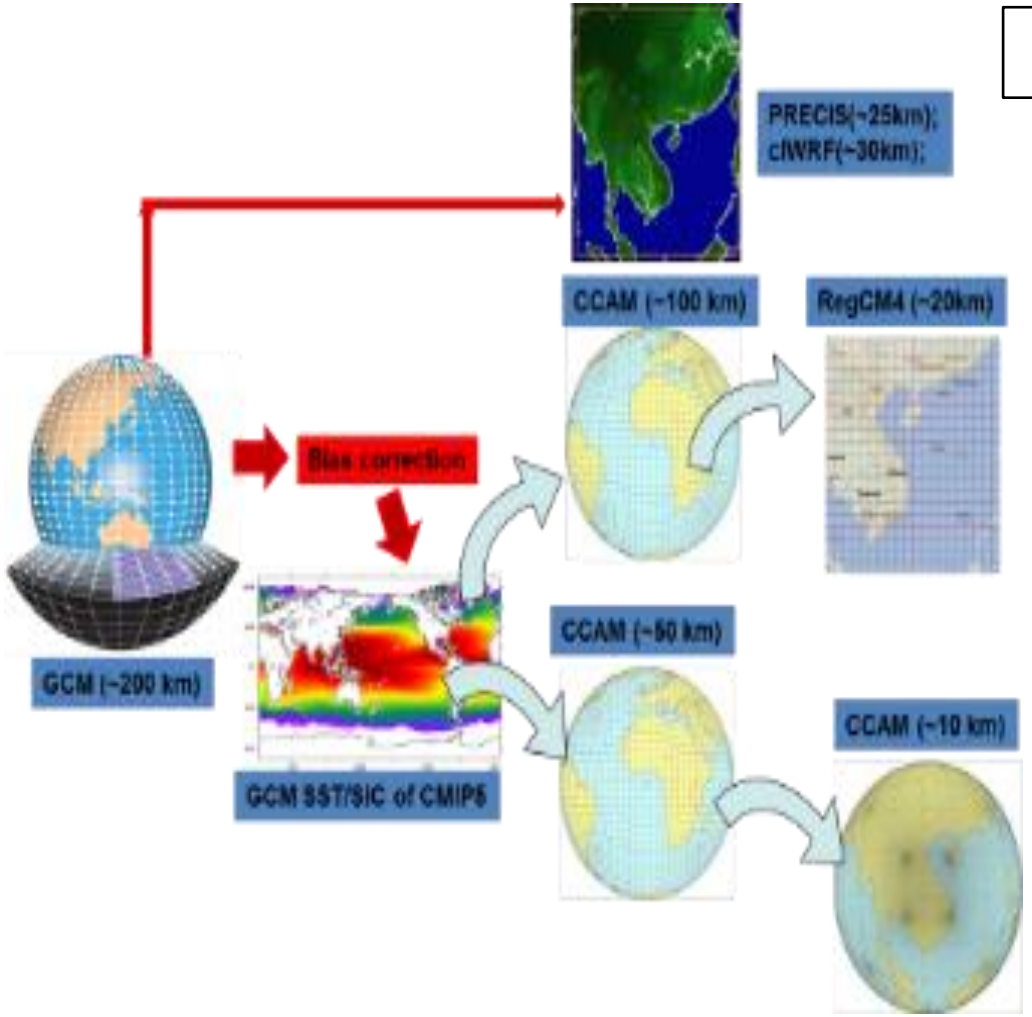
Sea level rise



- Mean sea level rise rate in Vietnam coastal is 3.1mm yr-1 between during 1986 and 2014
- Mean sea level rise rate at island increase more than near shore.

How will it Change?

Method for Climate Change Projection



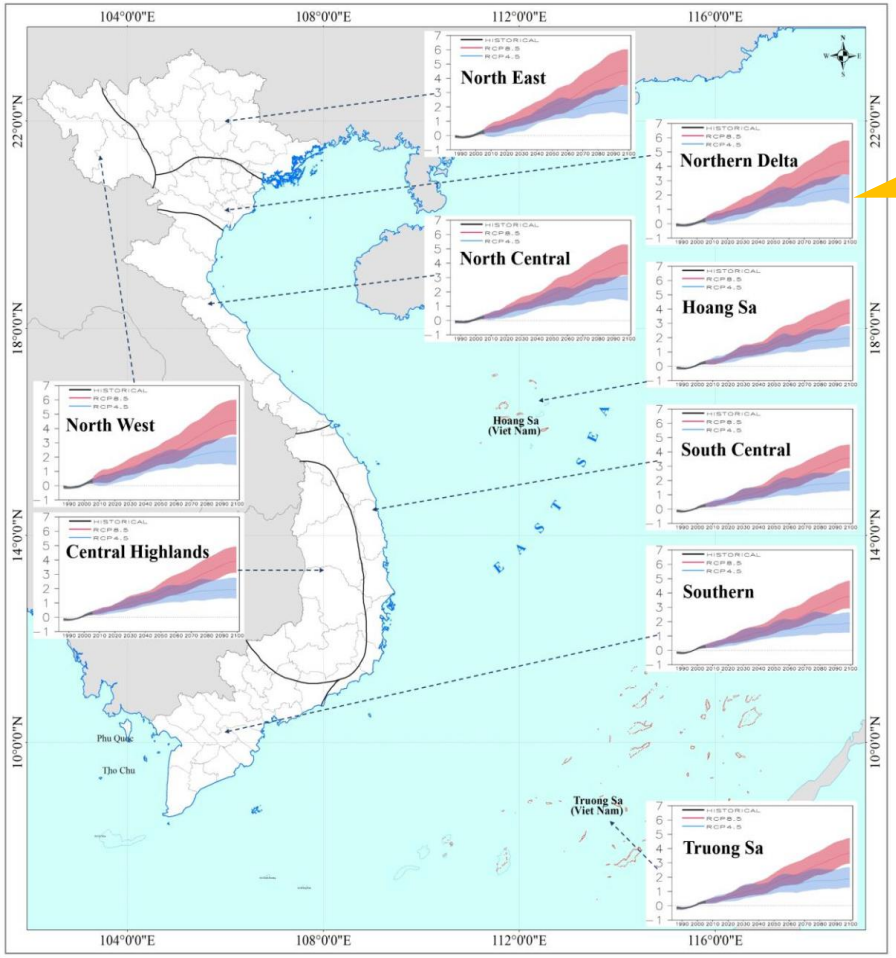
GHG Concentration Scenarios

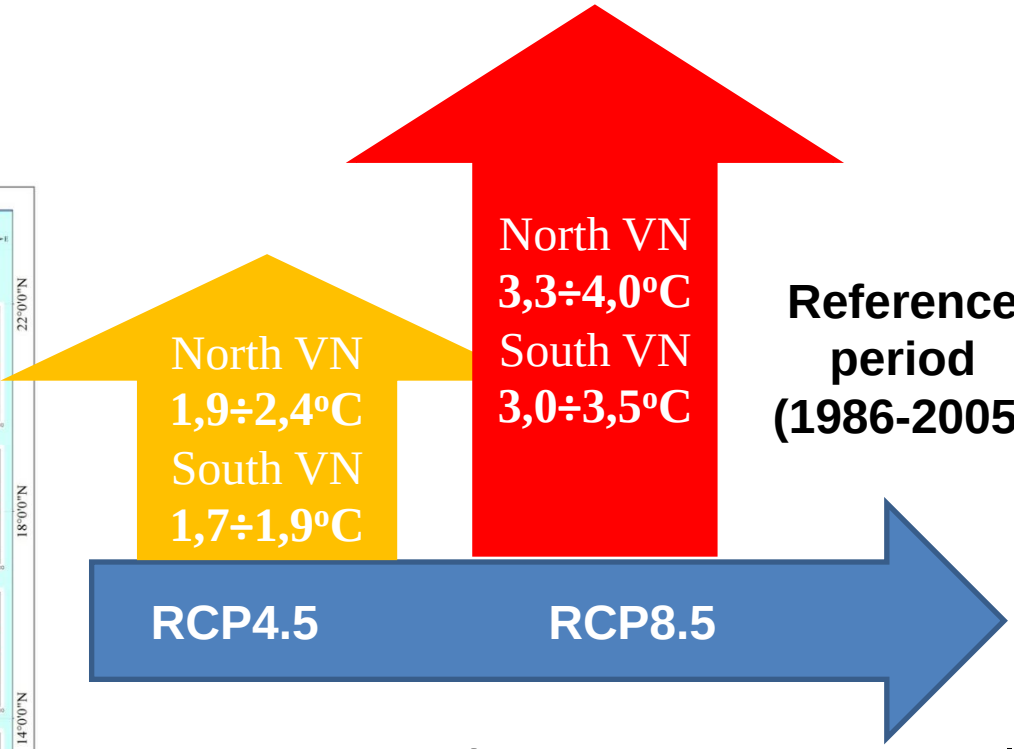
RCP	Radiative forcing in 2100	Temperature increase in 2100 (°C) compared to 1986-2005	SRES equivalent
RCP8.5	8.5 W/m^2	4.9	A1F1
RCP6.0	6.0 W/m^2	3.0	B2
RCP4.5	4.5 W/m^2	2.4	B1
RCP2.6	2.6 W/m^2	1.5	None

Dynamic Downscaling Method: 5 high-resolution regional climate model *(AGCM/MRI, PRECIS, CCAM, RegCM, and clWRF), cooperation between IMHEN and CSIRO-Australia, BCCR-Norway, MetOffice-UK, MRI-Japan,UNDP.*

Projection – Temperature

At the end of 21st century

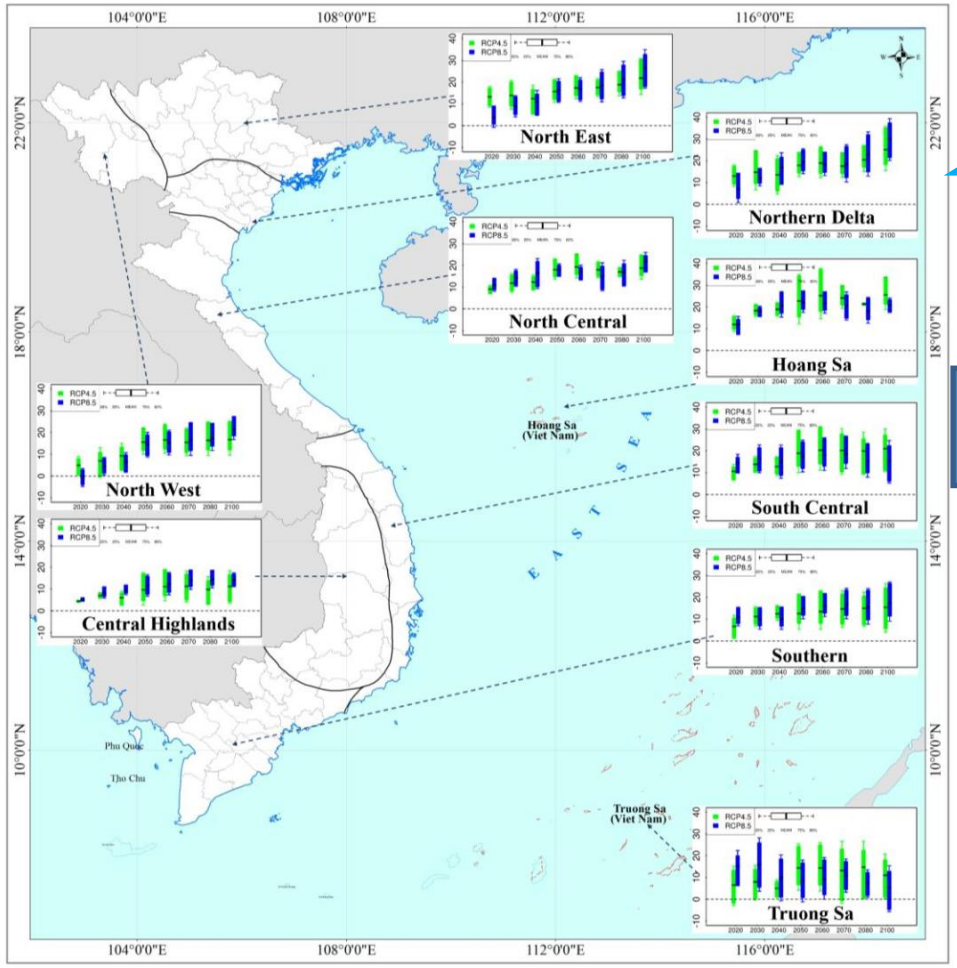


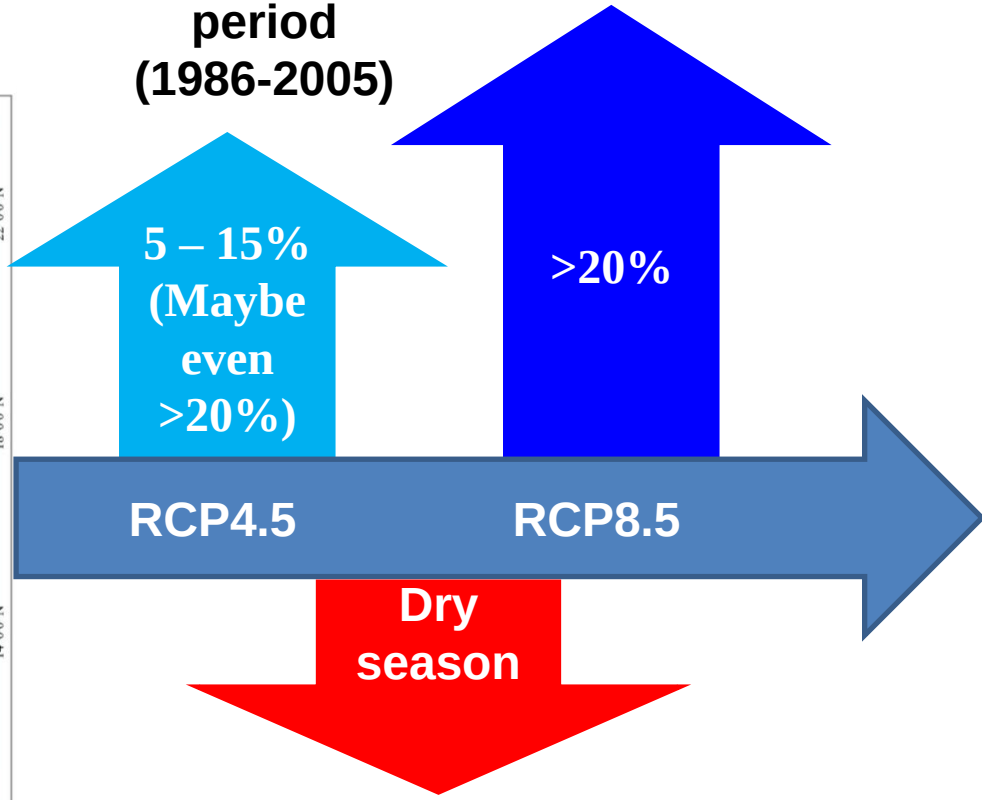


- RCP4.5: surface temperatures would increase by 1.9÷2.4°C in the North and 1.7÷1.9°C in the South.
- RCP8.5: temperature would increase by 3.3÷4.0°C in the North and 3.0÷3.5°C in the South

Projection – Rainfall

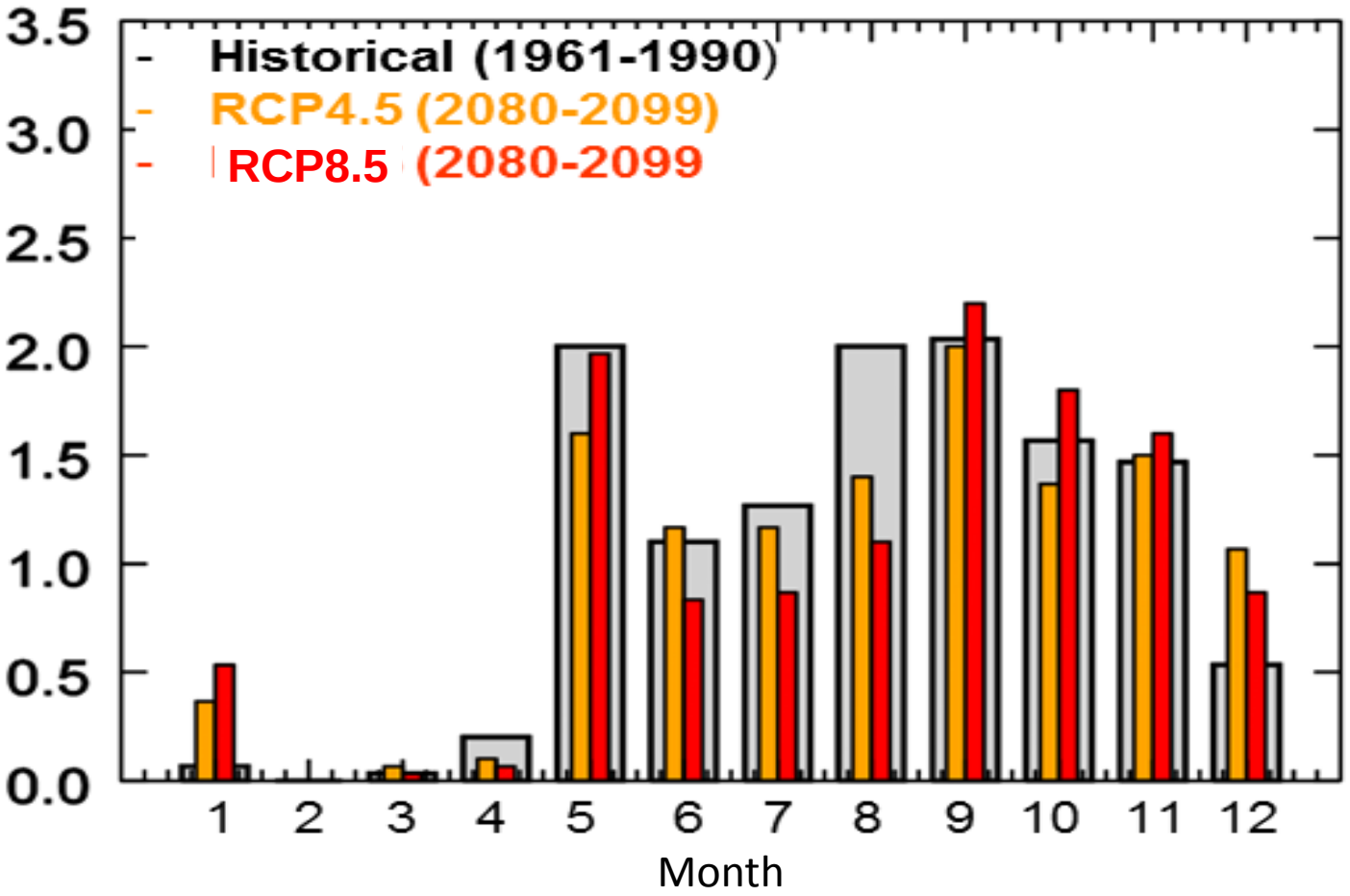
At the end of 21st century





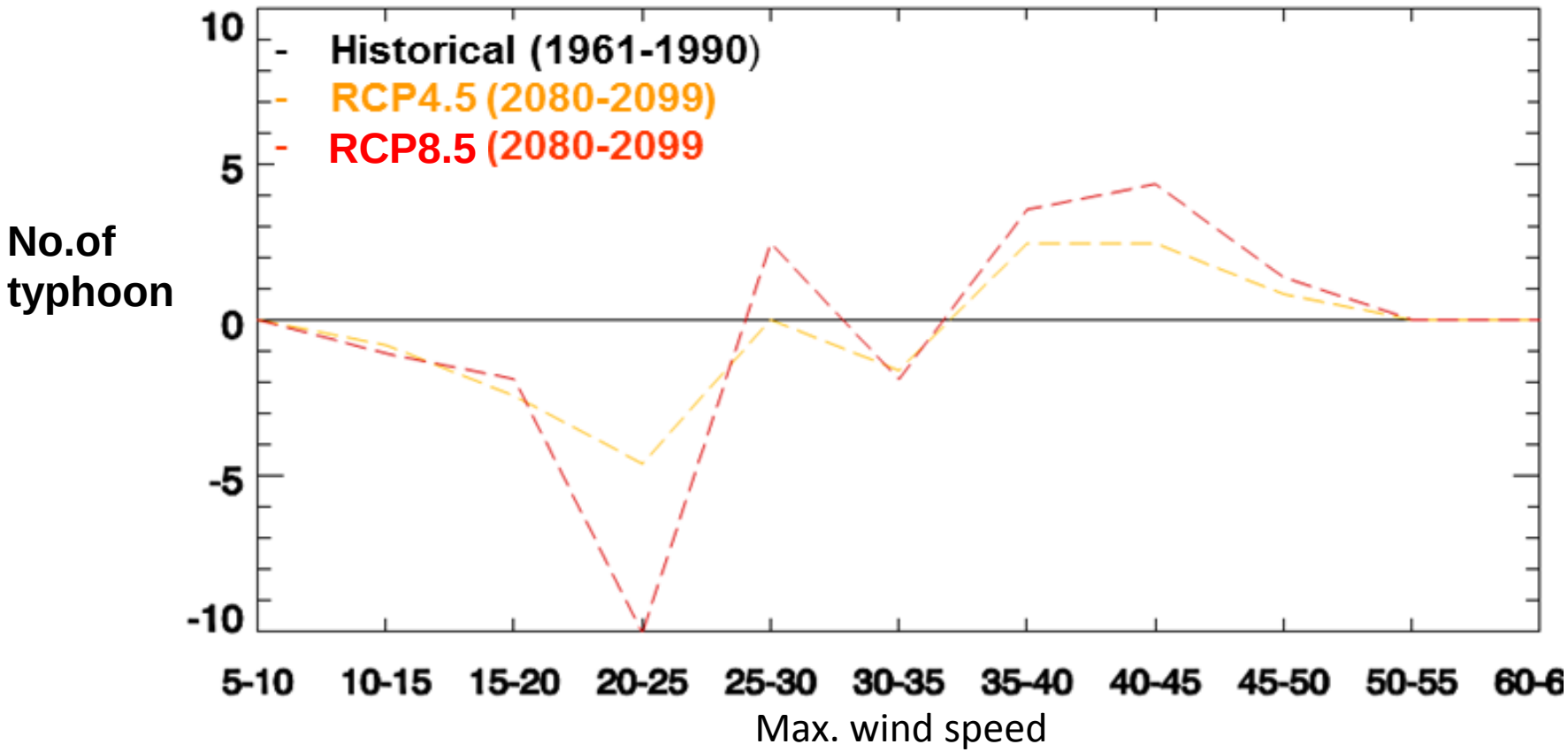
- RCP4.5: annual rainfall would generally increase in a range of 5÷15%.
- RCP8.5: the greatest increase would increase by over 20% in most of the North, Central Coast, a part of the South and Central Highlands.

Change in number of typhoon



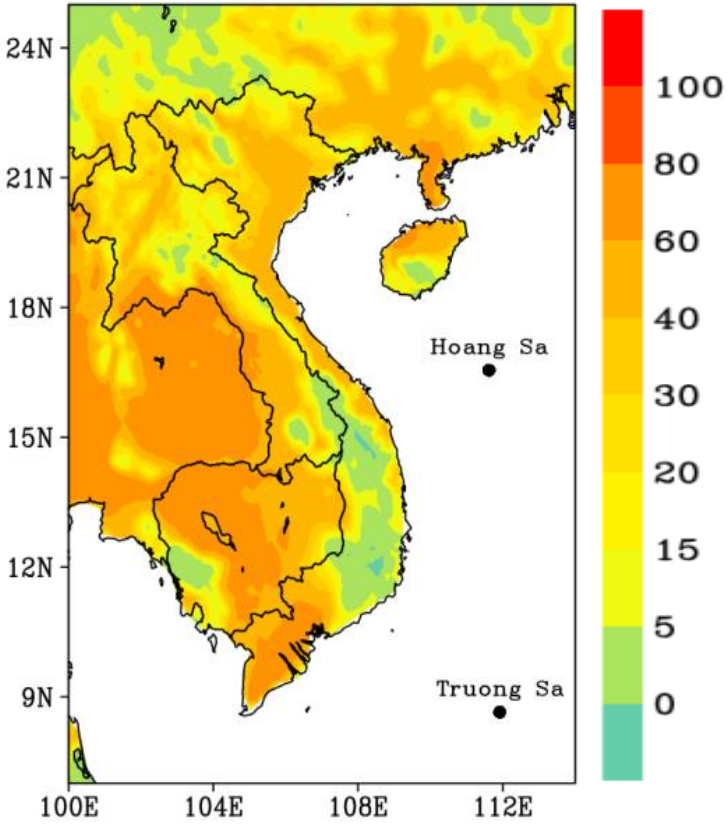
Based on the PRECIS model, the projected number of tropical depressions and typhoons in the East Sea will decrease at the beginning of the typhoon seasons (June - Agust) for both scenarios, RCP4.5 and RCP8.5. Thus, the tropical depressions and *typhoons will likely occur at the end of the typhoon season* which is a period of typhoon activity occuring mainly in the South

Change in number of strong typhoon



the number of weak and moderate typhoon will likely decrease, while the number of strong typhoons will likely increase when compared with the baseline period.

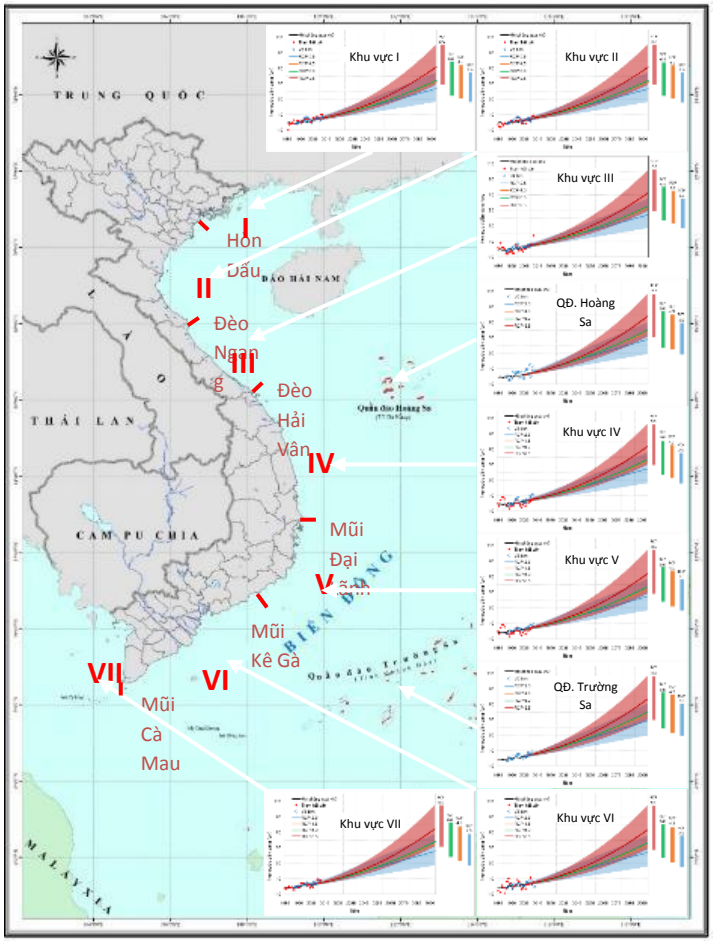
Projection – Other Extremes

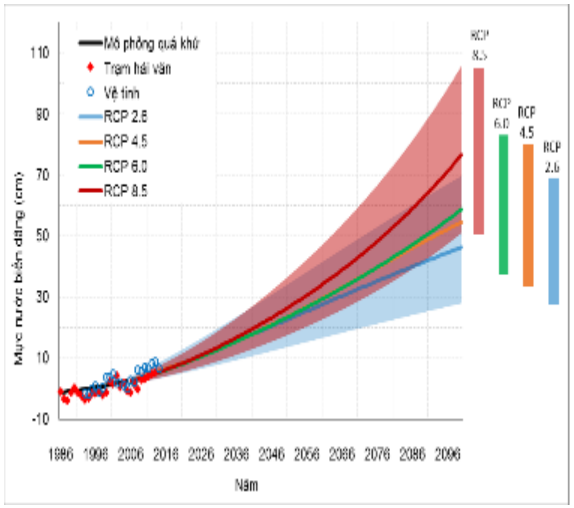


Change in no. of hot days
(day/year)
by end of century, RCP4.5

- Summer moon start earlier and last latter.
- Rainfall in monsoon increase.
- No. of cold day decreases.
- It is very likely that heat waves will occur with higher frequency and duration, especially in North Central, South Central, and South.

Projection - Sea Level Rise



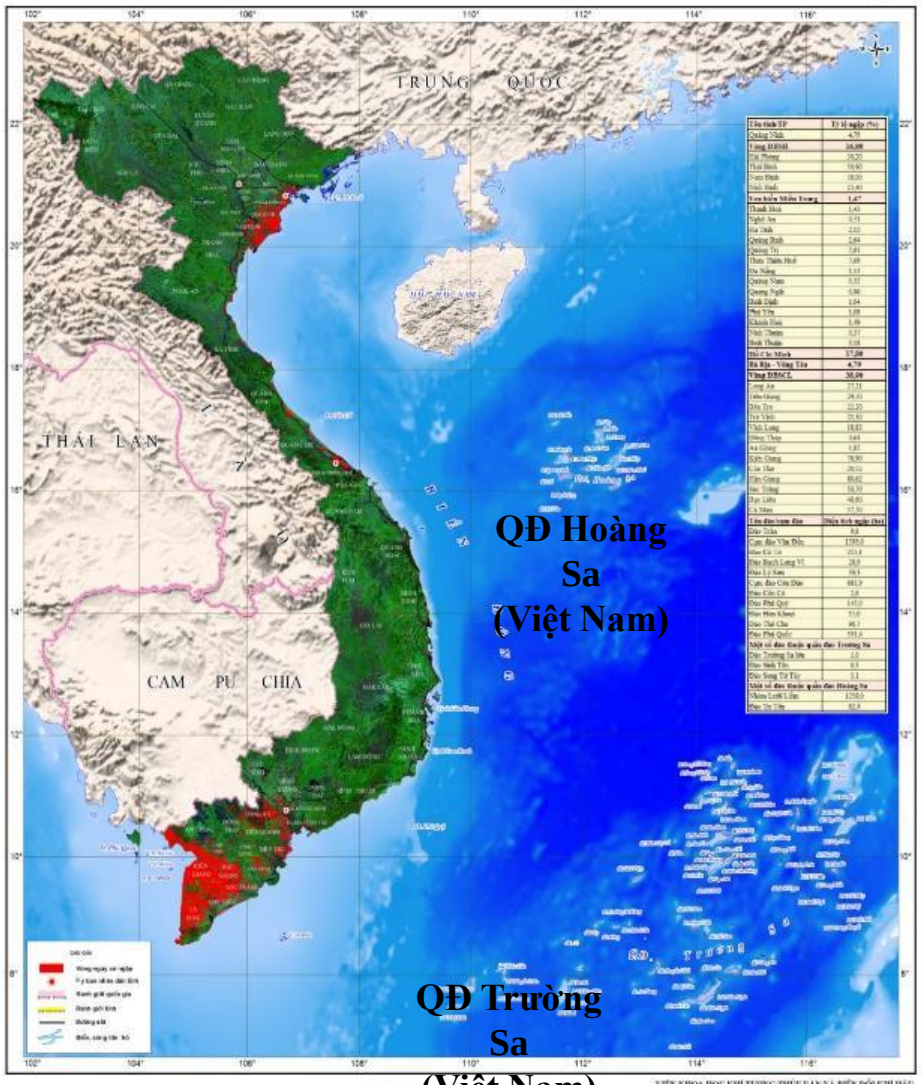


By 2100:

RCP4.5 Scenarios: Sea level rise highest in Hoàng Sa island: 58cm (36÷80cm), Trường Sa: 57cm (33÷83cm); Cà Mau-Kiên Giang 55cm (33÷78cm); Móng Cái-Hòn Dáu and Hòn Dáu-Đèo Ngang 53cm (32÷75cm).

RCP8.5 Scenarios: Sea level rise highest in Hoàng Sa island: 78cm (52÷107cm), Trường Sa: 77cm (50÷107cm); Cà Mau-Kiên Giang: 75cm (52÷106cm); Móng Cái-Hòn Dáu, and Hòn Dáu-Đèo Ngang: 72cm (49÷101cm).

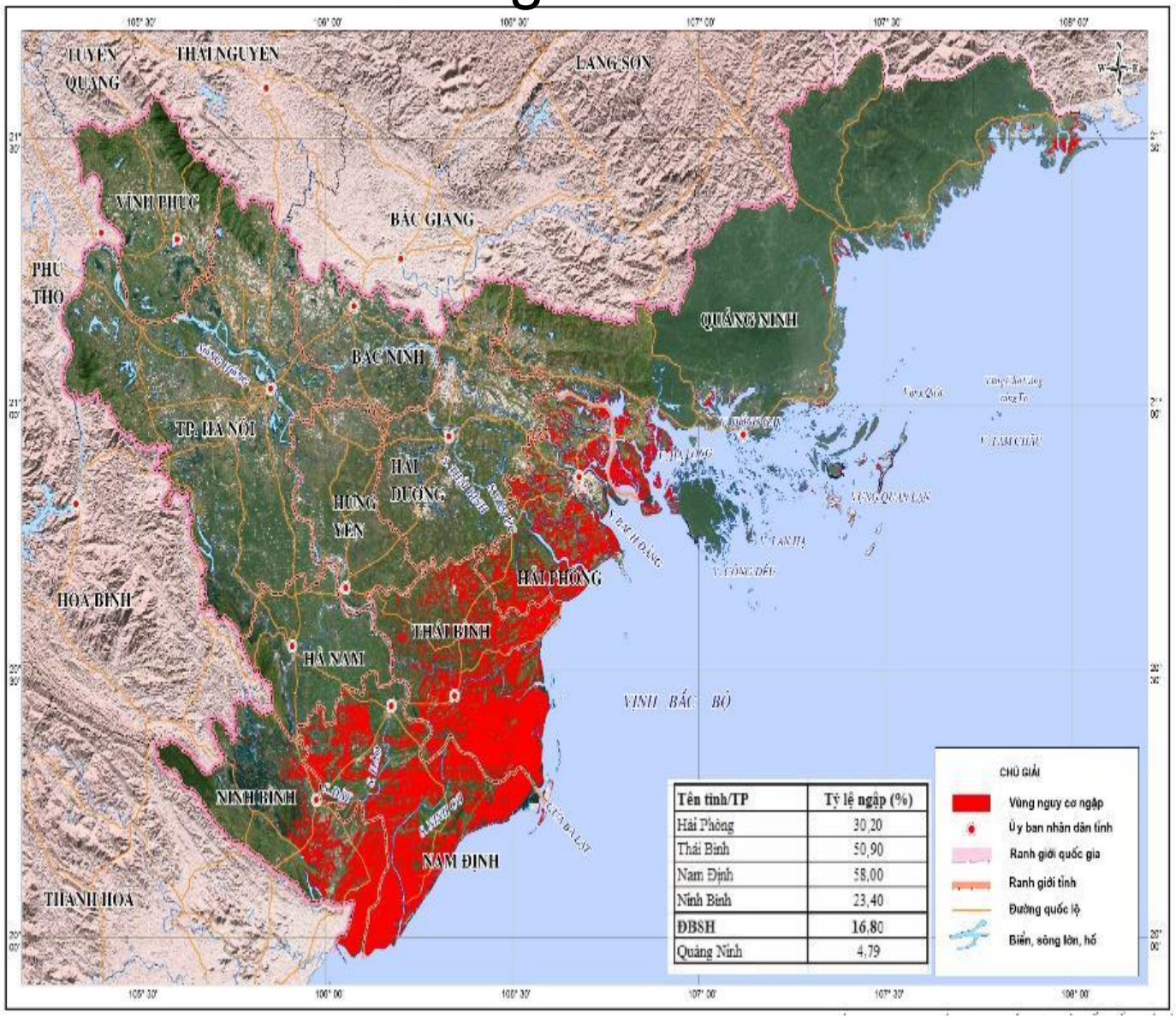
Projection - Inundation Risk



If sea level rise 100cm

- 16.0% Red River Delta, 1.5% coastal province in the Central (*Thanh Hóa - Bình Thuận*), 17.8% Hồ Chí Minh City, 38.9% Mekong Delta are at inundation risk.
- Large area of Vân Đồn, Côn Đảo and Phú Quốc islands have high inundation risk.
- Inundation risk of Trường Sa island is low compared to Hoàng Sa island, especially for island in the Lưỡi Liềm group and Tri Tôn island.

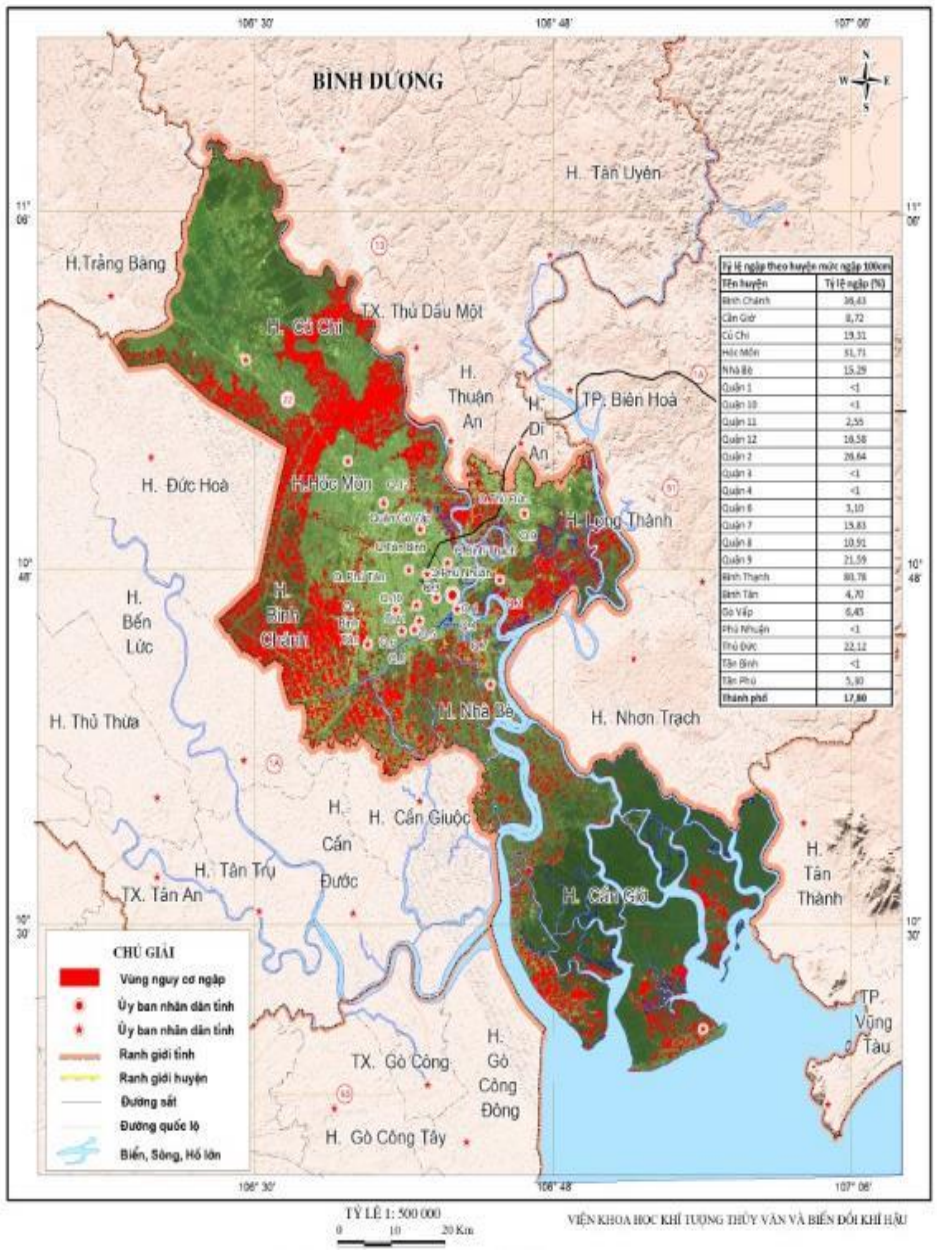
Inundation Risk due to Sea Level Rise – Red River Delta and Quảng Ninh



Tên tỉnh/TP	Tỷ lệ ngập (%)
Hải Phòng	30,20
Thái Bình	50,90
Nam Định	58,00
Ninh Bình	23,40
ĐBSH	16,80
Quảng Ninh	4,79

If sea level rise 100cm, **4.79%** Quảng Ninh province and **16.8%** Red River Delta are inundated. (*Thái Bình: 50.9%, Nam Định: 58.0% are at highest risk*).

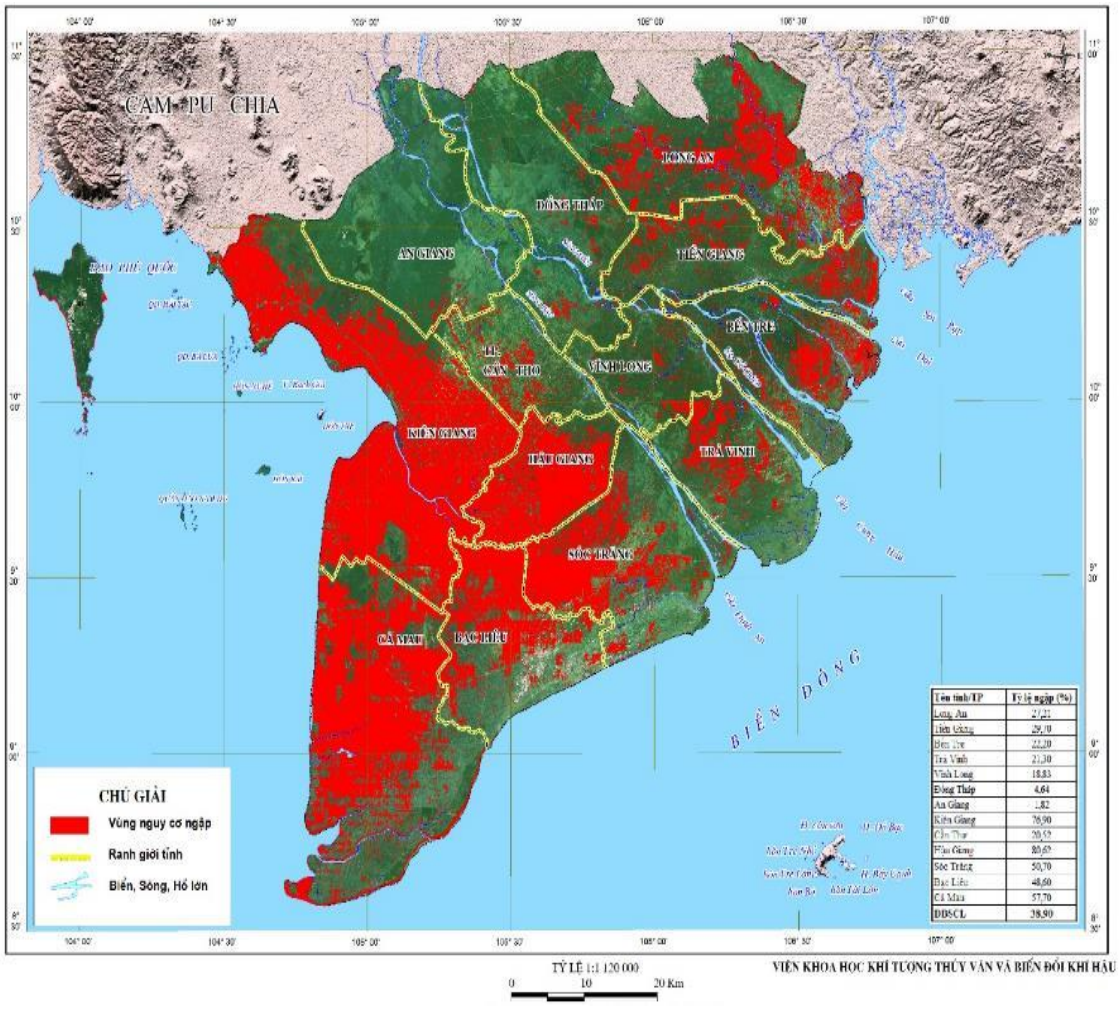
Inundation Risk due to Sea Level Rise – Hồ Chí Minh City



Tỷ lệ ngập theo huyện mức ngập 100cm	
Tên huyện	Tỷ lệ ngập (%)
Bình Chánh	36,43
Cần Giờ	8,72
Củ Chi	19,31
Hóc Môn	31,71
Nhà Bè	15,29
Quận 1	<1
Quận 10	<1
Quận 11	2,55
Quận 12	18,58
Quận 2	28,64
Quận 3	<1
Quận 4	<1
Quận 5	3,10
Quận 7	15,83
Quận 8	10,91
Quận 9	21,59
Bình Thạnh	80,78
Bình Tân	4,70
Gò Vấp	6,45
Phú Nhuận	<1
Thủ Đức	22,12
Tân Bình	<1
Tân Phú	5,30
Thành phố	17,80

If sea level rise 100cm, **17.84%** **Hồ Chí Minh** city is inundated *(Bình Thạnh district: 80.78%, Bình Chánh district: 36.43%).*

Inundation Risk due to Sea Level Rise – Mekong Delta



If sea level rise 100cm, **38.9% Mekong Delta** is inundated *(Hậu Giang province: 80.62%, Kiên Giang province: 76.86%, Cà Mau province: 57.69%)*.

Remarks: Observed changes

- Average annual temperatures increased by 0.62^{o}C in the period 1958-2014, aproximately 0.1^{o}C/decade.
- Annual rainfall decreased in the North, while it increased in the South.
- Extreme temperatures increased in most of climatic regions, Extreme rainfall increased considerably in South Central and Central Highlands.
- Frequency: The change is not clear.
- No. strong typhoon (> level 12) increase.
- The annual duration of typhoon activities lasts longer and the Typhoon track tends to forward the South.

Remarks: Projection

❖ **Very likely:**

- Extremes regarding to temperature tend to increase.
- No. Of strong typhoons tend to increase.
- Mean sea level in Vietnam coastal tend to increase.

❖ **Low to medium confidence:**

- Rx1day is able to increase over The North-west, The North-East, Central Highland, The Southern; Decrease over the rest.
- The Frequency of drought tend to increase and its duration lasts longer.

Thank you for your attention!