

**VIETNAM INSTITUTE OF  
METEOROLOGY, HYDROLOGY AND CLIMATE CHANGE**



# **WATER DISASTER MANAGEMENT AND CLIMATE CHANGE**

**DUONG HONG SON**





# CONTENT

- ✓ What is IMHEN?
- ✓ Water Disaster
- ✓ Climate Change
- ✓ Conclusion





# IMHEN FOUNDATION

**Total: 257**

**2014** Prof., Assoc. Prof.: 8 PhD: 26 MSc.: 44 BSc., Engineers: 150

**2003** VietNam Institute of Meteorology, Hydrology and Environment (IMHEN)  
Ministry of Natural Resources and Environment (MONRE)

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



# Most Likely and Serious Impacts

- More than 3,000 km coast line
- Sea level rises as the key impact



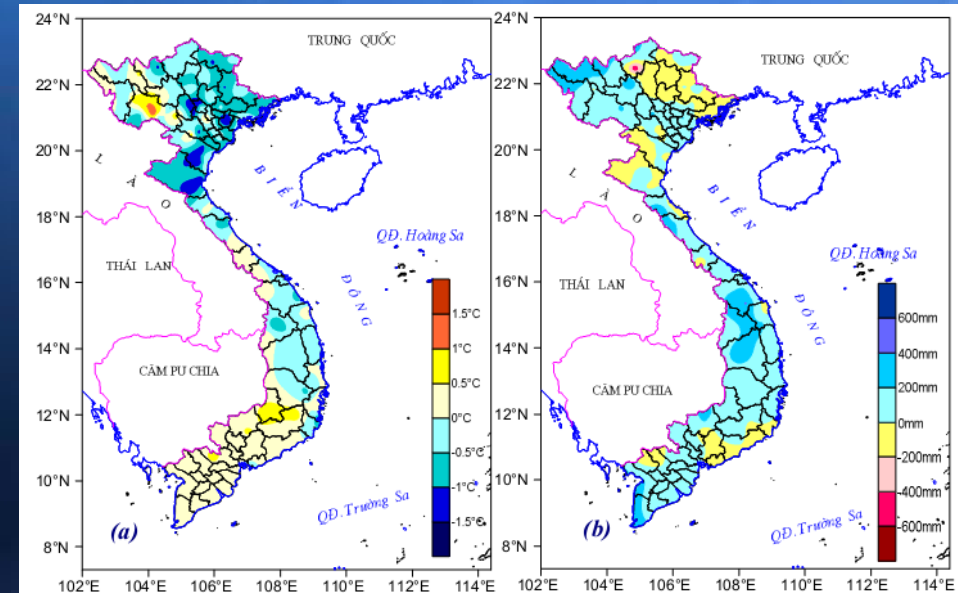


# Water disaster management



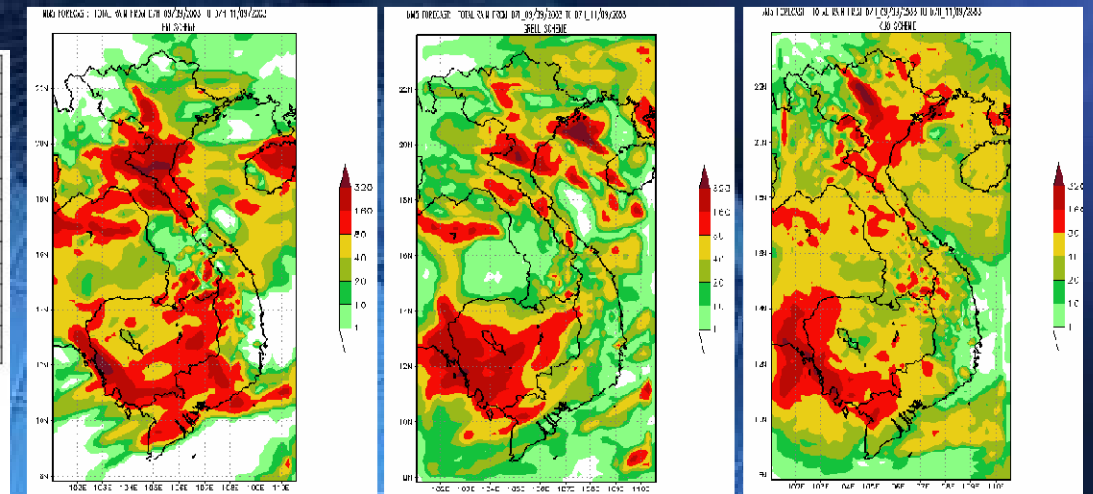
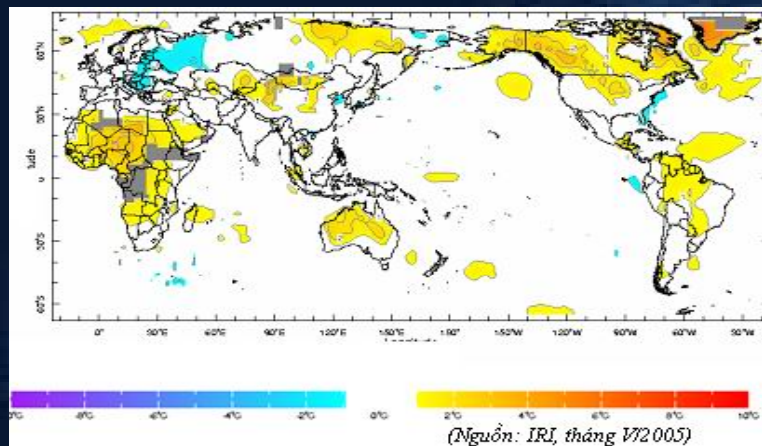
## Three month seasonal Tem. and rainfall anomaly predictions

- Seasonal climate bulletin and outlook
- Climate extreme events
- Prevention and mitigation of desertification in the Central Viet Nam
- Drought forecast and warning

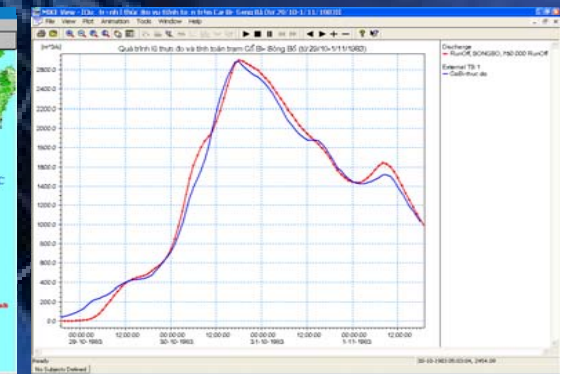
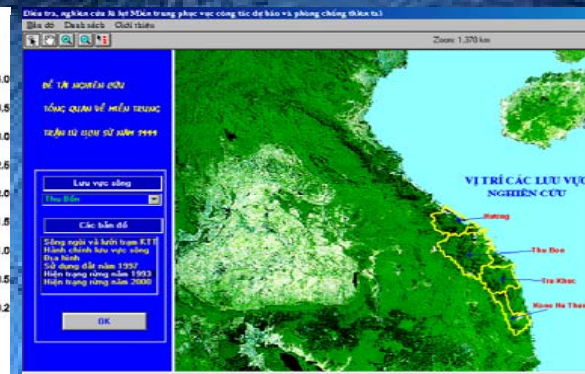
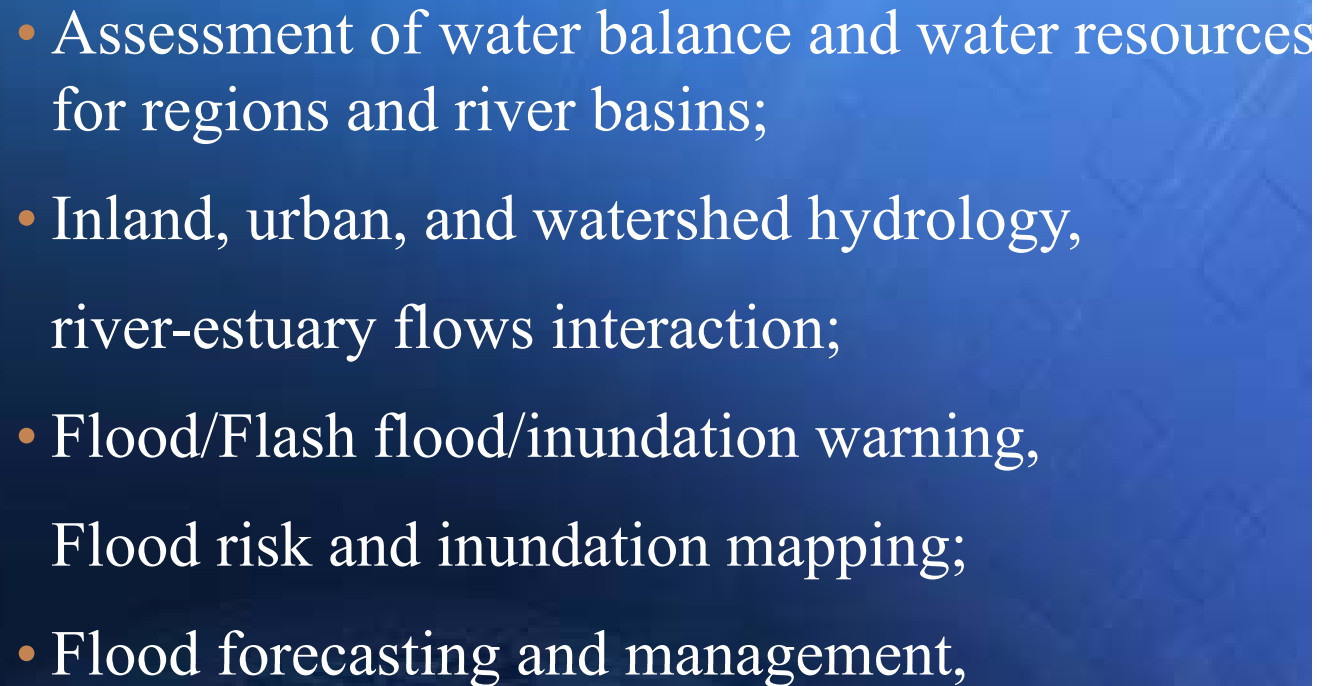


## Rainfall forecasts

### Three months Tem. anomaly prediction









# Water disaster management

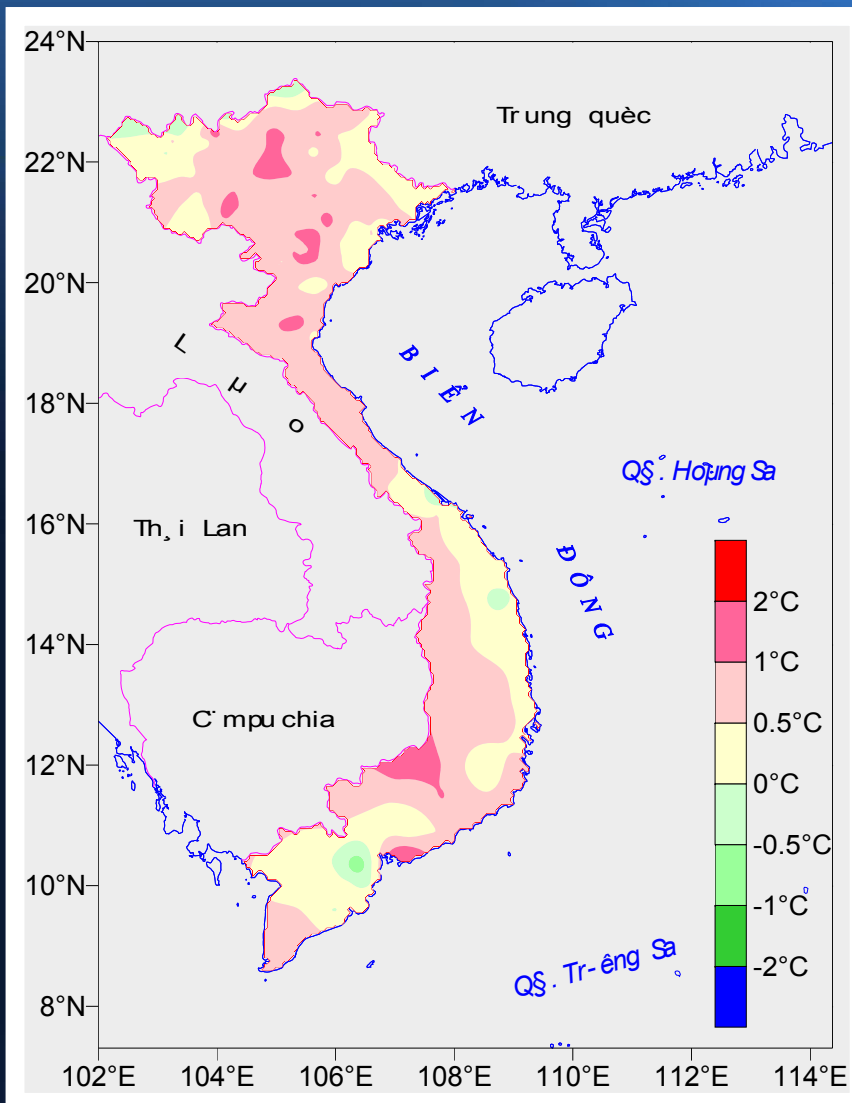


- Constructing the flood alert level in the main rivers in Viet Nam.
- Applied Research: Mapping the flash flood risk in Northern mountains, drought map in the Central Highlands and South Central, frost map, salinity intrusion
- Research on air and water pollution and proposing the mitigation measures.





# Mean Temperature

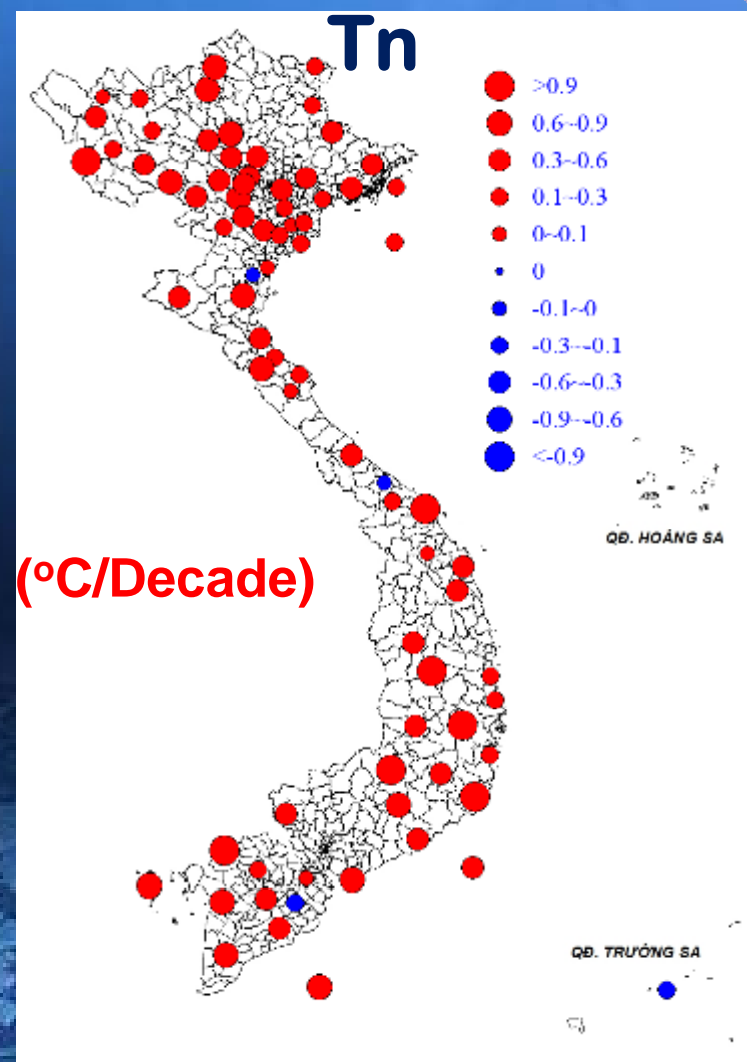
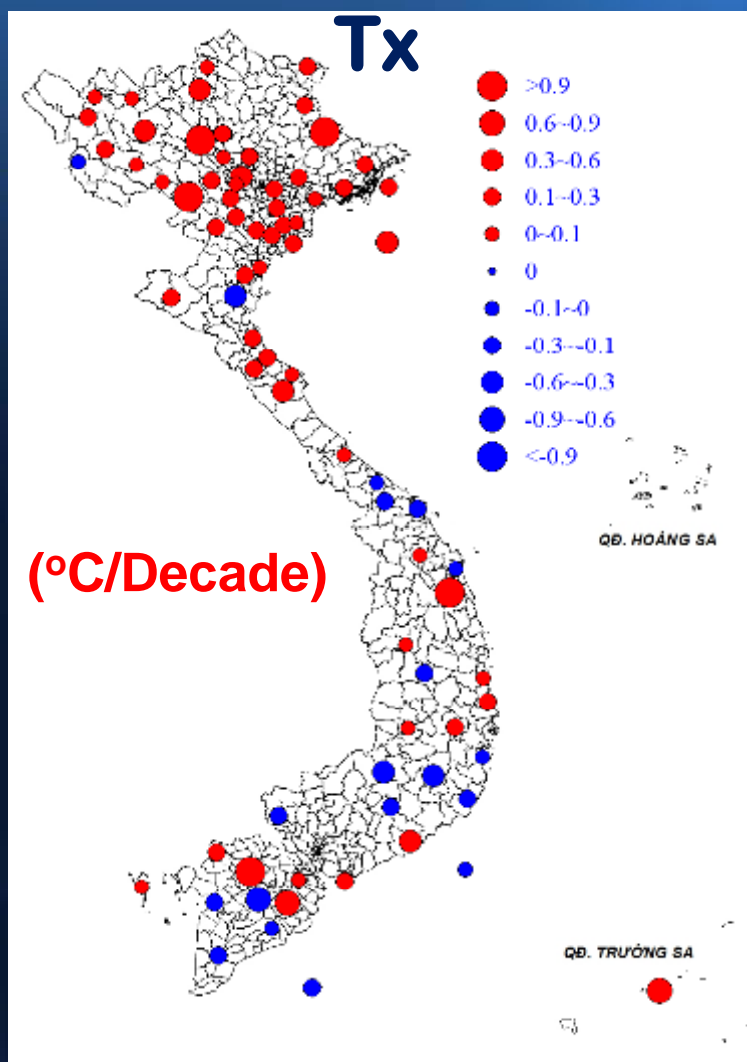


Trend of mean annual temperature

- ✓ Over the past 50 years, annual average temperature has increased 0.5°C.
- ✓ Winter temp increased faster than summer temp.
- ✓ Temp in the North increased faster than in the South.
- ✓ Temp inland increased faster than in coastal areas and islands.



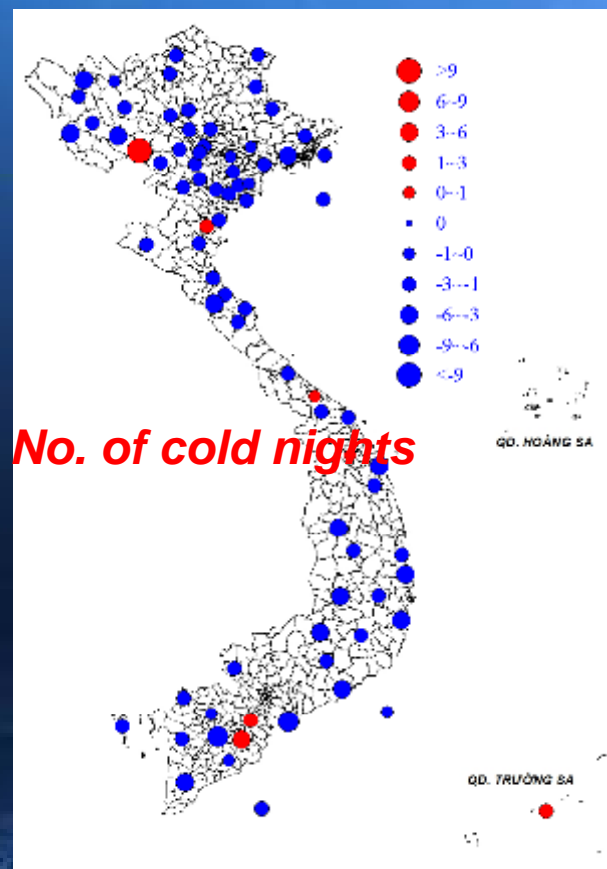
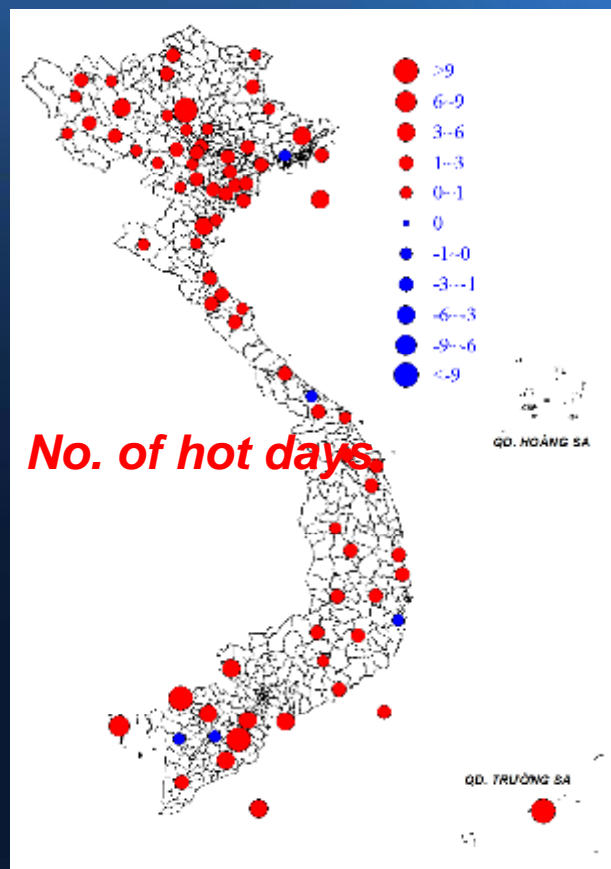
# Maximum and Minimum Daily Temperature



Min. temperature has increased more than Max. temperature, particularly over North West, South of North Central, South Central and Central Highlands



# Change in No. of Hot Days and Cold Nights



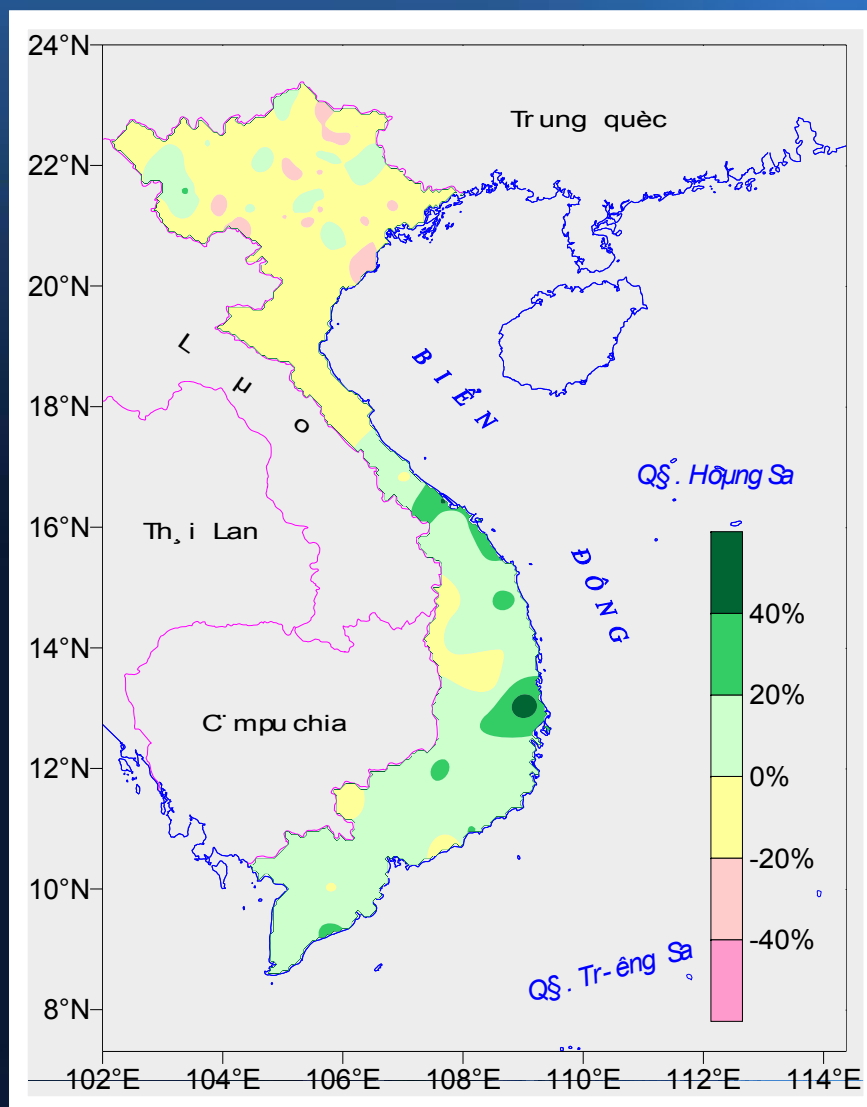
**Hot day:** Day with Max temp. higher than temp. of 90%

**Cold night:** Night with Min. temp. lower temp. of 10%

- No. of hot days increases significantly, about 34 day/decade.
- No. of cold night decreases about 11 day/decade (in the South)



# Rainfall

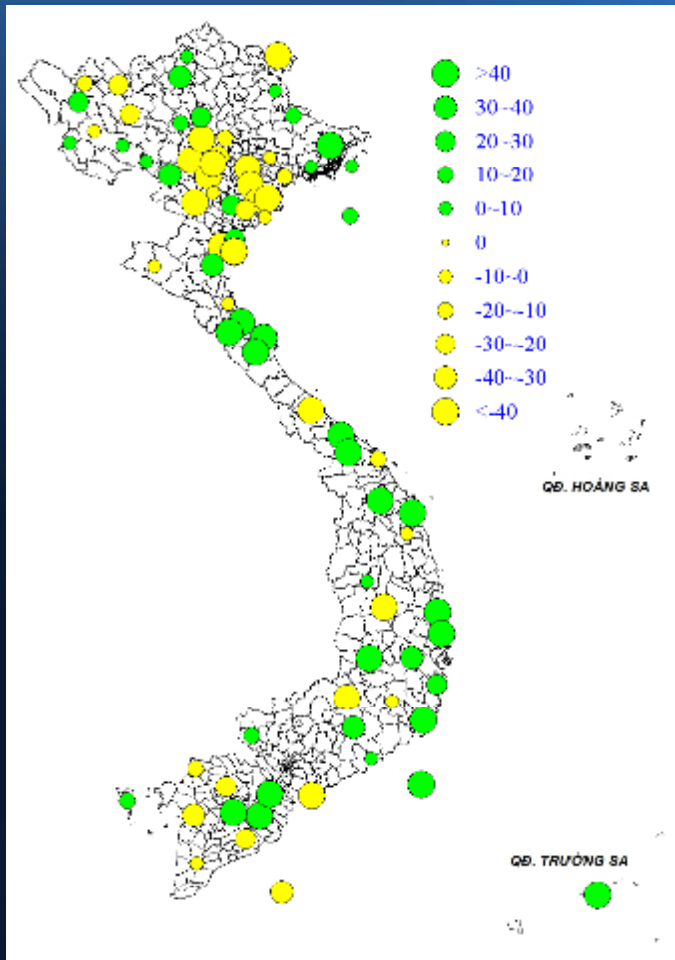


- Annual mean: Decreases in the North; Increases in the South,
- Dry season: Slight change in the North, but increases strongly in the South;
- Rainy season: Decreases 5-10% in the North, increases 5-20% in the South;
- Rainfall in rainy season in Central VN increases stronger than others, up to 20%/50 years;

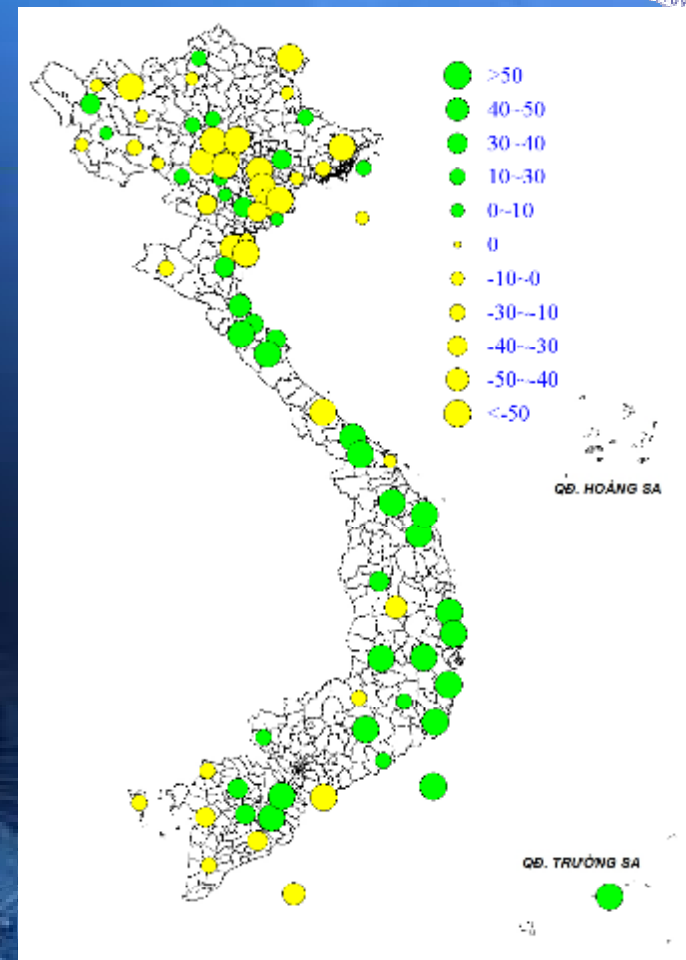
(%) over 50 past years



# Extreme Rainfall



*Annual maximum 1-day rainfall (mm)*



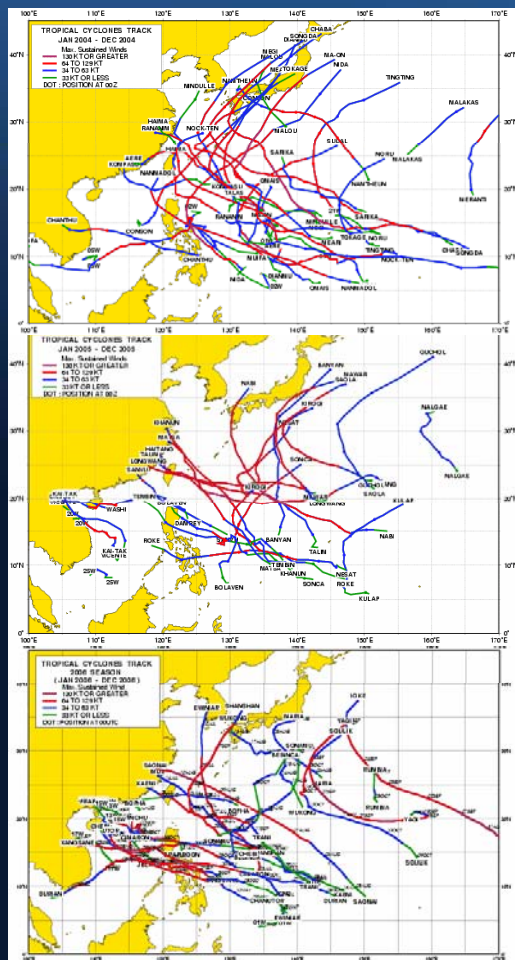
*Annual maximum consecutive 5-day rainfall (mm)*

- Significant **decrease** in **Northern Delta**, up to 11%/decade
- Significant **increase** in **South Central and Central Highlands**



# Tropical Storms

- Frequency: no clear change;
- Frequency of very strong typhoon (> level 12) increased;
- Typhoon track has a tendency of moving southward;
- Typhoon season tends to end later;
- More typhoons with abnormal movement.



Hình 1.11. Bản đồ tần suất XTNĐ hoạt động (a), hình thành (b) ở Biển Đông và ảnh hưởng đến đất liền Việt Nam (c) (Nguồn: IMHEN/2010)



# Droughts



- ❖ Droughts occur more frequently, especially with extreme levels.
- ❖ More severe in dry season (2005, 2010-2011, 2013), water levels in rivers, reservoirs reached the minimum levels.



Kông Chro, Gia Lai, 2013 (<http://laodong.com.vn>)



# Floods

- ❖ **Red River:** Annual flow has decreased in recent years, but strong floods occur frequently upstreams.
- ❖ **Mekong River:** Sequence of strong floods in 2000, 2001 and 2011, with water level at Tan Chau over 4,5m – increase of hydrological extremes.
- ❖ **Rivers in Central Viet Nam:** Very fast floods with severe damage



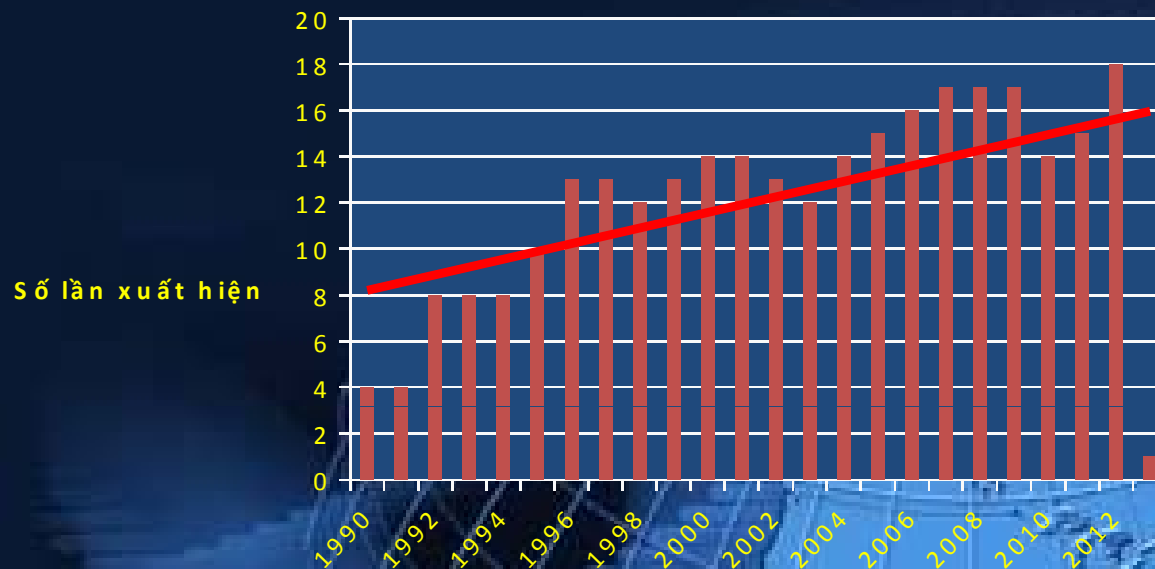


# Flash Floods



## *Number of flash floods increased*

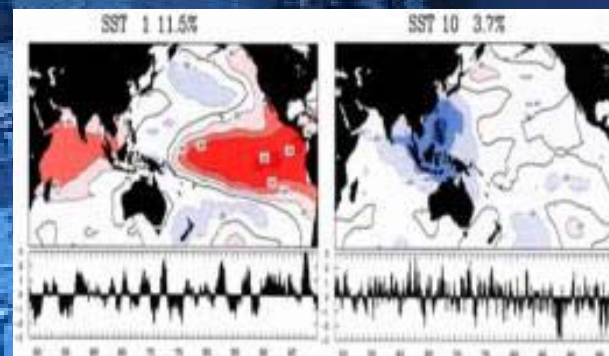
- 1970 - 1980 : 7 events
- 1981 - 1990 : 8 Events
- 1991 - 2000 : 101 event
- 2001 - 2013 : 182 event





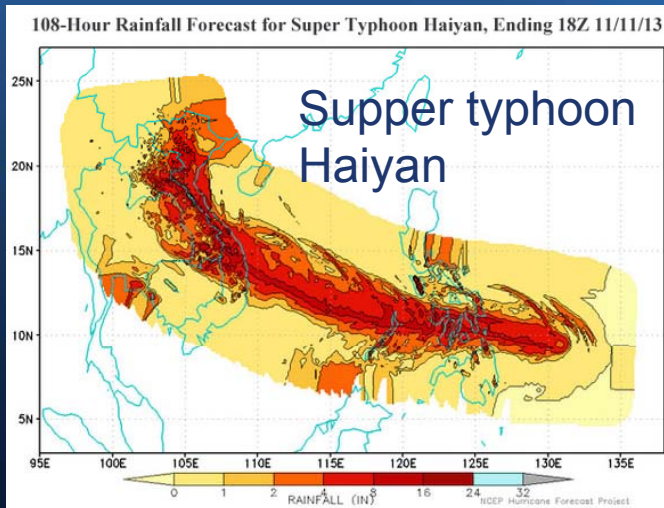
# Others Climate Extremes

- Drizzling rain decreased;
- Cold fronts decreased;
- Cold days, damaging cold days decrease, but **extremes cold spells appeared** (2008, 2013, 2014;
- Heat wave increases in central and southern areas;
- Off-season extreme rainfall occur more frequently;
- ENSO has stronger effects.





# Climate in 2013



TET holiday in the North Vietnam

Cold winter season  
with temp about  
- 40°C in EU, USA



Heatwave in Australia with temp about near 46 °C





# Climate Projections

The image features a central globe with a white grid of latitude and longitude lines. The globe is rendered in a light blue color, contrasting with the darker blue background. The background is a composite of several elements: blurred vertical lines resembling city skyscrapers at night, and abstract, glowing white lines that suggest data or network connections. The overall aesthetic is high-tech and futuristic, emphasizing global connectivity and data-driven insights.

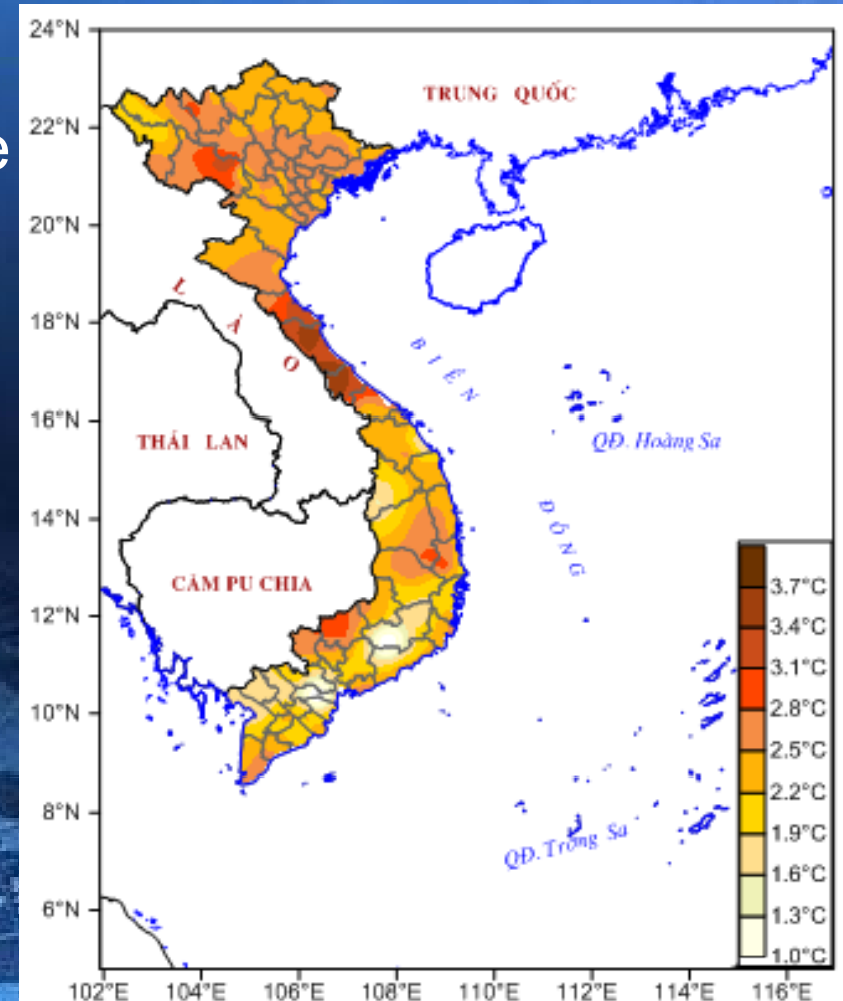


# Changes in temperature



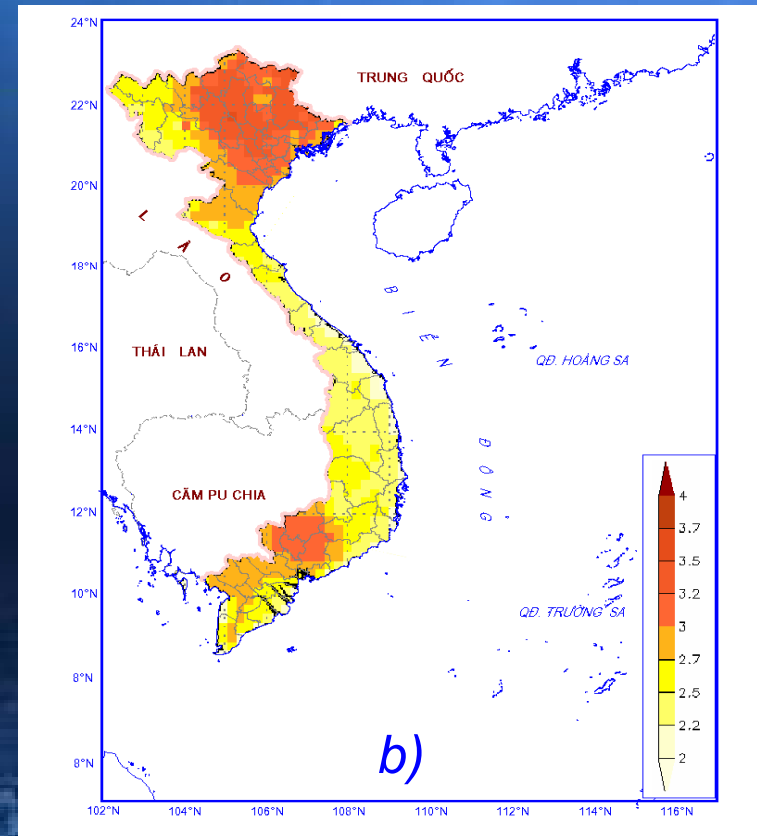
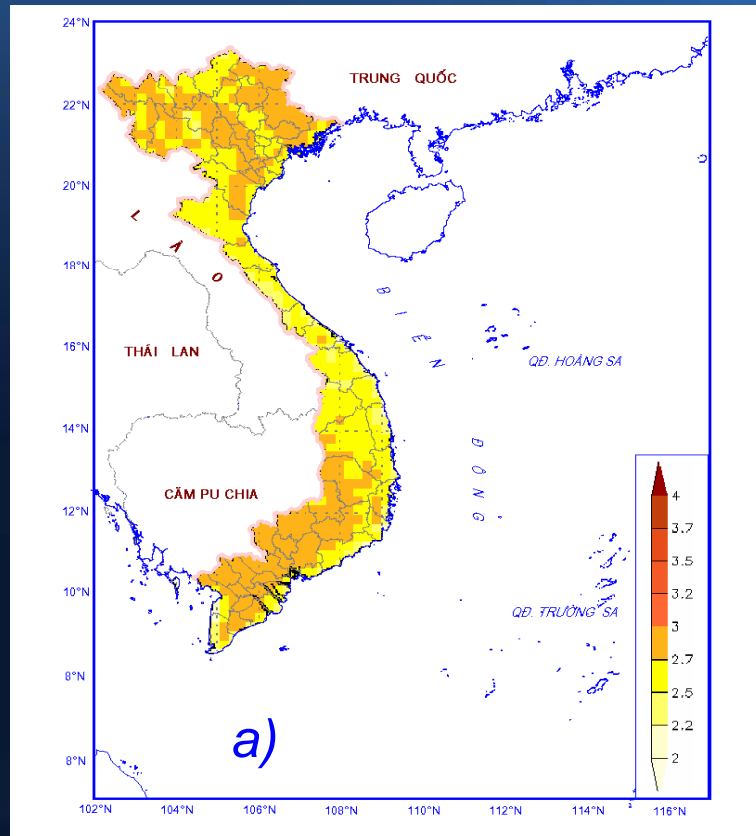
At the end of 21 century by medium emission scenario:

Annual mean temperatures increase by 2-3°C; Hà Tĩnh - Quảng Trị: higher rate.





# Change in Max/Min Temperature (compared to 1980-1999)



(a) Max. Temperature  $T_x$ , and (b) Min. Temperature  $T_m$  under B2 scenarios

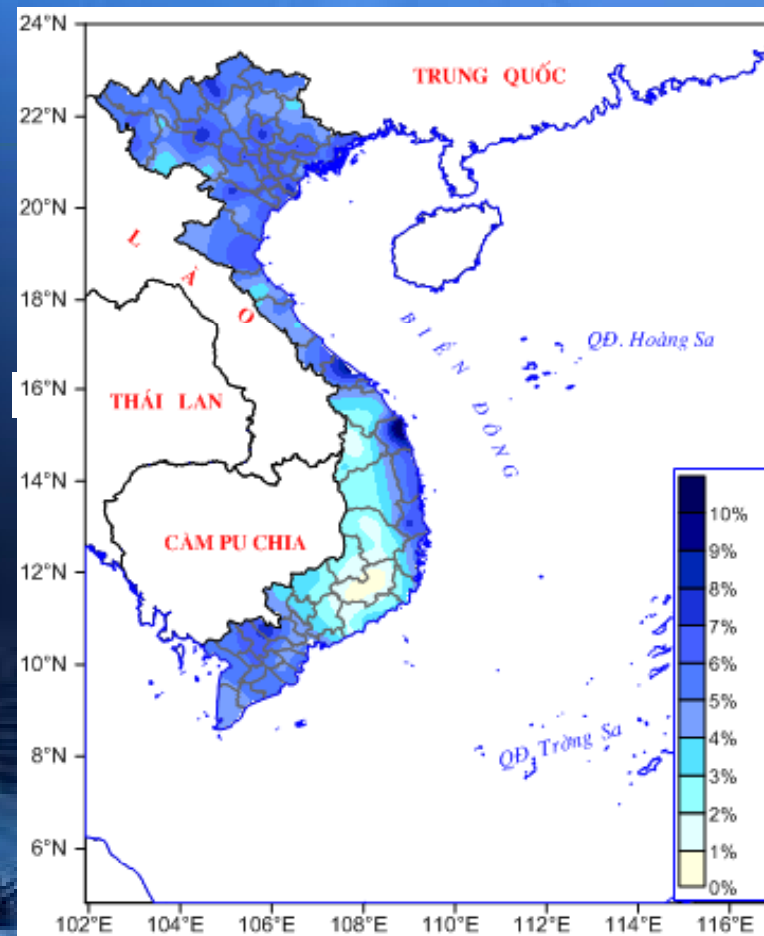
- $T_x$  is projected to increase about  $2.0-3.2^{\circ}\text{C}$ ;
- $T_m$  is projected to increase about  $2.2-3.9^{\circ}\text{C}$ .



# Projected Change in Rainfall

At the end of 21 century by medium emission scenario:

- Annual rainfall increases by 2-7%, Central Highlands and South Central:
- Overall seasonal trends: decrease in dry season and increase in wet season.
- Maximum daily rainfall increases in the North Delta, North Central but decreases in South Central and Central Highlands.

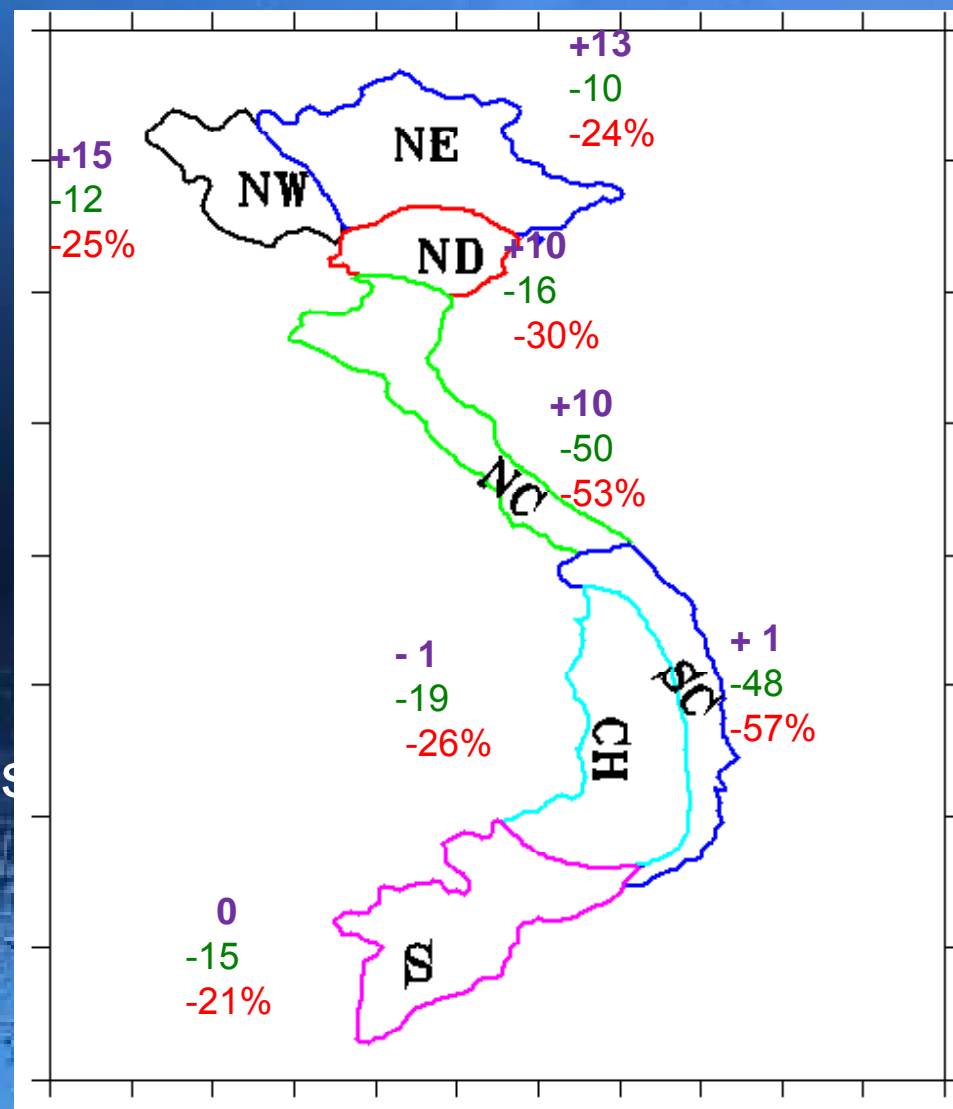




# Summer Monsoon

## Change by end of century

1. Onset date (days) unchanged in the South, about 12 days later in the north
2. Duration (days) becomes shorter from 10 days to 3 weeks and up to 1.5 months for North Central and South Central.
3. Rainfall intensity (%) decreases by more than 50% for North Central and South Central.



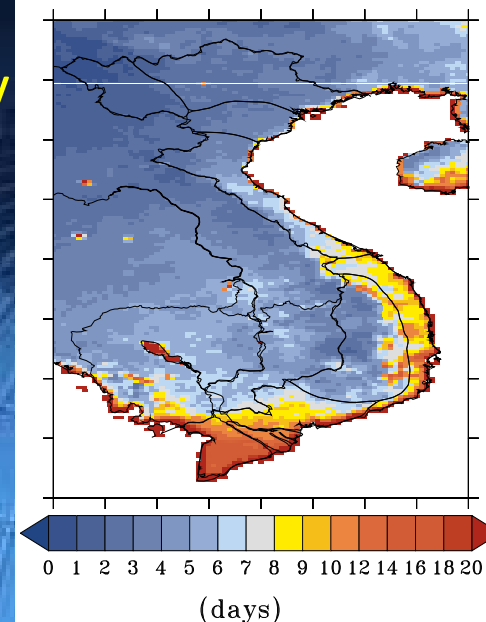
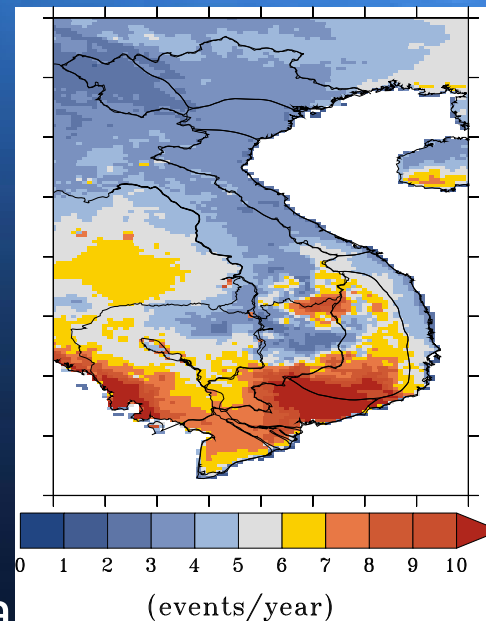


# Changes in Heat Wave



Heatwave = at least 5 consecutive days with extreme Temperatures (95<sup>th</sup> percentile daily maximum)

1. Increase in **frequency** and **duration** over whole Vietnam
2. Largest increase in **frequency** In Central Highlands and South
3. Largest increase in **duration** in South and South Central



Number of Heatwaves

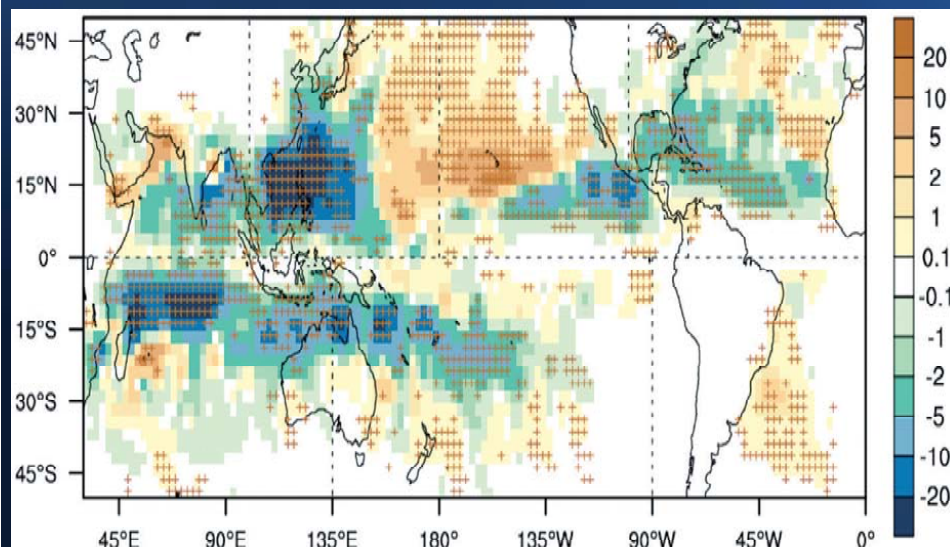


Length of Heatwaves



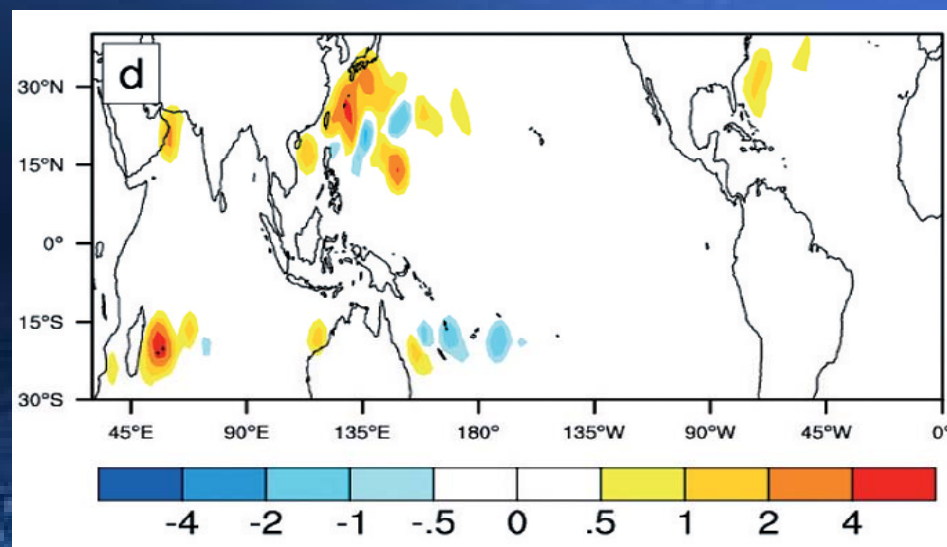
# Change in Typhoons

No. of tropical cyclones decreases



Change in TC frequency by the end of century (TC/25 years)

Strong tropical cyclones increases



Change in strong TC ( $V_{max} > 70 \text{ m s}^{-1}$ ) by end of the century





## CC Scenarios

### Temperature

- Low scenario (B1): 1,6 - 2,2°C
- Medium scenario (B2): 2 - 3°C
- High scenario (A1FI): 2,5 - 3,7°C

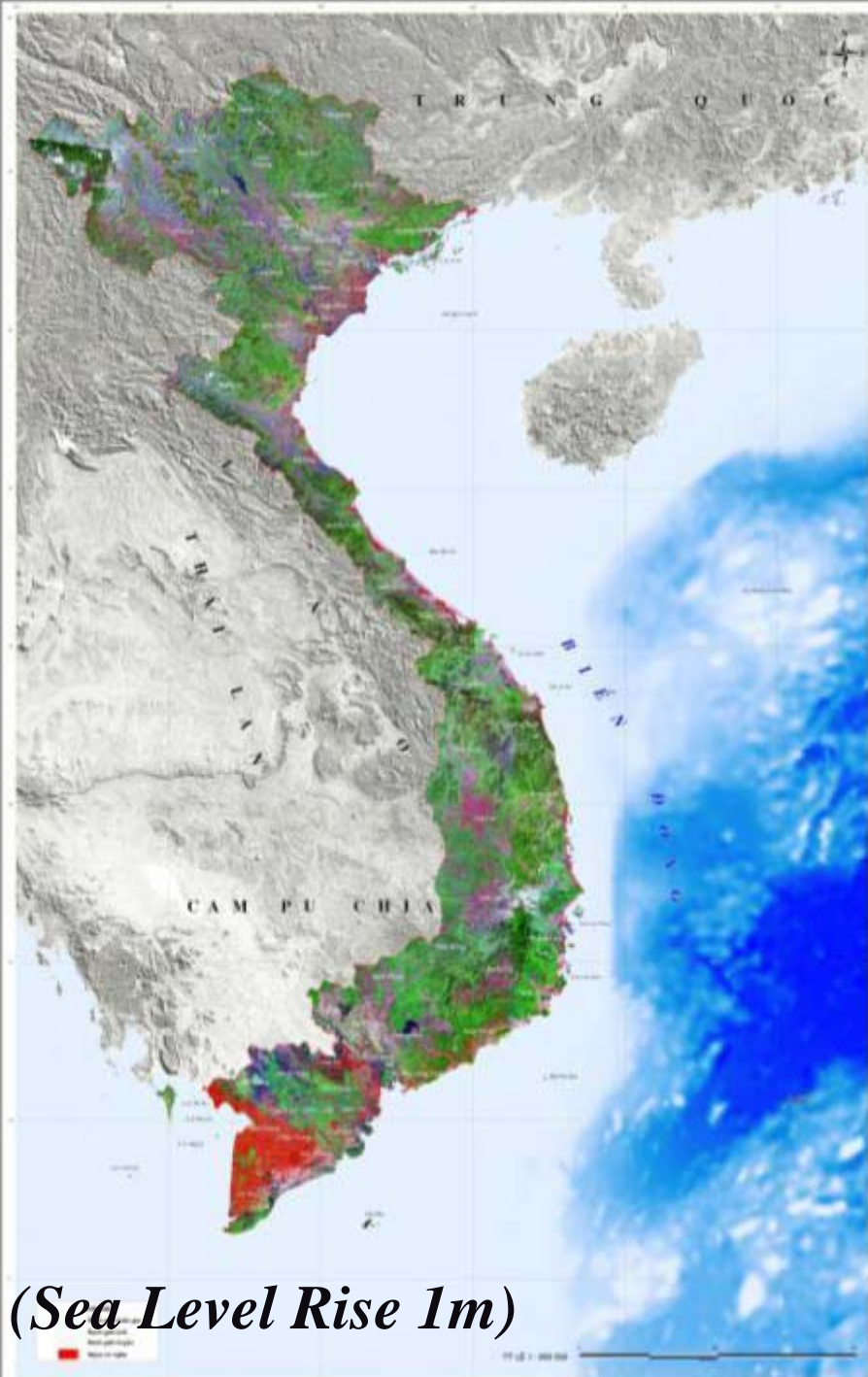
### Sea Level Rise

- Low scenario (B1): 49-64cm
- Medium scenario (B2): 57-73cm
- High scenario (A1FI): 78-95cm

### *If sea level rise 1 m:*

- 39% of Mekong Delta, 10% of Red River Delta, 2,5% of coastal area of the Central, 20% of HCM city will be inundated
- 35% population of Mekong Delta, 9% population of Red River delta, 9% population of the Central, 7% population of HCM City are directly affected.

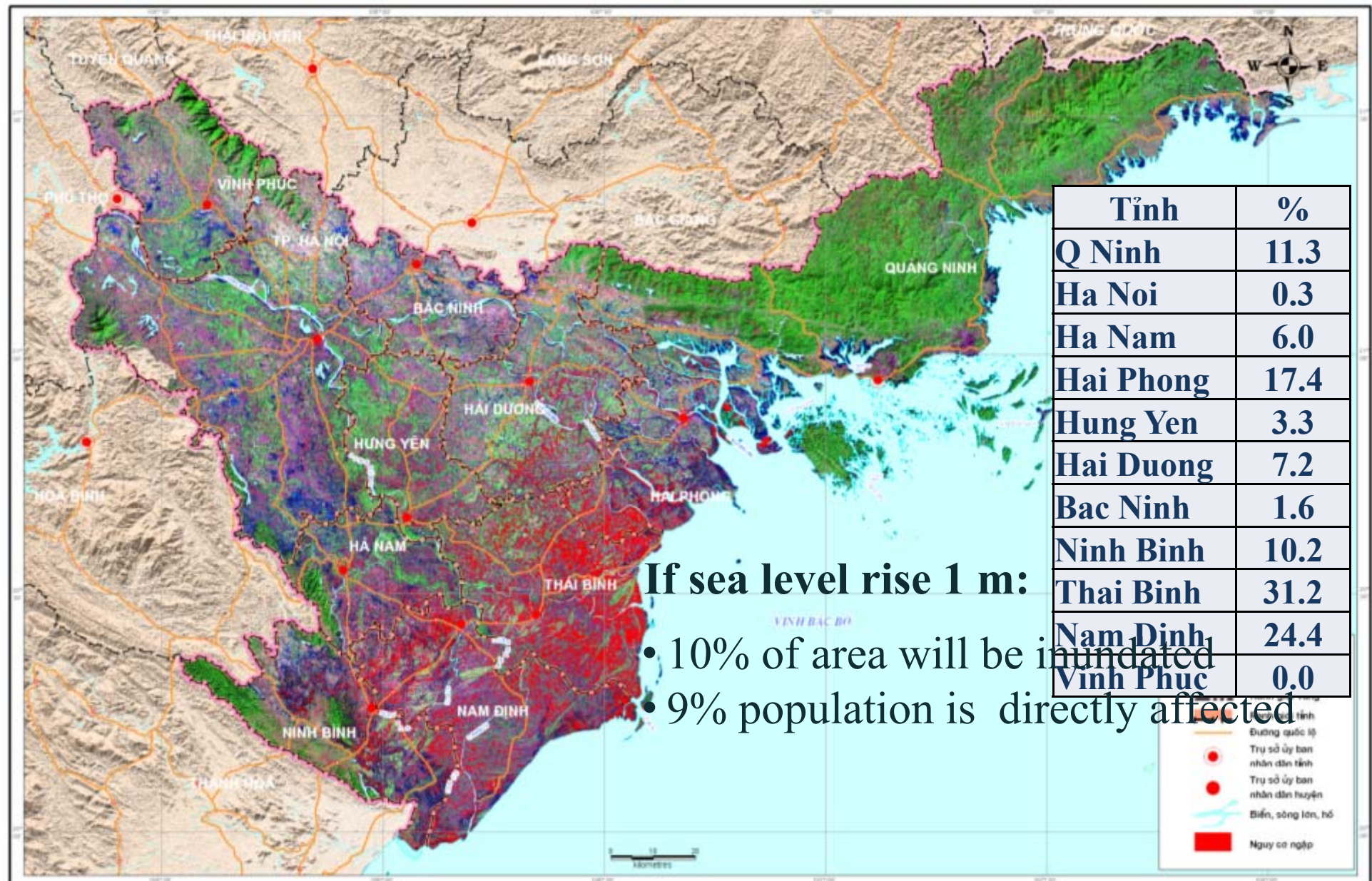
IMHEN, 2012



*(Sea Level Rise 1m)*



# Red River Delta

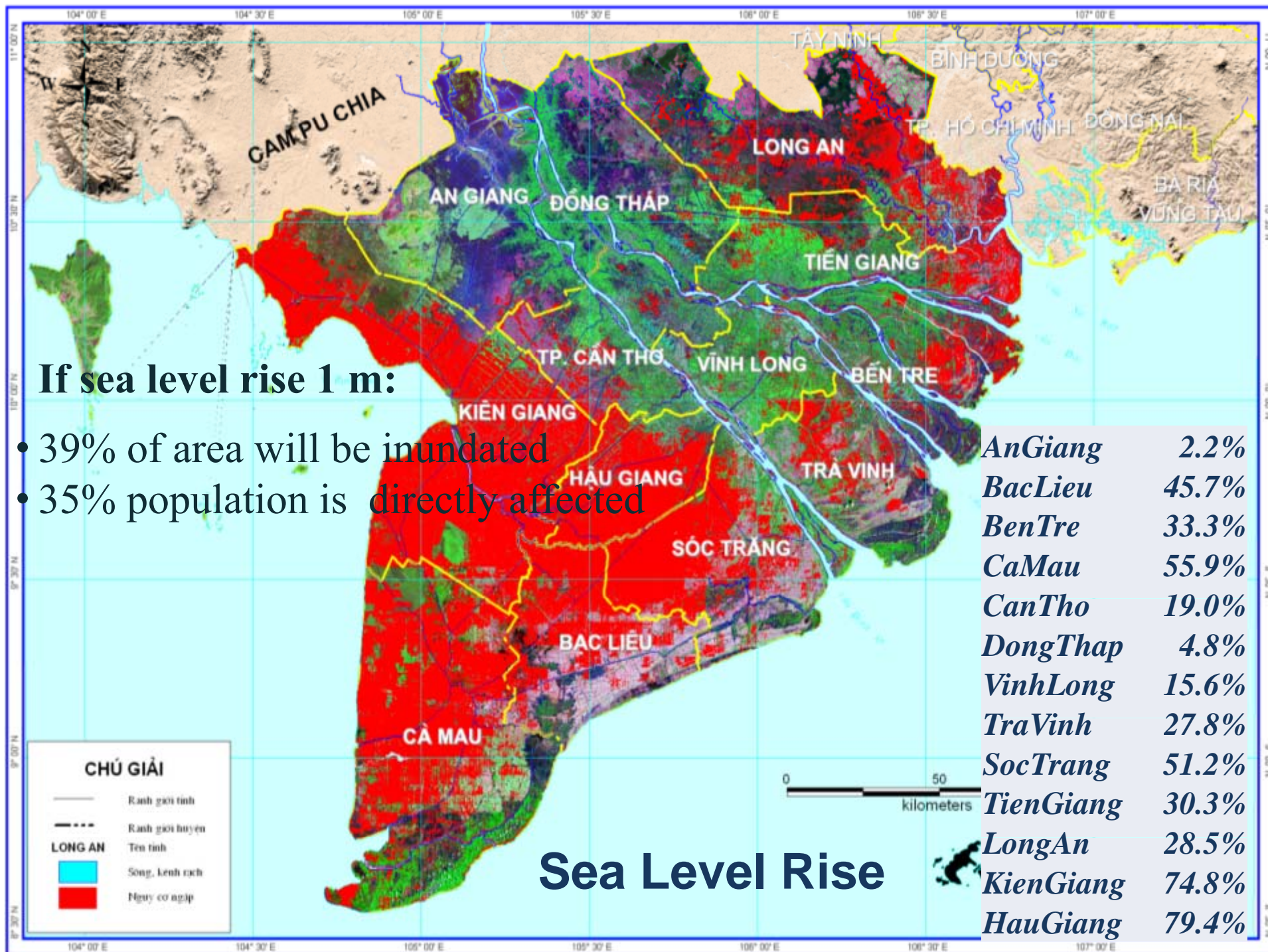


Tỉnh	%
Q Ninh	11.3
Ha Noi	0.3
Ha Nam	6.0
Hai Phong	17.4
Hung Yen	3.3
Hai Duong	7.2
Bac Ninh	1.6
Ninh Binh	10.2
Thai Binh	31.2
Nam Dinh	24.4
Vinh Phuc	0.0

If sea level rise 1 m:

- 10% of area will be inundated
- 9% population is directly affected





## If sea level rise 1 m:

- 39% of area will be inundated
- 35% population is directly affected



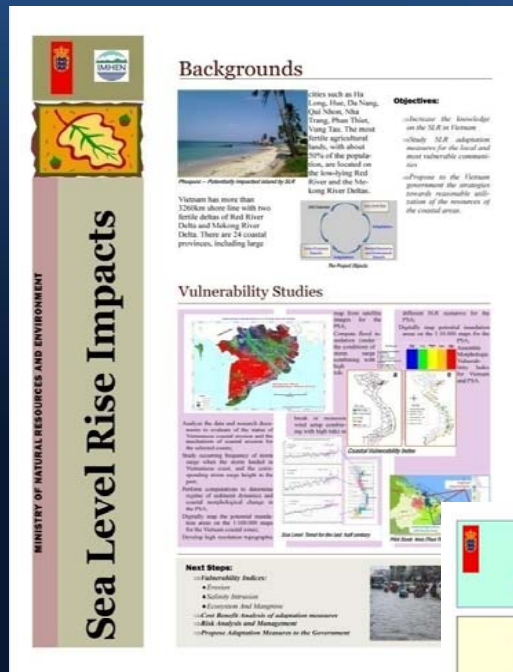
# Climate Change SEA WATER LEVEL RISE SCENARIOS AND POSSIBLE DISASTER RISK REDUCTION IN VN



**Funding: DANIDA, Implementing: IMHEN**

## IMPACT OF CC ON WATER RESOURCES AND ADAPTATION MEASURES,

**Funding: DANIDA,  
Implementing: IMHEN**





# Concluding Remarks



- Climate change has contributed to the increase of climate related disasters (storms, floods/inundations, flash floods, droughts,...) which are more changeable in magnitude and difficult to predict.
- Projected Average temperature increases: 2-3°C (2.5 - 3.7°C).
- Projected Sea level rise: 57-73cm (78-95cm).
- Increase in demand for climate and climate change information.
- Translating climate and climate change information into actions appropriate for sectors/locations is an urgent need.





**Thank you  
for your attention!**