

# THE CHALLENGES OF URBAN FLOOD MANAGEMENT IN HO CHI MINH CITY



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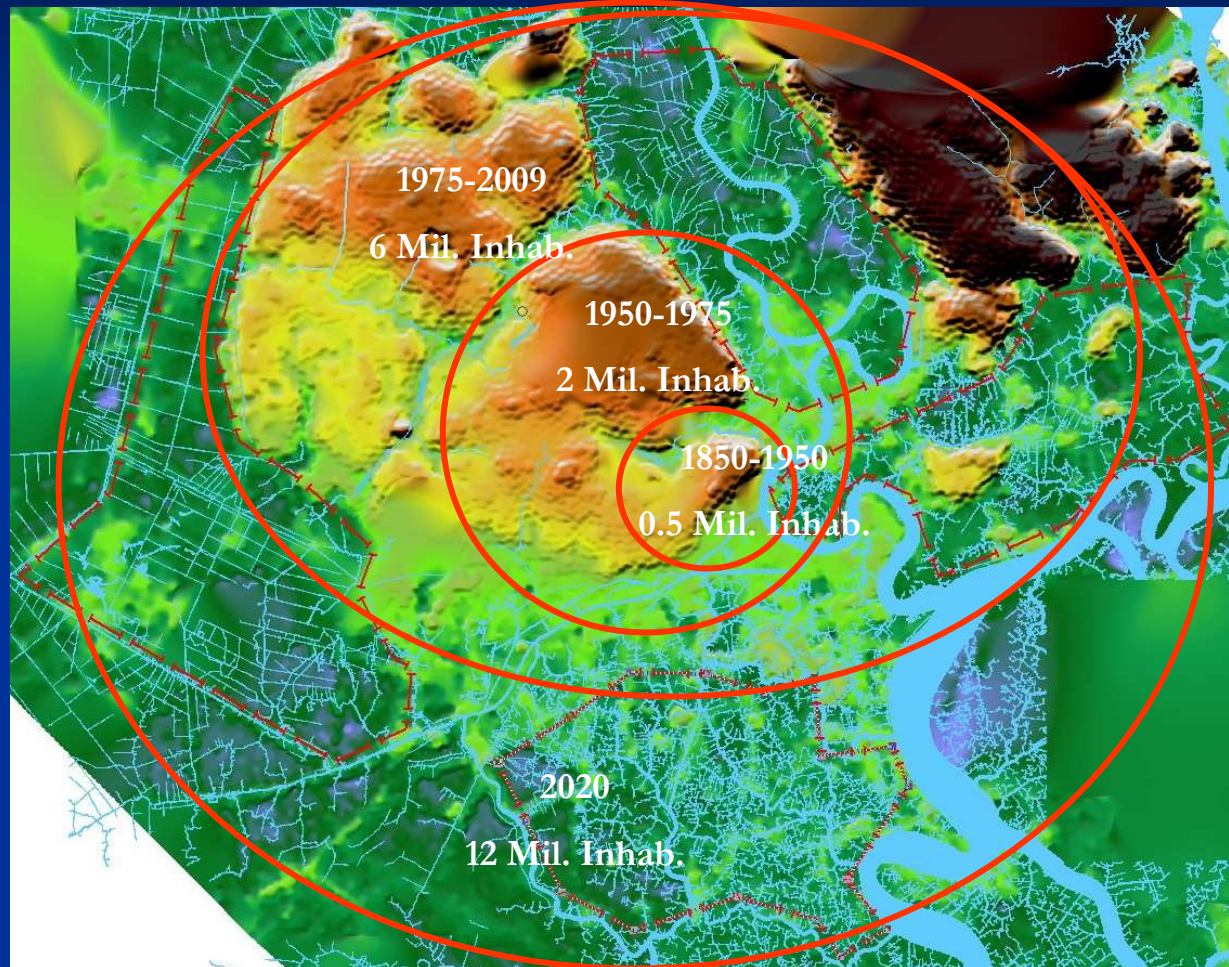
# Content

- Urbanisation
- Climate changes
- Urban flood and flood management projects
- Results and discussions
- Integrated Strategy for urban flood management
- Conclusions

# URBANISATION

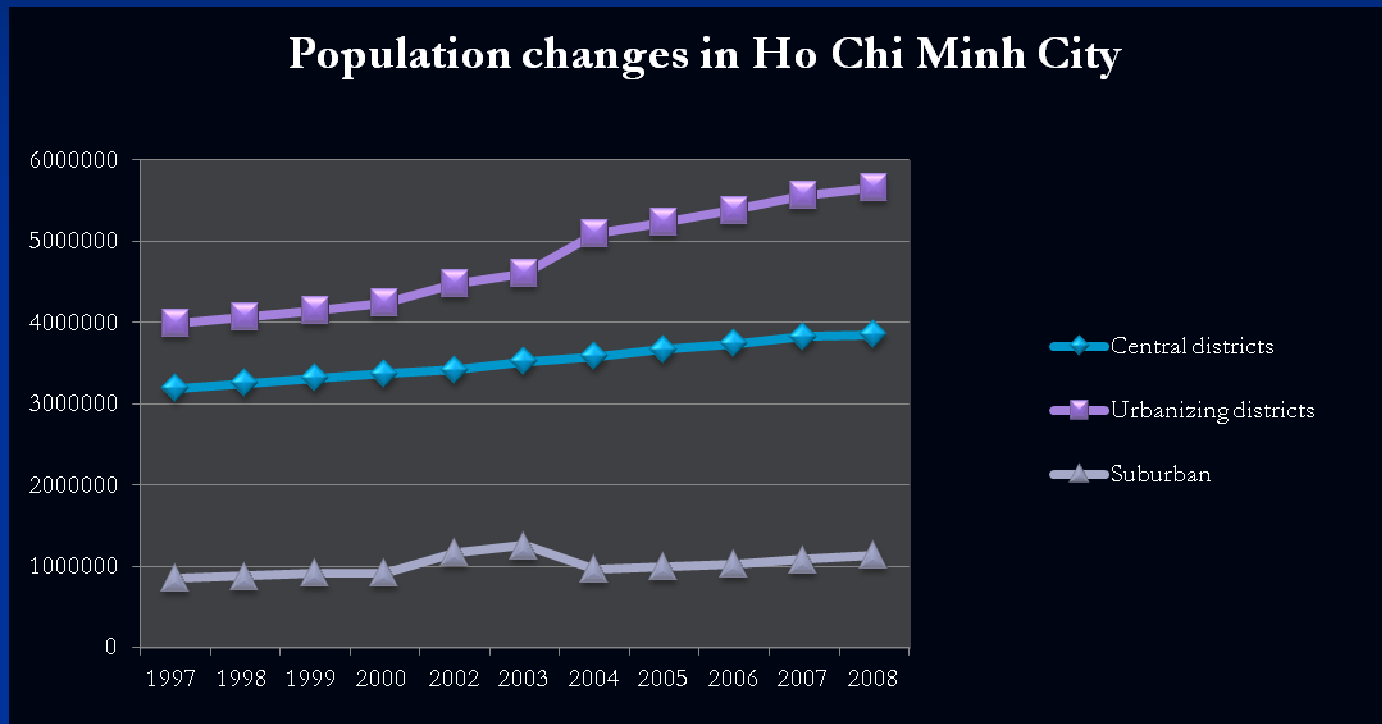


# Urbanisation



Urbanising areas have been developed on lowland under pressure of economic growth.

# Population growth



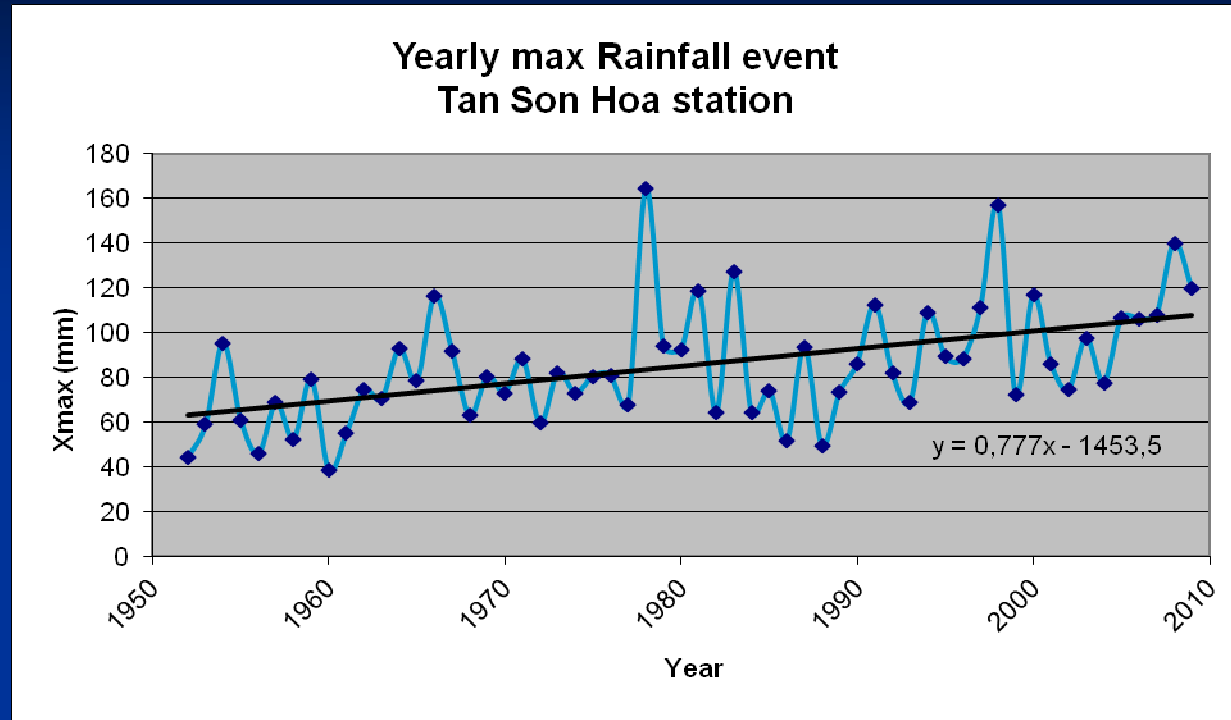
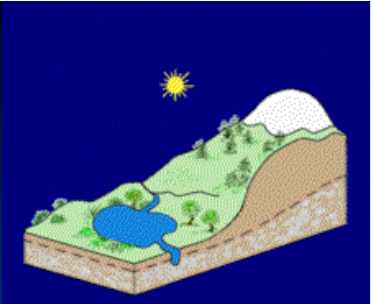
Population grows in all recently urbanised districts, where locate in low-land areas.  
About 3 Mn people have resettled in new urbanised districts since the last ten years



# CLIMATE CHANGES



# Rainfall



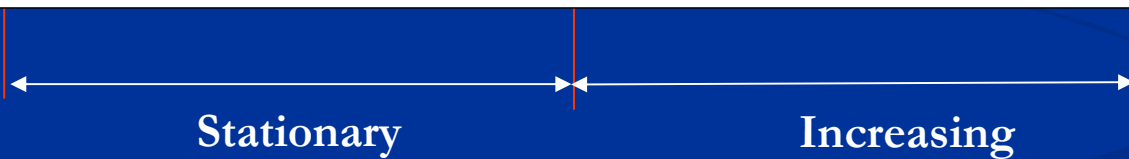
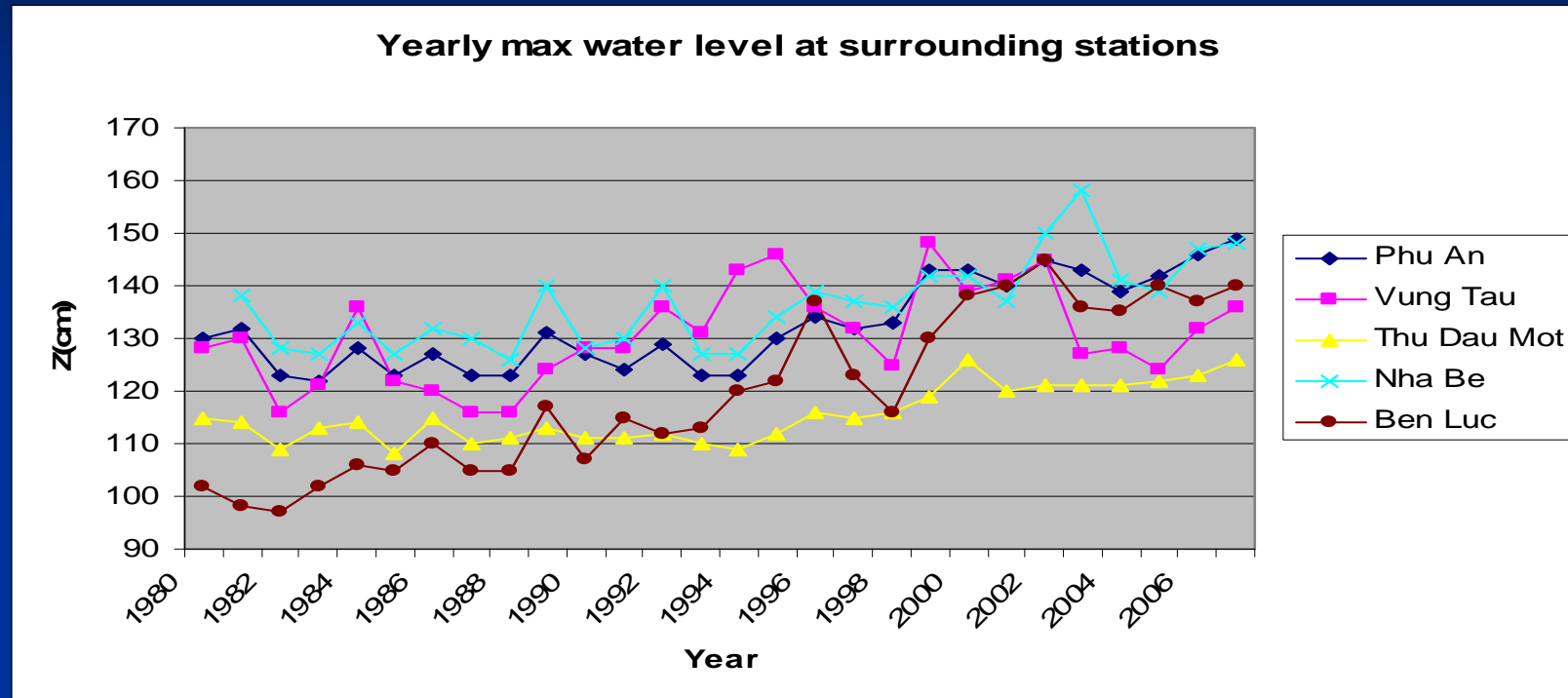
Volume of yearly-max rainfall events increased about 50mm upon the past 50 year

## Counts of 3-hour rainfall events with volume >100mm

| Period | 1952-1961 | 1962-1971 | 1972-1981 | 1982-1991 | 1992-2002 | 2003-2010* |
|--------|-----------|-----------|-----------|-----------|-----------|------------|
| Counts | 0         | 1         | 2         | 2         | 4         | 9          |

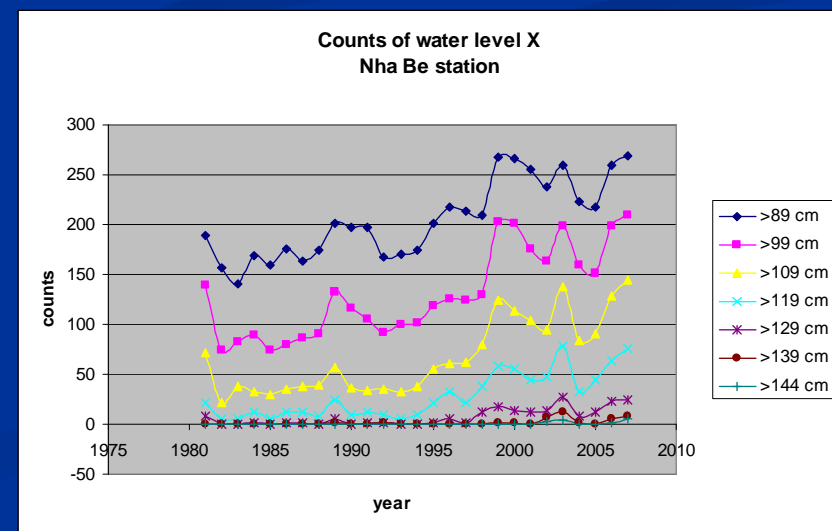
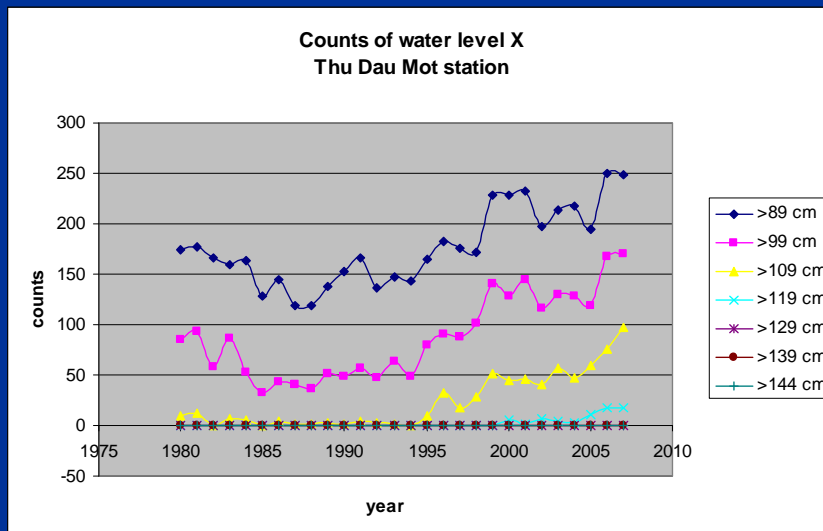
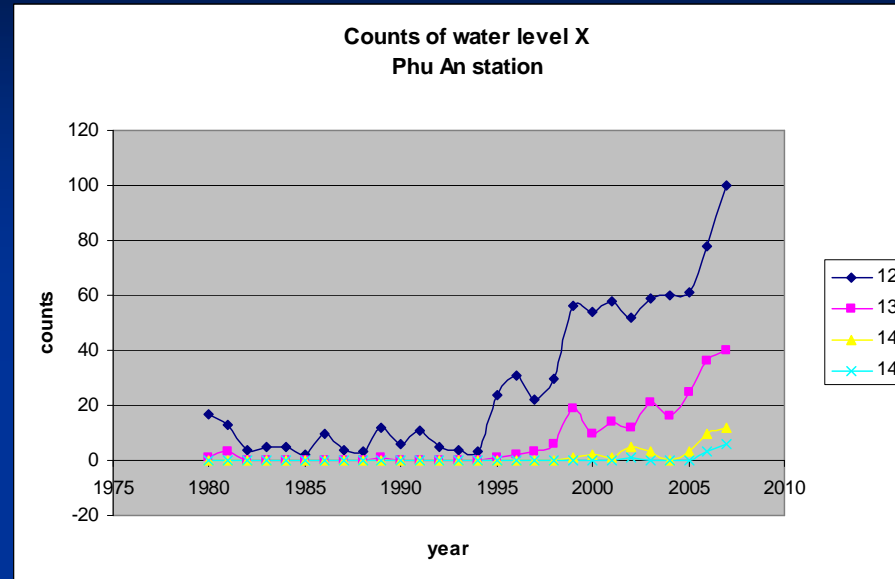
\*The last record consists of just 8 years data.

# Water levels

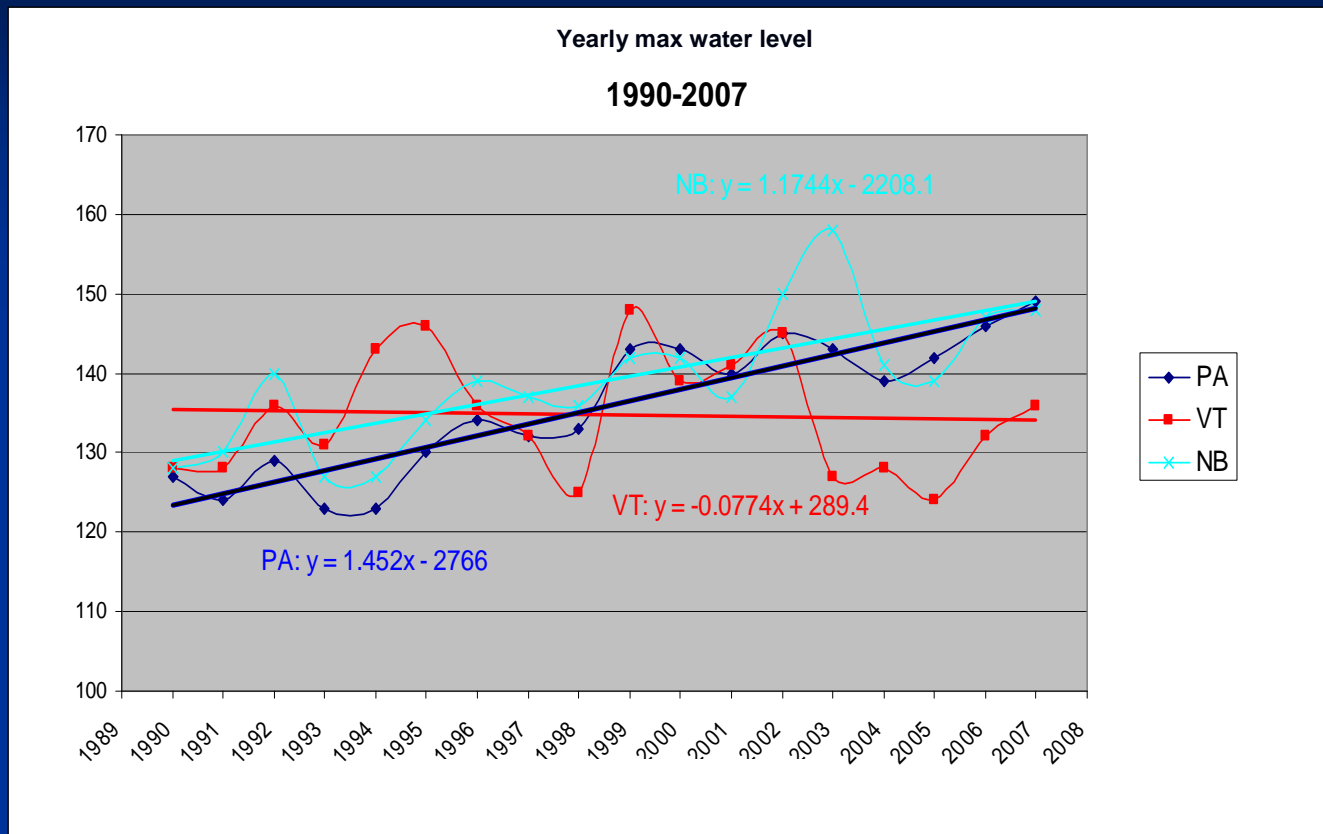


Statistical tests confirm the Non-stationary feature of the data series 1960-2009.

# Counts of water level exceedance



# Local trends in water level rise

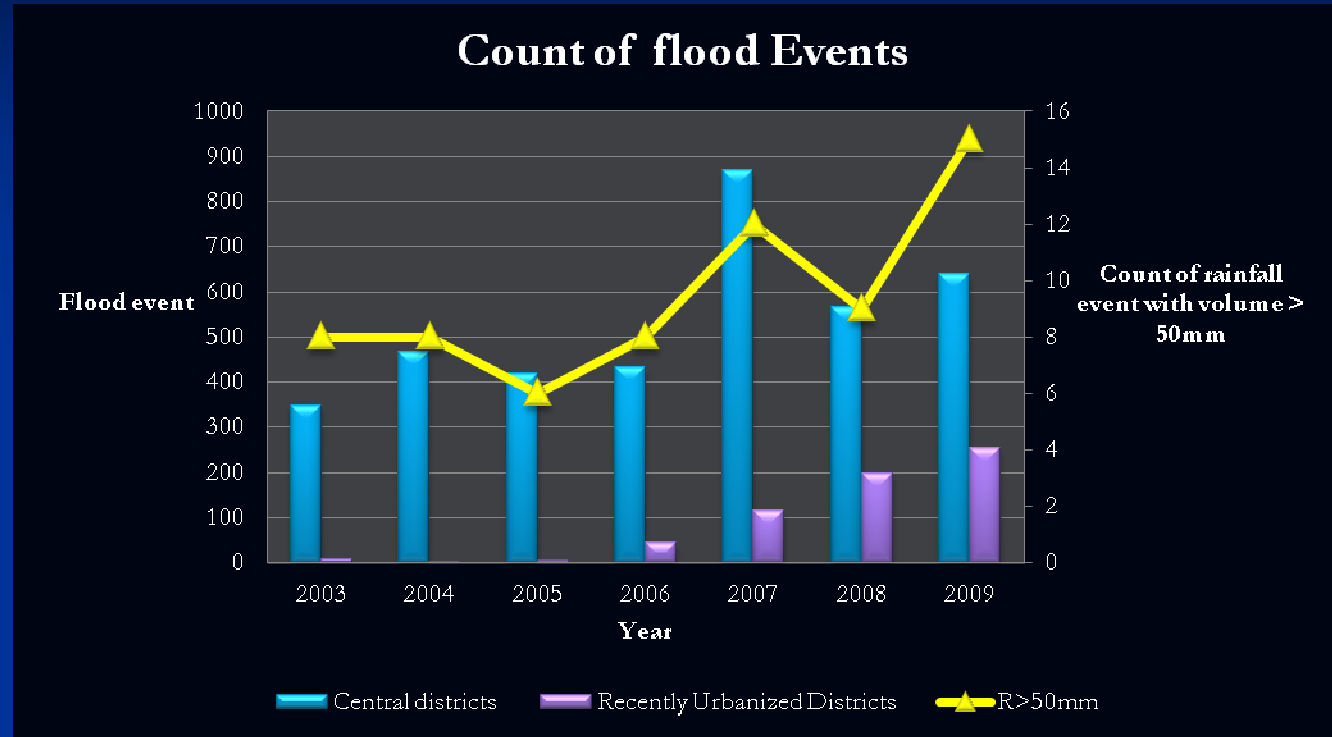


- Sea level at Vung Tau (**red line**) has been hardly changed, while all water levels at river stations has shown an average increasing of 1.5cm per year since 1990.

# URBAN FLOOD and FLOOD MANAGEMENT PROJECTS

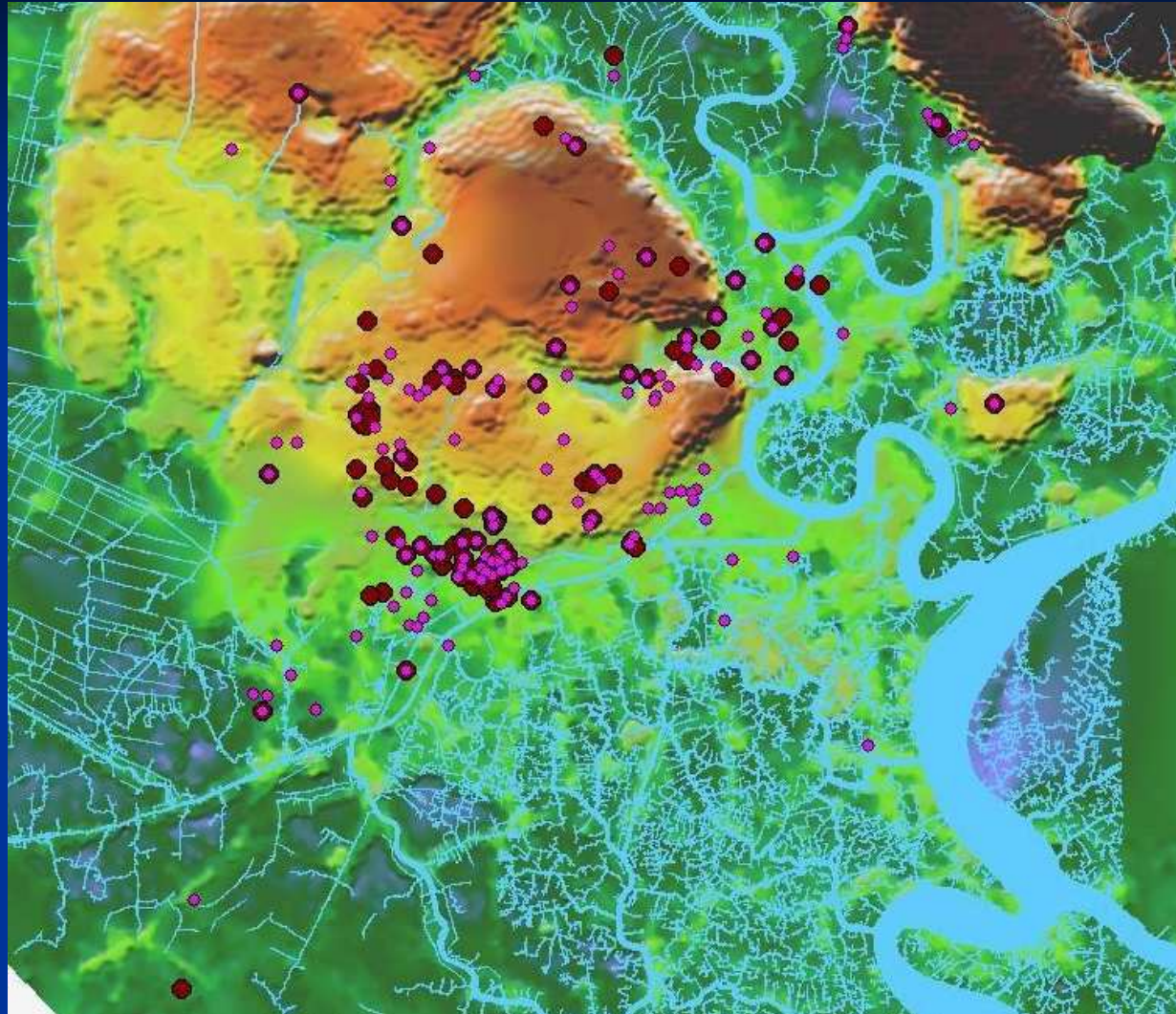


# Urban Flood in Ho Chi Minh City



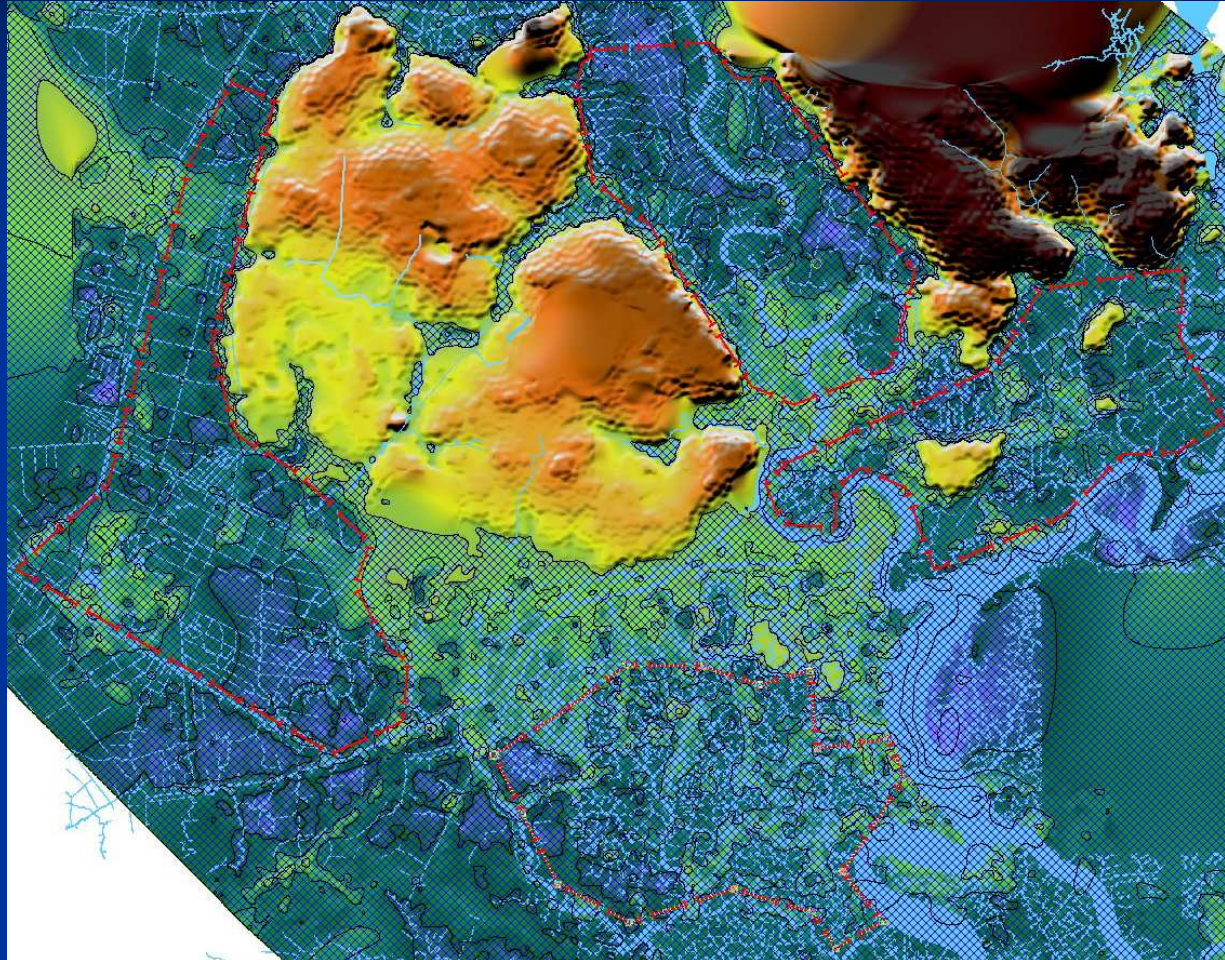
- The flooding situation in central districts has been improved since 2007, thank to flood management projects. Note that count of heavy rainfall events keeps on increasing.
- New flooded sites are developing in new urbanized districts.

# Flooded sites



Flooded sites are moving outwards to new urbanised districts .

# Flooded area at sea level +2.0



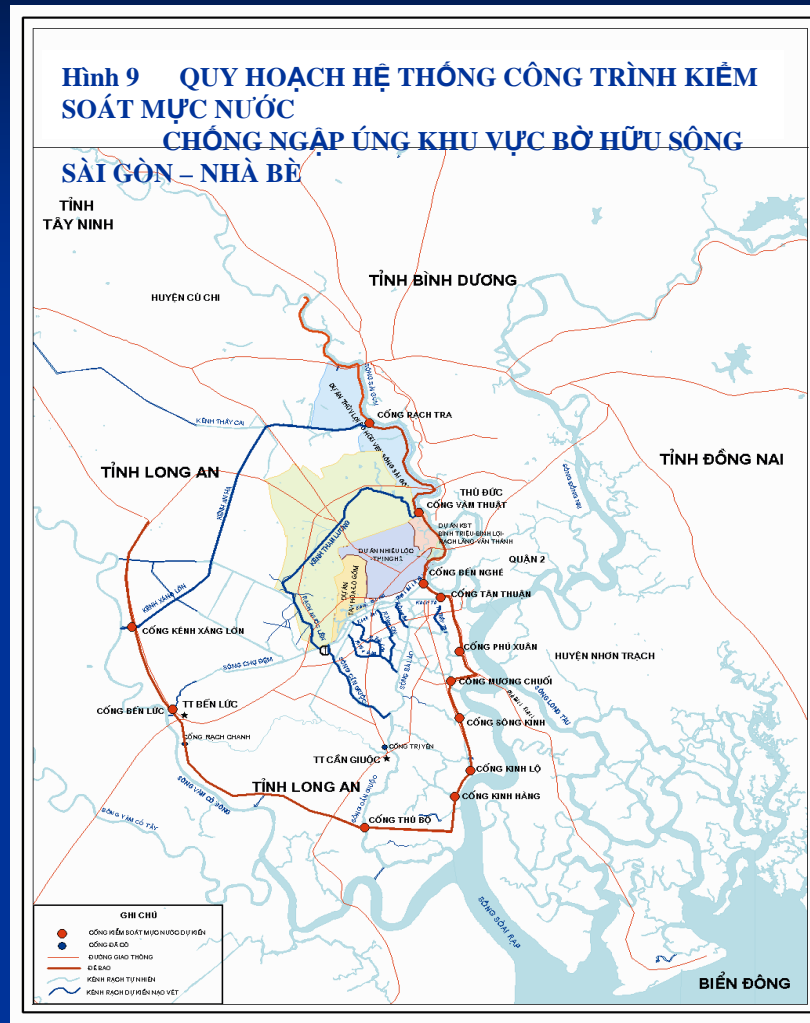
300 km<sup>2</sup> of HCM City would be flooded at water level +2.0, apart from Can Gio area.

# Urban Drainage Projects

- Master plan JICA (6/2001)
- Tham Luong-Ben Cat (USD 400 Mn., 30%)
- Nhieu Loc-Thi Nghe (USD 300 Mn., 90%)
- Tan Hoa-Lo Gom (USD 200 Mn., under construction)
- Tau Hu – Ben Nghe (USD 350 Mn., finished)
- Tide control project 1547 (USD 2 Bn., designing)
- Hundreds of small projects since 1990.
- \$6 Bn. is required for the next decades.



# Tide Control Project (MARD)



To cope with sea level rise, HCMC would be protected by a controversial plan of polder system.

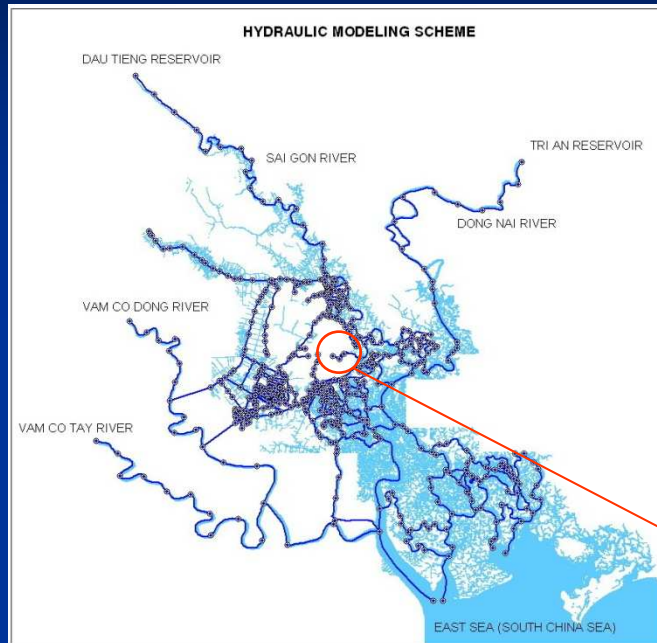
# Impacts of Climate Changes on Urban Flooding

## CASE STUDY

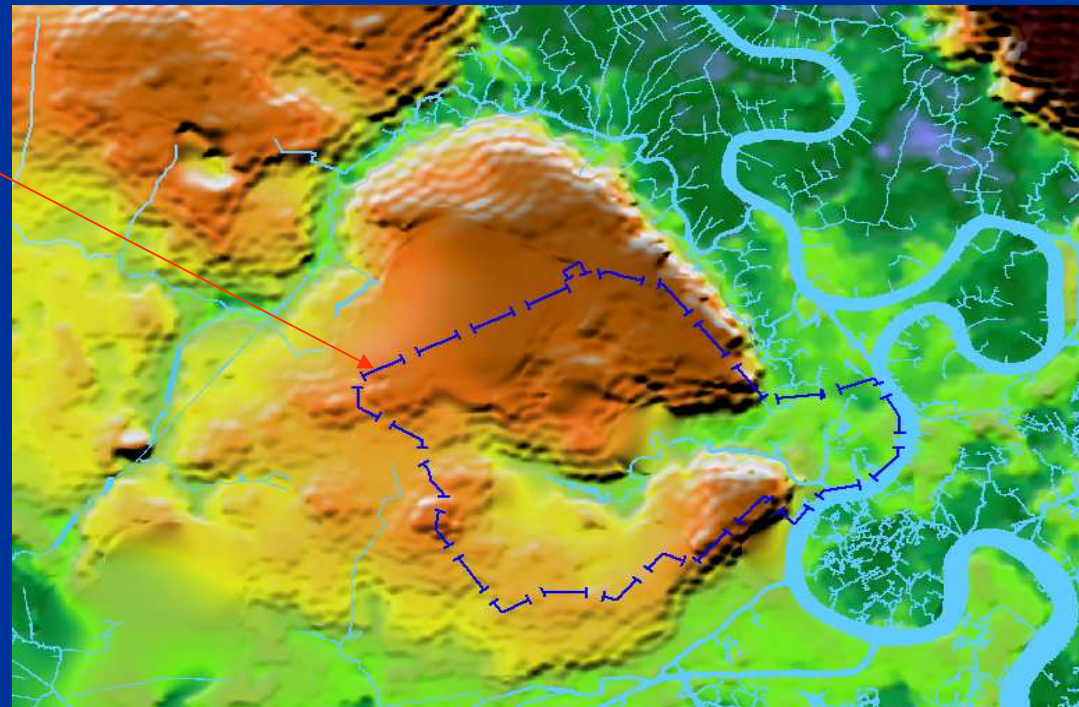
### Nhieu Loc -Thi Nghe Project



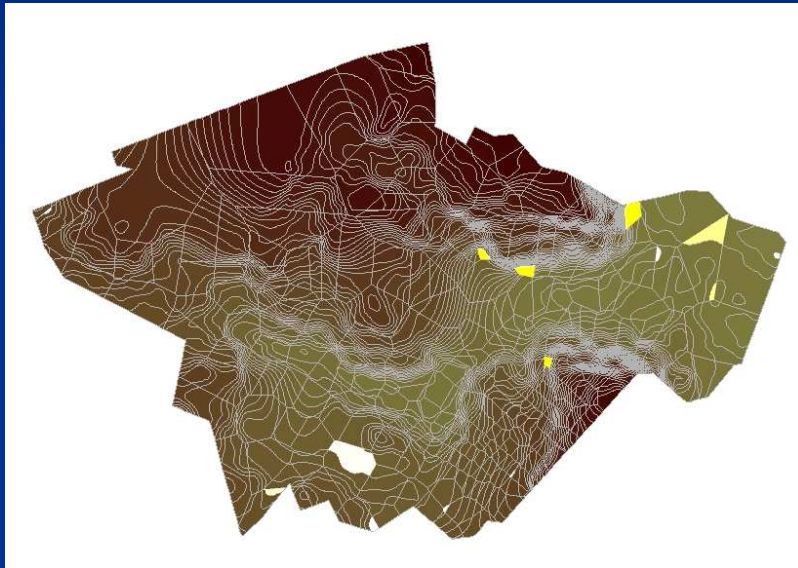
# Project outline



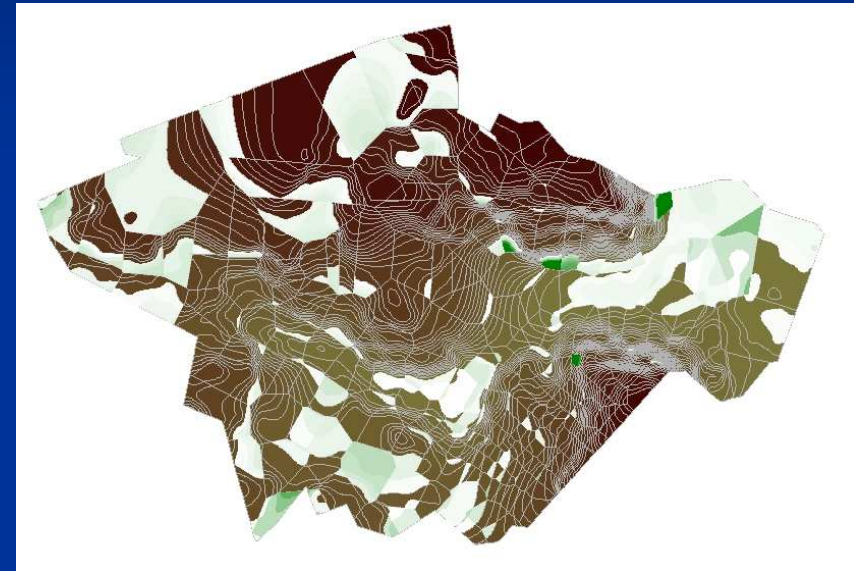
- Catchment area: 3500 ha.
- Cost: USD 300 Mn.
- Situation: Under construction phase



# Flooding prediction under extreme rainfall events (with tide gate)



| Rainfall volume (mm) | Flooded area (ha) |
|----------------------|-------------------|
| 100                  | <b>40.1</b>       |



| Rainfall volume (mm) | Flooded area (ha) |
|----------------------|-------------------|
| 200                  | <b>926</b>        |

As heavy rainfall event keeps on increasing as resulted by Urban Heat Island effect, the project performance would be reduced remarkably.

# Results and discussion

- Climate changes may result in **non-stationary time series** of rainfall and water level and require **new analysis approaches**.

- Climate changes would **reduce performance of urban drainage projects** remarkably as conventional solutions may be inappropriate.

- Tide control measures alone could not solve the **flood problems**.

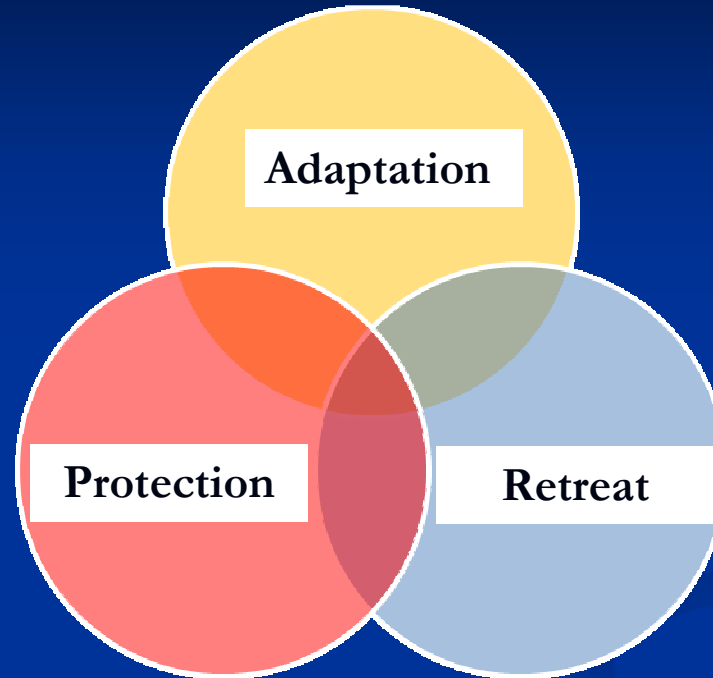


**An integrated strategy is required.**

# Integrated Strategy for Urban Flood Management



# Integrated strategy of urban flood management to adapt with Uncertainties



A sustainable urban flood management strategy should include *Adaptation* and *Retreat* components.

The optimal *balance* among the 3 components may *vary with location and/or time* and should be *decided by a robust DSS*.

# Integrated strategy of urban flood management to adapt with Uncertainties

## Protection

- Mostly constructional solutions
- Based on statistical extrapolation, therefore incapable to adapt with Uncertainties
- Easy to implement, applied dominantly

## Adaptation/ Mitigation

- Community consensus is essential
- Applied to existing urbanized areas, social impacts are important
- Partly engineering job, inter-disciplinary cooperation
- Difficult to implement

## Retreat

- Decided in Planning phase
- Most promising approach to cope with Uncertainties
- Very difficult to implement for urban areas.

# Protection: S-Principles

S

OFT:

An important principle of Sustainable Urban Flood Management is to introduce **SOFT components**, which can be adjusted to adapt with **UNCERTAINTIES** of urban development and climate changes.

S

ELF REGULATION:

Urban development projects should not overload neighborhoods with excess runoff or reduction of original discharge capacity.

S

CATTERED:

Distributed systems for various flexibility, -adaptability and -risk probability.

S

YSTEMATIC:

Operation should be centralized and early-warning based.

# Adaption

- The settlement within vulnerable areas, if not avoidable, should be emphasized with **Adaptation policies, Awareness and appropriate Facility.**
- There is **no 100% guarantee protection**, mitigation should be considered for extreme cases.



# Retreat (giving back)

- To adapt with uncertainties of climate changes, the policy to create (giving back) detention/regulation spaces for water.
- For urbanizing areas, the policy should be applied to Real estate investor/proprietor as an approval criterion.
- For existing urbanized districts, the policy should be implemented during:
  - urban upgrading process,
  - city compaction, or
  - building of underground structures (metro, parking house...).

# Integrated strategy of urban flood management

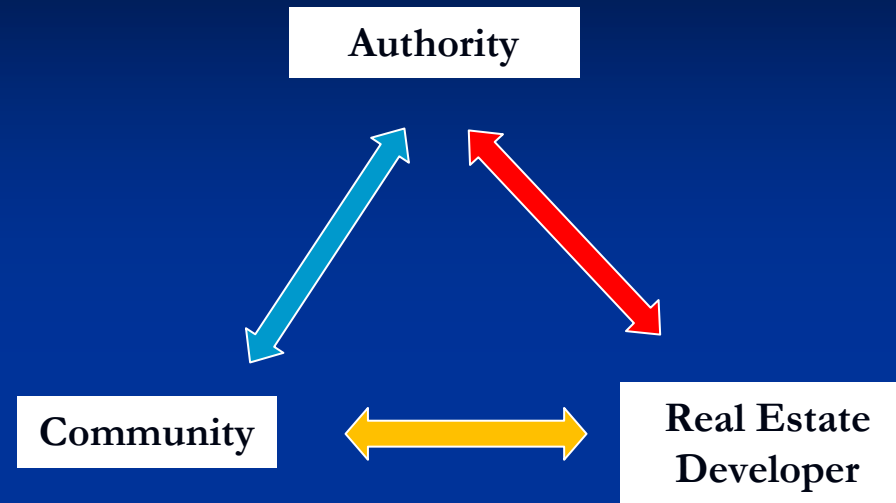


Legal framework  
Instruction/regulation  
Awareness raising  
Backbone facility building

Feed back  
Awareness/Preparedness  
Adaptation

Feedback  
Responsibility sharing  
Development Priority setting  
Auxiliary facility building

# The existing structure of Involvement



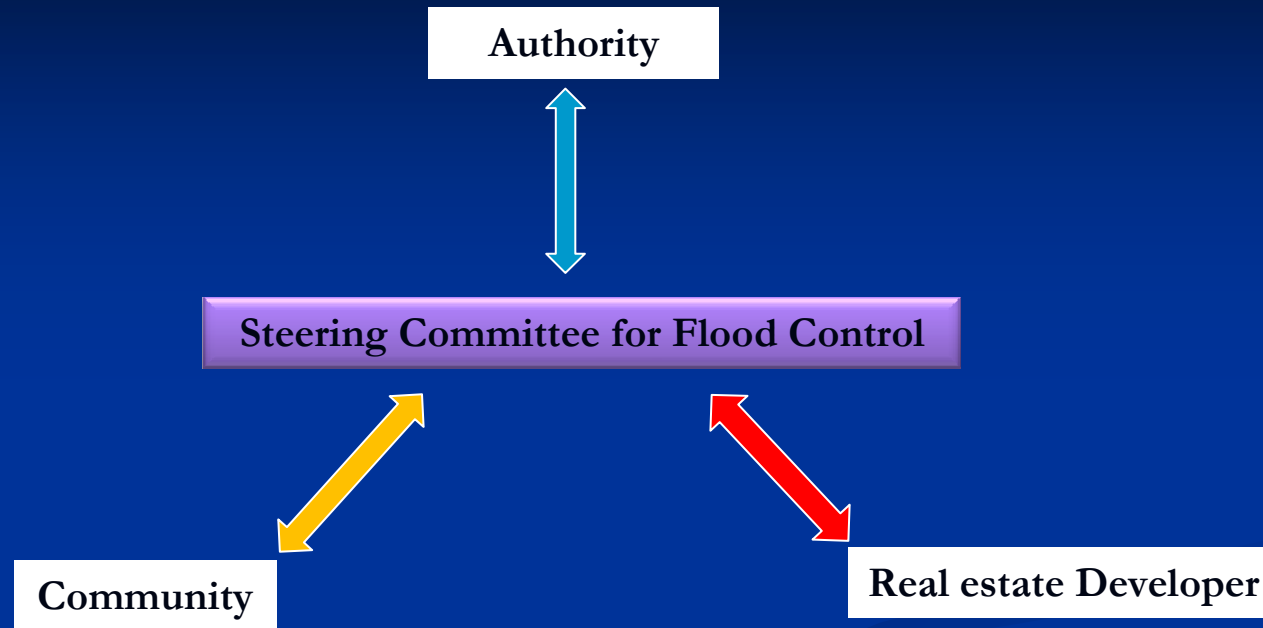
The interactions among 3 parties are usually difficult to reach agreement, causing by:

- Different information
- Different interest
- Different expertise
- Bias



Top-down planning is often preferable.

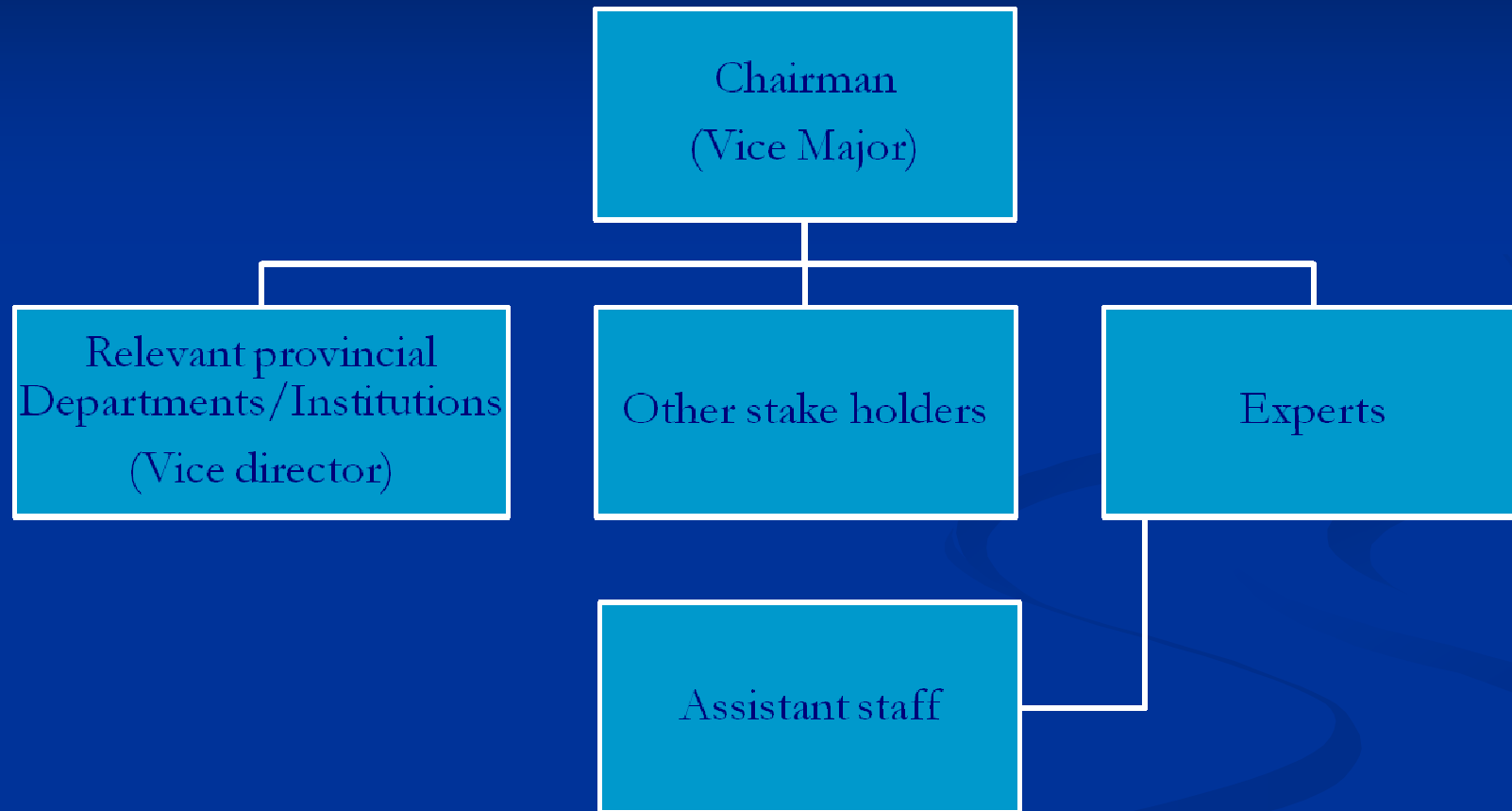
# The modified structure of Involvement



The role of the Steering Committee should be

- to share information and point of view
- to moderate interest/benefit
- to share expertise
- to represent common interest
- to response to urgent events

# The structures of the Steering Committee



# Conclusions



# Conclusions

- While sea level rise is still a potential danger, negative impacts of human-induced activities has been direct causes of the urban flood in HCMC.



- “Protection measures” using Hard solution may not capable to cope with such Uncertainties.

# Conclusions

- A dynamic balance among **Protection, Adaptation and Retreat** is requirement for the flood sustainable management strategy and can be determined by a robust DSS.



- **The flood management is no more sole engineering job** but rather integrated and multi-disciplinary.

# Conclusions

Community- and Real Estate Developer involvement in Flood management is essential.



A new structure of involvement should be introduced to moderate substantial differences among stakeholders.

**Thank you for your attention**

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