APHW Workshop

# Theories and Practices of River Restoration

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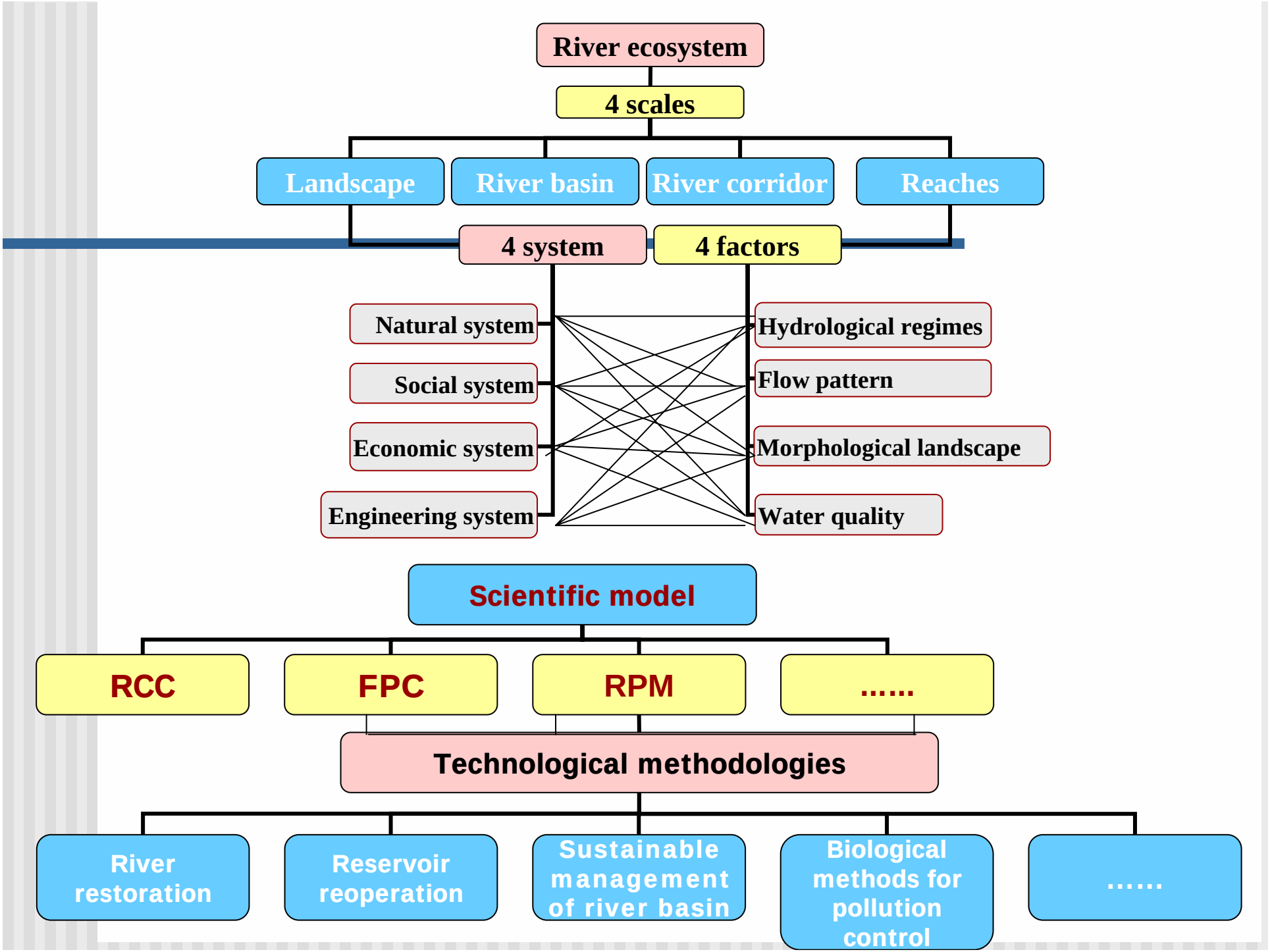
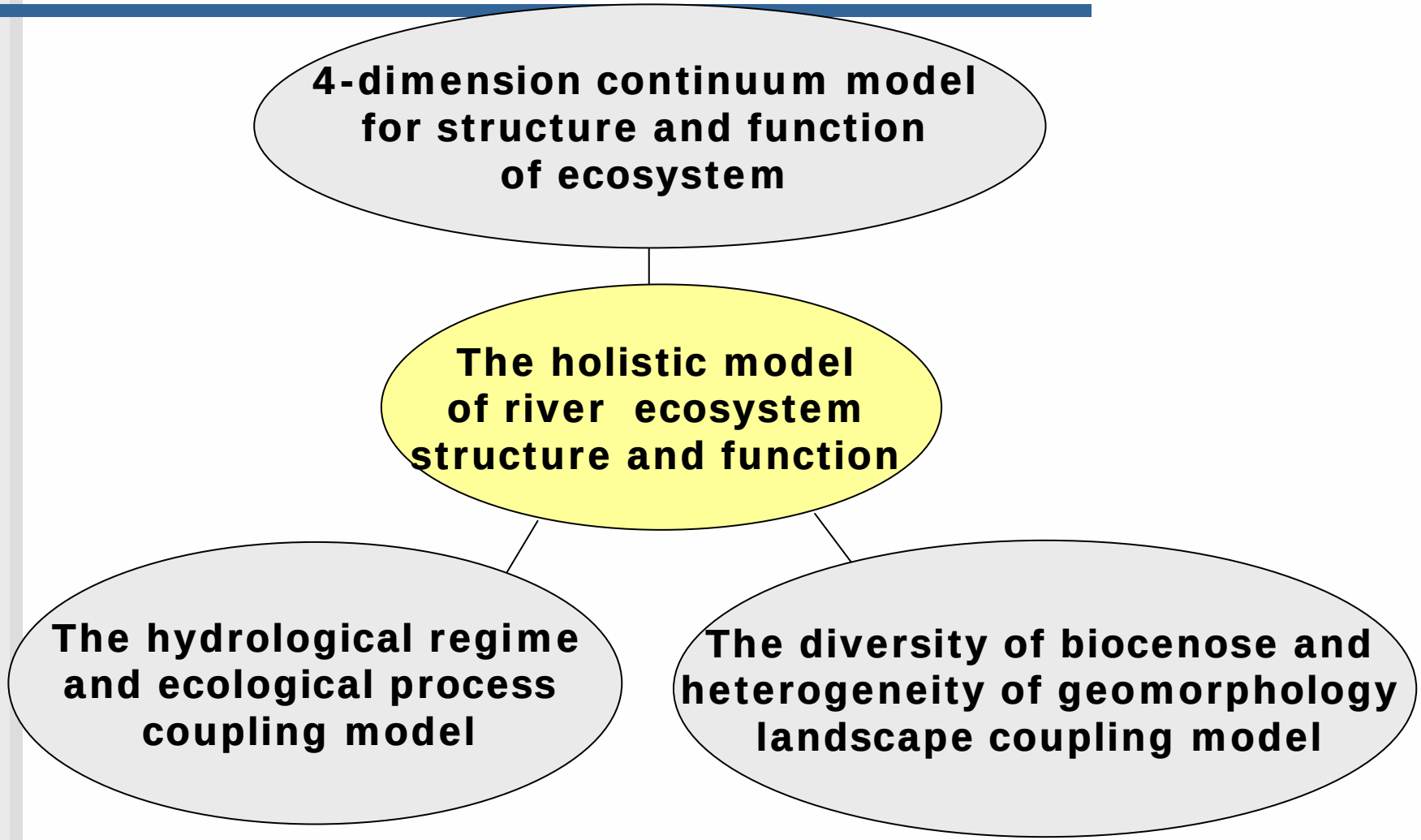
- Stresses of hydraulic engineering on river ecosystem
- Goals, tasks and principles of river restoration
- The state of the art of river restoration in China


River ecosystem
4 scales
Landscape
River basin
River corridor
Reaches
4 system
4 factors
Natural system
Social system
Economic system
Engineering system
Hydrological regimes
Flow pattern
Morphological landscape
Water quality
Scientific model
RCC
FPC
RPM
.....
Technological methodologies
River restoration
Reservoir reoperation
Sustainable management of river basin
Biological methods for pollution control
.....

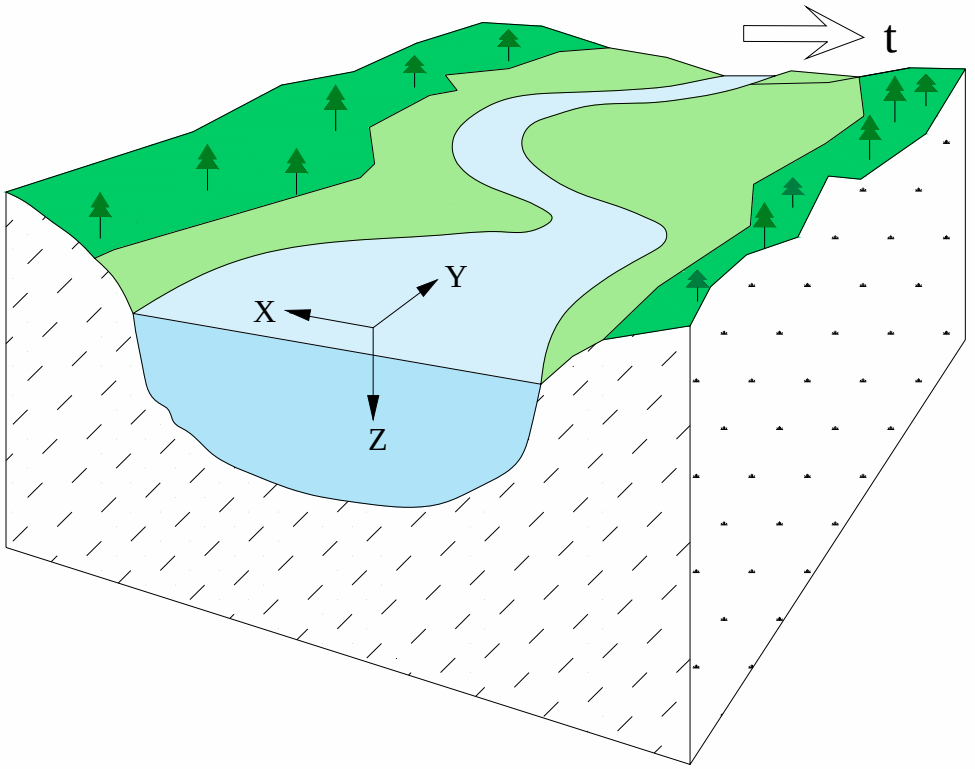
# Review of river ecosystem structures and functions

- Zonation concept
- River continuum concept
- Stream hydraulics concept
- Spiralling resource concept
- Serial discontinuity concept
- Flood pulse concept
- Riverine productivity model
- Catchment concepts
- Nature flow paradigm
- Inshore retentivity concept

# 1 Holistic model of river ecosystem structures and functions



# (1) 4-dimension continuum model for structure and function of ecosystem

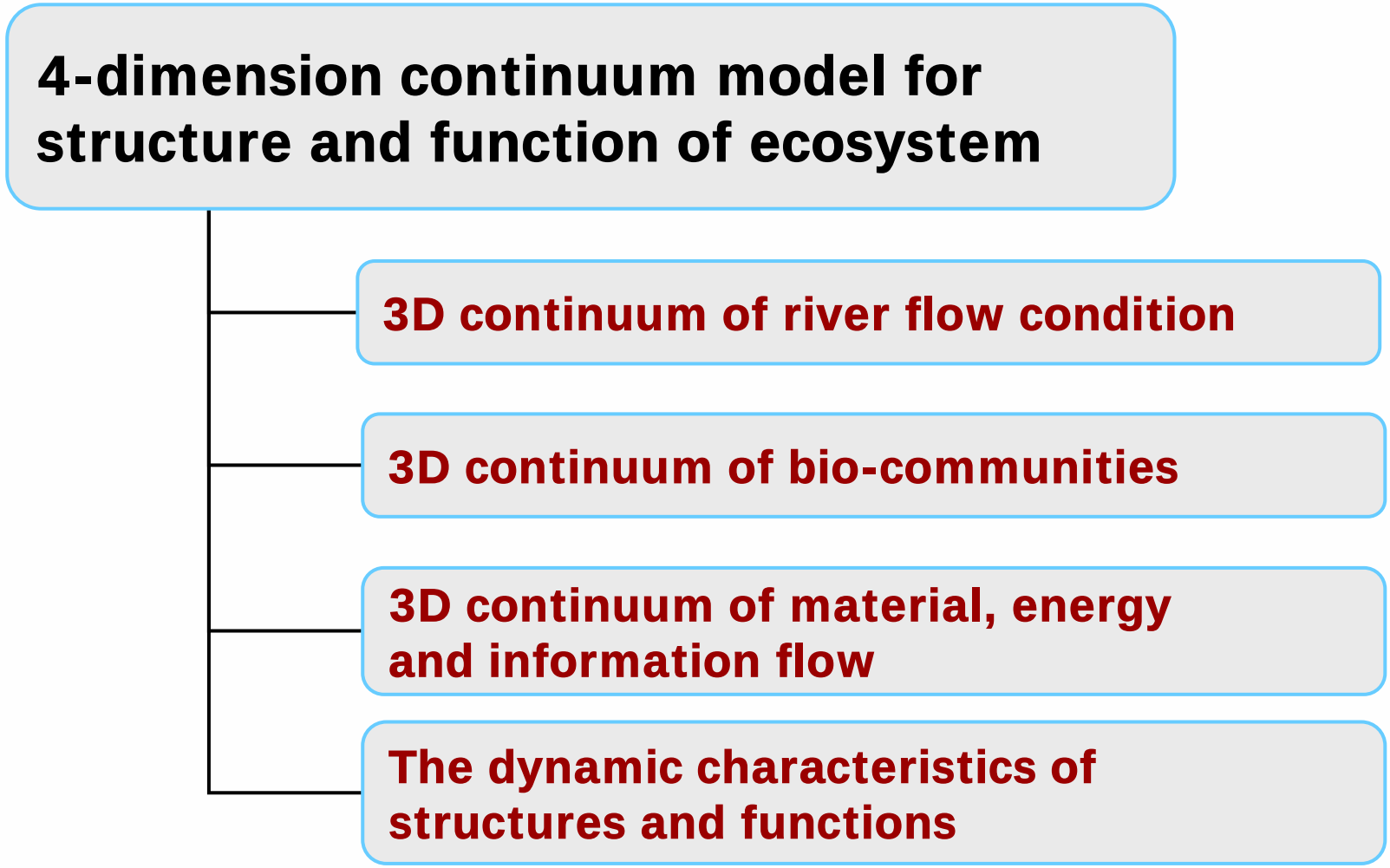



**The directions of the four-dimension**

**x: Lateral direction; y: River flow direction; z: vertical direction;**

**t: Temporal direction**

# (1) 4-dimension continuum model for structure and function of ecosystem



# (1) 4-dimension continuum model for structure and function of ecosystem

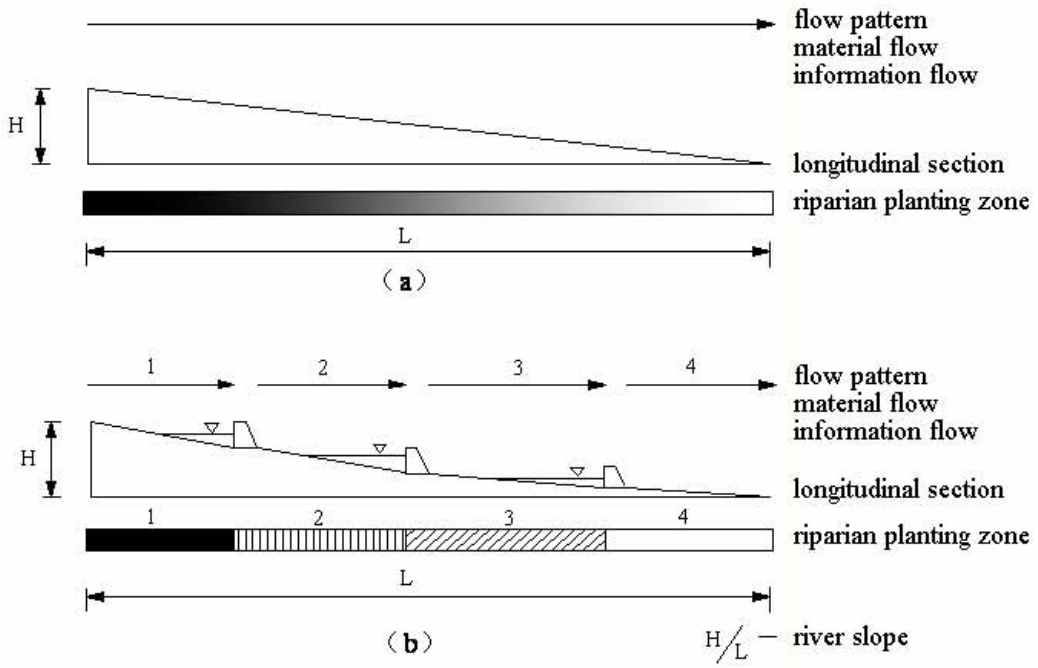
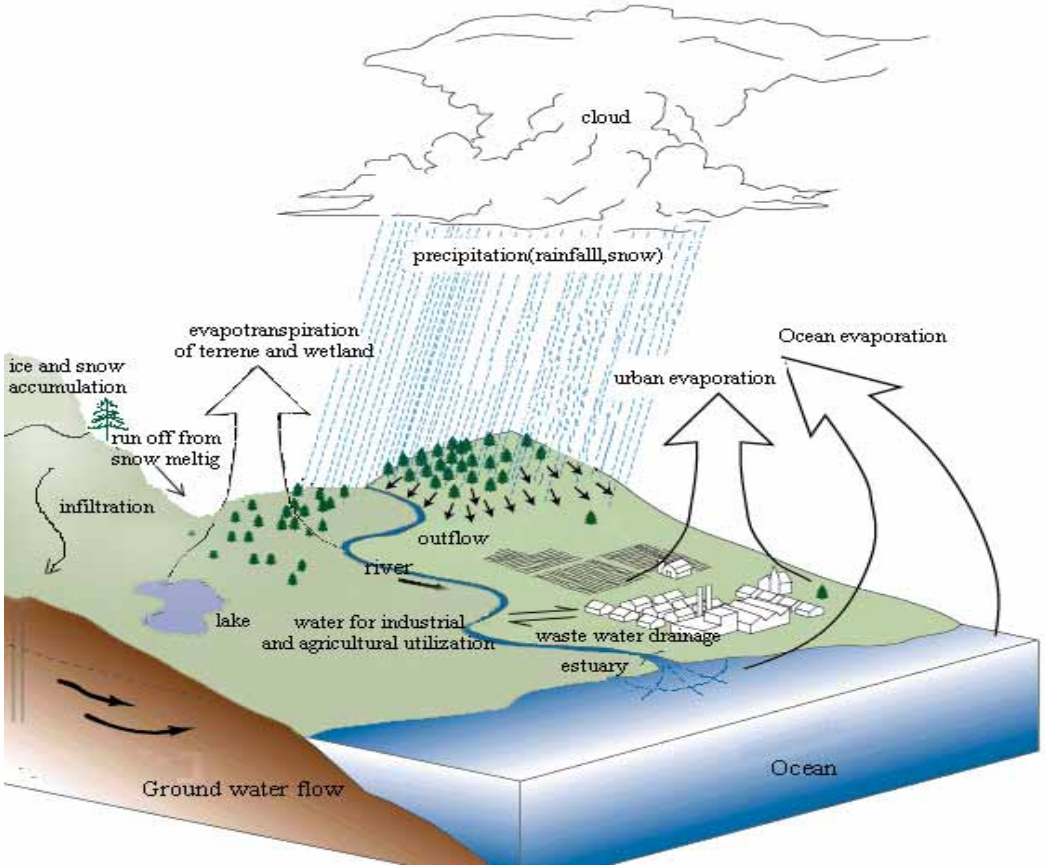



**Illustration of the 4-dimension continuum model**

# (2) The hydrological regime and ecological process coupling model

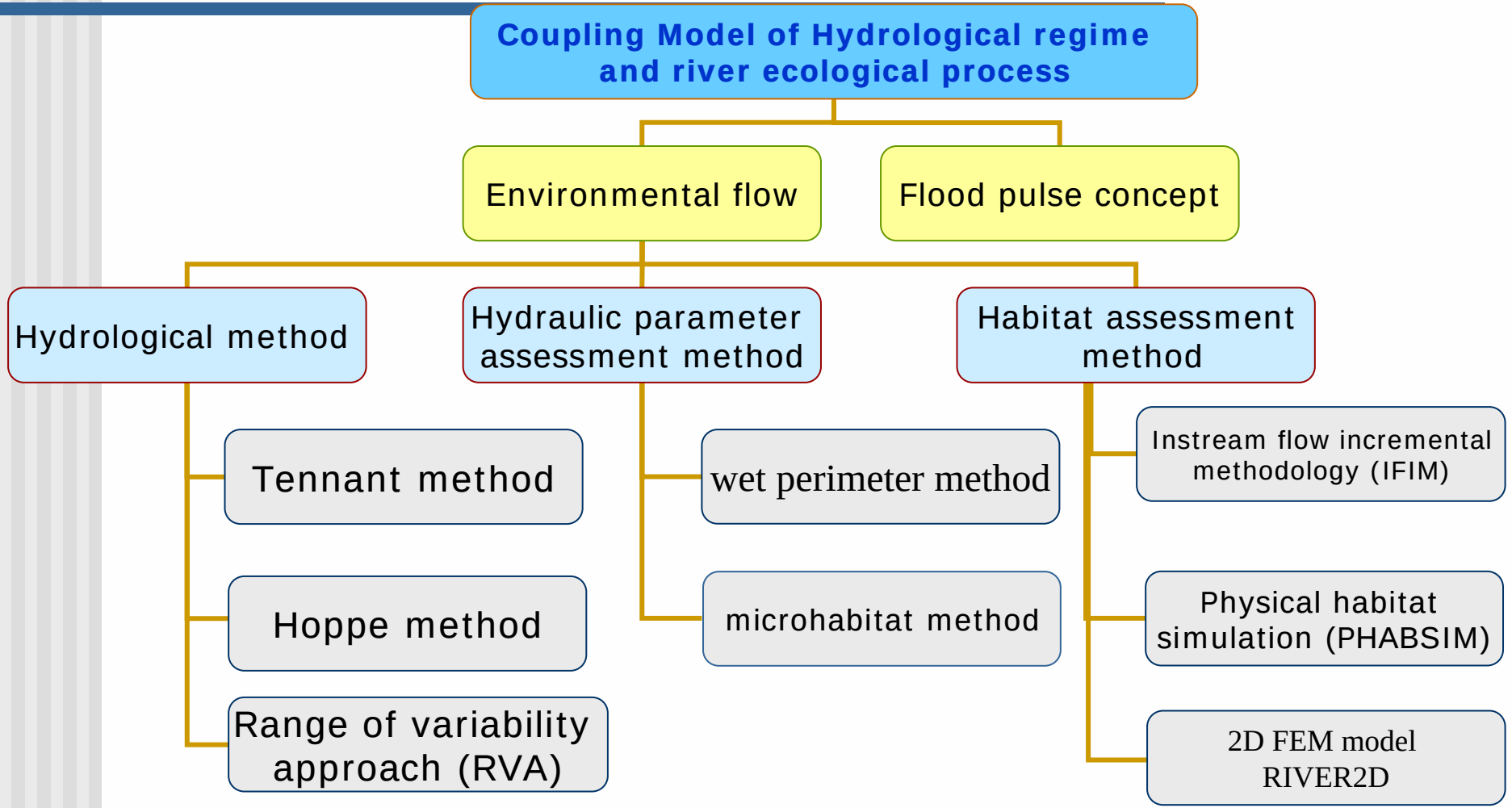



The interweaving of Hydrological cycle and biological processes

# (2) The hydrological regime and ecological process coupling model

- This sub-model include two concepts
  - Environmental flow
  - flood pulse.

# (2) The hydrological regime and ecological process coupling model

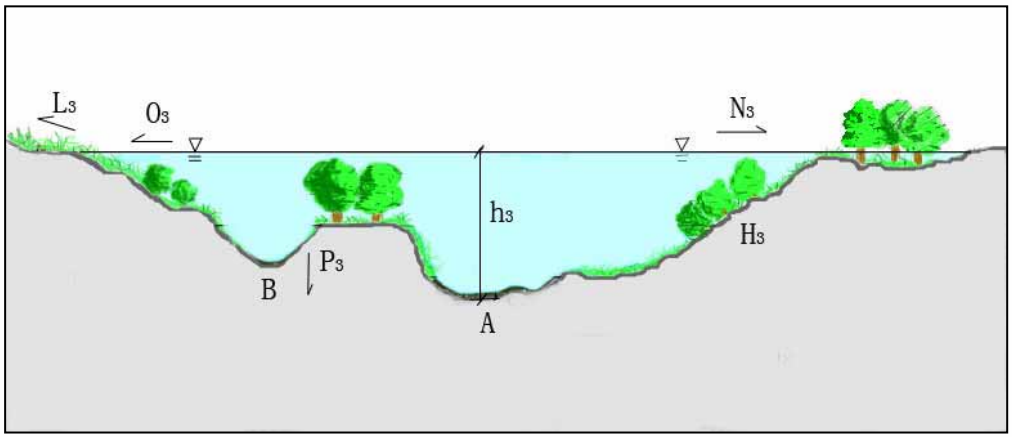


## (2) The hydrological regime and ecological process coupling model

- Environmental flow
- It is put forward for achieving the balance between human requirement and river ecological conservation
- Its main objective is to prevent the degradation of river ecosystem caused by run-off decrease.

# (2) The hydrological regime and ecological process coupling model

- Flood pulse concept
  - Flood pulses are the driver for the live, productivity of biology



# The drive effect of flood pulse

- ✓ Changes in high and low flow cycles of hydrological process will result in diverse behavioral trait of many species.

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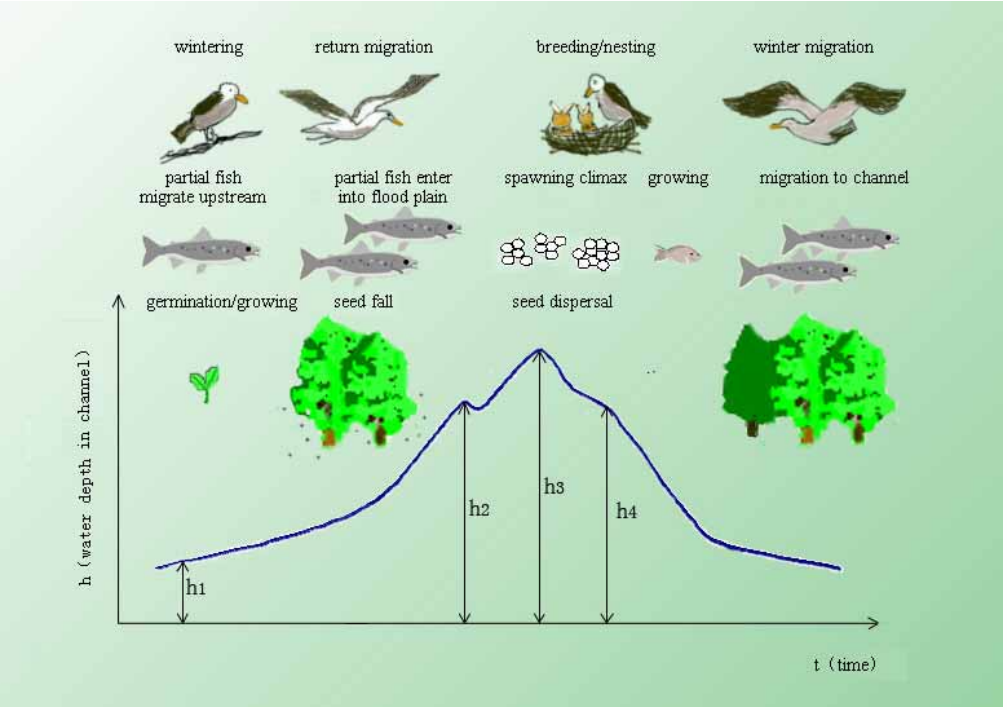
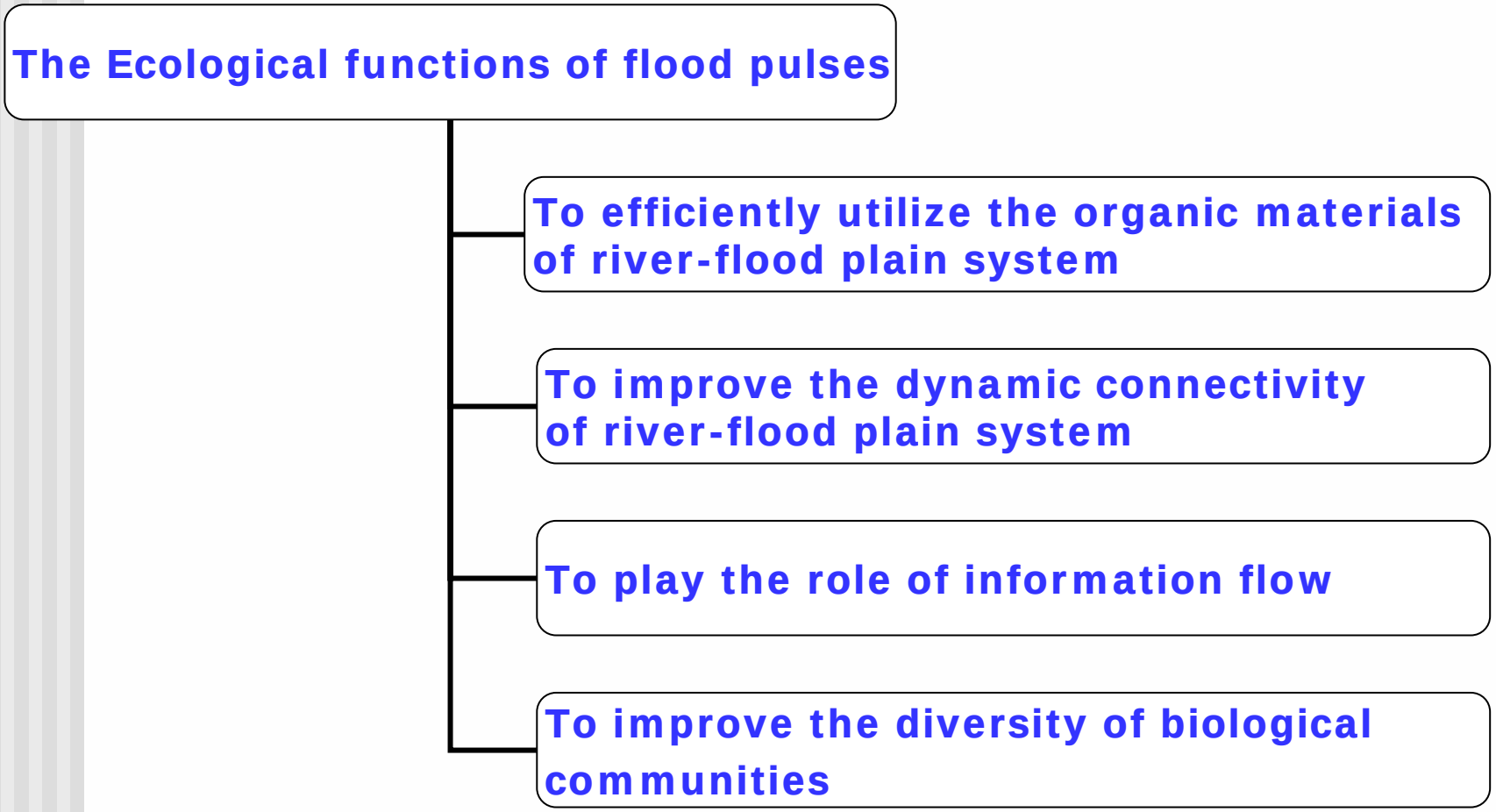
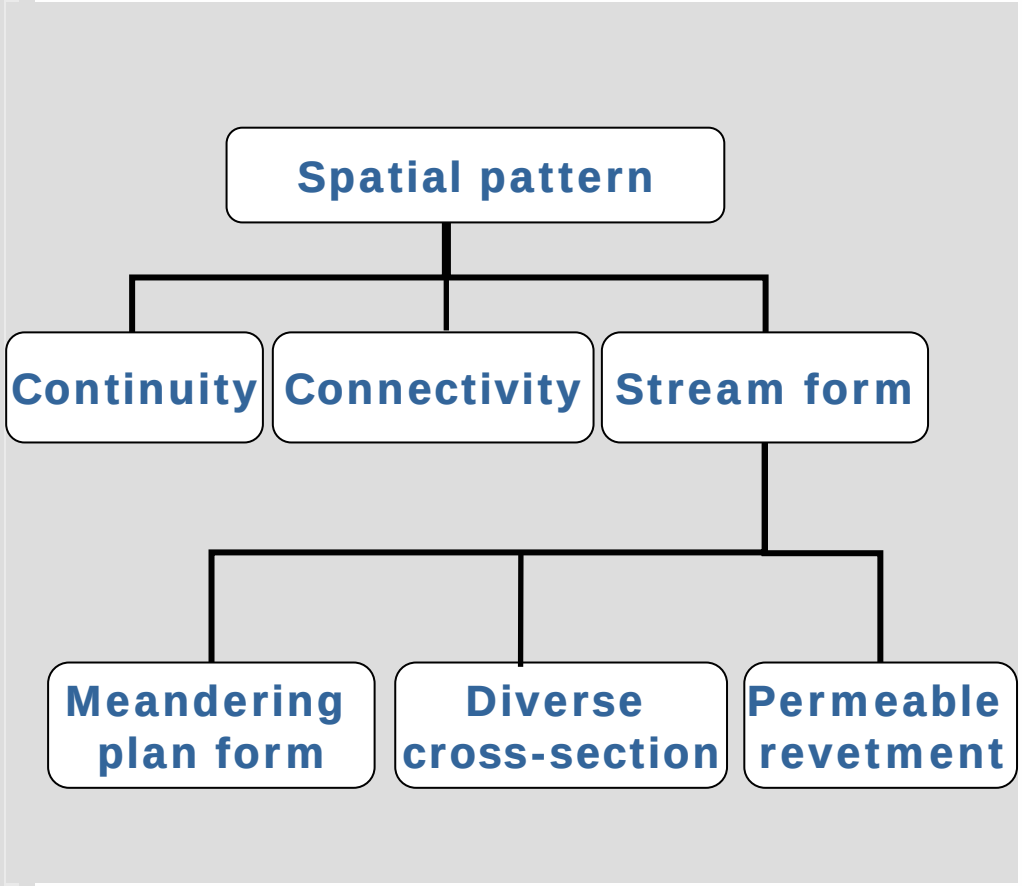
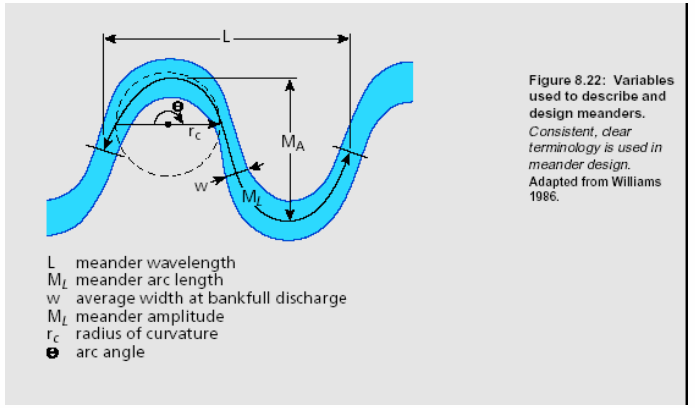


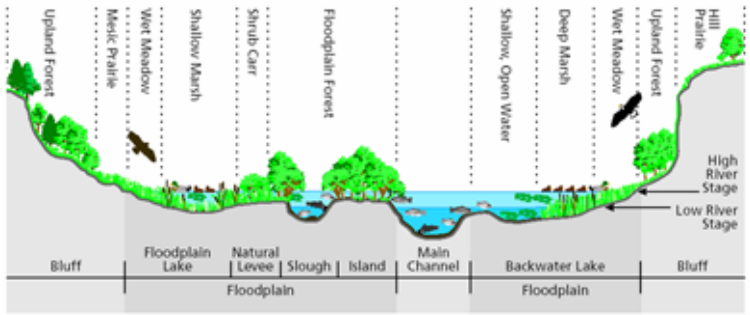
# The Ecological functions of flood pulses



# (3) The diversity of biocenose and heterogeneity of geomorphology landscape coupling model

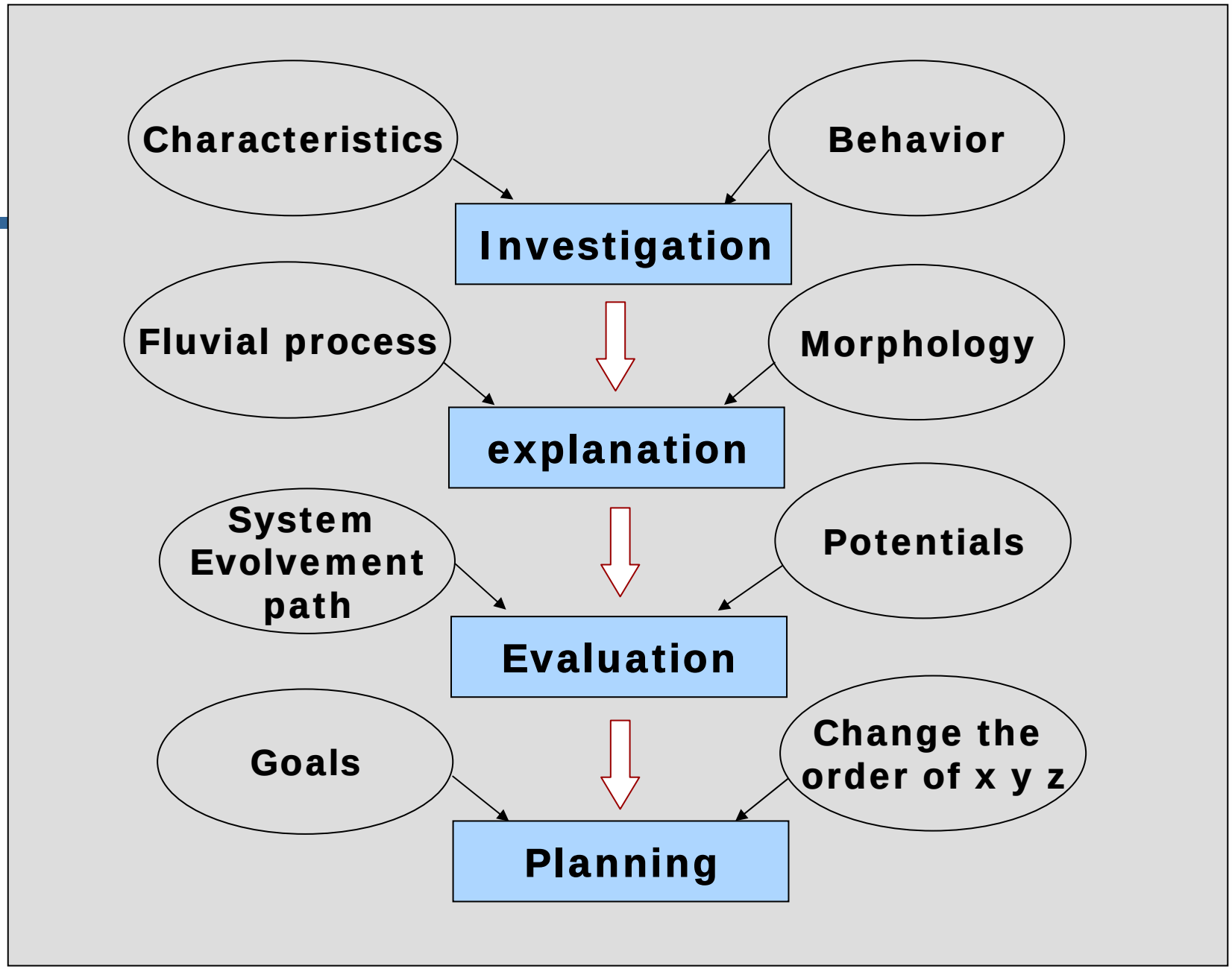


## (3) The diversity of biocenose and heterogeneity of geomorphology landscape coupling model

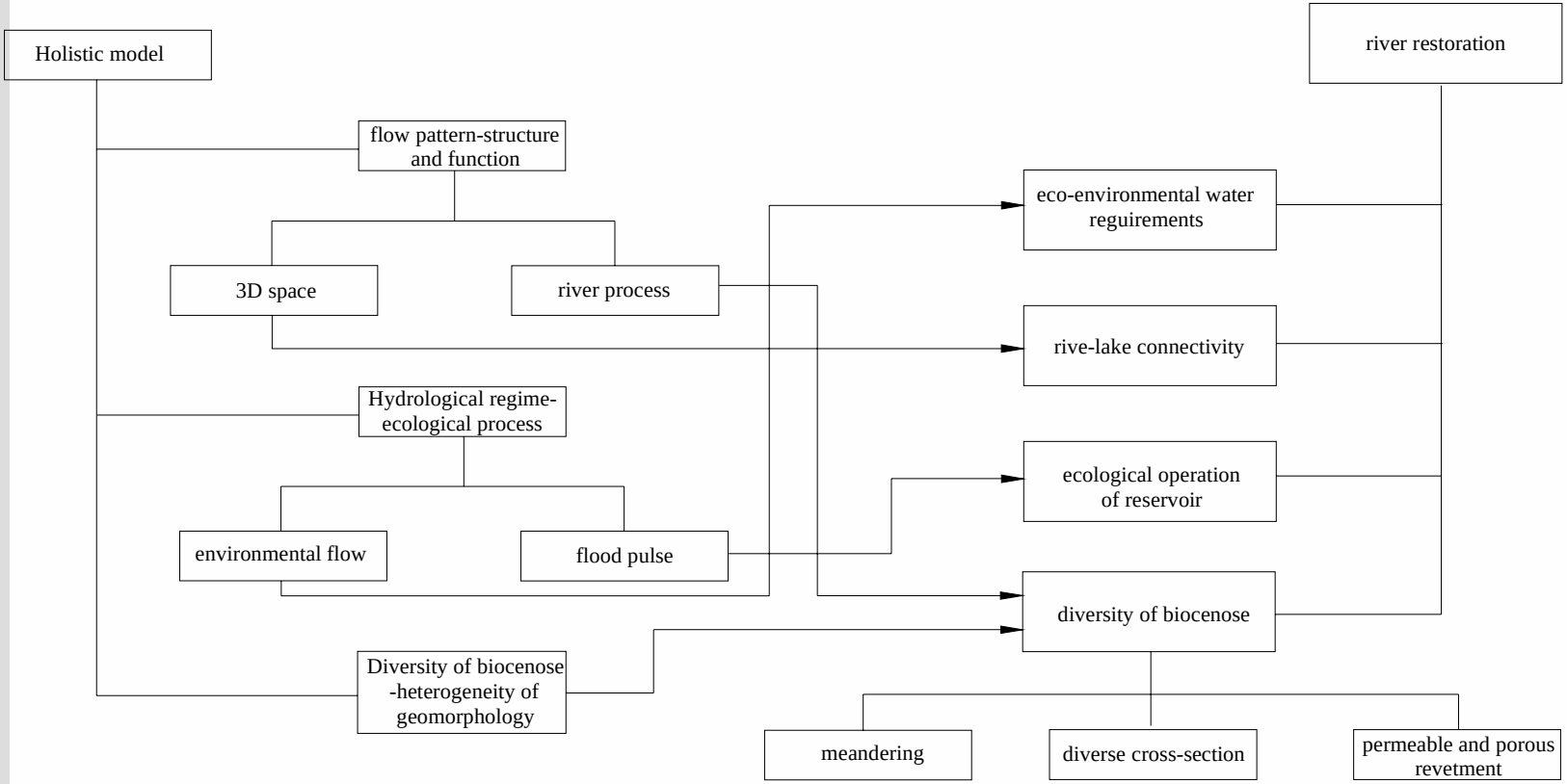
- Establish relationship of spatial heterogeneity and diversity of community.
- The coupling model is used for evalaation the condition of rive ecosystem and predicting its trend.


Characteristics
Behavior
Investigation
Fluvial process
Morphology
explanation
System Evolvement path
Potentials
Evaluation
Goals
Change the order of x y z
Planning

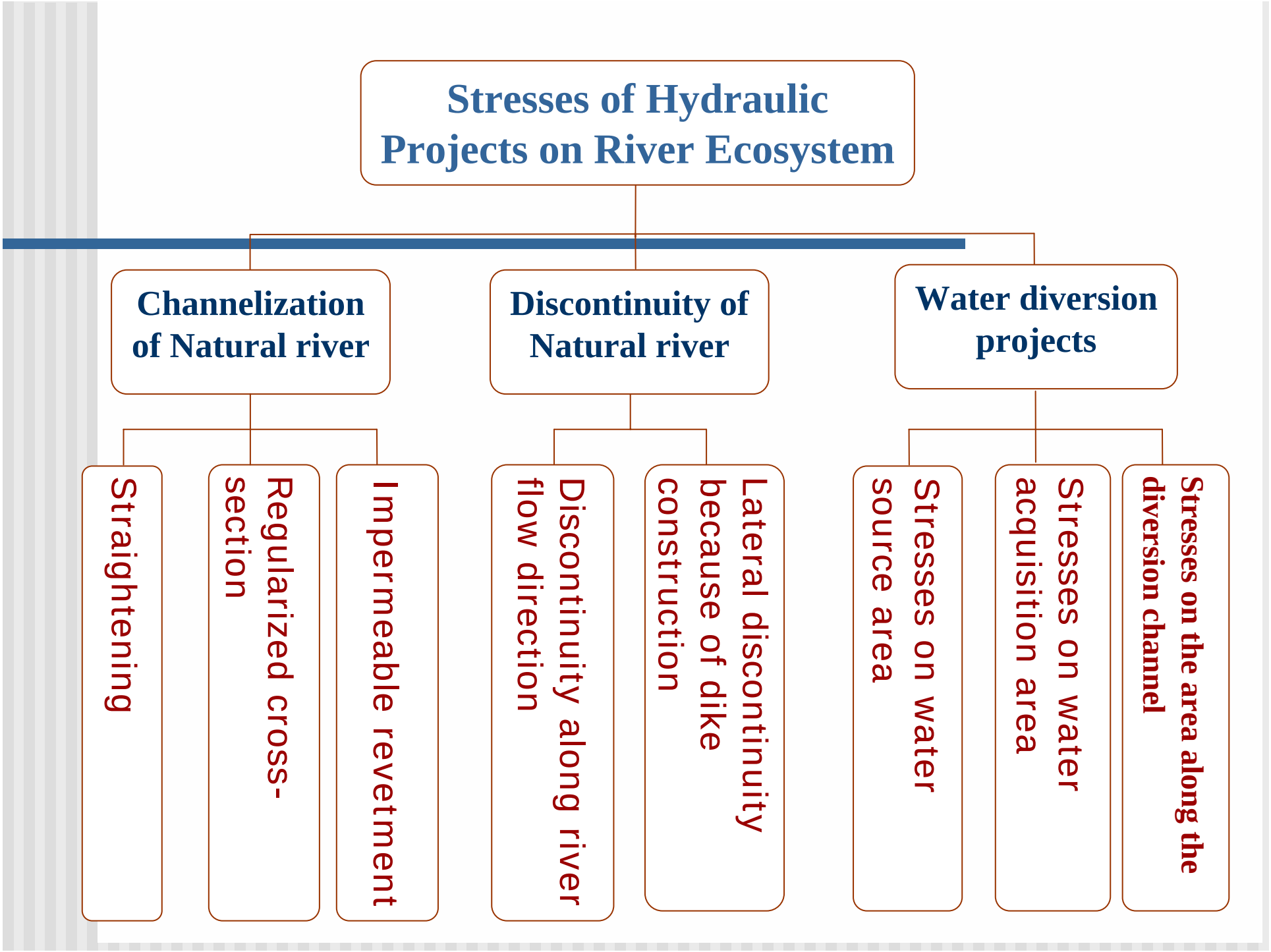
# 1 Holistic model of river ecosystem structures and functions

- This holistic model is a kind of conceptual description of river ecosystem;
- It is also the  basic for river restoration.

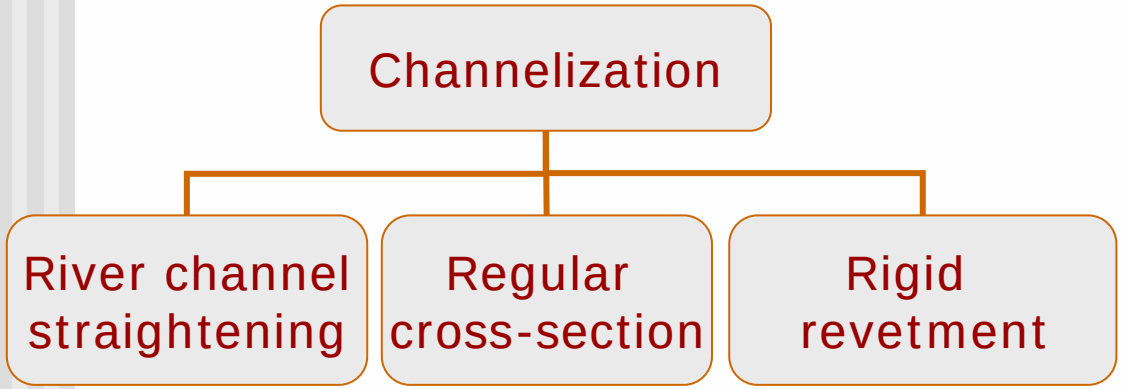
# Application of the models in river restoration



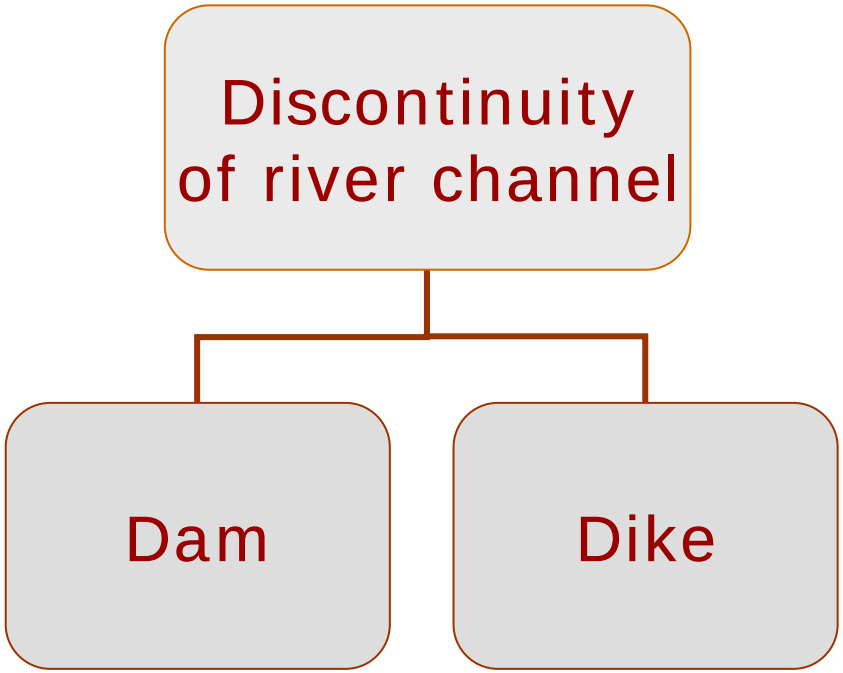
# 2 Stresses of Hydraulic Projects on River Ecosystem


Stresses of Hydraulic Projects on River Ecosystem
Channelization of Natural river
Straightening
Regularized cross-section
Impermeable revetment
Discontinuity of Natural river
Discontinuity along river flow direction
Lateral discontinuity because of dike construction
Water diversion projects
Stresses on water source area
Stresses on water acquisition area
Stresses on the area along the diversion channel

# a) Channelization of natural river

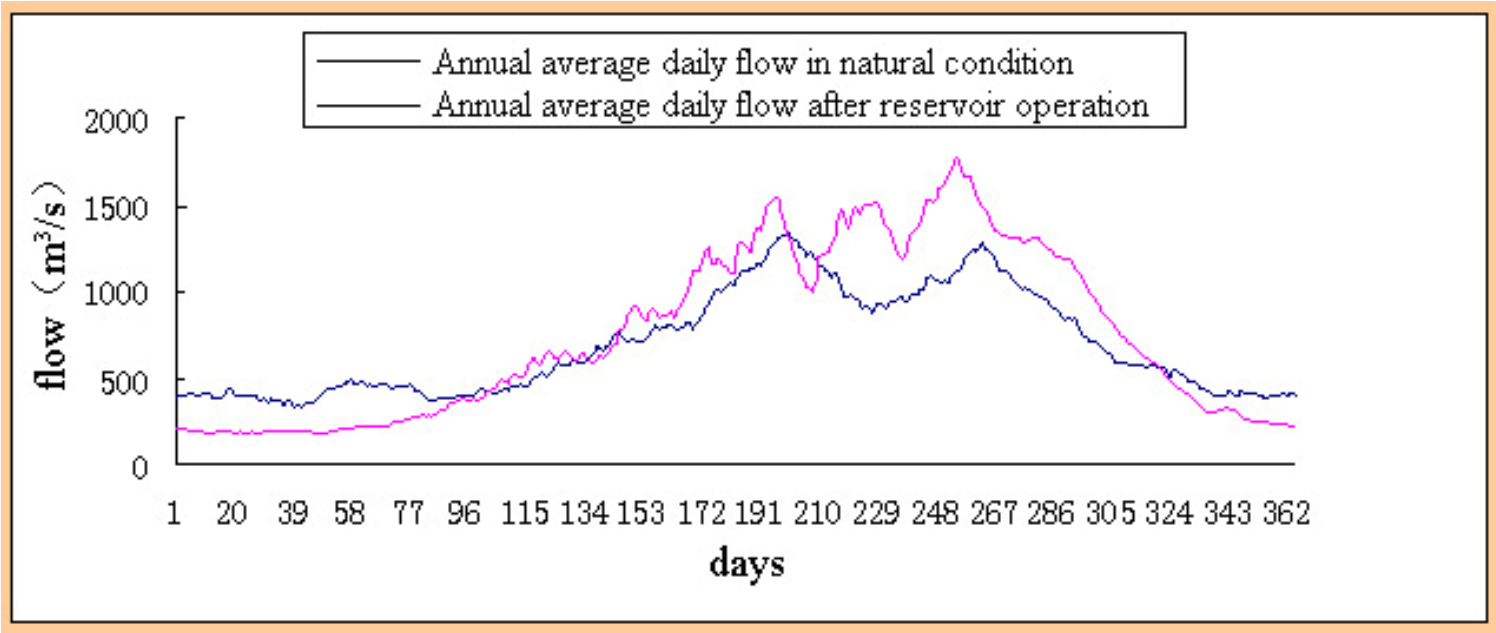



# b) Discontinuity of river channel




# b) Discontinuity of river channel-hydrological regime

- The uniformization of natural hydrological process including diverse flood pulses

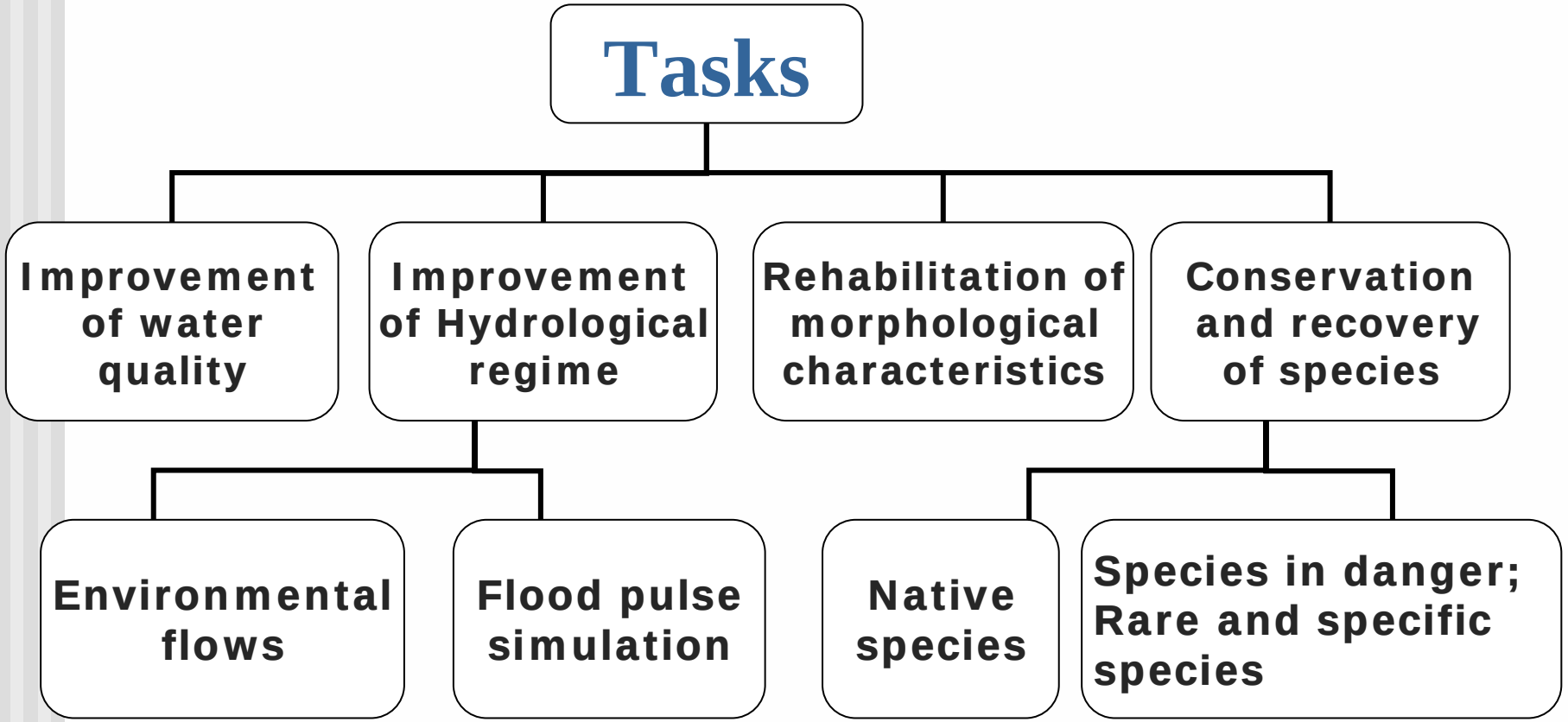


# 3 Goals and tasks of river restoration

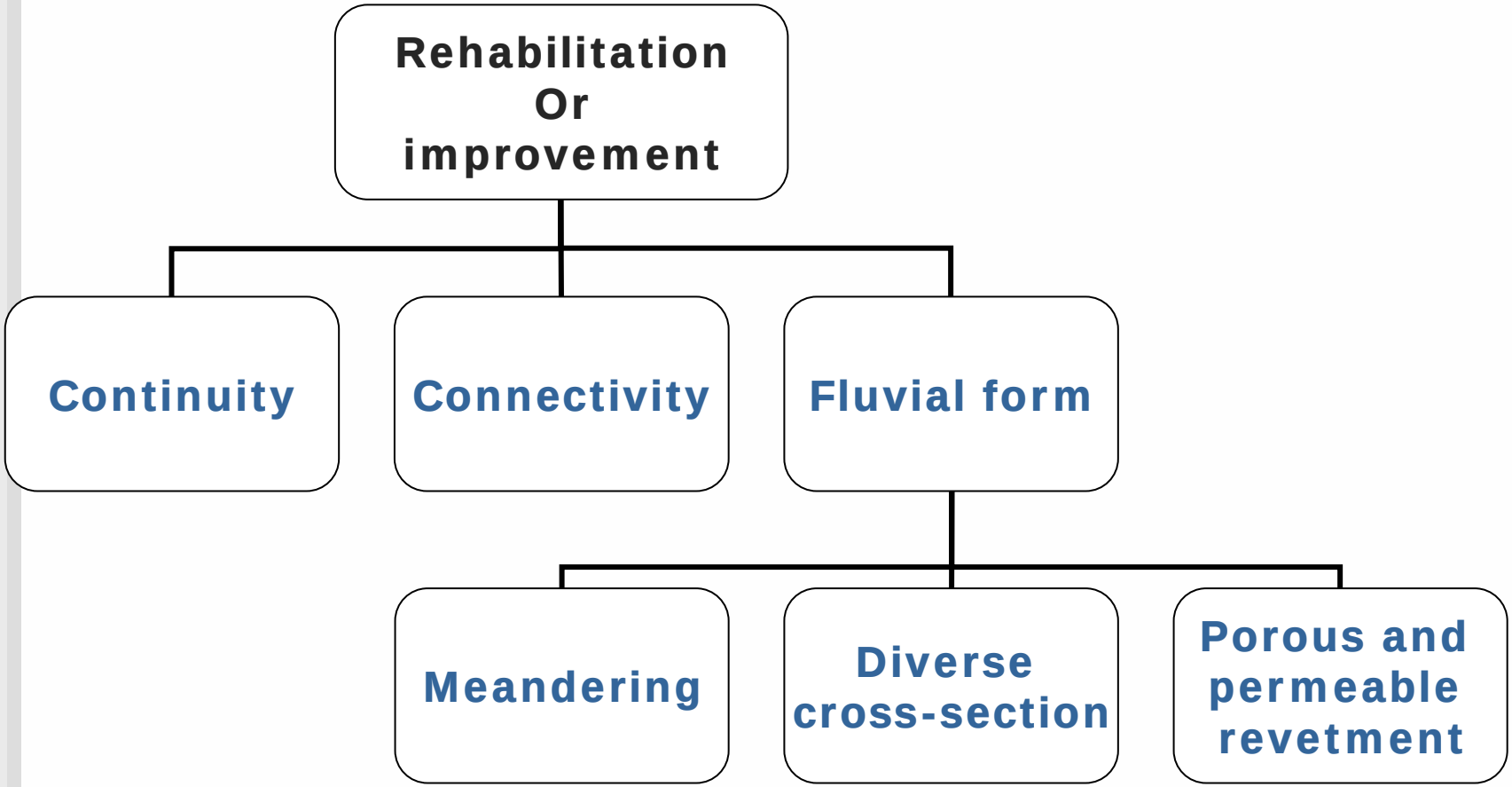
# 3 Goals, tasks and principles of river restoration

- Goals of river restoration
  - To restore or improve the structure and function of river ecosystem
- Indicator of the success of river restoration projects
  - The increase of bio- diversity

# Tasks of river restoration



# Rehabilitation of morphological characteristics



# 4 The state of the art of river restoration in China

- Since 2004, The Ministry of Water Resources (MWR) has conducted more than 10 demonstration projects
- China Institute of Water Resources and drydro power research (IWHR) has carryed out research program and the promote demonstration projects.

# The roles of MWR

**In 2006 and 2007, the planning 10 demonstration projects got the approval of MWR.**

# Demonstration Projects under the auspices of MWR

**In 2006 and 2007, eight sites are selected for demonstration**

- **Guilin City in Guangxi.**
- **Wuhan City in Hubei**
- **Wuxi City in Zhejiang**
- **Laizhou City in Shandong**
- **Lishui , Zhejiang**
- **Xinbin County in Liaoning**
- **Fenghuang County in Hunan**
- **Chagan Lake in Jilin**

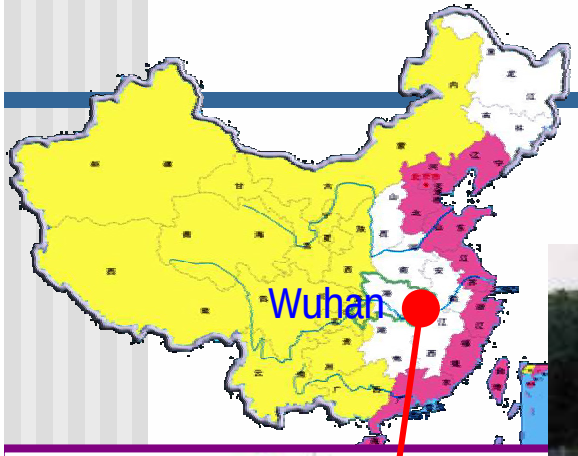
**These sites represent different aquatic characteristics, river, urban water network, lake, ground water, wetland, etc.**

# Introduction on several demonstration projects of MWR

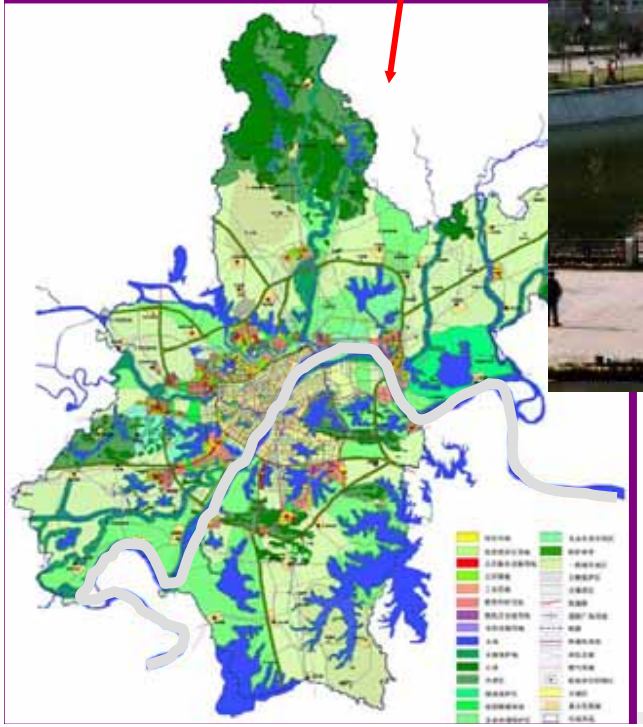
# (1) The restoration of aquatic ecosystem in Guilin reach of Lijiang river

- General goals: maintain river environmental flow, ensure the safety of flood defences, maintain water level in wetland, improve water quality, conserve the bio-diversity , enhance aquatic habitat
- Two-stage goals: 1st, 2010; 2nd, 2015.

# (2 )The restoration of aquatic ecosystem in urban area of Wuhan city




A city enwinds with rivers & lakes

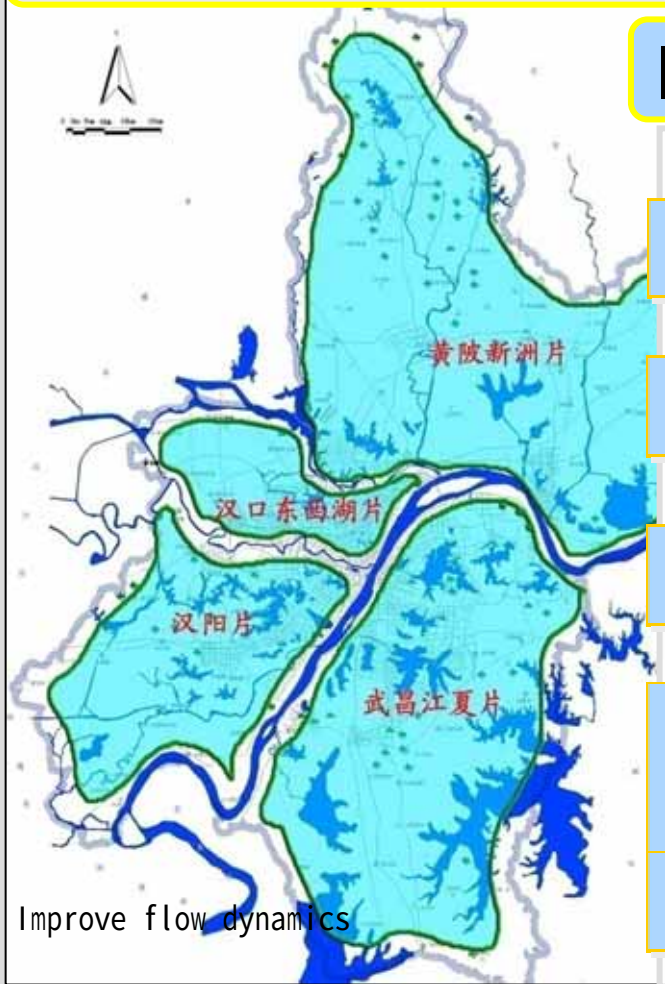


Yangtze river

# General Goals

## The Plan's outline (2002-2010/2020)

**Re-building River net**




**Improve water quality**

Various measures

**Point so**

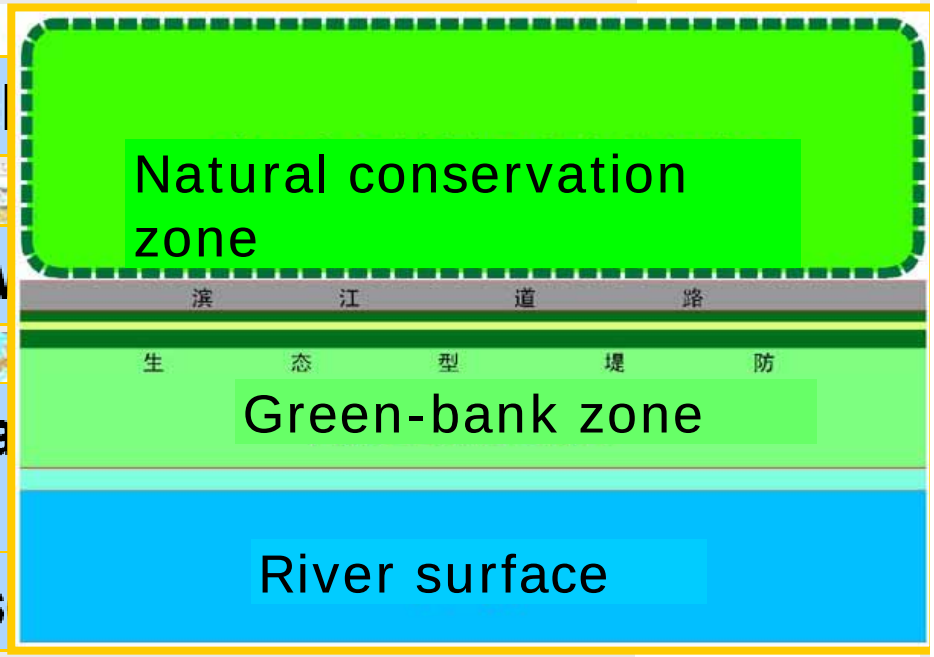
**Increase sel**

**Improve sev**

**Strength wa**
**ability**

**Non-point s**

**Riparian re-construction**



# Effects of the restoration projects

# Demonstration projects by IWHR

Case-1

# Xinjiangtan River in Haining county in Zhejiang Province

- Natural river form
- Diverse cross-section
- Diversity of aquatic habitat
- Plant revetment
- Diverse plants for landscape enhancement

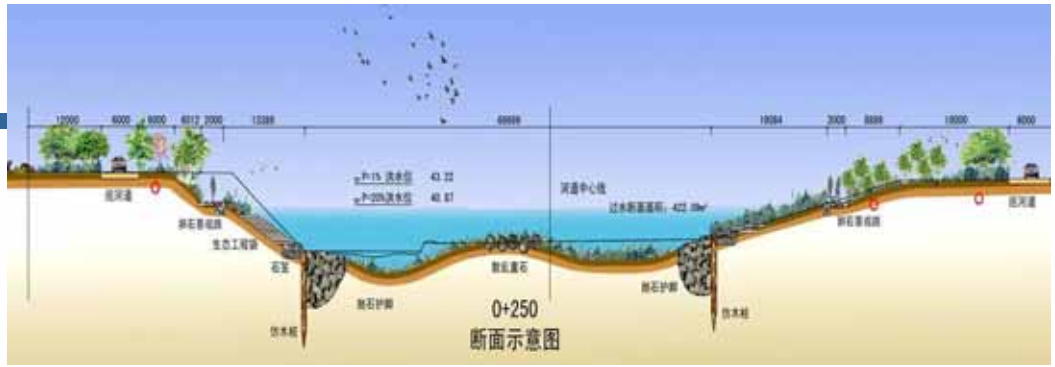
⇩

- Benefits of traditional hydraulic projects
- Water quality improvement
- Increase of biocenos diversity
- Cost saving of 23 million RMR

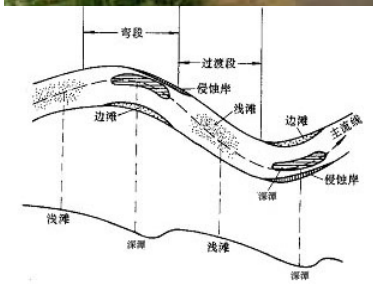
Case -2

# Guanlanhe river and Tianxiahe river

- The increase of habitat heterogeneity
  - Diverse morphological characteristics
  - Alternation of pool with riffle,
  - Distribution of torrent and slow flow.




Typical cross-section




Effects of the projects

Case-3

# Kuxihe River of Chongqing City

Change original landscape planning and design towards a comprehensive ecologically-friendly schemes

Diverse plant

Diverse cross-section

Habitat diversity

Fishing

Riparian planting

Plank road above water

# Plan of demonstration project of the MWR

- **In 2008 and 2009, additional 16 projects will be authorized for demonstration.**
- **Additionally, 30 projects will be authorized for demonstration by local governments.**

# Conclusions

- River restoration projects are highly complicated in China because of its broad area, diverse natural conditions and different ecological conditions of river basins.

# Conclusions

- Chinese river restoration work is promoted by governments at different levels. It is gradually carried out following the technical research, demonstration and generalization. It is now in favorable progress

# Conclusions

- In technical aspects, methodologies will be established primary .
- Draft Technical regulation is underway.

# Conclusions

- The shortcoming exists in disadvantage of wide-spread national investigation on the aquatic ecosystems.
- It is necessary to establish river ecosystem monitoring system in the large river basin.
- International cooperation should be strengthened for multi-lateral benefits.

# Lao Zi said :

Man follows the ways of earth,

Earth follows the ways of heaven,

Heaven follows the ways of Dao,

Dao follows the ways of nature.

- Lao Zi

《 Dao De Jing 》

# Thank you for your patience