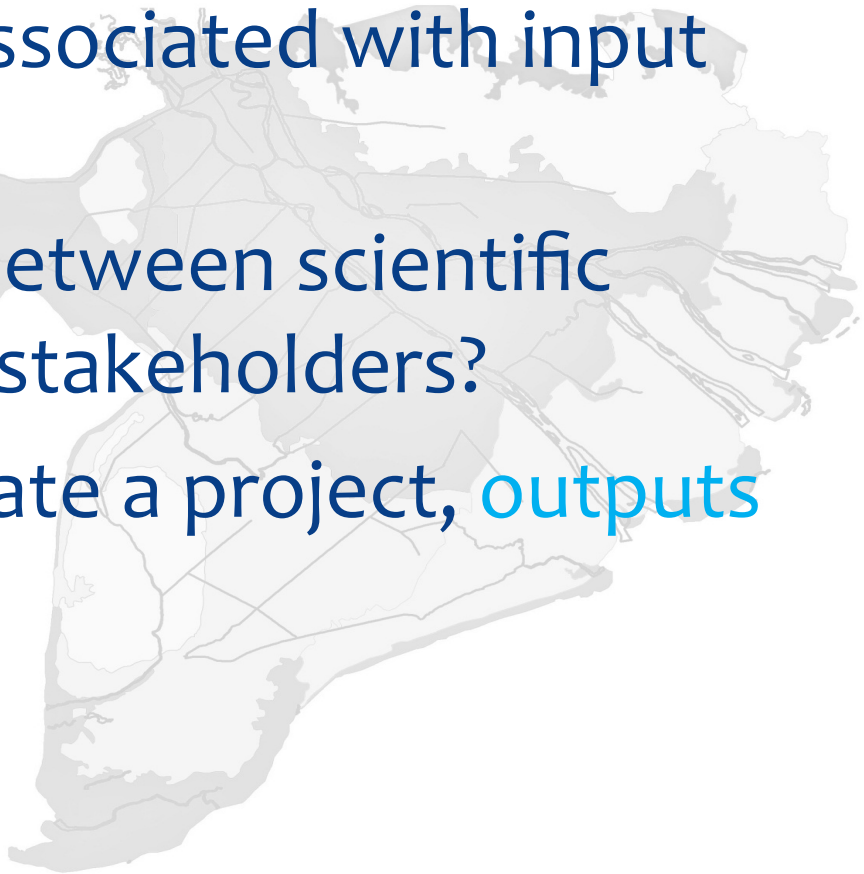
NUMERICAL MODELLING: INPUT CONSTRAINTS AND IMPACTS CHALLENGES

Van Pham Dang Tri, Ph.D.
(https://sites.google.com/a/ctu.edu.vn/vpdtri/)
Nguyen Hieu Trung, Ph.D., Assoc. Prof.
(https://www.researchgate.net/profile/Nguyen_Trung11?ev=hdr_xprf)
College of Environment and Natural Resources,
Research Institute for Climate Change (DRAGON),
Can Tho University, Viet Nam

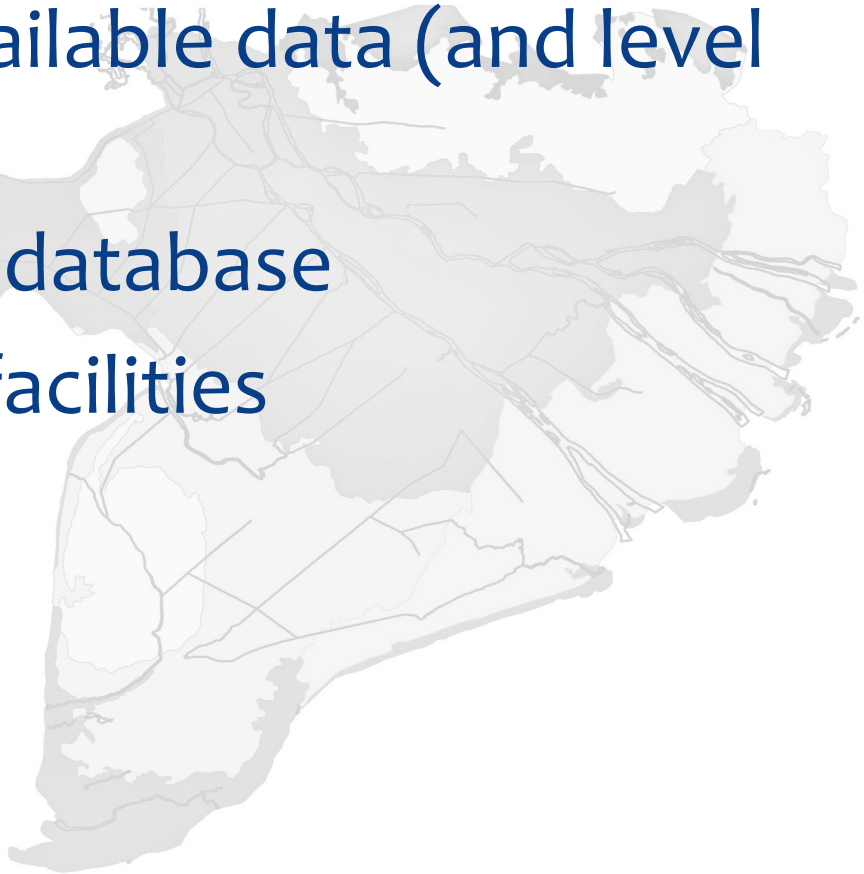
Content

- What are constraints associated with input data?
- What are the barriers between scientific communities and local stakeholders?
- Which phase to terminate a project, outputs or impacts?



Input data – CONDTRAINTS!

- Possibility to access available data (and level of accuracy)
- Format and up-to-date database
- Human resources and facilities
- Financial resources

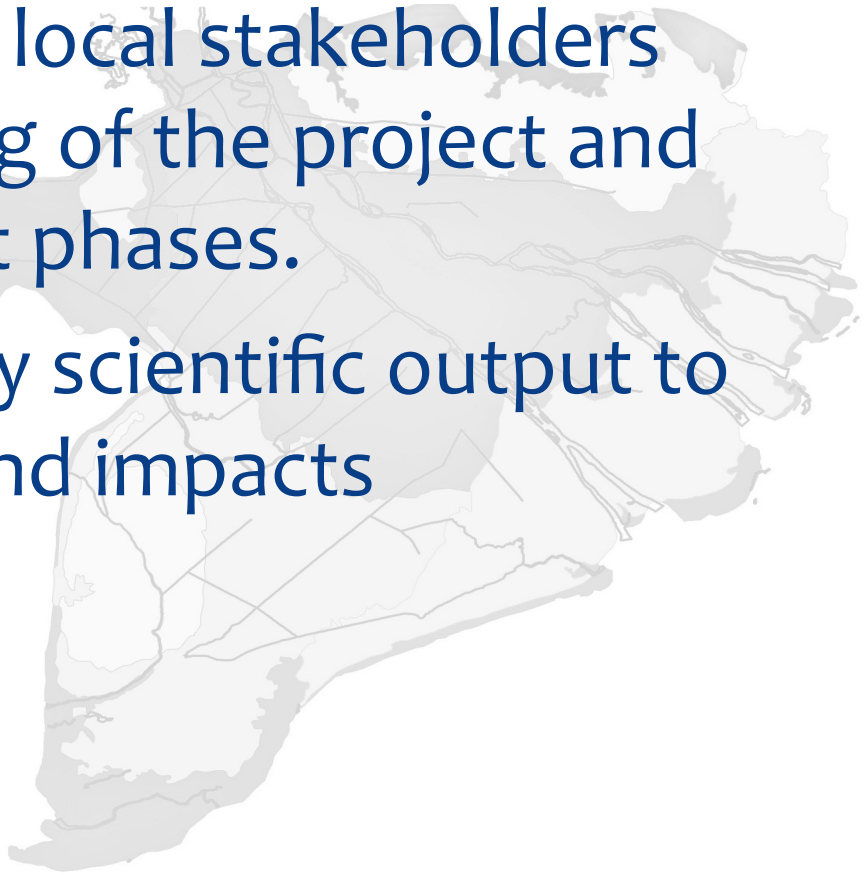


Communication Barriers

- **Beginning of the project:** Wishes of researchers vs. those of authorities at different levels and local communities.
- **Executing the project:** Scientific approaches vs. those at site-specific conditions.
- **Project's impacts:** 'Scientific languages' *vs. a clear-cut answer* to local communities.

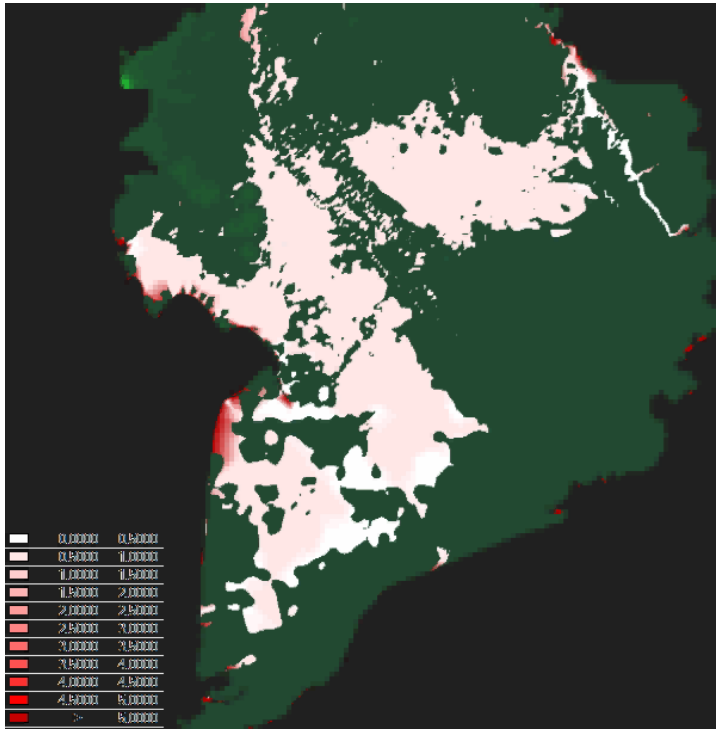
Scientific knowledge to be conveyed – in which way?

- Working together with local stakeholders from the very beginning of the project and during different project phases.
- Being flexible to convey scientific output to obtain the outcomes and impacts

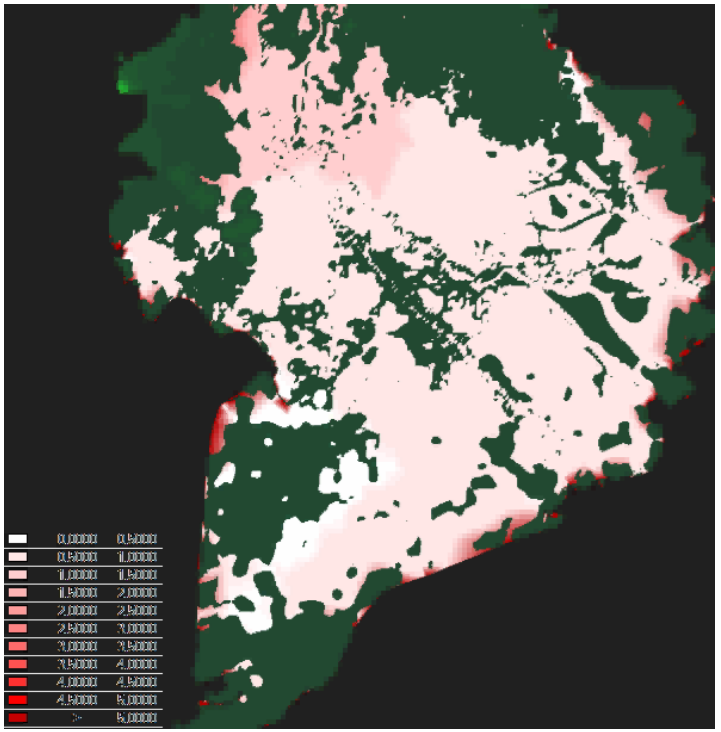


Delta hydraulic models

Flood simulation with ISIS-1D



2000



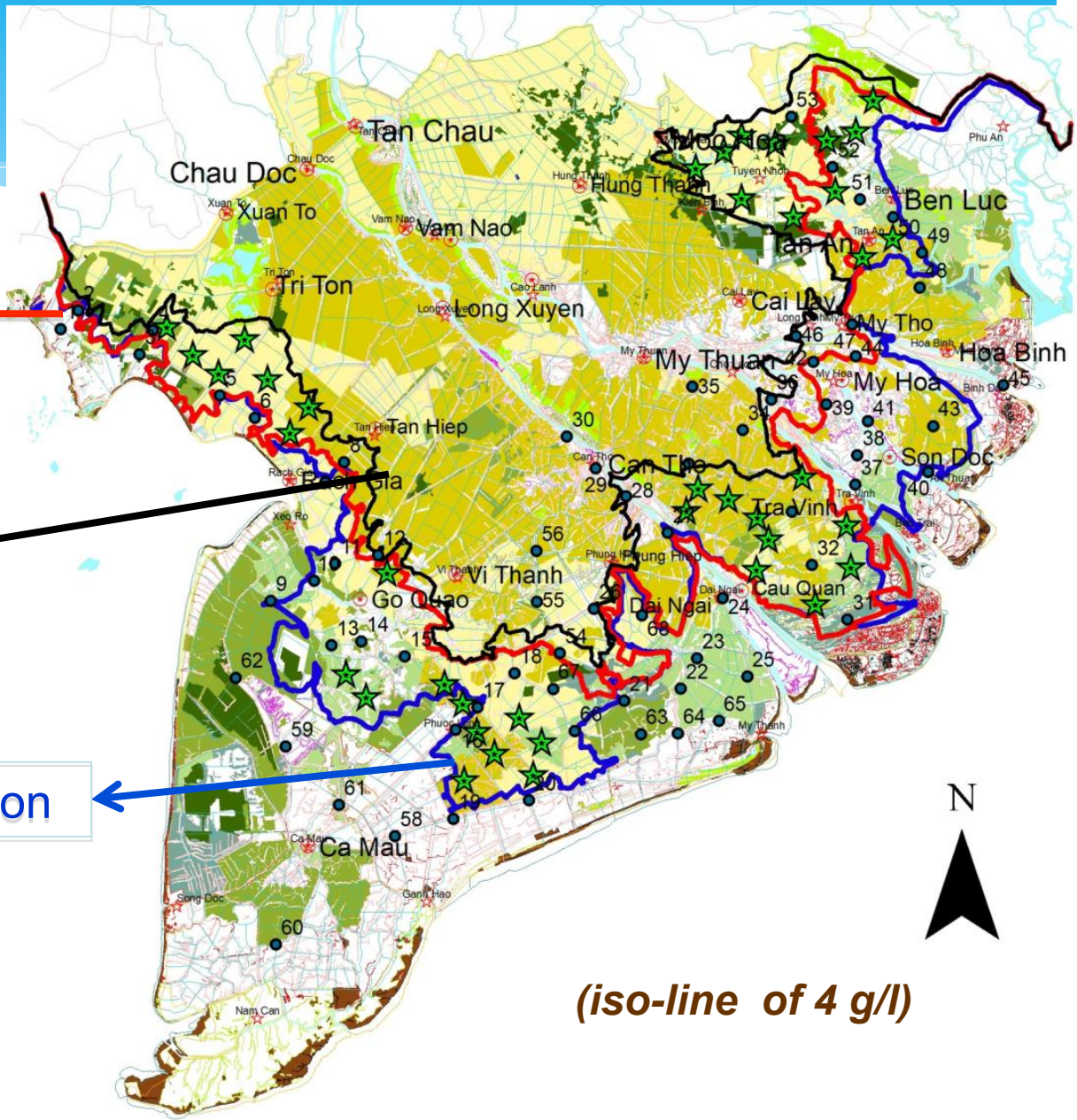
2050

Saline Intrusion

SCN 1 -SLR 30 cm

SCN 2 – worst case

SCN 3 – structural intervention



(iso-line of 4 g/l)

Mike 11 + ArcGIS

Local numerical models

CANTHO UNIVERSITY

Flow dynamics of the Long Xuyen Quadrangle under the impacts of full-dyke systems

Nguyen Thanh Tuu[1][*], Van Pham Dang Tri [1] [2], *and* Nguyen Hieu Trung [1] [2]

[1] Research Institute for Climate Change, Can Tho University, Vietnam
[2] College of Environment and Natural Resources, Can Tho University, Vietnam
(*)Email: nttuu@ctu.edu.vn

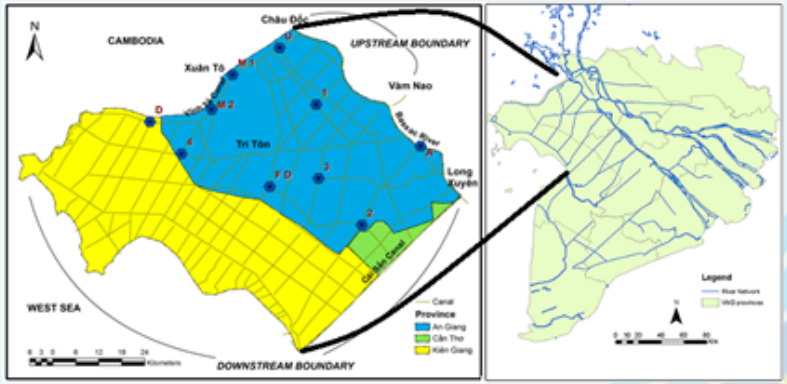


Figure 1: Vietnamese Mekong Delta, and developed river network in Long Xuyen Quadrangle

INTRODUCTION

- One-dimensional hydraulic model (HEC-RAS) was developed for the Long Xuyen Quadrangle.
- To determine the flow properties of flood based on different scenarios.
- To understand possible impacts of the full-dyke systems to the area if the flood event in 2000 happened in the future.

MODEL DESCRIPTION

- 257 canals
- 1,280 cross-sections
- 532 lateral structures
- 145 junctions
- 130 storage areas
- DEM of Long Xuyen Quadrangle.
- 2 upstream discharge; and, 26 downstream water level.

Scenarios	Discharge	Water level	Dyke systems
Scenario 1	In 2000	In 2000	In 2000
Scenario 2	In 2000	In 2000	Full-dyke systems

CALIBRATION

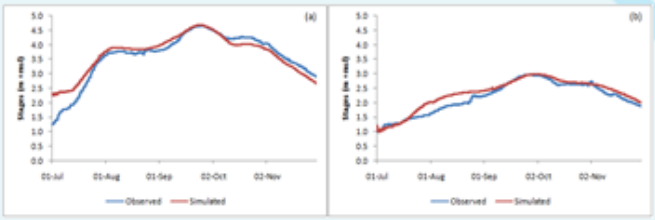


Figure 2: Dynamics measured and simulated stages at Xuan To (a) and Tri Ton (b)

RESULTS

After building full-dyke systems:

- Less flood.
- More protected triple rice crops.
- Greater water level in main channels.
- Negative impacts on agricultural production in the downstream provinces.
- Higher surface slopes ⇨ Bank erosion.
- Flow directions change.

FURTHER DEVELOPMENT

- Update the hydraulic constructions.
- Study the impacts of climate change and in-situ development on the flood dynamics.
- Collect related data to make sure the model is well calibrated and validated.

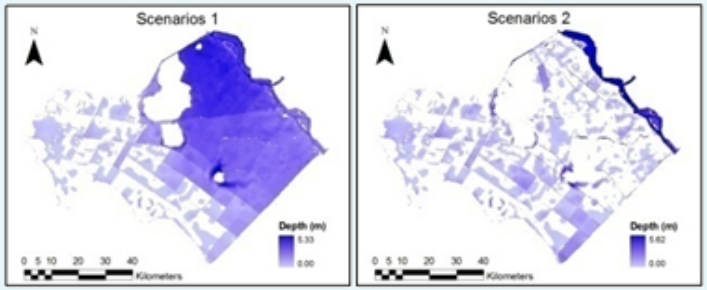
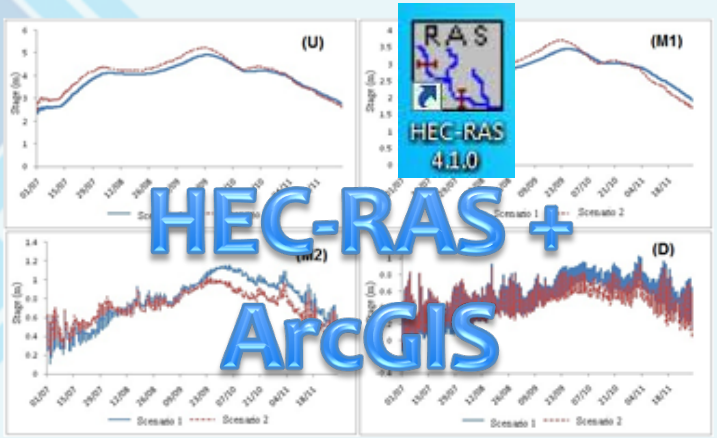


Figure 4: Inundation maps according to the two scenarios in September 23rd.



HEC-RAS + ArcGIS

Figure 3: Simulated stages (from upstream to downstream) at different locations along the Vinh Te canal according to the two scenarios

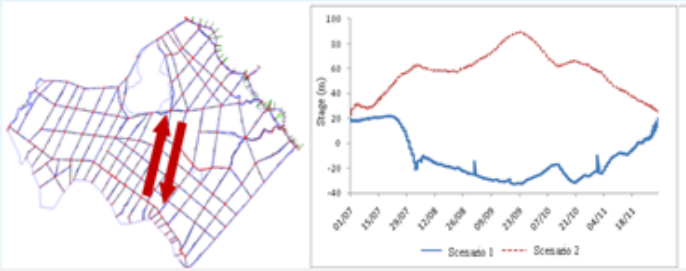


Figure 5: Flows changed according to changes of boundary conditions in different scenarios

Water dynamics in a downstream river network of the Mekong River in the Vietnamese Mekong Delta

College of Environment and Natural Resources, Can Tho University,\
Research Institute for Climate Change, Can Tho University

INTRODUCTION

Salinity intrusion is one of the major problems currently faced in the downstream section of the Mekong river in the Vietnamese Mekong Delta.

Salinity intrusion will affect the livelihoods of people, *including* lack of fresh water for agriculture, water supply for domestic use, negative impacts on freshwater ecosystems, and threaten biodiversity.

METHODOLOGY

The study was done following the general procedure presented in Figure 1, in which the two main blocks were identified, namely: (A) Preparation of the spatial data; and, (B) Application of unsteady flow module in HEC-RAS to simulate the flows dynamics in the study river network.

Figure 1: Location of the study area

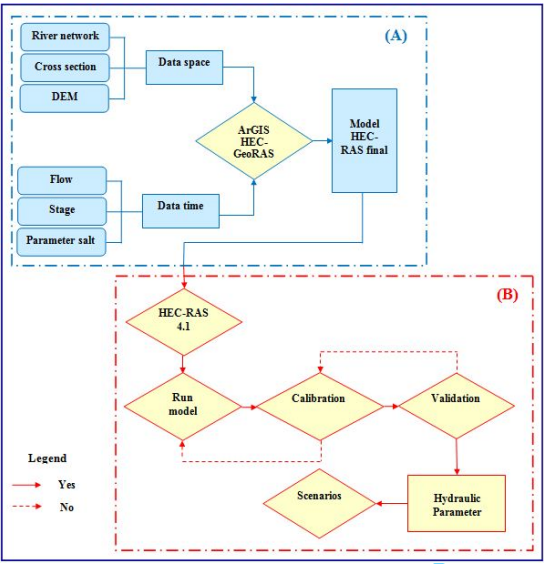


Figure 2: General approach of the study

MODEL DESCRIPTION

No. of cross – sections: 205
No. of culverts: 1
No. upstream boundaries: 1
No. downstream boundaries: 6

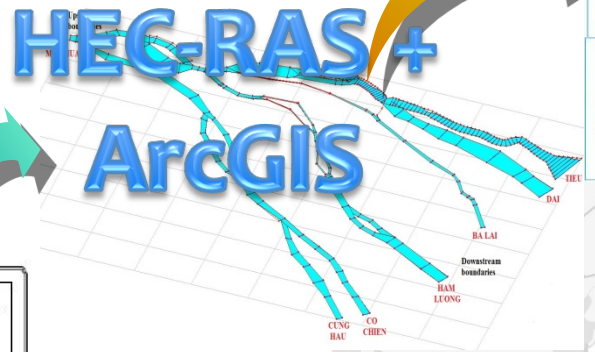


Figure 3: Planview of the Tien river network in HEC-RAS

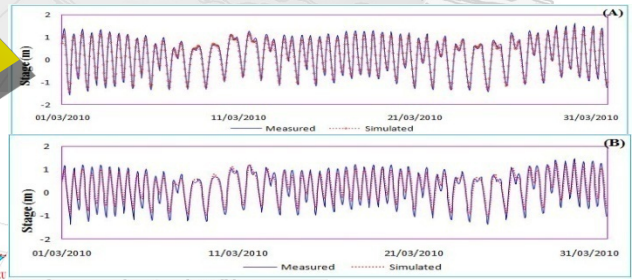


Figure 4: Simulated and measured stages at Tra Vinh (A) and My Tho (B) in 2010

RESULTS

Study project salinity intrusion on the downstream section of the Tien river in different scenarios of changes of upstream discharge and downstream sea level rise.

Hydrodynamics and saline intrusion modelling in coastal areas of the Vietnamese Mekong

College of Environment and Natural Resources, Can Tho University, Vietnam

Introduction

- Negative impacts of the reduction of upstream discharge and the sea level rise lead to changes of hydrological conditions and therefore the vulnerability of [illegible] living in the coastal areas [illegible] Mekong Delta.
- Improving the in-situation operation of the hydraulic constructions may help to ease such negative impacts.

HEC-RAS + ArcGIS

Methodology

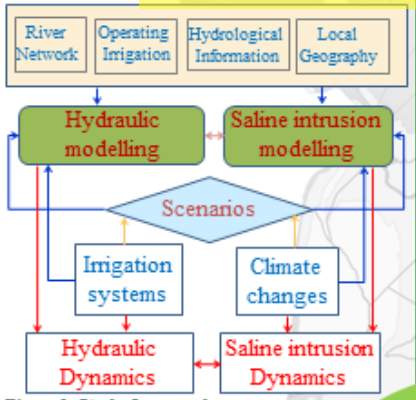


Figure 1: Study framework

Model Description

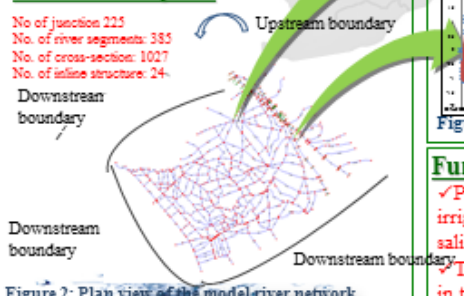


Figure 2: Plan view of the model river network.

Approaching processs

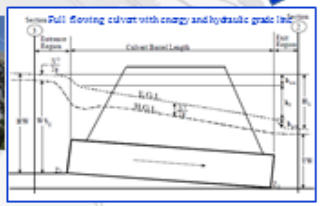


Figure 3: The relationship between water resources and management

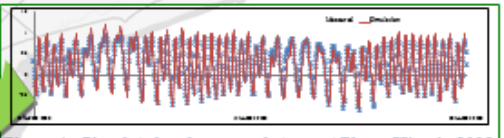


Figure 4: Simulated and measured stages at Phung Hiep in 2005

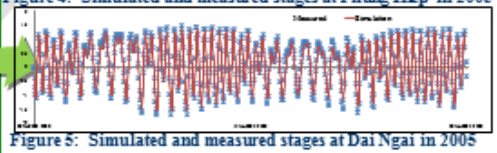


Figure 5: Simulated and measured stages at Dai Ngai in 2005

Further Results

✓Possible impacts of climate change and operation of irrigation network on the in-river hydrodynamics and saline intrusion .

✓The suitable strategies for water management, especially in the context of future hydrological changes.

Water resource management for rice farming systems in the Vietnamese Mekong Delta in the context of climate change

College of Environment and Natural Resources, Can Tho University, Vietnam

INTRODUCTION

- Salinity intrusion in the Vietnamese Mekong Delta (VMD) is increasing (in terms of space and time) leading to negative impacts on existing rice farming systems. It is projected to be one of the major problems in the VMD in the context of climate change.

-The main focus of this study is to study water storage capacity in the canals which can be used to irrigate rice fields during the water-shortage periods (caused by salinity intrusion). In addition, the study is also to provide an insight into the future about water changes of scenarios climate change and current water requirements of existing farming systems.

METHODOLOGY

-Based on the physical features of the study area (local weather and canals system) and bio-features of existing farming systems (life cycle and water demand at each growing stage) are collected in order to figure out the mutual relationship between water demand and supply during the growing season.

Figure 1: Rice fields and sluices at Ngo Nam (Soc Trang)

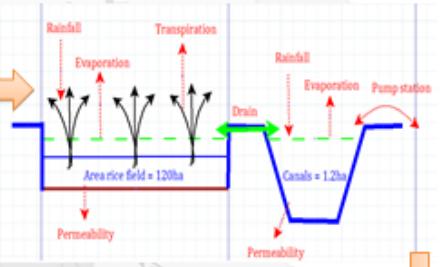


Figure 2: Water cycle in a rice farming system

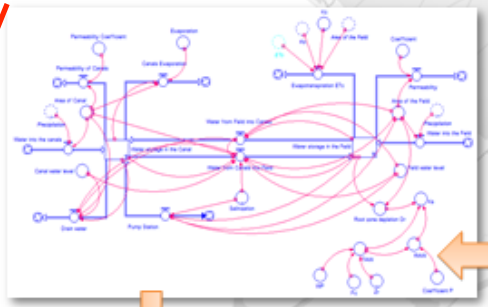


Figure 3: A dynamic system model of water cycle in farming systems

Figure 4: Relationship between water in canals and rice-fields

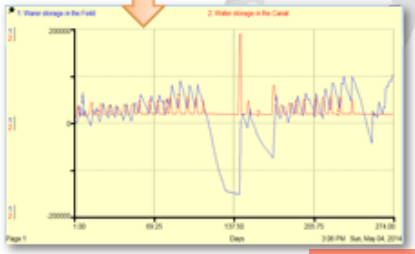


Figure 5: Currently water in field and canal in the rice farming system

RESULTS

-The water in the canals can supply for 20% area rice field in period salinity intrusion and increasing area canals to 3.5 time possible supply water to irrigate for whole area rice field.

-It need to change from sowing to transplant to make short time existing crops in field and combine making shorten harvesting to avoid salinization .

http://www.iseesystems.com/softwares/Education/StellaSoftware.aspx

STELLA

Not modelling only,

Community-Based Environmental Monitoring, Mekong Delta, Vietnam

Duong Van Ni[1], Nguyen Hieu Trung[1], Van Pham Dang Tri[1], Ly Hoang Phi[1], Ngo Thao Nguyen[1], Truong Quoc Dinh[2], Lam Chi Nguyen[2], Cindy Thatcher[3], Craig Conzelmann[3], Scott Wilson[3], Ryan Twilley[4] and Bryan Switzer[5]

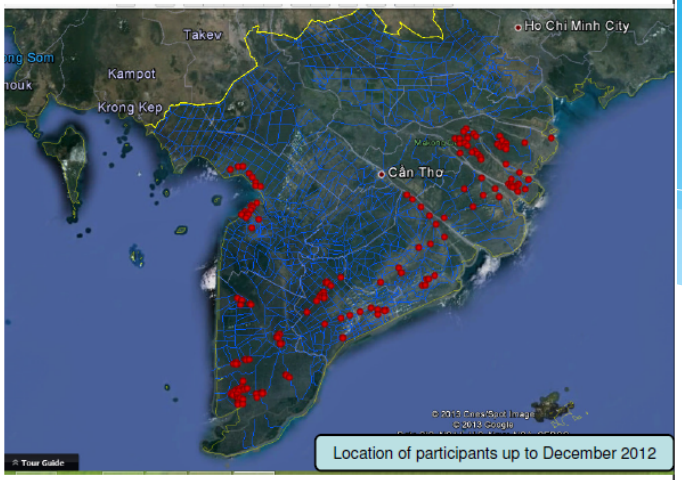
1.The College of Environment and Natural Resources (CENRes), Cantho University (CTU), Vietnam
2.The College of Information & Communication Technology (CICT), Cantho University (CTU), Vietnam
3.The Geological Survey of United States (USGS)
4.The International Association for the Properties of Water and Steam (IAPWS)
5.State Department's Bureau of Oceans, Environment and Science Regional Environment, United States Agency for International Development (USAID)

Problems

- Salinity intrusion at the coastal areas of the Mekong Delta is complicated and unexpected!
- Community lacks environmental information and production only relied on their available experiences;
- Environmental information is collected by governmental agencies but public announcement is delayed!

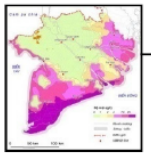
Objectives

- To advise community about the changes in the environment BEFORE their decisions for production were made;
- To exchange environmental information between individuals in the community for better preparation and adaptation;
- To apply available information technology and communication for real time environmental information display and build an environmental database for the Mekong Delta.



Location of participants up to December 2012

Method

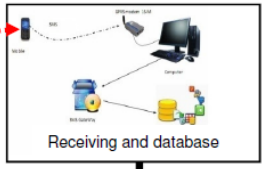


Salinity intrusion zone

Select and train the participants about salinity measurement, field preparation and crops application. Geographic positioning determination and text messaging

Participants measure salinity and exchange information

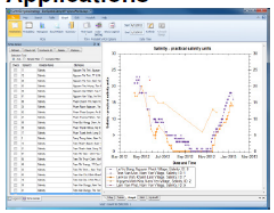
Text and messaging



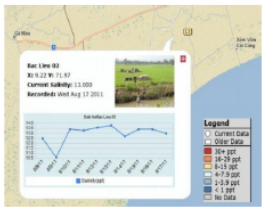
Receiving and database

Feedback (early informing): messages, internet

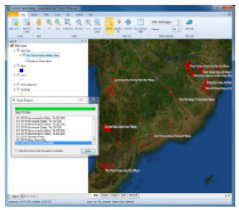
Applications



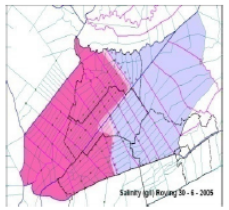
Education, research and resources management



Cropping systems management, sluices operation



Public relation: connect to internet for free



Modeling, scenarios, broadcasting

Future

The project will apply to environmental issues (water levels, air temperature, rainfall), crop management (insects, bird flu, land uses) and bio-diversity (fish diversity, bird migration, invasion of alien species) in the areas of the Mekong Delta of Vietnam. Later on through the Wetland University Network the project will expand to Cambodia, Laos PDR, Thailand and Myanmar in the wider Mekong Basin.

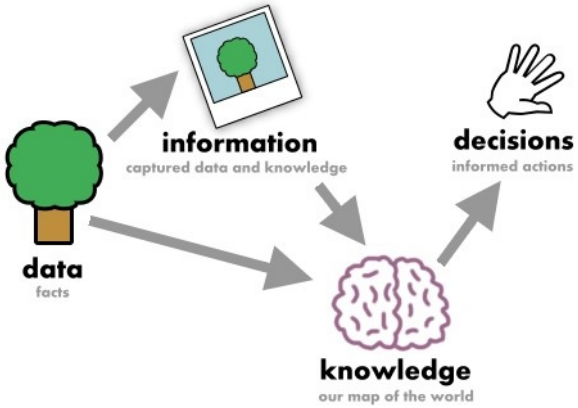
Contact person: Duong Van Ni: Natural resources management department, Environment & Resource Management College, Cantho University. Campus II, 3-2 street, Cantho city, Vietnam. Cell phone: +84 (0) 909 987 887. Email: dvni@ctu.edu.vn (add. duongvani@gmail.com)

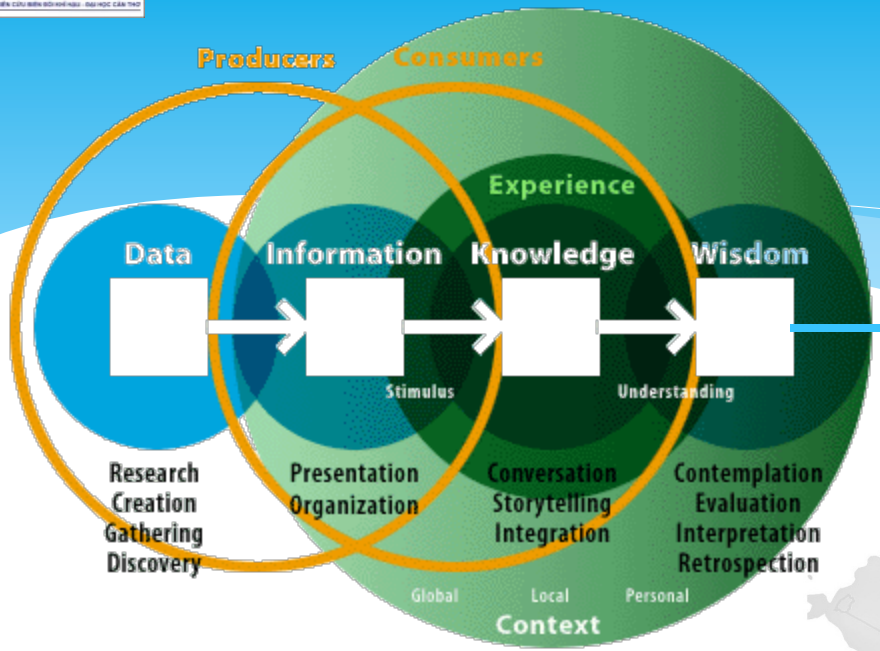
- Bringing stakeholders together:
  - Scientists (IT and environmental experts)
  - Government and farmers

⇒ Sharing information
⇒ Supporting decisions
⇒ Improving livelihoods

In conclusion

To bring together different sources of data, information and knowledge (multi-disciplinary) for better decisions at different spatial and temporal scales.





Vision

Thank you very much,