Model integration and scenario analysis for effective management of Tonle Sap Lake environment

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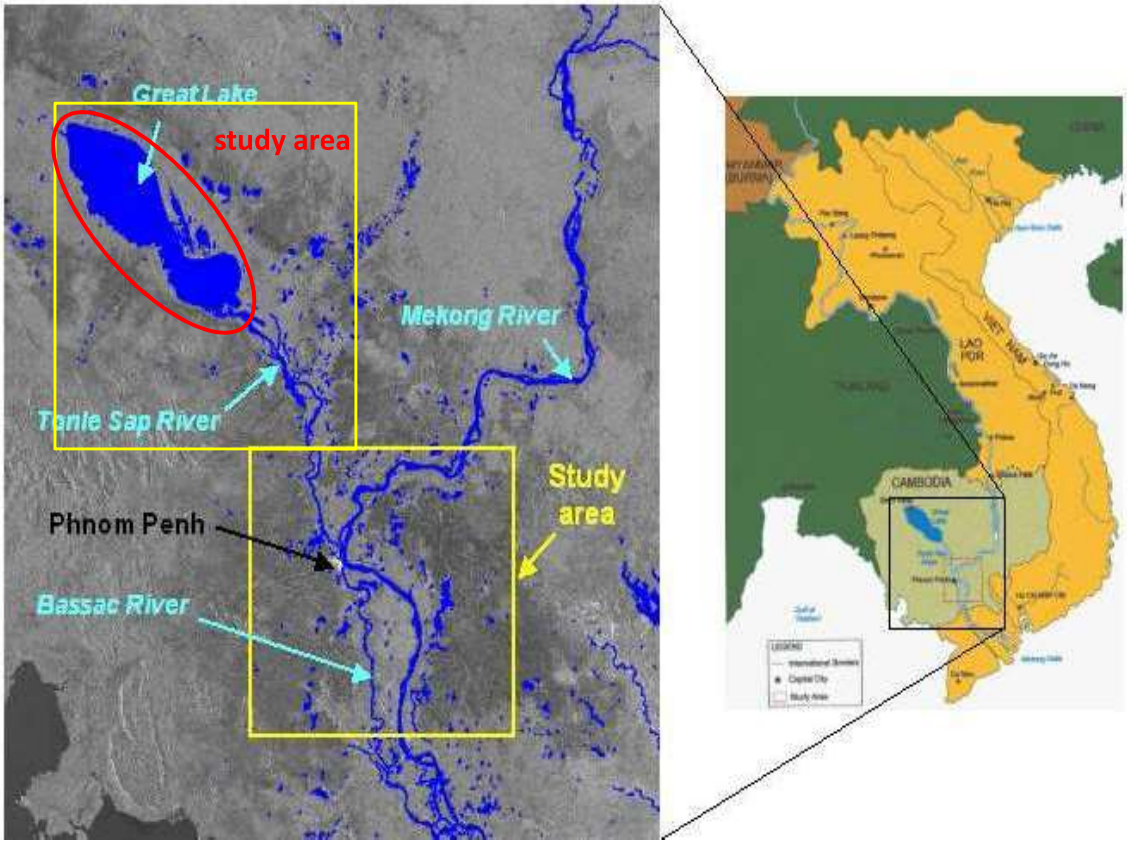
Study area



Importance of Tonle Sap Great Lake

- Unique freshwater system (highly dynamic lake)
- The largest lake in Southeast Asia
- High productivity and high biodiversity
  - 370 (186 in TSA) plant species, 225 bird species, 149 (109 in TSA) fish species
  - 1 Ramsar site and 3 protected areas
- More than 1 million people
- Located in a transboundary basin (Mekong River)
- The heart for Cambodia
  - Culture, economy, and identity
  - Developed with this lake
  - 60-80% of animal protein consumption

Greater Adjutant
(Leptoptilos dubius)

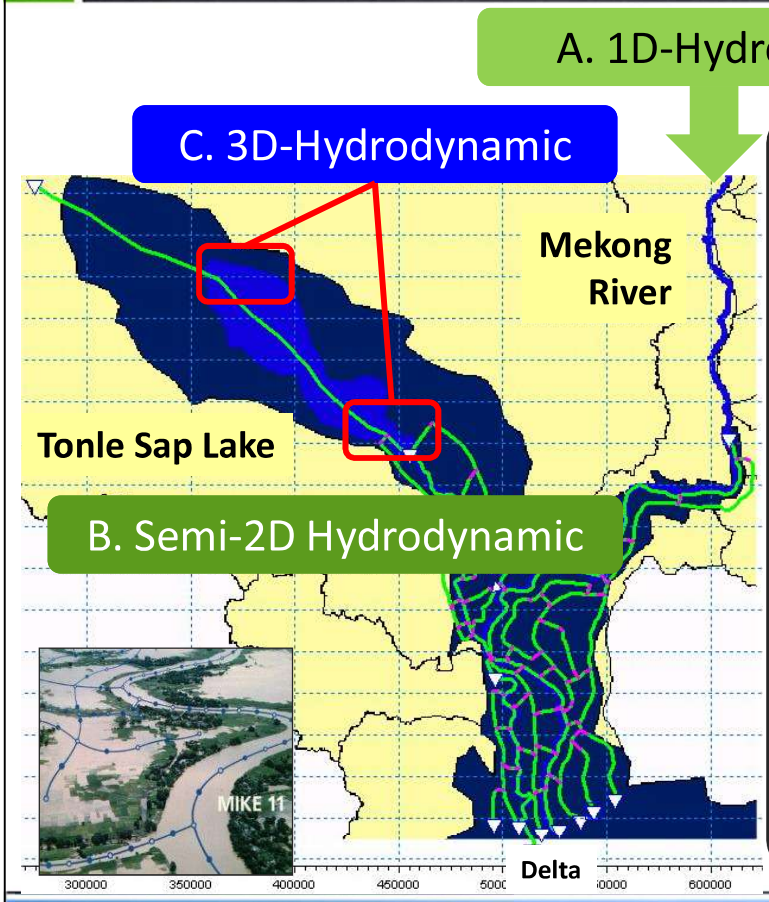
Mekong giant catfish
(Pangasianodon gigas)

Current Problems

- Hydrology and Water Resources Management
- Water Pollution
- Ecosystem Management
- Fishery and Floating Villages
- Education, Health, and Economy

Tonle Sap Authority (2014)

Basis of Water Env. Analytical Tool



A. 1D-Hydrological Model
(Mekong River Basin)
- Distributed Hyd. Model (GBHM)
- + SS and possibly nutrients

B. 2D Hydrodynamic M.
(Tonle Sap River Basin)
- Semi-2D Hyd. Model (Mike11)
- Temp., SS, DO, Salinity and so on.

C. 3D-Hydrodynamic Model
(TITech-WARM)
- Same water quality variables
- Pathogens

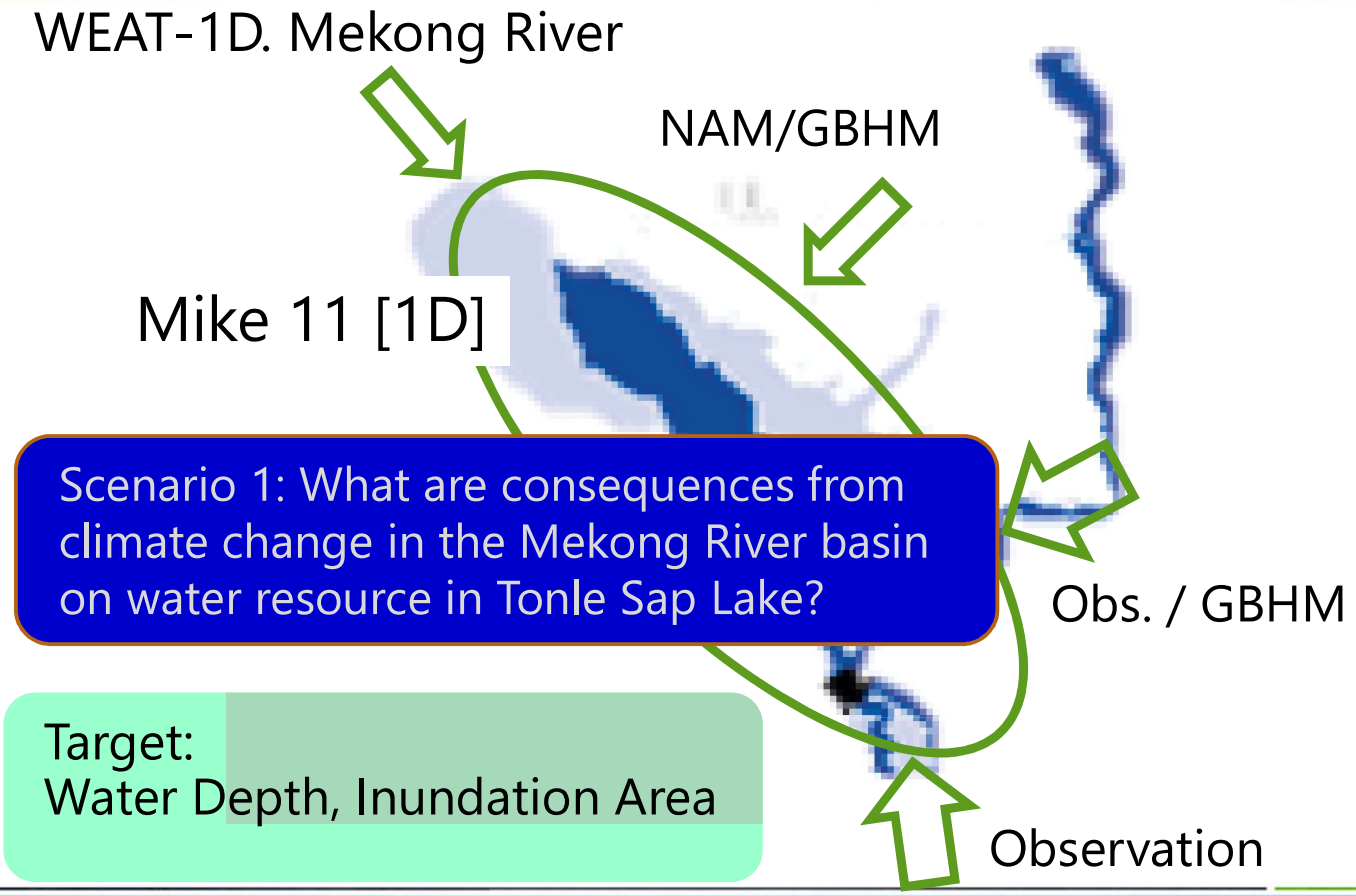
Scenarios Analysis

Scenario 1. What are consequences from human activities and climate change in the Mekong River basin on water resource in Tonle Sap Lake?

Scenario 2. What are consequences from land cover changes in tributaries of Tonle Sap Lake?

Scenario 3. What is the relationship between water quality and health conditions of people in floating villages?

Basis of Water Env. Analytical Tool in Basin Scale



Climate Change Scenarios

Scenario	Duration	RCP	GCM
Baseline	1998-2000	-	-
2.6HG	2041-2050	RCP2.6	HadGEM2
2.6MIR	2041-2050	RCP2.6	MIROC
8.5HG	2041-2050	RCP8.5	HadGEM2
8.5MIR	2041-2050	RCP8.5	MIROC

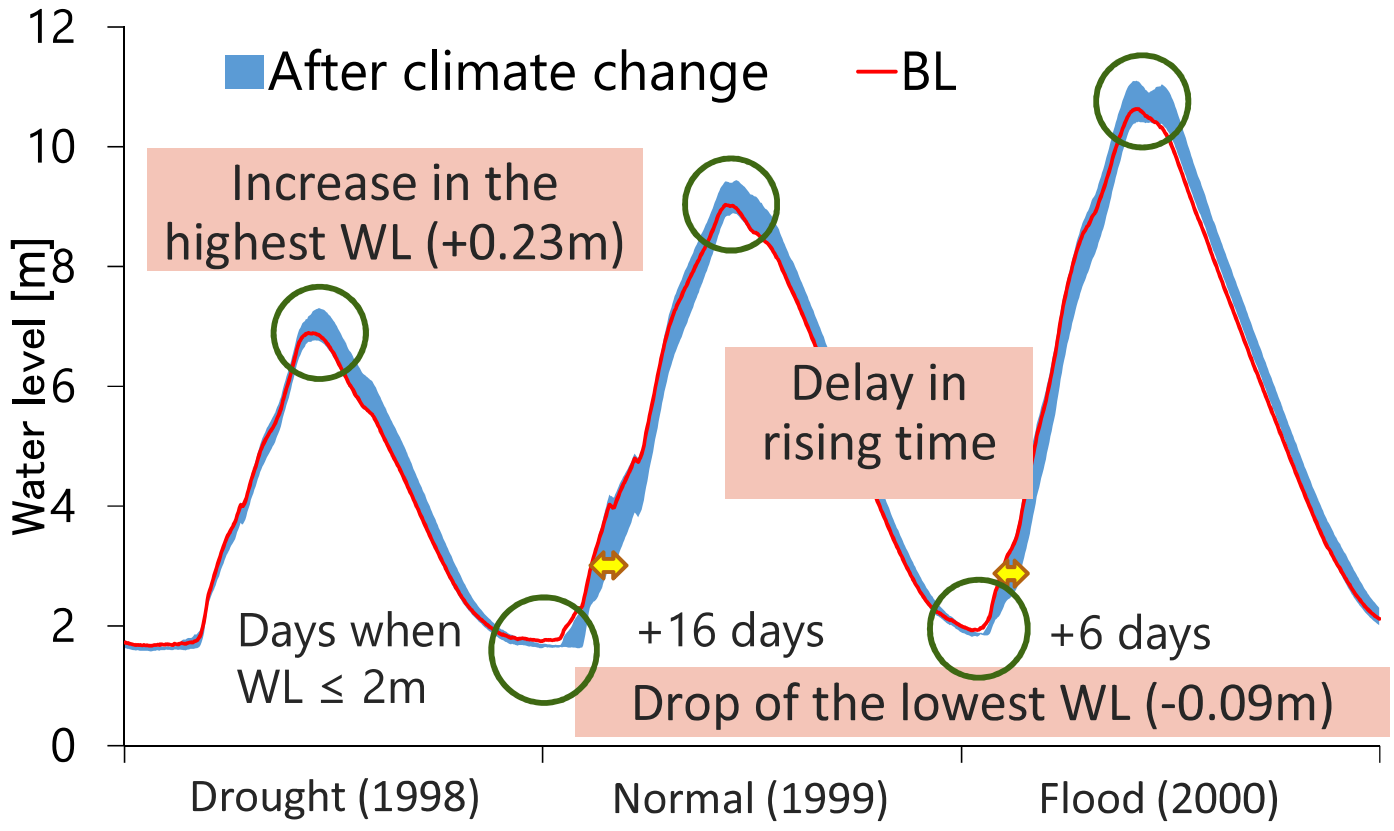
- Rainfall and temperature data used : bias-corrected by ISI-MIP for each RCP of GCM

RCP : Representative Concentration Pathways

GCM : Global Climate Model or General Circulation Model

ISI-MIP : Inter-Sectoral Impact Model Intercomparison Project

Change in Water Level at Kg. Luong in TSL



Projected Impact of Climate Change

1. WL of TSL

- **Highest WL →Rise +0.23m**
- **Lowest WL →Drop -0.09m**
- **Low water period under 2m → Prolonged +7.3days**

2. Inflow to the TSL

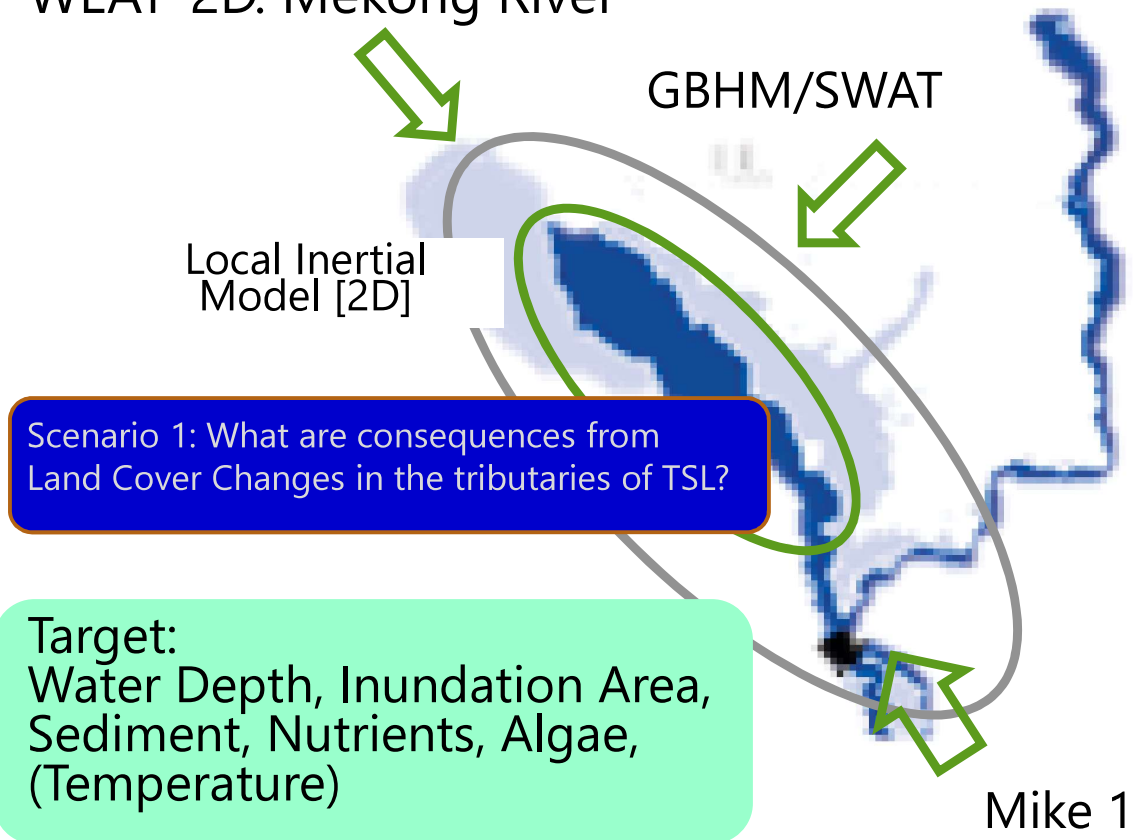
- **Increase inflow from Tonle Sap River and floodplain**
- **Decrease in inflow from tributary river**

3. Outflow to the TSL

- **Decrease in runoff from Tonle Sap river**
- **Evaporation from lake surface**

Basis of Water Env. Analytical Tool in Lake Scale

WEAT-2D. Mekong River

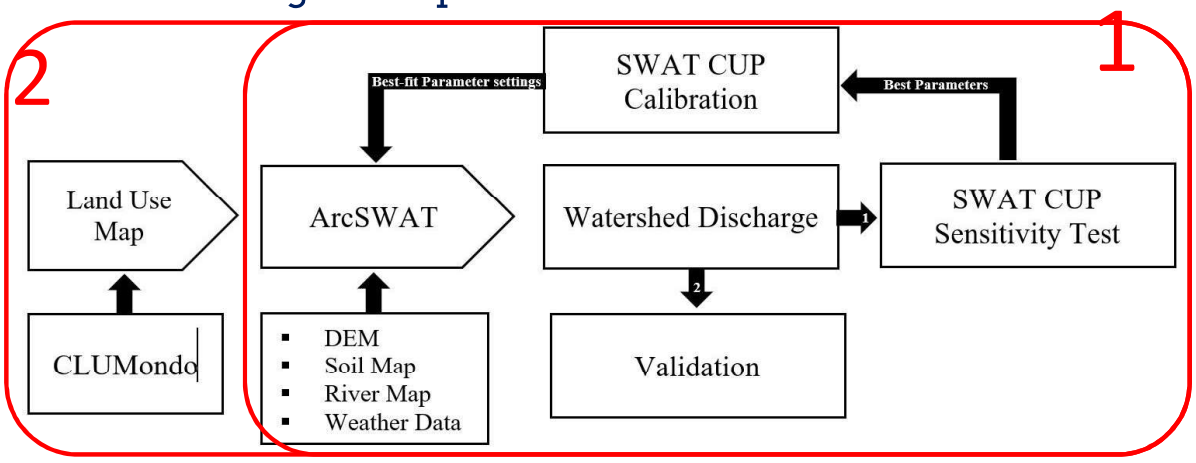


Scenario 1: What are consequences from Land Cover Changes in the tributaries of TSL?

Target:
Water Depth, Inundation Area, Sediment, Nutrients, Algae, (Temperature)

Land Cover Changes on Discharges

The methodological steps are visualized:



1. ArcSWAT is used to obtain a best possible discharge which resembles the observed discharge (with the help of SwatCup)
2. The CLUMondo land use maps are implemented in ArcSWAT to assess the different impacts

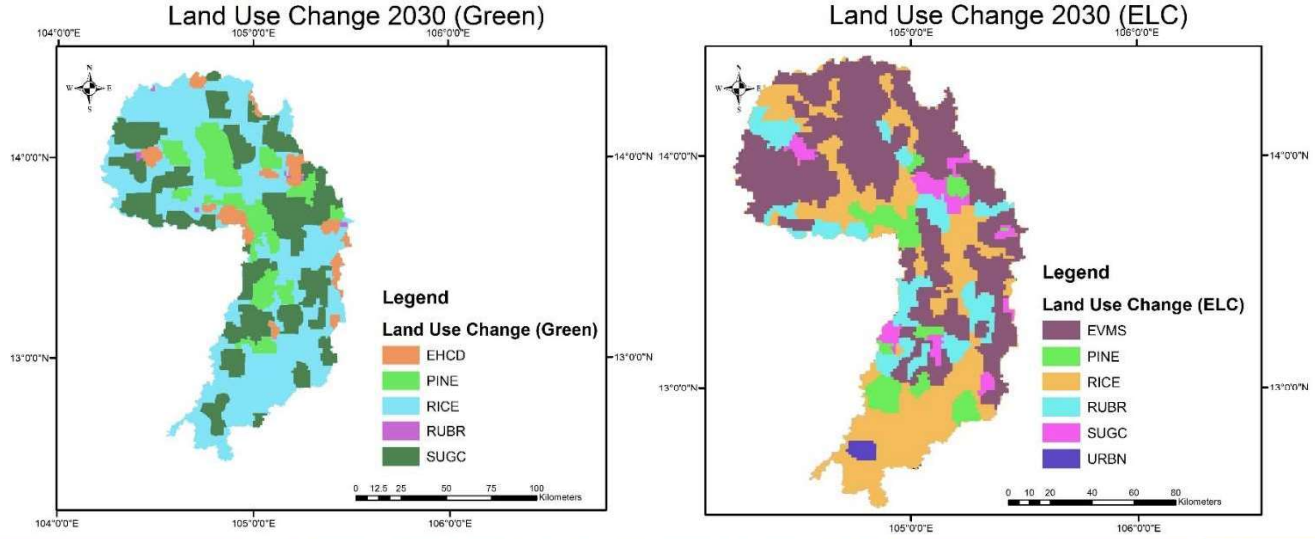
Land Cover Changes on Discharges

LAND USE CHANGE SCENARIO

Two land-use change projections using CLUMondo:

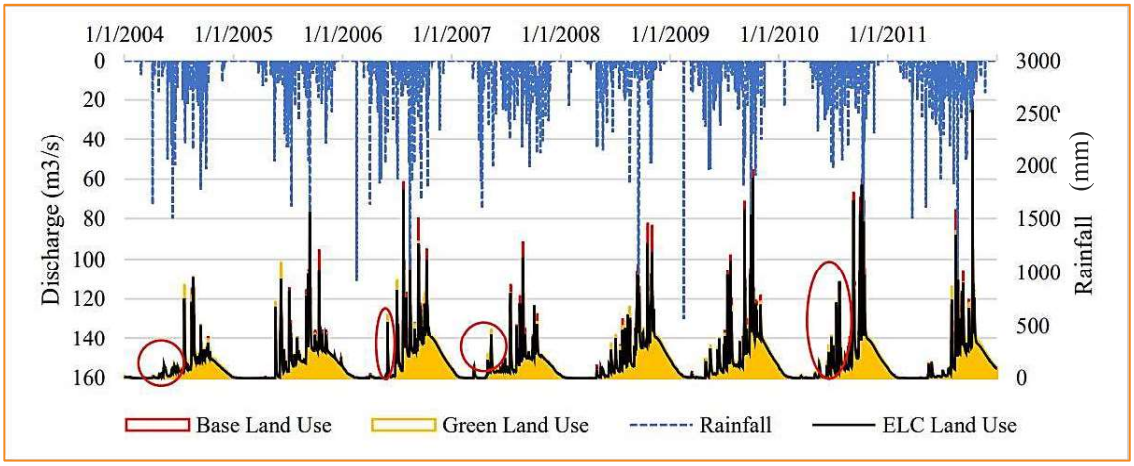
GREEN scenario (with environmental preservation of dense forests)

ELC (Economic Land Concession) scenario :(business as usual scenario)



Land Cover Changes on Discharges

STUNG SEN Catchment Discharge per Scenario

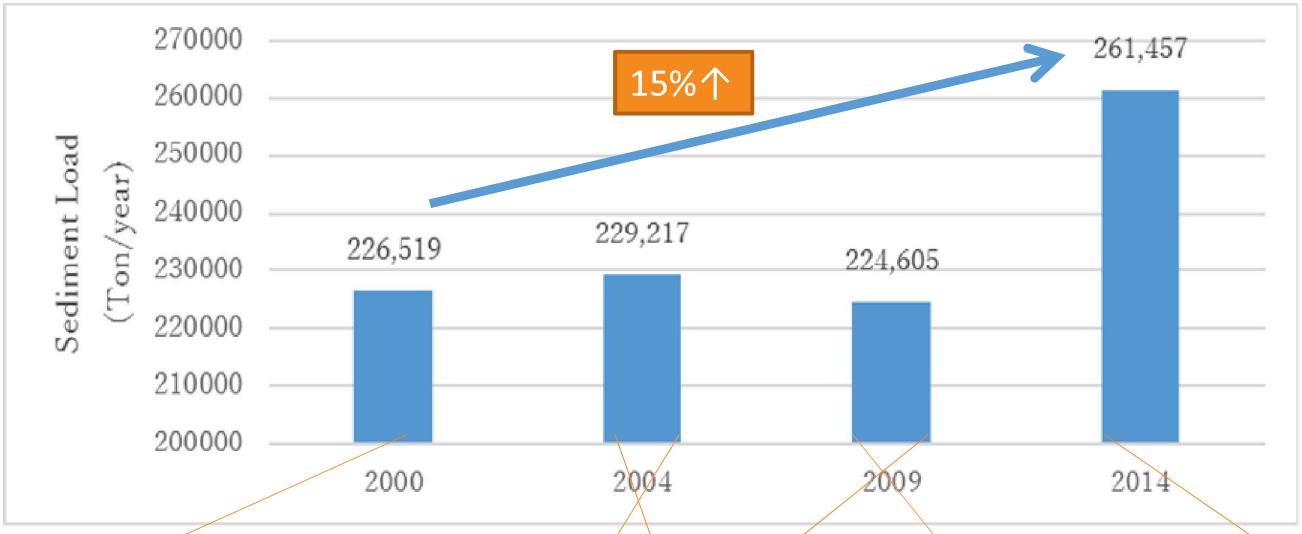


Overall, discharge will significant rise between LU2014 and ELC 2030, gradually increase between LU2014 and GREEN 2030

As result of the model and by comparing to LU-2014, peak flow for ELC2030 will increase by **7%**, and LU-GREEN2030 will increase **14% in rainy season**

However, **in dry season** flow will decrease by **18%** and **22%**, respectively

Past Shift of Total SS Load in TSL Basin (using GBHM)



Forest: 4.47%↓, Mixed Forest: 1.97%↓

Forest: 7.04%↓, Mixed Forest: 5.81%↓

SS load is sensitive to the change in forest area.

Forest: 2.96%↓, Mixed Forest: 5.44%↑
Total Forest: **2.48%↑**

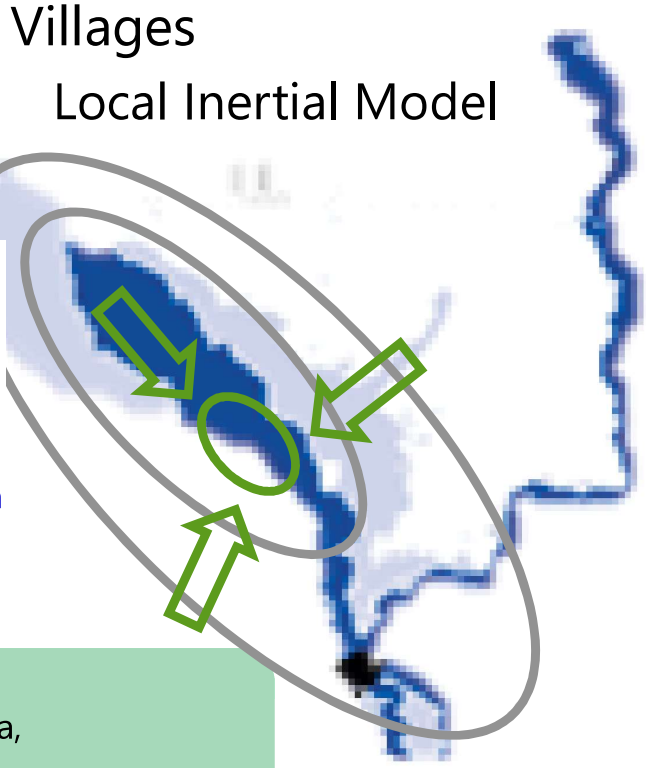
Basis of Water Env. Analytical Tool in **Village Scale**

WEAT-3D. Floating Villages

Local Inertial Model

Titech WARM [3D]

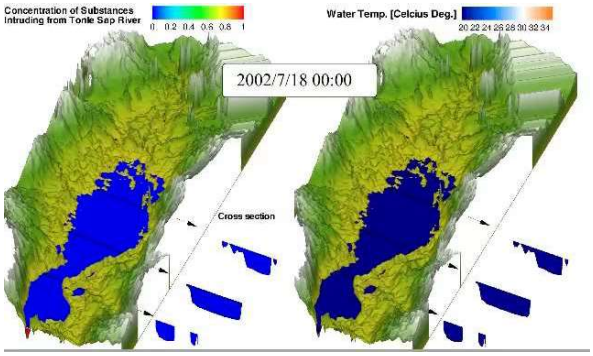
Scenario 3. What is the relationship between water quality and health conditions of people in floating villages?



Target:
Water Depth, Inundation Area,
Sediment, Nutrients,
DO, Pathogens, Health Risk, (Algae)

Basis of Water Env. Analytical Tool in Village Scale

3D Hydraulic Model : TITech-WARM



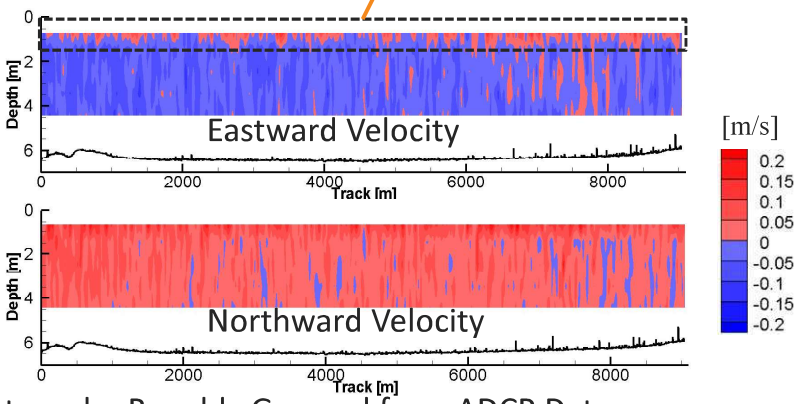
✓ Pilot Application : Apply to a Whole Area
Evaluation of Compt. Cost

Mesh 500m x 500m → 4 days for 1 month

✓ For Validation : Checking ADCP Data (Site B)

August Observation

Wind Driven Current?



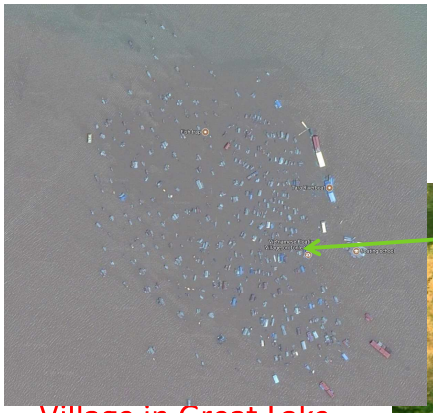
Spatial Profile of Current can be Roughly Grasped from ADCP Data

Basis of Water Env. Analytical Tool in Village Scale

3D Hydraulic Model : TITech-WARM

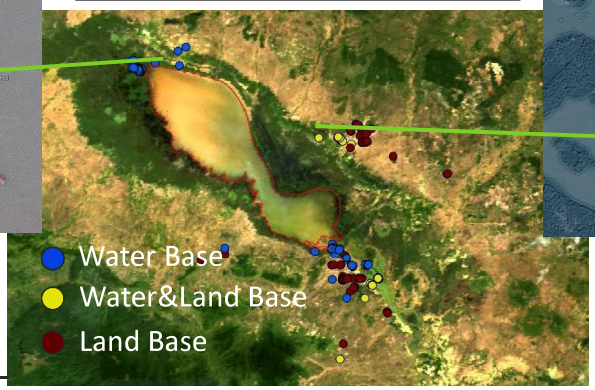
✓ Surveying Application Sites :

Through the base-line survey, WG6 investigates the difference between the three types of village.



Village in Great Lake
(Water Base)

Locations of Baseline Survey by WG6



Village along River
(Water&Land Base)

A candidate of application:

- Applying 3D Model to the Water-base village and Land/WaterLand base village
- Investigating an impact of the location of village (in River or Lake) on Dilution of Domestic Wastewater.

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