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Assessing Water Discharge in Be River Basin, Vietnam using SWAT model

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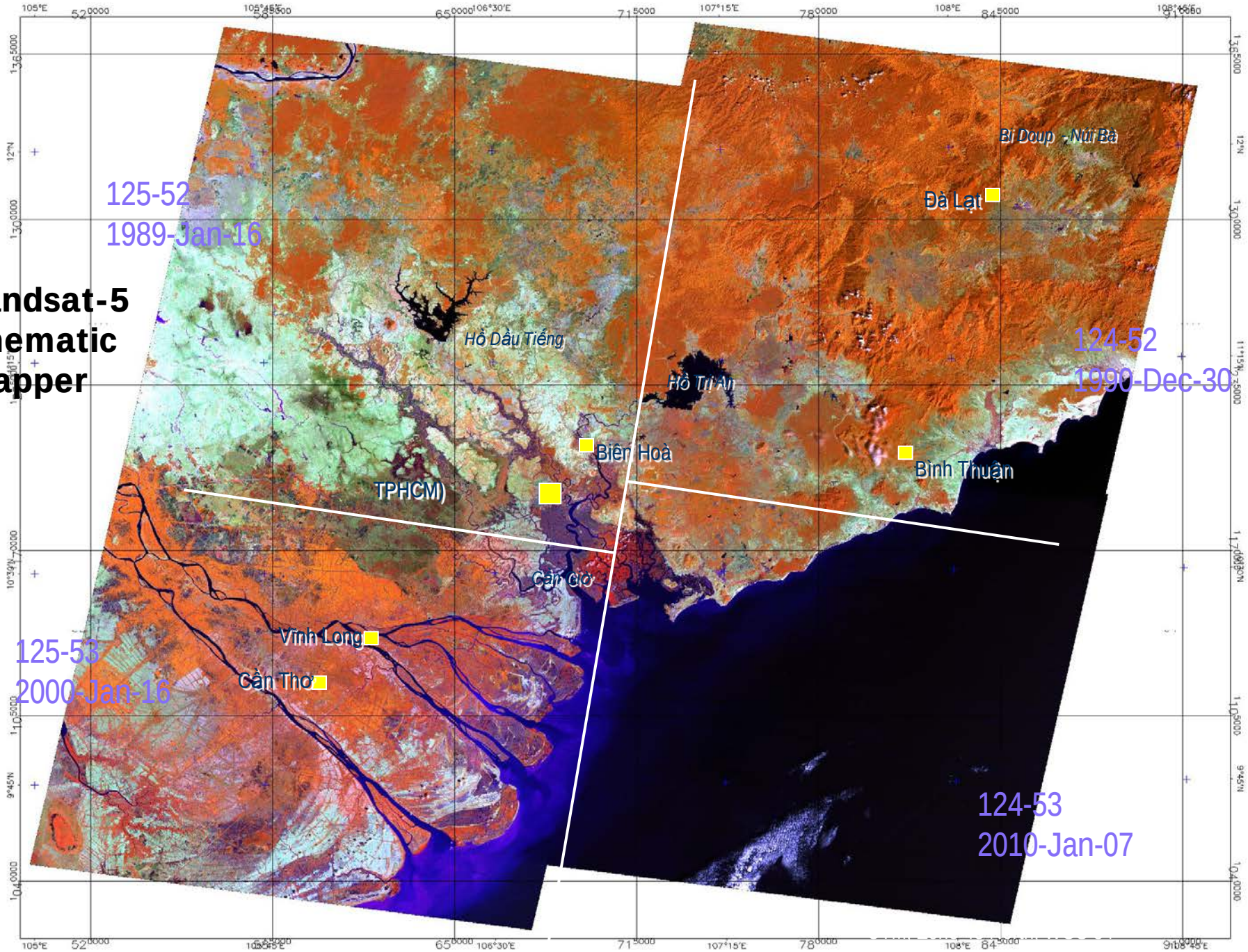
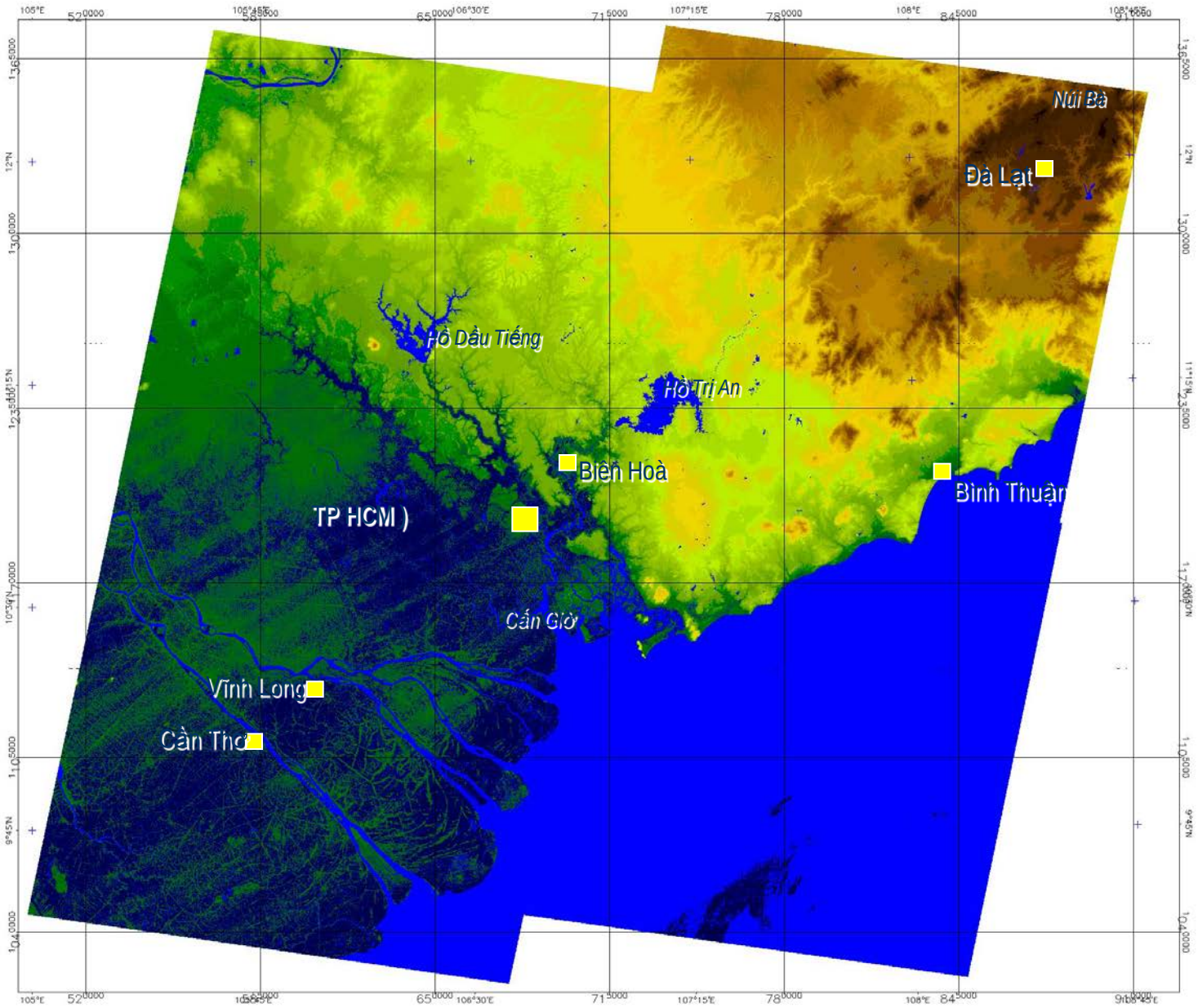
Landsat-5 Thematic Mapper

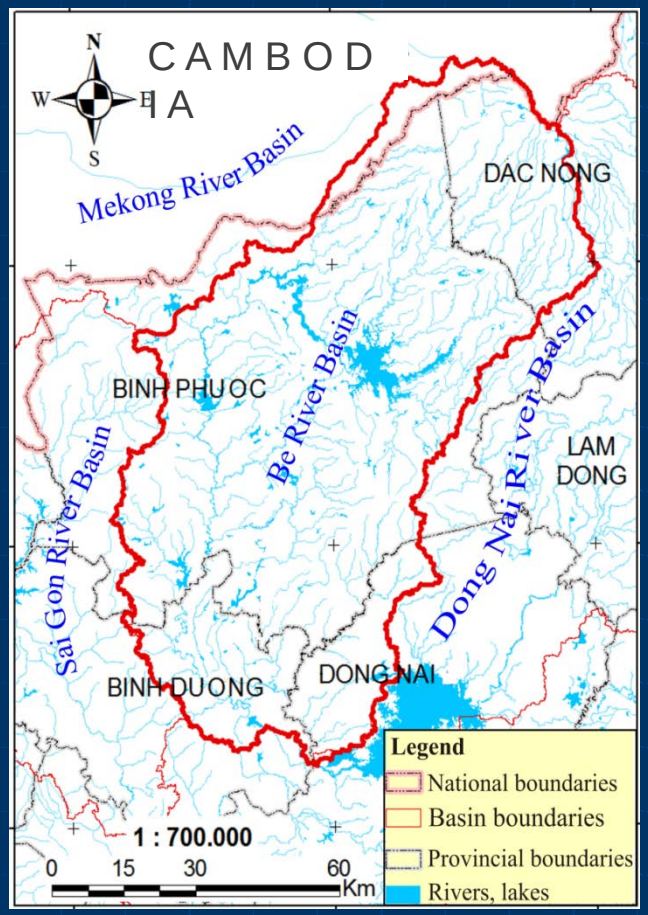


SRTM Digital Elevation



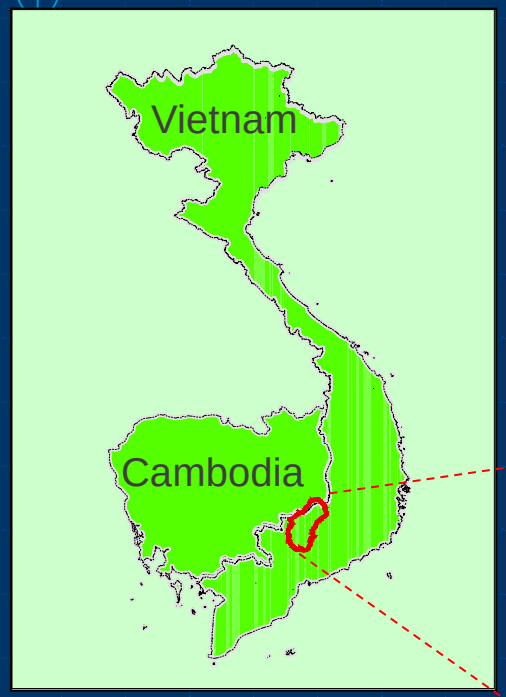
Song Be River basin Problem Identification

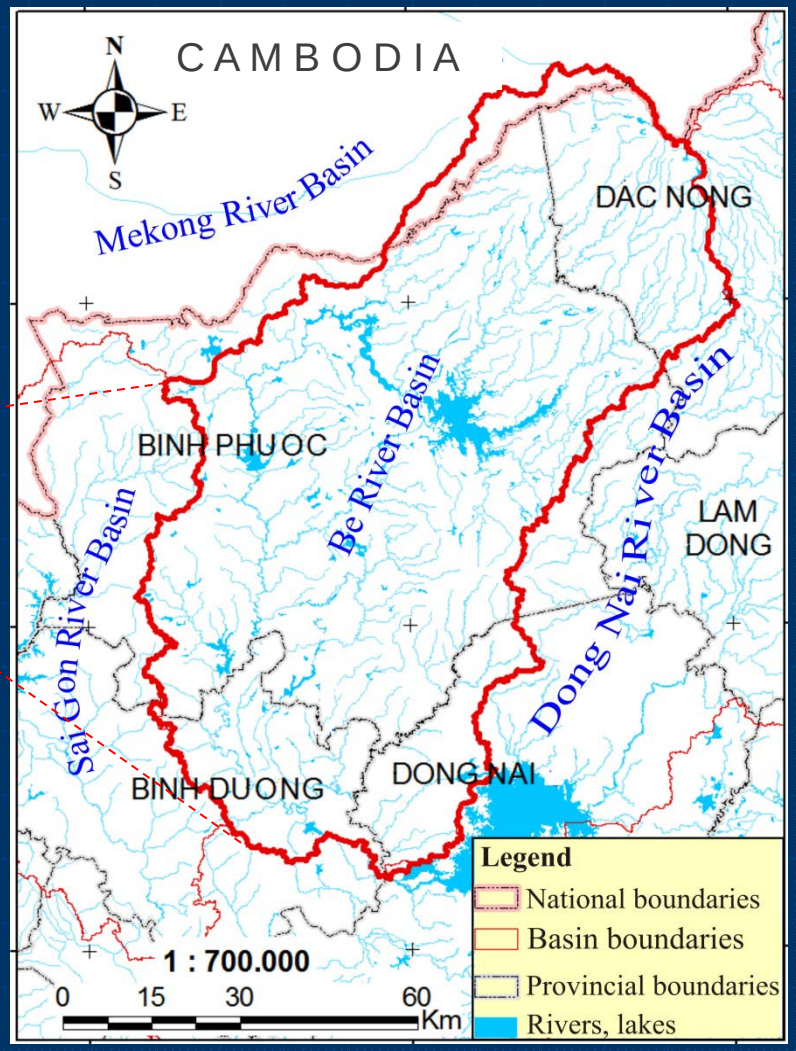
- Emerging water problems threaten the livelihood of local people
- Coffee growers in Western Highlands exhaustedly water in 1997
- In the historical flood of 1999, 2000, 2009
- Relation of water problem
- The development approach and the failure of trade-off between conservation and development in watershed area



- **High growth of population**
- **Social complex**
- **Agricultural activities**
- **Land use planning**

Be river basin





Area:
7,650 km²

Elevation:
80 – 1,000 m

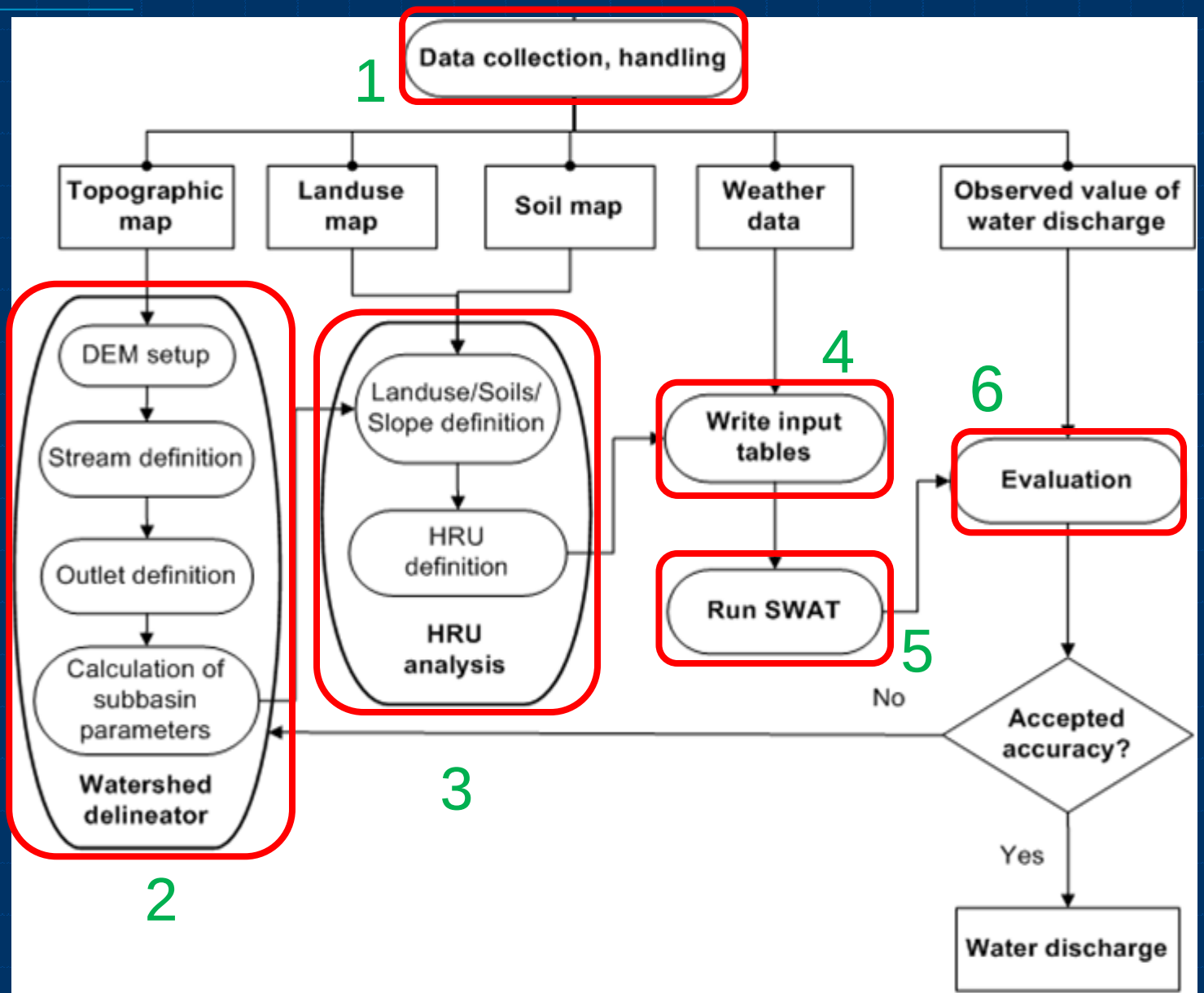
Mean precipitation:
2,200 – 2,600 mm

Mean temperature:
25.5 – 26.7°C

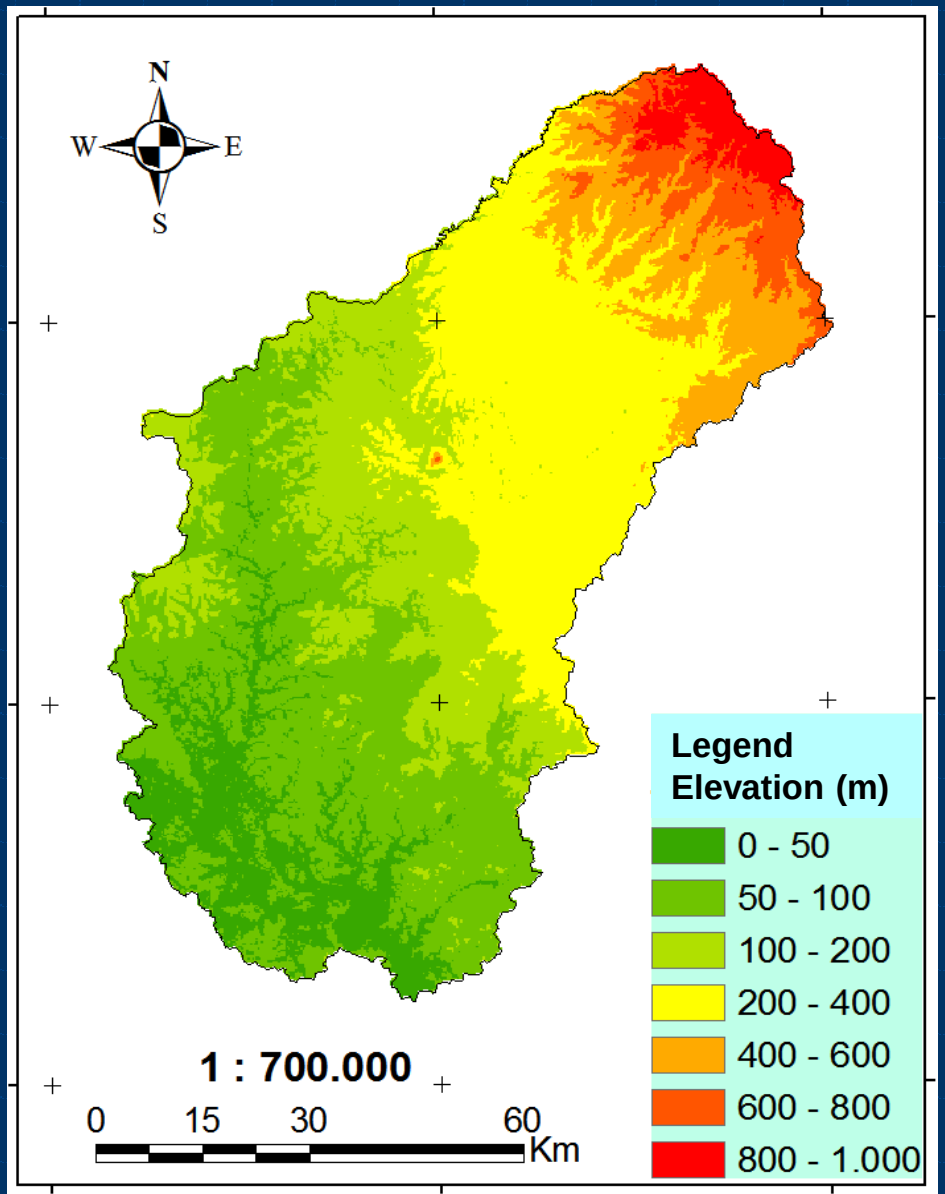
Objective of research

- To simulate stream flow from Digital Elevation Model (DEM), land use, soil and weather data using SWAT model.
- To assess fluctuations and find out the rule of water discharge in Be river basin.

Method – Model setup



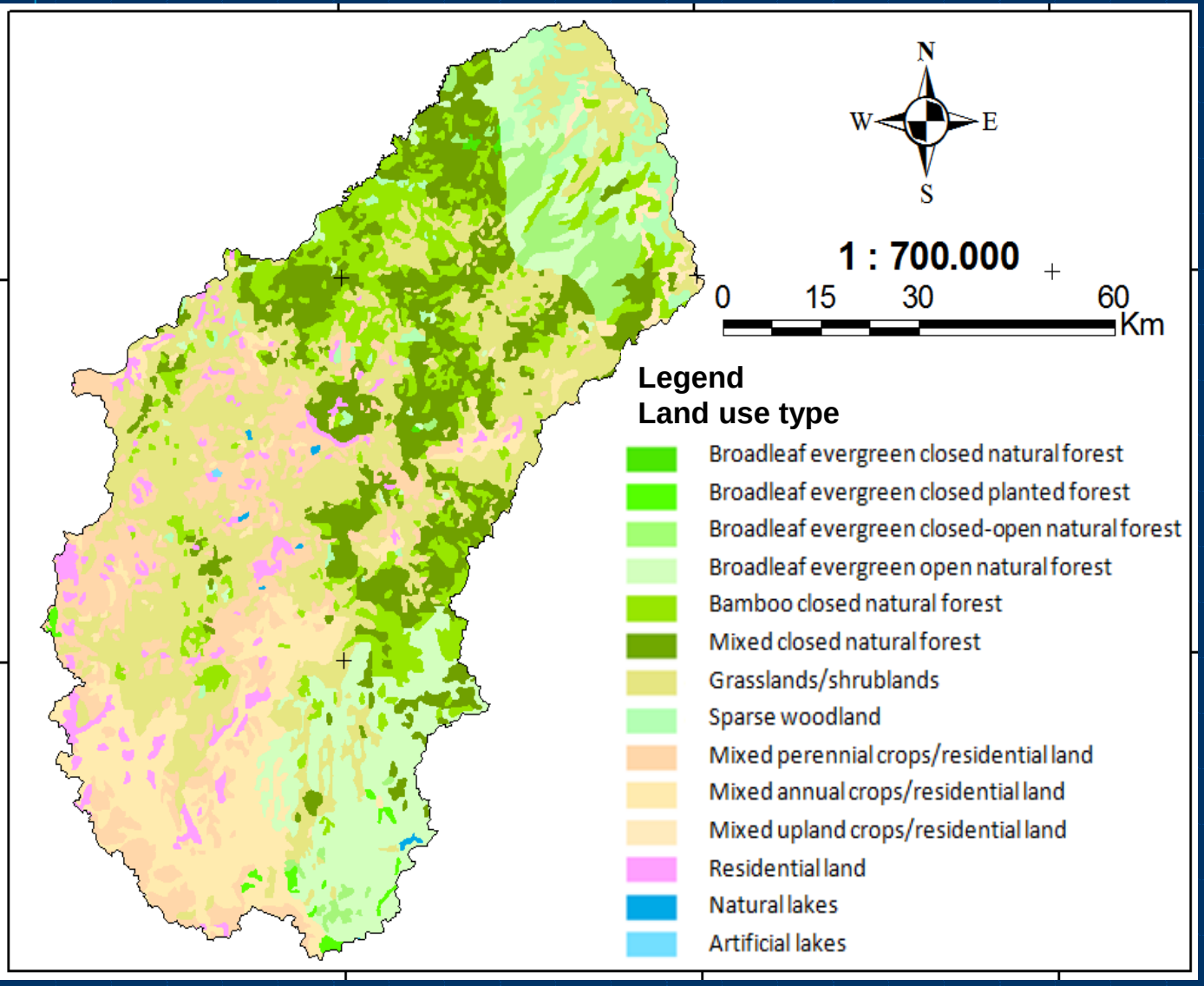
Method – Input data



DEM

- ASTER GDEM
- Resolution: 30 m
- Range: 0 - 987 m

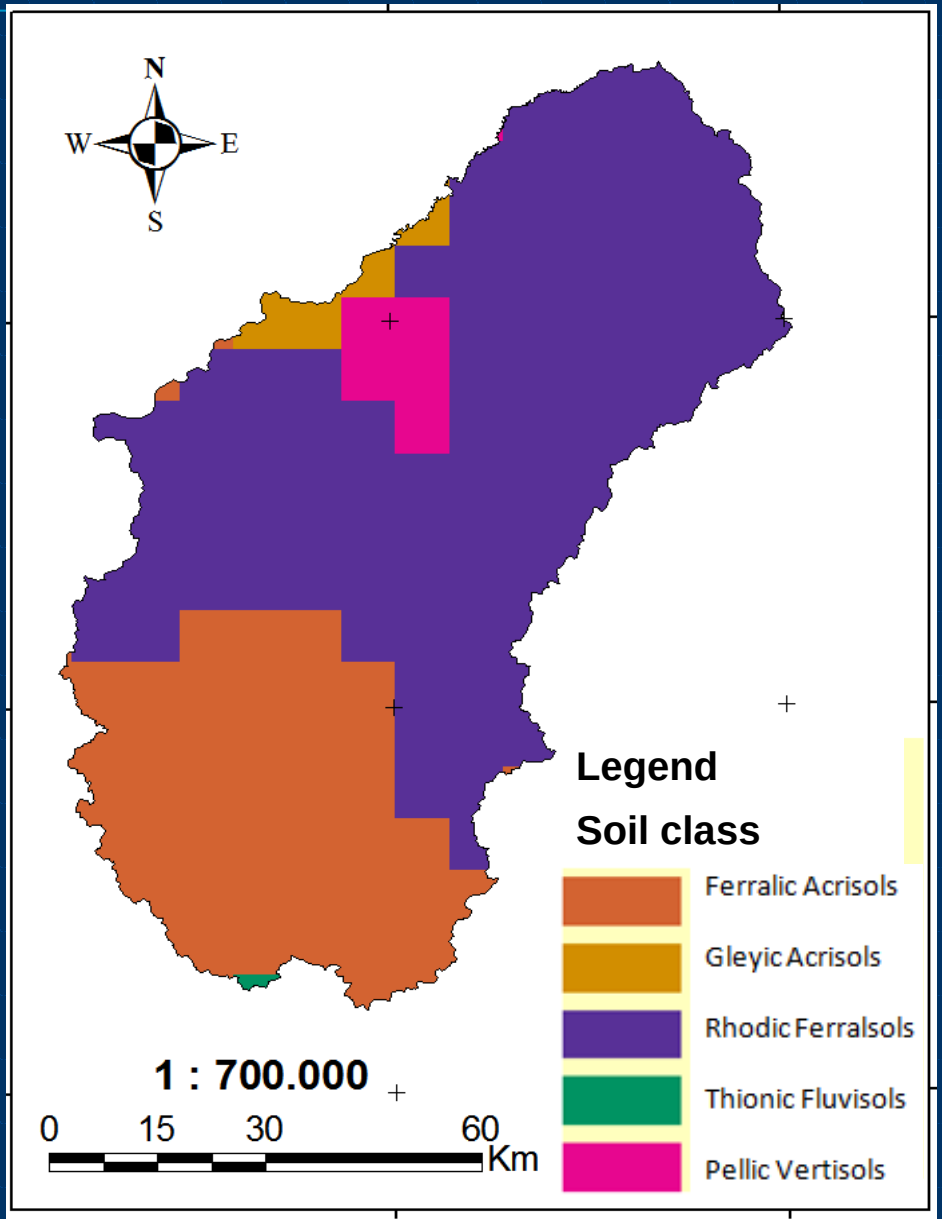
Method – Input data



Land use Data

- SIWRP (Southern Institute for Water Resources Planning)
- 14 land use types
- Grasslands/ shrublands (28.18 %), Mixed closed natural forest (15.16 %)

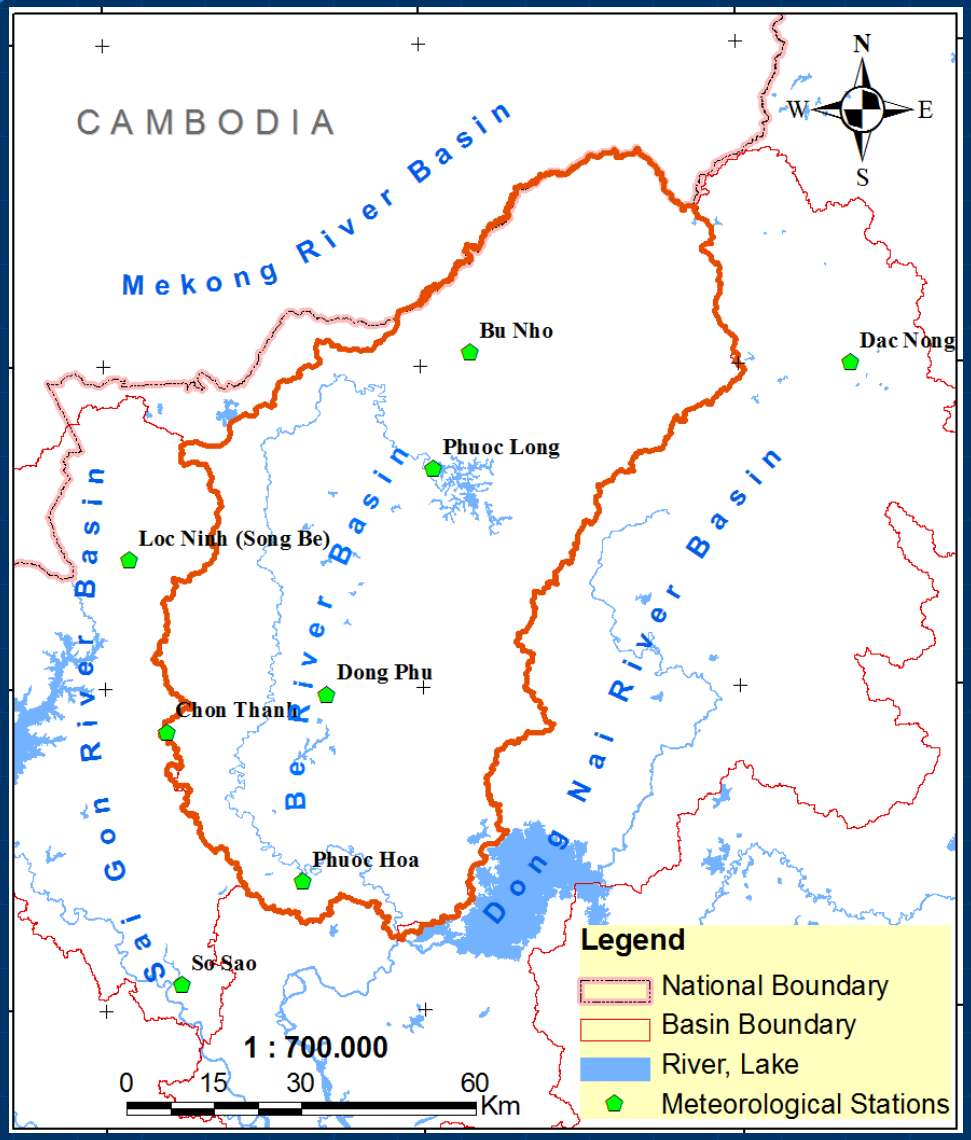
Method – Input data



Soil map

- Department of Soil Science in HCM City (1995)
- 5 soil classes
- Rhodic Ferralsols (63.85 %), Ferric Acrisols (29.95 %)

Method – Input data



Weather

- Southern Institute for Water Resources Planning (SIWRP)
- 8 meteorological stations: Bu Nho, Chon Thanh, Dac Nong, Dong Phu, Loc Ninh (Song Be), Phuoc Hoa, Phuoc Long and So Sao
- Temporal resolution: Daily
- Period: 1979 - 2007

Method – Input data

Discharge

- Southern Institute for Water Resources Planning (SIWRP)
- 2 flow gages: Phuoc Long, Phuoc Hoa
- Temporal resolution: Monthly
- Period: 1979 - 2007

Model evaluation

- Coefficient of determination (R^2)

$$R^2 = \left(\frac{\sum_{i=1}^{n}(O_i - \bar{O})(P_i - \bar{P})}{\sqrt{\sum_{i=1}^{n}(O_i - \bar{O})^2}\sqrt{\sum_{i=1}^{n}(P_i - \bar{P})^2}} \right)^2$$

- Nash-Sutcliffe Index (NSI)

$$NSI = 1 - \frac{\sum_{i=1}^{n}(O_i - P_i)^2}{\sum_{i=1}^{n}(O_i - \bar{O})^2}$$

O_i is the observed discharge at time i,

$\bar{O}$ *is the average observed discharge,*

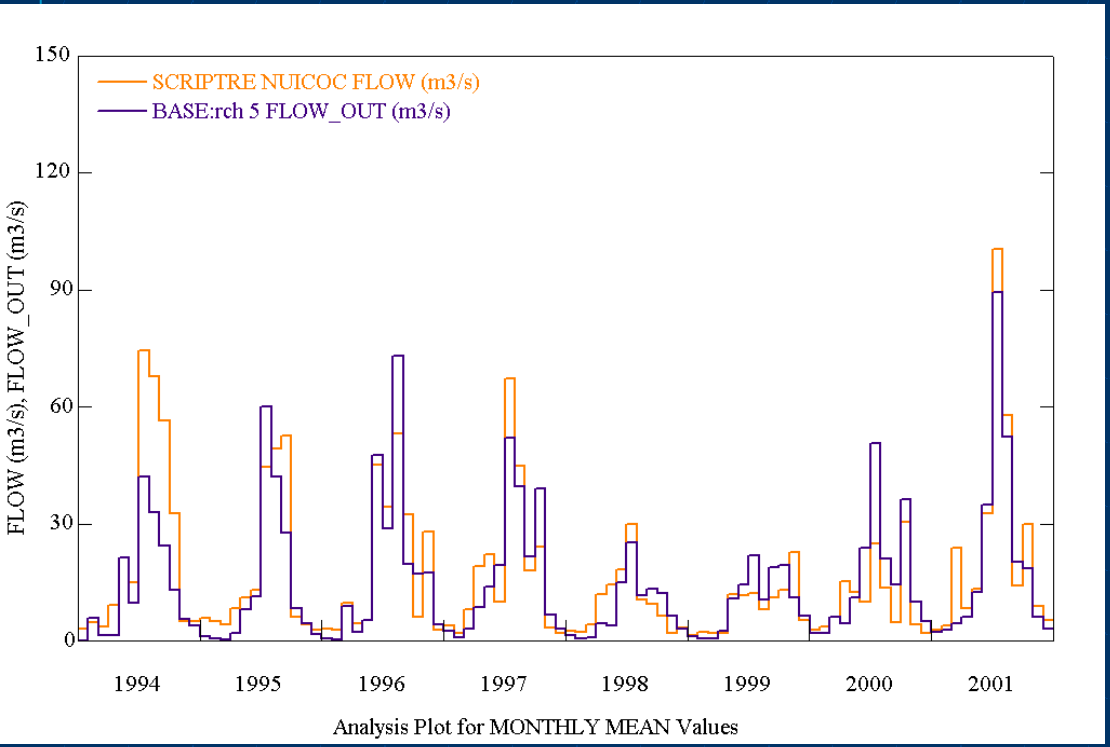
P_i is the simulated discharge at time i,

$\bar{P}$ *is the average simulated discharge,*

n presents the number of registered discharge data.

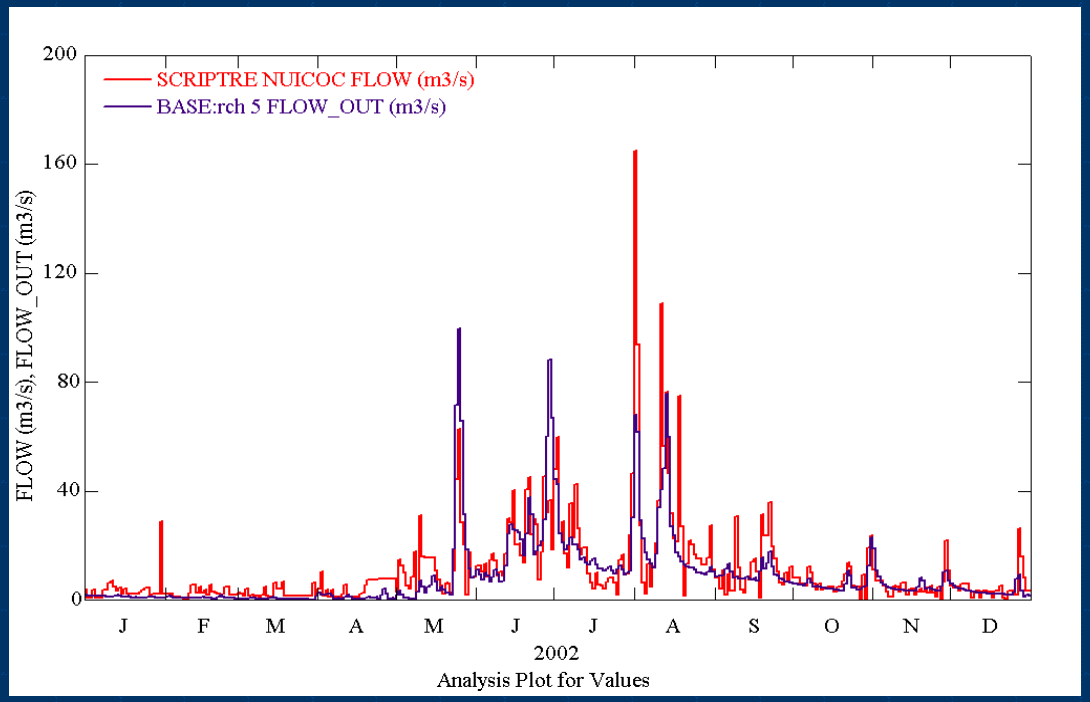
Results

Monthly stream flow calibration (1994 – 2001)



Statistics	2000-2005 Monthly stream flow (m^3/s)	
	Measured	SWAT Calibration
Mean	16.7	14.79
Max	101	89.5
Min	1.4	0.1
Range	99.6	89.4
Standard deviation	19.13	17.11
Correlation coefficient	0.65	

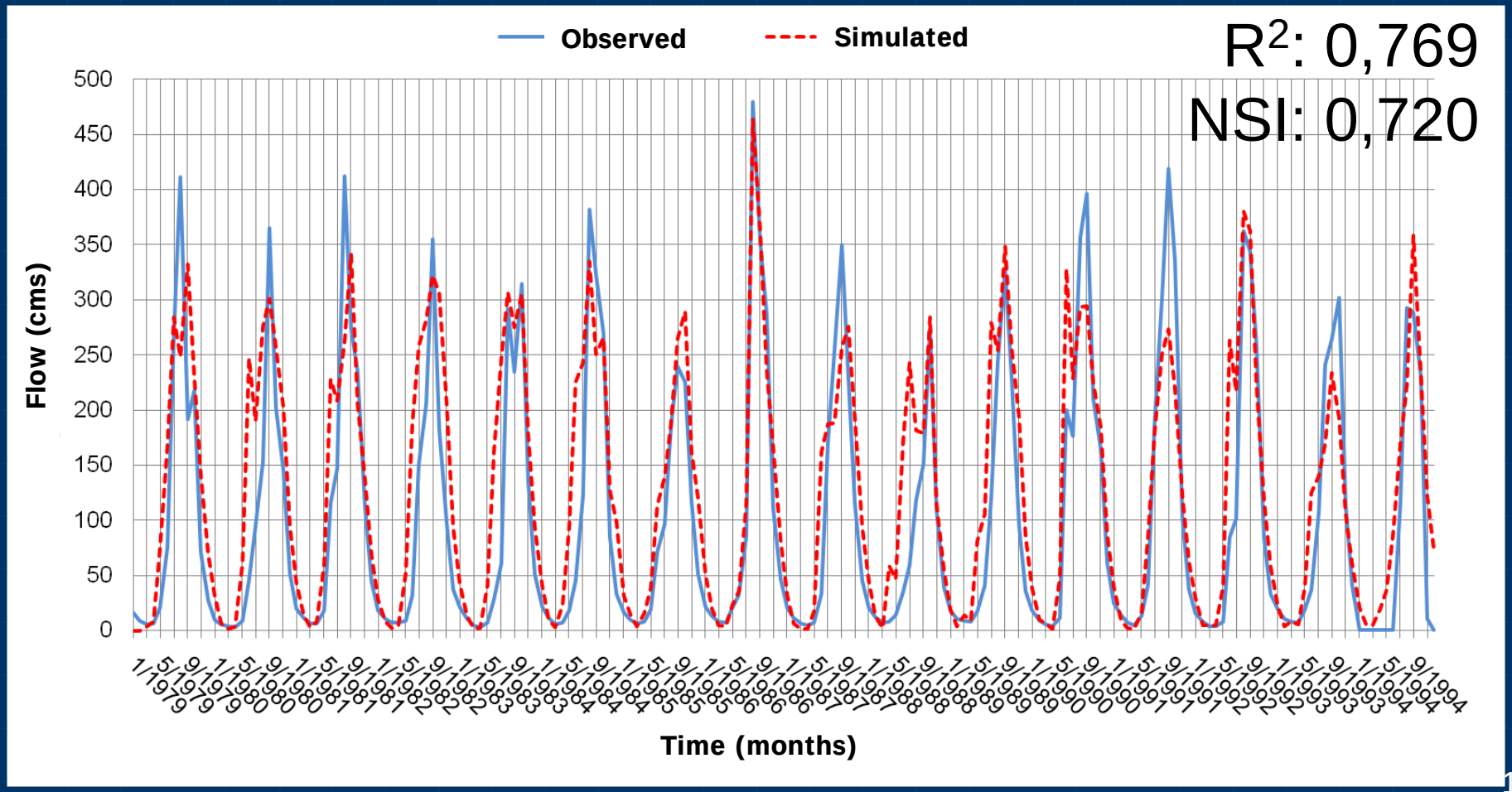
Daily stream flow validation - 2002



Statistics	2002 daily stream flow (m^3/s)	
	Measured	SWAT Validation
Mean	10.78	8.79
Max	165	99.7
Min	0	0.2
Range	165	99.5
Standard deviation	15.79	13.47
Correlation coefficient	0.66	

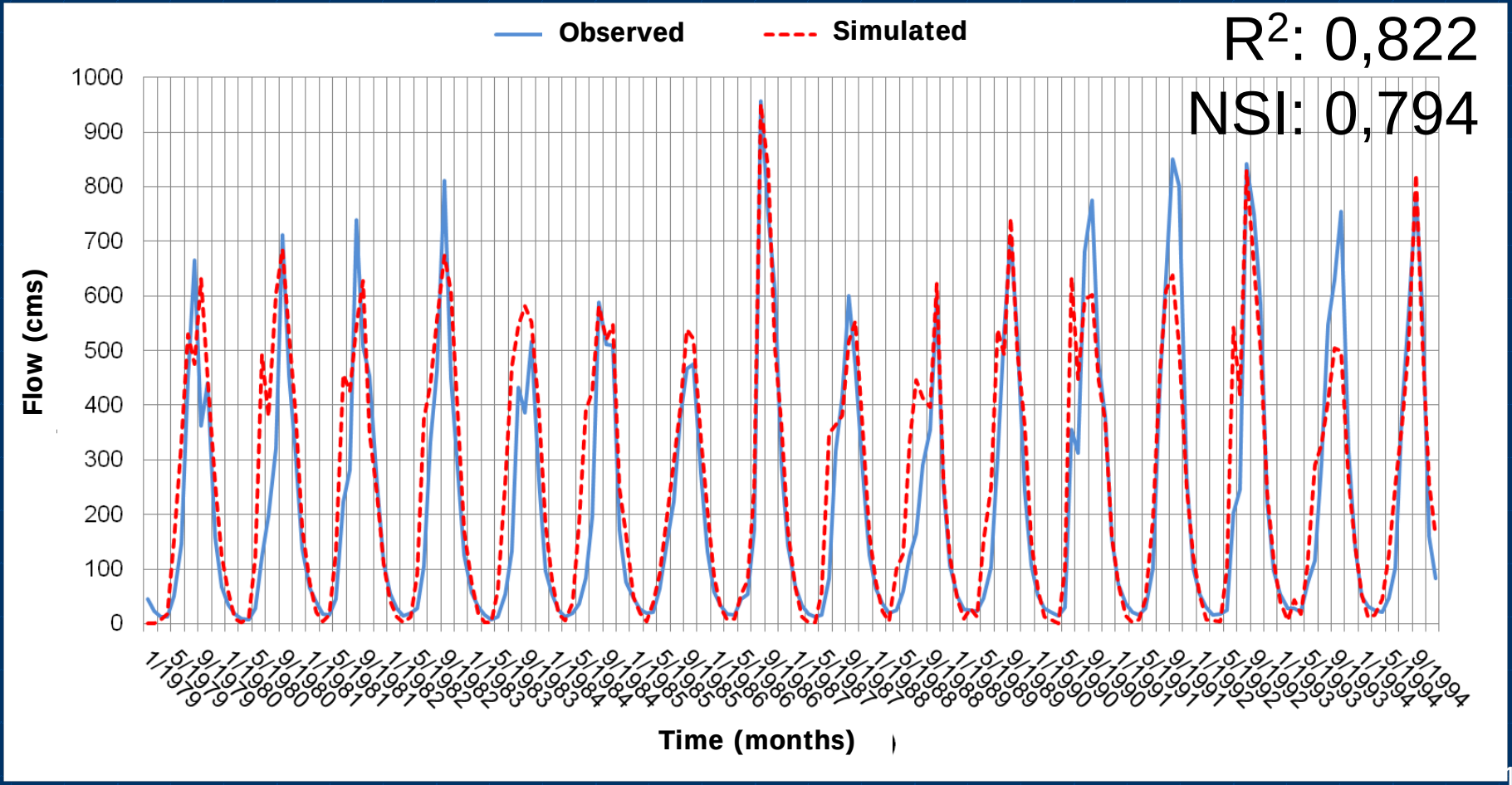
Results

- Monthly water discharge at Phuoc Long (1979 – 1994)



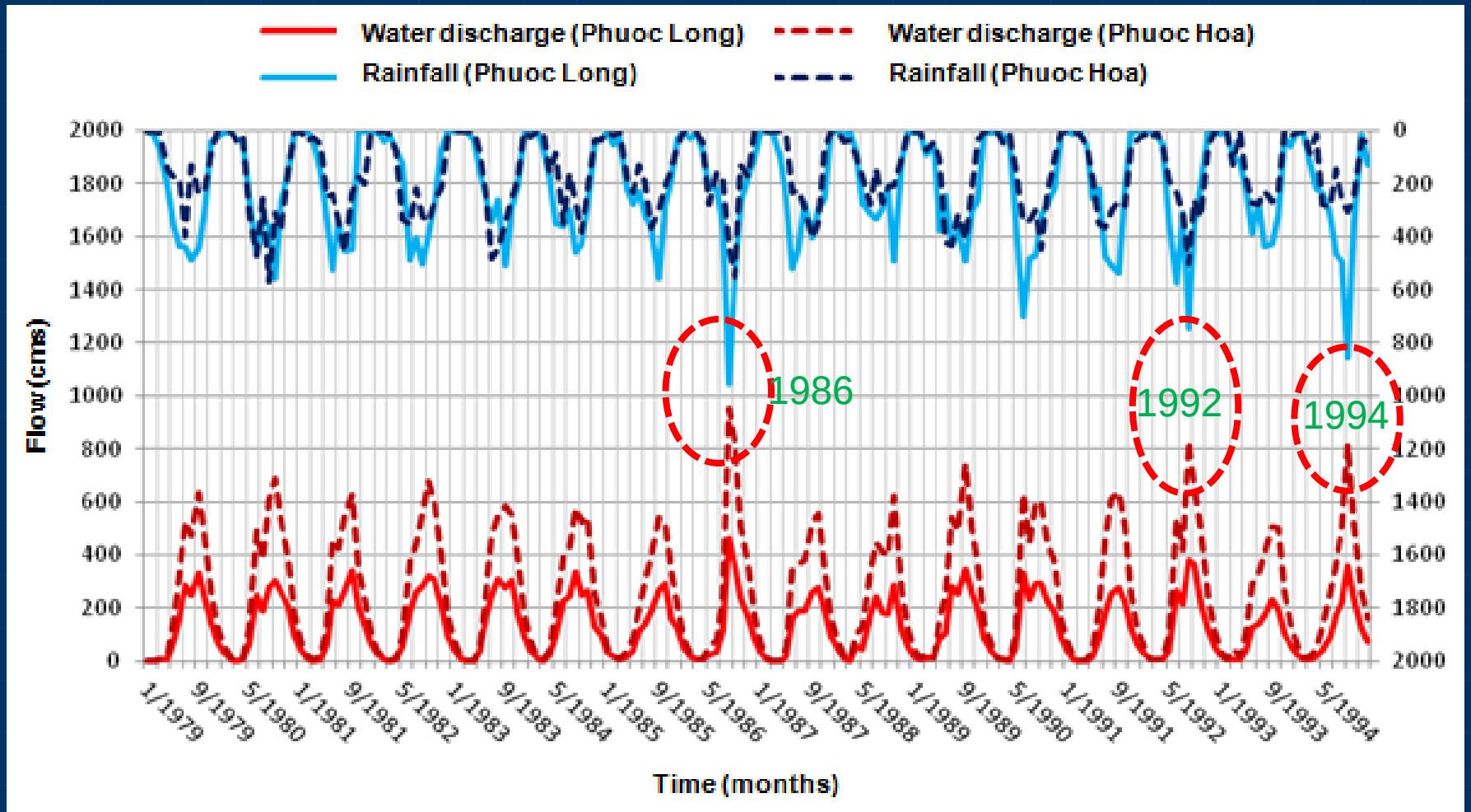
Results

- Monthly water discharge at Phuoc Hoa (1979 – 1994)



Results

- The variations of rainfall and water discharge at Phuoc Long and Phuoc Hoa (1979 - 1994)



Conclusion

- The study simulated the water discharge of Be river basin in the period from 1979 – 2007 by SWAT model.
- The model gives good results for the monthly time step (R^2 and NSI > 0.7).
- The preliminary results show that SWAT can be used in Be river basin to simulate the flow and especially for the monthly time step.

Future research directions

- Data improvements and more calibration must be done to use the model for the daily time step.
- Assessing the impact of land management practices and climate change on water discharge.

ACKNOWLEDGEMENTS

- Southeast Asian Regional Center for Graduate Study and Research in Agriculture (SEARCA)
- Nong Lam University (NLU), Ho Chi Minh City

The 6th Multi-Disciplinary International Workshop on Artificial Intelligence

MIWAI 2012

Ho Chi Minh City, Vietnam, December 26-28, 2012

Website: http://khamreang.msu.ac.th/miwai12

Theme: "AI for Climate Change"

"...it is the major, overriding environmental issue of our time, and the single greatest challenge facing environmental regulators. It is a growing crisis with economic, health and safety, food production, security, and other dimensions."

Ban Ki-Moon
UN Secretary General

In the last several years, we have witnessed all kinds of changes in the world's climate. These changes have affected our lives profoundly. The catastrophic flood in Thailand in 2011, for example, was one of the worst in that country's and the world's history. There were 12.8 million affected people, hundreds of thousands lived their lives under water for more than a quarter of the year, while many others were homeless. The flood also struck Thailand's economy heavily. Most of the industrial estates in central Thailand were under water, and, as a consequence, hundreds of thousands of jobs were floated away. The World Bank estimated that the economic loss was 1.44 trillion Baht—more than half of the country's annual

Important Dates

Papers due:	July 15, 2012
Author notification:	September 15, 2012
Camera-ready due:	September 30, 2012
Tutorial day:	December 26, 2012
Workshop dates:	December 27-28, 2012

Call For Papers

Artificial intelligence is a broad area of research. We encourage researchers to submit papers in the following areas but not limited to:

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- Agent-oriented software engineering
- Agents and Web
- Game theory
- Genetic Algorithms
- Internet/WWW intelligence

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underpinning technology, can promptly respond to help leverage the full computational power to deal with the problem.

Thus, MIWAI-2012 invites papers on advances in AI techniques and related fields, e.g., GIS, neural networks, decision trees, genetic algorithms, fuzzy logic, etc., for climate change. Of course, papers in other areas of AI are also welcome as usual. We do hope that the works presented in the workshop will not only provide observation and recommendations, but also help the community to bestow better problem solvers in the area at the same time.

About MIWAI

The MIWAI series of workshops aims to be a meeting place where excellence in AI research meets the needs for solving dynamic and complex problems in the real world. Through the workshops, the academic researchers, developers, and industrial practitioners will have extensive opportunities to present their original work, technological advances and practical problems. Participants can learn from each other and exchange their experiences in order to fine tune their activities to help each other better. The main purposes of the workshops are as follows:

- To provide a meeting place for AI researchers and practitioners.
- to raise the standards of practice of AI research via the presence of outstanding international invited speakers and feedback from an internationally renowned program committee.

- Distributed AI
- E-Commerce and AI
- Fuzzy logic
- Uncertainty in AI
- Web services

Proceedings Index

The MIWAI 2011 proceedings were published in Springer's LNAI series. This year, we are in the process of negotiating with Springer about publishing the MIWAI 2012 proceedings in the LNAI series again.

Submission Requirements

Submissions of the following categories are invited:

Category A: Regular papers

Papers presenting new original work. Submitted papers should not exceed a length of 12 pages in the Springer LNAI format style. Regular papers will be reviewed on overall quality and relevance. Reviewing of category A papers will be double-blind. In order to make blind reviewing possible, the authors should follow that:

- The authors' names and institutions should not appear in the paper. Unpublished work of the authors should not be cited.
- Using "we" or "us" in reviews of literature should be avoided, e.g., "In [1] we have proposed..." should be changed to "In [1] the authors have proposed...".
- The program committee will evaluate Category A papers as either "rejected" or "accepted as long paper" or "accepted as short paper". All accepted category A papers (long and short) will be fully published in the proceedings.

The authors can submit their papers via this link: https://www.easychair.org/account/signin.cgi?conf=miwai2012

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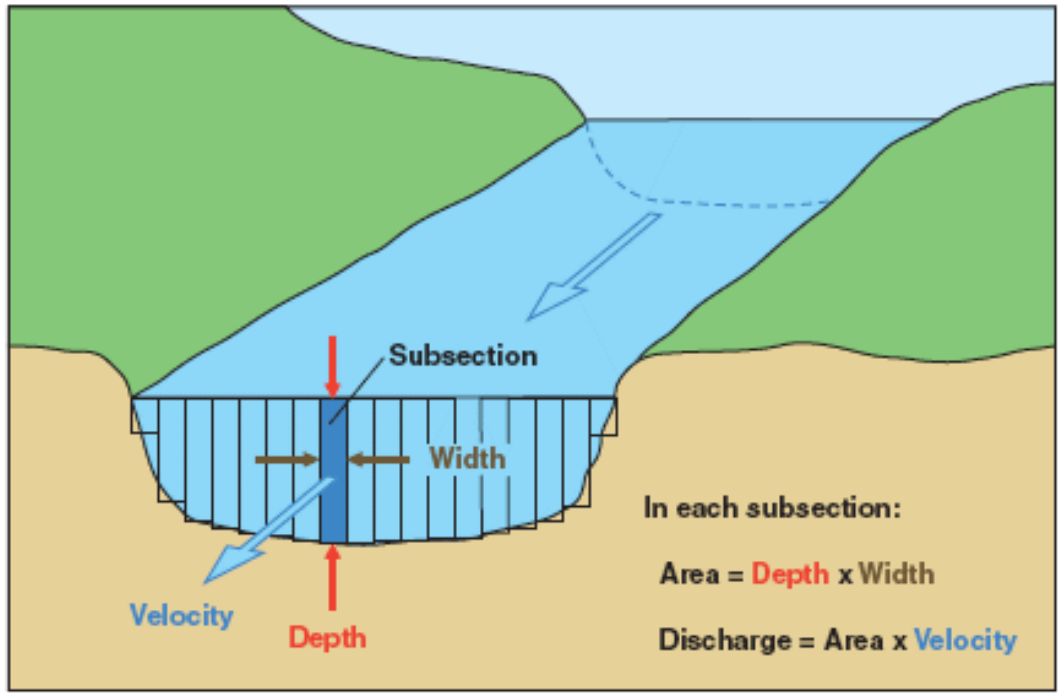
Thank you for your attention!

Definition of Water discharge

- The volume of water moving past a cross-section of a stream over a set period of time (unit: m^3/s).
- Water discharge

= area x velocity



Current-meter discharge measurements are made by determining the discharge in each subsection of a channel cross section and summing the subsection discharges to obtain a total discharge.

Role of Water discharge

- Water discharge defines
  - shape,
  - size and
  - course of the stream.
- Water discharge modeling provides useful information for
  - flood forecasting,
  - predicting sediment loads and
  - assessing the impact of climate change to water resource.

How is Water discharge formed?