IAHS Decade of Predictions in Ungaged Basins (PUB) 2003-2012

Kuniyoshi Takeuchi

IAHS

University of Yamanashi

Yamanashi University, Kofu, Japan, 28-29 March 2002

Kick-Off Workshop on

IAHS DECADE OF PREDICTION IN UNGAGED BASINS (PUB)

- Hydrological Sciences on Mission -

20-22 November 2002

Brasilia, Brazil

Organized by
IAHS and
Brasilia University (UNB),
Sponsored by
IAHS, MEXT Japan, IAEA, IHP-NC France, IHP-NC UK
CGEE, CNPq, CT-Hydro, ABRH

Supported by
UNESCO, WMO, CEOP, GEWEX, HELP, FRIEND, CAUHSI, CHASM, NASA, …

The 3rd
World Water Forum
March 16-23,2003 in Kyoto.Shiga and Osaka,Japan

World Water Council(WWC)
National Streering Committee
Water Action Unit
Secretariat of the 3rd World Water Forum

Science, Tecnology & Management Panel

IAHS PUB Session:

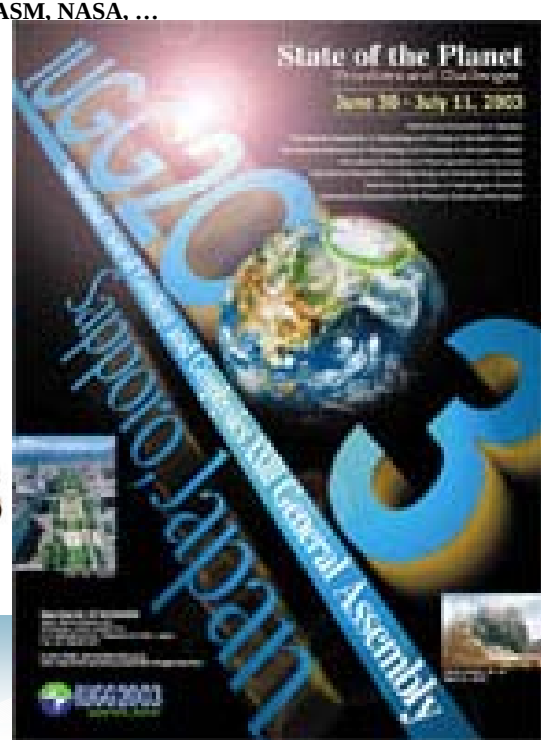
Hydrology for Society: What Can Hydrology Offer for Ungauged Basins?

20 March 8:45-11:30

Room E, Kyoto International Conference Hall

Welcome to

IUGG2003
Sapporo, Japan
June 30 - July 11, 2003



HSJ Vol. 48 (6), 857-880, 2003

PUB Science and Implementation Plan

IAHS Decade on Predictions in Ungauged Basins (PUB), 2003-2012: Shaping an Exciting Future for the Hydrological Sciences

- Introduction
- IAHS PUB Initiative on Predictions in Ungauged Basins
- PUB Science Plan
  - PUB Scientific Objectives
  - PUB Science Focus: Reduction of Predictive Uncertainty
  - PUB Science Questions
  - PUB Science Targets
  - PUB Science Strategy: Science Themes
- PUB Implementation Plan
- PUB Organisational Structure
- Conclusions

Definition of “predictions in ungaged basins”

- PUB is the prediction of the hydrological response (e.g. of streamflow, groundwater, sediments, nutrients, etc.) of ungauged or poorly gauged basins with its associated uncertainty, using climatic inputs (observed, forecast or otherwise specified), soils, vegetation, geology and topography, but with no possibility or allowance for direct *calibration*.

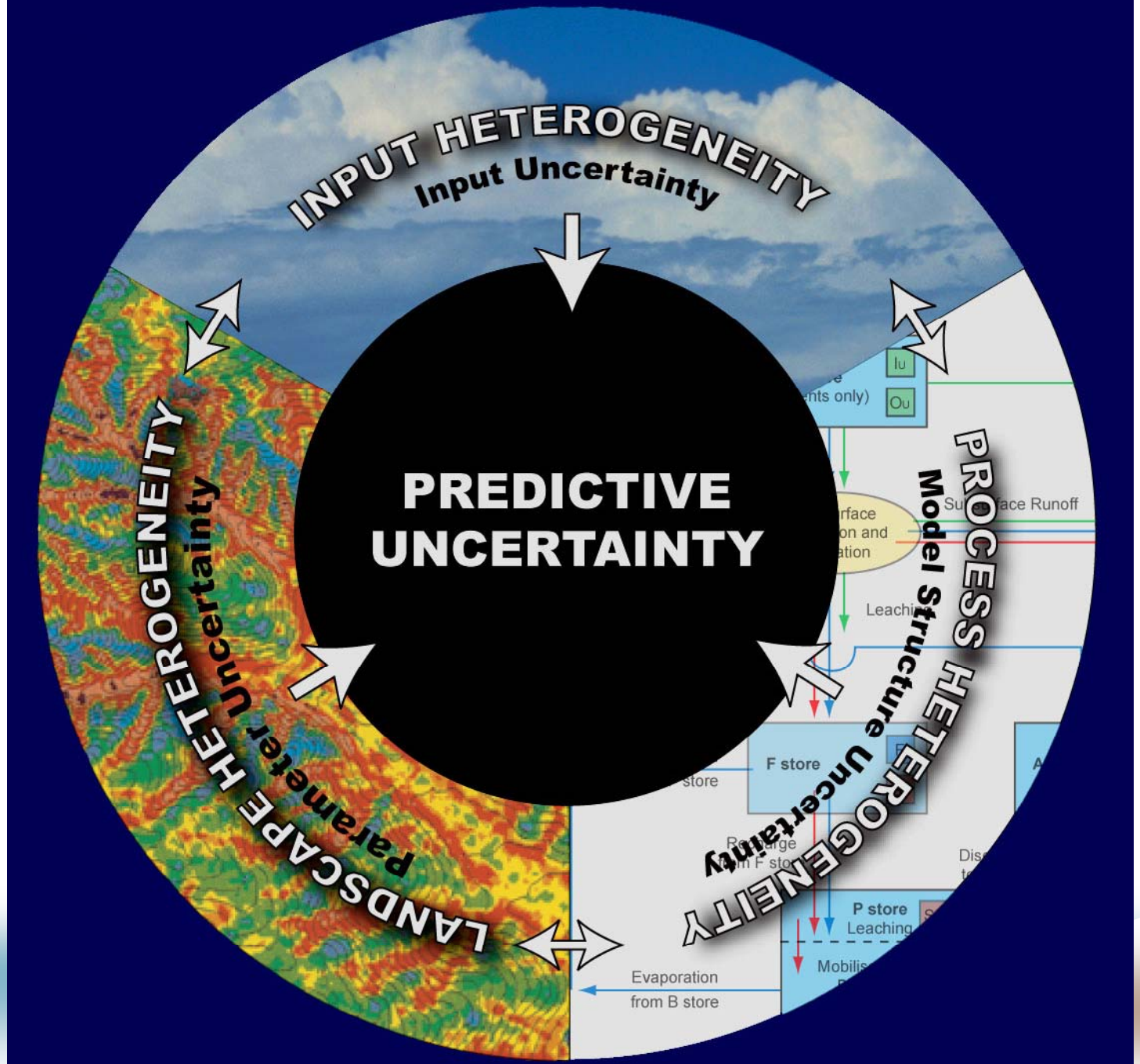
Sivapalan et al., HSJ Vol. 48 (6), 857-880, 2003

PUB Science Questions

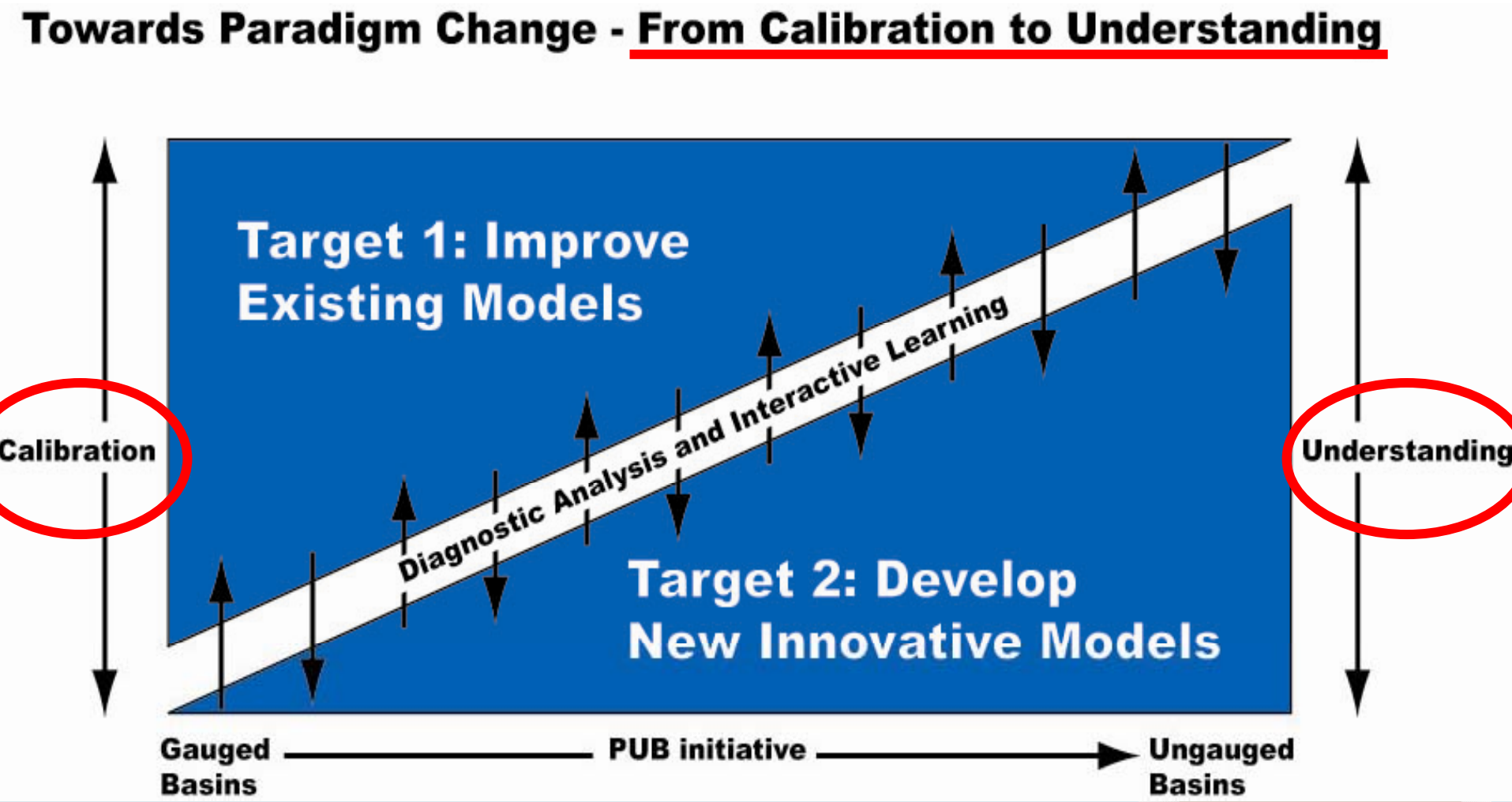
- What are the key gaps in our knowledge that limit our capacity to generate reliable predictions in ungauged catchments?
- What are the minimum information requirements to reduce predictive uncertainty in the future?
- What experimentation is needed to underpin the new knowledge required?
- How can we employ new observational technologies in improved predictive methods?
- How can we improve the hydrological process descriptions that address key knowledge elements that can reduce uncertainty?
- How can we maximise the scientific value of available data in generating improved predictions?

PUB Community Objectives

- Develop an observational field program.
- Increase the awareness of the value of data.
- Advance the technological capability to make predictions in ungauged basins and to constrain the uncertainty.
- Advance the scientific foundations to improve the understanding of hydrologic processes, and on the uncertainty of predictions.
- Actively promote "capacity building" activities.


INPUT HETEROGENEITY
Input Uncertainty
PREDICTIVE UNCERTAINTY
LANDSCAPE HETEROGENEITY
Parameter Uncertainty
PROCESS HETEROGENEITY
Model Structure Uncertainty
Iu
Ou
F store
P store
Leaching
Evaporation
from B store

Methodological Strategy



PUB Environment

- UN Intern Decade for Action "Water and Life" 2005-2015
- Kobe spirit: Reduce by 50% the loss of lives due to natural disasters by 2015
- UNESCO/WMO IFI, ILP, CHARM
- IFNet GFAS-2
- GEO/GEOSS

PUB Environment

- UNESCO IHP FRIEND/HELP/PUB collaboration agreement, May 2004
- WMO CHy, Oct 2004: IAHS/PUB presented
- EOS 85(44) 451, 457, 2 Nov. 2004 T. Wagner et al., Predictions in ungaged basins as a catalyst for multidisciplinary hydrology
- WWC Associate Program
  - Space to Earth Alliance: Addressing the issues of ungaged basins worldwide
- PUB WGs,
- CUAHSI, AGU, EGU, AOGS, APHW
- GEWEX/WRAP, CEOP

WG1 - Top-Down Modelling Working Group (Europe, Australia, US, Brazil)

WG2 - MOPEX Working Group（US)

WG3 - Orographic Precipitation, Surface & Ground Water Interactions and their Impact on Water Resources (US)

WG4 - Japan Working Group - Suimon Adventure for Knowledge Evolution (SAKE)

- WG4.1 - Estimation of Extreme Events
- WG4.2 - Model Selection and Uncertainty Evaluation
- WG4.3 - Hydrologic and Landscape Diveristy
- WG4.4 - Global Hydrologic Modelling
- WG4.5 - Downscaling Global Hydrologic Information

WG5 - Design Flows for Ungauged Basins (Italy)

WG6 - China Working Group

- WG6.1 - Hydrological Modelling and Water Resources Assessment under High Water-Stress
- WG6.2 - Evaluation and Prediction of the Groundwater
- WG6.3 - Flood Forecast and Damage Estimation
- WG6.4 - Prediction of Water Resources and its Consumption in the Arid Region
- WG6.5 - Study of the Ecologically Vulnerable Basins
- WG6.6 - Development of the Coupled Model for the Hydrologic Cycle and Water Quality in the Urbanized River Basins
- WG6.7 - Applications of New Technologies, Theories and Methods to the Hydrological Prediction in Ungauged Basins

WG7 - Uncertainty Estimation for Hydrological Modelling (US, UK, Germany, Australia)

WG8 - Remote Sensing and Data Assimilation (US, UK, Netherlands, Australia, New Zealand)

WG9 - Mediterranean Climate Ungaged Basins

WG10 - Drought and Flood Risk : Hydrology and Sediment Transport in Mountain Catchments

PUB WSs

- Perth, AU, Jan 2004
- Yellowknife, CA, May 2004
- Windhoek, Angora,
- Moscow, Sept 2004
- Colombo, Sri Lanka, Nov 2004
- Kyoto, Jan 2005

VIIth IAHS Scientific Assembly

VII^e Assemblée Scientifique de l'AISH

Freshwater : Sustainability within Uncertainty

Foz do Iguaçu (Brazil)

3-9 April / *Avril* 2005

S#7 Prediction in Ungauged Basins : Promises and Progress (PUB WG)

S#7-1. Model improvements through detailed process studies

S#7-2. Model evaluation and comparison: uncertainty analysis and diagnostics

S#7-3. New data collection approaches and model development

S#7-4. Complex Systems and Ecohydrology

S#7-5. Nonlinearity, Complexity, Scaling and PUB

S#7-6. New Distributed Modelling Approaches and Methods for Testing Models Against Observations

S#7-7. Progress in PUB Implementation (PUB WG)

W#5 Model Parameter Estimation MOPEX-5 (IAHS/WMO-GEWEX WG, ICCLAS, ICSW, PUB WG)

W#6 Transferring Hydrological Data Across Spatial and Temporal Scales (IAHS/WMO-GEWEX WG, PUB WG, GEWEX-WRAP, ICCLAS,ICRS, ICSI)

W#7 Land-use and Water Quality Relationships in Ungauged Basins (ICCE, ICWQ, ICGW, PUB WG)

W#8 Workshop on Isotope Tracers and Remote Sensing Techniques for Assessing Water Cycle Variability (ICT, ICRS, PUB WG)

PUB in Asia

- Japan PUB: MEXT funds (Tachikawa, Oki, Takeuchi)
- China PUB: (Jiangyun Zhang, MWR) Meeting 2005?
- Thailand PUB: (Chavalit, TU; Saisunee, MU) Uncertainty, Modelling, T-J joint Meeting 2005.3
- SriLanka PUB (S.B.Weerakoon, U Peradeniya) Mahawali R.
- Korean PUB (Soontak Lee, Yongnam U) Intern Hydrological Environmental Society Meeting 2005?

Thai_PUB

URL of Thai-PUB Website:
http://gis.eng.ku.ac.th/Thai_PUB/index.html

Participants

Prof. Tawatchai Tingsanchali [AIT]	Mr. Thanapon Piman [AIT]	Dr. Ekasit Kositsakulchai [KU]
Dr. Dushmanta Dutta [AIT]	Dr. Chavalit Chaleeraktrakoon [TU]	Dr. Hansa Vathananukig [KU]
Dr. Mukand S. Babe [AIT]	Dr. Kasemchart Sriwalai [TU]	Dr. Saisunee Budhakooncharoen [
Mr. Devesh Sharma [AIT]	Dr. Sunisa Smittakorn [TU]	Dr. Siriluk Chumchean [MU]
Mr. Jahangir Alam [AIT]	Dr. Unuya Weesakul [TU]	Dr. Perapol Begkhuntod [TMD]
Mr. Le Ngoc Son [AIT]	Mr. Anongrit Kangrang [TU]	Dr. Somchai Boonmong [TMD]
Mr. Nguyen Mai Dang [AIT]	Mr. Narunat Meeboonmak [TU]	Mr. Panavwat Pinthong [KMIT]
Mr. Niu Shutian [AIT]	Mr. Pongpan Kanjanakaroon [TU]	Dr. Chatchai Jothiyangkoon [SUT]
Mr. Noor M. Khan [AIT]	Mr. Srawut Samalithak [TU]	

Activities

2547	1st Meeting	- Summary of Meeting
	2nd Meeting	- Meeting Images

Webboard

- Asian Institute of Technology
- Kasetsart University
- King Mongkut Institute of Technology
- Mahanakorn University
- Suranaree University of Technology
- Thai Meteorological Department
- Thammasat University

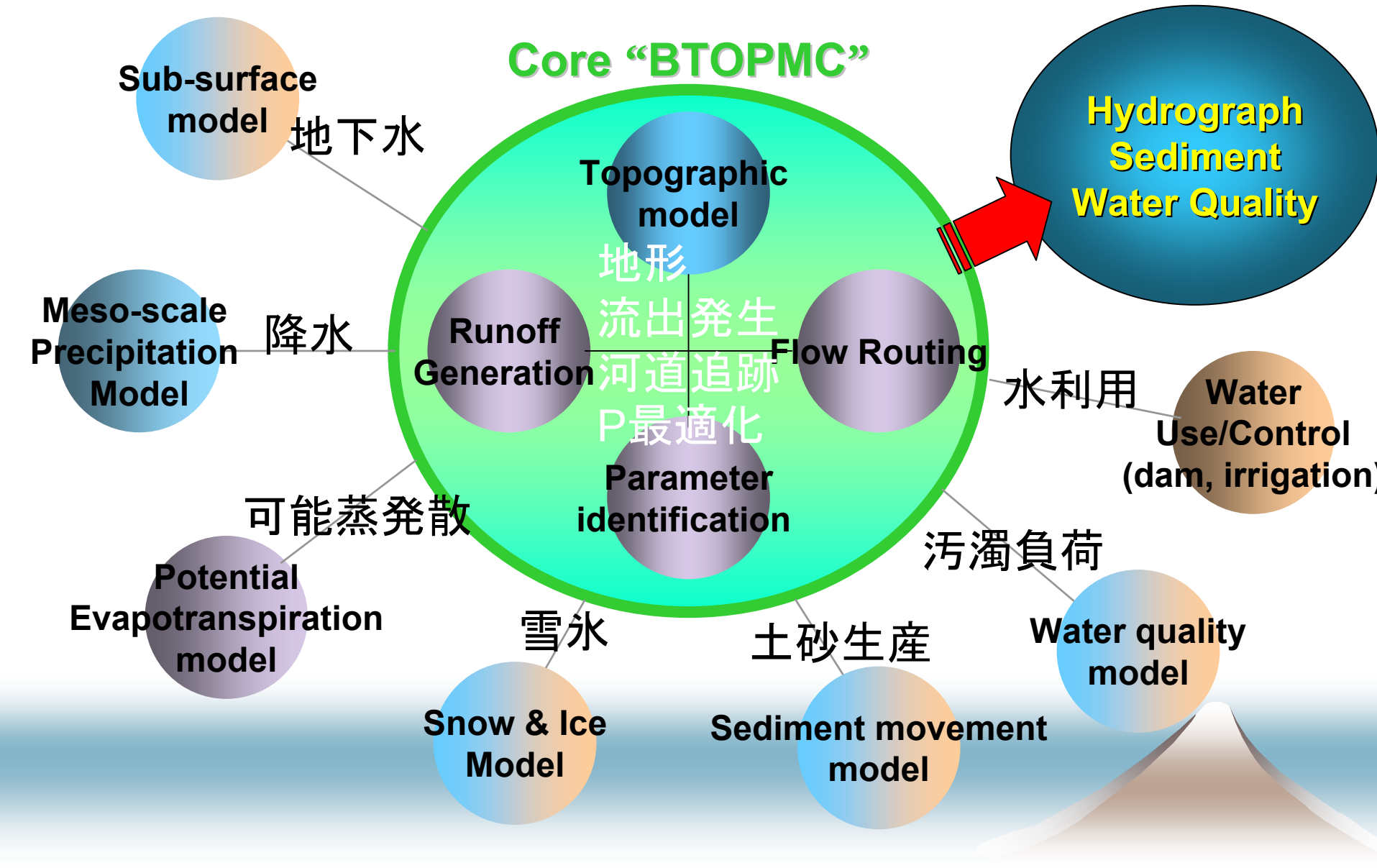
①不確定性評価基準とそれを用いたモデル構築のガイドライン、
②データ不足流域での異常水文現象の頻度推定、
③卓越水文過程とそのスケール問題、
④自然変動と人工影響の地球規模モデル化、
⑤流域管理のための地球規模研究のダウンスケーリング

Japan PUB（SAKE)

- 5 WGs
  - Uncertainty assessment and modelling guideline
  - Frequency analysis of extremes for ungaged basins
  - Dominant processes and their scale issues
  - Global scale modelling of natural variation and human impacts
  - Downscaling of global research products for basin management
- Ungaged basins blind test
  - Chao Phraya (Ping.14 Basin) at 7-9 March 2005
  - Salween R as an ungaged basins
  - Field investigation in Myanmar in 2006

YHyM : component

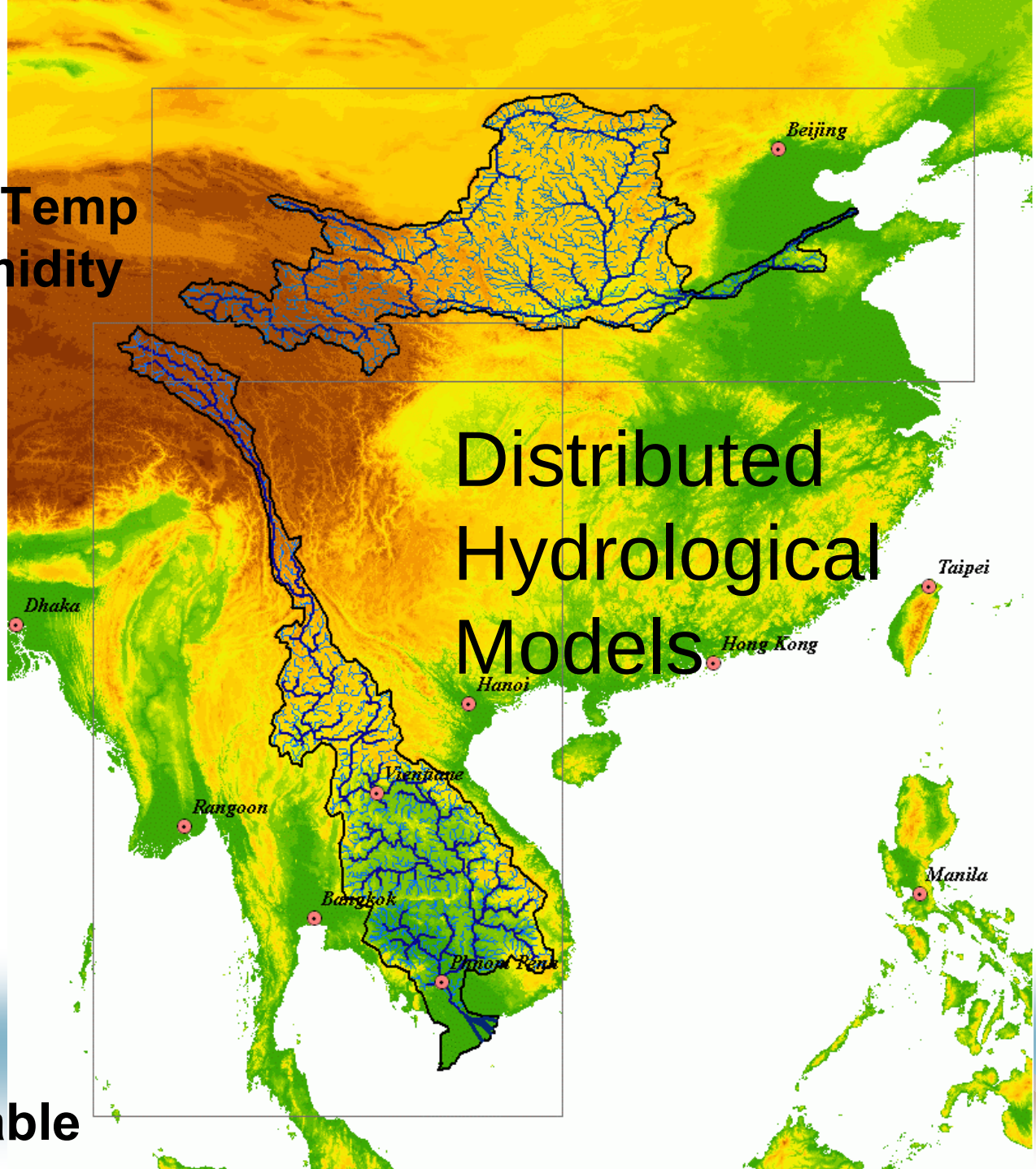
University of Yamanashi Distributed Hydrological Model



DEM
Soil Vegetation
Radiation Wind Temp
Rain Snow Humidity
Land use
Water use
Reservoirs

PET Snowmelt
Infiltration

Discharge
Sediments
Water Quality
Soil Wetness
Actual ET
Groundwater Table



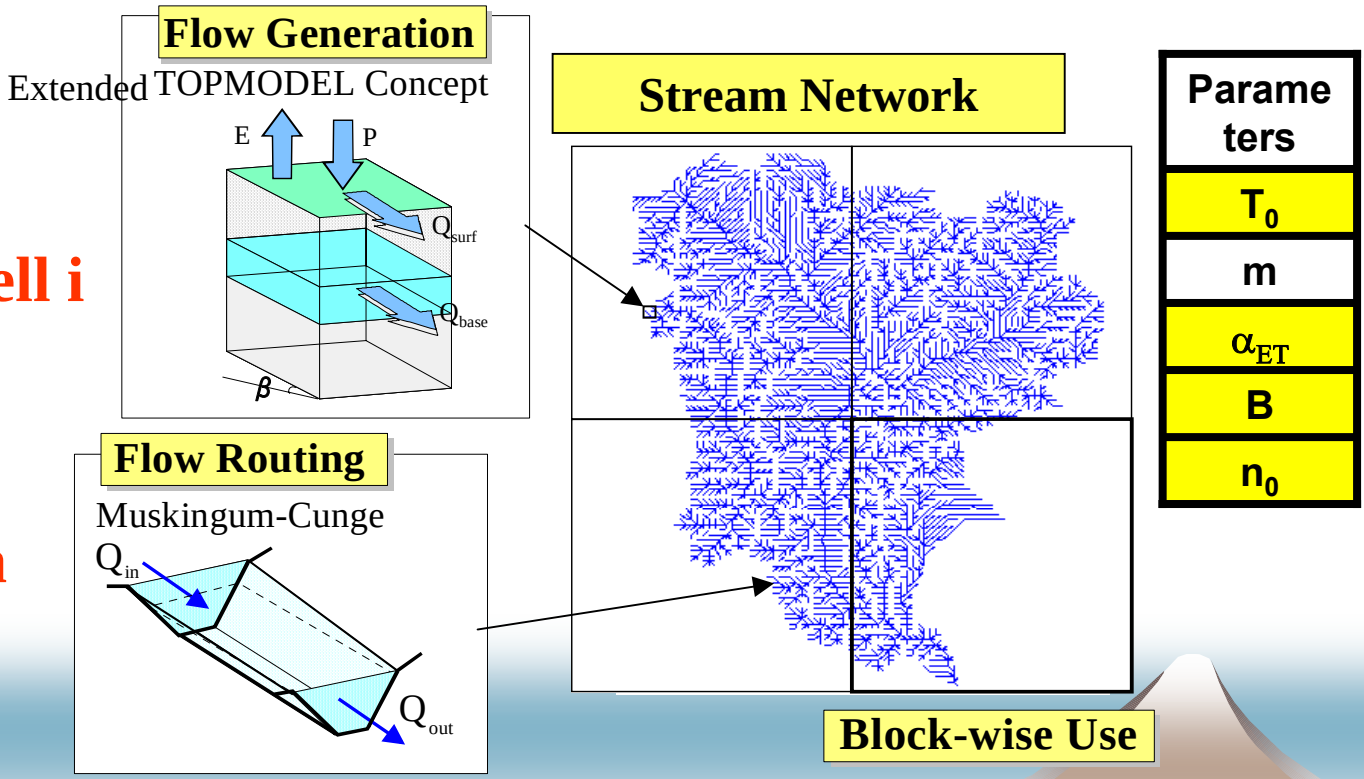
BTOPMC (A core hydrol mdl of YHyM)

(Takeuchi, Ao et al., 1999)

Both OF and BF are generated at each gridcell,
according to local SD reflecting block average SD
$SD(i) = \overline{SD} + m(\overline{\gamma} - \gamma(i))$
Flow routing over all the flow segments.

At each gridcell i

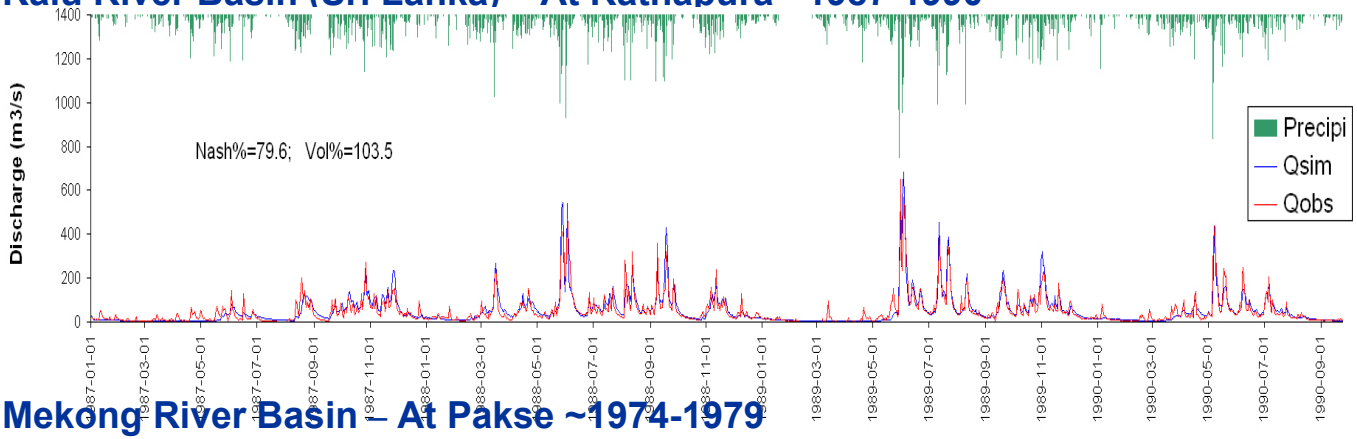
For all stream segments



Simulation results of the Kalu River Basin – At Ratnapura ~1987-1990

Area=603 km²

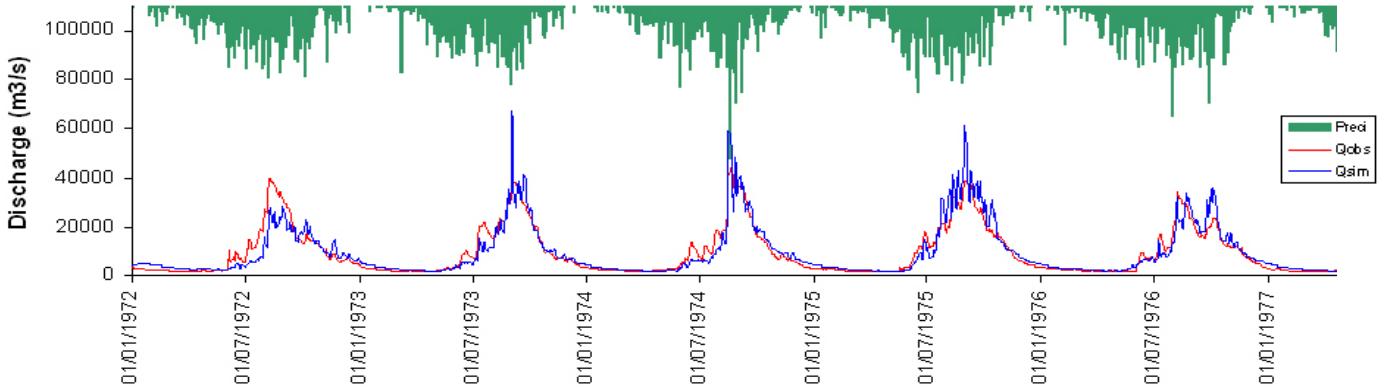
Grid size=1 km (0.5 min.)



Simulation results of the Mekong River Basin – At Pakse ~1974-1979

Area=545 000 km²

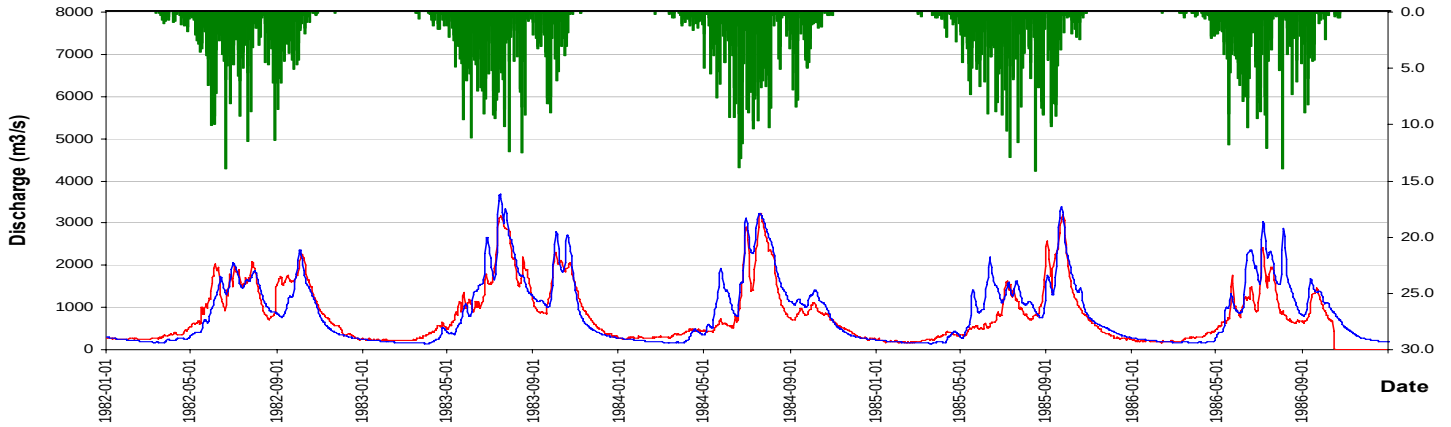
Grid size= 3 min. (6 km)

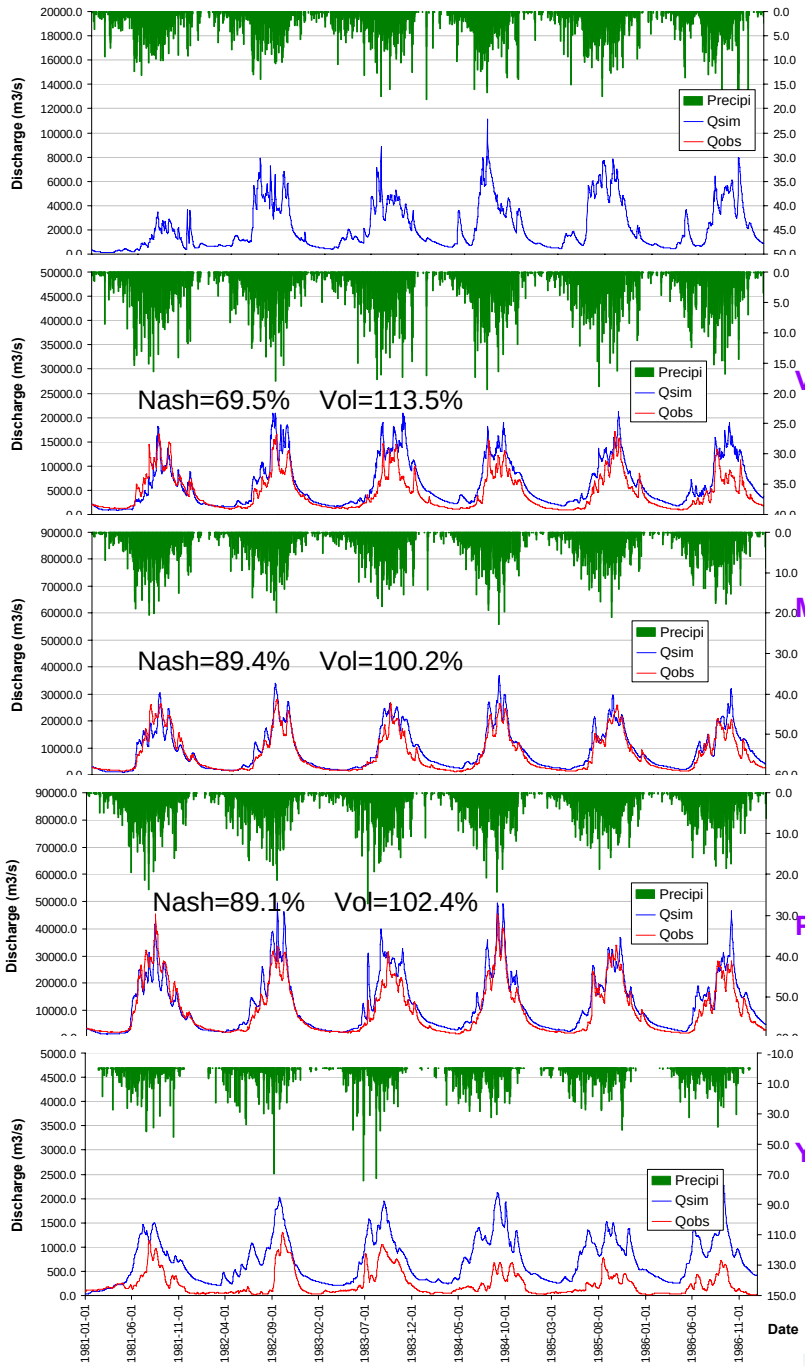


Simulation results of the Yellow River Basin – At Guide ~1982-1986

Area=137 000 km²

Grid size= 2 min. (4km)





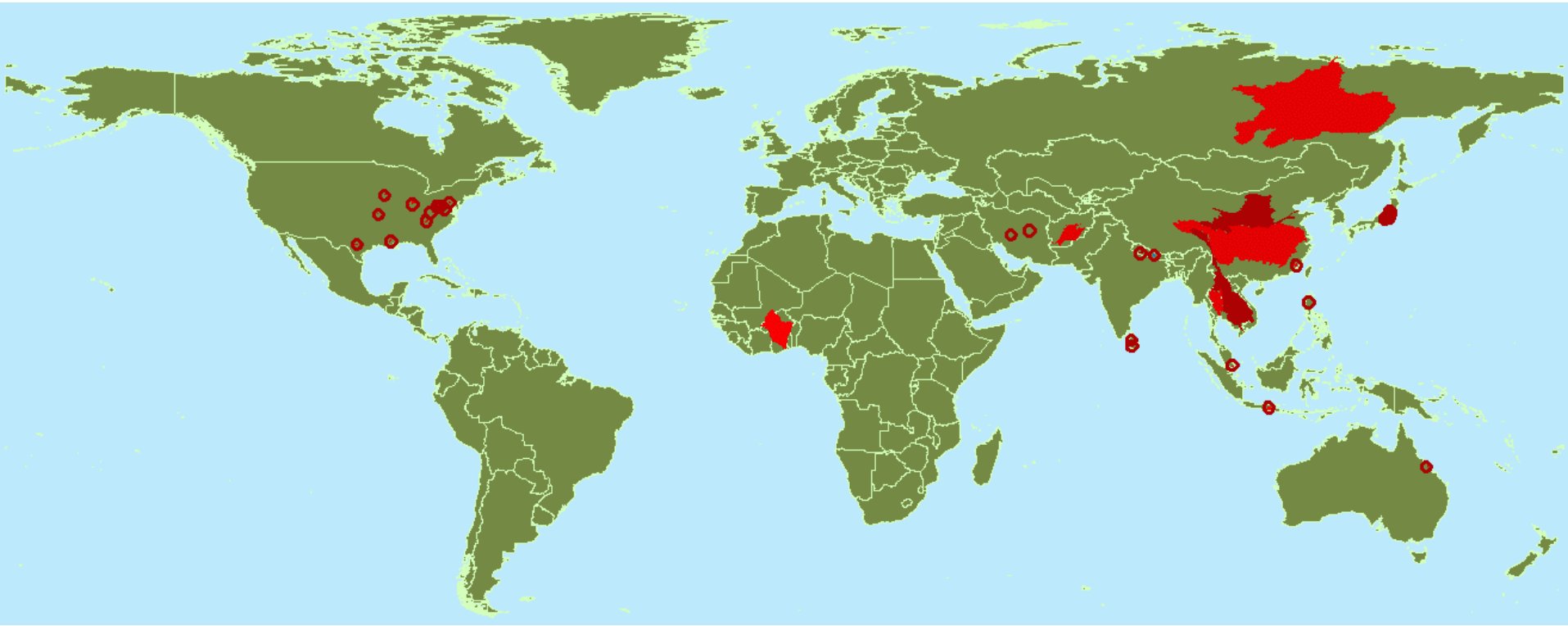
Vientiane

Mukdahan

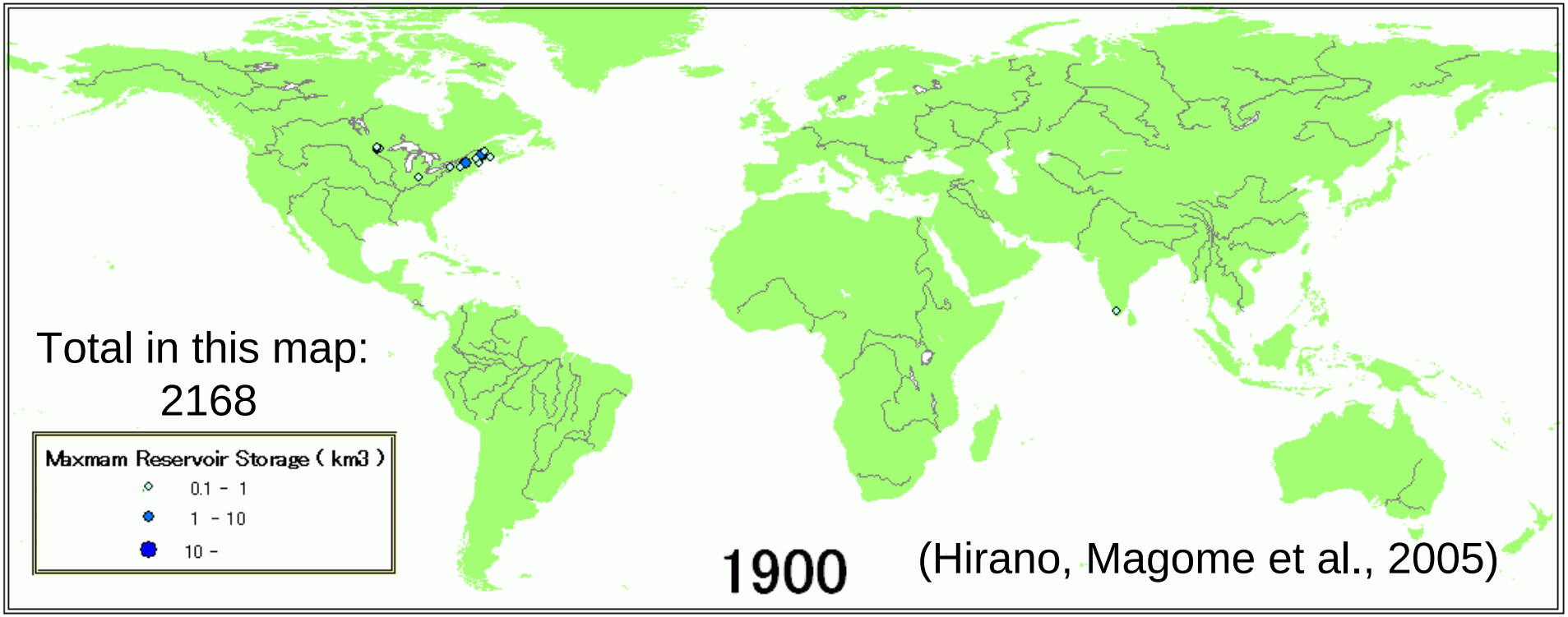
Pakse

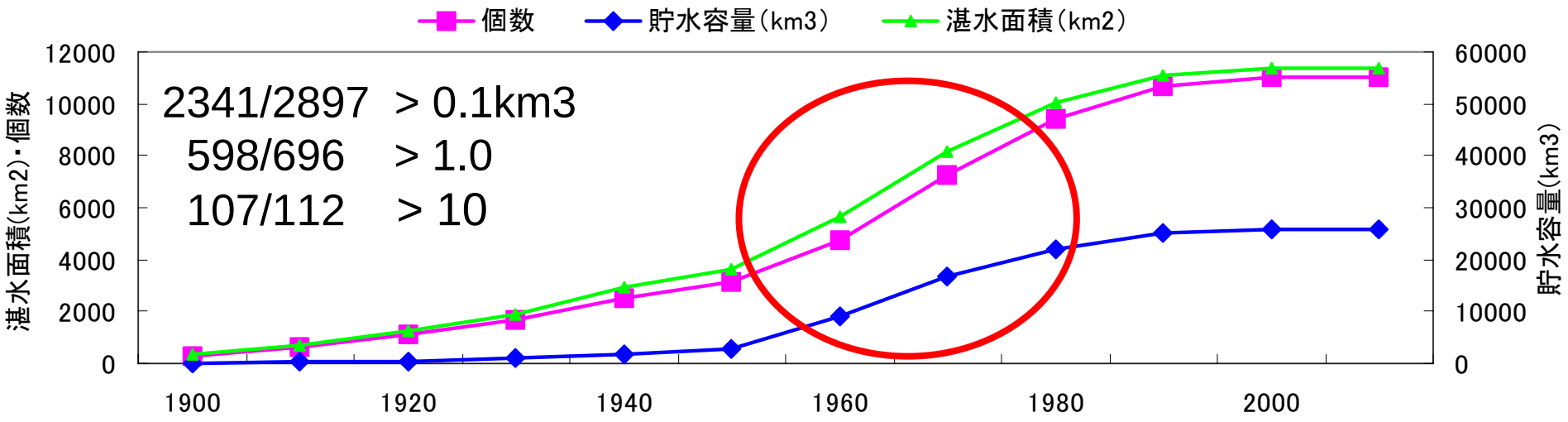
Yasothon

YHyM Application Map 2005.01.31



Chronology of Large Dams Construction



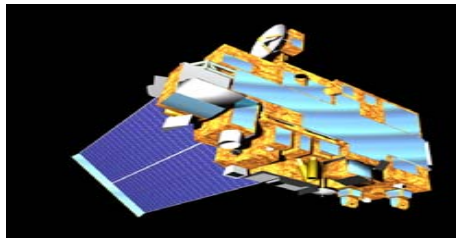


Reservoir Storage Estimation

貯水池・湖沼位置情報

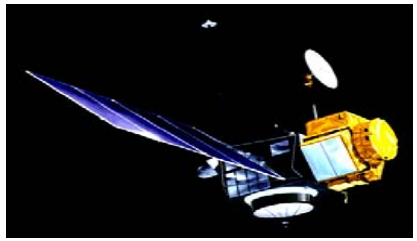
Terra/MODIS

A

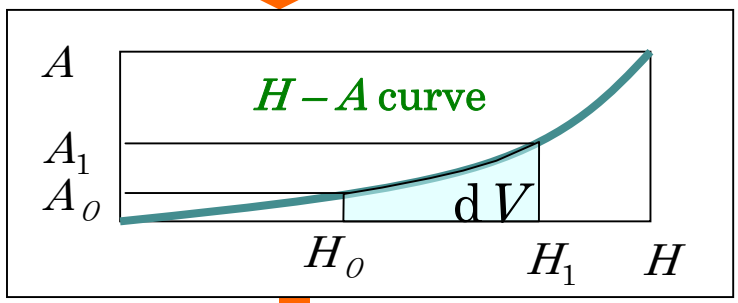


T / P

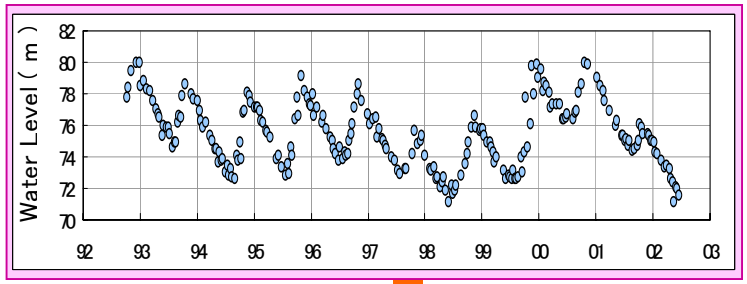
H



H-A 関係

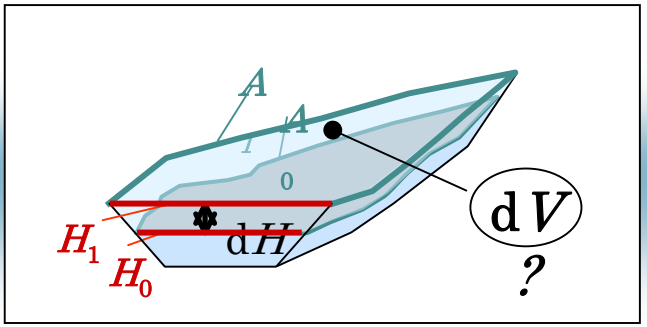


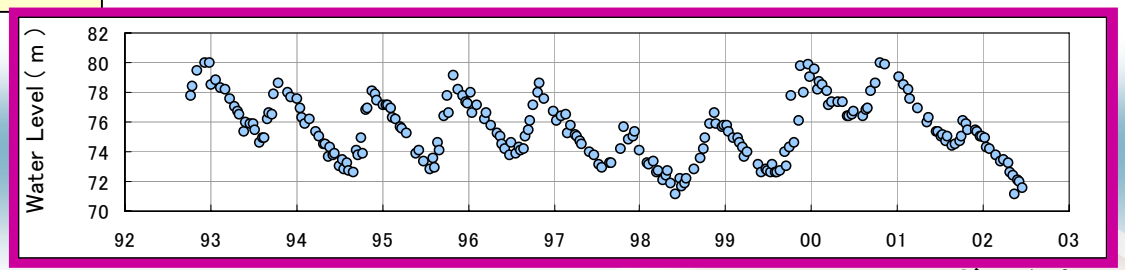
H



ボルタ湖

ΔV

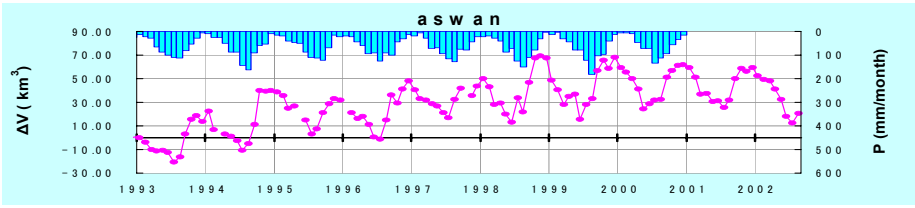


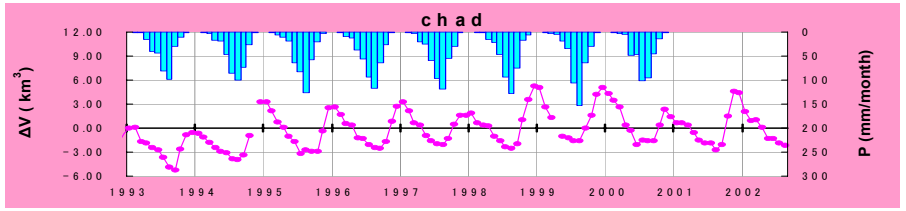


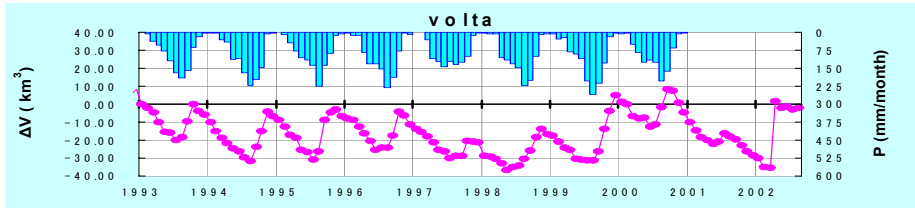
ボルタ湖

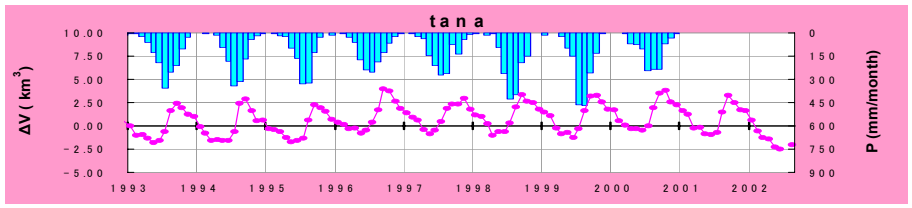
12 Reservoirs/Lakes Storage

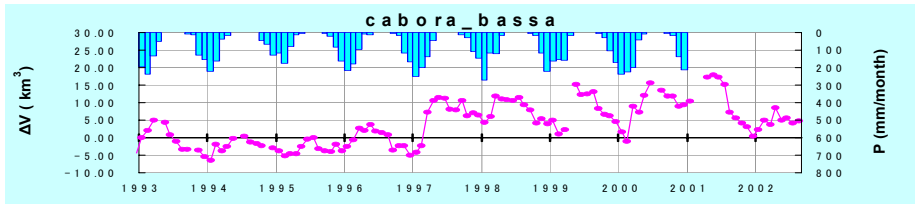
貯水池 湖沼

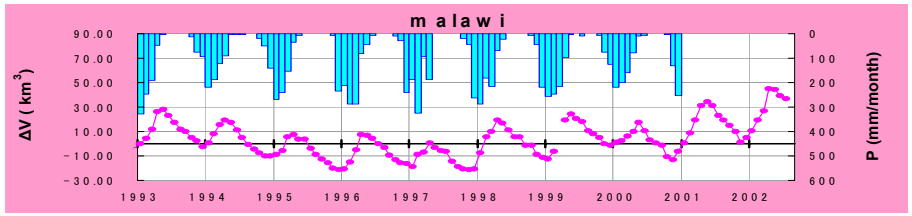


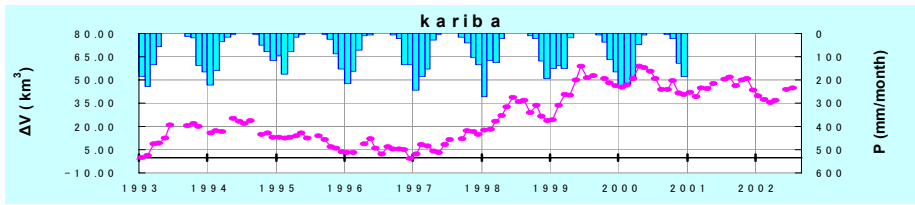


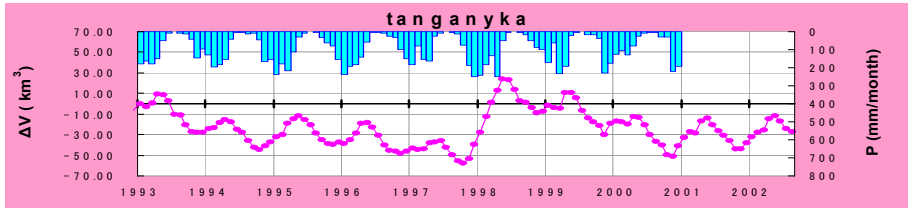


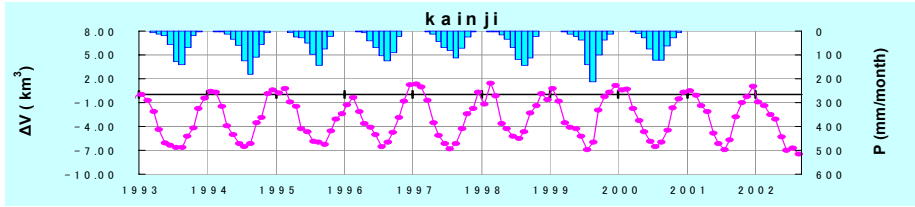


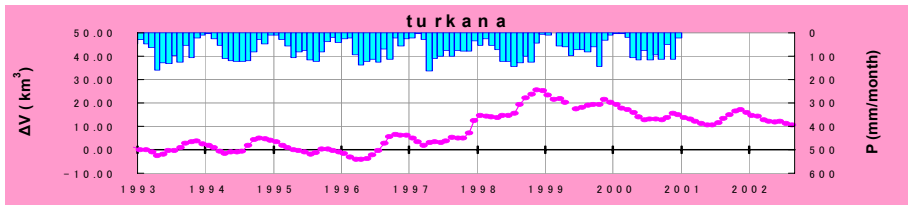


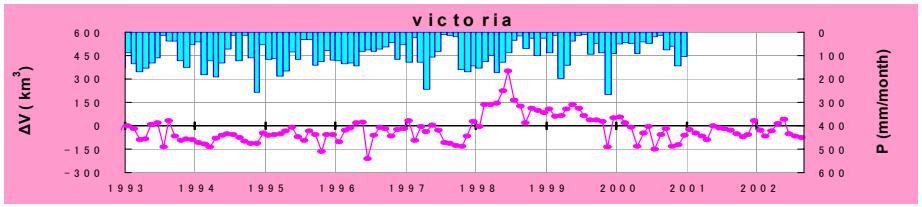


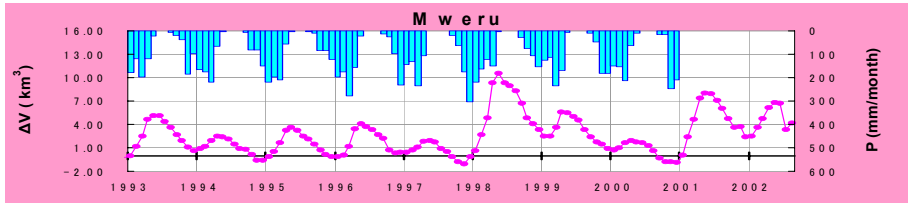






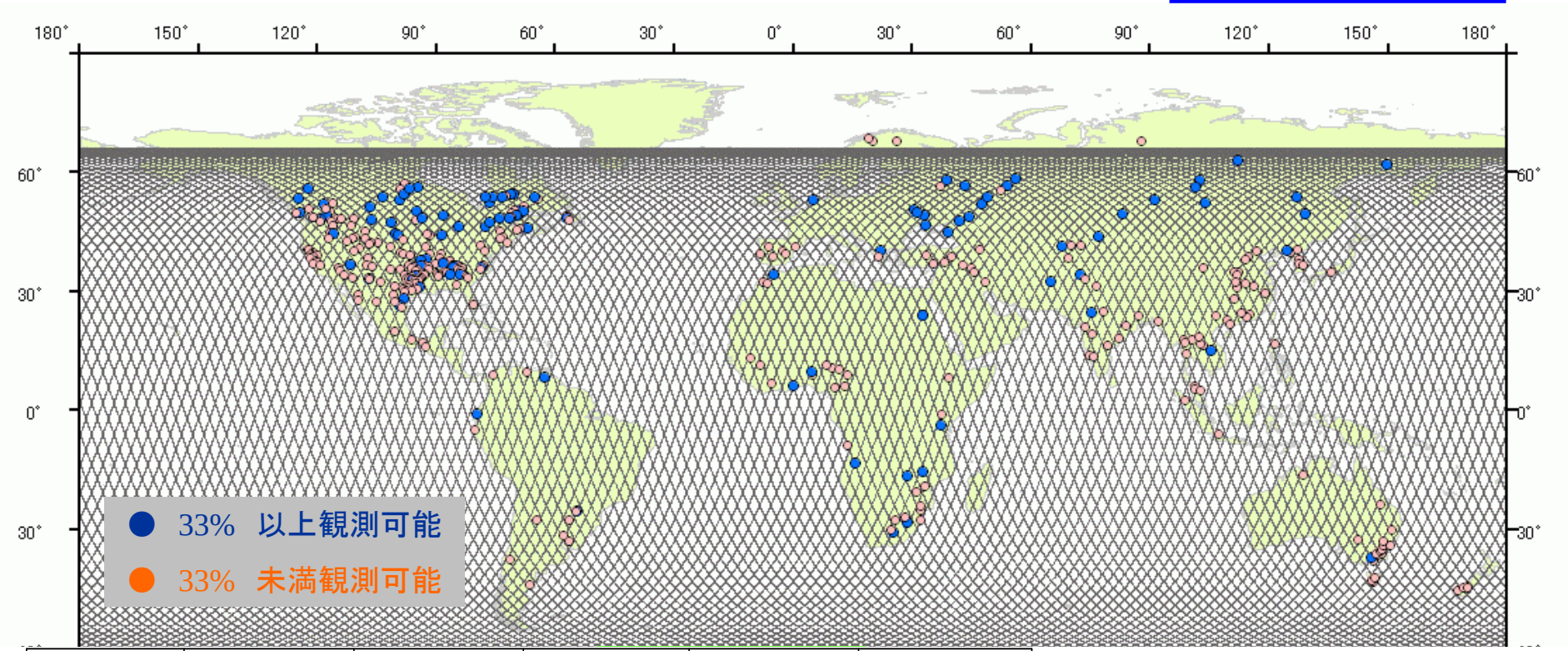






TOPEX/POSEIDON Tracks

About 315km under Equator



	80%以上ヒット	50%以上ヒット	33%以上ヒット	11%以上ヒット	それ以下
	320回以上	200回以上	133回以上	44回以上	44回以下
	平均14日以上	平均20日以上	平均月単位	平均３ヶ月以上	平均３ヶ月以下
個数	50	86	102	129	254
割合(%)	13	22	25.5	32.25	66
容量(km^3)	1810	2296	2393	2529	1020
割合%	51	65	67	71	29

月単位から季節単位で、衛星による貯水量モニタリングが可能