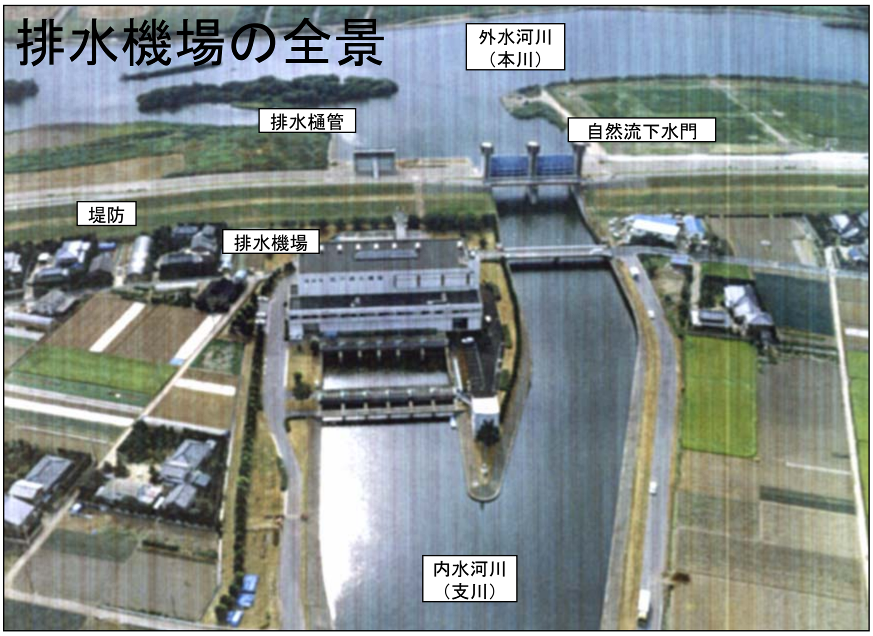
APS power point

2009/07

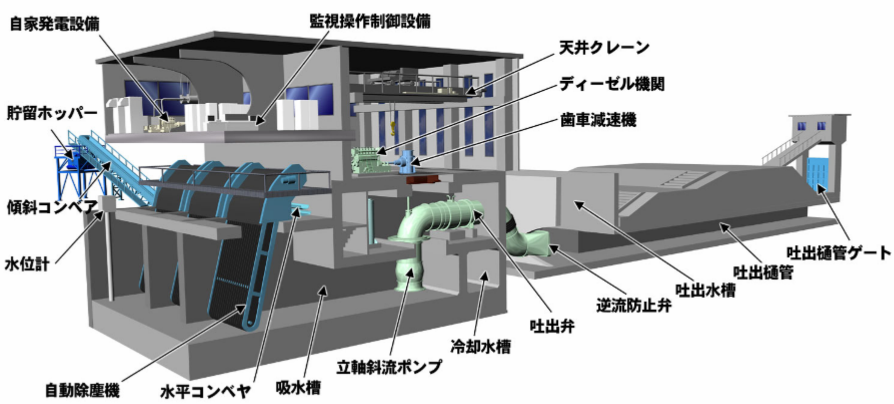
排水機場の全景



(社)河川ポンプ施設技術協会

排水機場の設備構成

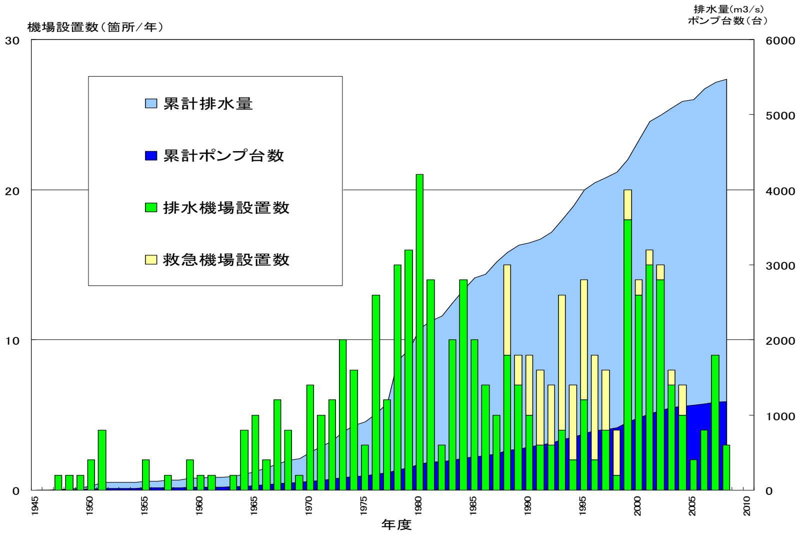
ディーゼル機関駆動のポンプ（従来型）



(社)河川ポンプ施設技術協会

排水機場の排水能力の推移国土交通省直轄

（平成20年末まで）



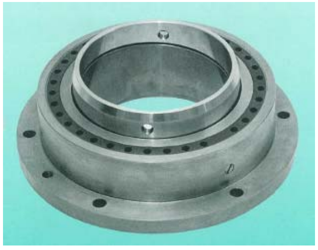
河川ポンプ設備の技術動向テーマ

No.	テ　ー　マ	内　　　　　　容
1	信頼性向上技術	①空冷化技術の開発による機場設備の簡素化
		②高機能監視操作制御システム導入による操作制御の信頼性向上
		③コンピュータ解析や実証試験による高度なシミュレーション技術の実用化
2	コスト縮減技術	①土木・建築を含めた総合的なコスト縮減を実現する技術開発
		②規模、緊急度、重要度を考慮した最適システムの計画
		③周辺機器の開発、標準化による設備の簡素化
		④機場のライフサイクルマネージメントによるコスト縮減手法の開発
		⑤ニーズに対応した新製品、新システムの開発
3	運用維持管理技術	①機械設備の運転・維持管理技術者の育成
		②広域運用管理のためのCALSの研究
		③合理的な運用維持管理技術の研究
		④設備総合診断による更新計画の立案
4	河川環境関連・複合技術	①河川、湖沼等の浄化システムの研究・開発
		②揚排水機場の多目的利用の研究
		③親水・水に関わる景観の研究
		④クリーンエネルギー活用の研究・開発
		⑤ニーズに対応した新製品、新システムの開発

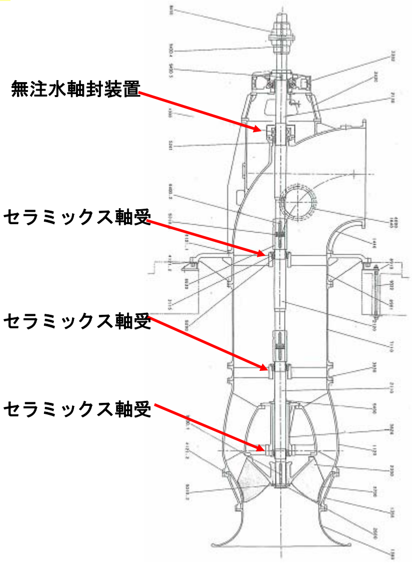
ポンプの信頼性向上

■技術概要
○立軸ポンプに使用される水中軸受で潤滑水の外部注入が不要
○軸受材としてセラミックスを採用

■開発効果
○潤滑水系統が不要
○耐摩耗性が高く、耐用年数が長い
○簡素化により維持管理が容易



セラミックス軸受



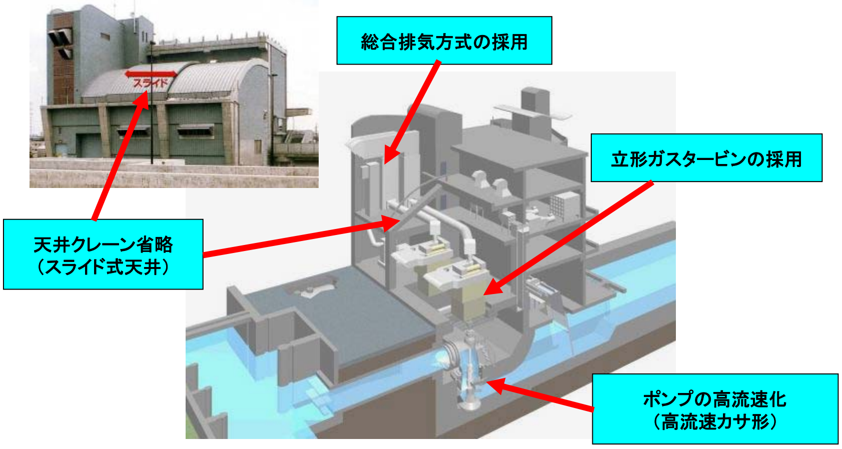
信頼性向上（空冷化）

■技術概要
○ポンプ駆動用原動機として冷却水の不要なガスタービンを採用
○クラッチの不要な二軸式を開発

■開発効果
○冷却水系統が不要
○低振動・低騒音化が可能

ガスタービン

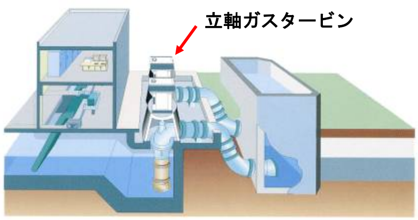
排水機場の合理化



新形駆動機システムの開発

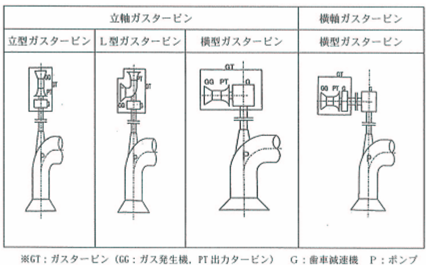
■技術概要
○立軸ポンプの駆動用として
　ガスタービンを立軸化

■開発効果
○小型化・軽量化による土木費縮減
○機場及び原動機スペースの縮減



効果：機場及び原動機スペースの縮減

立軸ガスタービン

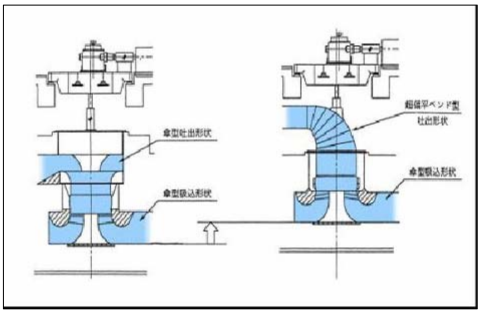


ガスタービンの軸形式の分類

ポンプの高速・小型化

■技術概要
○回転速度と流速が速いコンパクトなポンプ
○吸込性能を向上させたポンプ

■開発効果
○水路幅が小さく、底盤レベルの浅い機場
○従来ポンプ場幅の約７５％で土木建築費の縮減

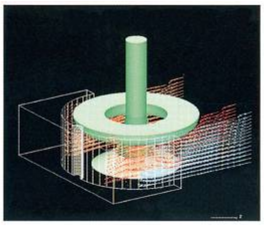


大容量ポンプの高速・小型化

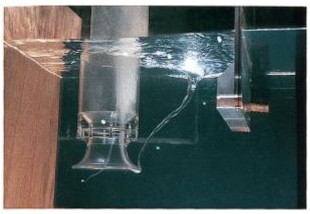
吸込水路の高流速化

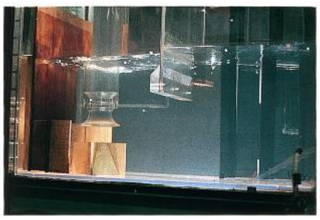
■技術概要
○流速が速くても空気吸込渦や水中渦が発生しない吸込水路
○大容量ポンプでは従来流速の２倍

■開発効果
○大容量ポンプでは従来吸込水路幅の７５%となり土木　建築費の縮減



流れ解析



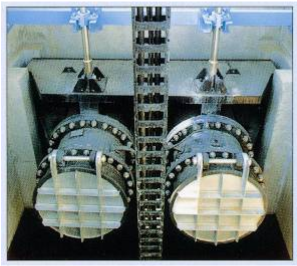


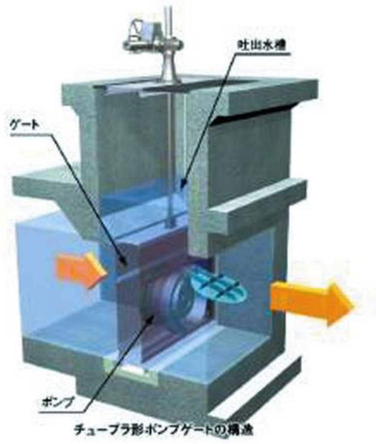
吸込水槽模型試験

新システムの開発

■技術概要
○排水機場を自然排水路に設ける小規模システム
○ポンプとゲートの一体化

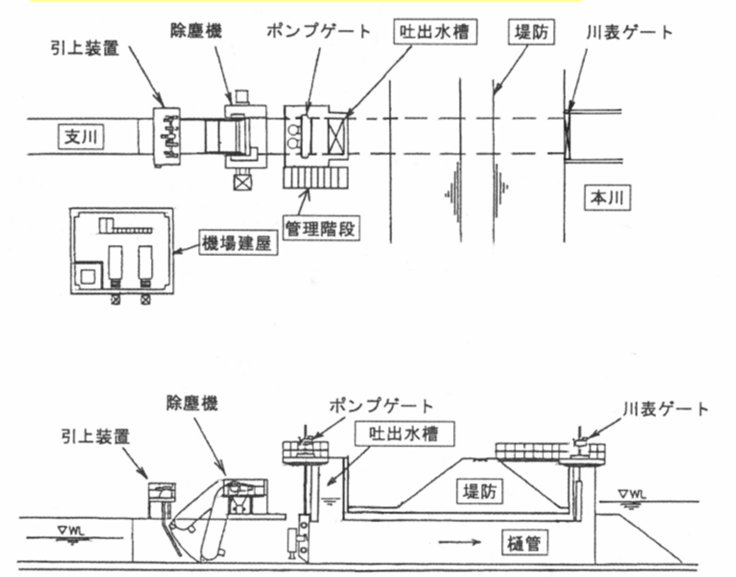
■開発効果
○バイパス水路、排水機場用地の省略によるコスト縮減





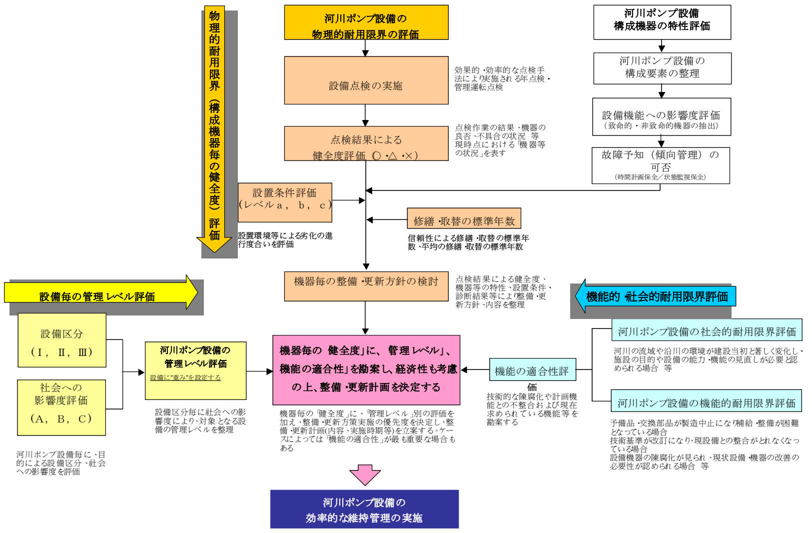
ポンプゲート

ポンプゲート式小規模排水機場



運用維持管理技術

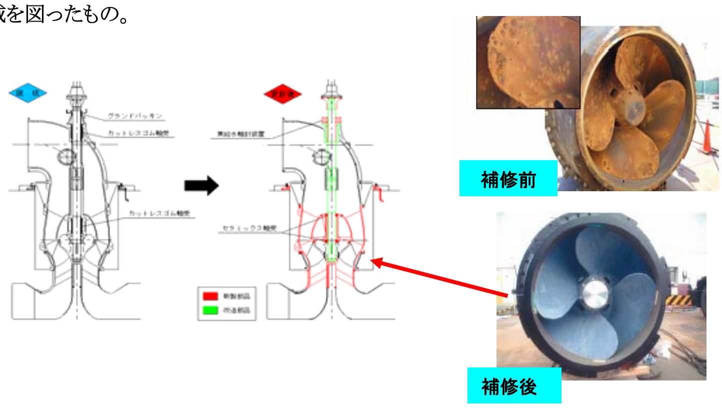
河川ポンプ設備　点検・整備・更新マニュアル（案）の概要



出典：河川ポンプ設備点検・整備・更新検討マニュアル（案）

効率的な整備によるポンプの長寿命化事例

ポンプ設備全体の劣化度診断を実施し、過去の故障履歴・点検結果等を使用してポンプ設備全体の健全度を評価し修繕を実施した。その際、主ポンプの構成部分において羽根車、吐出ベント管などの再利用可能な部分の効率的な活用により、長寿命化・コスト縮減を図ったもの。

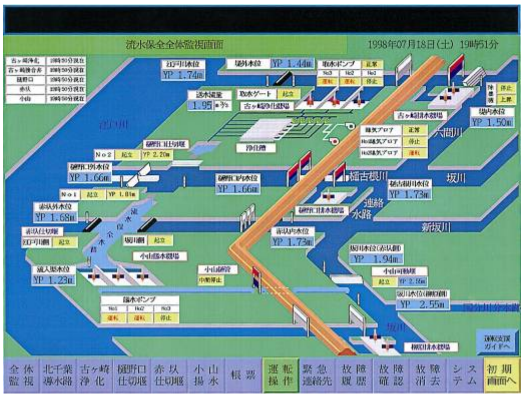


出典：国土交通省出前講座「河川ポンプの新たな維持管理手法について」より

運用維持管理

■技術概要
〇河川情報、施設情報、運用情報を統合管理
〇複数の河川管理施設の統合監視、運転支援、運用管理

■開発効果
〇広域化、複雑化する河川管理への対応



遠隔化システム

排水ポンプ車

■技術概要
〇局所排水に対応できる
　移動式のポンプシステム

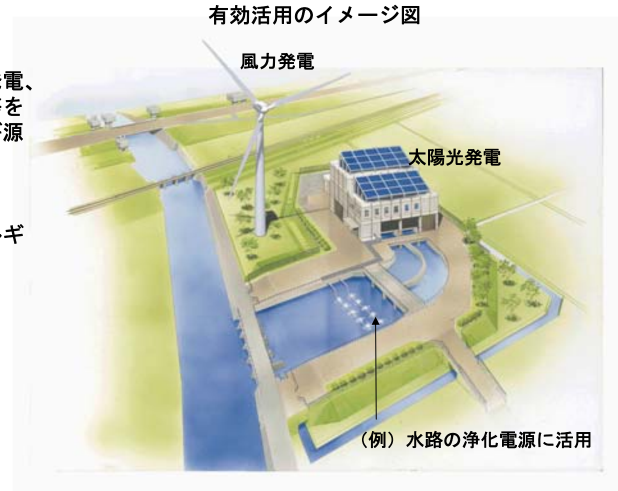
■開発効果
〇排水容量アップ
　車両１台当たり排水量
　30m3/min ～ 150m3/min
〇現地作業性の向上
〇機動性に優れ、広域対応が可能

未利用エネルギの活用

■技術概要
○大気汚染のない風力発電、ソーラー発電、小水力等を河川管理施設のエネルギ源として有効活用

■開発効果
○環境にやさしいエネルギの供給

有効活用のイメージ図



新素材の活用

■技術概要
○エンジニヤリングプラスチック製自動除塵機
○運転時の騒音が小さく、耐食性に優れ、軽量

■開発効果
○住宅地域の騒音対策に効果
○維持管理が容易

低騒音形除塵機

排水機場の耐水化

平成12年／東海水害 → 冠水による機能停止が発生

↓

平成13年「揚排水ポンプ設備設計指針（案）同解説」改訂
耐水対策の具体的な解説を記述

耐水対策の基準とする水位（次のいずれか高い水位）
①既往最高内水位
②内水側支川の計画堤防高
③計画降雨時のポンプ無稼働湛水位

↓ ← 施工性、維持管理性など総合的に検討要

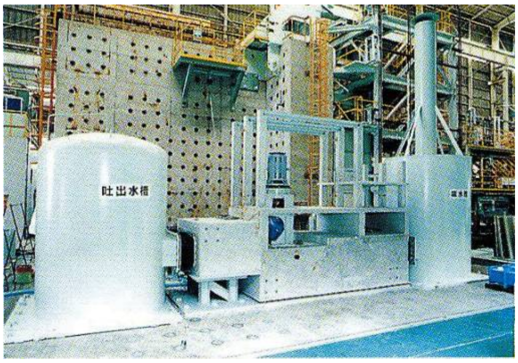
対策の具体案
- 機器、配線の高設置化
- 水密構造化
- 機器の水密化

浸水したニューオーリンズの機場
出典：FEMAのHPより

ポンプ設備の耐震化

■技術概要
○地震による機場被害の調査分析
○機器・配管の耐震対策の検討
○基礎ボルトの強度設計
○耐震点検マニュアルの策定

■開発効果
○地震時の機場信頼性の向上



ポンプ設備の耐震化

ICHARM power point

2009/07

Outline of ICHARM Activities

Akira TERAKAWA

Deputy Director, ICHARM
Public Works Research Institute (PWRI)
Tsukuba, Japan

International Centre for
Water Hazard and
Risk Management

(ICHARM)

under the auspices of UNESCO

Background: Birth of ICHARM

- IDNDR 1990-1999 & ISDR 2000-, MDGs, WSSD, Hyogo Framework of Action 2005 etc.
- ICHARM was proposed by the Japanese Government and approved at UNESCO 33rd General Conference, October 2005
- Agreements signed by UNESCO, G of Japan & PWRI on March 3, 2006
- ICHARM was established on March 6, 2006
  - A UNESCO Category II Global Center hosted by Public Works Research Institute (PWRI), Tsukuba, Japan

UNESCO
(United Nations Educational, Scientific and Cultural Organization)

- One of the special organizations of the United Nations established in 1946 (Japan became a member in 1951)
- Aims to promote collaboration among member nations through education, science, and culture and contribute to peace and security of the world
- “That since wars begin in the minds of men, it is in the minds of men that the defenses of peace must be constructed” (Preamble of the Constitution of the UNESCO)

IHP

(International Hydrological Programme)

- **A platform for activities on water sciences**
- **Promotes scientific studies on water cycle, studies and proposals on sustainable management of water resources and education in developing countries**
- **Seventh-term Program (2008 to 2013)**

1) Adapting to the impacts of global changes on river basins and aquifer systems
2) Strengthening water governance for sustainability
3) Ecohydrology for sustainability
4) Water and life support systems
5) Water education for sustainable development

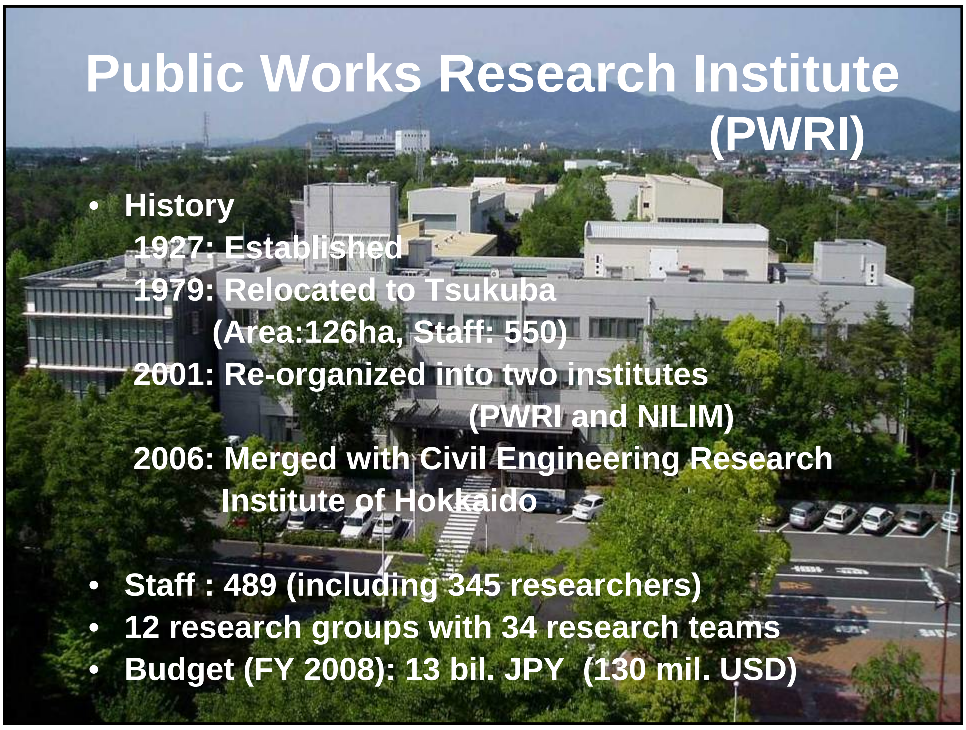
List of existing IHP UNESCO centers

Centre	Abbreviation	Location (Country)
International Research and Training Centre on Erosion and Sedimentation	IRTCES	Beijing (China)
International Research and Training Centre on Urban Drainage	IRTCUD	Belgrade (Serbia and Montenegro)
Water Centre for the Humid Tropics of Latin America and the Caribbean	CATHALAC	Panama (Panama)
Regional Humid Tropics Hydrology and Water Resources Centre	HTC	Kuala Lumpur (Malaysia)
Regional Centre for Training and Water Studies of Arid and Semiarid Zones	RCTWS	Cairo (Egypt)
Regional Centre on Urban Water Management	RCUWM	Tehran (Iran)
UNESCO-IHE Institute for Water Education	UNESCO-IHE	Delft (Netherlands)
International Centre on Qanats and Historic Hydraulic Structures	ICQHS	Yadz (Iran)
IHP-HELP Centre for Water Law, Policy and Science		Dundee (UK)
Regional Water Centre for Arid and Semi-arid Zones of Latin America and the Caribbean	CAZALAC	La Serena (Chile)
International Centre for Water Hazard and Risk Management	ICHARM	Tsukuba (Japan)
European Regional Centre for Ecohydrology		Lodz (Poland)
Regional Centre for the Management of Shared Groundwater Resources	RCSARM	Tripoli (Libya)

Missions of ICHARM

The mission of ICHARM is to function as an international center for providing and assisting the implementation of the most practicable strategies to prevent and mitigate water related disasters (floods, droughts, sediment-related disasters, tsunamis, storm surges, water contamination, etc.) in the world.

※ Focus on flood related disasters at the initial stage

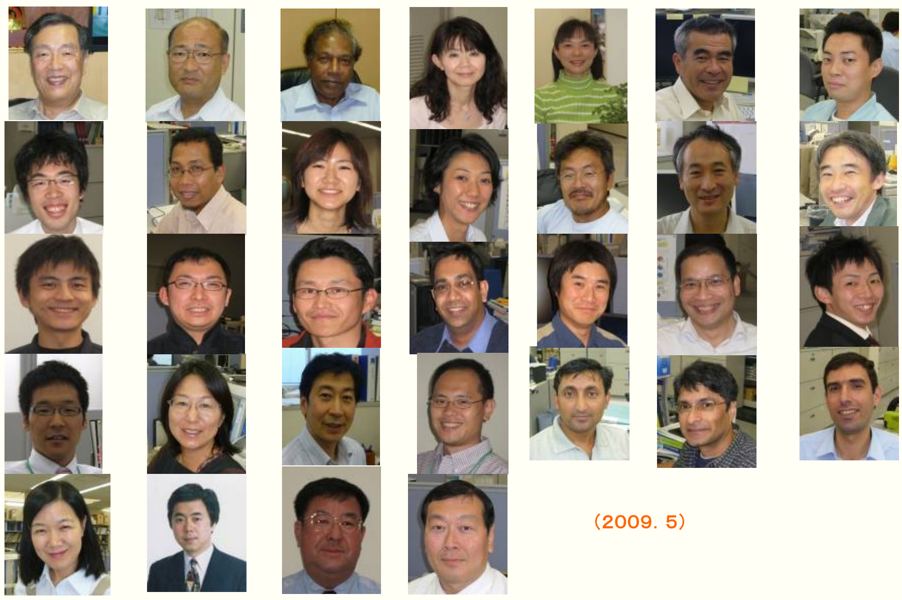


8 Research Groups with 20 teams

(in Tsukuba)

- Construction Technology
- Material and Geotechnical Engineering
- Water Environment
- Hydraulic Engineering
- Erosion and Sediment Control
- Road Technology
- Water-related Disaster Prevention
- Bridge and Structure

ICHARM members



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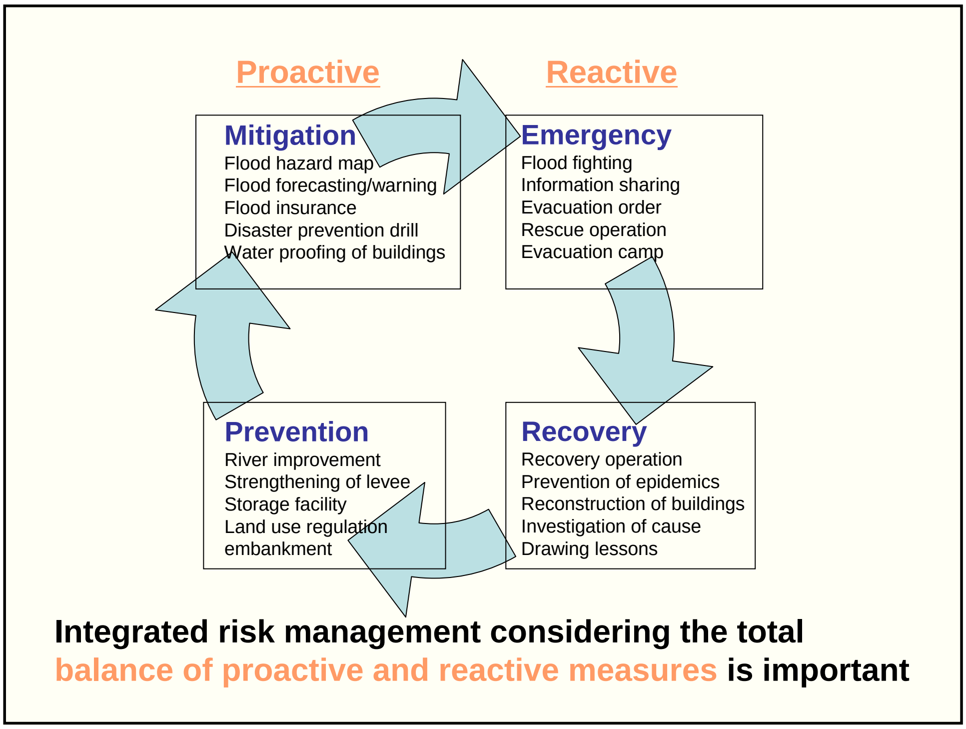
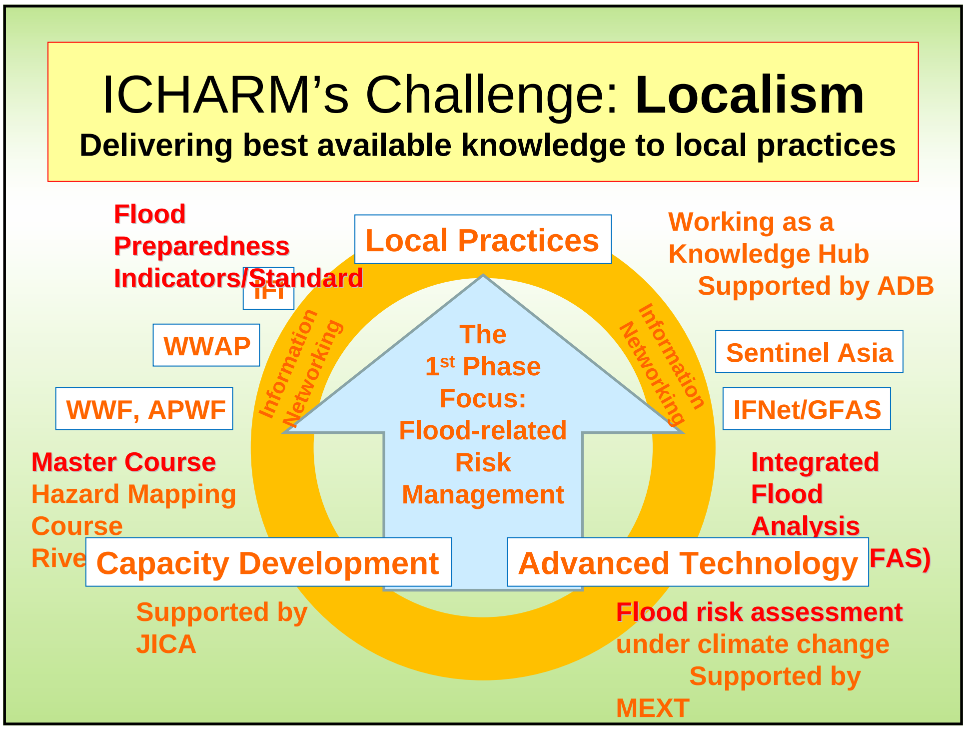

Proactive
Reactive
Mitigation
Flood hazard map
Flood forecasting/warning
Flood insurance
Disaster prevention drill
Water proofing of buildings
Emergency
Flood fighting
Information sharing
Evacuation order
Rescue operation
Evacuation camp
Prevention
River improvement
Strengthening of levee
Storage facility
Land use regulation
embankment
Recovery
Recovery operation
Prevention of epidemics
Reconstruction of buildings
Investigation of cause
Drawing lessons
Integrated risk management considering the total
balance of proactive and reactive measures is important


ICHARM's Challenge: Localism
Delivering best available knowledge to local practices
Flood
Preparedness
Indicators/Standard
IFI
Local Practices
Working as a
Knowledge Hub
Supported by ADB
WWAP
Information
Networking
The
1st Phase
Focus:
Flood-related
Risk
Management
Information
Networking
Sentinel Asia
WWF, APWF
IFNet/GFAS
Master Course
Hazard Mapping
Course
Integrated
Flood
Analysis
Capacity Development
Advanced Technology
FAS)
Supported by
JICA
Flood risk assessment
under climate change
Supported by
MEXT

Research

- **Local studies** (Identification of the real needs of the people in diverse localities) → Diagnosis & Prescription
  - **Disaster (Flood) Preparedness Indices**
- **Flood Alert System** using satellite information (with JAXA, IFNet/GFAS/IFAS etc.)
- **Risk analysis and adaptation measures to global warming**
  - JMA/MRI GCM (20km mesh) →
    - Drawing a Global flood risk map,
    - Estimating Adaptation cost (structural & non-structural)
- **Flood Hazard Mapping**
  - methodologies to map in remote localities with poor data
  - effective and beneficial use of HMs in various conditions

Capacity Building

- **Training courses**
  - Flood hazard mapping course 2004-2008
    (is to be renewed from 2009)
  - River and Dam engineering course started in 1969
- **Follow up program** for ex-trainees
- **Master course on Flood Disaster Management** with National Graduate Institute for Policy Studies（GRIPS) started in 2007

Water-related Risk Management Course

A master's degree program
by GRIPS* and ICHARM/PWRI

Objective :

to develop trainee's capacity to practically manage the problems and issues concerning water-ralated disasters

Duration : 1yr from October to September

Language : in English

Course Program :

Lectures

Disaster Management Policy, Basic Subjects (Hydrology, Hydraulics), Integrated Flood Risk Management, Hazard mapping and Evacuation Planning, Sustainable Reservoir Development and Management, Control Measures for Landslide and Debris Flow, Introduction to International Cooperation

Hands-on Training session

Individual study

*GRIPS : Graduate Research Institute for Policy Studies (www.grips.ac.jp)

Following up Seminar of FHM training course

(Jan. 30-Feb. 1, 2008 Guanzou, China)

Cooperation with related organizations and programs

- Participating in international activities as a secretariat and a player, such as WWAP, IFI, the UN Joint Monitoring Programme for Water Supply and Sanitation, and Asia Water Forum
- Promoting joint projects in cooperation with existing UNESCO centres
- Maintaining and strengthening mutually cooperative partnerships with affiliate research institutes by exchanging personnel and conducting joint researches
- Building a close collaboration and appropriately sharing responsibilities with diverse related international programmes such as IF-Net, JWF and the Network of Asian River Basin Organizations (NARBO) to achieve synergy among the respective activities
- Planning and implementing research and training projects in cooperation with funding organizations such as the Japan International Cooperation Agency (JICA), Asia Development Bank (ADB) and World Bank (WB)

International Flood Initiative (IFI)

http://www.ifi-home.info

Mission

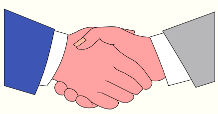
Promote an integrated approach to flood management

by reducing the risk of social, environmental and economic effects that result in and from floods and increasing the benefits from floods and the use of flood plains

Implementation

UNESCO, WMO, UNU, UN-ISDR, IAHS, IAHR ･･･

Secretariat : ICHARM



Asia-Pacific Water Forum (APWF)

http://www.apwf.org

- Launched during the WWF4 in Mexico
- to contribute to sustainable water management in order to achieve the targets of the MDGs in Asia-Pacific region
- 1st Asia Pacific Water Summit was held in Beppu, Japan on December 3 – 4, 2007
- 3 Priority themes
  - Water Financing
  - Water-related Disaster Management
  - Water for Development and Ecosystem
- ICHARM served as the leading agency for the theme of water related disaster management

Function of ICHARM as a APWF Knowledge Hub

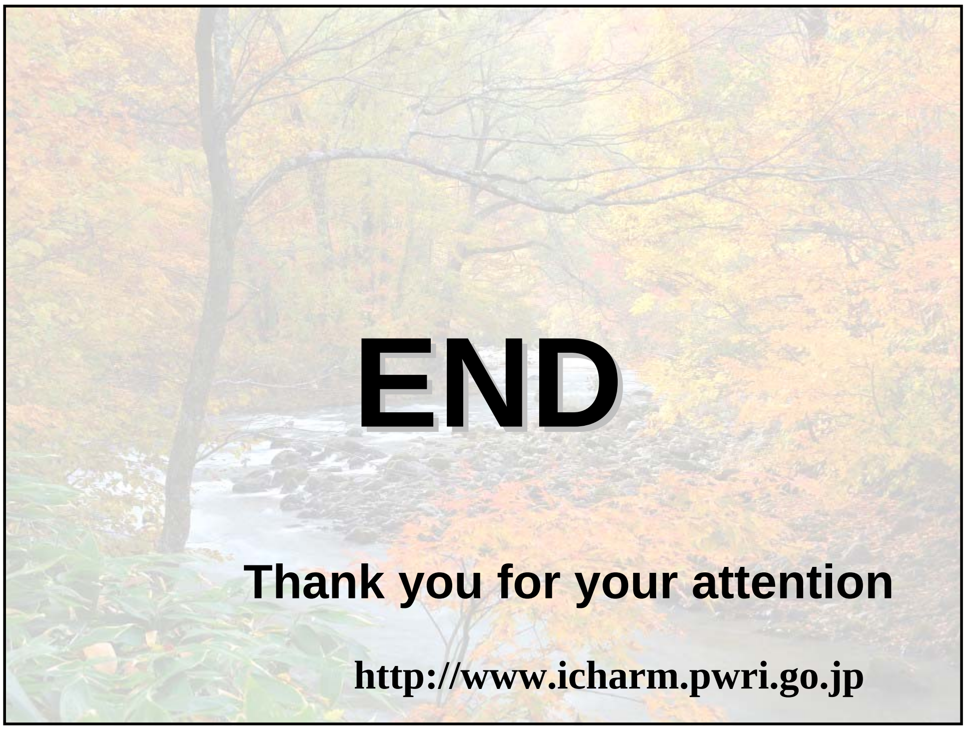
http://www.apwf-knowledgehubs.net

- Providing training courses mainly for practical engineers in charge of flood risk management
  - Flood Hazard Mapping Training Course (5 weeks, total 16 trainees from 8 countries)
  - Disaster Management Policy Program - Water related risk management course (1year, master course, 10 students)
- Following up activities for ex-trainees
  - Follow up seminars
  - Help desk site
- Conducting Joint research projects for collaboratively finding solution to local challenges and capacity building
  - Personal exchange with related organizations
  - International recruitment of fixed term researchers

Network of Asian River Basin Organizations (NARBO)

http://www.narbo.jp

- Established in February 2004 based on the agreement at the 3rd World Water Forum in 2003
- To help achieve Integrated Water Resources management (IWRM) in river basins throughout Asia
- Secretariat : Japan Water Agency (JWA) and Asian Development Bank (ADB)
- 65 organizations from 12 countries (Bangladesh, Cambodia, India, Indonesia, Japan, Korea, Lao, Malaysia, Philippines, Sli Lanka, Thailand, Vietnam) are participating as of February 2008
- *ICHARM joined as an international knowledge partner in the field of water related disaster management*



GFAS/IFAS

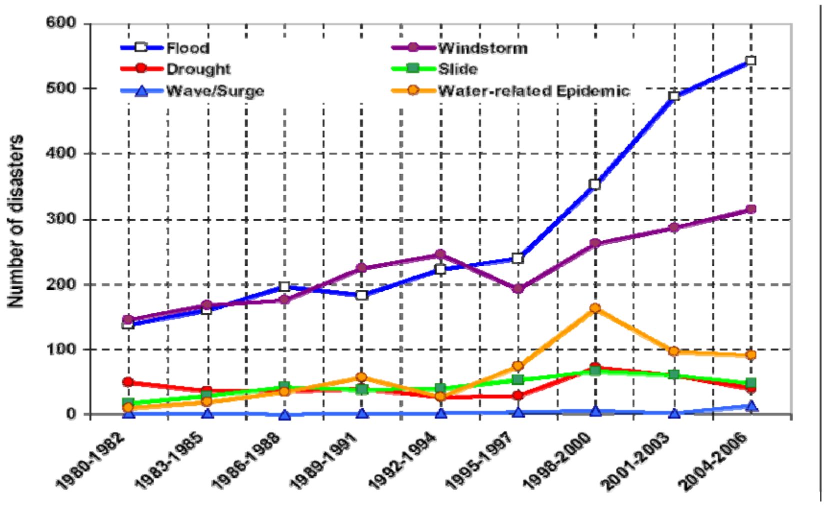
GFAS-Rainfall
GFAS-Streamflow (IFAS)

Tomonobu SUGIURA

Senior Researcher
International Centre for Water Hazard and Risk Management (ICHARM)

Background of development of GFAS

Current trend of water-related disasters

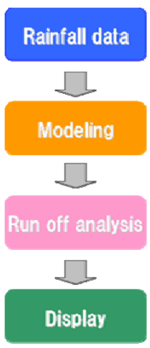


Made by ICHARM based on CRED EM-DAT

IFNet ICHARM

Necessity of satellite-based rainfall data

- In the countries where river improvements are not sufficient, smooth evacuation from flooding is important for decreasing loss of life and properties.
- Dissemination of risk by hazard maps, etc. and direction of evacuation by issuing flood forecasts and alerts are necessary.
- However, in reality, development of a flood warning system in these countries has not advanced properly because of financial difficulty, lack of rainfall data, etc.



- Lack of real-time hydrologic data
- Installation of an observation facility takes a large amount of expense and time

- Lack of hydrological and geophysical data for modeling
- Lack of landuse and geology data for estimating parameter

- Development of a calculation engine takes a large amount of expense and time.

- Display function is required
- Development of a software package takes a large amount of expense and time.

Technical issues for flood forecasting

Non real time observation

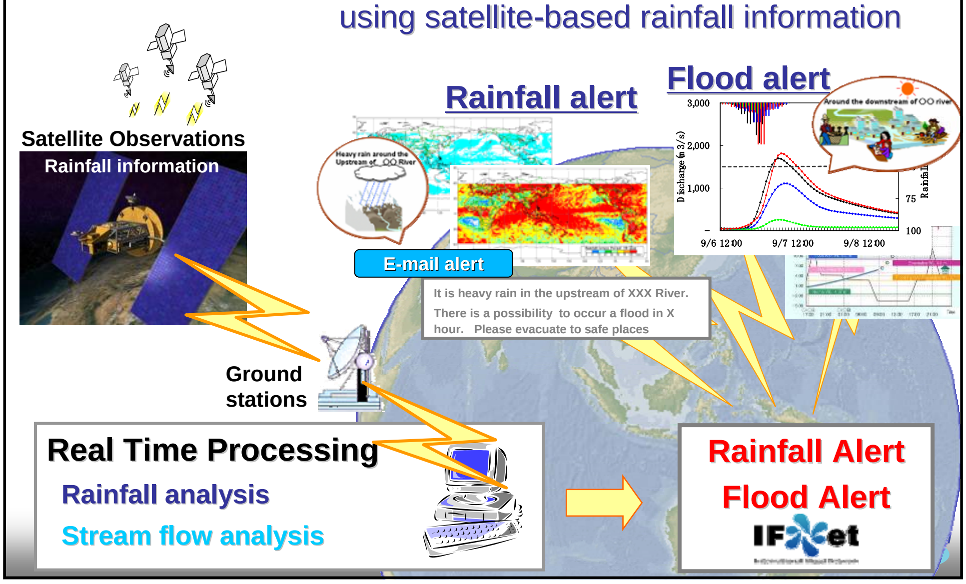
No data of river discharge

IFNet ICHARM

GFAS (Global Flood Alert System) concept

GFAS = rainfall alert + flood alert

using satellite-based rainfall information



Satellite-based rainfall information

Rainfall data

- Ground-based rainfall data

  A large amount of expense and time for implementation of rain gauges

  Lack of historical and statistical hydrologic data

  Lack of data in a upstream area (in case of an international river)

- Satellite-based rainfall data (NASA-3B42RT)

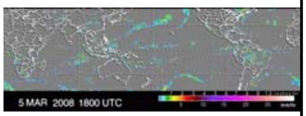
  Global coverage including oceans: between 50N-50S latitude

  Mesh size: **0.25 degrees** of latitude and longitude (**about 25km**)

  Data delivery: **every 3 hour** (**10 hours time lag**)

  Accumulation of the past data: since 2002

  Provided by NASA through the Inter-Net HP for free



NASA HP

- Satellite-based rainfall data (GSMaP)

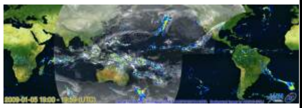
  Global coverage including oceans: between 60N-60S latitude

  Mesh size: **0.1 degrees** of latitude and longitude (**about 10km**)

  Data delivery: **every 1 hour** (**4 hours time lag**)

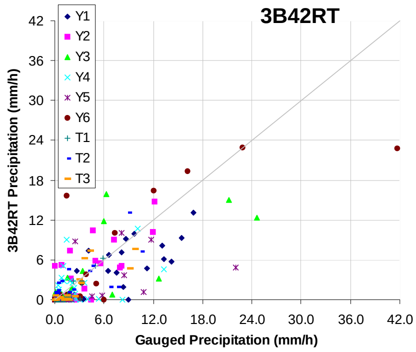
  Accumulation of the past data: from 2003 to 2006, 2008-

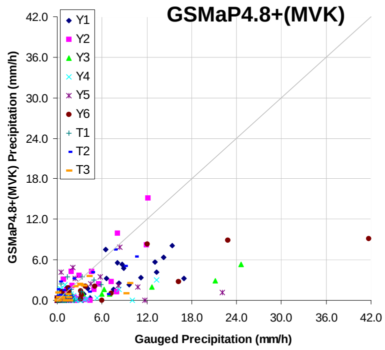
  Provided by JST/CREST, OPU,JAXA etc. through the Inter-Net HP for free



JAXA HP

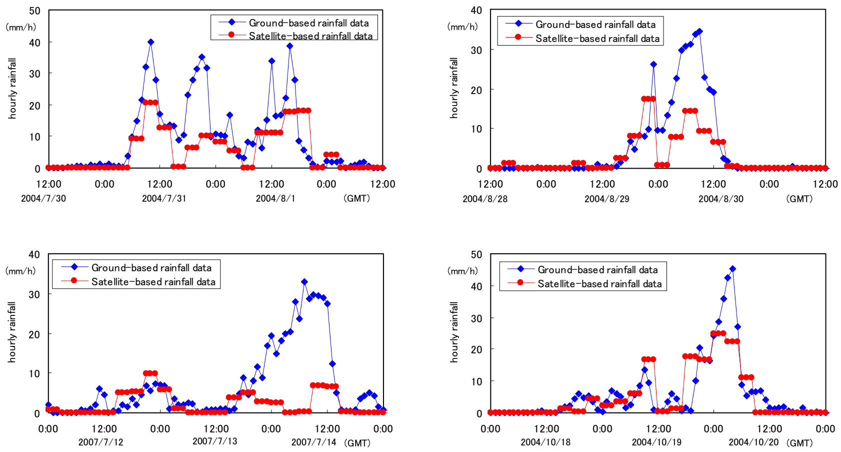
Accuracy of satellite-based rainfall Data (1)





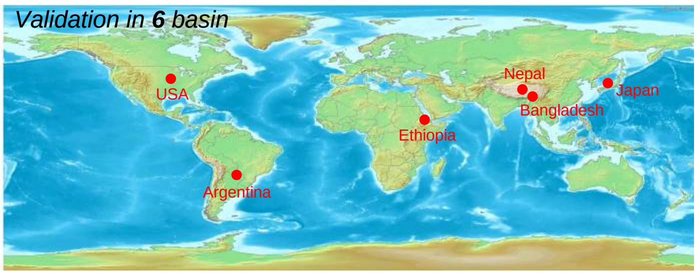
Basin	Event	From (GMT)	To (GMT)
Yoshino River basin (A=3,750km2)	Y1	2004.07.29 00:00	2004.08.05 12:00
	Y2	2004.08.15 12:00	2004.08.24 00:00
	Y3	2004.08.27 00:00	2004.09.02 18:00
	Y4	2004.09.03 18:00	2004.09.16 12:00
	Y5	2004.09.25 15:00	2004.09.30 12:00
	Y6	2004.10.17 00:00	2004.10.21 18:00
Tone River basin (A=16,840km2)	T1	2004.10.01 18:00	2004.10.05 18:00
	T2	2004.10.07 12:00	2004.10.14 18:00
	T3	2004.10.18 18:00	2004.10.21 18:00

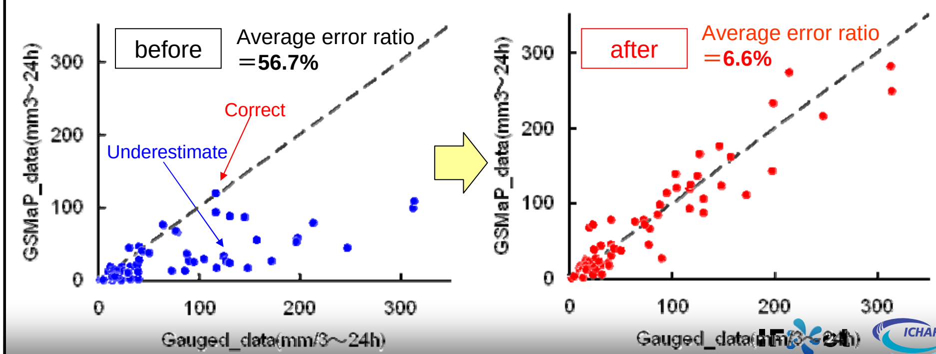
Accuracy of satellite-based rainfall Data (2)



Comparison with satellite-based (3B42RT)
and ground-based rainfall of Sameura dam basin (A=472km2) in JAPAN

Correction method of satellite-based rainfall (1)

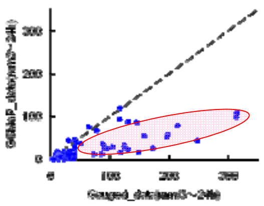


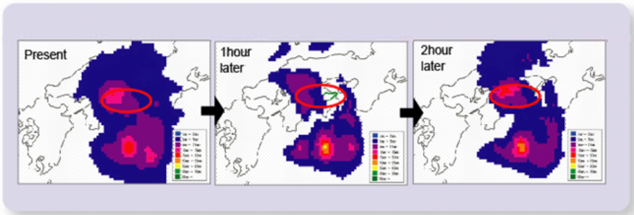


※24hour accumulative rainfall (3h in USA, 6h in Japan)

Correction method of satellite-based rainfall (2)

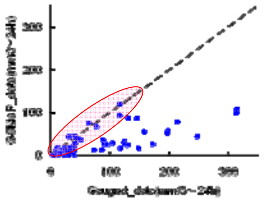
underestimation

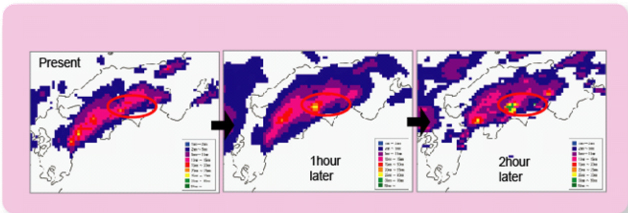




The movement of rainfall area is **moving quickly**

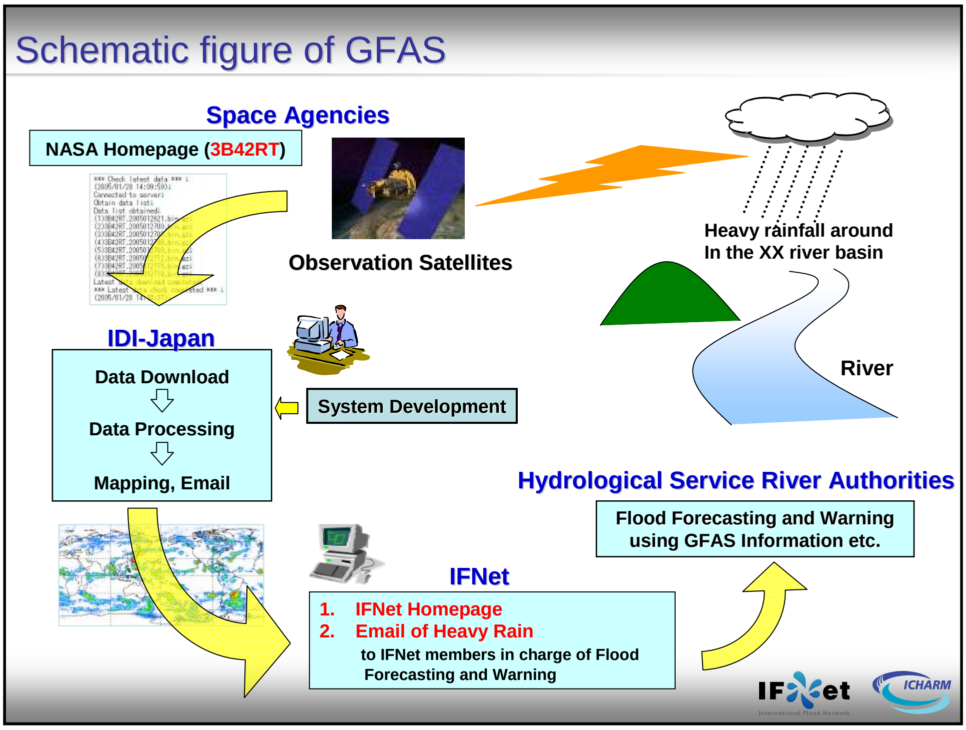
correct

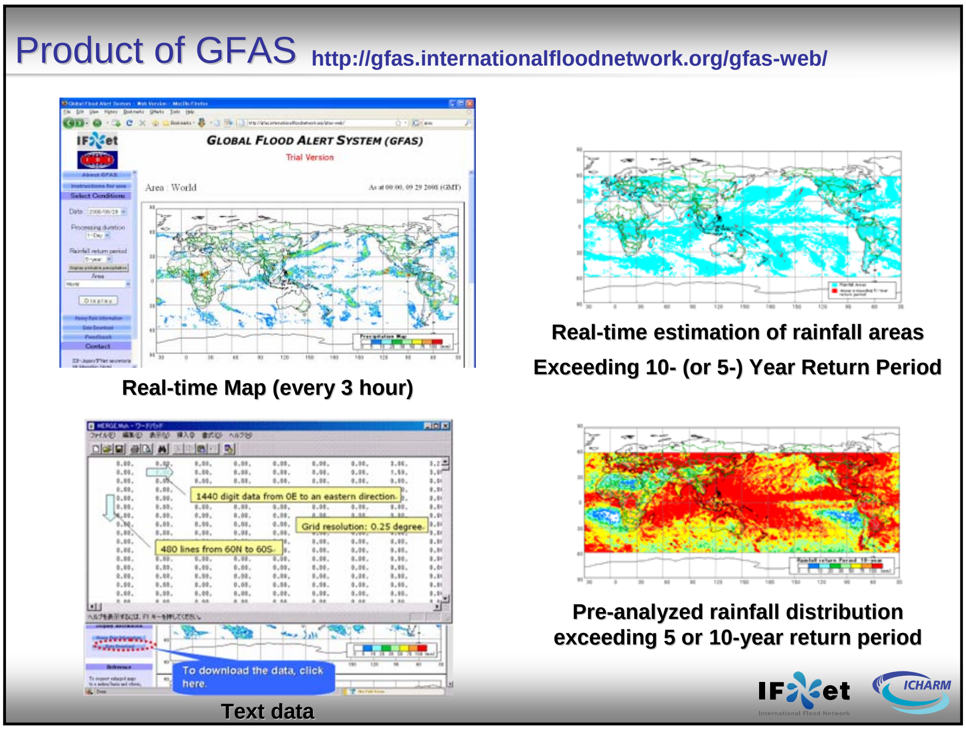




The movement of rainfall area is **moving slowly**

GFAS - Rainfall


Schematic figure of GFAS
Space Agencies
NASA Homepage (3B42RT)
Observation Satellites
Heavy rainfall around
In the XX river basin
IDI-Japan
Data Download
Data Processing
Mapping, Email
System Development
River
Hydrological Service River Authorities
Flood Forecasting and Warning
using GFAS Information etc.
IFNet
1. IFNet Homepage
2. Email of Heavy Rain
to IFNet members in charge of Flood
Forecasting and Warning
IFNet
ICHARM


Product of GFAS
http://gfas.internationalfloodnetwork.org/gfas-web/
GLOBAL FLOOD ALERT SYSTEM (GFAS)
Trial Version
Real-time Map (every 3 hour)
Real-time estimation of rainfall areas
Exceeding 10- (or 5-) Year Return Period
1440 digit data from 0E to an eastern direction.
Grid resolution: 0.25 degree.
480 lines from 60N to 60S.
To download the data, click here.
Text data
Pre-analyzed rainfall distribution
exceeding 5 or 10-year return period
IFNet
ICHARM

GFAS-Streamflow

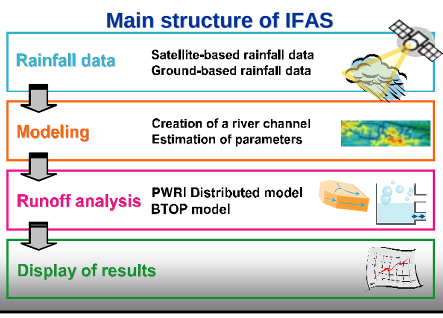
IFAS (Integrated Flood Analysis System)

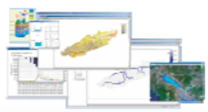
IFAS

IFNet ICHARM

IFAS concept

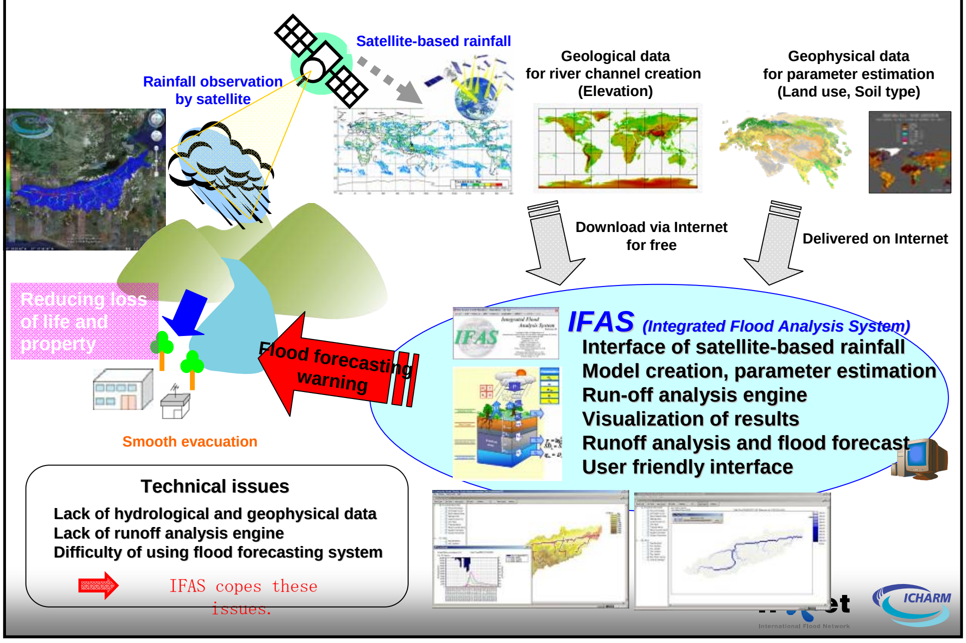
- ***Integration of Satellite-based rainfall*** for flood analysis
- ***Multi*** run-off analysis ***engines***
- ***Automatic*** data downloads and model operation
- ***Automatic*** correction for GSMaP
- ***User friendly and Visualized Interface***
- ***Easy, but high-level analysis tools***
- ***Free*** distribution (Download on ICHARM HP)





IFNet ICHARM

Schematic figure of IFAS



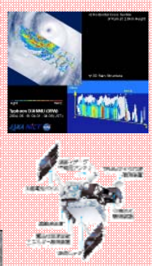
Data input function

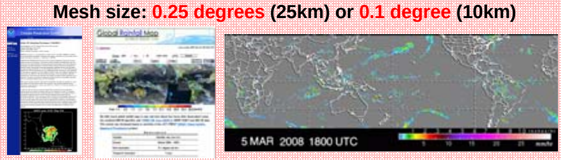
1) Satellite-based rainfall data

- TMPA-3B42RT (NASA)
- QMORPH/CMORPH (NOAA)
- GSMaP (JST/CREST, OPU,JAXA etc.)

Global coverage : between 60N-60S latitude

Mesh size: 0.25 degrees (25km) or 0.1 degree (10km)





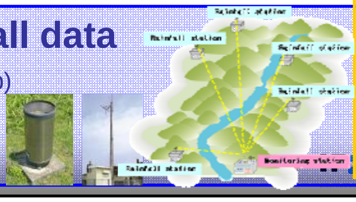
Automatic Data Extraction for area of interest

Provided by NASA, NOAA, JAXA and IFNet-GFAS through the Internet for free

2) Ground-based rainfall data

Observed Own data (Local Ownership)

CSV file format

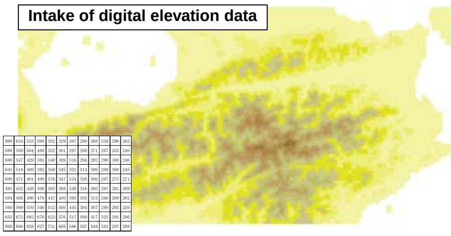


3) Integration (Correction of Rainfall)

ICHARM

Modeling function

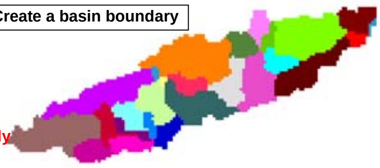
Intake of digital elevation data



IFAS creates a basin boundary and a river channel network use of digital elevation data.

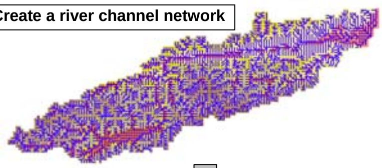
automatically

Create a basin boundary



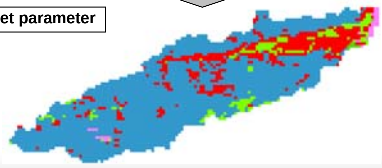
automatically

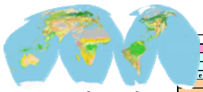
Create a river channel network



automatically

Set parameter





Landuse data

GLCC (USGS HP)

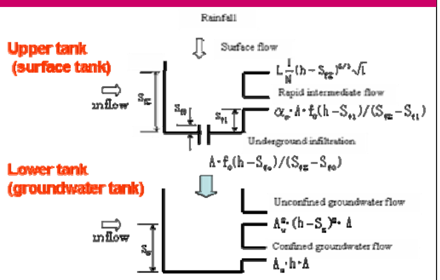
Land Cover Classification (GLCC)	IFAS Classification
Urban and Built-Up Land	Urban area
Dryland Cropland and Pasture	Wetland
Irrigated Cropland and Pasture	
ed Dryland/Irrigated Cropland and Pasture	
Cropland/Grassland Mosaic	Grassland
Cropland/Woodland Mosaic	
Grassland	
Shrubland	
Mixed Shrubland/Grassland	
Savanna	
Deciduous Broadleaf Forest	Forest
Deciduous Needleleaf Forest	
Evergreen Broadleaf Forest	
Evergreen Needleleaf Forest	
Mixed Forest	
Water Bodies	Water Bodies
Herbaceous Wetland	Wetland
Wooded Wetland	
Barren or Sparsely Vegetated	Grassland
Herbaceous Tundra	
Wooded Tundra	
Mixed Tundra	
Bare Ground Tundra	
Snow or Ice	Water Bodies

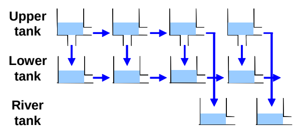
IFAS estimates parameter based on the classification that we set up beforehand.

IFNet ICHARM

Multi-model Approach

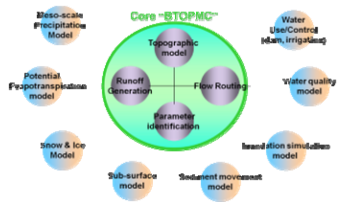
PWRI-Distributed Hydrological Model Ver. 2.0



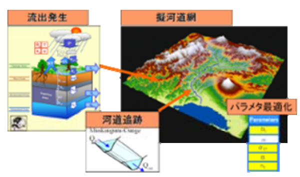


- Easy parameter calibration
- Developed and tested at many basins in JAPAN

YHyM/BTOP Model Ver. 1.4



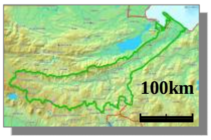
Core module and Multi-Module



- Applied well more than 100 river basins

IFNet ICHARM

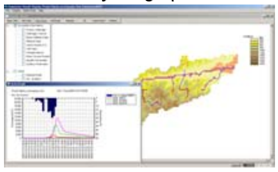
Display function



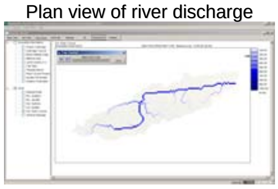
Guatemala (Motagua Basin:15,169km)

Plan view of river discharge on Google Earth

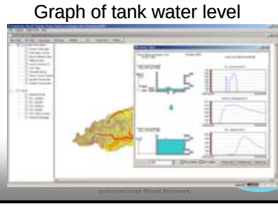
Hydro-graph



Plan view of river discharge

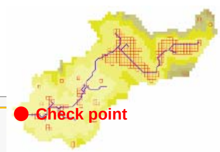


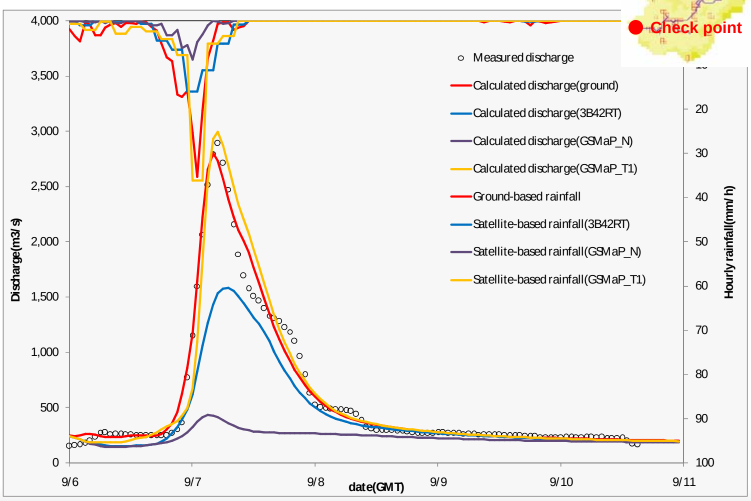
Graph of tank water level



Experimental application to actual basins

Sendaigawa river Basin (Japan) **L=137km A=1,600km2**

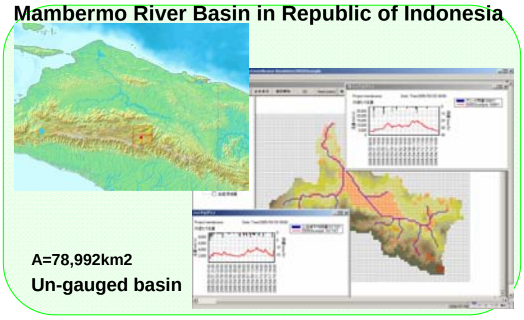




IFNet ICHARM

Experimental application to actual basins

Mambermo River Basin in Republic of Indonesia

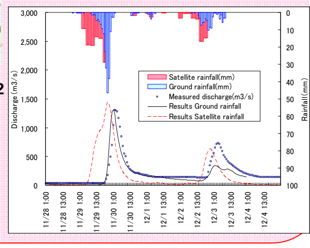


A=78,992km2

Un-gauged basin

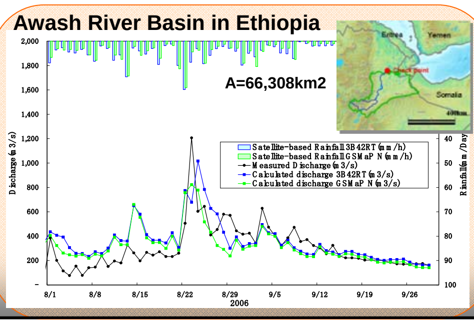
Pasig River Basin in Republic of the Philippines

A=499km2



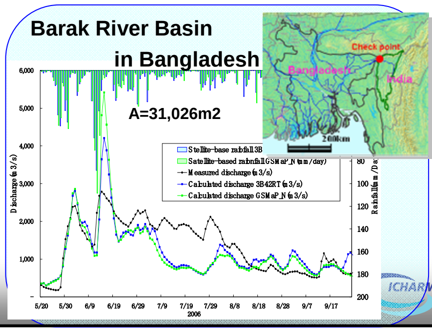
Awash River Basin in Ethiopia

A=66,308km2



Barak River Basin in Bangladesh

A=31,026m2



Training workshop

FOR THE GLOBAL FLOOD ALERT SYSTEM (GFAS) VALIDATION
3-8 Oct, 2008 JAPAN

Purpose of the training course

- To build capacities to undertake hydrological prediction/forecasting in relatively ungauged basins using satellite-based rainfall.

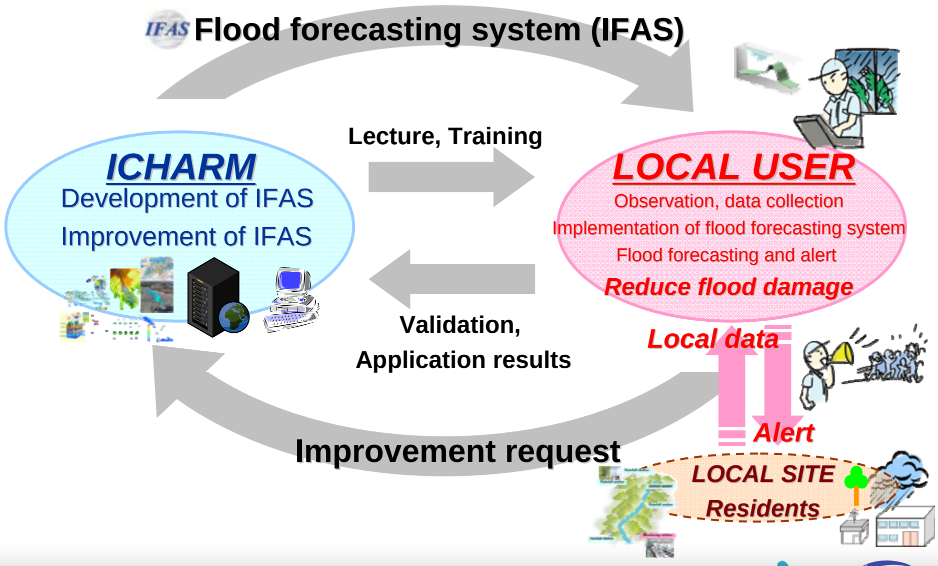
Participants

- Ethiopia, Zambia, Cuba, Argentina, Bangladesh, Guatemala, Nepal (7countries)

Program

- Remote Sensing of Precipitation from Space (JAXA)
- Historical evolution of flood management system in Japan
- Introduction of Global Flood Alert System
- Operating procedures for IFAS
- Validation method of satellite-based rainfall
- Current conditions and problems in each country
- Validation plans using IFAS

Local ownership



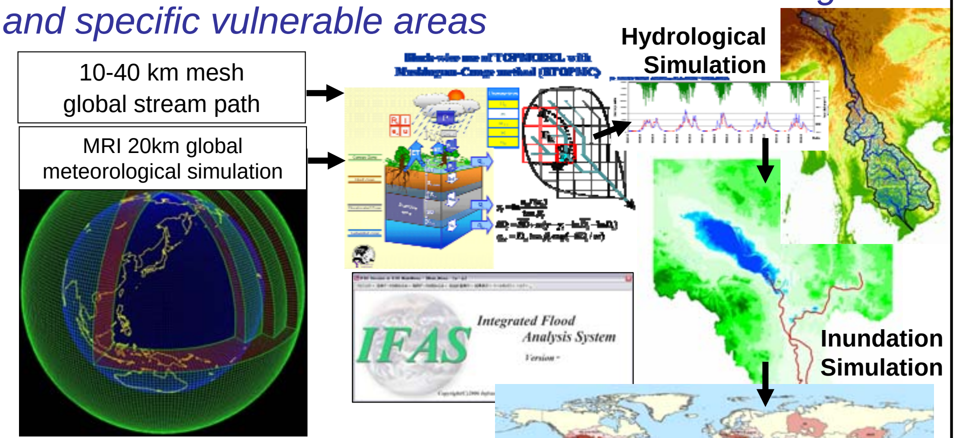
More info

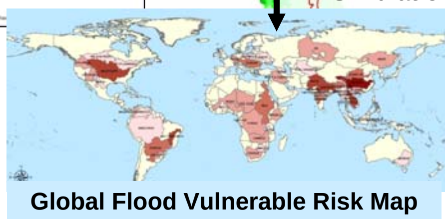
Thank you for your kind attention.

IFNet : http://www.internationalfloodnetwork.org/index.html
GFAS : http://gfas.internationalfloodnetwork.org/gfas-web/
IFAS : http://www.icharm.pwri.go.jp/html/research/ifas/index.html

Hydrologic Engineering Research Team,
International Centre for Water Hazard and Risk Management (ICHARM),
Public Works Research Institute (PWRI)
E-mail: suimon@pwri.go.jp

Assessment of the impact of climate change on flood disaster risk and its reduction measures over the globe and specific vulnerable areas





KAKUSHIN

Innovative Program of Climate Change Projection for the 21st Century

Project Period: 2007 Apr. – 2012 Mar.

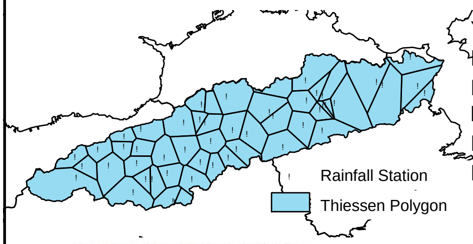
GCM20 Data provided by Meteorological Research Institute (MRI), Japan

	Period	Data Item	Range	Temporal Resolution	Spatial Resolution
Present	**1979 Jan. ～2004 Dec.**	temperature, **precipitation**	Latitude: -90 – 90 Longitude: 0 – 360	Hourly	0.1875 deg （20km）
		Snow water equivalent, specific humidity, atmospheric pressure, wind velocity, wind direction		Daily	
Near Future	2015 Jan.～ 2036 Dec.				
Future	**2075 Jan. ～2100 Feb.**				

- ●Only surface data is provided.
- ●SRES A1B scenario is adopted for greenhouse gas emission.
- ●Observed SST data is input to AGCM for the simulation of present climate condition.
- ●The trend of SST for near future and future climate projection is provided by the multi model ensemble of AOGCMs adopted in IPCC AR4.

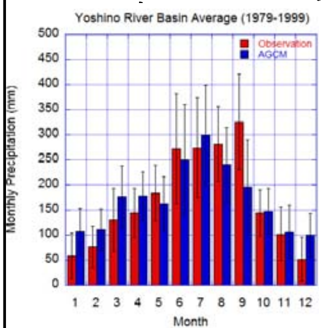
- □The spatial resolution of MRI-AGCM is **20 km**. There is no other model which spatial resolution is finer than this model in the world.
- □Because of this fine resolution, MRI-AGCM shows advantage in simulating typhoons.
- □It is planed that ICHARM will receive updated MRI-AGCM data from FY2009.

Example of comparison（Yoshino River Basin, Japan）

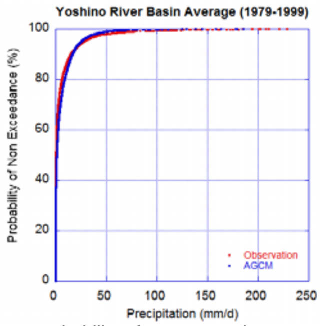


Yoshino River Basin (Japan)

- Basin Area：3,750 km2
- Number of Rainfall Stations：51 stations（73.5 km2/sta）
- Number of Grid of AGCM：29
- Annual Precipitation：1,800 mm – 2,000 mm

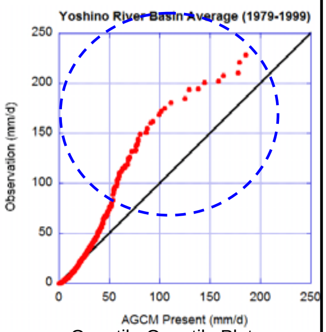


Monthly Precipitation



Probability of Non Exceedance
(Daily Precipitation)

GCM20: Underestimation



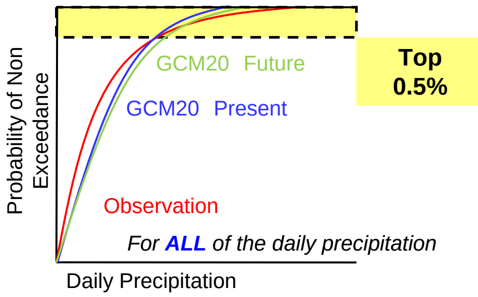
Quantile-Quantile Plot
(Daily Precipitation)

- AGCM underestimates observation for heavy precipitation.
- It is necessary to apply a correction method on AGCM precipitation data for flood analysis.

Concept of bias correction method for GCM20

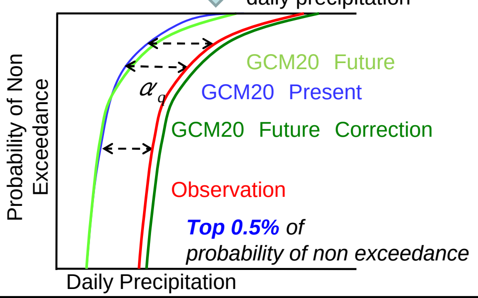
Hybrid Method

A) Extreme Value
⇒The samples in top 0.5% of prob. of non exceedance are considered.
B) Other value
⇒They are divided into each month.



①The samples in top 0.5% on probability of non exceedance for observation, GCM20 Present and GCM20 Future are abstracted.

Abstraction of top 0.5% daily precipitation



②The ration for each quantile (α_q) between observation (P_Obs_q) and GCM20 Present ($GCM20\_Pre_q$) is estimated. α_q is regarded as a correction coefficient for each quantile and multiplied to the value of GCM20 Future of same quantile ($GCM20\_Fut_q$) and corrected value (P_Fut_q) is obtained.

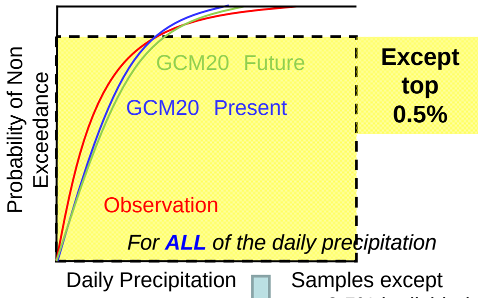
$$\alpha_q = \frac{P\_Obs_q}{GCM20\_Pre_q}$$

$$P\_Fut_q = \alpha_q \times GCM20\_Fut_q$$

Concept of bias correction method for GCM20 (continue)

Hybrid Method

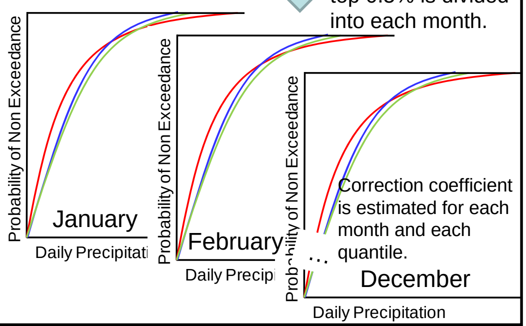
③Samples except top 0.5% on observation, GCM20 Present and Future are divided into each month.



④The ratio between observation ($P\_Obs_{m\_q}$) and GCM20 Present ($GCM20\_Pre_{m\_q}$) is estimated for each month and each quantile (α_{m_q}). α_{m_q} is regarded as correction coefficient and multiplied to GCM20 Future of same month and same quantile ($GCM20\_Fut_{m\_q}$) and corrected value ($P\_Fut_{m\_q}$) is obtained.

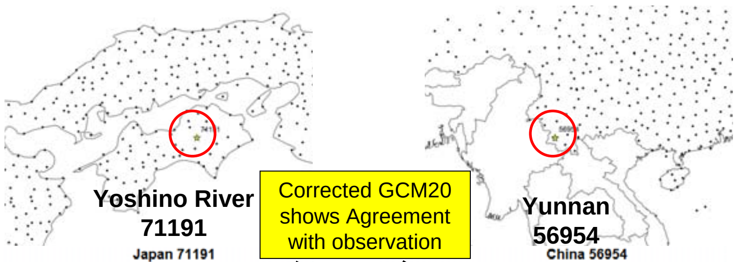
$$\alpha_{m\_q} = \frac{P\_Obs_{m\_q}}{GCM20\_Pre_{m\_q}}$$

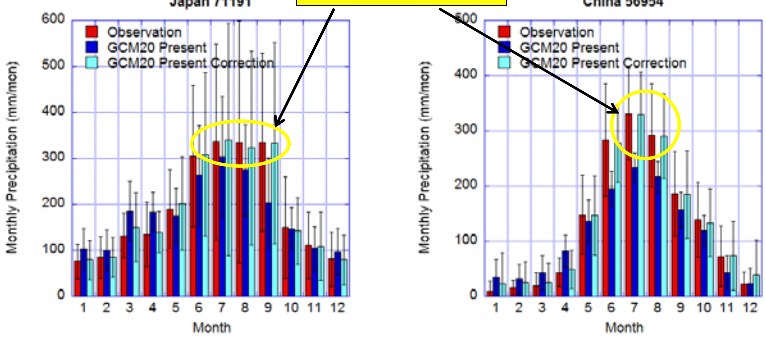
$$P\_Fut_{m\_q} = \alpha_{m\_q} \times GCM20\_Fut_{m\_q}$$



Result of correction method (Japan, China, each 1 point)

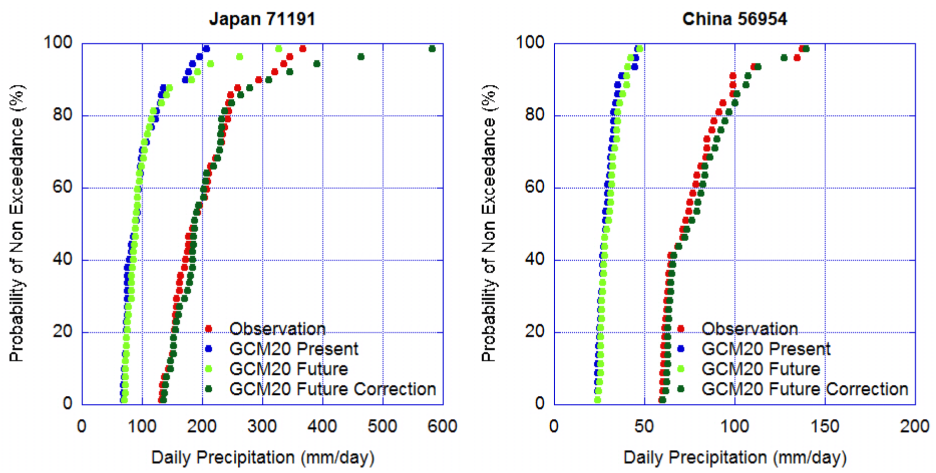
Verification of present climate condition, *Monthly Precipitation*





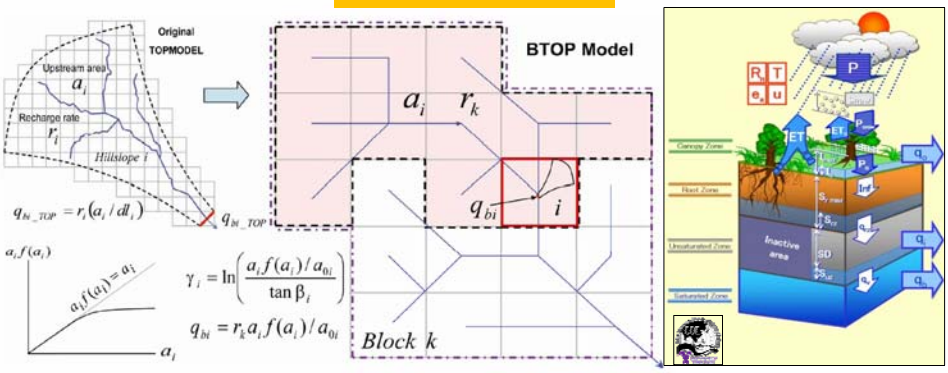
Average of 1980-2004 (25 Years)   Average of 1979-2000 (22 Years)

Result of correction method (Japan, China, each 1 point)
Verification of present climate condition, *Extreme value*

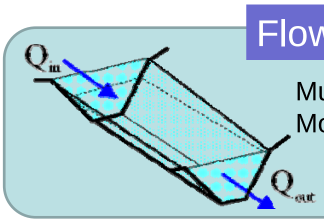


BTOPMC model

Runoff Generation



Flow Routing

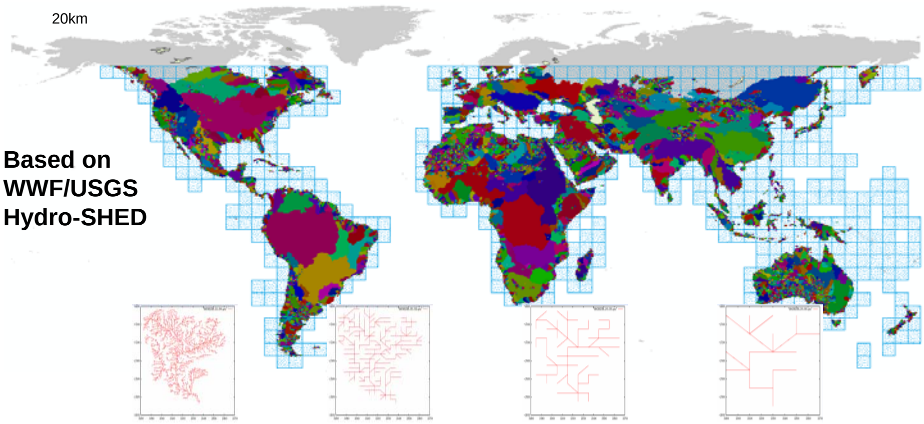


Muskingum-Cunge
Modified Manning Eq.

Takeuchi, Ao, Ishidaira, HSJ, 44(4), 1999
Takeuchi, Hapuarachchi, Zhou, Ishidaira, Magome, HP, 22, 2008

Takeuchi, Ishidaira, Sawada, Masumoto (eds) Studies of the MRB, HP, 22(9), 2008

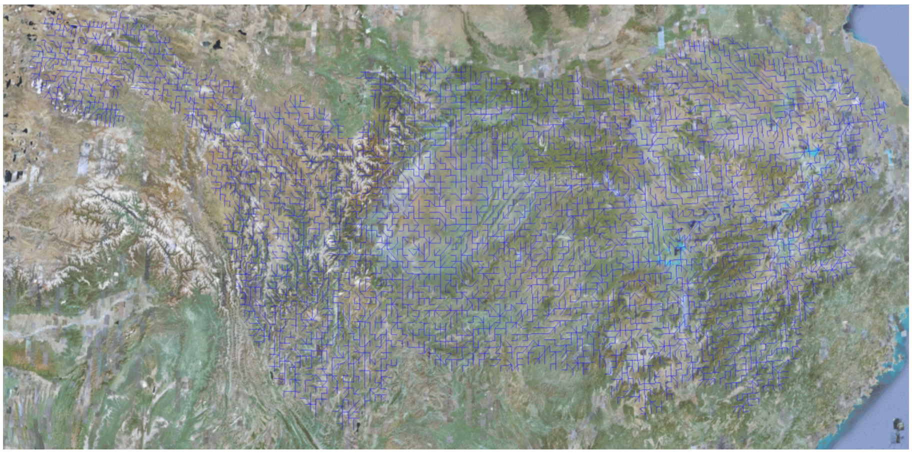
Development of Global Scale free Stream Network



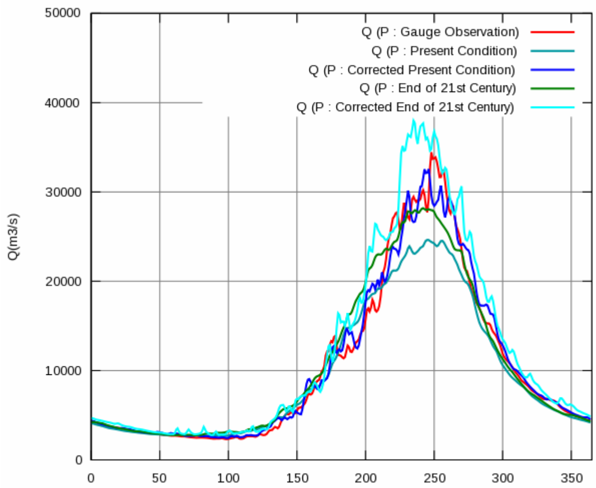
Based on WWF/USGS Hydro-SHED

High Resolution 3”(≒90m original), 6”, 9”, 12”, 15”
Middle Resolution 0.5’ (≒ 1km), 1’, 2’, 3’,
90m-20km 11 kinds
Low Resolution 5’ (≒10km), 10’’

Yangtze River Basin 5, 10, 20km mesh

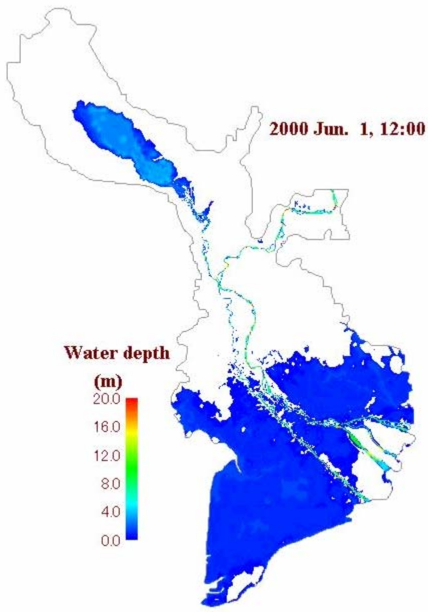


Effect of the correction method
River Discharge Simulation (Preliminary Result)
for Ikeda station in Mun and Chi River Basin, Mekong



The simulation results by **corrected GCM20** precipitation data showed better accuracy than simulation results by **raw GCM20** precipitation data.

Year 2000 Flood inundation for the Mekong River Delta



Flood Disaster Risk Indicators

$R=HxV_BxE/C$

Disaster Risk

- Human Damage: deaths/causalities, affected, displaced
- Economic Losses: direct, indirect
- Goods: house hold gods, commercial goods, production goods, agricultural, energy, foods, cultural heritage
- Properties: buildings, public infrastructure, landscapes
- Livelihood: business continuity, traffic, lifeline services
- Environmental damage: Environment, ecology , pollution
- Duration, frequency, timing, spatial extent affected

Natural Hazard

- Magnitude, intensity, duration, frequency
- Timie and place of occurrence
- Human amplification activities: deforestation, slop development
- Human mitigation activities: artificial rainfall

Societal Basic Vulnerability

- Poverty: GDP, Economic Vulnerability Index
- Governance: accountability, compliance, political stability, administrative efficiency, discipline, legal preparedness, bribe control
- Health, nutritious, handicapped, sick population
- Demographic composition: infants, maternity, elderly population
- Education level: illiteracy, IT illiteracy
- Institutional arrangement for weak & vulnerable people, squatters
- Social Capital, mutual help

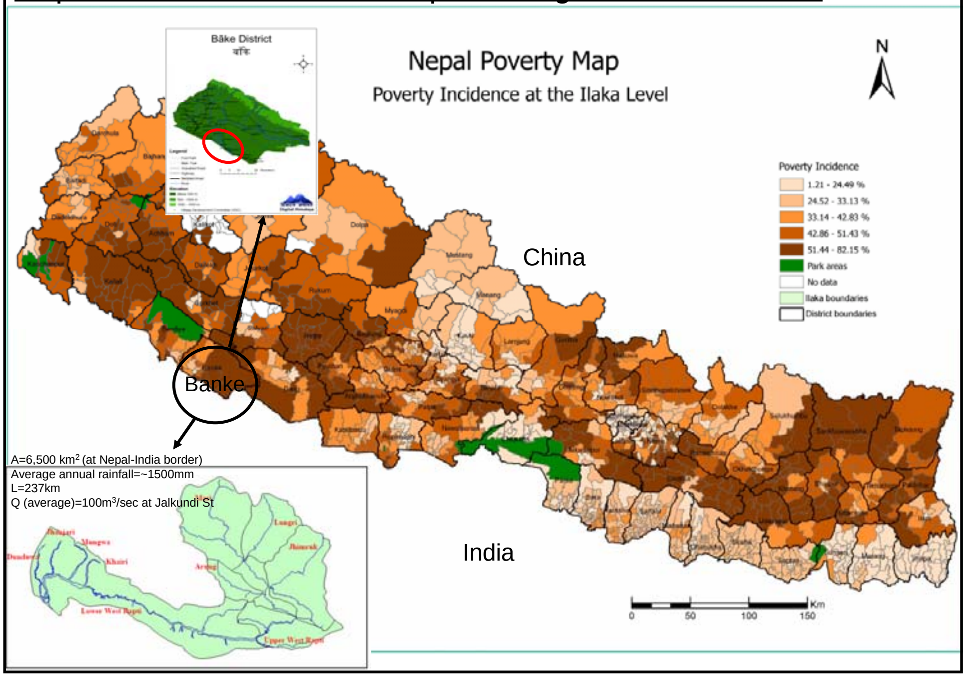
Exposure

- Population, economic activities and their density in risk areas: active faults, active volcanic areas, flood plain, high slopes, landslide areas, zero meter areas, reclaimed areas
- Land use control: industrial area regulation, urban inundation acceptance, regulation and incentives, tax reduction, subsidy

Coping Capacity

- Structural infrastructure: dams, dikes, diversions, sabo works, urban storage & infiltration facilities, piloti houses,
- Nonstructural infrastructure as below:
- Preparedness: risk assessment, hazard maps, its use, drills
- Early warning: observation stations, data transmission/processing, dissemination media, research
- Evacuation, shelter, relief &recovery supports, volunteers
- Institutional structure: central/local prevention/emergency response structure, local community defense forces
- Finance: prevention, emergency, recovery, ODA, S/T Research funds
- Culture, education, training: traditional/indigenous culture, school disaster education, multi hazard drills.

Rapti River Basin, Banke, Nepal-Background Information



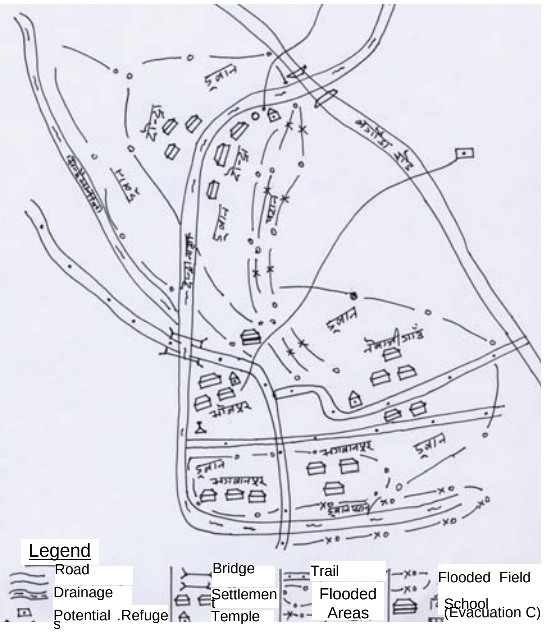
2008 Local Level Consultation Meeting

2008 Country Level Consultation Meeting

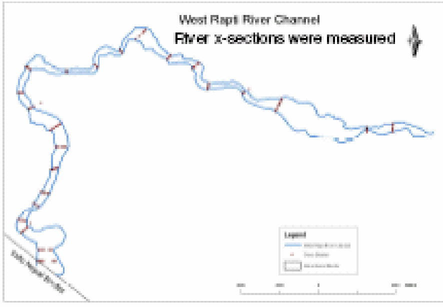
2009 Local Level Consultation Meeting

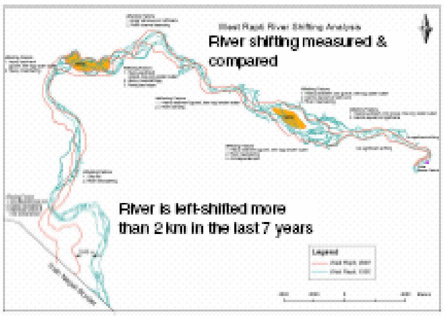
2009 Country Level Consultation Meeting

Community based flood hazard mapping

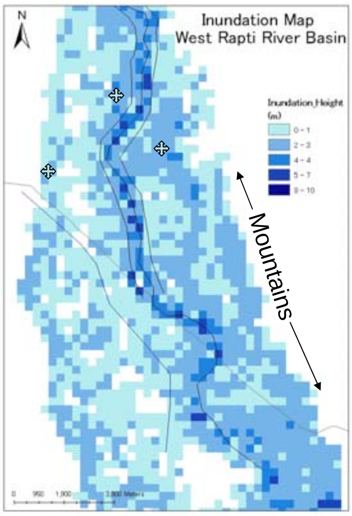


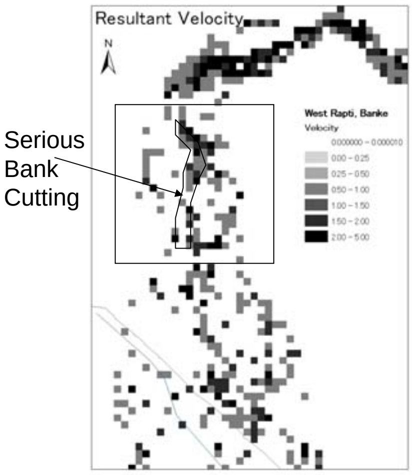
Field Activities III





Results produced by 2D- Flow Model





✣ Cross-checked points at the field


Thank you for kind your attention!!

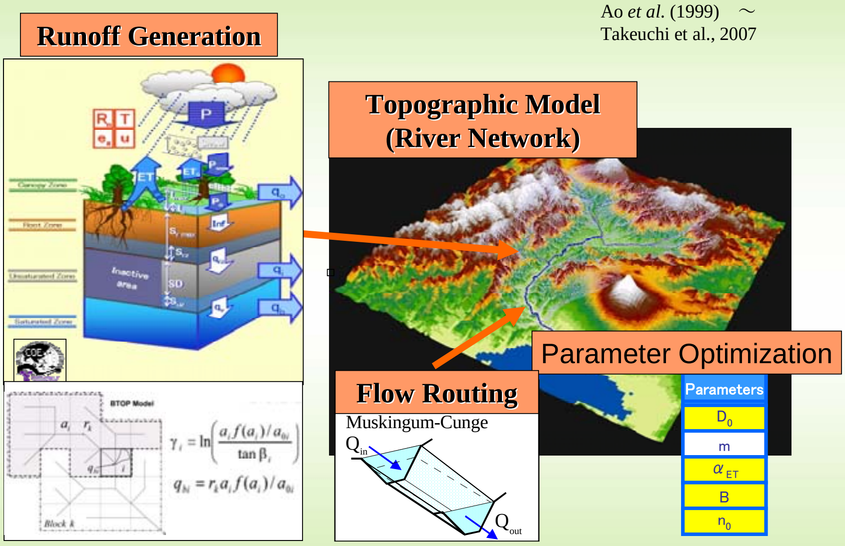
2009/06/02
JICA Training

Importance and Meaning of flow discharge measurement in actual rivers

Atsuhiro, YOROZUYA, Ph.D.
Research Specialist
Hydrologic Engineering Research Team
International Centre for Water Hazard and Risk Management (ICHARM) under the auspices of UNESCO, Public Works Research Institute(PWRI), Japan

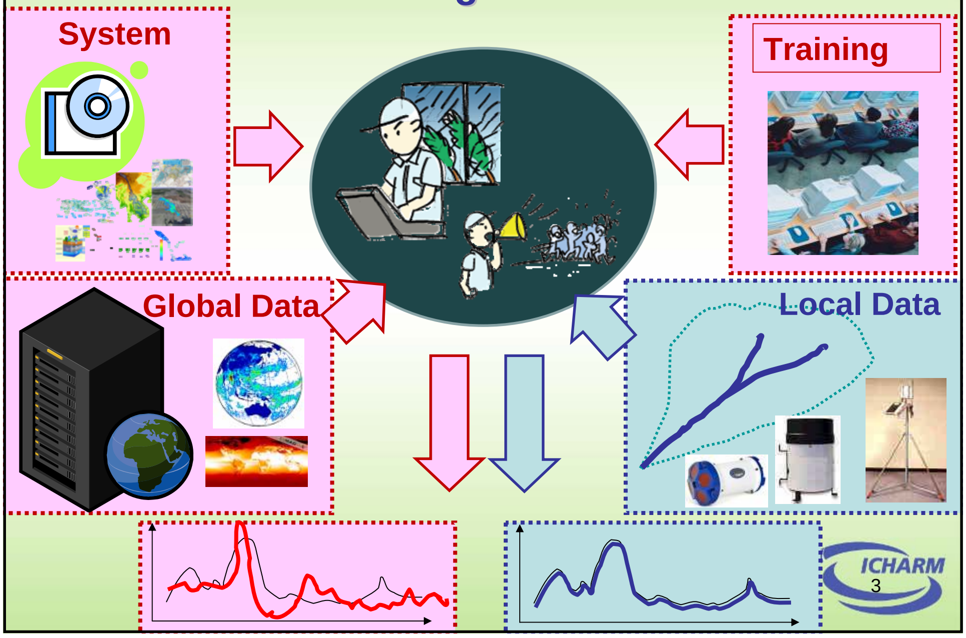
One of example of runoff analysis

Ao *et al.* (1999) ～
Takeuchi et al., 2007



Need to train the system for determining parameter with **water-discharge measurement; Q**

System of flood forecasts and importance of water-discharge measurement



3

Discharge measurement is

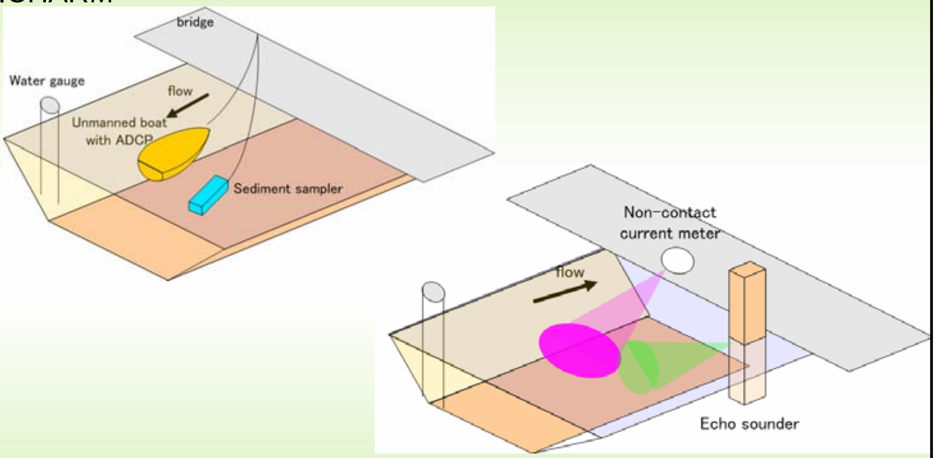
- indispensable for river planning
- necessary for training the system for runoff analysis
- necessary for early warning
- necessary to obtain current situation before climate changes

Discharge measurement is difficult, since

- water surface of river during flooding vibrates
- cross sectional area changes during flooding

4

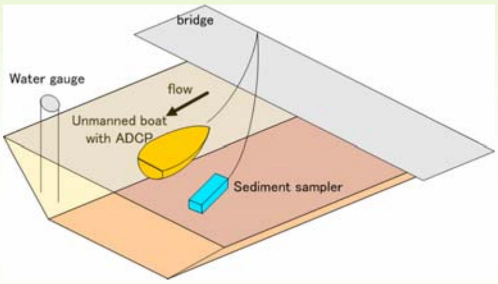
Water/sediment Discharge measurement project of MLIT (Ministry of Land, Infrastructure, Transport and Tourism) with NILIM and ICHARM



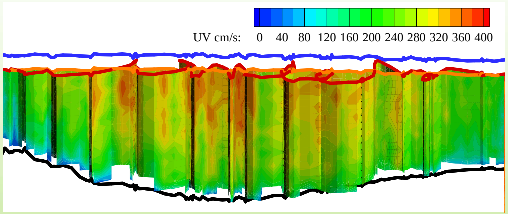
Automatic observation is one of goal
observing in highly accurate and with good precision
→ today's discussion. How difficult it is. Need to share with Taiwanees.

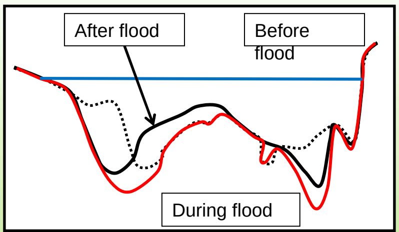
Discharge measurements sometime involve difficulties

Water/sediment Discharge measurement project of MLIT (Ministry of Land, Infrastructure, Transport and Tourism) with NILIM and ICHARM 2/2



Acoustic Doppler Current Profiler (ADCP)





Development of unmanned boat for safety and reliable observation with ADCP by ICHARM 1/3 (in field)

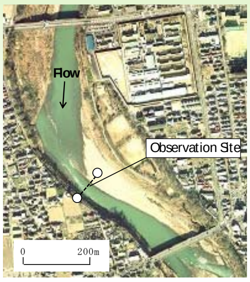


Fig.3 Plan view of observation site at Tone River

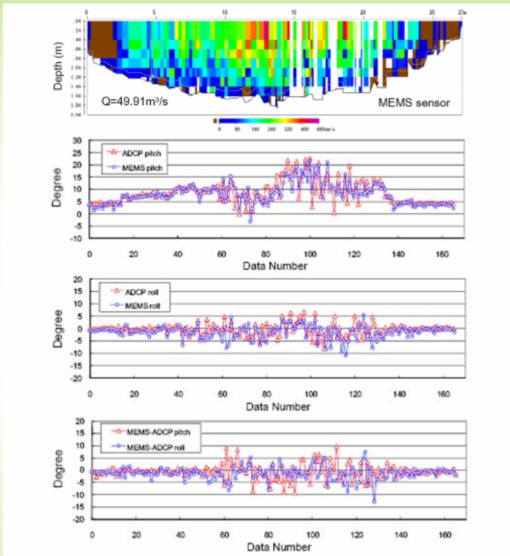
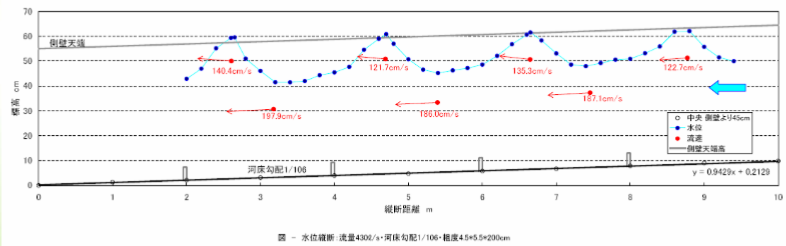


Fig.4 Time series of velocity and tilt angle measured by internal and MEMS sensor

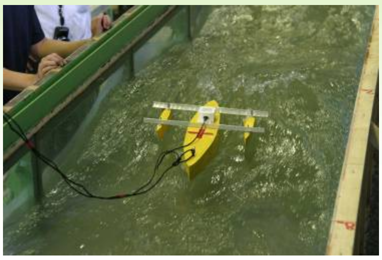
Shoji Okada, Atsuhiro Yorozuya and Takashi Kitsuda, (2009) Effect of Fluctuation of a Moving Boat Equipped with ADCP on Velocity-Profiles and Water-Depth Measurements, 33rd International Association of Hydraulic Engineering & Research (IAHR) congress, August 9-14, Vancouver, Canada, full paper in CD-ROM

Development of unmanned boat for **safety** and **reliable** observation with ADCP by ICHARM 2/3 (in experimental flume)

- 430 litter/seconds
- width of ex-flume 90 cm
- slope of ex-flume 1/100
- wave length about 2 m
- Model scale 1/3

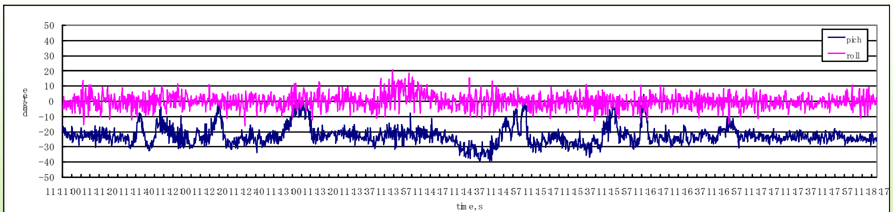


Development of unmanned boat for safety and reliable observation with ADCP by ICHARM 3/3 (in experimental flume)



Trimaran type

Monohull type



One of example of pitch/roll angles

Thank you for paying attention

WEP (Water and Energy transfer Process) Model

- Integrated Analysis Tool for Water/Energy and Material (biogeochemical) Cycles at Watershed Scale -

Hemantha RAJAPAKSE

Hydrologic Engineering Research Team
International Centre for Water Hazard and Risk Management (ICHARM) under the auspices of UNESCO,
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[rajap@pwri.go.jp]

The International Centre for Water Hazard and Risk Management
ICHARM
Hydrologic Engineering Research Team

Outline of the presentation

- **Basic introduction**
- **WEP (Water and Energy Processes) model**
  - o *Hydrological & energy process model: structure and methods*
  - o *Coupled basin-wide water quality model for nitrogen/phosphorus*
  - o *Suspended solids (SS) and soil-bound nutrients: erosion, transport and sedimentation*
- **Application examples**
  - o *Japan, China, Korea….*
- **Ongoing research**

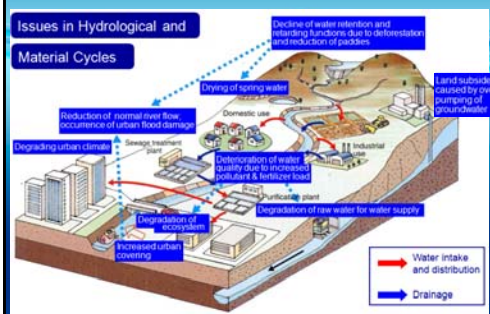
Basic introduction

- **Overall picture**
  - *Global warming and other anthropogenic activities have changed natural hydrological and material processes in watersheds*
  - *Tools for holistic analysis of hydrological/energy and material cycles for sustainable water resource development and management*
  - *Physically-based distributed hydrological models to reflect the effects of spatial variations of hydrological factors…*
  - *Integrated management of water resources at watershed scale for sustainable development….*

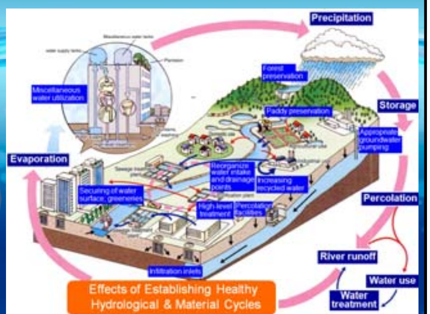
Basic Introduction

-Hydrological and material cycle modeling for Integrated Watershed Management

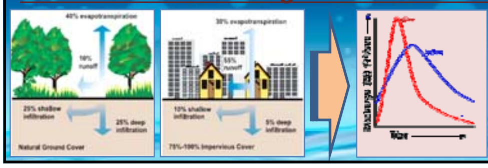
Water quality degradation in diminishing freshwater resources….



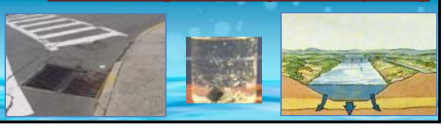
Towards Integrated Basin-wide Water Resources Management….



Effects of land use change and urbanization



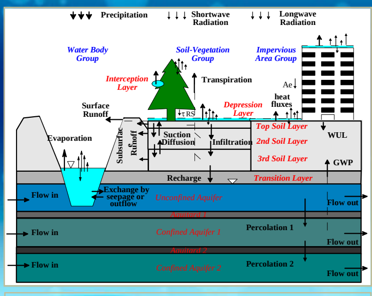
Retards the natural ecosystem functioning affecting water quality



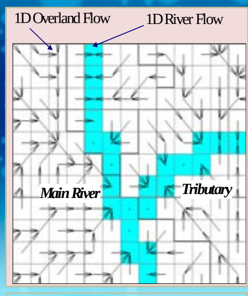
WEP (Water and Energy Transfer Processes) model

Model attributes:

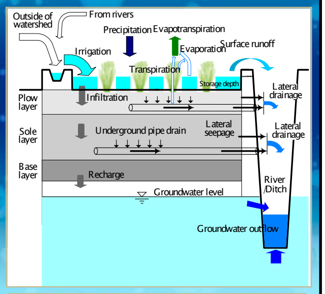
- Physically based, distributed-parameter model
- Simultaneous simulation of water, energy & material transport processes
- Subgrid heterogeneity for complex land covers is considered by using the mosaic method (Avissar and Pielke, 1989)
- Numerical simulation of groundwater/subsurface water flows to directly reflect topographical effects in runoff generation, thus cable of modeling infiltration excess, saturation excess and mixed runoff generation mechanisms
- Detailed modules to simulate infiltration trenches and paddy/tile drain effects



Vertical structure inside a grid cell



Planar structure



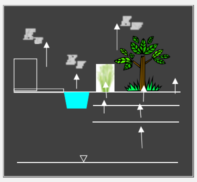
Coupled paddy/tile-drain model

WEP (Water and Energy Transfer Processes) model

Modeling methodology:

Evapotranspiration

- Grid-averaged method : Penman, Penman-Monteith formulae
- Surface temperature (Force-restore method)



$$E = F_W E_W + F_{SV} E_{SV} + F_U E_U$$

$$Ew = \frac{(RN - G)\Delta + \rho_a C_p \delta e / r_a}{\lambda(\Delta + \gamma)}$$

$$Esv = Ei_1 + Ei_2 + Etr_1 + Etr_2 + Es$$

$$Ei = Veg \cdot \delta \cdot Ep$$

$$Etr = Veg \cdot (1 - \delta) \cdot E_{PM}$$

$$E_{PM} = \frac{(RN - G)\Delta + \rho_a C_p \delta e / r_a}{\lambda[\Delta + \gamma(1 + r_c / r_a)]}$$

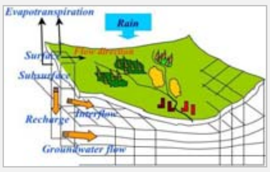
Energy balance

$$RN + Ae = IE + H + G$$

Infiltration & Runoff

- Rain intensity <= Ks

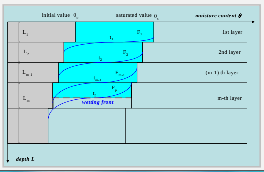
  Richards equation



- Rain intensity> Ks

  Green-Ampt Model

$$f = k_m \cdot \left(1 + \frac{A_{m-1}}{B_{m-1} + F}\right)$$



Subsurface flow

- Unconfined aquifer

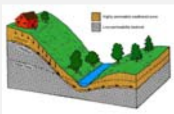
$$C_u \frac{\partial h_u}{\partial t} = \frac{\partial}{\partial x}\left[k(h_u - z_u)\frac{\partial h_u}{\partial x}\right] + \frac{\partial}{\partial y}\left[k(h_u - z_u)\frac{\partial h_u}{\partial y}\right] + (Q_1 + WUL - RG - E - Per - GWP_u)$$

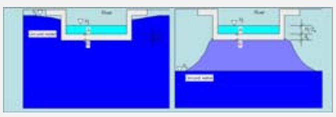
- Confined aquifer

$$C\frac{\partial h}{\partial t} = \frac{\partial}{\partial x}\left(kD\frac{\partial h}{\partial x}\right) + \frac{\partial}{\partial y}\left(kD\frac{\partial h}{\partial y}\right) + (Per - GWP - Perc)$$

- Outflow to rivers

$$RG = \begin{cases} k_b A_b (h_u - H_r) / d_b & h_u \geq H_r \\ -k_b A_b [1 + (H_r - Z_b) / d_b] & h_u < H_r \end{cases}$$

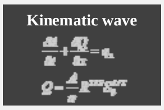




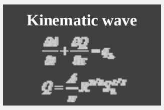
WEP (Water and Energy Transfer Processes) model

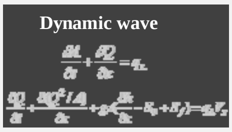
Modeling methodology:

- Routings of Overland Flow and River Flow
  - Overland Flow: Kinematic wave method



  - River Flow: kinematic wave or dynamic wave



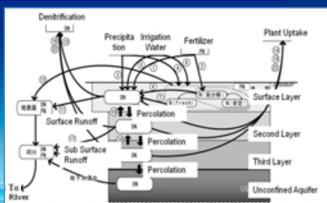


- Others:
  - Anthropogenic water use
    - Irrigation, industrial, domestic and others
  - Artificial energy use/sources
  - Coupled pollutant/biogeochemical modules

Coupled biogeochemical model *for simulating transport of dissolved/particulate N & P*

Schematics of the biogeochemical model

- The pre-calibrated WEP hydrologic model with all parameters unchanged was used to generate runoff and subsurface flows necessary to perform material flow simulations in the presently developed water quality model
- The nutrient movements were assumed to follow the surface runoff and groundwater pathways in WEP model
- Material budgets were estimated using concentrations and mass balance in mesh level
- N & P components were modeled as active, stable and fresh constituents in organic part and soluble & particulate mineral N & P in the mineral pool



Nitrogen component
Dissolved N [$NO_{2,3}$-N, NH_4-N]
Particulate N

Phosphorus component
Dissolved P [PO_4-P]
Particulate P

Surface Layer

$$\frac{\partial\theta_1}{\partial t} = \frac{1}{d_1}(Q_0 + QD_{12} - Q_1 - R_{21} - Es - Etr_{11} - Etr_{21})$$

$$\frac{\partial N_1}{\partial t} = \frac{\partial N_{\min,0}}{\partial t} + \frac{1}{d_1}\begin{pmatrix} N_{in,0} + N_{suc,12} - N_{uptake,1} \\ - N_{drain,1} - N_{lateral,1} - N_{den,1} \end{pmatrix}$$

Second Layer

$$\frac{\partial\theta_2}{\partial t} = \frac{1}{d_2}(Q_1 + QD_{23} - QD_{12} - Q_2 - R_{22} - Etr_{12} - Etr_{22})$$

$$\frac{\partial N_2}{\partial t} = \frac{1}{d_2}\begin{pmatrix} N_{in,1} + N_{suc,23} - N_{uptake,2} \\ - N_{drain,2} - N_{lateral,2} - N_{den,2} \end{pmatrix}$$

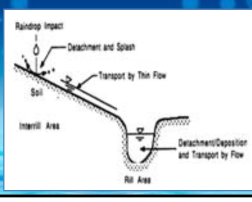
Third Layer

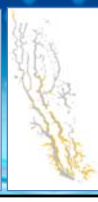
$$\frac{\partial\theta_3}{\partial t} = \frac{1}{d_3}(Q_2 - QD_{23} - R_{23} - Q_3 - Etr_{13})$$

$$\frac{\partial N_3}{\partial t} = \frac{1}{d_3}\begin{pmatrix} N_{in,2} - N_{suc,23} \\ - N_{uptake,3} - N_{drain,3} - N_{lateral,3} - N_{den,3} \end{pmatrix}$$

Erosion, transport and sedimentation

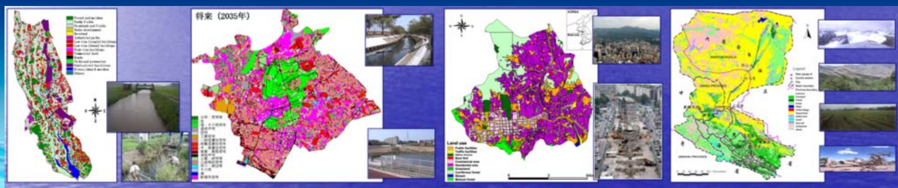
- To incorporate soil-bound nutrients in pollutant modeling
- Rill and interrill erosion is modeled based on runoff energy and transport capacity
- Process-based sediment erosion, transport, deposition and associated pollutant load simulation procedure





WEP Application examples

-Hydrological and material cycle modeling for Integrated Watershed Management



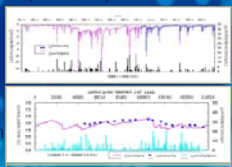
Japan: Yata River Watershed (166 km^2) | Japan: Ebi River Watershed (29 km^2) | Korea: Cheonggye-cheon Watershed (51 km^2) | China: Heihe River Basin(317,800 km^2)

Applications:

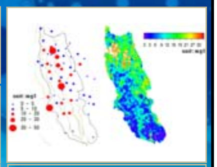
- Yata River Basin (166 km2), Ebi River Basin (29 km2) & Takasaki River Basin (86 km2) in Japan
- Cheonggye-cheon (51 km2) & Dorimcheon (22 km2) catchments in Korea
- Yellow River Basin (794,700 km2) & Huaihe River Basin (317,800 km2) in China

Simulated effects:

- Variations in river discharges and groundwater table due to rapidly changing land-use patterns
- Effects of urbanization on hydrological and heat cycles in watershed scale (water budget & heat balance)
- Effect of surplus agricultural fertilizer loading (diffuse-source) on river and subsurface water quality



Observed and simulated river discharge & groundwater level data in Yata River Basin

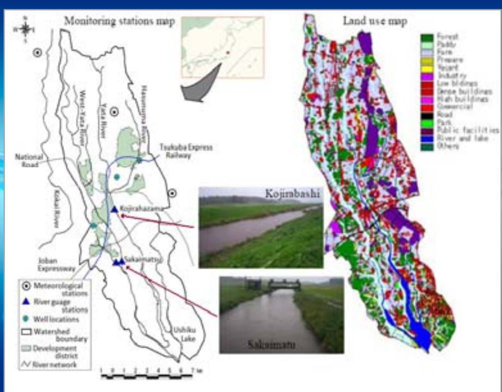


Variations in groundwater dissolved nitrogen due to surplus fertilizer loading

-WEP model as a tool for ensuring healthy hydrologic and material cycles in rapidly urbanizing areas with changing land-use patterns…

WEP Application examples contd…

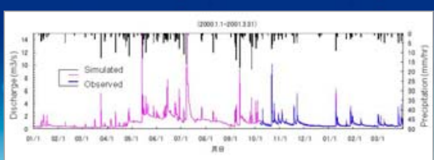
Application to an Agricultural Watershed→Yata River Basin (166 km^2, Ibaraki Prefecture, Japan) [*Jia et al., 2005*]

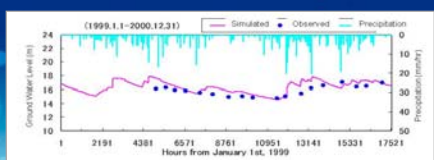


Year	Past and expected land use ratio in Yata River Basin (%)							Impervious Ratio
	Forest	Paddy	Fileds	Buildings	Roads	Water	Others	
1976	22	15	39	7	‹ 1	5	12	0.12
1994	16	14	33	18	4	4	11	0.23
2020	14	13	28	23	5	4	13	0.31

Basin and simulation characteristics

- Land-use: Mainly agricultural (Farmlands & paddy 50%), Semi-urbanized (urban area~20%), decreasing area of forests
- Spatial/temporal resolution: 100 m X 100 m grid for simulation
- Time step of 10 min for river flow routing during rainfall periods, and 1-hr for all other hydrological processes



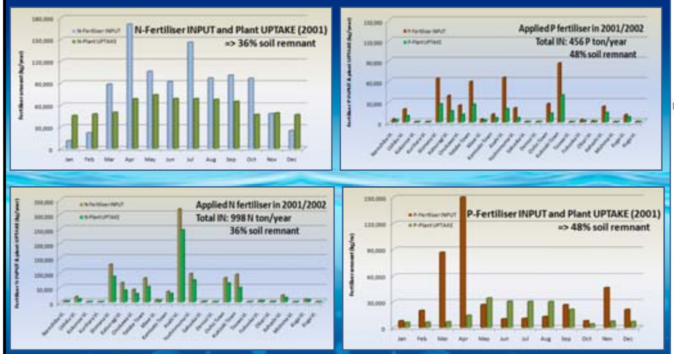


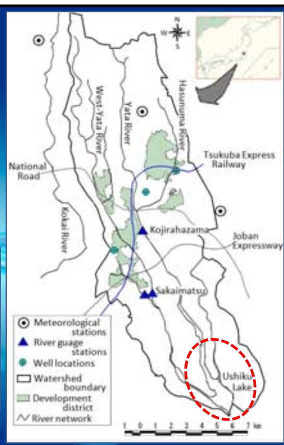
→ Long-term decline in groundwater table due to decreasing pervious area (inceasing urban cover)

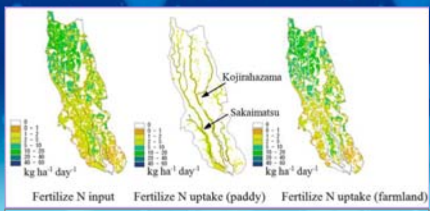
→Nessesity of artificial infiltration drains to maintain healthy hydrologic cycle in the basin

– [Jia et al., 2005; Kinouch et al., 2005]

Simulation Results & Implications







Estimated spatial distribution of fertilizer N input and plant uptake data in paddies and farmlands in Yata River Basin for simulated period

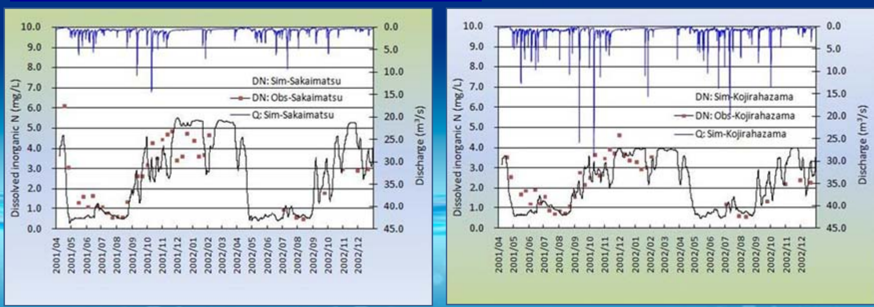
➔ N and P fertilizer input loadings:

998 N ton/year (*with a rate of application of 12-180 kg ha^{-1} yr^{-1}, in each sub unit*)

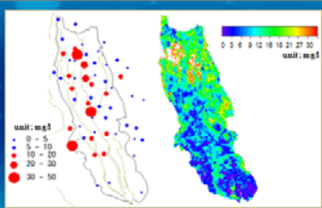
456 P ton/year (*5-42 kg ha^{-1} yr^{-1}*) in total

➔ But, only 64% of N and 52% of P respectively, were absorbed by crops & removed via harvesting in 2001/02

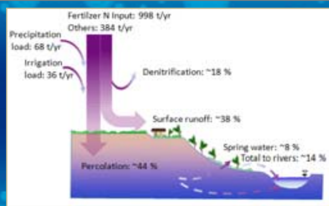
Simulation Results & Implications (cont.)



Observed and simulated dissolved N concentrations at recorded stations e Kojirahazama and Sakaimatsu in Yata River & West-Yata River (2001/2002)



Observed and simulated dissolved N concentrations in groundwater in November 2000 in Yata River Basin



Overall budget and pathways of nitrogen component in the Yata River Basin, as simulated by numerical model

➔ The river water N and higher levels of NO_3-N observed in the upper part of the basin could be well simulated in the numerical model with the present level of fertilizer N usage in the basin

➔ The higher percent loadings of fertilizer N & P into downstream Ushiku Lake imply major pathways of N and P losses in the catchment and resultant water quality degradation in the system

Ongoing further research

The hydrologic Engineering Research Team at ICHARM will continue to further improve the WEP model, in order to enhance its performance and capabilities:

- Further improvements to WEP model for highflow/lowflow and urban conditions
- Soil-bound pollutants sediment erosion dynamics components

while promoting model applications

- in local level through its local study series (Takasaki Basin, Chiba Pref., Japan) and
- in international level through various research collaborations

expanding the knowledge-base vital for the development of integrated river basin management perspectives and guidelines

Thank you..........

The International Centre for Water Hazard and Risk Management ICHARM

Hydrologic Engineering Research Team