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Hydro-meteorological data and modelling for forecasting and leading to better response for flood management in Indus River basin in Pakistan

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([1]: UNESCO Office Jakarta, [2]: UNESCO Office Islamabad, [3]: formerly UNESCO Paris, [4]: UNESCO Paris)

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Project Implementation Partners acknowledgement

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Outline

- About UNESCO, IHP and IHP-RSC SEAP
- Pakistan 2010 Mega Flood
- National Disaster Management Act and Plan
- Strategic Strengthening of Flood Warning and Management Capacity of Pakistan

General Description of IHP (International Hydrological Programme)

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Education Sector

Sciences Sectors

Culture Sector

Social and Human Sciences

Natural Sciences

- International Hydrological Programme (IHP);
- Intergovernmental Oceanographic Commission (IOC);
- Man and the Biosphere Programme (MAB);
- International Geosciences Programme (IGCP);
- International Basic Sciences Programme (IBSP).

International Hydrological Programme

-UNESCO's Intergovernmental Scientific Cooperative Programme in Hydrology and Water Resources

-The only intergovernmental programme of the UN system devoted to water research, water resources management, and education and capacity building

-Established in 1970's, now that prepared the eighth phase of IHP (IHP-VIII) for 2014 - 2021

IHP- VIII 2014-2021

Water Security: Response to Global, Regional and Local Challenges

UNESCO IHP Network

UNESCO-IHP in the Asia Pacific Region

- 17 IHP National Committees
- 6 UNESCO Water Centres
- 6 UNESCO Water Chairs in the Asia Pacific Region.
- Regional Steering Committee for Southeast Asia and the Pacific

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UNESCO's Actions for Disaster Reduction
Long-term Goals

- Observation and early warning networks of natural hazards
- Hazard risk mapping
- Disaster-resistant building codes
- Education for disaster reduction
- Help make schools safer
- Promotion of public awareness through communication
- Protection of cultural monuments and sites

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Pakistan

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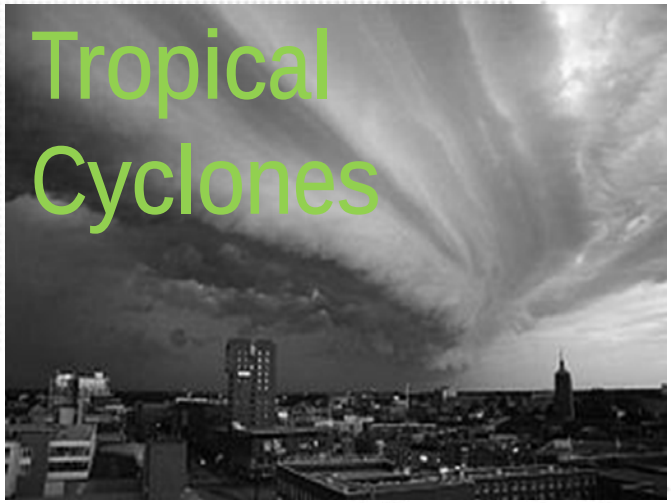
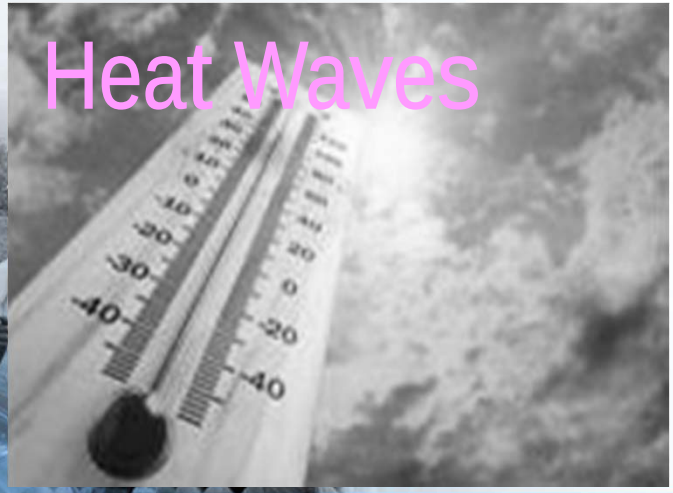
Extreme Weather Events in Pakistan





The 2010 mega flood

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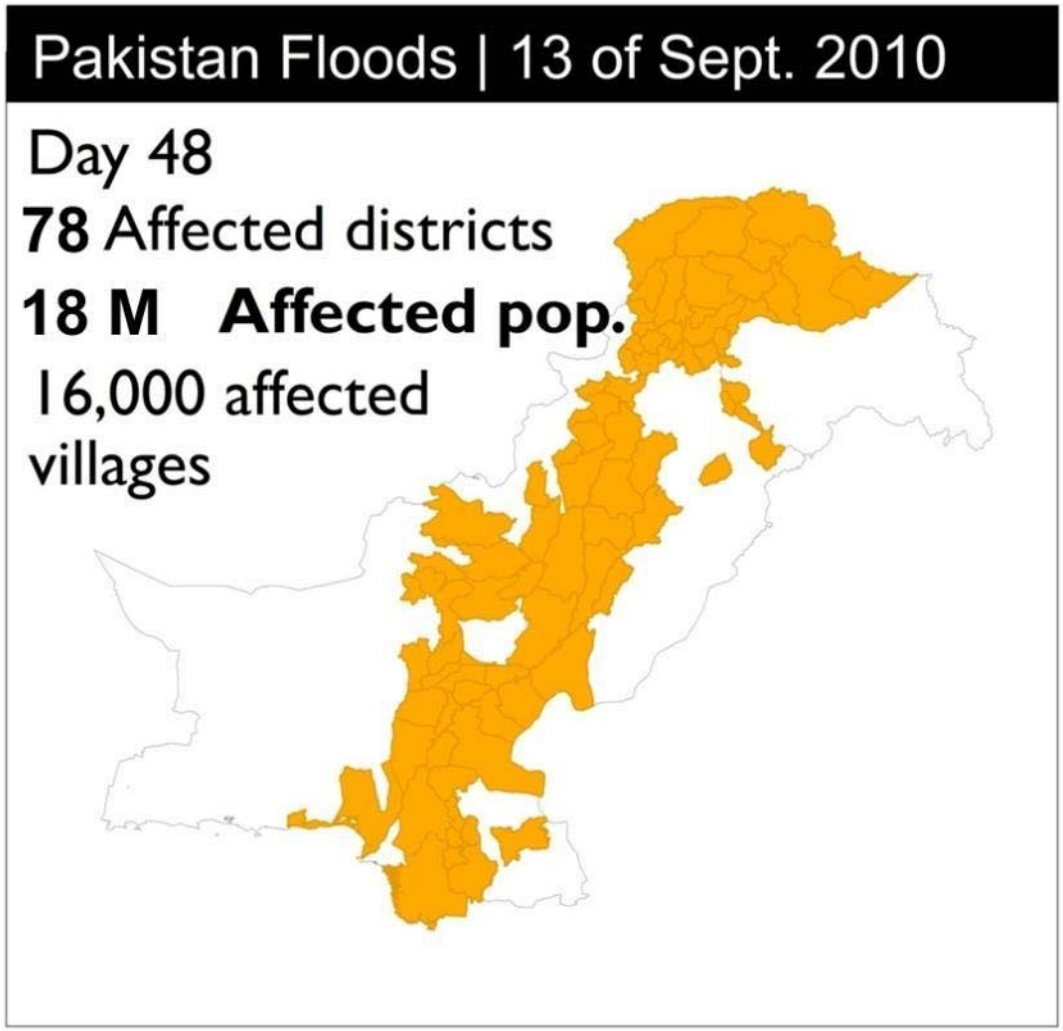
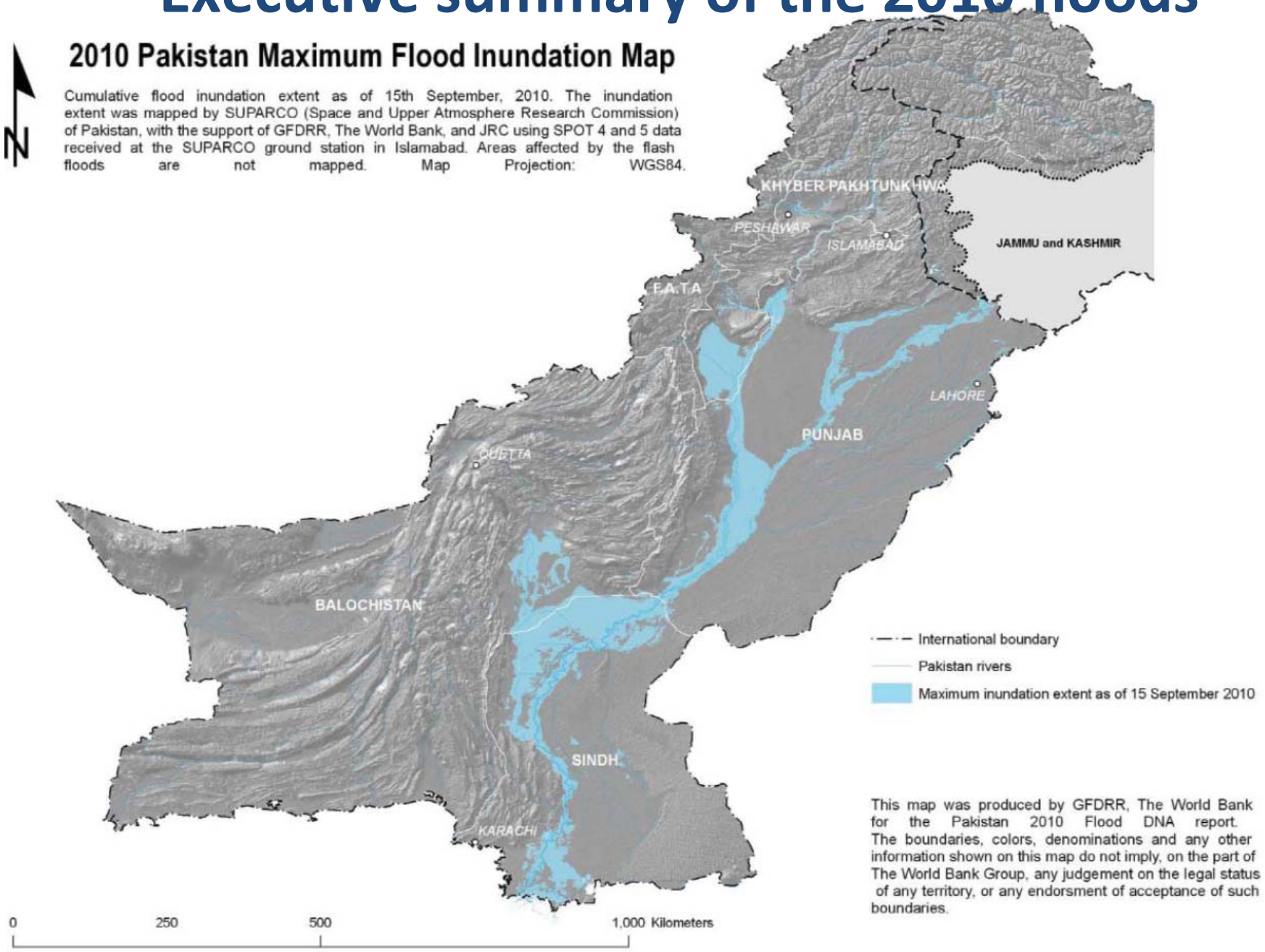
Inundated area OCHA



Executive summary of the 2010 floods



The 2010 mega flood

- PMD : The Start-end date of Flood-2010 is determined using **High flood level at Upstream station (Besham) and the last downstream station (Kotri)**. So the dates are ***28th July -12th Sep 2010***. During these days the River Indus remain in high Flood level. (but some places remained inundated until Dec because of the poor drainage of flood water from the field land to the river Indus or into the Sea)

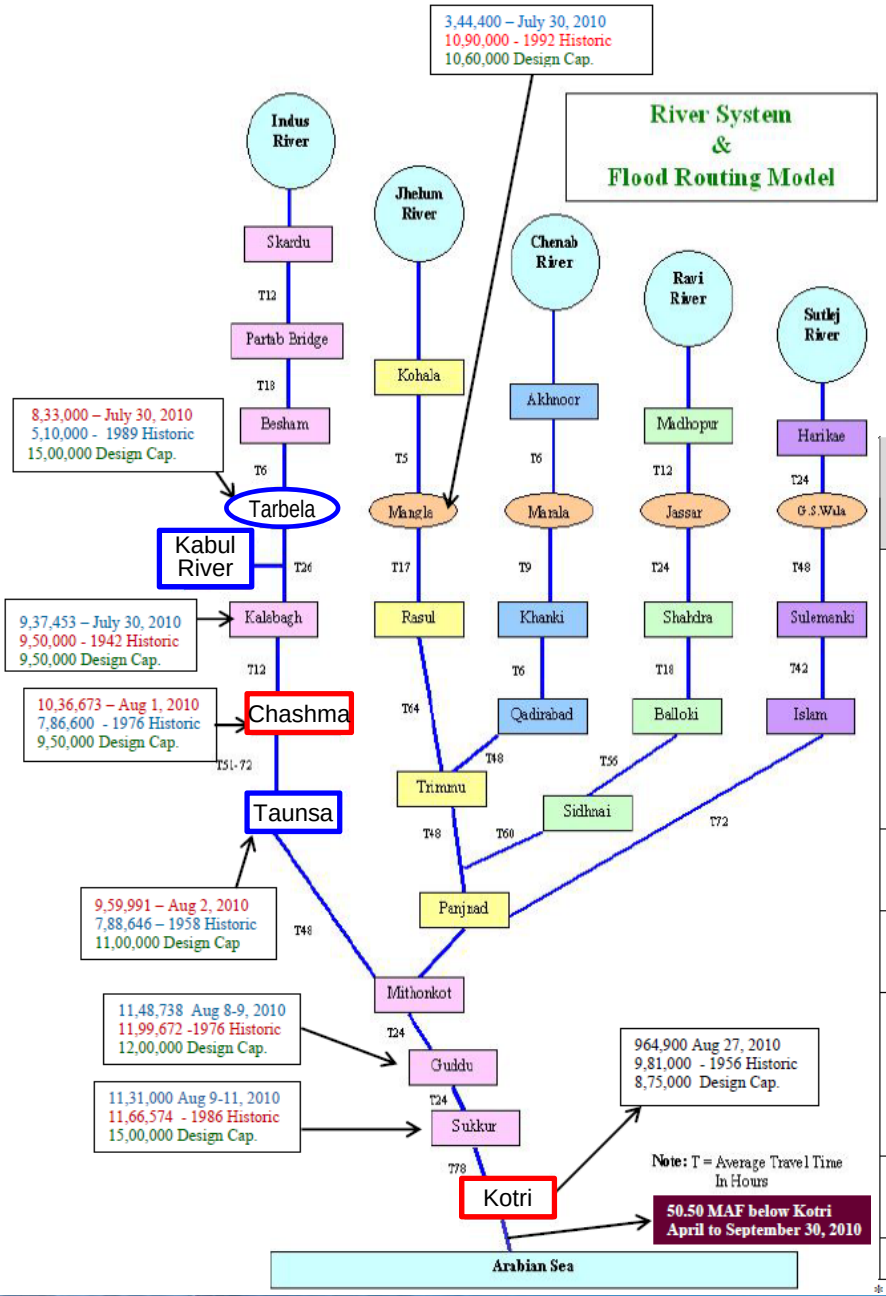
Flood Limits of Rivers & Nullahs

RIVERS ((In Lacs of Cusecs) 1lac =3000m3/s

RIVER	SITE	DESIGN CAPACITY	LOW	MED	HIGH	VERY HIGH	EX. HIGH
INDUS	TARBELA	15.0	2.5	3.75	5.0	6.5	8.0

courtesy of PMD

Executive summary of the 2010 floods



Recorded the historical Maximum

Recorded above the Designed Capacity

Table-5: Historic Maximum vs 2010 Maximum Peak Discharges of Major Rivers of Pakistan

River	Barrages/ Head-works/ Bridges	Designed Capacity	Historic Maximum Peak (cusecs)		Maximum-2010 Peak (cusecs)	
			Flood	Date	Flood	Date
Indus	Tarbela	15,00,000	5,10,000	31-7-89	8,33,000	30-7-10
	Kalabagh	9,50,000	9,50,000	14-7-42	9,37,453	30-7-10
	Chashma	**9,50,000**	7,86,600	3-8-76	**10,36,673**	01-8-10
	Taunsa	11,00,000	7,88,646	22-7-58	9,59,991	02-8-10
	Guddu	12,00,000	11,99,672	15-8-76	11,48,738**	8&9-8-10
	Sukkur	15,00,000*	11,66,574	15-8-76	11,31,000#	9&11-8-10
	Kotri	**8,75,000**	9,81,000	14-8-56	**9,64,900**	27-8-10
Jhelum	Mangla	10,60,000	9,33,000	10-9-92	3,44,400	30-7-10
	Rasul	8,50,000	9,32,000	10-9-92	2,63,800	30-7-10
Kabul	Warsak	5,40,000	1,50,680	8-7-78	1,52,710	30-7-10
	Nowshera	-	-	-	2,49,100^	10-8-10
Chenab	Marala	11,00,000	11,00,000	26-8-57	3,14,378	06-8-10
	Qadirabad	8,07,000	9,48,530	11-9-92	3,29,483	07-8-10
	Trimmu	6,45,000	9,43,225	8-7-59	3,28,926	11-8-10
	Panjnad	7,00,000	8,02,516	17-8-73	3,10,000	13-8-10
Ravi	Balloki	2,25,000	3,89,845	28-9-88	69,900	23-8-10
	Sidhnai	1,50,000	3,30,210	2-10-88	27,600	28-7-10
Sutlej	Sulemanki	3,25,000	5,97,000	8-10-55	58,300	03-9-10

* Existing design capacity as reported by PID, Sindh is 9,00,000 cusecs

Executive summary of the 2010 floods

Flood affected area : 78/121 districts(64%)
Population affected : 20 million (1/9 of population)
Deaths : 2000 approx.
Injured : 3000 approx.
Houses damaged : 1.6 million
Area affected : 100,000 km2
Economic losses : US$10.0 billion
(Direct 6.5billion, Indirect3.6billion)
Reconstruction cost : US$8.74-10.85billion

* Source: Preliminary Damage and Needs Assessment by ADB&WDB

The 2010 mega flood

- Numbers (Source: OCHA (Geneva Member states briefing presentation on 18March 2011) Humanitarian Response in Pakistan.)

Death	**1,984**
Injured	***2,946***
Houses Damaged	1,744,471
Population Affected	***18 million (> 10%of total population)***

- Area affected: over 160,000km^2 (+/-20%of the total area of Pakistan) (Source: OCHA (Geneva Member states briefing presentation on 18March 2011) Humanitarian Response in Pakistan.)
- Economic losses : US$10.0 billion
- (Direct 6.5billion, Indirect3.6billion)
- Reconstruction cost : US$8.74-10.85billion

Institutions and Disaster Risk Management in Pakistan

- Dec 2010: Government of Pakistan promulgated the **National Disaster Management Act** established in three levels: national, provincial and district.
  - Establishment of **National Disaster Management Commission** → laying down policies and guidelines for disaster risk management and for approval of the National Plan.
  - **NDMA**: executive arm of NDMC in charge of implementation, coordination and monitoring for DRM at national level and formulate the **National Disaster Plan** including emergency response activities for all stakeholders including SOPs of emergency response.
- JICA project (April 2010- June 2012 (~333 million Yen)) with plan ready in 2012 and approved in March 2013.

National Disaster Plan approved in March 2013

- "National Disaster Management Plan" as a **national official policy and guideline for comprehensive disaster risk reduction and management in Pakistan**, "Multi-hazard Early Warning System Plan" as a guideline and plan in terms of multi-hazard early warning system in Pakistan, "Human Resources Development Plan" as a guideline and plan human resources capacities enhancement, and "Guideline on Community Based Disaster Risk Management" as a guideline to conduct Community Based Disaster Risk Management. (JICA)

- **Multi-Disasters**:
  - Floods
  - Earthquakes
  - Tsunamis
  - Droughts
  - Sediment disasters
  - Avalanches
  - GLOFs
  - Cyclones with storm surge

National Disaster Management Act, 2010

National Disaster Plan

- Six Key issues:
  1. **Strengthen disaster management** administration at the national, provincial and local levels.
  2. Enhance the disaster management system in the stages of **pre, during and post disaster period**.
  3. Establish **mechanisms for monitoring and assessment of disaster risks**
  4. Promote **mechanism for mainstreaming DRR** measures into development planning processes.
  5. Promote disaster risk management at **local and community** levels.
  6. Strengthen **capacity** of all relevant players in disaster management.

National Disaster Management Plan, 2013

National Disaster Plan

- Ten interventions (2012-2022 >774million USD):
  1. Establish the **institutional and legal system** for disaster management.
  2. Prepare **disaster management plans** at various levels.
  3. **Establish national hazard and vulnerability assessment**.
  4. Establish **multi-hazard EWS**.
  5. Promoting **training, education and awareness** in relation to disaster management.
  6. Strengthen the awareness program on DRR at the **local level**.
  7. **Infrastructure** development for DRR
  8. **Mainstreaming** DRR into development
  9. Establish a **national emergency response system**
  10. **Capacity development** for **post**-disaster recovery.

National Disaster Management Plan, 2013

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Institutions in charge from Pre-disaster, Early warning, Evacuation to Emergency Response in the case of Flood

- Pre-disaster phase
  - **Federal Flood Commission**, local governments and related national government organization (including **SUPARCO**):
    - identify flood prone area and develop **Flood Hazard Maps**.
    - Prepare guidelines and policies measures and basic strategies of **river improvement, flood protection and river management**.
  - FFC and NDMA: Culture of Disaster, awareness and preparedness (drills, safety measures etc)

National Disaster Management Plan, 2013

Institutions in charge from Pre-disaster, Early warning, Evacuation to Emergency Response in the case of Flood

- Forecasting and Early Warning
  - **Flood Forecasting Division of Pakistan Meteorological Department** :
    - Give Alert of Disaster (preparation of Evacuation) by **qualitative and quantitative forecasts**
- Evacuation order
  - **Flood Forecasting Division of Pakistan Meteorological Department** :
    - Evacuation order by Quantitative forecasts, **significant flood forecast and Areal Flood Inundation Flood Forecast**
  - National Emergency Operations Centre
    - Inform public and residential people who are likely to be affected by the disaster

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http://www.pmd.gov.pk/FFD/index_files/floodlimits.htm

FLOOD LIMITS OF RIVERS & NULLAHS

Rivers (In Lacs of Cusecs)

1lac =3000m3/s

RIVERS	SITE	DESIGN CAPACITY	LOW	MEDIUM	HIGH	VERY HIGH	EX.HIGH
INDUS	TARBELA	15.0	2.5	3.75	5.0	6.5	8.0
	ATTOCK	*	2.5	3.75	5.0	6.5	8.0
	KALABAGH	9.5	2.5	3.75	5.0	6.5	8.0
	CHASHMA	9.5	2.5	3.75	5.0	6.5	8.0
	TAUNSA	10.0	2.5	3.75	5.0	6.5	8.0
	GUDDU	12.0	2.0	3.5	5.0	7.0	9.0
	SUKKUR	9.0	2.0	3.5	5.0	7.0	9.0
	KOTRI	8.5	2.0	3.0	4.5	6.5	8.0
JHELUM	KOHALA	*	1.0	1.5	2.0	3.0	4.0
	MANGLA	10.6	0.75	1.1	1.5	2.25	3.0
	RASUL	8.5	0.75	1.1	1.5	2.25	3.0
CHENAB	JAMMU TAWI	*	0.2	0.7	0.83	1.7	*
	AKHNUR	*	0.75	1.97	2.97	3.5	*
	MARALA	11.0	1.0	1.5	2.0	4.0	6.0
	KHANKI	8.0	1.0	1.5	2.0	4.0	6.0
	QADIRABAD	8.07	1.0	1.5	2.0	4.0	6.0
	TRIMMU	6.45	1.5	2.0	3.0	4.5	6.0
	PANJNAD	7.0	1.5	2.0	3.0	4.5	6.0
RAVI	JASSAR	2.75	0.5	0.75	1.0	1.5	2.0
	RAVI SYPHON	4.5	0.4	0.65	0.9	1.35	1.8
	SHAHDARA	2.5	0.4	0.65	0.9	1.35	1.8
	BALLOKI	2.25	0.4	0.65	0.9	1.35	1.8
	SIDHNAI	1.5	0.3	0.46	0.6	0.9	1.3
SUTLEJ	SULEMANKI	3.25	0.5	0.8	1.2	1.75	2.25
	ISLAM	3.0	0.5	0.8	1.2	1.75	2.25
	G.S.WALA	*	19.5 feet	21.5 feet	23.3 feet	25.3 feet	*
KABUL	WARSAK	5.4	0.3	0.5	1.0	2.0	4.0
	NOWSHERA	*	0.45	0.8	1.4	2.0	4.0

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Institutions in charge from Pre-disaster, Early warning, Evacuation to Emergency Response in the case of Flood

- Emergency response
  - National Emergency Operations Centre
    - Determine status of disaster-affected areas
    - In alert to be able to implement emergency response measures promptly and precisely.
  - NDMA, PDMAs, DDMAs
    - Initial damage assessment
    - Relief and rescues activities including rehabilitation and reconstruction.

What was missing in 2010?

- Forecasting system for Upper Indus
  - Most of the 2,000 victims were in KPK where flash floods occurred.
- Inundation model
  - With on demand breaching scenarios simulation possibility?

UNESCO Post 2010 Floods Actions in Pakistan

1) UNESCO DG sent a team of flood management experts to Pakistan on 22nd August 2010.

2)Based on the mission to Pakistan, UNESCO prepared response project with the Pakistani authorities to reinforce the country's capacity in:

- integrated flood and watershed management
- groundwater resources for emergency situations
- landslides and ground instability especially for relocation of affected population.

Japanese ODA and UNESCO project

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Japan International Cooperation Agency

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Press Releases

July 12, 2011

Japan funds UNESCO for strengthening flood warning system in Pakistan

The grant amount of Japanese Yen 284 million will be utilized by UNESCO for following three interrelated pillars of the captioned project.

A) Strategic augmentation of flood forecasting and flood risk and hazard mapping capacity.

B) Knowledge platform for sharing transboundary databases and community flood management information.

C) Capacity development for flood forecasting and hazard mapping.

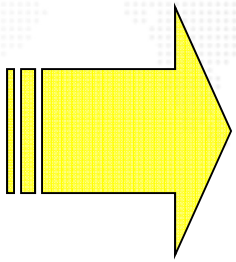
< 3million USD

Mr. Takatoshi Nishikata exchanging Grant Agreement with Dr. Kozue Kay Nagata

Problem revealed by the flood 2010 and counter measures taken in this project

Upper Indus

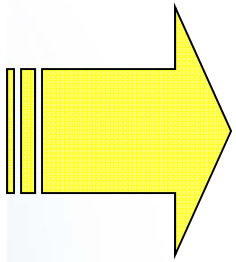
There was limited or no flood forecasting ability for the areas severely damaged by the floods



Flood forecasting including upper-Indus will be introduced by a new system utilizing satellite data（A1)

Lower Indus

The flood devastated the areas which had no inundation experience in the past



Updating flood hazard maps in lower Indus to cover the new inundated areas（A2)

Component of the Pakistan Flood Project

A. Strategic Augmenting of Flood Forecasting and Hazard Mapping Capacity

A-1 Development of Indus IFAS
A-2 Floodplain and Hazard Mapping of Lower Indus

B. Knowledge Platforms for Sharing Transboundary and Community Data

B-1 International Networking for Sharing of Transboundary Data
B-2 Knowledge platform for timely national, provincial and district level data sharing

C. Capacity Development for Flood Forecasting and Hazard Mapping

- *Master degree training course for the Pakistan government staff*
- *Short training courses for the senior water managers*
- *Training workshops on use of flood forecasting models and flood hazard maps*

Implementation Framework

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Pakistan Authorities

PMD
Development of
Flood Forecasting System Component: A1

Data support

PCRWR
Soils and Hydrological data
Component: A1

SUPARCO
Flood Risk Hazard Mapping
Component: A2

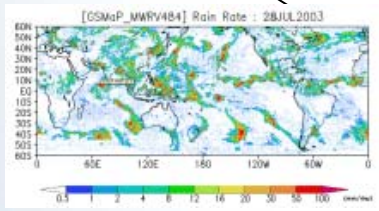
NDMA (Including NIDM)
National Policy and
Flood Management at National, Province, District level
Component: B2, C

FFC
Coordination for flood management at provincial level Component: B2

Indus River Commission
Transboundary Data sharing
Component:B1

- Flood forecasting and early warning system
- Hazard mapping

- GSMAP Local Calibration
*Satellite based rainfall



UNESCO

Project Implementation

International Partners

UNESCO International Network

Experts
UNESCO Network
Component: A1, A2

UNESCO Water Center

ICHARM
International Centre for Water Hazard and Risk Management under the auspices of UNESCO
Component: A1, C

JAXA
Japan Aerospace Exploration Agency
Component: A1, A2

Project Component

A1

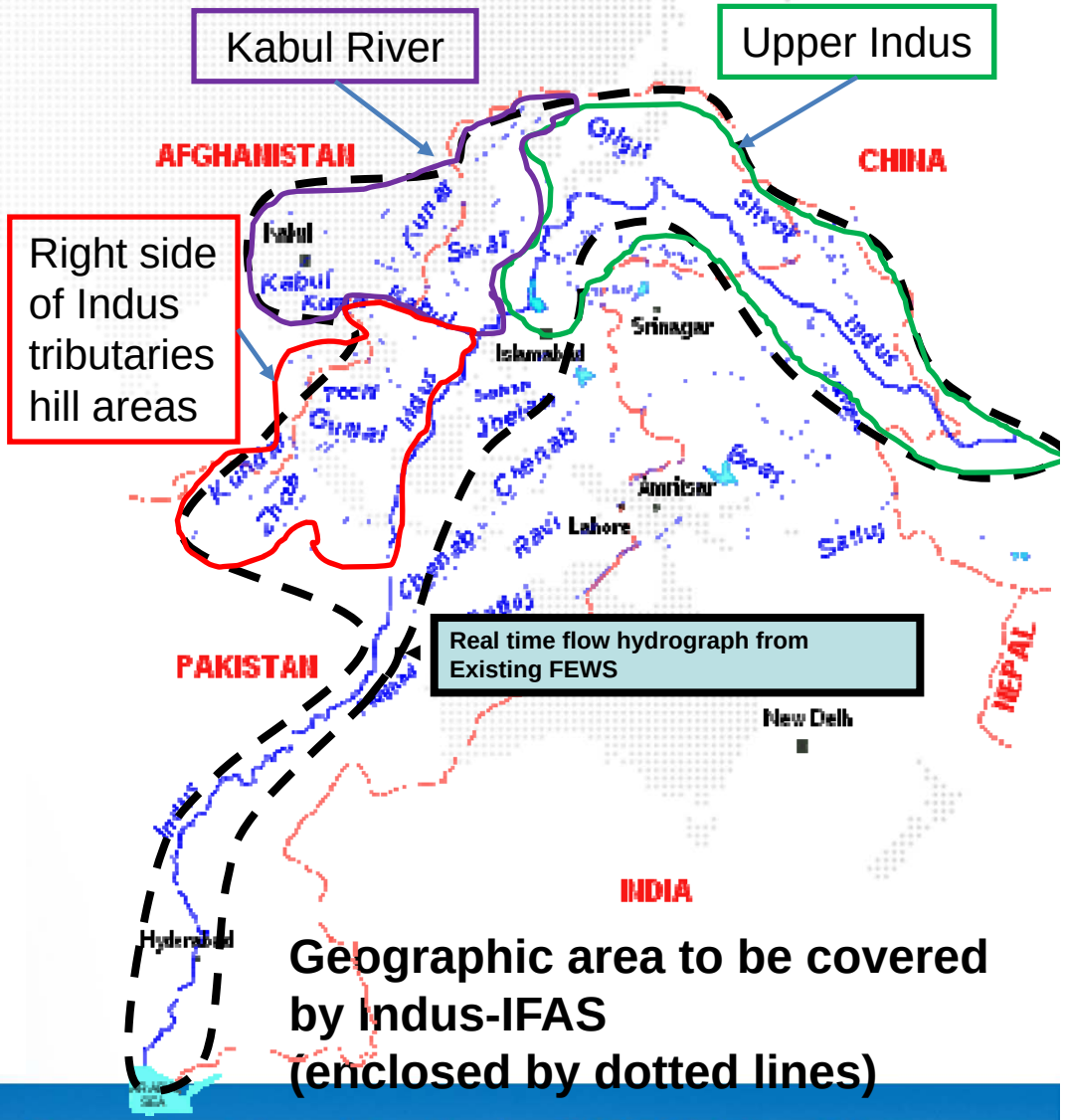
IFAS — *Integrated Flood Analysis System*

IFAS Introduction

- Indus-IFAS has been developed in collaboration with UNESCO & ICHARM
- Test operation in 2012
- Validation and update in 2013*

  *The result was published through FFD/PMD website

- Models have been made operational toward flood season in 2014

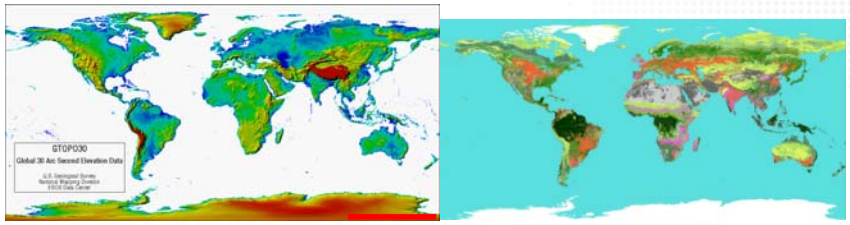


Geographic area to be covered by Indus-IFAS (enclosed by dotted lines)

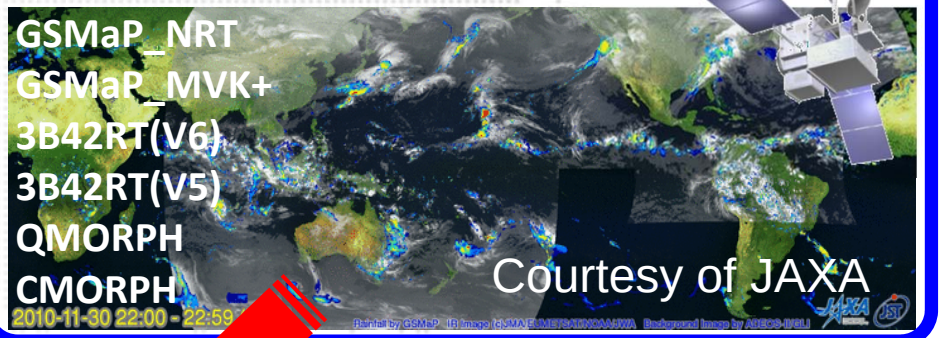
Integrated Flood Analysis System (IFAS

Flood forecasting system using satellite data

Global Geological data for modeling Elevation data, Land use data, etc.



Ground rainfall and Satellite-based rainfall



input

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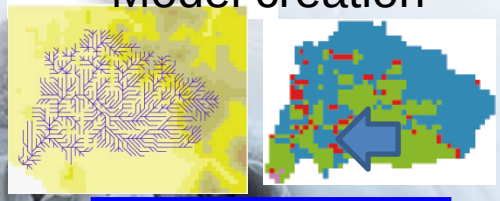
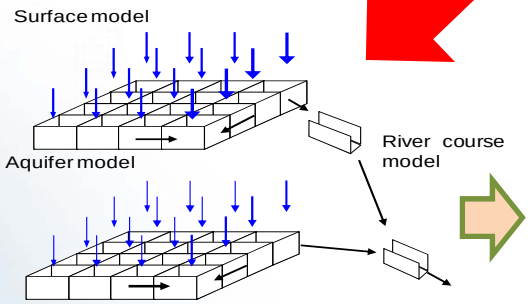
IFAS

Integrated Flood Analysis System

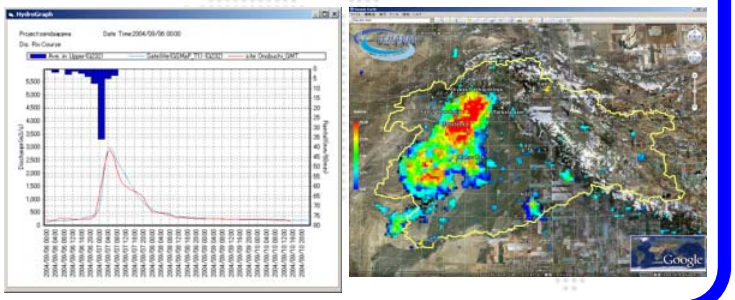
Model creation



Run-off analysis



River discharge, Water level, Rainfall distribution



Calculation

Flow/water level

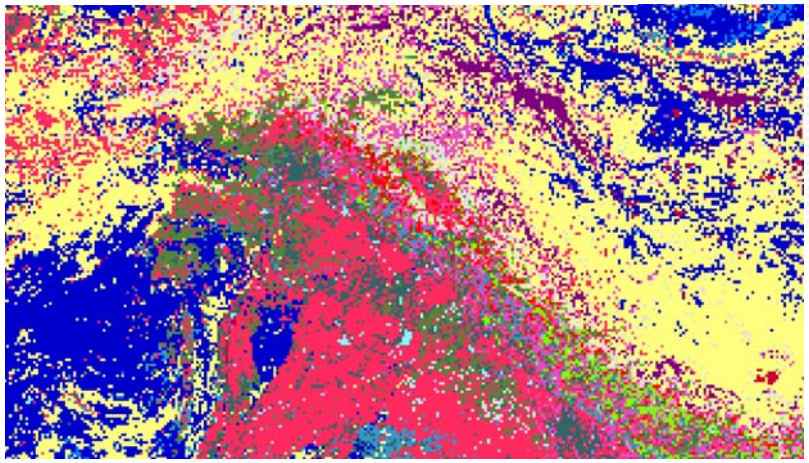
Flood forecasting/warning

Reduce/Prevent flood damage

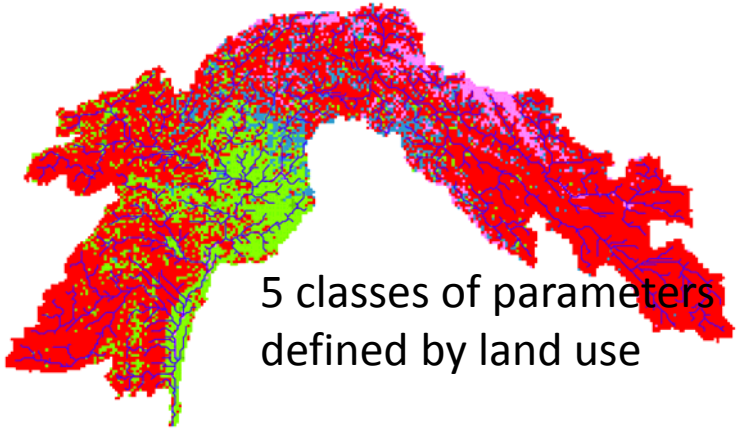
Promoting safe evacuation

Parameterization (automatized in IFAS)

Global map (Land cover)



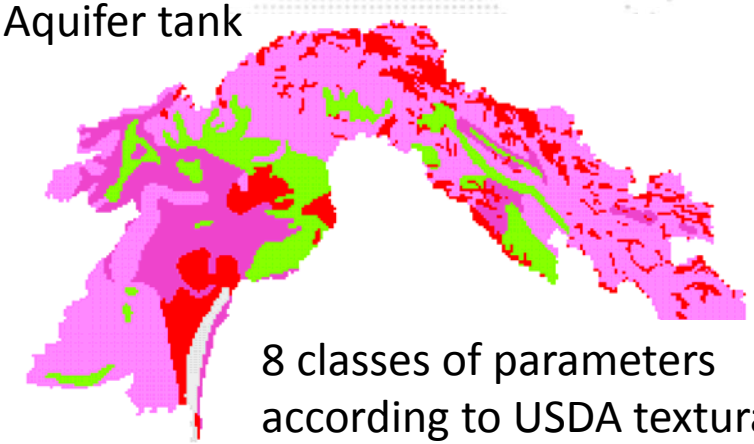
Parameter distribution for Surface tank



5 classes of parameters defined by land use

FAO/UNEP DHSM Soil texture map

Parameter distribution for unsaturated tank and Aquifer tank



8 classes of parameters according to USDA textural classification, **140 field survey points by PCRWR**.

Difference between Rainfall-Runoff model and RRI model

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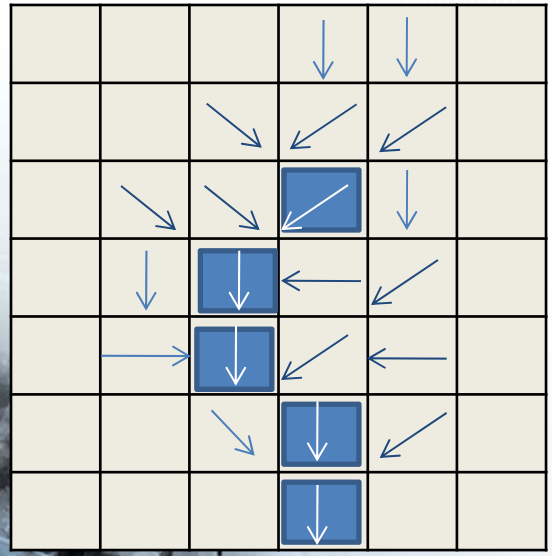
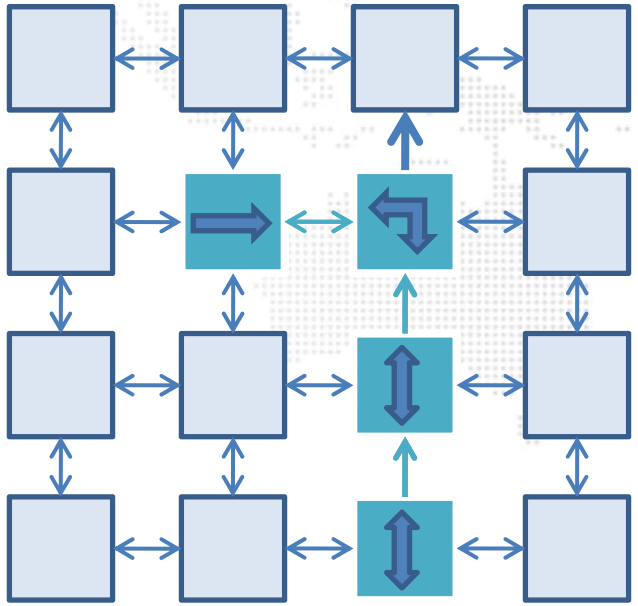
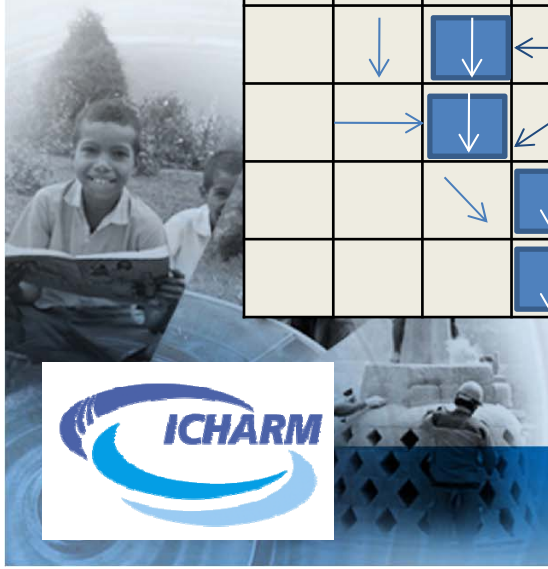
Distributed R-R Model	**RRI Model**
Flow directions are fixed based on topography	Flow directions change based on water levels





Land River



ICHARM

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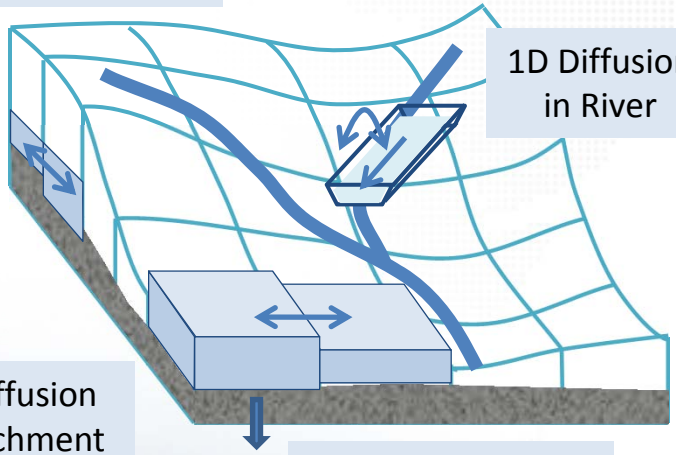
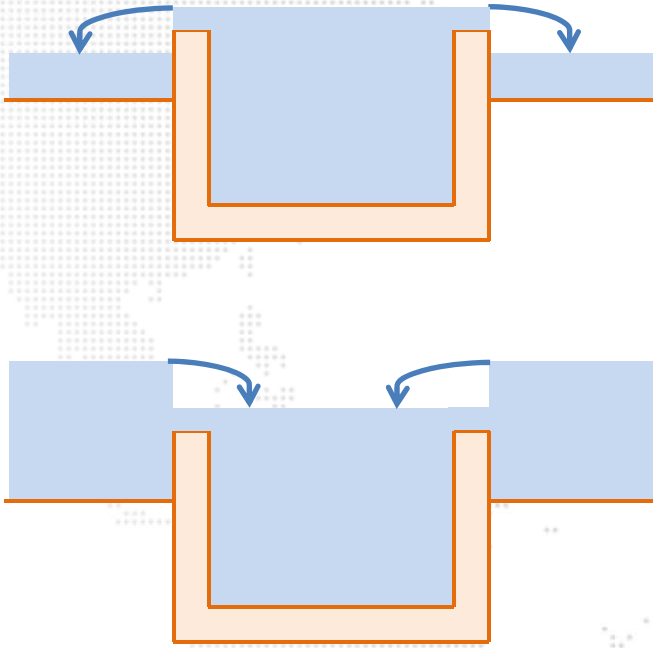
Rainfall-Runoff-Inundation (RRI) Model

Subsurface + Surface



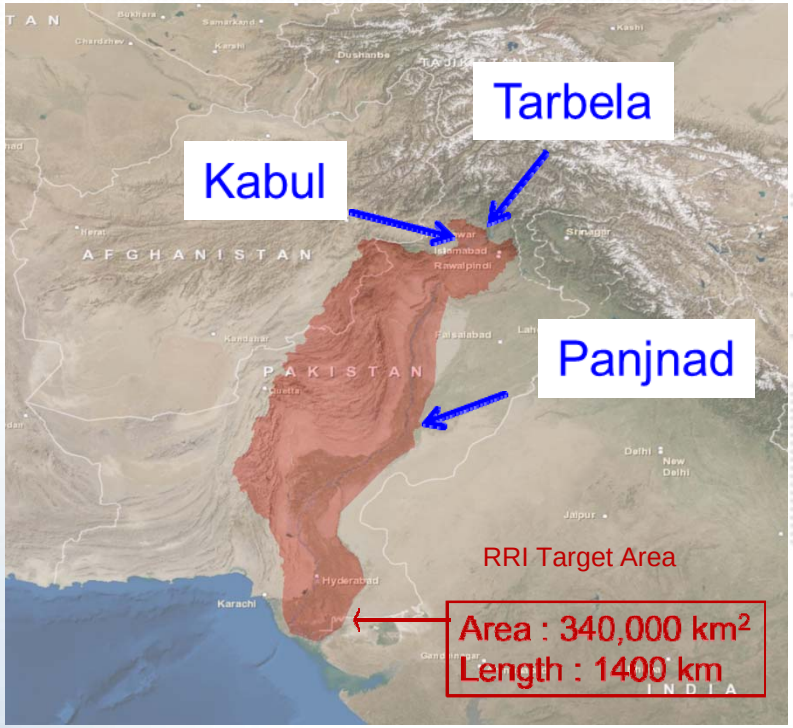


- Diffusion Wave Approximations
  - 1D in River
  - 2D in Catchment
- Subsurface flow
  - Vertical Infiltration with Green-Ampt
  - Saturated Subsurface + Surface Flow

- Rectangular river cross sections
  - Width, Depths, Levee heights can be assigned for each river grid-cells
- Over-topping and step-down formulae are used to compute the interactions between water in river and on slope
- Water depth and discharge boundary conditions can be wet at any grid-cell

Sayama, T. et al.: Rainfall-Runoff-Inundation Analysis of Pakistan Flood 2010 at the Kabul River Basin, *Hydrological Sciences Journal*, 57(2), pp. 298-312, 2012.

Rainfall-Runoff-Inundation (RRI) Model



RRI model application area in the lower Indus River Basin

Rainfall-Runoff-Inundation (RRI) Model

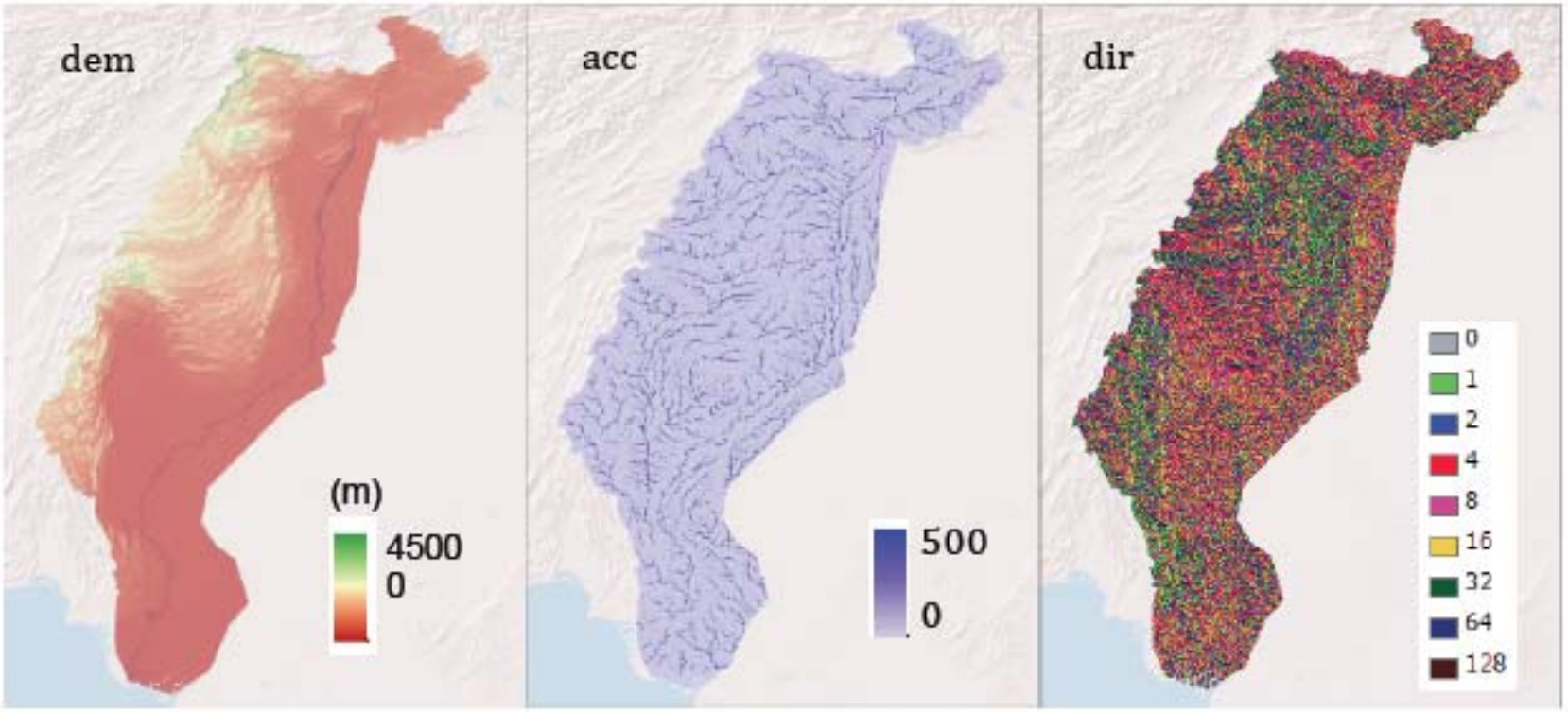


Figure 25 Topographic data used for the simulation

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RRI:Rainfall–Runoff–Inundation (RRI) Model

- The locations of modeled levee

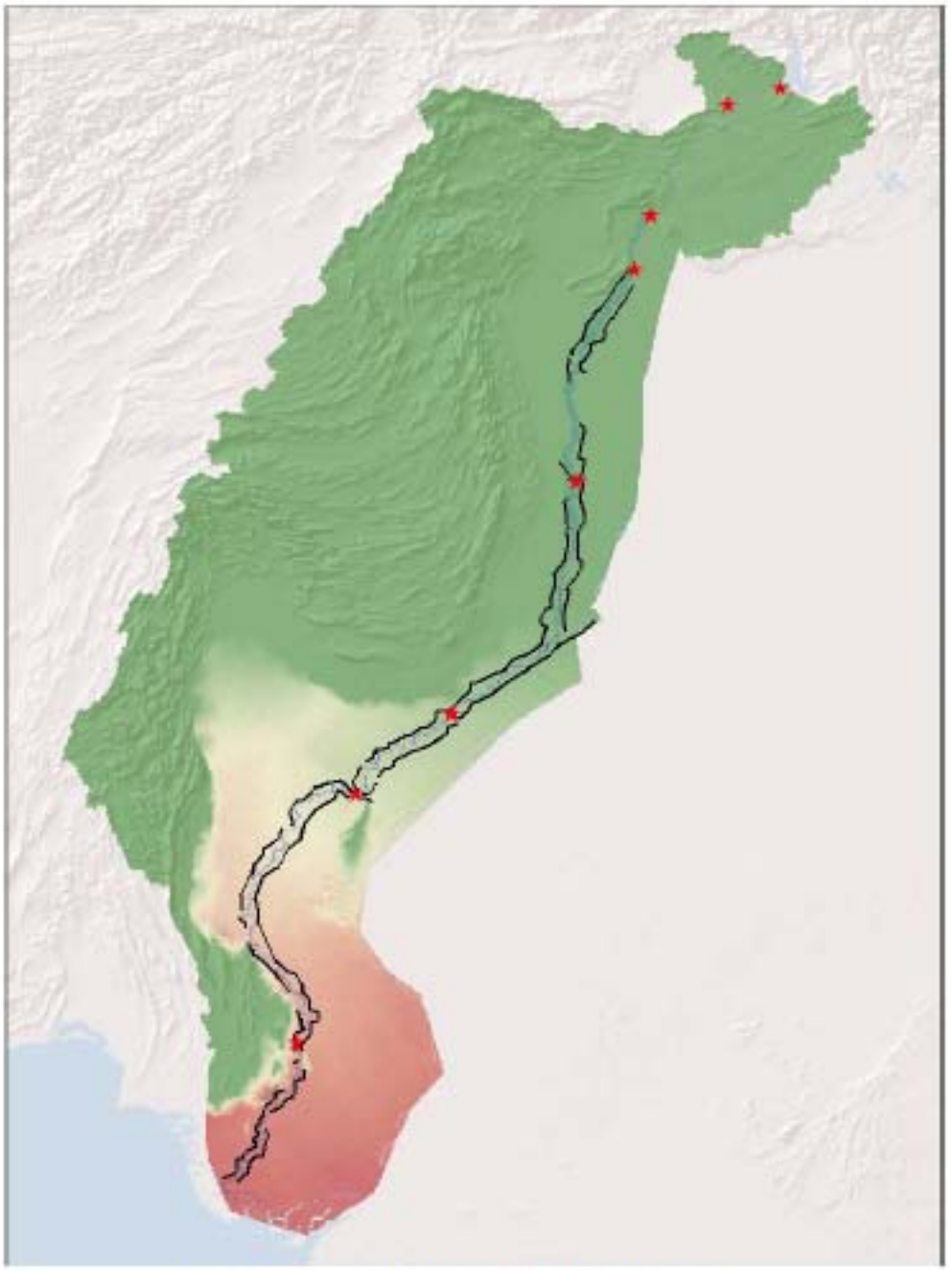
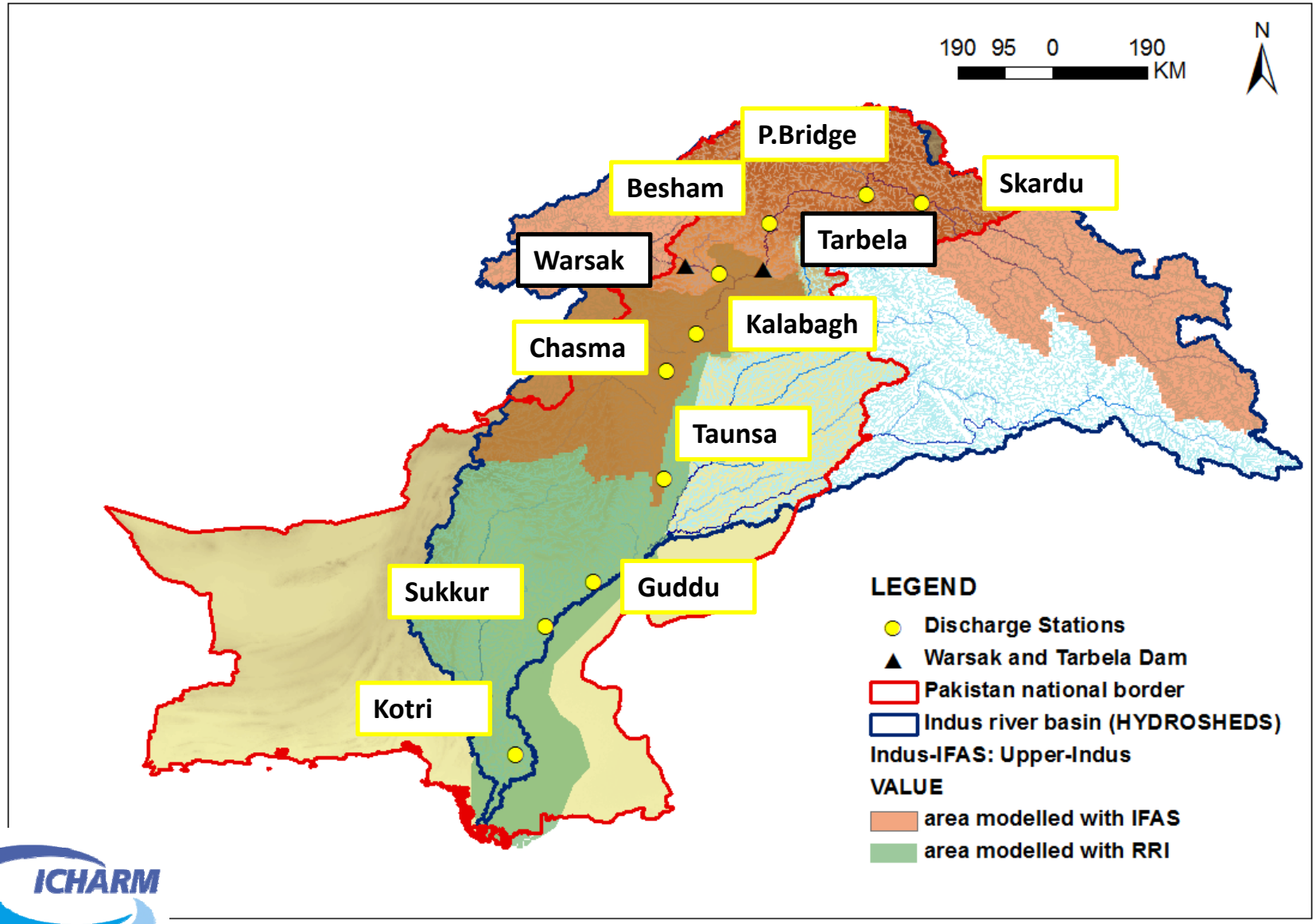
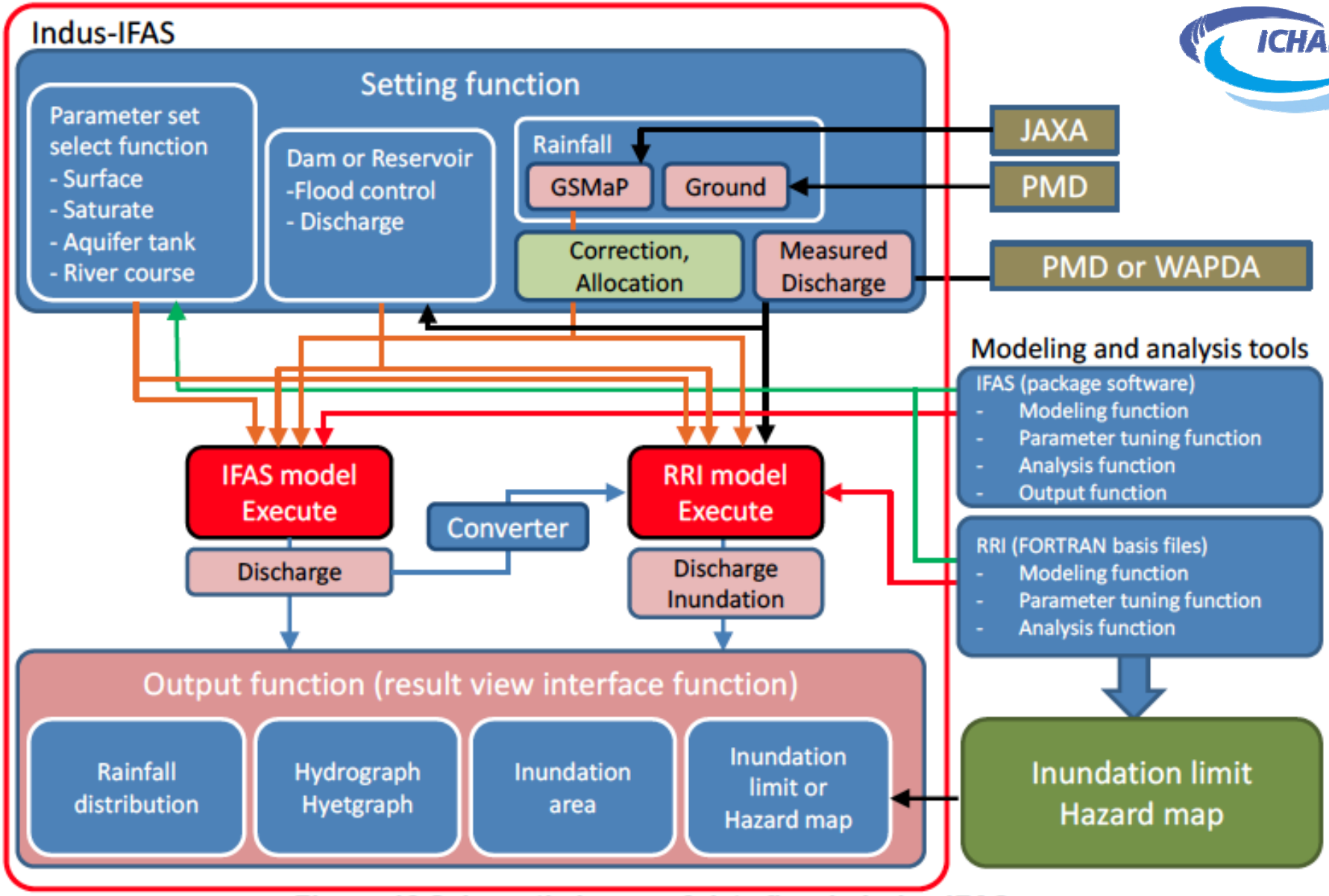


Figure 28 The location of modeled levee.

Complete Target Area



Flowchart for Indus-IFAS



What is Indus-IFAS?

- A multi-engine model covering the main Indus river basin:
  - From upstream to Taunsa covered by IFAS (rainfall runoff analysis)
  - From Tarbela dam to the Arabian sea covered b y RRI (rainfall-runoff-inundation analysis)
- An interface able to
  - Download/use satellite rainfall estimates GSMaP as an input in real-time (GSMaP-NRT has a 4hours delay)
  - Provide rainfall distribution maps, hydrographs and hyetographs, inundation limits and hazard maps

Indus-IFAS: flood forecasting system based on IFAS / RRI (UNESCO-Pakistan project 2012-13)

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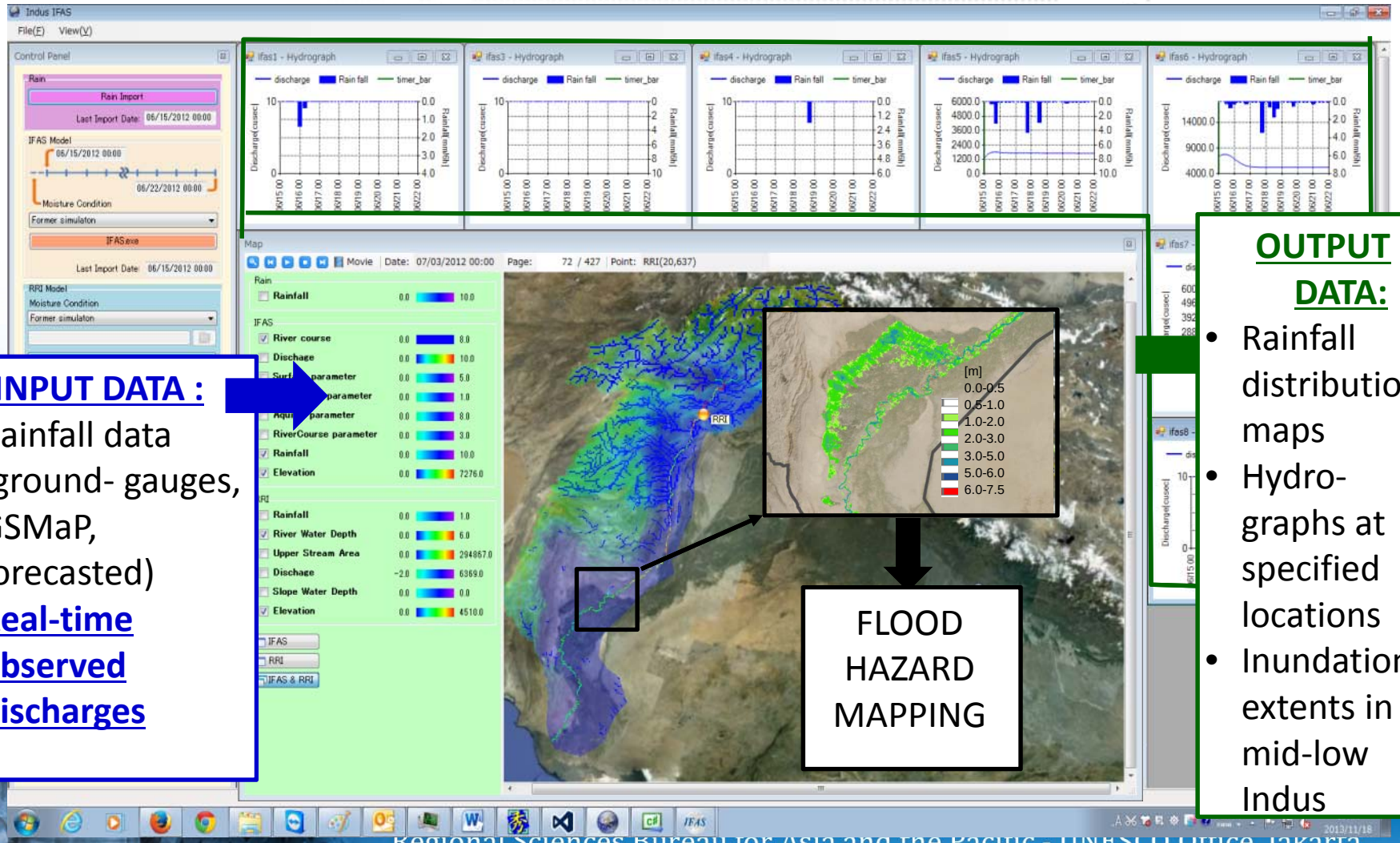


INPUT DATA :

- Rainfall data (ground- gauges, GSMaP, forecasted)
- **Real-time observed discharges**

OUTPUT DATA:

- Rainfall distribution maps
- Hydro-graphs at specified locations
- Inundation extents in mid-low Indus

Framework for Indus-IFAS calibration and validation

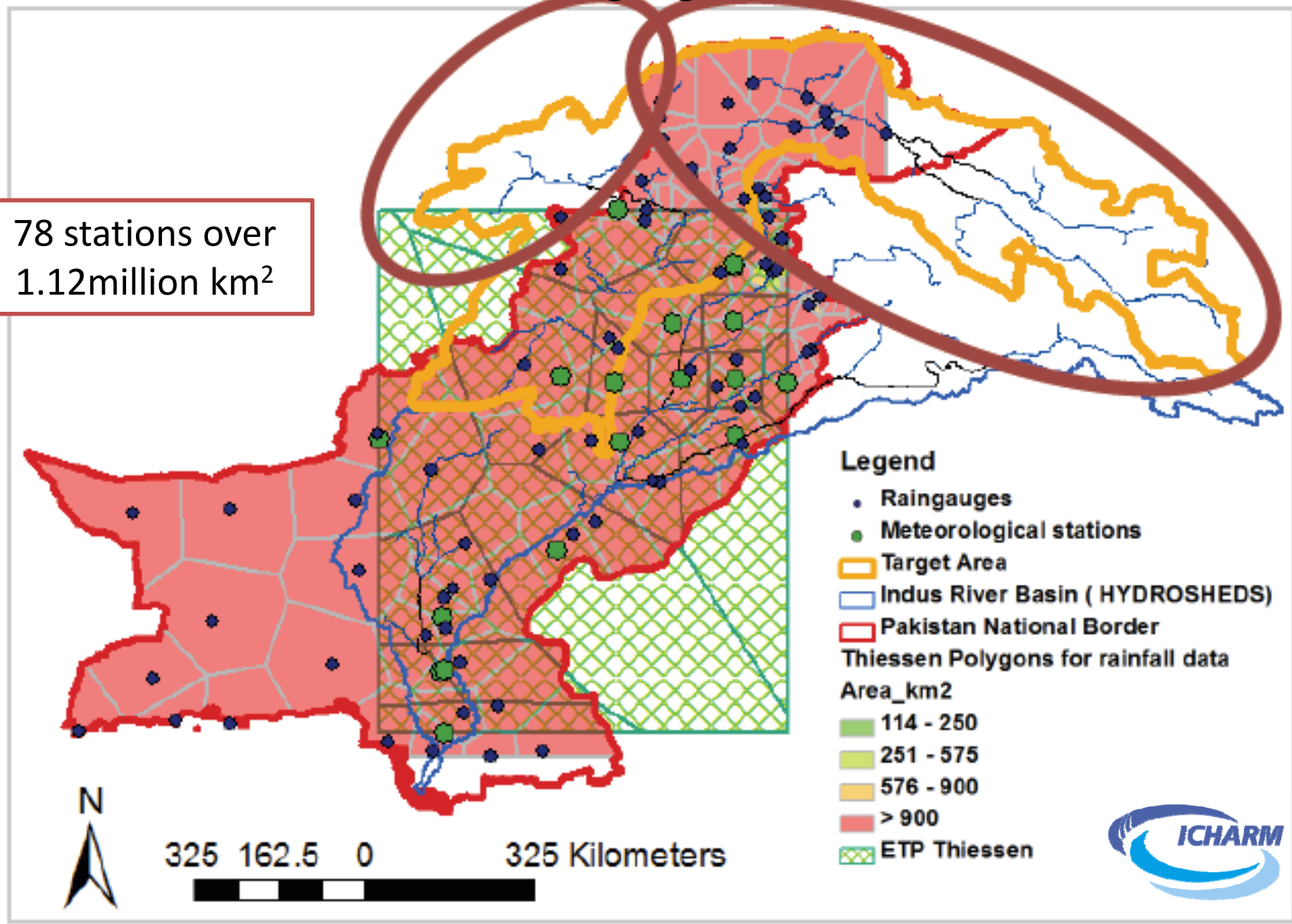
- 6 flood events to be considered:
  - 3 for calibration: 1988, 1997, 2010.
  - 3 for validation: 1992, 1994, 2012.
- Input data for hydrological process:
  - Rainfall data (PMD daily data)
  - Evapotranspiration data (global data→ NCEP monthly daily average at 1.9° resolution)
  - Measured discharges data at Warsak, Tarbela dams and 7 barrages (from Kalabagh to Kotri) and 3 river stations (Skardu, P.bridge and Nowshera).

Challenges for Indus river basin modeling

- **Lack of precipitation data for the North (Himalayas) (snowmelt contribution is not negligible) and very big uncertainty.**
- Insufficient rain gauges network (>900km^2 as WMO minimum requirement for plain areas and >250km^2 for hilly areas).
- *Unclear dam operation rules*
- Field surveys are difficult due to law and order situation.

Thiessen polygons coverage based on raingauges

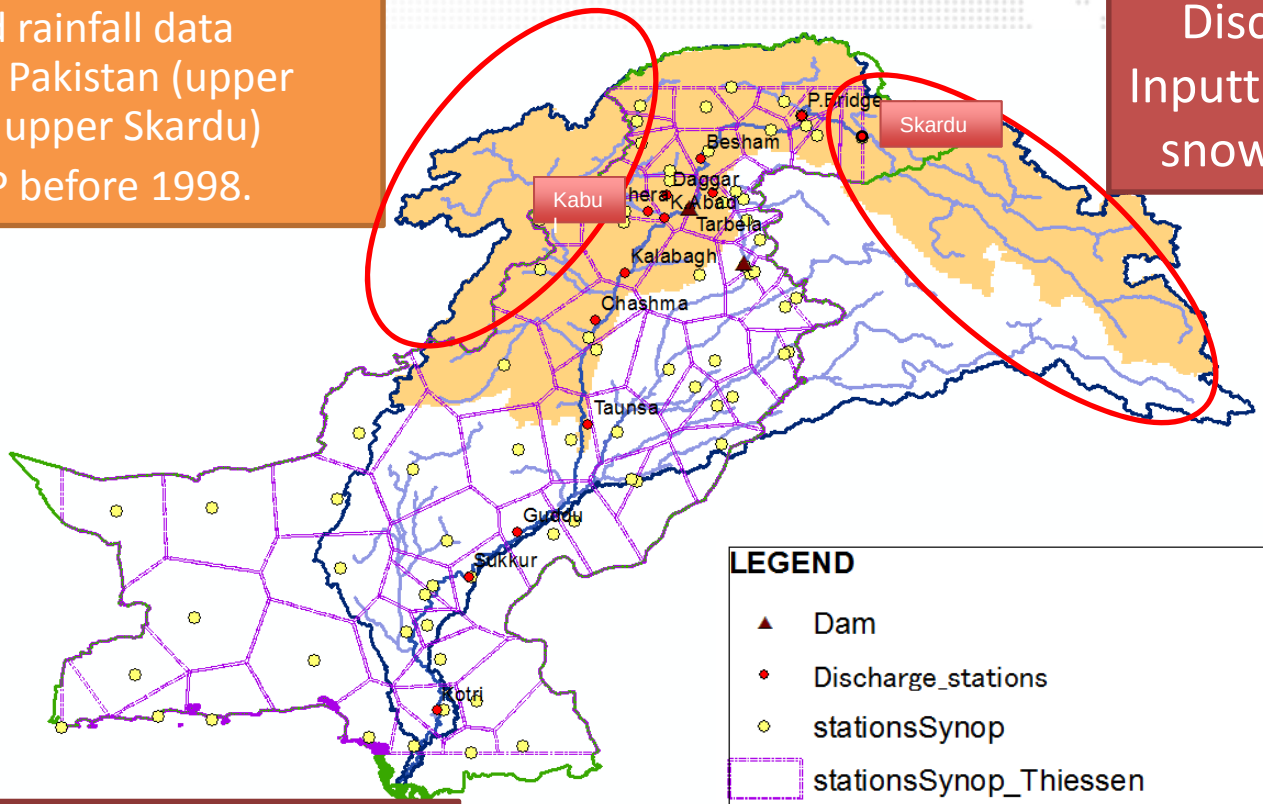
78 stations over 1.12million km^2



Coverage of rainfall and discharges observation data

- No ground rainfall data outside of Pakistan (upper Kabul and upper Skardu)
- No GSMaP before 1998.

Discharge data Inputting instead of snowmelt runoff



Discharge data inputting instead of rainfall/snowmelt data in upstream area of P.Bridge, Kabul river basin → by inputting discharges

WMO recommended minimum densities of stations

- WMO, 2008: Guide to Hydrological Practices. Sixth Edition, WMO- No. 168, Geneva.

Table I.2.6. Recommended minimum densities of stations (area in km^2 per station)

Physiographic unit	*Precipitation*		*Evaporation*	*Streamflow*	*Sediments*	*Water quality*
	Non-recording	*Recording*				
Coastal	900	9000	50000	2750	18300	55000
Mountains	250	2500	50000	1000	6700	20000
Interior plains	575	5750	5000	1875	12500	37500
Hilly/undulating	575	5750	50000	1875	12500	47500
Small islands	25	250	50000	300	2000	6000
Urban areas	–	10–20	–	–	–	–
Polar/arid	10000	100000	100000	20000	200000	200000

GSMaP NRT rainfall

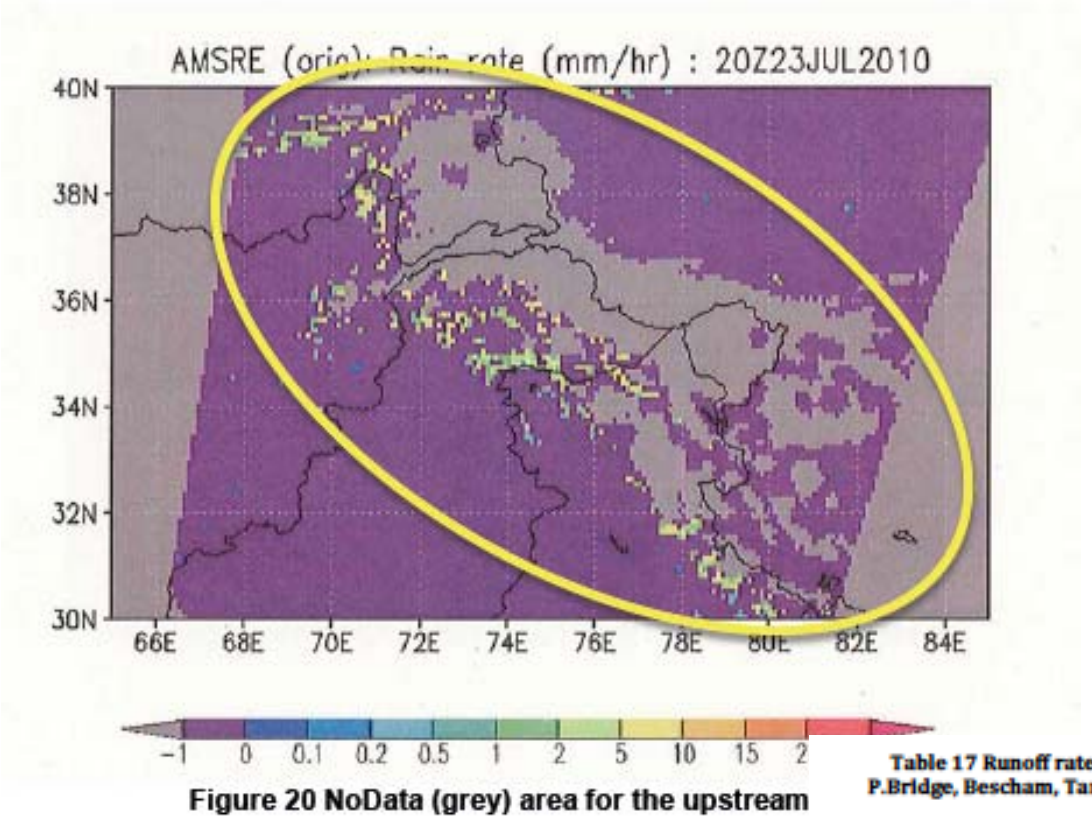


Figure 20 NoData (grey) area for the upstream

(Source: EORC–JAXA).

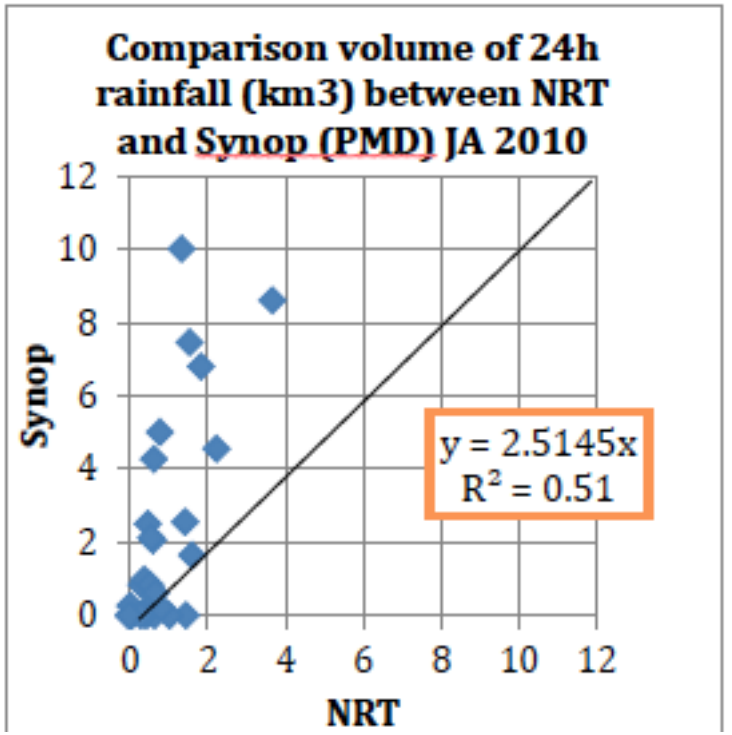


Table 17 Runoff rates for PMD daily Rainfall as percentage of observed discharges at Skardu, P.Bridge, Bescham, Tarbela, Kabul, Kalabagh, Chasma and Taunsa for 1988, 1997 and 2010 (PMD and GSMaP)

%	2010_PMD_daily	2010_GSMaP_NRT
TAUNSA	60	212
CHASMA		
KALABAG		
KABUL		
TARBEL		
BESHAM		
P.BRIDGE	382	1162
SKARDU	227	798

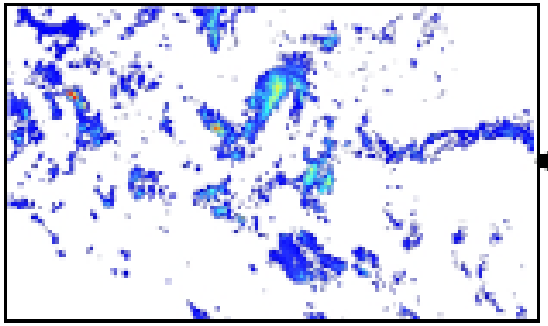
Need for CALIBRATION!

衛星全球降水マップ
GSMAP
GLOBAL SATELLITE MAPPING OF PRECIPITATION

3. What is "GSMaP Calibration System (GSMaP IF) "?

- GSMaP Customization Interface (**GSMaP-IF**) is **a software to customize GSMaP**, extracting subset area of GSMaP data and correcting the rainfall rate.
- **GSMaP-IF** downloads hourly GSMaP data automatically, and corrects the data in your area of interest.

GSMaP Rainfall Data (Original)



Hourly rainfall [mm/hr]
YYYYMMDD HH:00
(Provided after four hours from satellite observation)

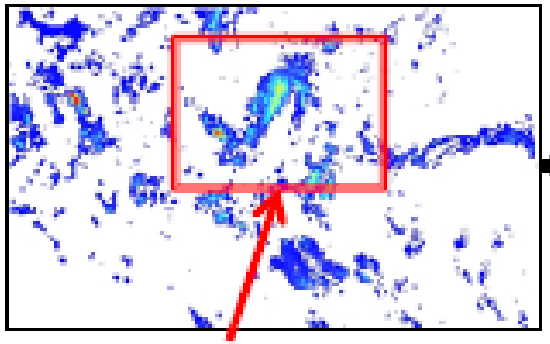
Download

GSMaP-IF

Extracting Subset Area

Correction

Corrected Rainfall Data



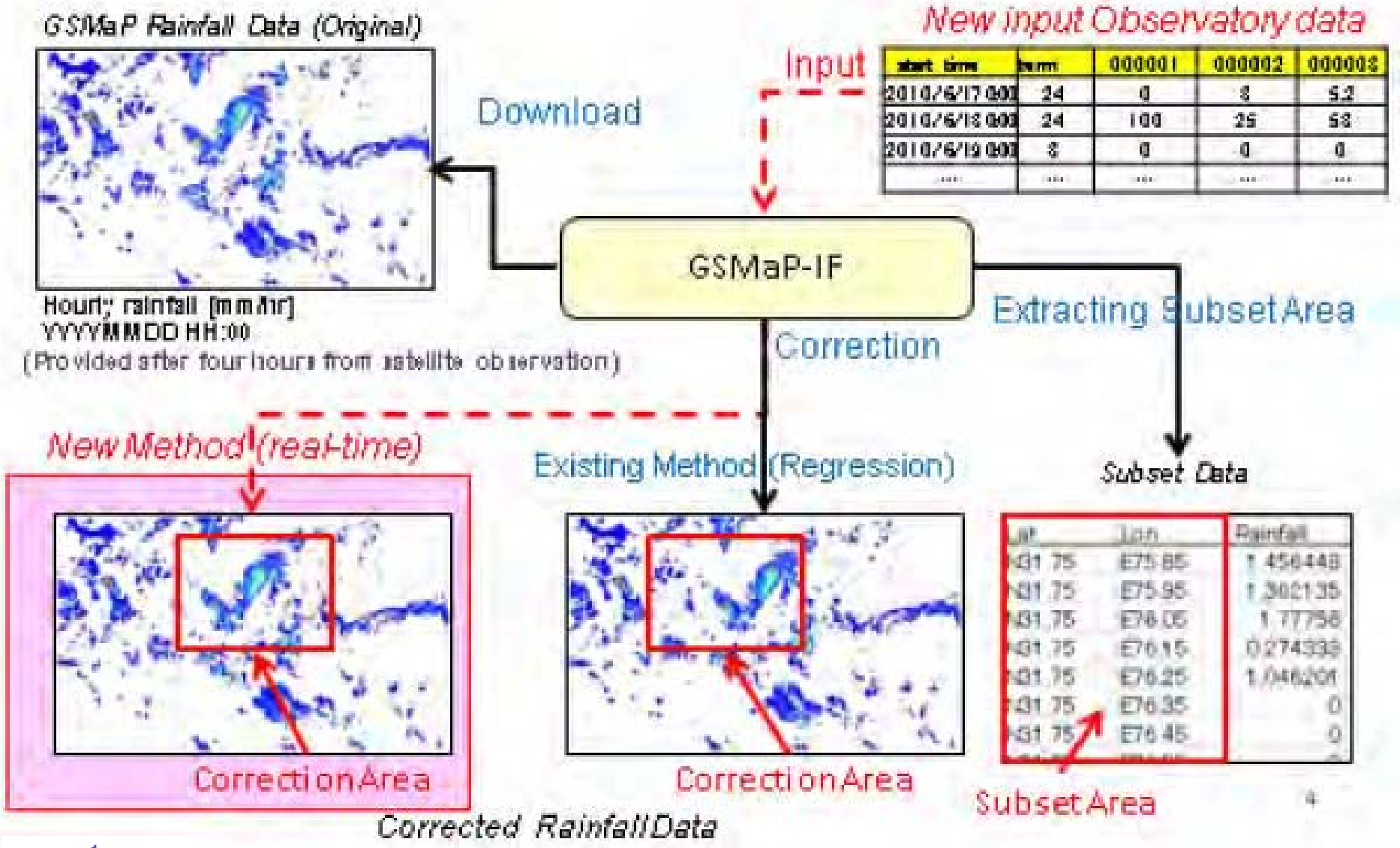
Correction Area

Subset Data

Lat	Lon	Rainfall
N31.75	E75.85	1.456448
N31.75	E75.95	1.362135
N31.75	E76.05	1.77756
N31.75	E76.15	0.274333
N31.75	E76.25	1.046201
N31.75	E76.35	0
N31.75	E76.45	0

Subset Area

衛星全球降水マップ
GSMaP
GLOBAL SATELLITE MAPPING OF PRECIPITATION



Addition of real-time calibration function to GSMaP-IF

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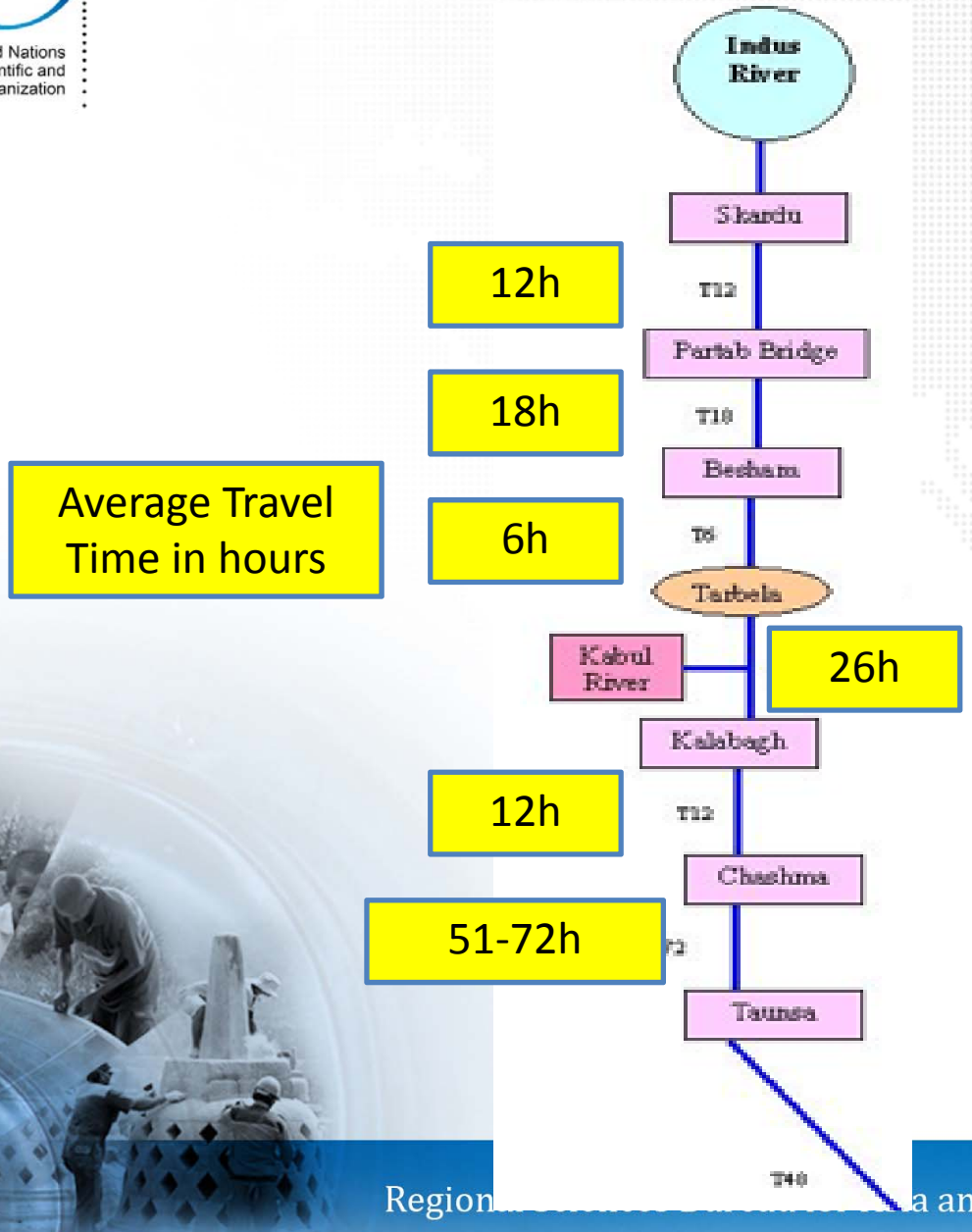
PMD River system and flood routing model



Calibration strategy

- Upper Indus is divided into 6sub-basins according to discharge gauging station
- Discharge input to the model for calibrating parameters

Calibration in Kabul sub-basin is possible only for 2010 when corrected GSMaP will be available

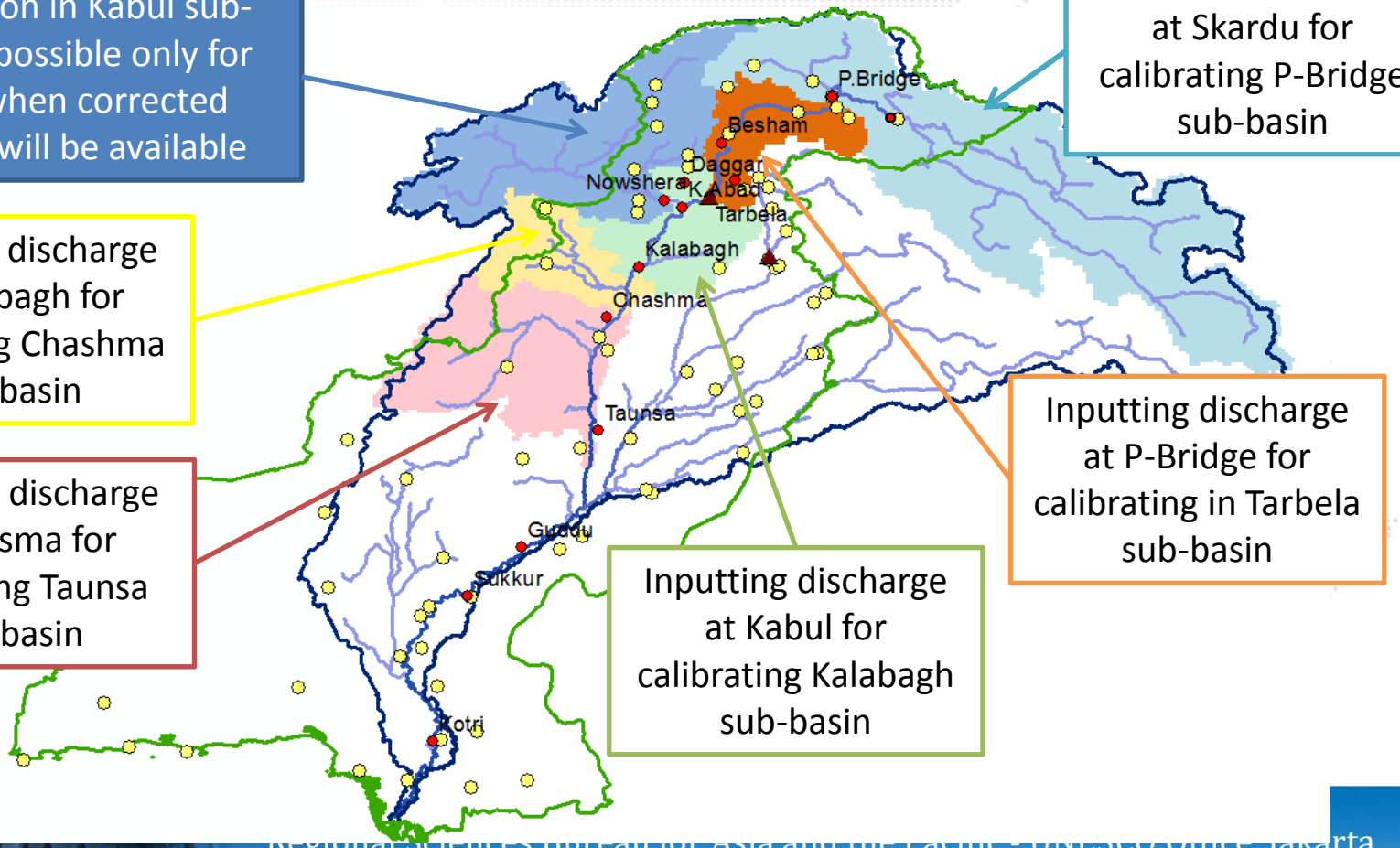
Inputting discharge at Skardu for calibrating P-Bridge sub-basin

Inputting discharge at Kalabagh for calibrating Chashma sub-basin

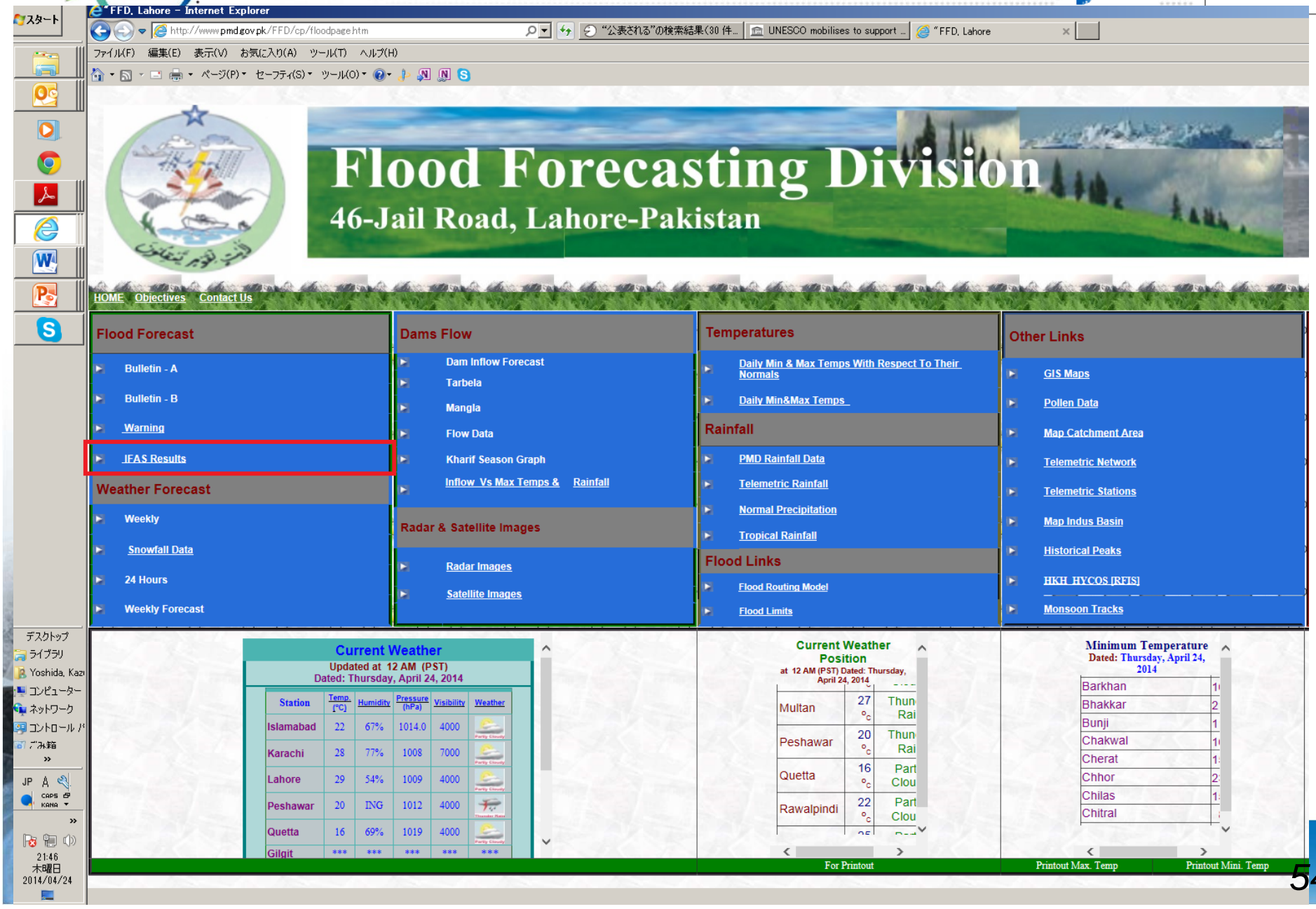
Inputting discharge at Chasma for calibrating Taunsa sub-basin

Inputting discharge at Kabul for calibrating Kalabagh sub-basin

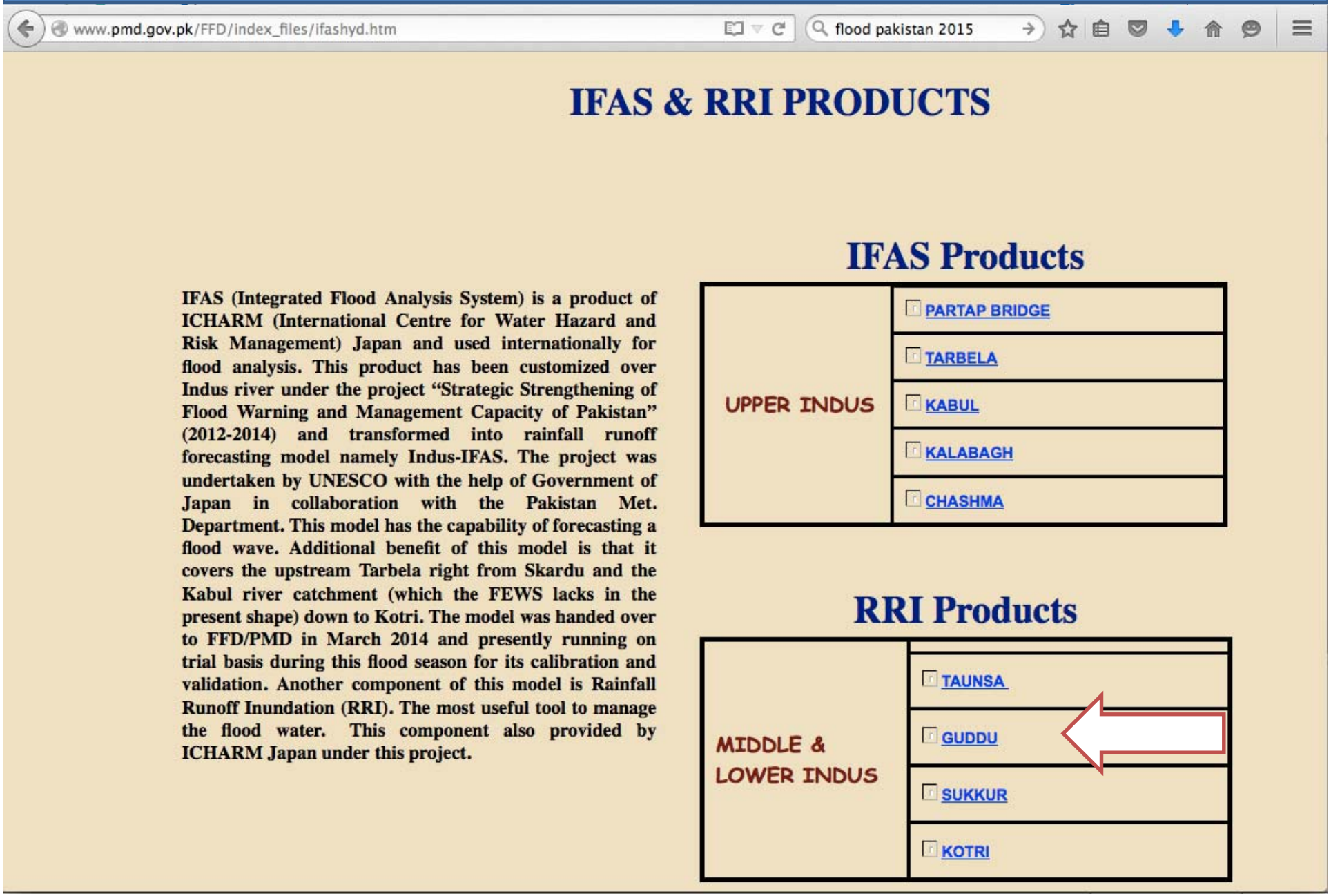
Inputting discharge at P-Bridge for calibrating in Tarbela sub-basin



Project Component



On FFD WEBSITE:
http://www.pmd.gov.pk/FFD/index_files/ifashyd.htm

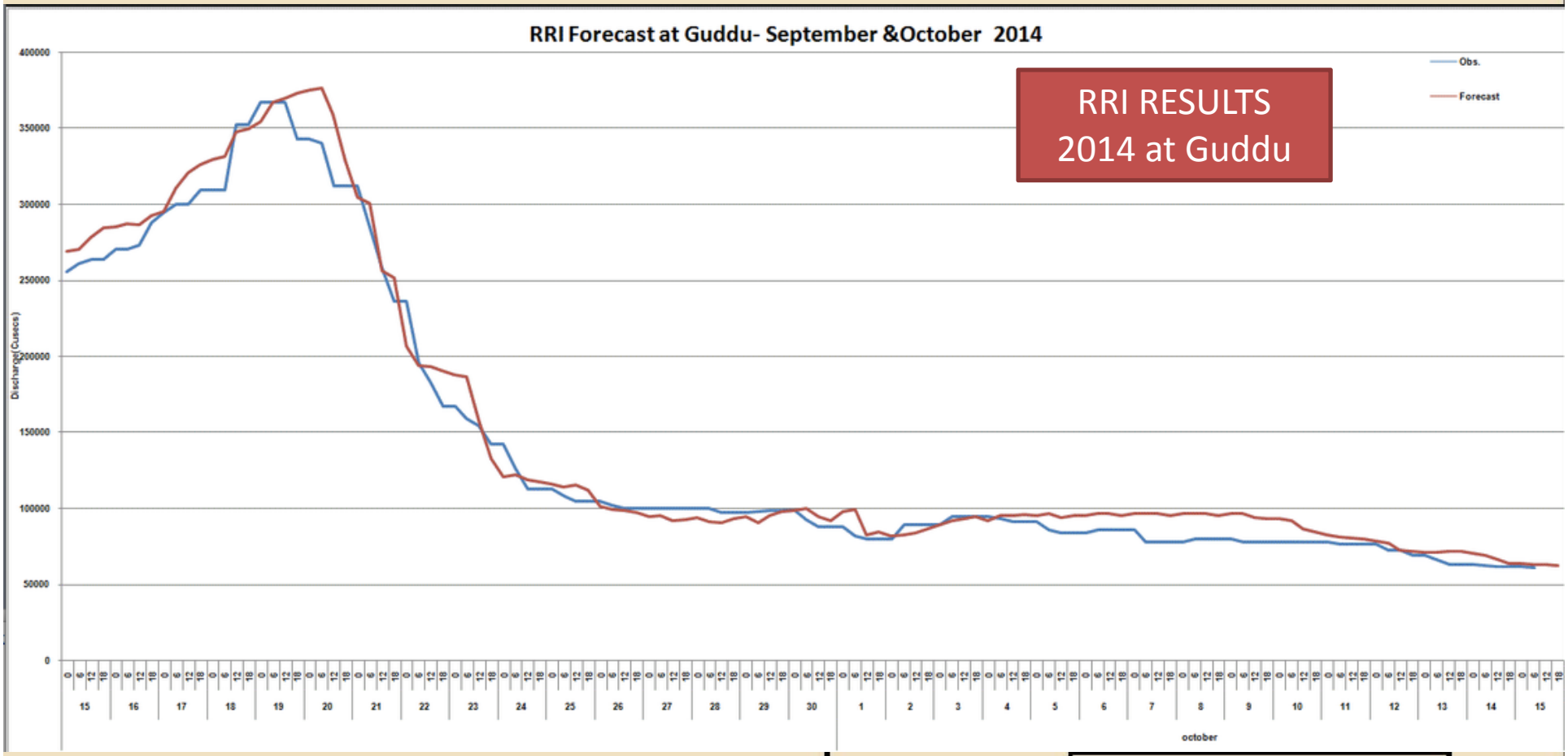


On FFD WEBSITE:
http://www.pmd.gov.pk/FFD/index_files/ifashyd.htm

www.pmd.gov.pk/FFD/index_files/ifashyd.htm

flood pakistan 2015

IFAS & RRI PRODUCTS



RRI RESULTS
2014 at Guddu

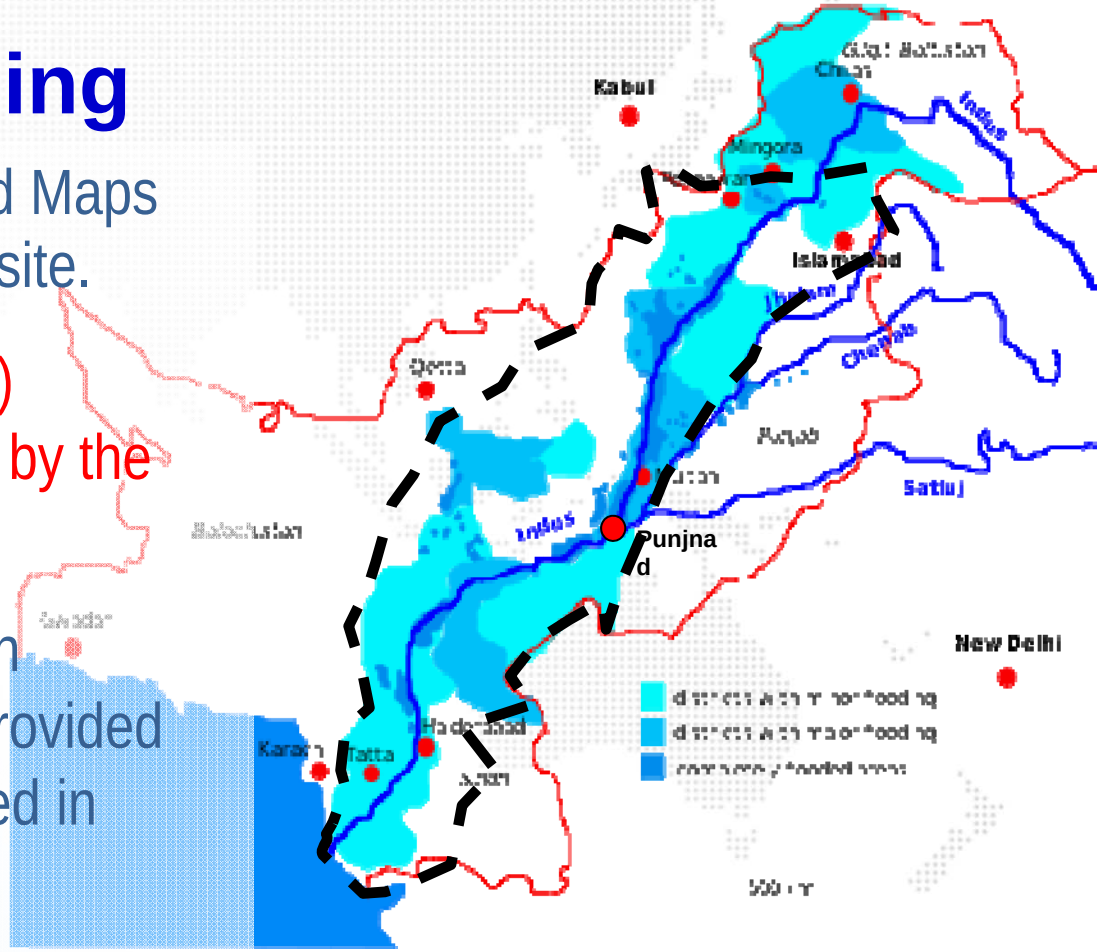
KOTRI

Project Component

A2

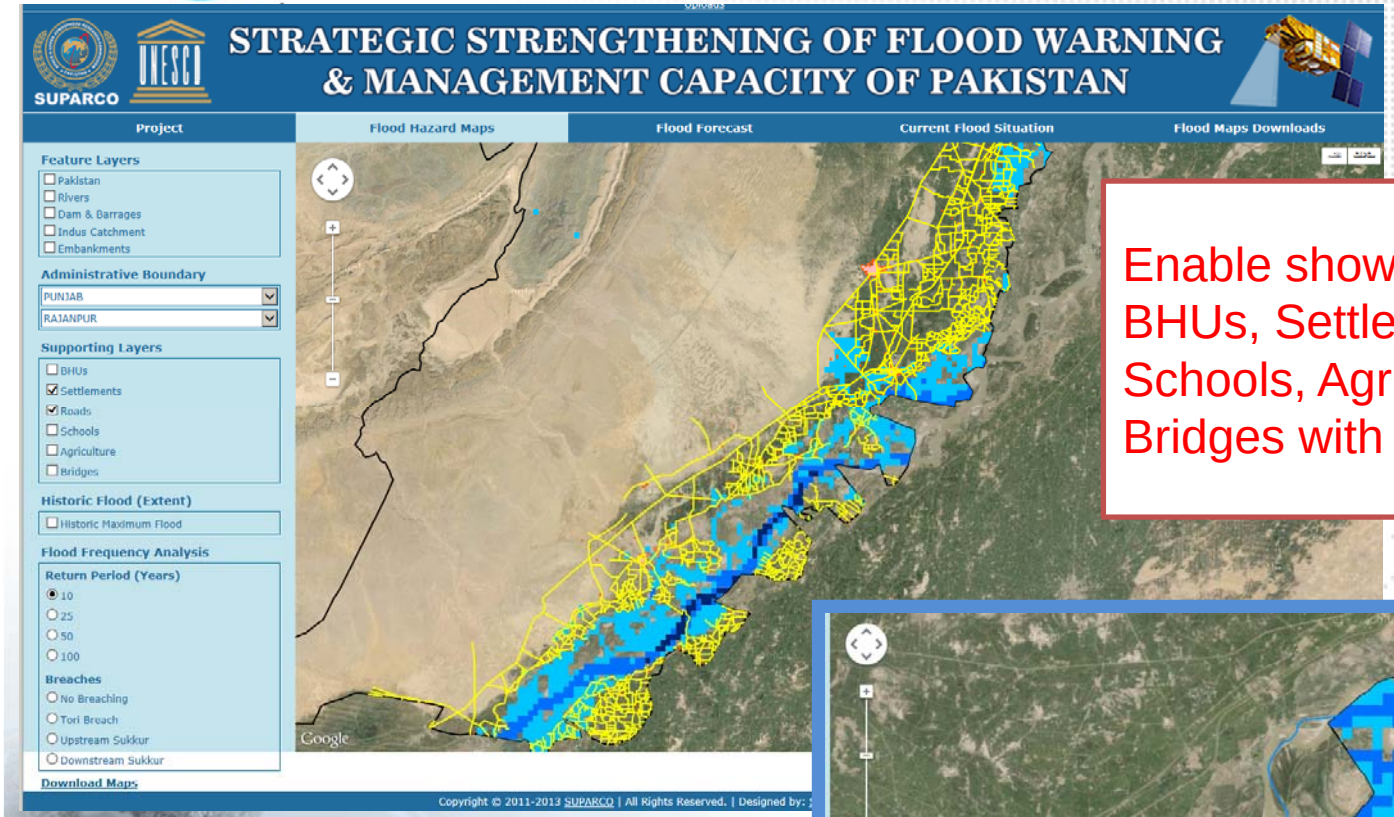
Flood Hazard Mapping

- Updated and simulated Hazard Maps are available through the web site.
- Cover lower Indus (32 districts) including newly affected areas by the flood 2010
- Real time inundation simulation model(RRI model) has been provided and its accuracy will be checked in coming flood seasons.

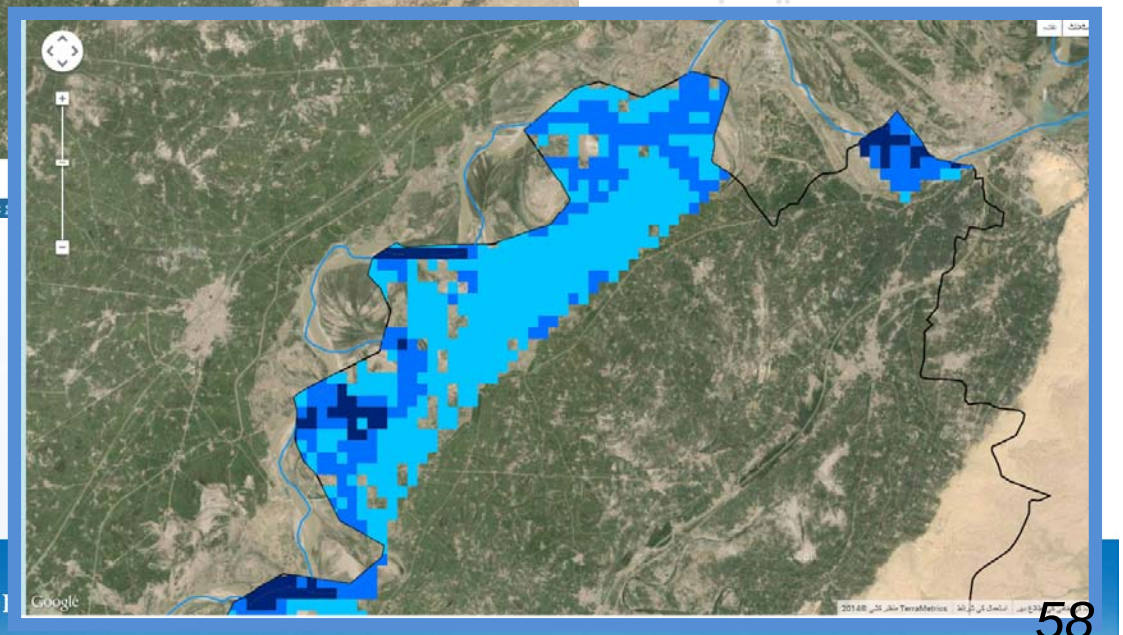


Flood Hazard Mapping Area (enclosed by dotted lines)

Project Component



Enable show
BHUs, Settlements, Roads, Schools, Agriculture and Bridges with rayers



SUPARCO

ICHARM

Regional Scie

Project Component

B

Software Platform for Transboundary and domestic data sharing

- The Hydro-meteorological data sharing information system, called PIFMIS, has been provided to FFD/PMD.
- This system is expected to provide a common platform for all flood-related stakeholders in flood management (PMD, SUAPRCO, IRSA, FFC, WAPDA, IWC, provincial irrigation departments, etc.)
- PFIMIS enables hydro-meteorological data entry, analysis, and display of flood related information in a user-friendly way and enhances inter-organizational coordination, while sharing precipitation, stage, and discharge data in near real-time.

- International dialogue for transboundary data sharing/flood management has been started with neighboring countries through the the international forum/conference with using UNESCO water network.

Project Component

B

Software Platform for Transboundary and domestic data sharing

- A media centre equipped with advanced devices was newly established in PMD-FFD in Lahore within the framework of the project and it enables to directly provide the real time flood forecasting and warning to the public.

Project Component
C Human Capacity Development

Master Degree Course training

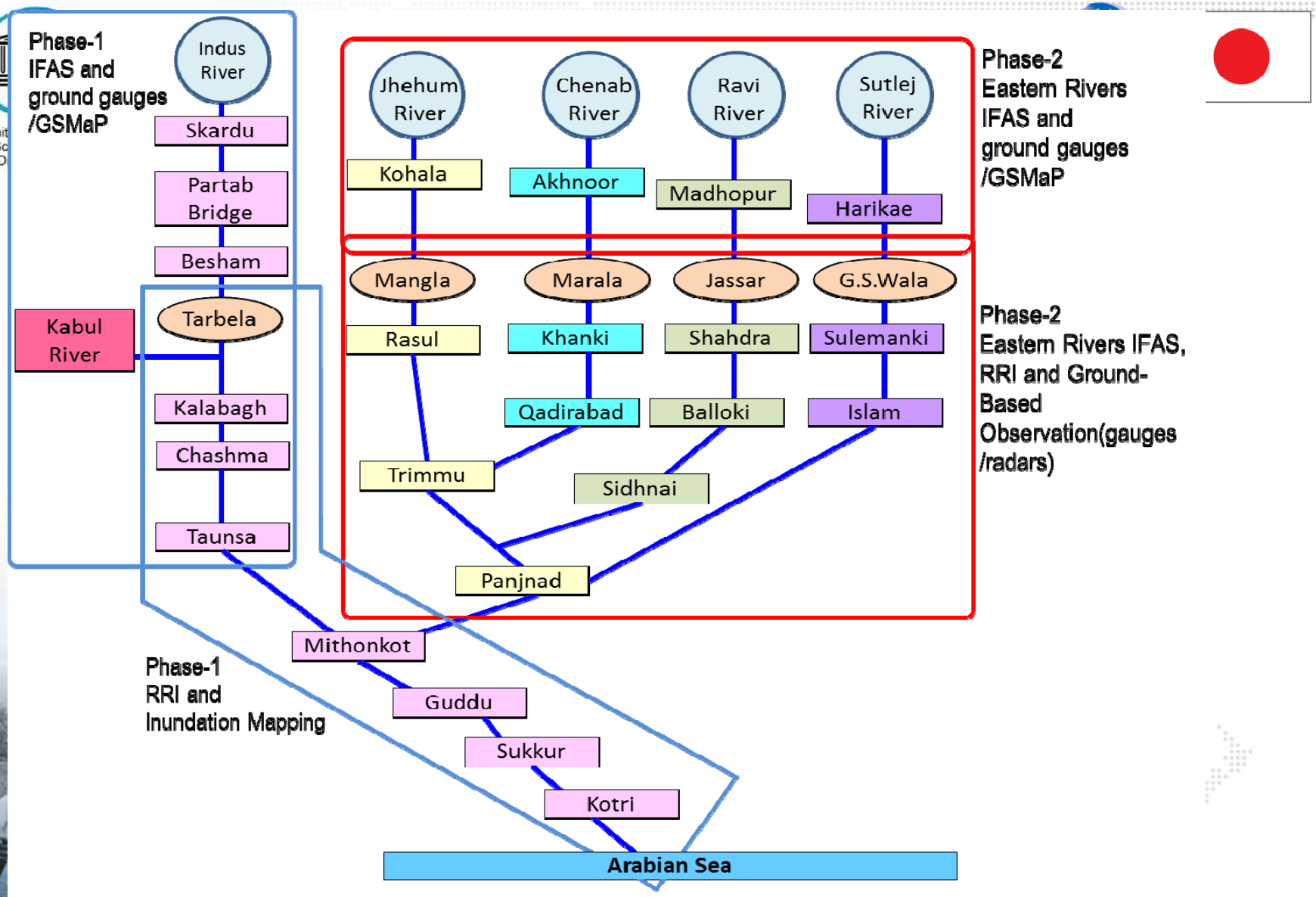
Flood fighting drill & Flood forecasting/ operation room observation (short term training)

- Several human capacity building activities were conducted for Pakistan agencies.
- 6 Pakistan professionals(PMD, SUPARCO, Irrigation department) have graduated and obtained Master's Degrees through ICHARM training course in Japan
- Intensive short term trainings were conducted for senior managers in Japan and 11 experts have received trainings on flood forecasting and management in Japan.

Brief Project Outline

Strategic Strengthening of Flood Warning and Management Capacity of Pakistan
- Phase 2-

Funded by the Government of Japan



The rivers covered by the previous project (Phase-1) and by the proposed project (Phase-2)

Component of the Pakistan Flood Project -Phase 2-

United Nations Educational, Scientific and Cultural Organization

A. **Establi … stainable capacity … ecasting, early w … ncies**

- **MODELLING and DATA ACQUISITION**
- 50 new Automatic weather stations to be installed
- Bathymetry, river cross-sections, discharges to be checked and measured on 25% of rivers
- 90 additional field survey points for soil hydraulic properties.

B. **Te … coop … trans … ry data shari …**

C. **Capacity building and education to community on flood management for proper utilization of flood hazard information and tools**

Current Status

1) Government of Japan and
UNESCO signed an agreement of $ 4.05 million for strengthening flood warning system in Pakistan (Islamabad, 10 March 2015)

2) International Partners Technical and Capacity Building Meeting (5-8 Aug 2015), Avari Hotel, Lahore with ALL PARTNERS gathered for the first time.

3) First inception workshop in Jakarta:
"Post audit of flood forecasting models (Phase-I) and charting of future collaborations (Phase-II)"
GrandKemang Hotel, Jakarta, Indonesia
20-21 November 2015

4) International workshop organised by UNESCO and PCRWR in Islamabad, 21-23December 2015 (tentative):
"Meaning and characterizing river morphology for hindcasting and forecasting river responses to major floods"
Islamabad, 21-23December 2015

Summary

Flood Risk Reduction in Pakistan:

- From institutional point of view:
  - National Disaster Management Act
  - National Disaster Management Plan
- From technical point of view for pre-disaster:
  - Models are available for forecast and FHM
  - Means of communication and information diffusion has been strengthened
  - Expertise is available and has been strengthened
  - The lack of hydro-meteorological data (raingauges, discharge data, meteorological data) including transboundary data is limiting even more efficient DRR.

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Thank you very much for your attention.

21st International Congress on Modelling and Simulation (MODSIM2015)

MODSIM G5. Non conventional data acquisition and modelling of hydrological extremes in data sparse environments (UNESCO, IFI, IDI)

Gold Coast, Broadbeach, Queensland, Australia from Sunday 29 November to Friday 4 December 2015