

# Application of Satellite Rainfall Estimation for Flood Risk Reduction in the Himalayan Region

Public Forum  
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International Centre for Integrated Mountain Development

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## Outline

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- About ICIMOD
- Overview of floods in the Himalayan Region
- Satellite Rainfall Estimation in the HKH Region
  - Why Satellite Rainfall
  - Data and Methodology
  - Analysis
  - Outcome
- Way Forward

## About ICIMOD

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- A regional mountain knowledge, learning and enabling centre devoted to sustainable mountain development in the Hindu Kush-Himalayan region
- To develop an environmentally and economically sound mountain ecosystem to improve the living standards of mountain people

### The Hindu Kush-Himalayan Region

Extends over 3500 km from Afghanistan to Myanmar And Home to 200 million People



intergovernmental and independent organisation with eight member states

## River Basins of HKH region

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Supports lives and livelihoods of more than 200 million people and many more living downstream...

HKH Map with major river basins

## Water Induced Disasters in the HKH-region

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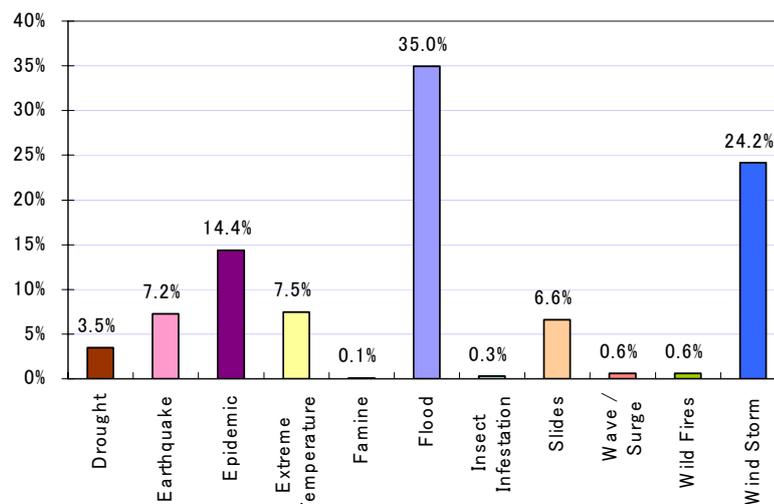
- Floods and Landslides
- Glacial Lake Outburst floods
- Landslide Dam Bursts
- Avalanches
- Flashfloods
- Cyclone



## Disasters in the Himalayas (1975-2005)

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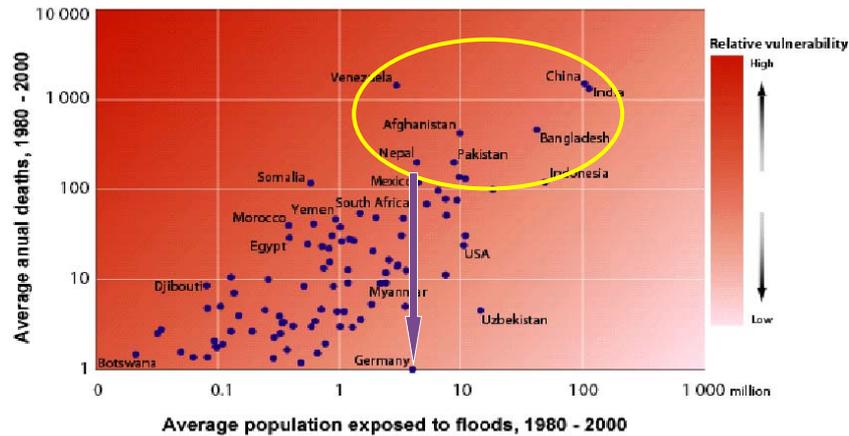


Source: OFDA/Cred Database

# Relative Vulnerability to Floods

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Source: The EM-DAT OFDA/CRE Disasters and Databases and UNEP/GRID-Göteborg

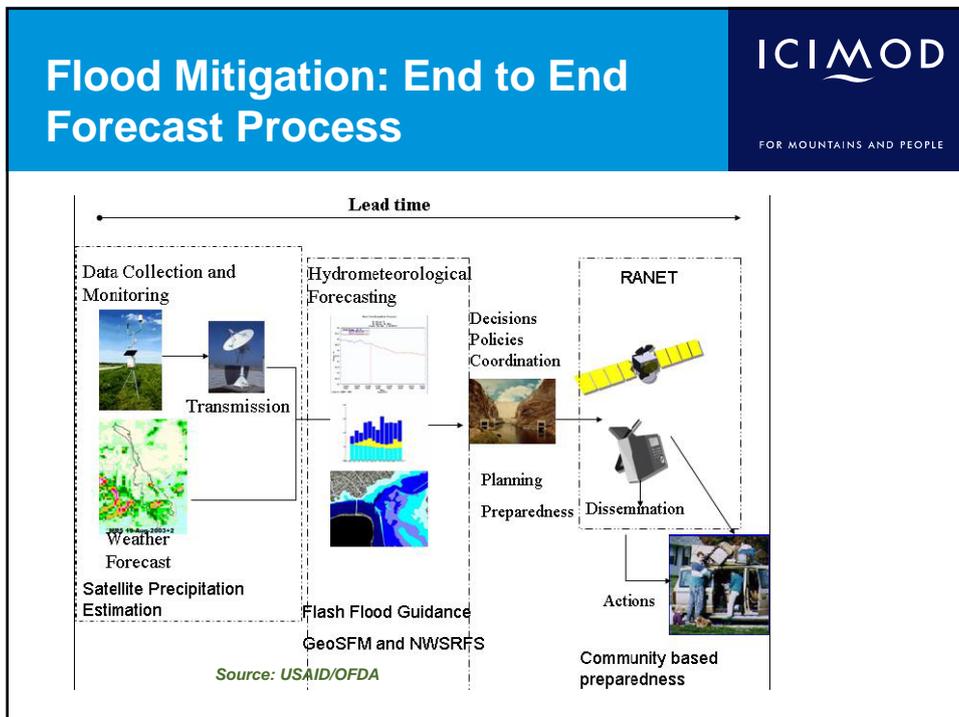
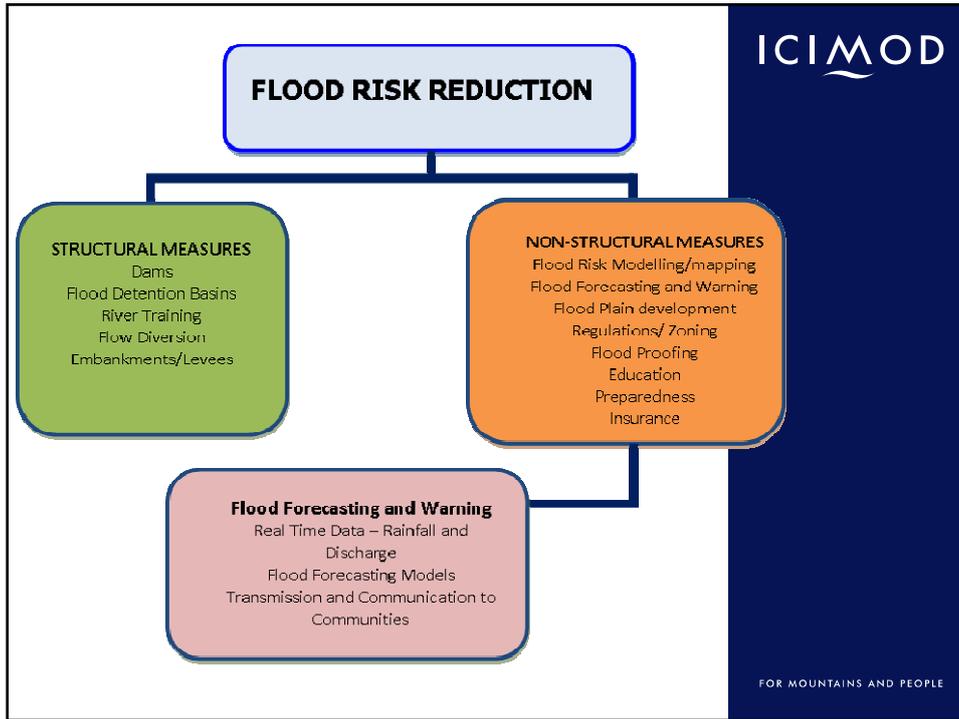
# Key Issues: Floods

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- Transboundary rivers - Shared vulnerability across national borders
- Lack of exchange of timely real time data especially across national boundaries - Not adequate lead time
- Affects Poverty Alleviation, Food Security and Sustainable Development Outcomes
- Diversity of technical, scientific and institutional know-how
- Some bilateral agreements/treaties exist and Regional mechanism just beginning



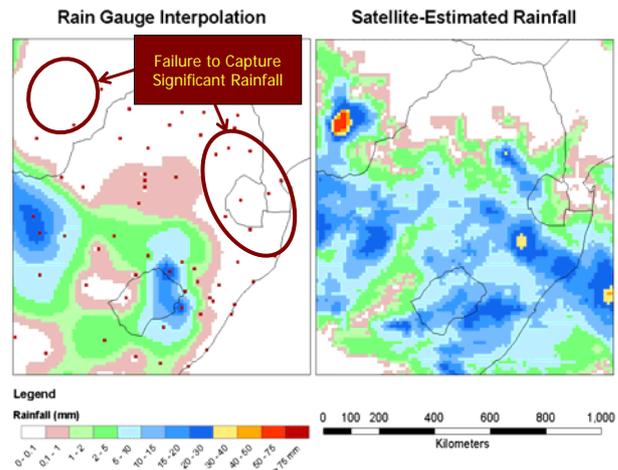


# Why Satellite Rainfall Estimate?

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- Inadequate Hydrometeorological stations
- Delay in data transmission
- Not adequate lead time – absence of data sharing across transboundary borders



# SRE Project: Goal and Objectives

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## Overall Goal:

The goal of the project is to minimize the loss of lives and properties via reduction in natural vulnerability ( floods and droughts) in the Himalayan Region in particular the Indus, Ganges, Brahmaputra and Meghna Basins.

## Objectives:

- To validate satellite based rainfall estimates provided by NOAA and improve rainfall estimate products
- Apply rainfall estimates to rainfall-runoff modelling for predicting streamflow during flood season
- Enhance the capacity of hydromet services/partners in satellite rainfall estimation

## Funding:

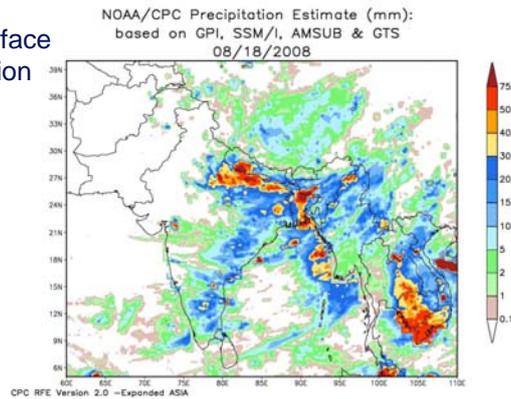
USAID/OFDA

## Satellite Based Rainfall Estimation: NOAA CPC-RFE2.0

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- Initial version became operational in January 2001
- Originally run over the African continent then expanded to southern Asia and western Asia / eastern Europe
- Product is a combination of surface and satellite precipitation information
- Spatial resolution: 0.1 degree
- Temporal resolution: daily
- 5° to 40°N, 60° to 110°E



## Satellite data availability – Rainfall Estimation

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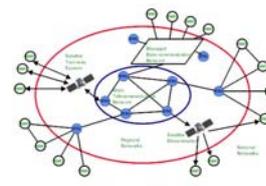
**Visible (VS) & Thermal Infrared (IR) -**  
Meteosat and GMS (Meteosat-5: Positioned at 63°  
longitude; 0° latitude)

### Microwave

- Special Sensor Microwave/Imager (SSM/I) –  
Defense Meteorological Satellite Program
- Advance Microwave Sounding Unit (AMSU) –  
NOAA-15 polar orbiter



**GTS (The Global Telecommunication System )**



# Methodology for Validation

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## Satellite Based Rainfall Validation

### Data Acquisition

#### In-situ Data

- Data Formatting
- Data Quality Control
- Data Conversion (GIS)
- Change of Projection parameters
- Interpolation

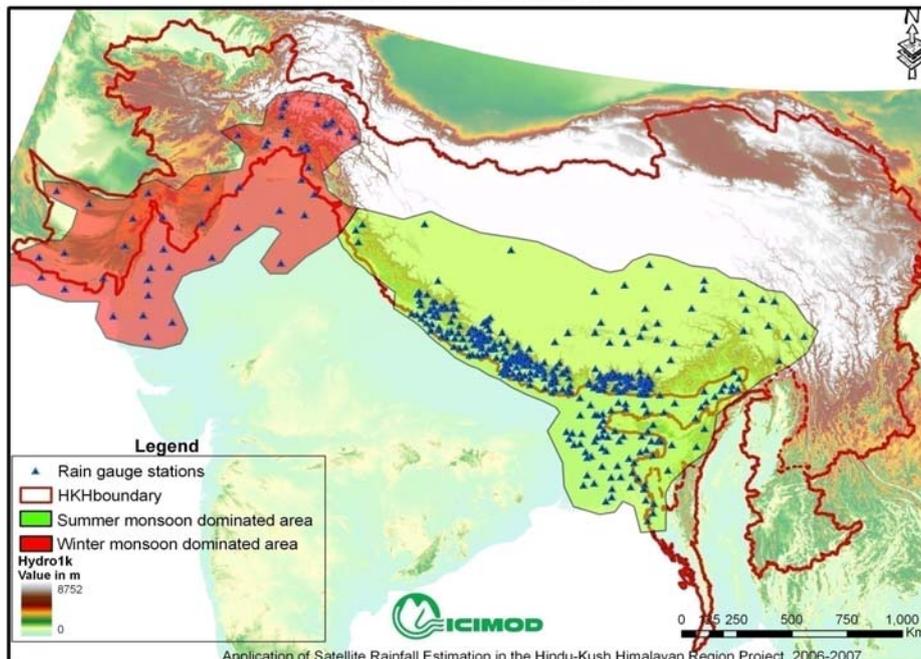
#### Satellite based Data

NOAA-CPC\_RFE2.0 Product

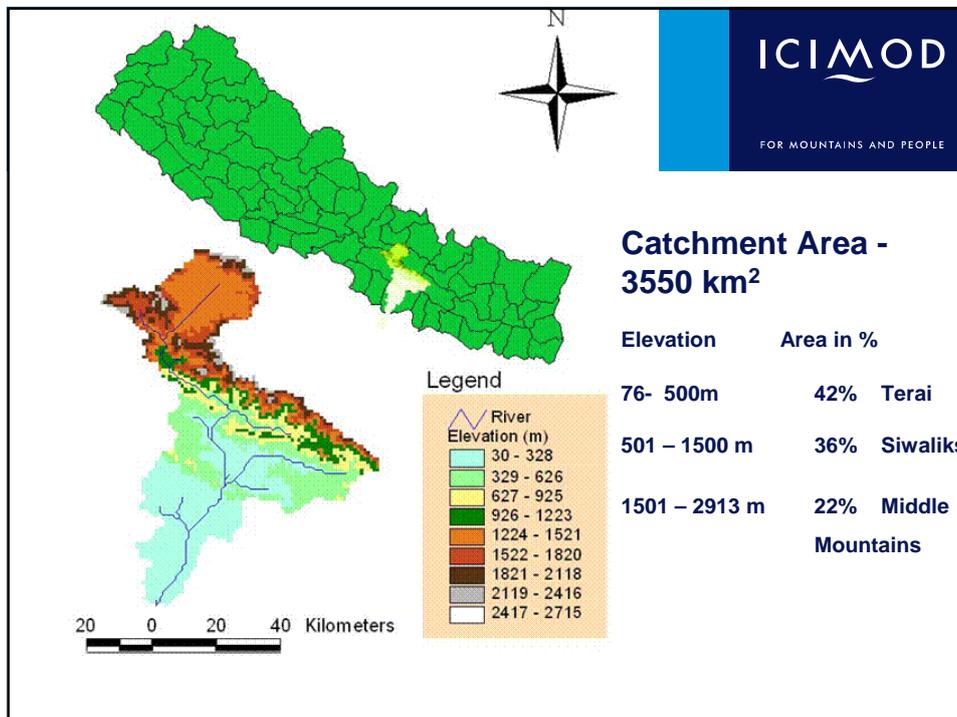
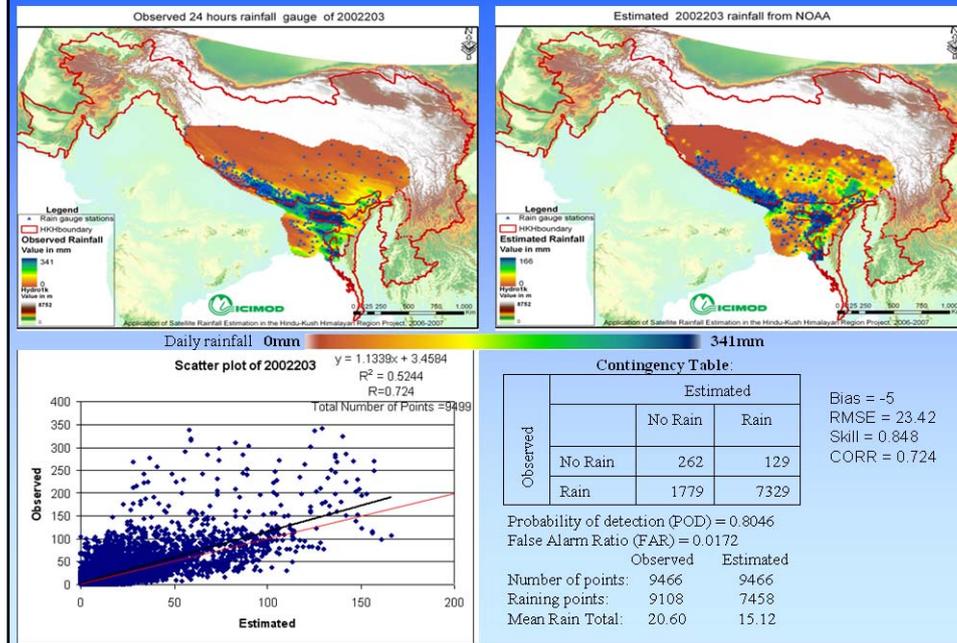
### Data Validation

- Visual Analysis – scatter plot
- Contingency Tables (POD and FAR)
- Statistical Analysis (Bias, RMSE, Correlation coefficient, % error)

## Regional Rainfall Regimes



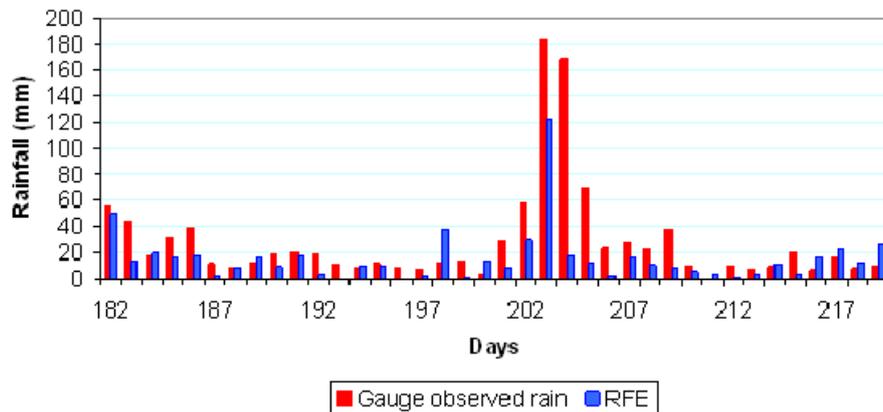
# HKH Regional Summer Monsoon Dominated Area Validation



## Comparison of rain gauge observed and RFE: July 2002

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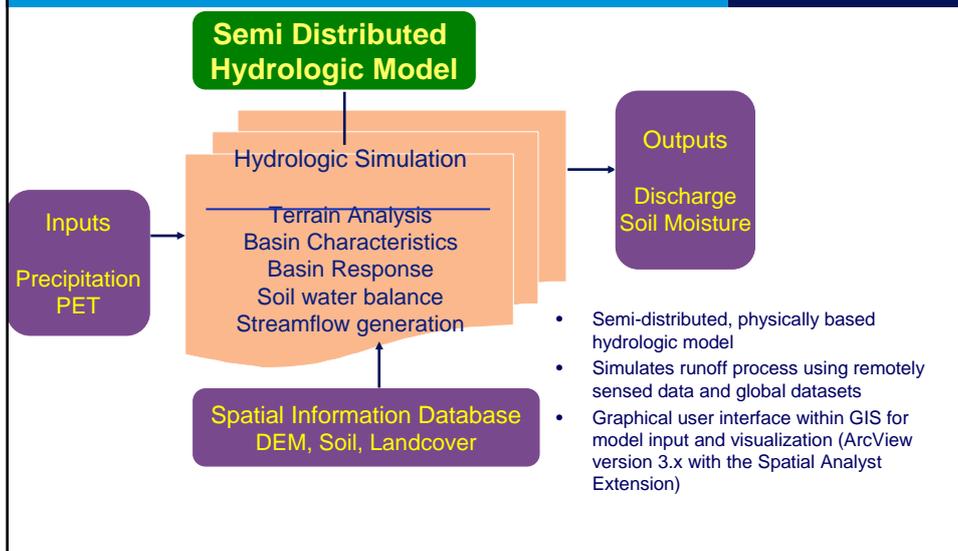
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## GeoSFM model: Framework

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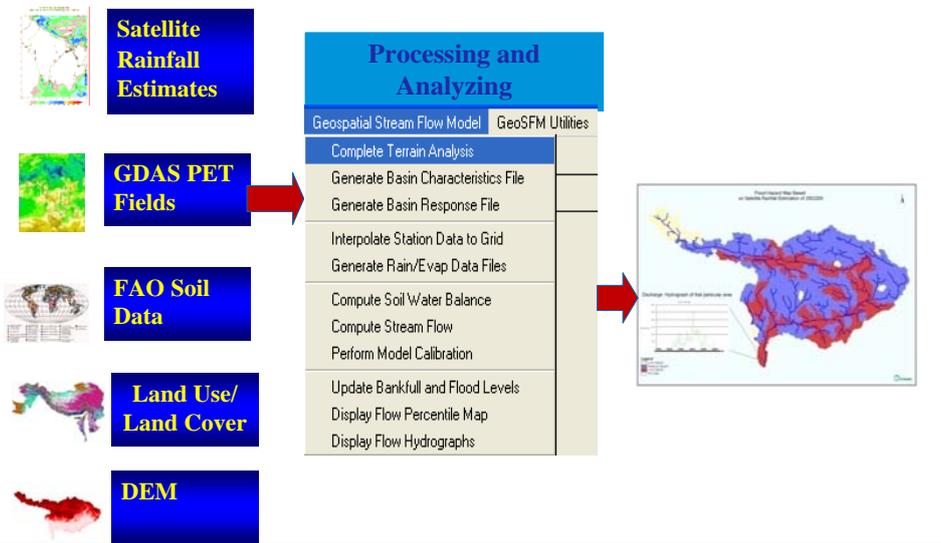
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# Rainfall-runoff Modelling

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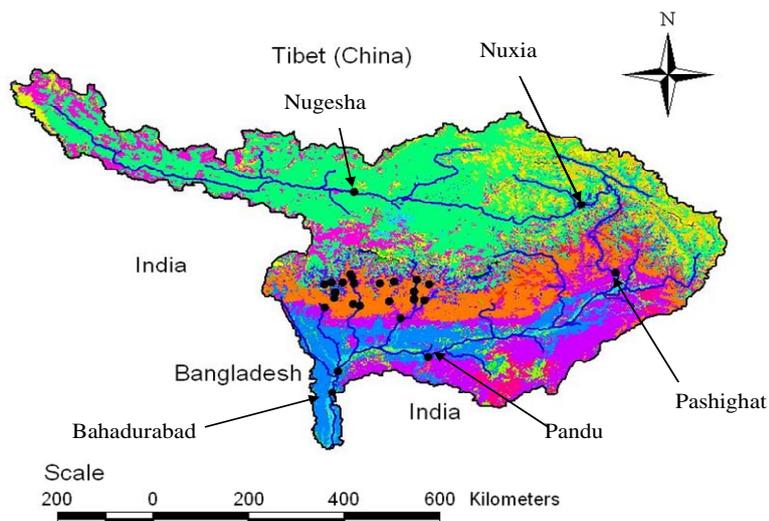
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# Brahmaputra Basin

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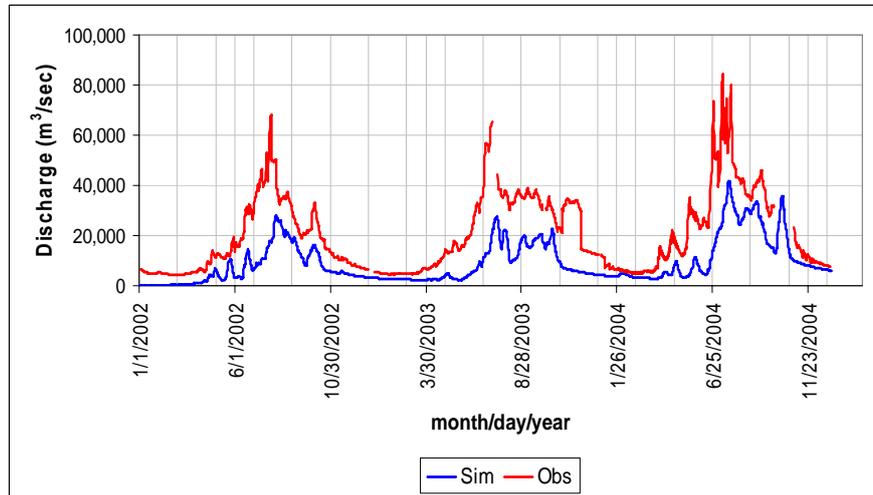
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## Comparison of Simulated and Observed Discharge at Bahadurabad

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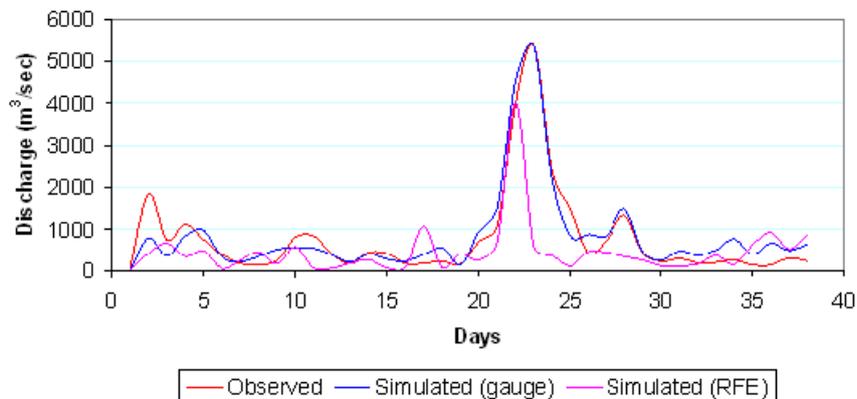
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## Bagmati: Comparison of observed and simulated daily flows at Pandheradovan

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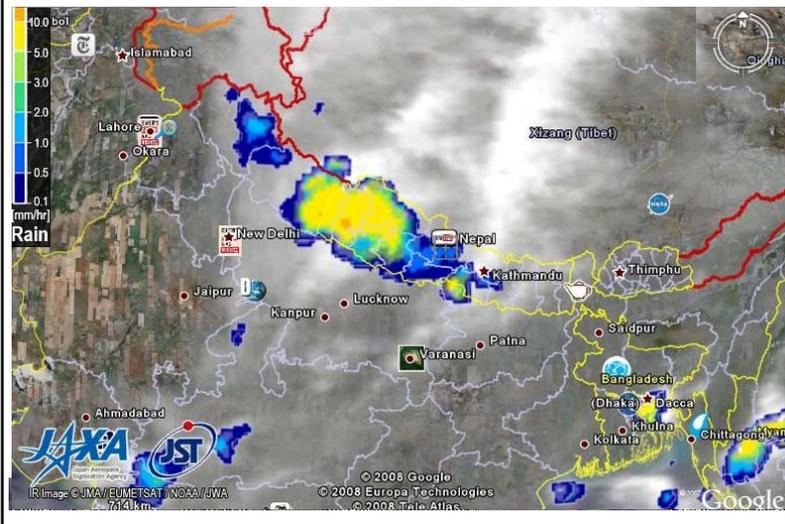


- Underestimation of flows by using satellite based rainfall estimates

## Monitoring of Rainfall Event: Nepal - Sept 2008

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## SRE Phase I: Outcomes

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- Metadata of meteorological stations- Country level and regional level database
- Trained people and **enhanced capability of national institutions** in SRE to enable timely and accurate estimation of rainfall, which will contribute to the effective early warning systems and thus help reduce the risk of water induced disasters
- National and regional level RFE validations – indicates underestimation of flows
- **Testing** of GeoSFM modeling for streamflow prediction for flood forecasting

## Gaps and Constraints

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- Technical infrastructure and capacity for forecasting and warning highly variable
  - Knowledge base limited
  - Satellite based rainfall estimates underestimates runoff – needs improvement or bias adjustment
  - In snowfed basins there is a need to account for the snow and glacier component which is not accounted for in the GeoSFM
- Phase II of the Project initiated

## Way Forward

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- Continue the use of ***new technology and advanced scientific knowledge*** for monitoring, assessing, forecasting and communicating information
- Continue ***training and capacity building*** in satellite-based rainfall in the region to enhance flood risk management
- Improve understanding of flood forecasting methods and models  
Intercomparison of satellite based rainfall estimates and models for flood forecasting
- Contribution of Snow and Glacier component needs to be better understood
- Continued dialogue, regional cooperation and coordination between and amongst countries for Disaster Risk Reduction.

Thank you

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