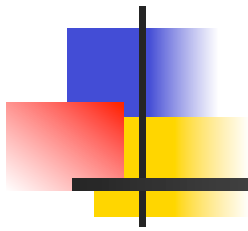


Climate Change Impact Assessment on Indian Water Resources



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Civil Engineering Department

Indian Institute of Technology Delhi

Groundwater Management in India: Issues and
Challenges



IWRM a viable option

- River Basin is the basic unit
 - Makes possible to work out water balance
 - Understanding about spatial and temporal variability
 - Environmental Impacts assessment
 - Implications of manmade changes
 - Implications on account of Climate change and adaptation options thereof



Biodiversity & EIA

- EIA is usually limited to an audit of the present conditions
- Impact assessment due to the proposed intervention is usually missing
 - Worst affected is the biodiversity

Issues around water resources development



- Many parallel programs with competing demands
 - Such as watershed management, rainwater harvesting, water intensive industry, etc.
- No mechanism for tradeoffs between competing demands
- Ignoring environmental demand



Scientific base is essential

- Specific models to be deployed
 - Hydrological model
 - Hydraulic model
 - Water quality model
 - Groundwater model
 - Environment model
 - System model
 - Frameworks to allow interoperability



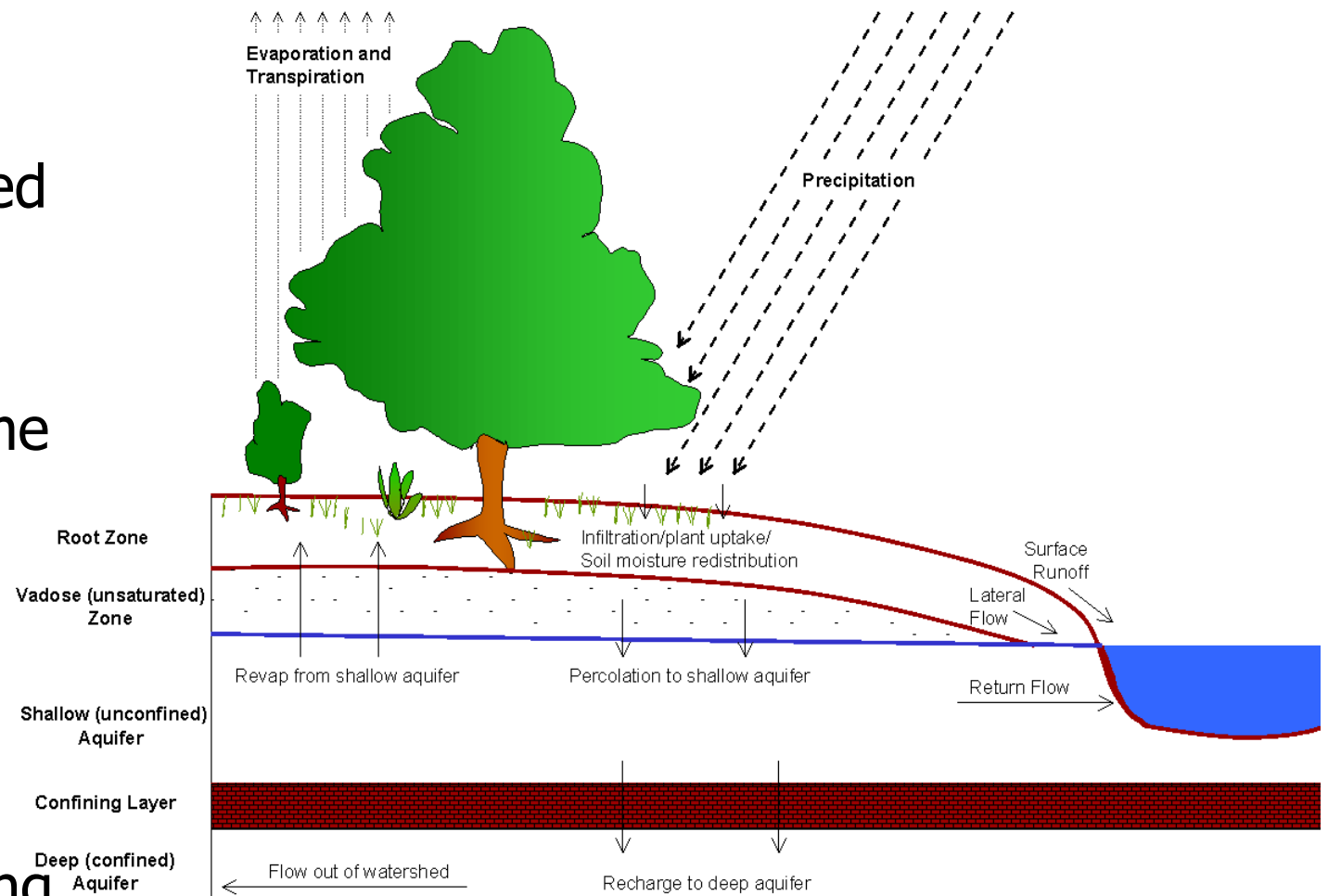
Some of the efforts made by IIT Delhi

- India's National Communications (NATCOM) to UNFCCC Coordinated by MoEF
- The first communication was made in 2004 and the Second in 2012
 - Work on quantification of climate change impacts on water Resources was entrusted to IIT Delhi

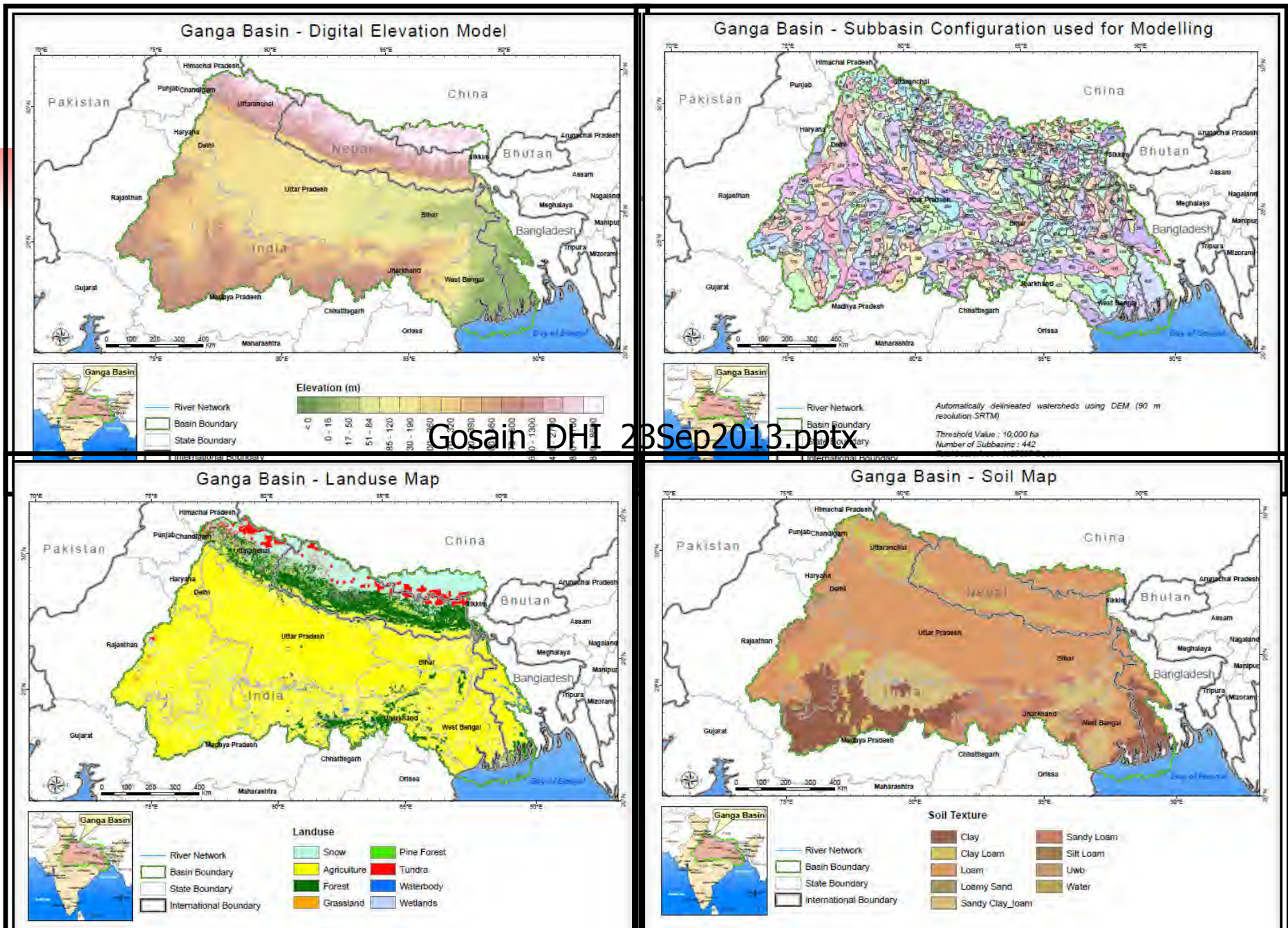
SWAT Model Components

Features

- Physically based
- Distributed model
- Continuous time model (long term yield model)
- Uses readily available data
- Suitable for long term impact studies

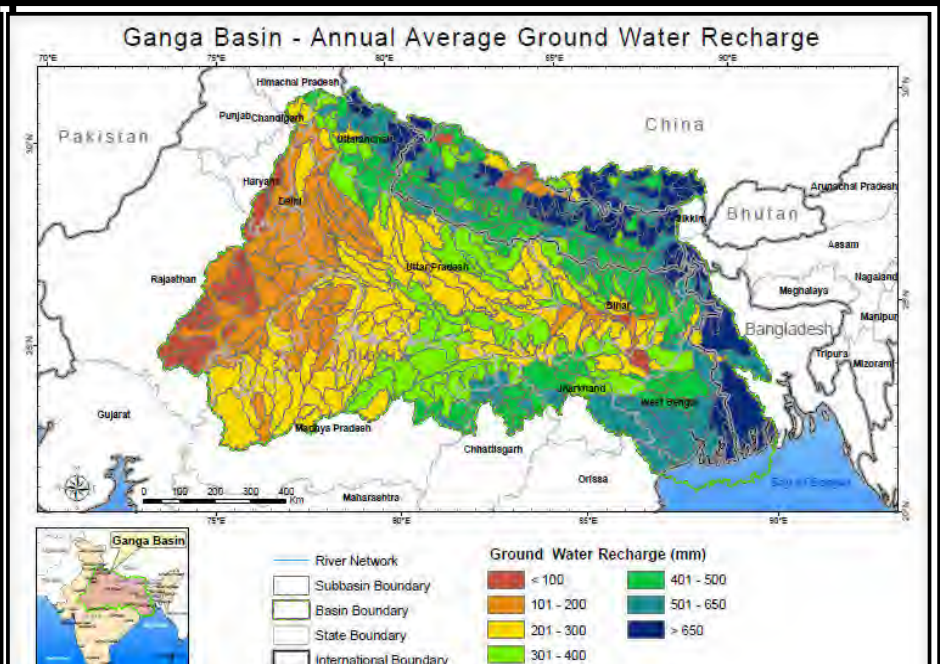
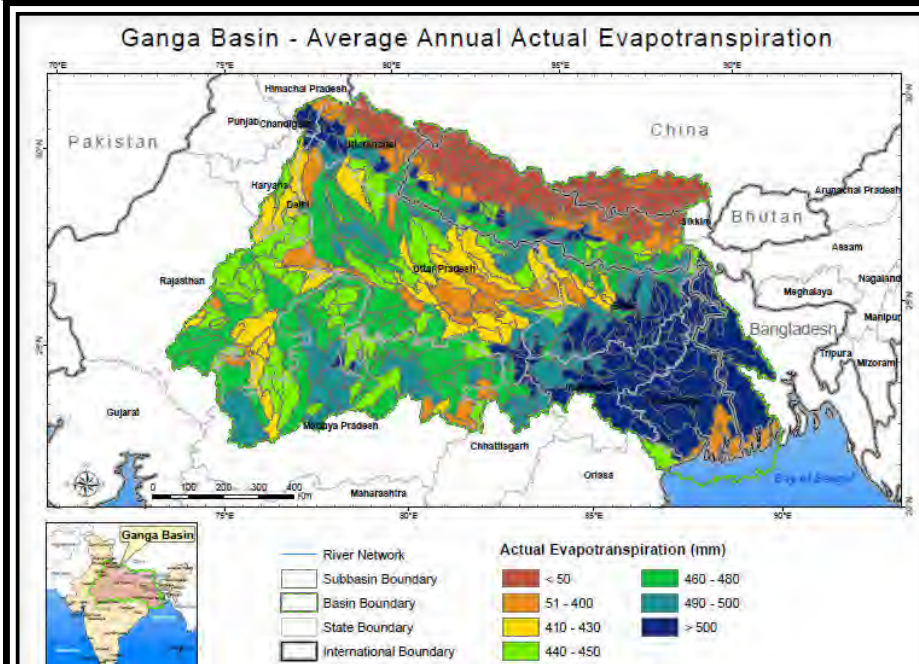
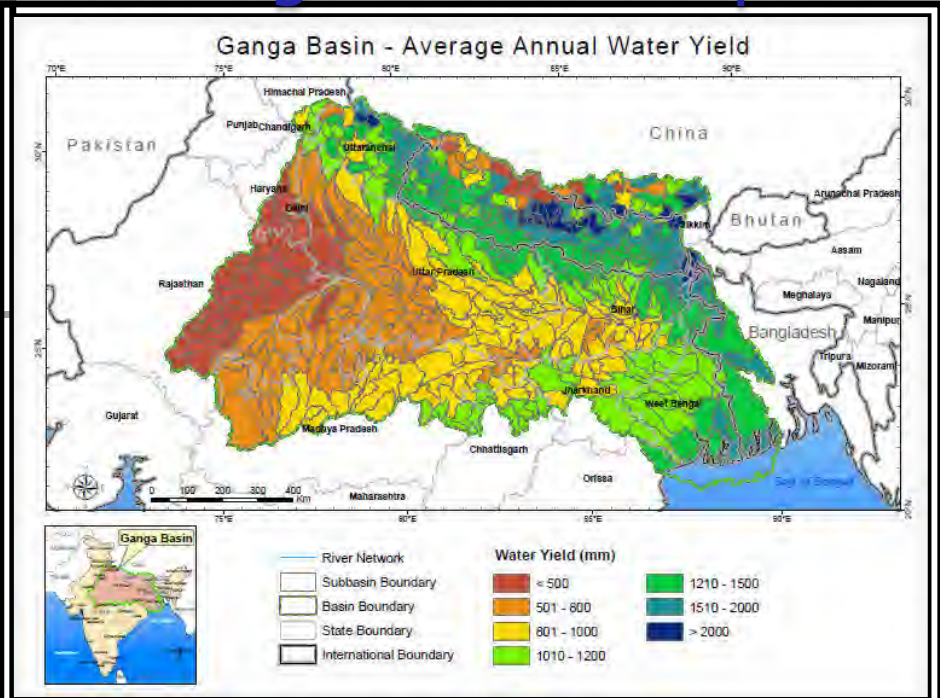
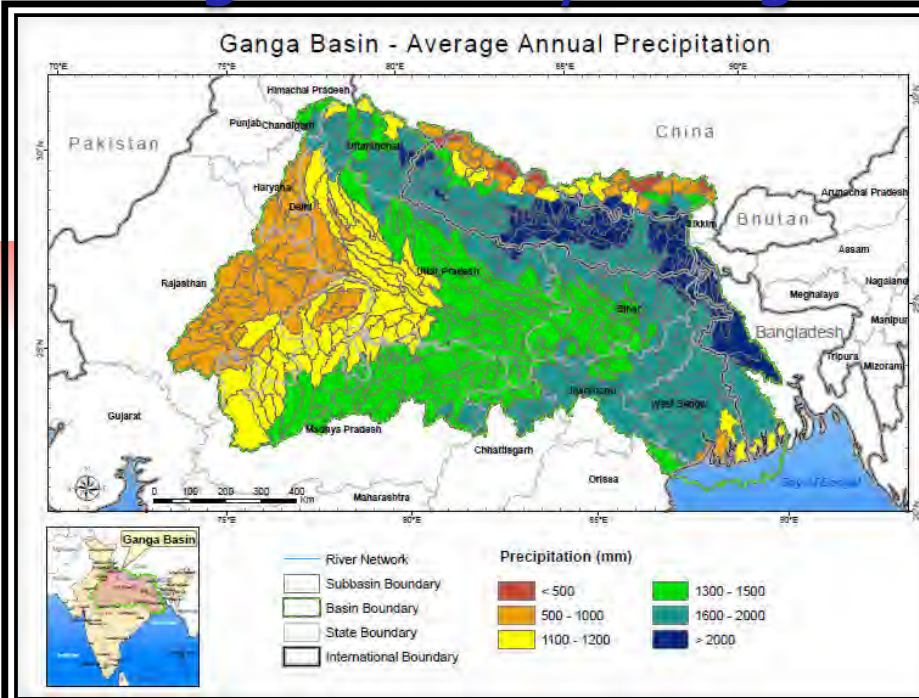


Ganga Basin Hydrological Modelling – Base layers

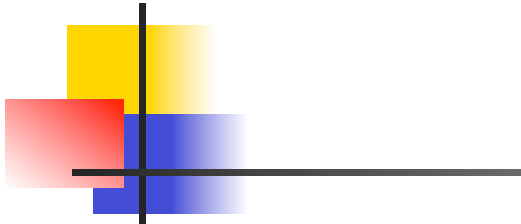


Gosain DHI 23Sep2013.pptx

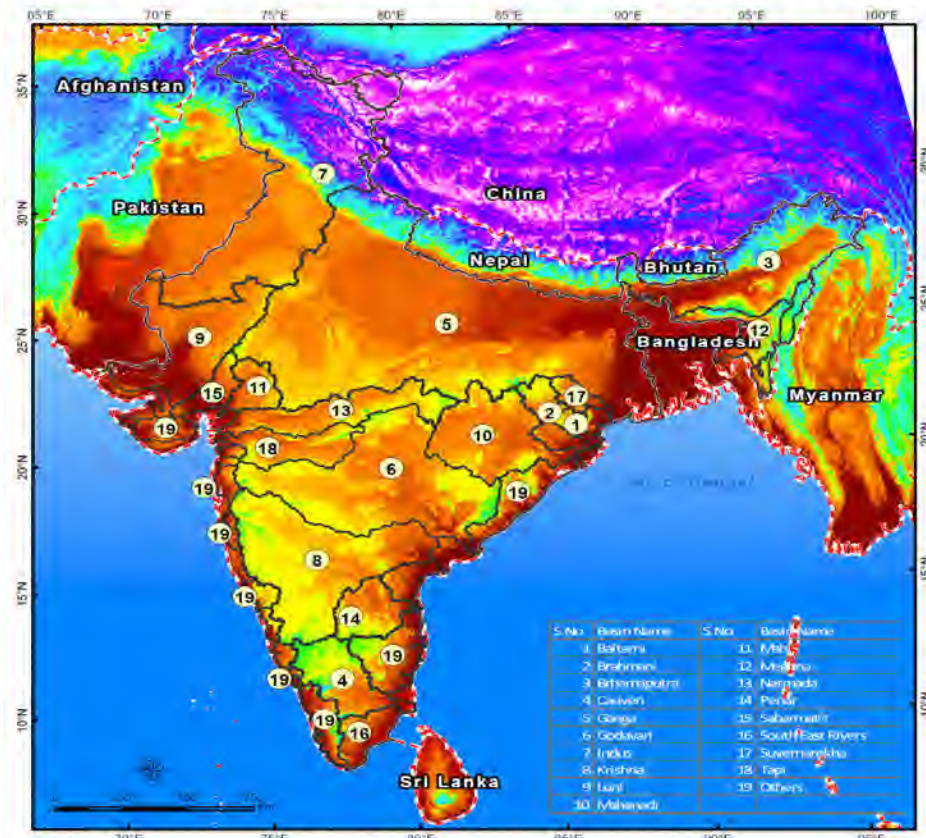
Ganga Basin Hydrological Modelling – SWAT Outputs



River Basins Modeled – NATCOM II



Index map of River Basins used for Hydrological Modelling



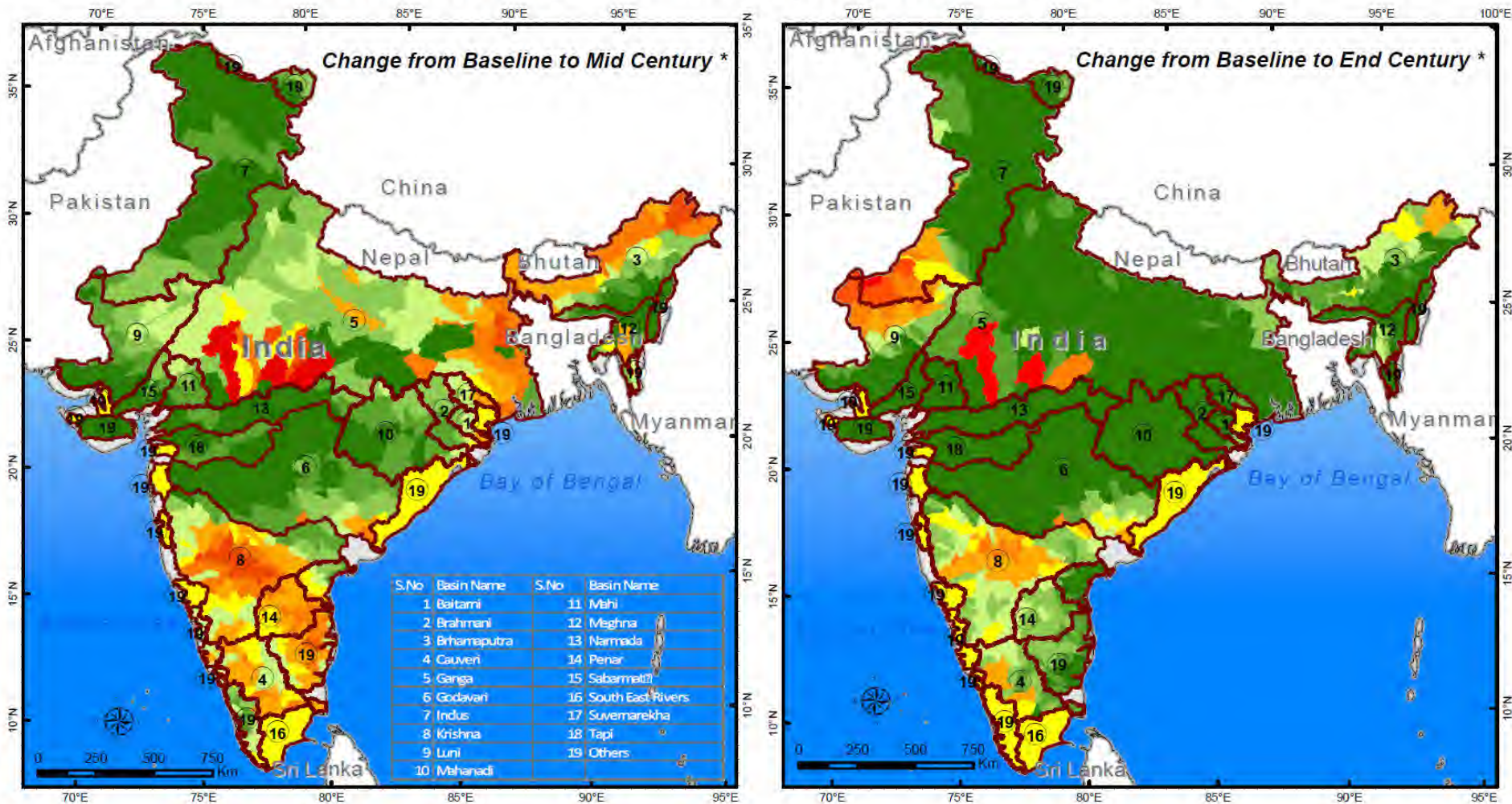
Analysis and Layouts prepared by IIT Delhi in association with INRH Consultants



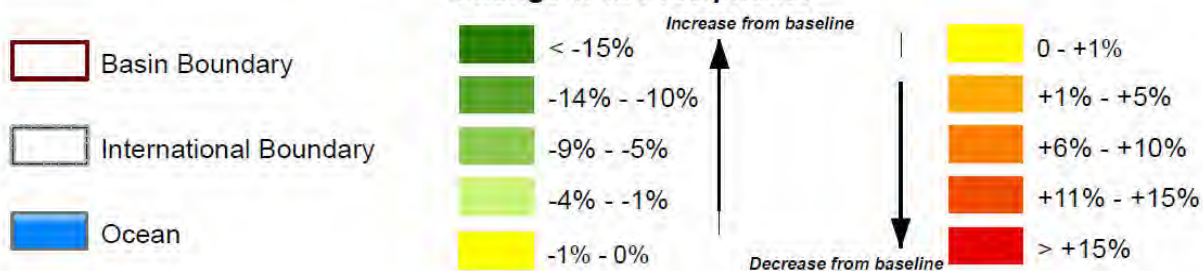
Modelling Outcomes

- Detailed outputs include all the water balance component at spatial and temporal scales which are analysed for
 - Changes in magnitude and frequency of flood peaks
 - Severity of droughts
 - Changes in flow patterns
 - Changes in groundwater recharge

Percent Change in Precipitation across India



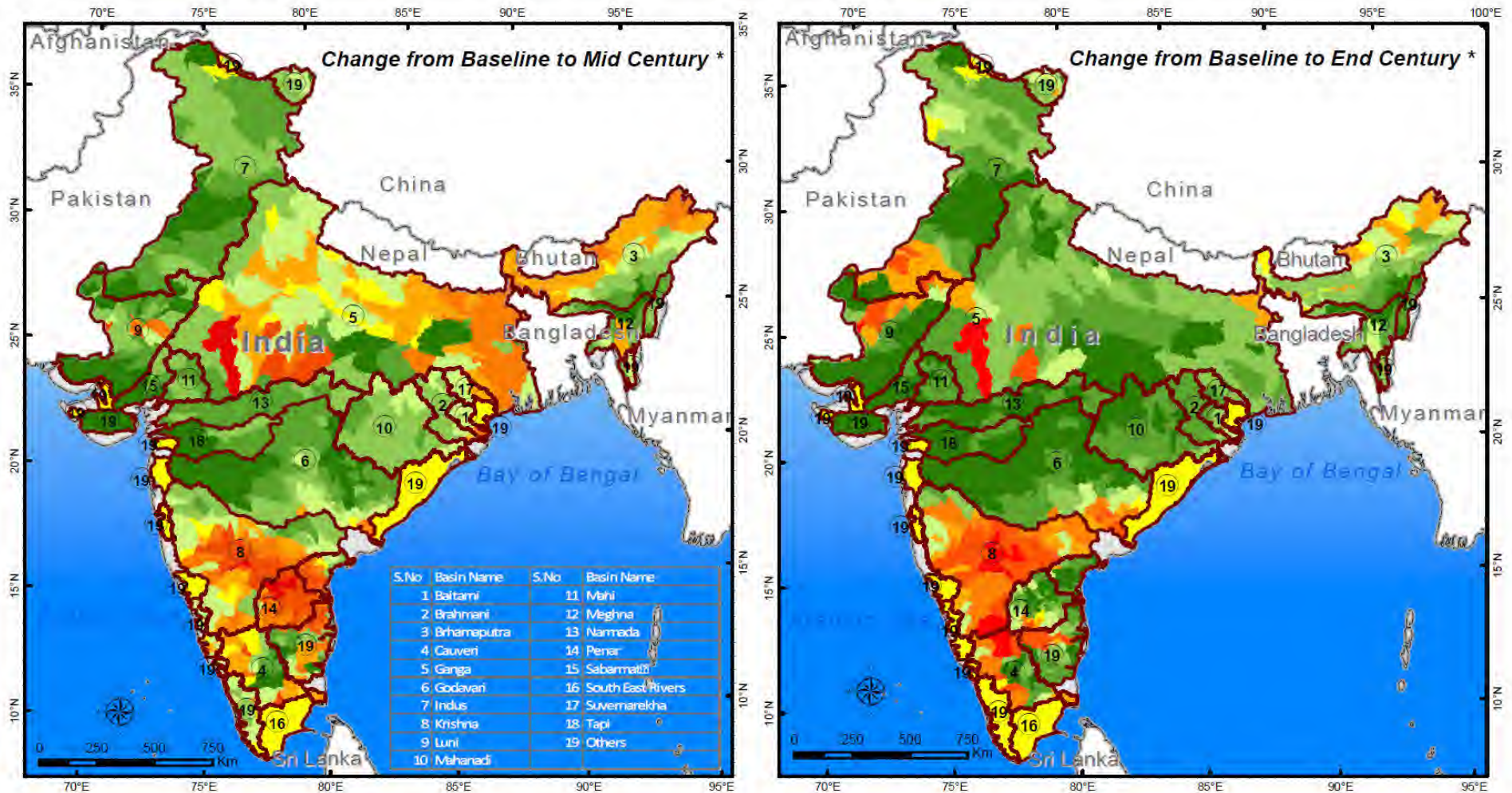
Change % in Precipitation



SWAT hydrological model results simulated using PRECIS RCM* daily weather datasets provided by the Indian Institute of Tropical Meteorology, Pune

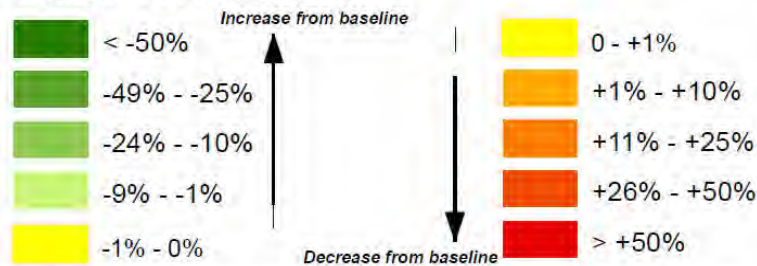
* IPCC SRES A1B Scenarios (Q14 QUMP ensemble) - Baseline (1961-1990), Mid Century (2021-2050) & End Century (2071-2098)

Percent Change in Water Yield across India



Change % in Water Yield

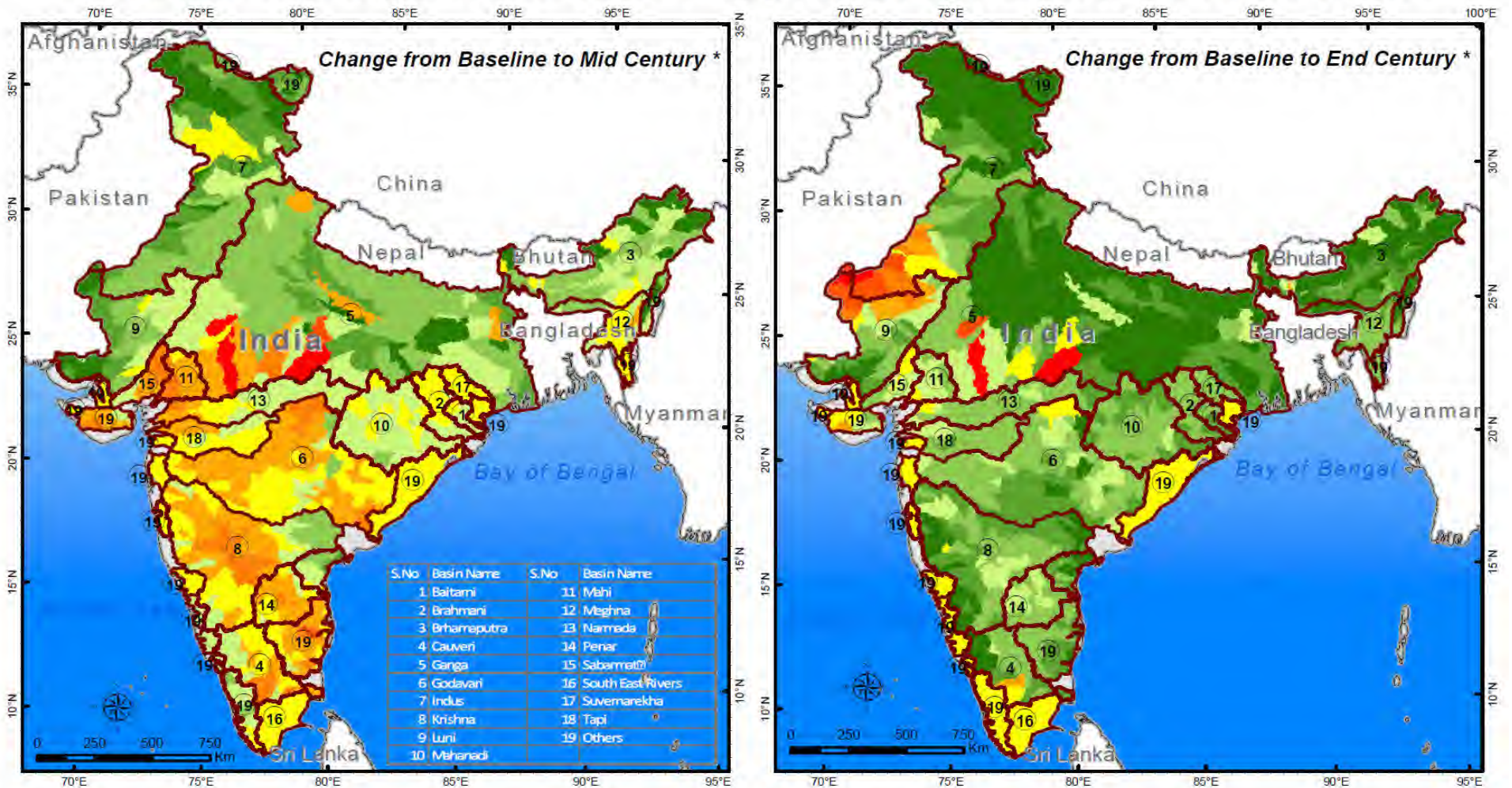
- Basin Boundary
- International Boundary
- Ocean



SWAT hydrological model results simulated using PRECIS RCM* daily weather datasets provided by the Indian Institute of Tropical Meteorology, Pune

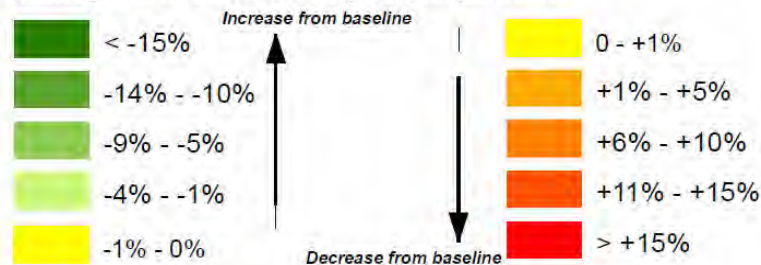
* IPCC SRES A1B Scenarios (Q14 QUMP ensemble) - Baseline (1961-1990), Mid Century (2021-2050) & End Century (2071-2098)

Percent Change in Actual Evapotranspiration across India



Change % in Actual Evapotranspiration

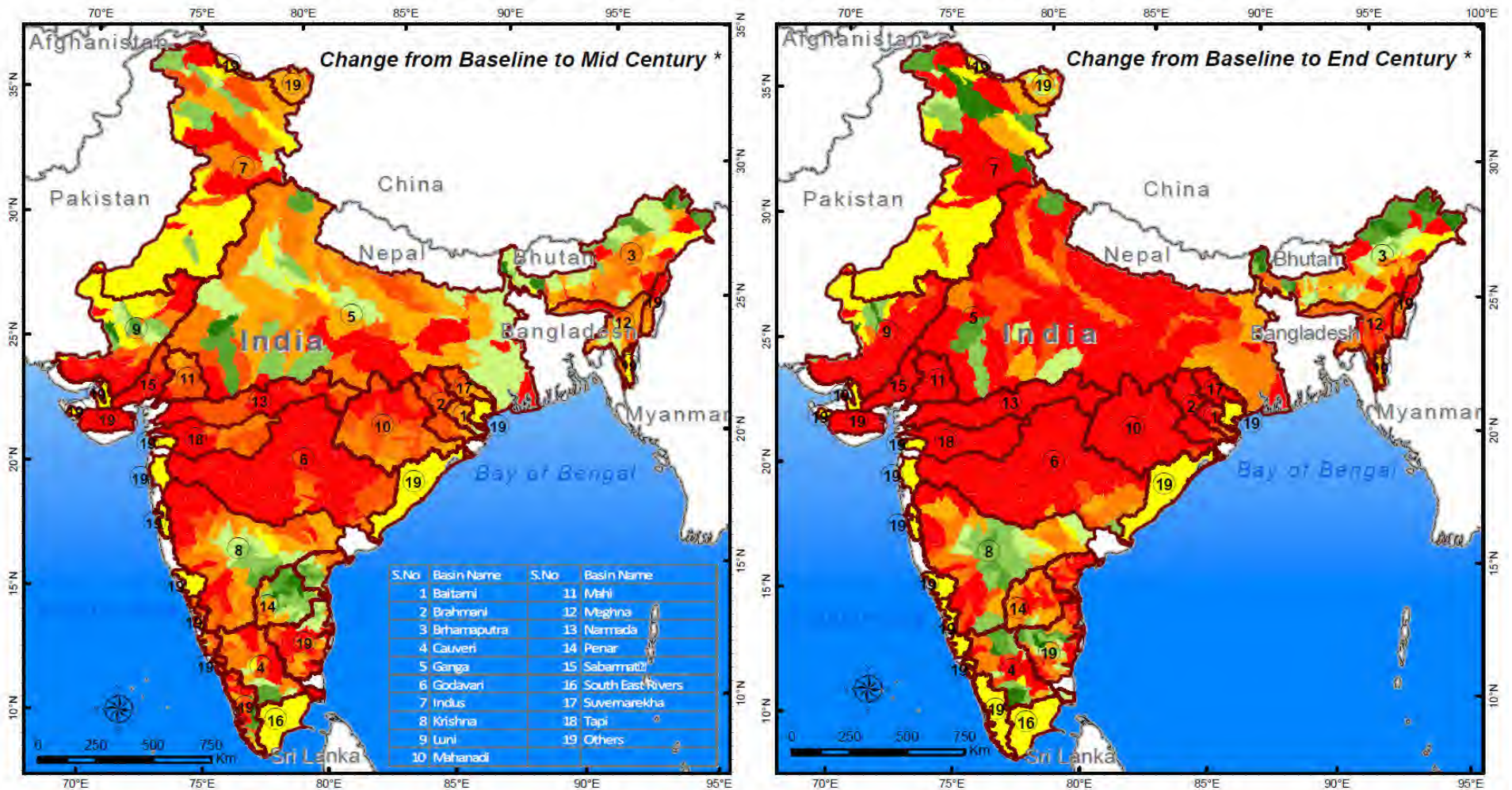
- Basin Boundary
- International Boundary
- Ocean



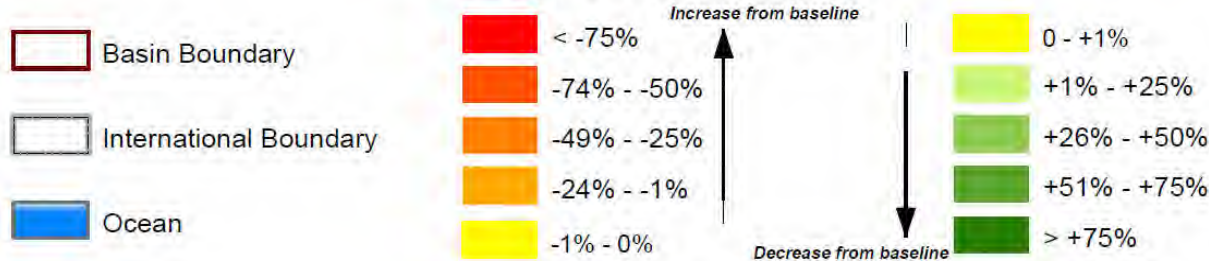
SWAT hydrological model results simulated using PRECIS RCM* daily weather datasets provided by the Indian Institute of Tropical Meteorology, Pune

* IPCC SRES A1B Scenarios (Q14 QUMP ensemble) - Baseline (1961-1990), Mid Century (2021-2050) & End Century (2071-2098)

Percent Change in Sediment Yield across India



Change % in Sediment Yield

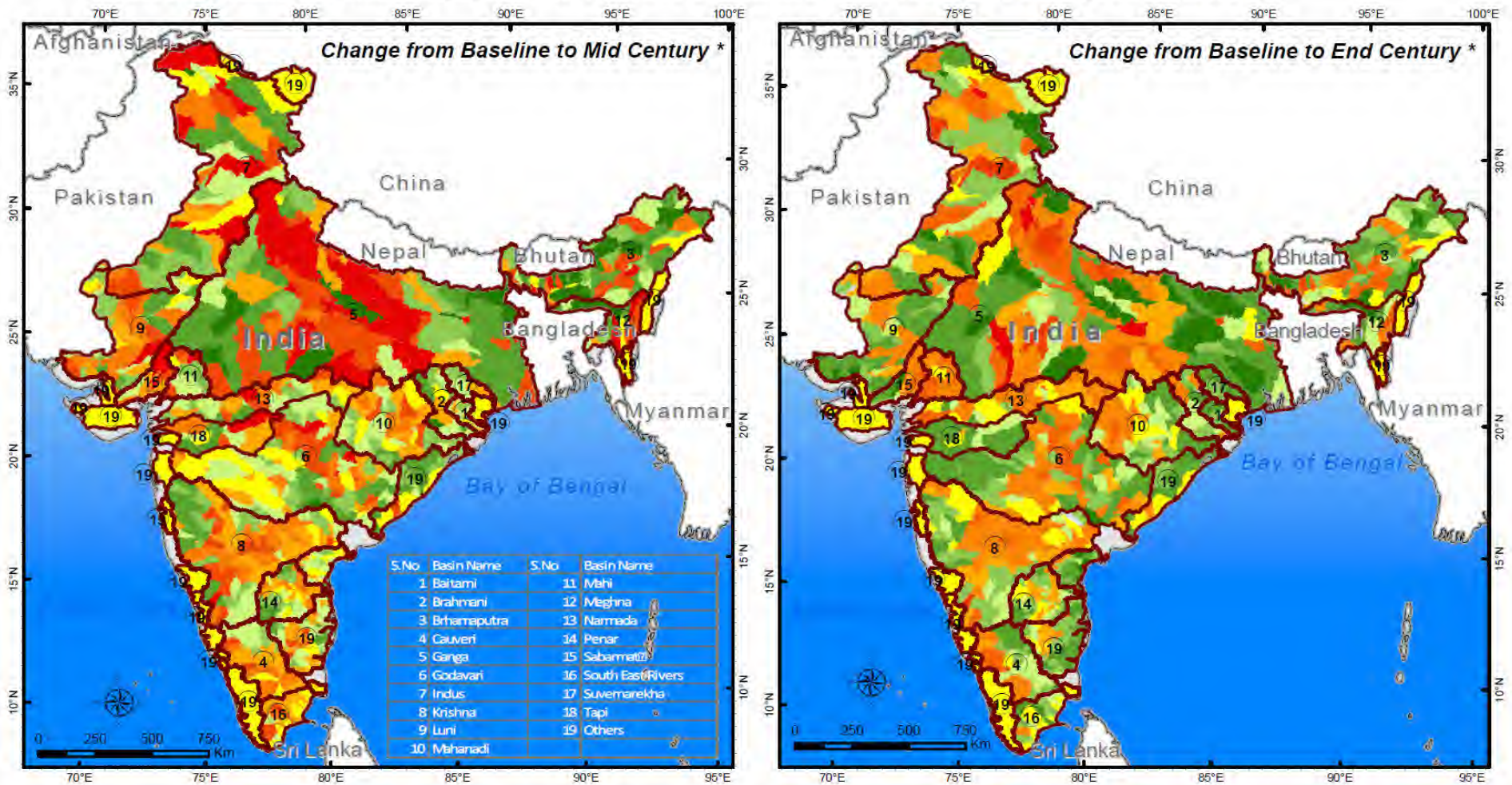


SWAT hydrological model results simulated using PRECIS RCM* daily weather datasets provided by the Indian Institute of Tropical Meteorology, Pune

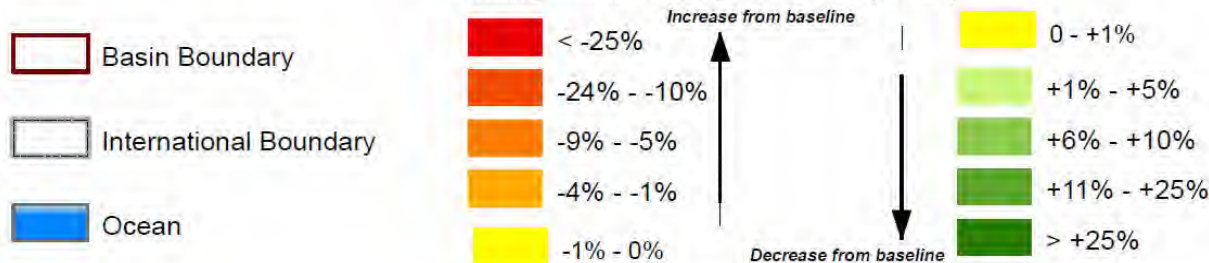
* IPCC SRES A1B Scenarios (Q14 QUMP ensemble) - Baseline (1961-1990), Mid Century (2021-2050) & End Century (2071-2098)

Percentage Change in Drought Weeks (JJAS) across India

Based on Agriculture Drought Index ranging from -2 to -4 (moderate to extreme soil moisture stress during critical growth stages of crops)



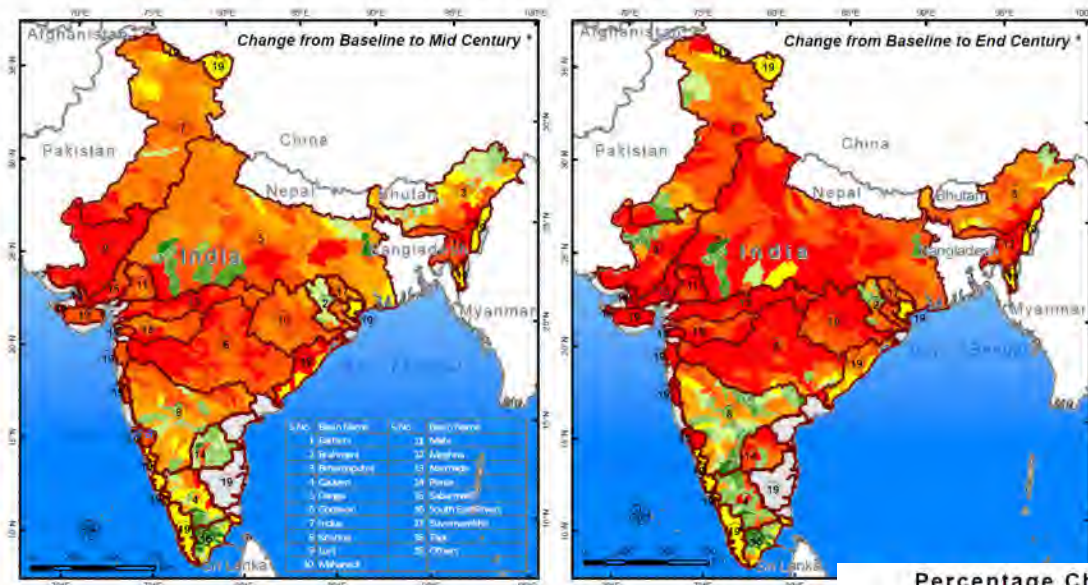
Change % in Drought Weeks (JJAS)



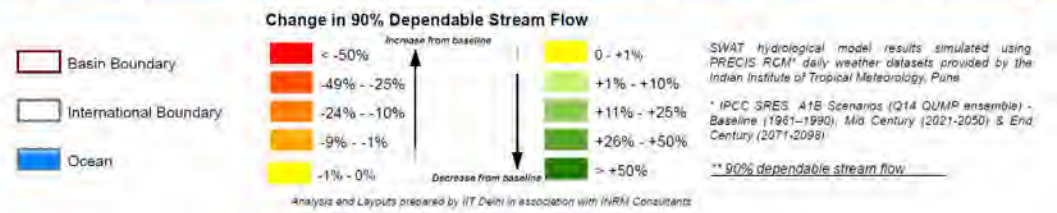
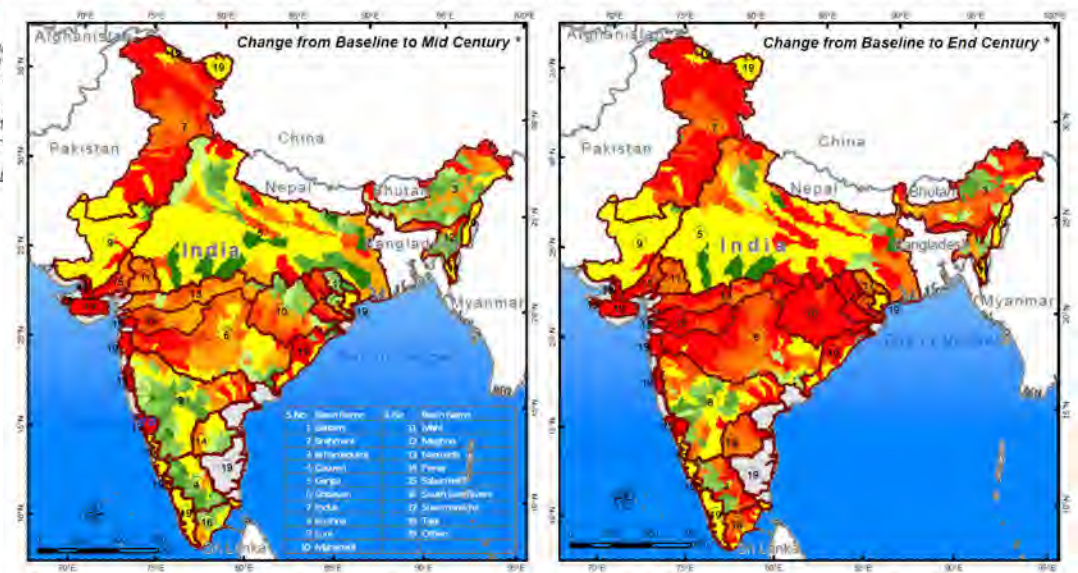
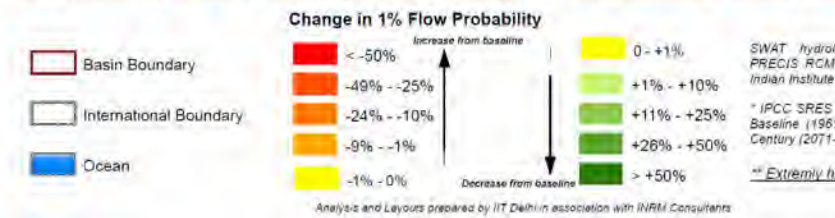
SWAT hydrological model results simulated using PRECIS RCM* daily weather datasets provided by the Indian Institute of Tropical Meteorology, Pune

* IPCC SRES A1B Scenarios (Q14 QUMP ensemble) - Baseline (1961-1990), Mid Century (2021-2050) & End Century (2071-2098)

Percentage Change in Stream Discharge at 99th percentile** across India



Percentage Change in Stream Discharge at 10th percentile** across India





A shareable information base

- To keep pace with the fast changing baseline
- To provide an integrated information for river basins including transboundary
- Generate scenarios and provide information on implications thereof
 - To create adaptation options
 - Can be used for disaster management

Hydrological Information System (NATCOM) - Mozilla Firefox
http://gisserver.civil.iitd.ac.in/natcom/

Deptt. of Civil Engineering, IIT Delhi Help
Visitor No: 2562

Hydrological Information System (NATCOM)

--Select Region-- --Select Basin-- --Select Catchment-- --Select Subcatchment-- --Select Watershed-- | CLEAR

Print Map

Map Controls

- HydroInfoSystem
 - Region
 - Basin
 - Catchment
 - SubCatchment
 - Stream@10LakhThreshold
 - Stream@2LakhThreshold
- WaterYield
 - SubCatchmentwiseAnnual
 - 0.00
 - 0.01 - 54.59
 - 54.60 - 170.95
 - 170.96 - 308.24
 - 308.25 - 473.47

0 81 162 364 546 728 Miles

Find: search Next Previous Highlight all Match case

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SubBasinwise Model Results

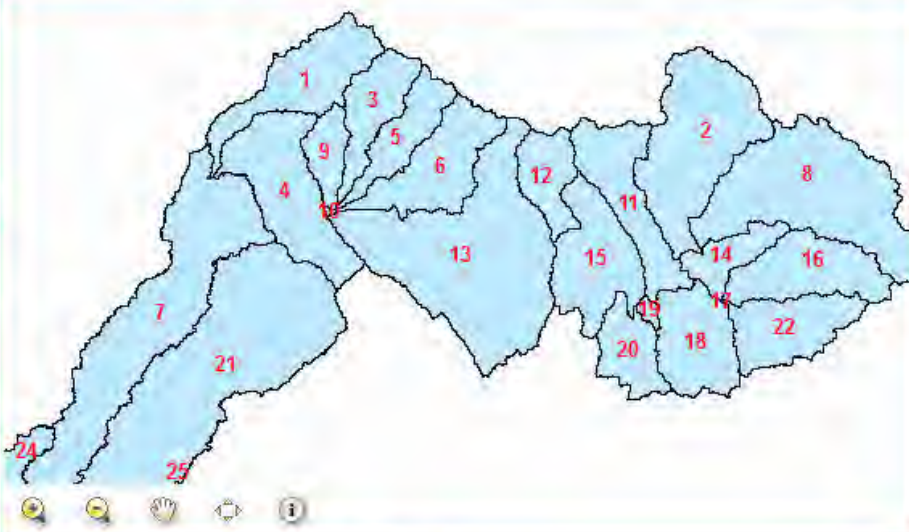
Select ID:
0002
0003
0004
0005

Select Parameter:
Water Balance

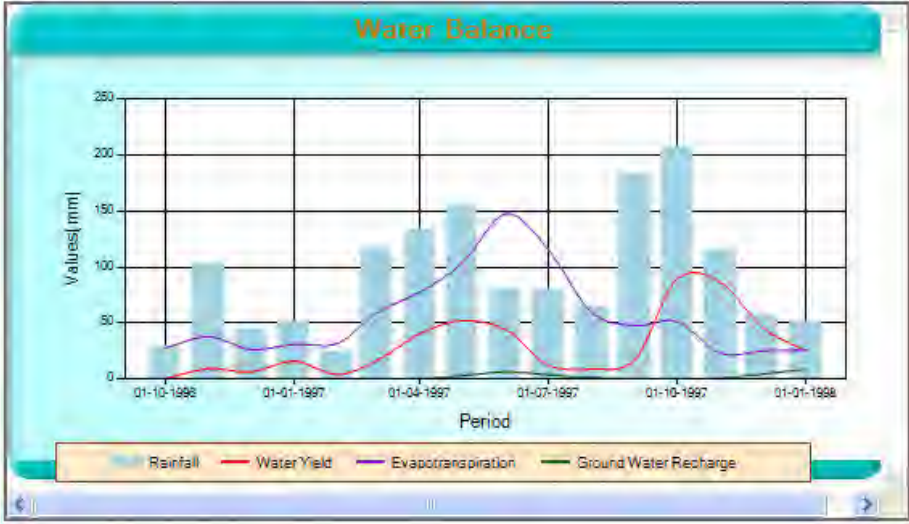
Select Time Range
From: 1996/01/1
To: 1998/01/1

Show Table

Show Graph



SubBasin Beas



Basinwise Model Results (SWAT)

MODEL RESULTS | VULNERABILITY ASSESSMENT | CLIMATE CHANGE ANALYSIS | ADVANCED ANALYSIS

Model Results: Chambal 20322

Virgin Condition

BL Condition

Select Parameter

Discharge

Run with IMD Grid Data (1971-2005)

HadRM3 Baseline (BL) (1961-1990)

HadRM3 GHG Scenario (A2) (2071-2100)

HadRM3 GHG Scenario (B2) (2071-2100)

A1B Baseline Scenario (1961-1990)

A1B Mid Century Scenario (2021-2050)

A1B End Century Scenario (2071-2098)

Select Period: (Start-End)

1971

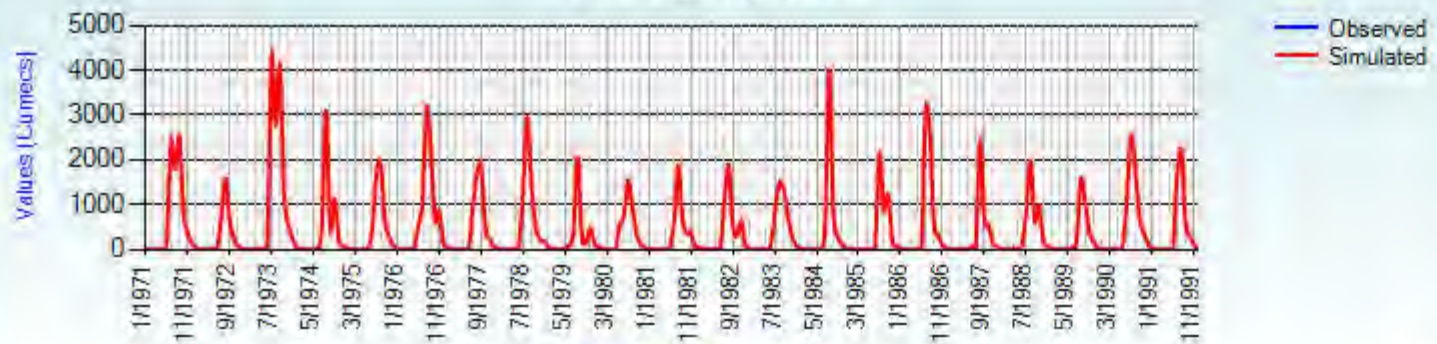
1991

Show Graph

Show Table

Discharge Graph: Chambal 20322

IMD Grid data: Virgin Condition

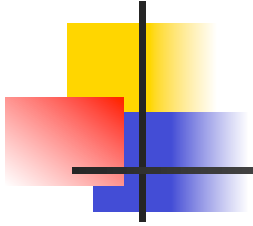


Period : (1971-1991)



Conclusions

- To address water issues better:
 - IWRM principles should be deployed to formulate River Basin Management plans
 - Detailed climate change implication studies should be undertaken to quantify the implications
 - Use thus created science base for formulating effective adaptation options
 - Creation of sharable information is essential for sustainable use of water resources through engagement of stakeholders



Thank you