Geospatial Framework for Water Resources Assessment & Planning

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IIT Delhi, INRM, & TAMU

India's National Communications to UNFCCC

- Coordinated by MoEF
- The first communication was made in 2004
  - Work on water Resources was entrusted to IIT Delhi
  - Second National Communication has just just been completed & IIT Delhi has again lead the Water Resources segment

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Data Used for Modeling

- Digital Elevation Model: SRTM 90 m grid
- Land use: Global data, 1:2M USGS
- Soil: Global data, 1:5M FAO
- Drainage: 1:250,000
- Weather: Data generated by the "Hadley Centre for Climate Prediction" U.K. at a resolution of 0.44° X 0.44° latitude by longitude grid points obtained from IITM, Pune
  - PRECIS Regional Climate Model
  - A1B IPCC SRES Climate Change scenario
  - Baseline (1961–1990, BL)
  - Mid Century (2021-2050, MC)
  - End Century (2070 – 2100, EC)
  - HadRM3 A2, B2 scenarios
  - BL and EC scenarios only

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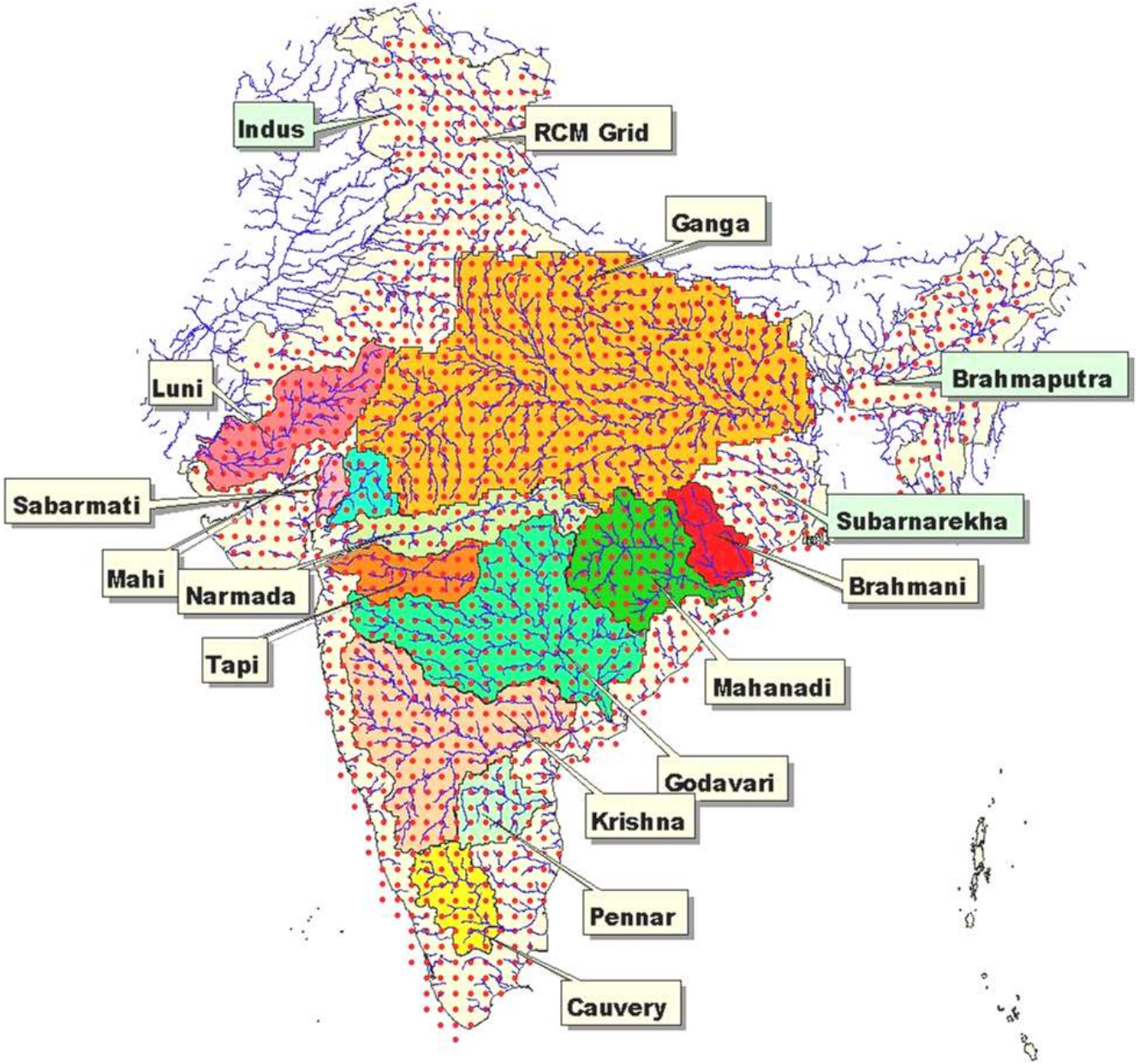
River Basins Modeled



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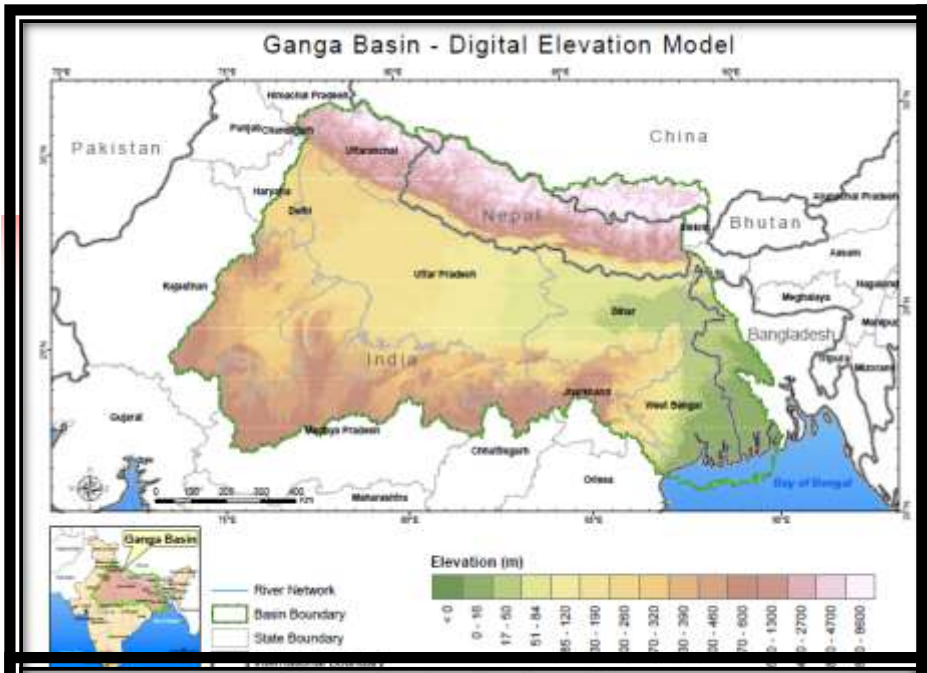
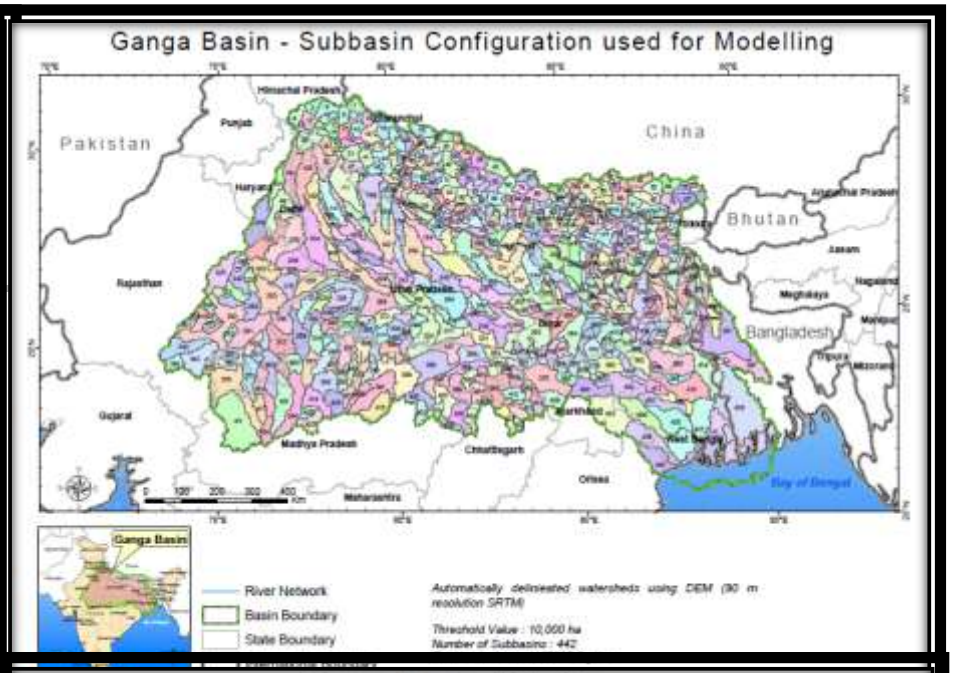
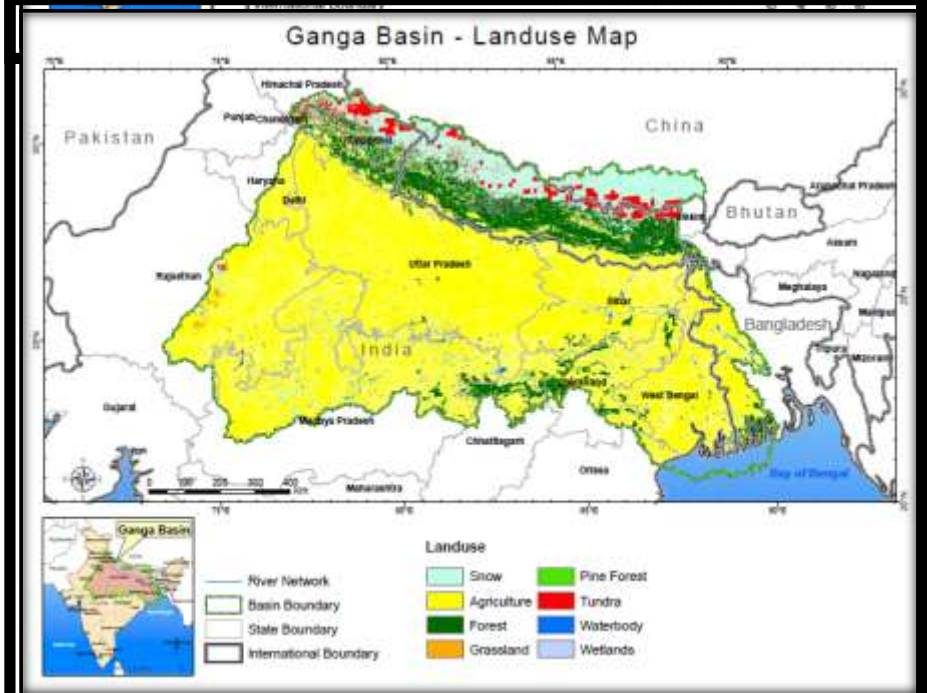
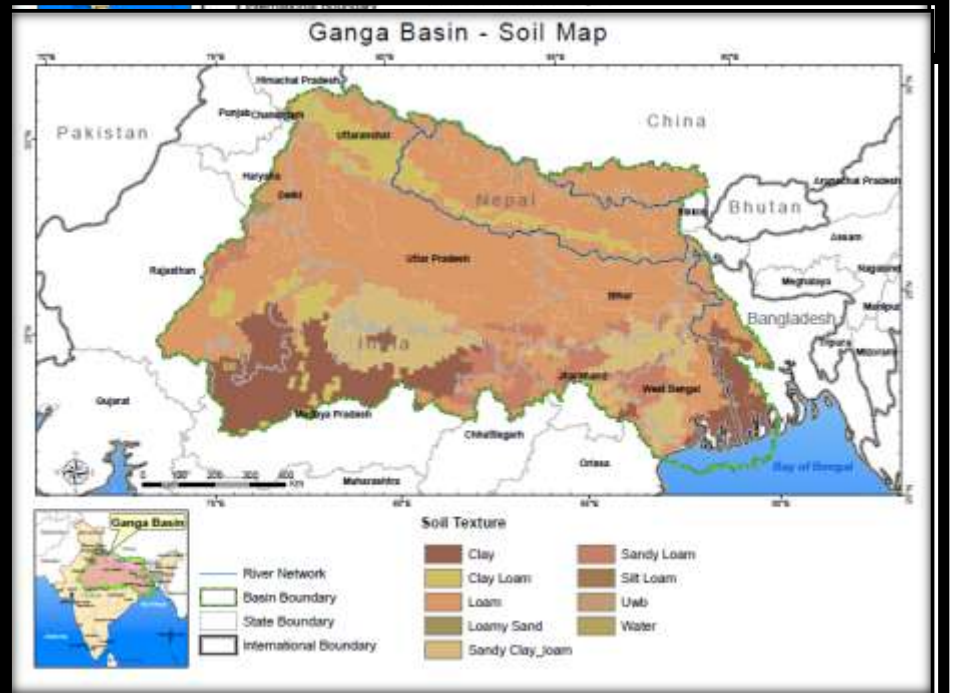
Ganga Basin Hydrological Modelling – Base layers

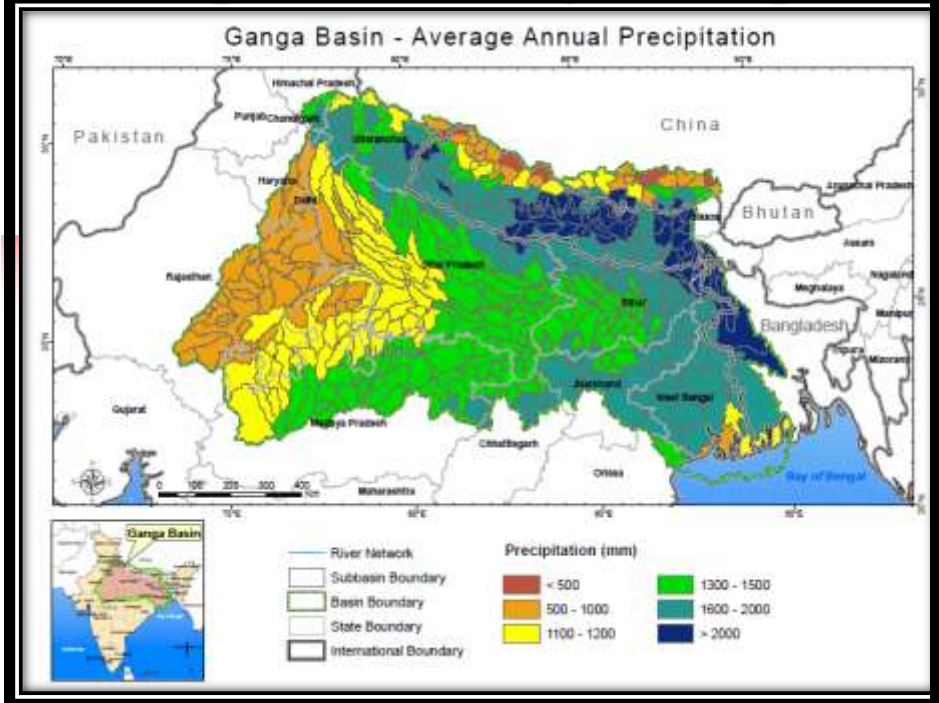


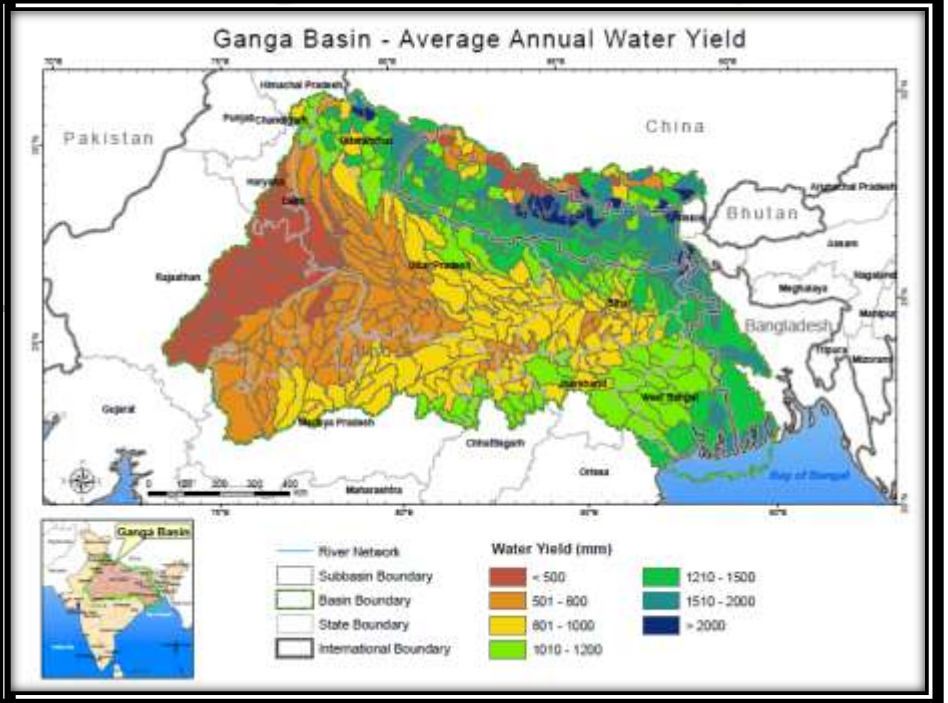


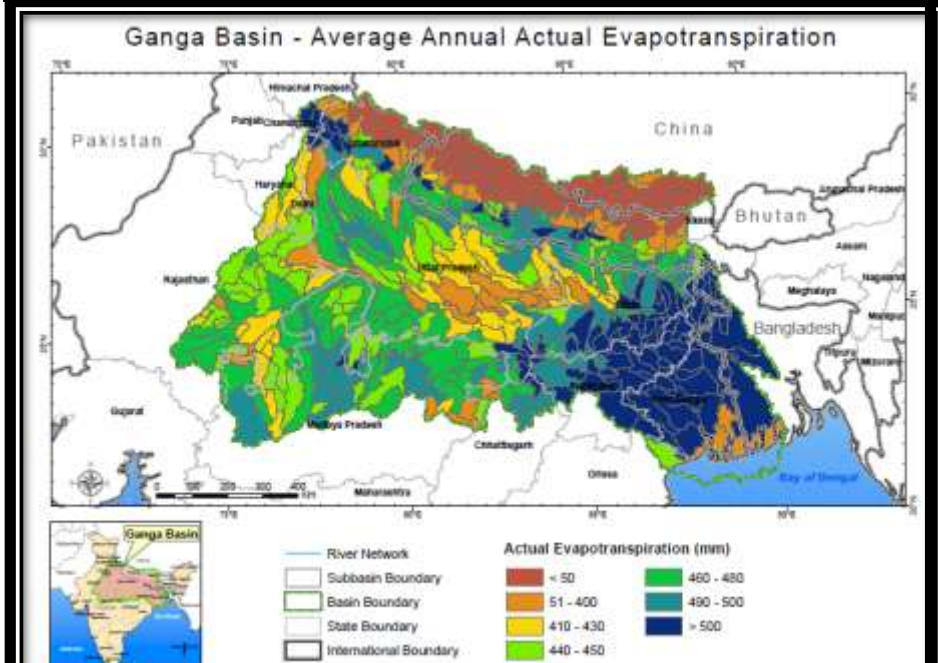


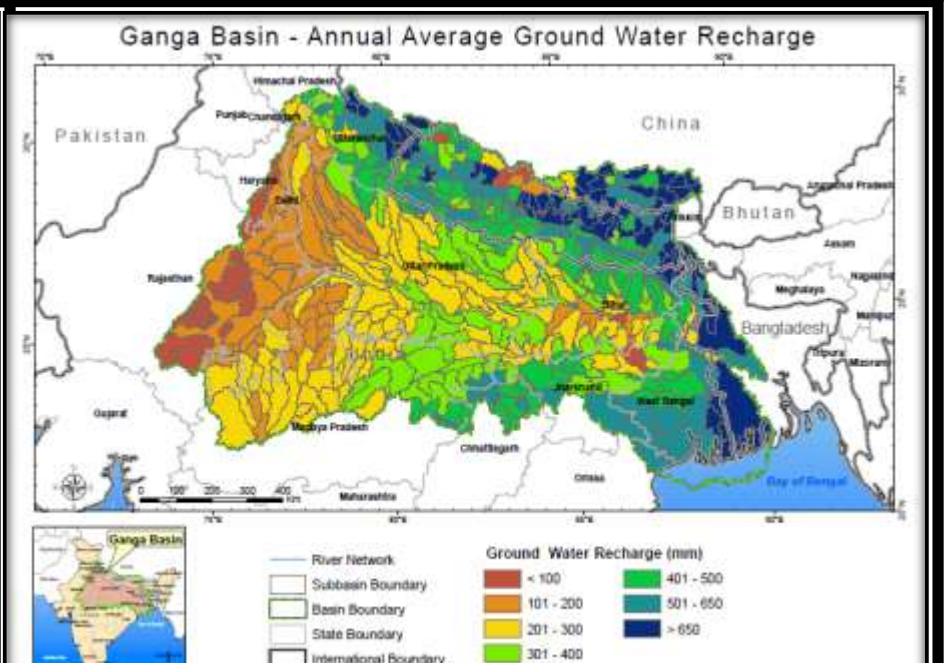


Ganga Basin Hydrological Modelling – SWAT Outputs

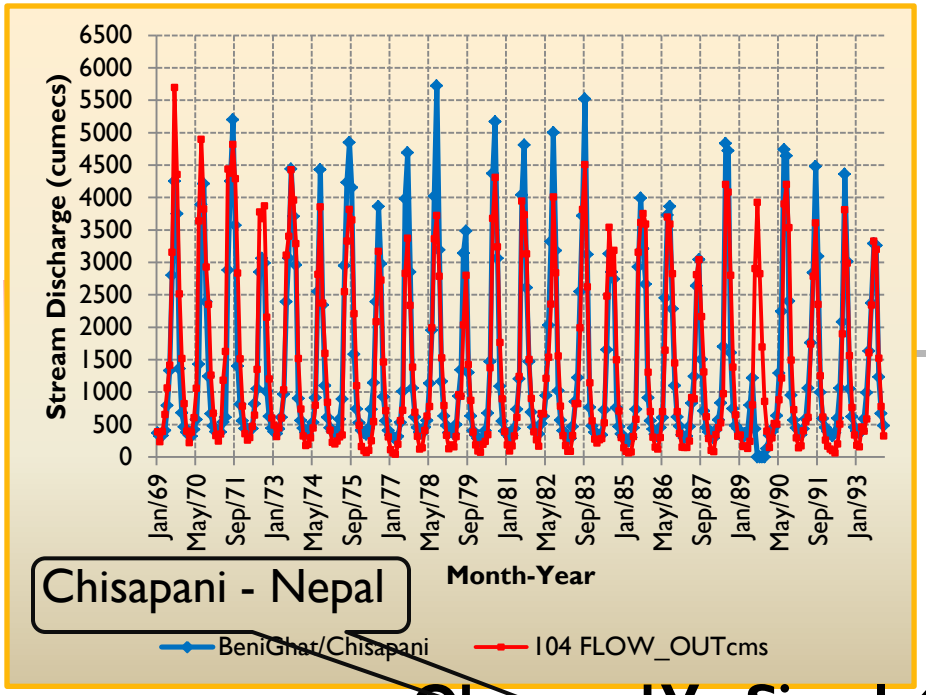


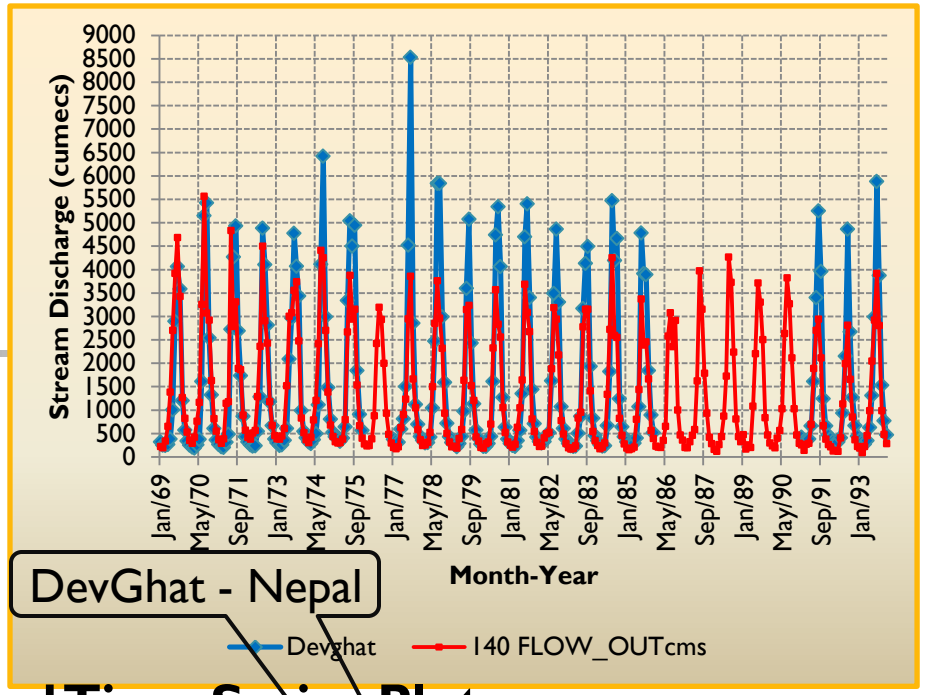


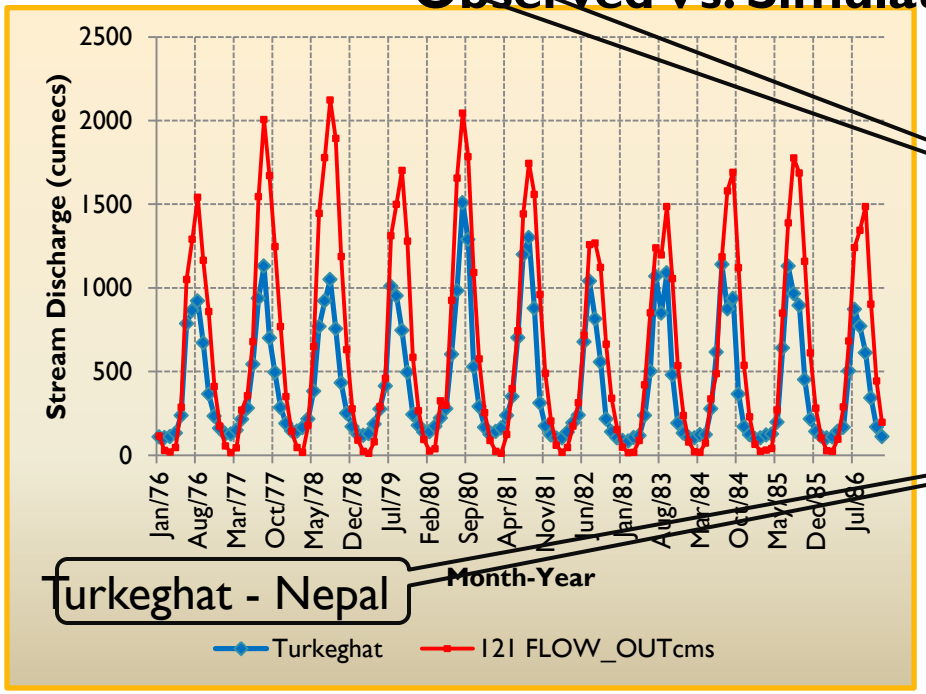


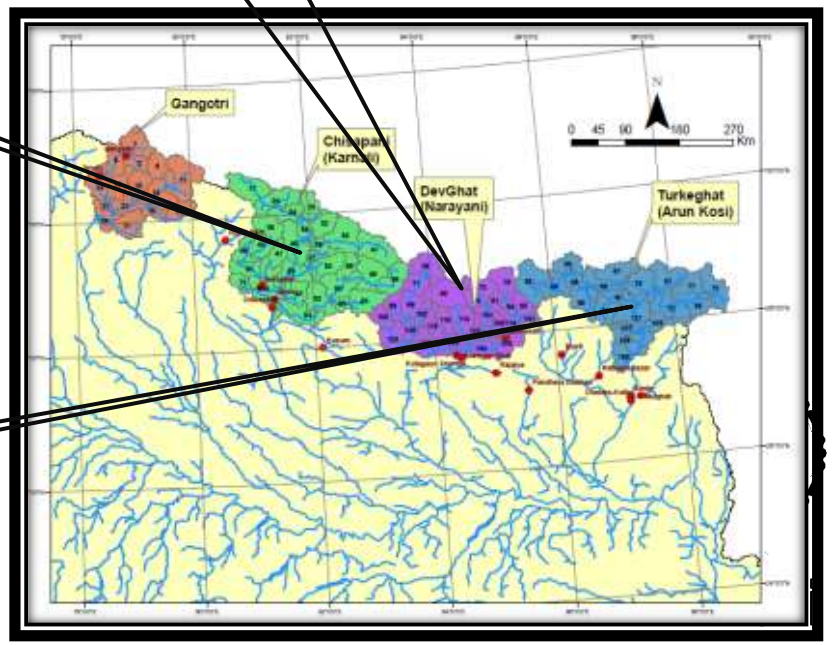


Observed Vs. Simulated Time Series Plots

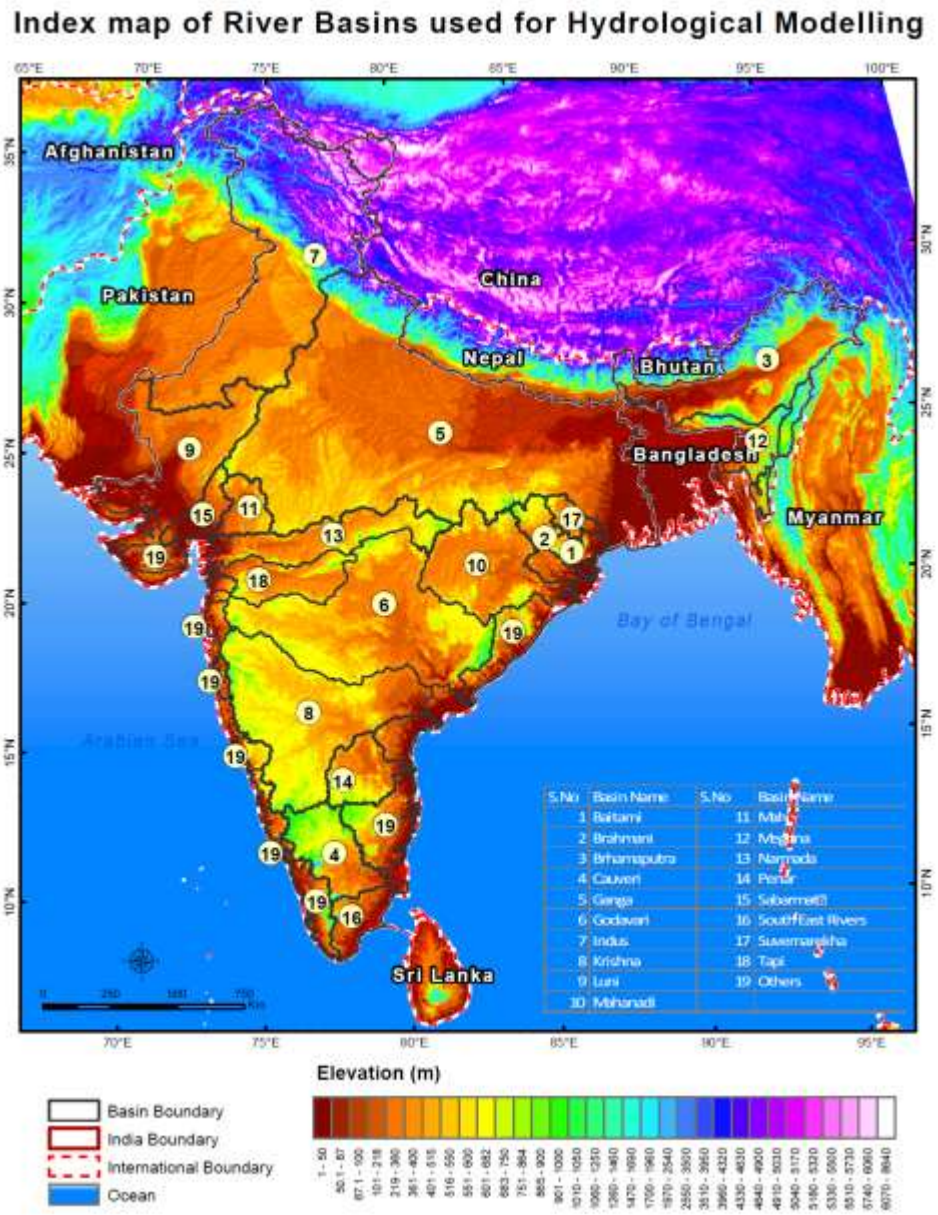








River Basins Modeled – NATCOM II



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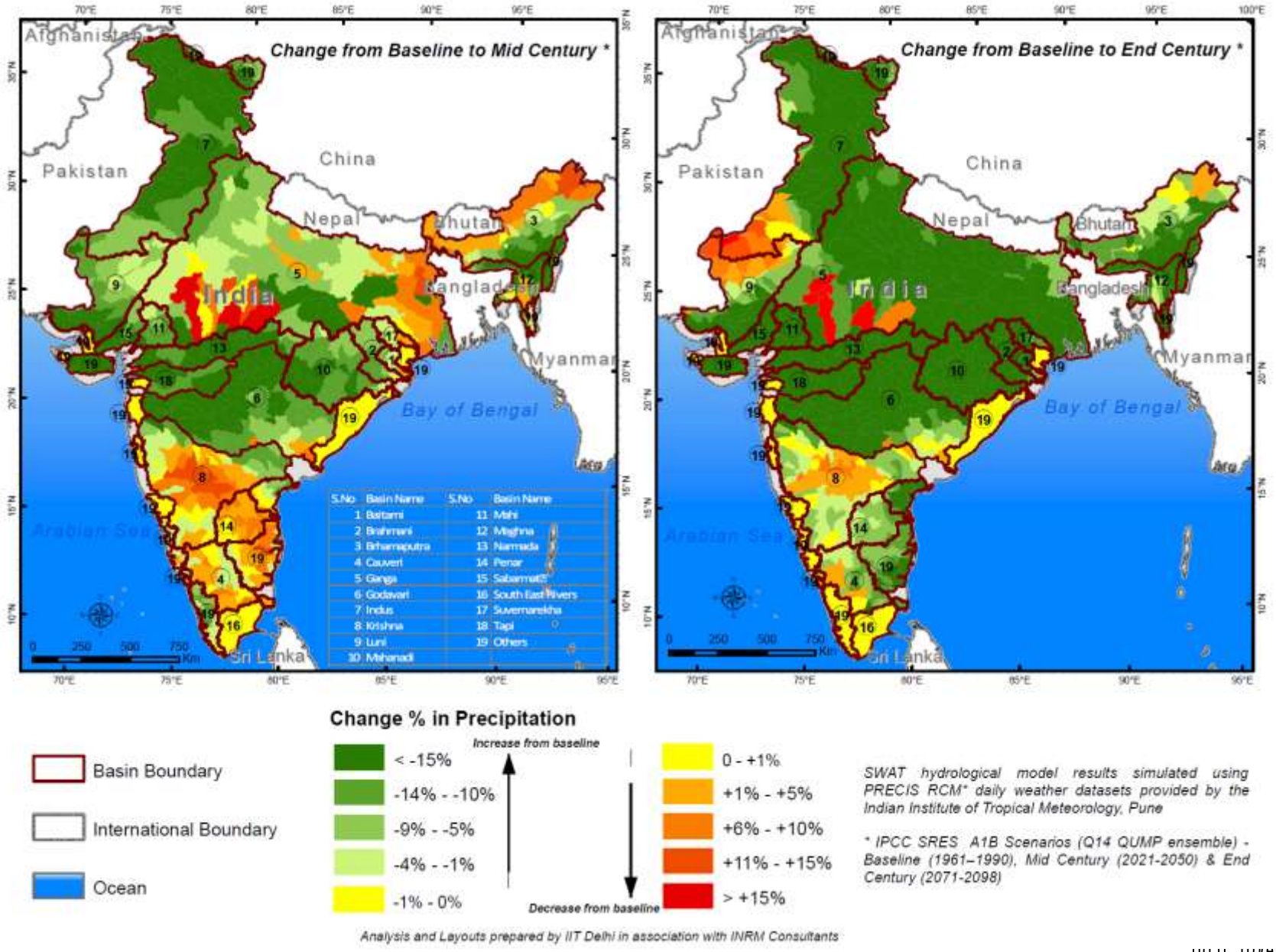
Percent Change in Precipitation across India



Change % in Precipitation

Increase from baseline

< -15%	0 - +1%
-14% - -10%	+1% - +5%
-9% - -5%	+6% - +10%
-4% - -1%	+11% - +15%
-1% - 0%	> +15%

Decrease from baseline

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)*

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

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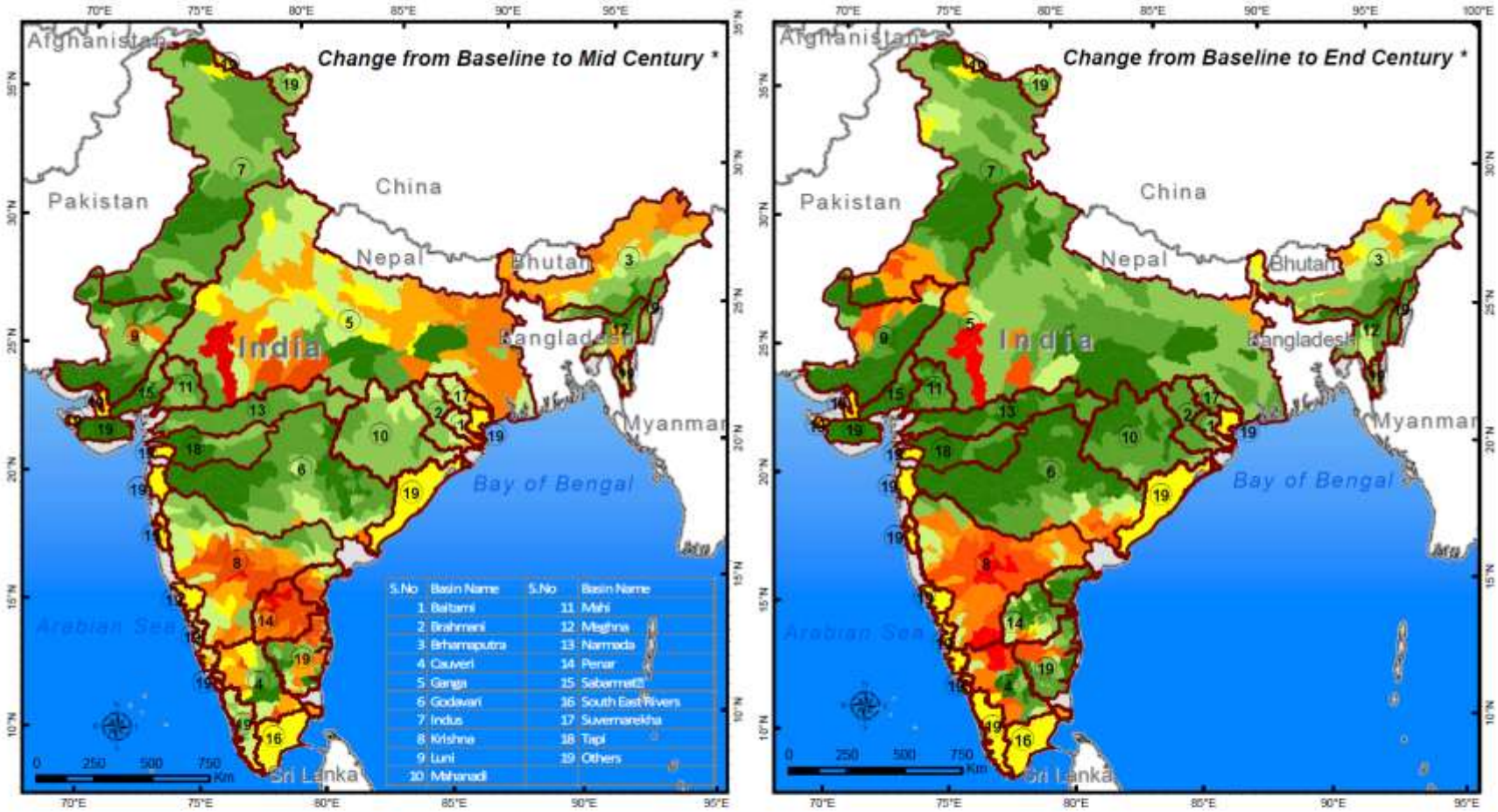
Percent Change in Water Yield across India



Change % in Water Yield

Basin Boundary

International Boundary

Ocean

Increase from baseline

< -50%

-49% - -25%

-24% - -10%

-9% - -1%

-1% - 0%

0 - +1%

+1% - +10%

+11% - +25%

+26% - +50%

> +50%

Decrease from baseline

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)*

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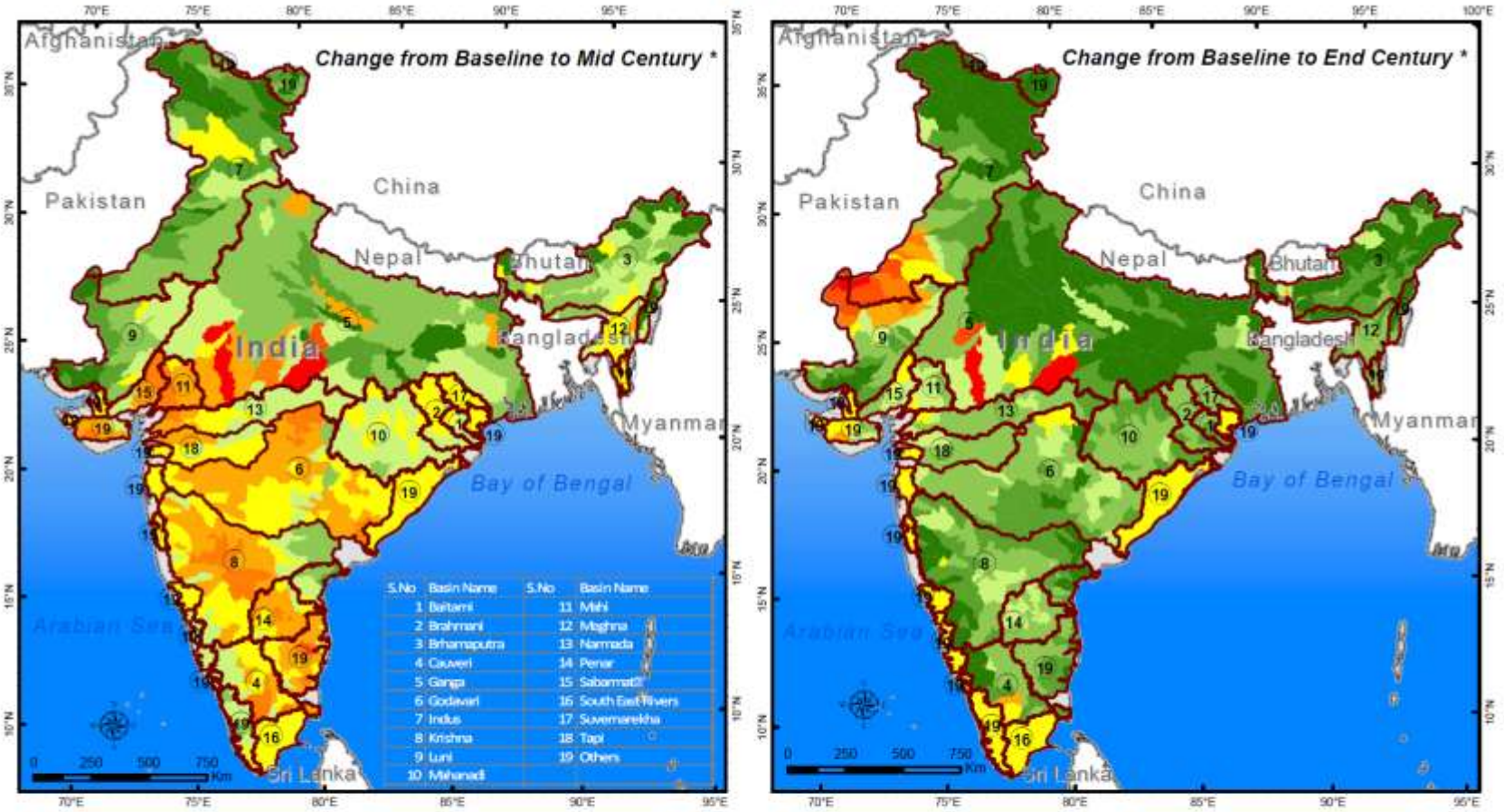
Percent Change in Actual Evapotranspiration across India



Change % in Actual Evapotranspiration

Basin Boundary

International Boundary

Ocean

Increase from baseline

< -15%

-14% - -10%

-9% - -5%

-4% - -1%

-1% - 0%

Decrease from baseline

0 - +1%

+1% - +5%

+6% - +10%

+11% - +15%

> +15%

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

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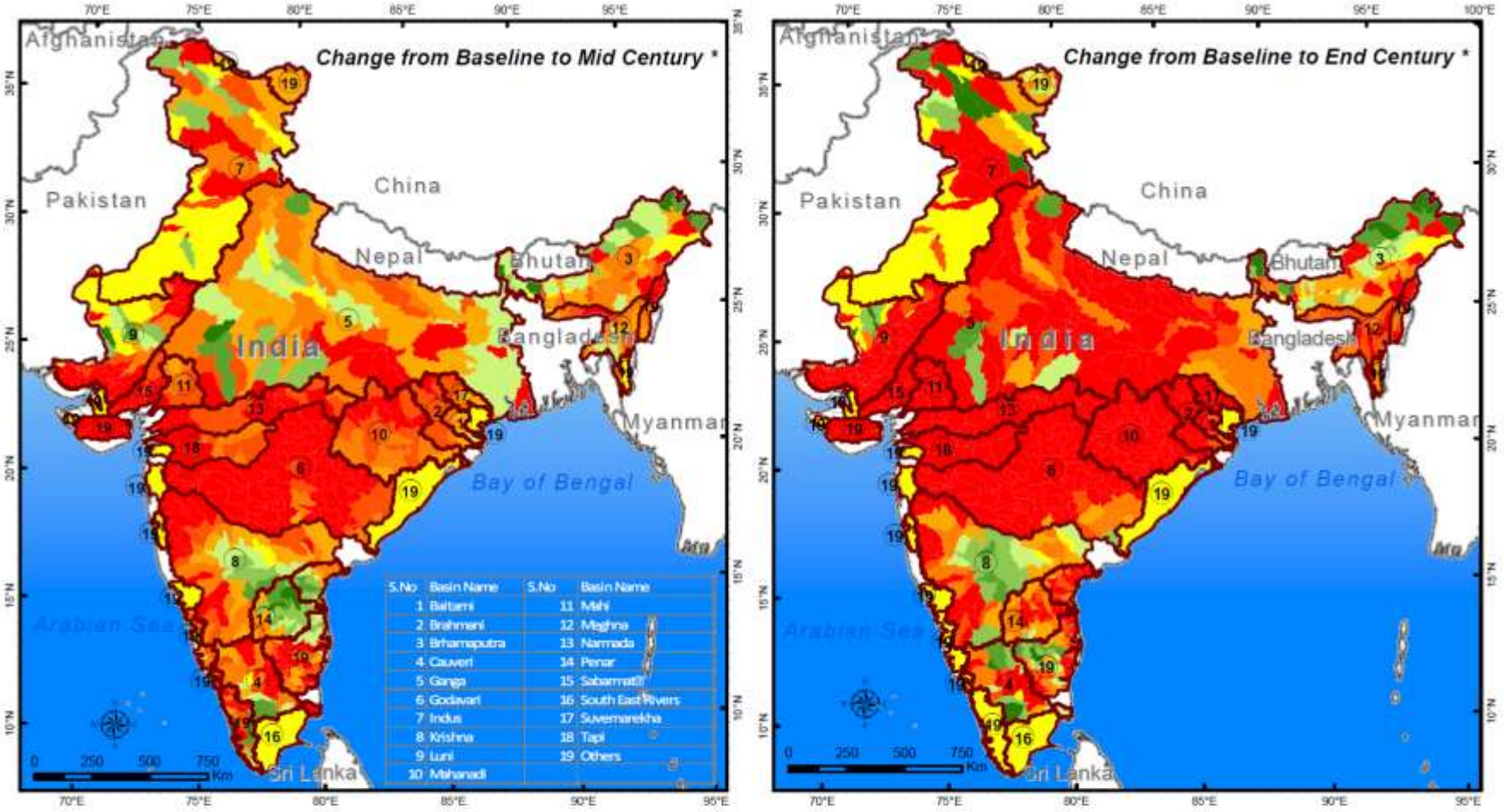
Percent Change in Sediment Yield across India



Change % in Sediment Yield

Increase from baseline

< -75%	0 - +1%
-74% - -50%	+1% - +25%
-49% - -25%	+26% - +50%
-24% - -1%	+51% - +75%
-1% - 0%	> +75%

Decrease from baseline

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*

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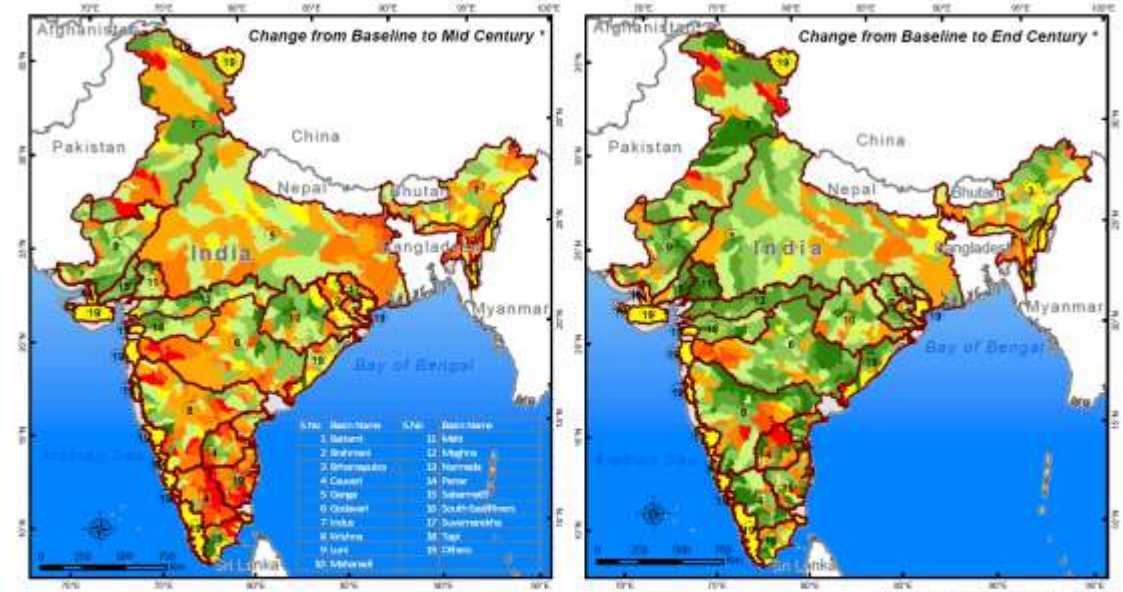
Percentage Change in Drought Weeks (JJAS) across India

Based on Agriculture Drought Index -1 (drought onset condition)



Change % in Drought Weeks (JJAS)

Basin Boundary

International Boundary

Ocean

Increase from baseline

< -30%
-29% - -20%
-19% - -10%
-9% - -1%
-1% - 0%

Decrease from baseline

0 - +1%
+1% - +10%
+11% - +20%
+21% - +30%
> 30%

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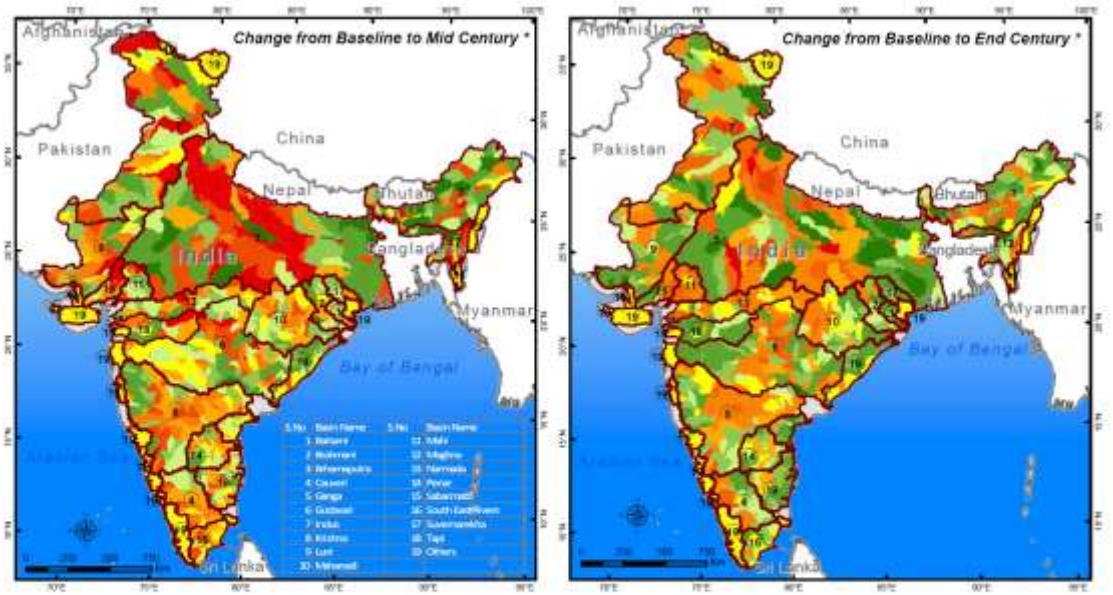
Percentage Change in Drought Weeks (JJAS) across India

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)

Basin Boundary

International Boundary

Increase from baseline

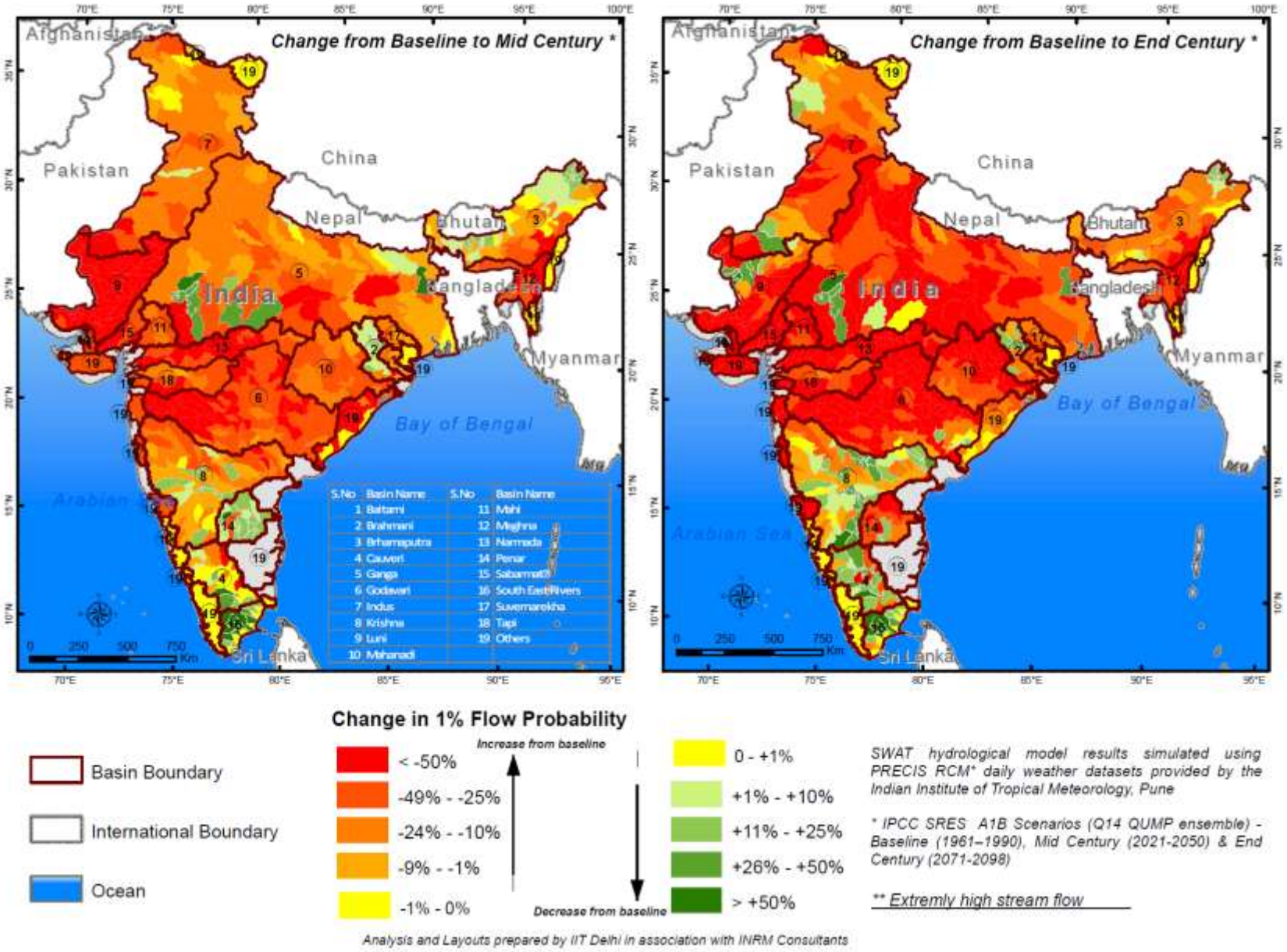
< -25%
-24% - -10%
-9% - -5%

0 - +1%
+1% - +5%
+6% - +10%

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

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



Change in 1% Flow Probability

Basin Boundary

International Boundary

Ocean

Increase from baseline

< -50%

-49% - -25%

-24% - -10%

-9% - -1%

-1% - 0%

Decrease from baseline

0 - +1%

+1% - +10%

+11% - +25%

+26% - +50%

> +50%

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)*

*** Extremly high stream flow*

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What the country needs?

- A common framework is required to provide integration across
  - Scales (interconnections of watersheds & river basin)
  - Sectors
- Shall provide mechanism to evaluate the interventions through simulation to
  - Provide scientific backup to development
  - Address the sustainability issue effectively under present and future conditions

Hydrological Information System (NATCOM) - Mozilla Firefox

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Hydrological Information System (NATCOM)

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

Print Map

Results

Map Contents

- HydroInfoSystem
  - Region
  - Basin
  - Catchment
  - SubCatchment
  - Stream@10LakhThreshold
  - Stream@2LakhThreshold
- WaterYield
  - SubCatchmentwiseAnnualV
    - 0.00
    - 0.01 - 54.59
    - 54.60 - 170.95
    - 170.96 - 308.24
    - 308.25 - 473.42

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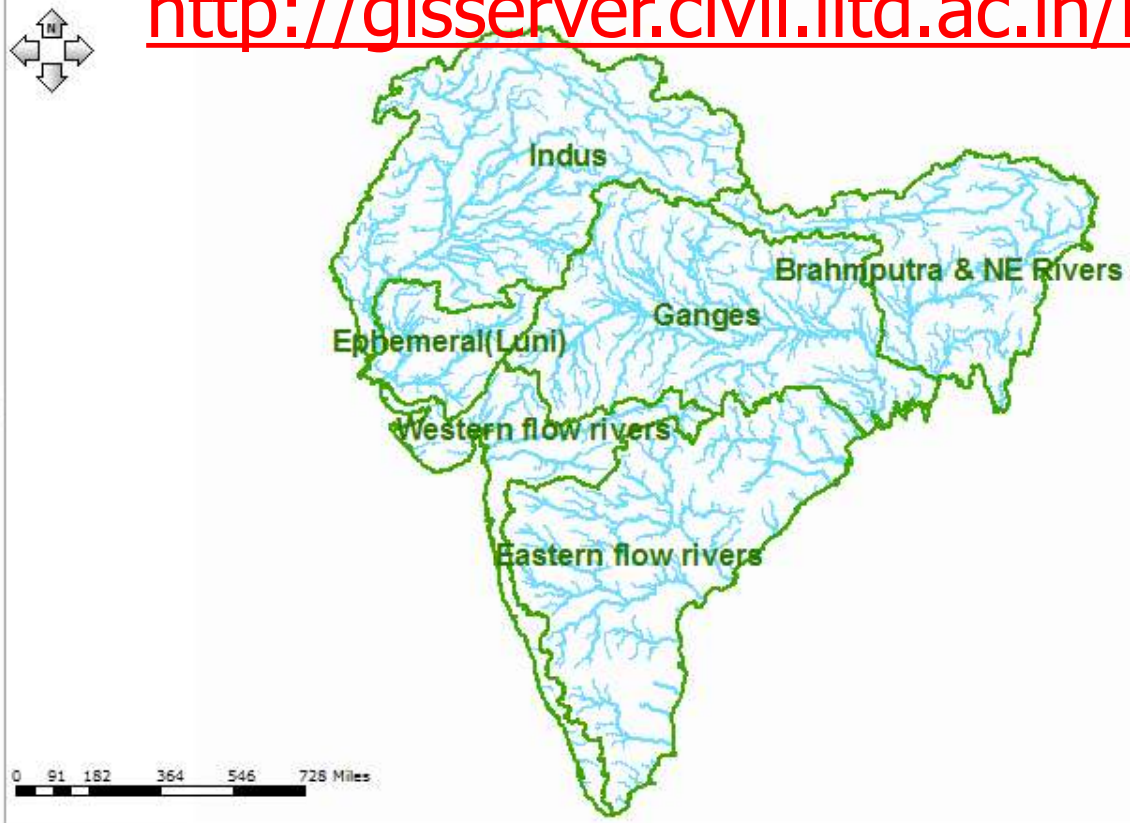

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SubBasinwise Model Results - Microsoft Internet Explorer

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SubBasinwise Model Results

Select ID:

0002
0003
0004
0005

Select Parameter:

Water Balance

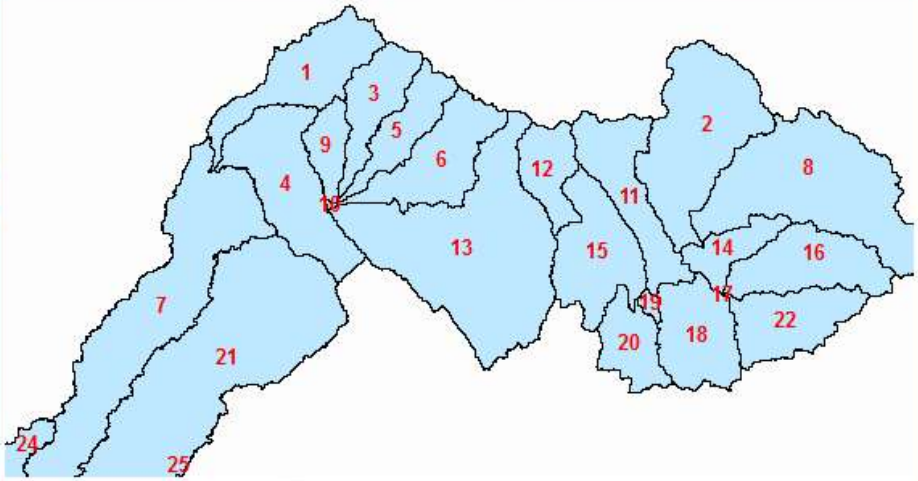
Select Time Range

From: 1996/01/1

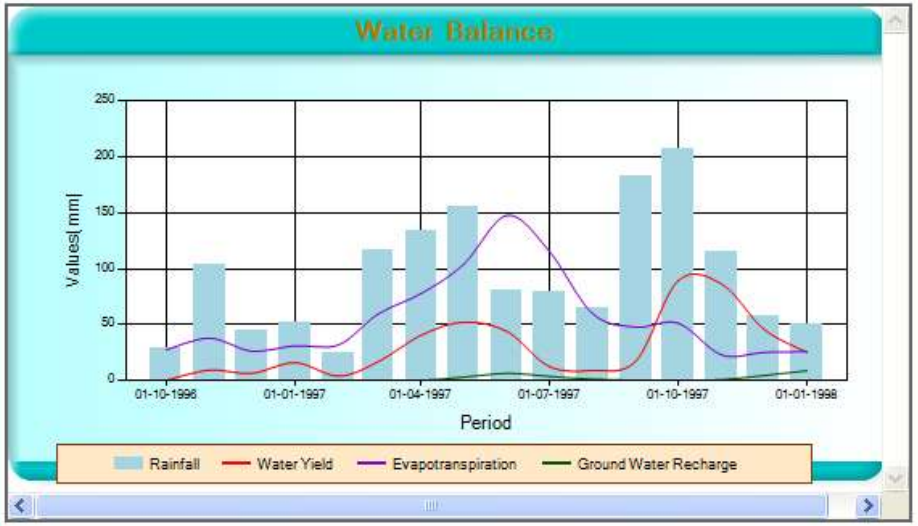
To: 1998/01/1

Show Table

Show Graph



SubBasin Beas



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Basinwise Model Results - Windows Internet Explorer

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Basinwise Model Results (SWAT)

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

Model Results: Chambal 20322

- Virgin Condition
- BL Condition

Select Parameter: Discharge

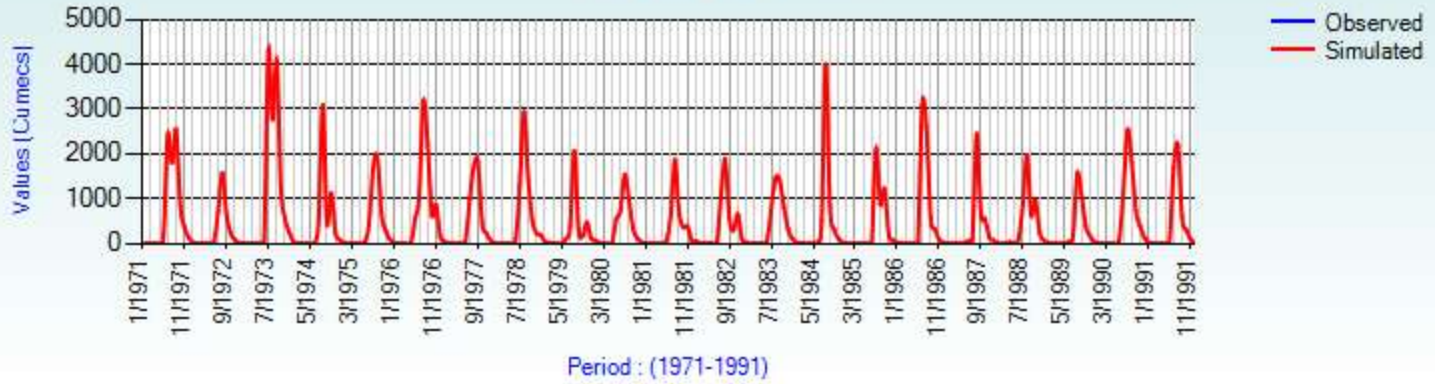
- Run with IMD Grid Data (1971-2005)
- HadRM3 Baseline (BL) (1961-1990)
- HadRM3 GHG Scenario (A2) (2071-2100)
- HadRM3 GHG Scenario (B2) (2071-2100)
- A1B Baseline Scenario (1961-1990)
- A1B Mid Century Scenario (2021-2050)
- A1B End Century Scenario (2071-2098)

Select Period: (Start-End) 1971 1991

Show Graph | Show Table

Discharge Graph: Chambal 20322

IMD Grid data: Virgin Condition



wb.aspx Internet | Protected Mode: On 100%

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Basinwise Model Results - Windows Internet Explorer

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Basinwise Model Results (SWAT)

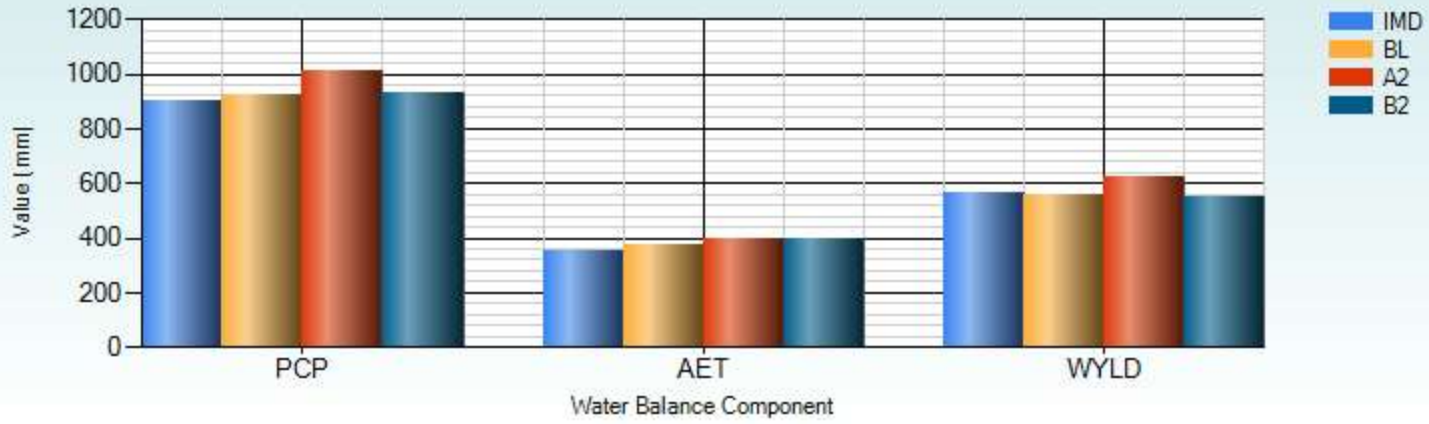
MODEL RESULTS VULNERABILITY ASSESSMENT ▸ CLIMATE CHANGE ANALYSIS ADVANCED ANALYSIS ▸

Climate Change Analysis: CHAMBAL 2032207

Average Annual Water Balance Components for IMD, with respect to Control for GHG Scenario

Show Graph

Average Annual Water Balance Components for IMD, with respect to Control for GHG Scenario Climate Scenario



IMD (1971-2000), BL (1961-1990), A2 (2071-2100), B2 (2071-2100)

analysis.aspx

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Conclusions

- Integrated water resource development and management framework is required to be adopted
- Creation of sharable information is essential for sustainable use of water resources
- The framework shall be useful for selecting meaningful adaptation options to climate change impacts

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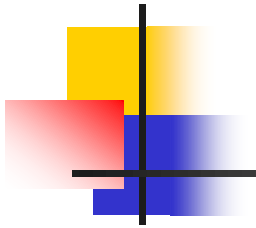

Thank you

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