CLIMATE CHANGE IMPLICATIONS ON DROUGHT AND FLOOD SITUATION OF THE KRISHNA AND MAHANADI RIVER BASINS

Focus of the study

- to understand the developments of drought in Krishna river basin and flood in Mahanadi river basins
- initial inferences of hypothesis suggest that Krishna river basin is more prone to the drought, whereas Mahanadi river basin indicate more flood prone events in future climate change projections

Spatial and Temporal Impacts

- Extreme events
  - Drought (Monsoon period) – reduced flows in dry seasons
  - Floods – higher flows during wet season

Climate Change and its Impact

- NATCOM – MoEF (with IIT Delhi) - Climate Change and its Impact on Water Resources
- Tools used
  - Modelling: SWAT (Soil and Water Assessment Tool)
  - GIS framework: acts as a pre-processor for the distributed modelling and for visualization of the outputs/results in terms of V & A
- Data used
  - Digital Elevation Model: SRTM 90 m
  - Land use: Global data, 1:2M USGS
  - Soil: Global data, 1:5M FAO
  - Drainage: 1:250,000
  - Weather: IPCC SRES A1B, Hadley Centre U.K. at a resolution of 0.44° X 0.44° latitude by longitude grid points obtained from IITM, Pune
    - Simulated climate outputs from PRECIS regional climate model (RCM) for Baseline (1961–1990) Mid-Century (2021-2050) and End-Century (2071-2098) used for SWAT Hydrology Model
- Impacts Studied
  - Extreme events – Floods and Droughts

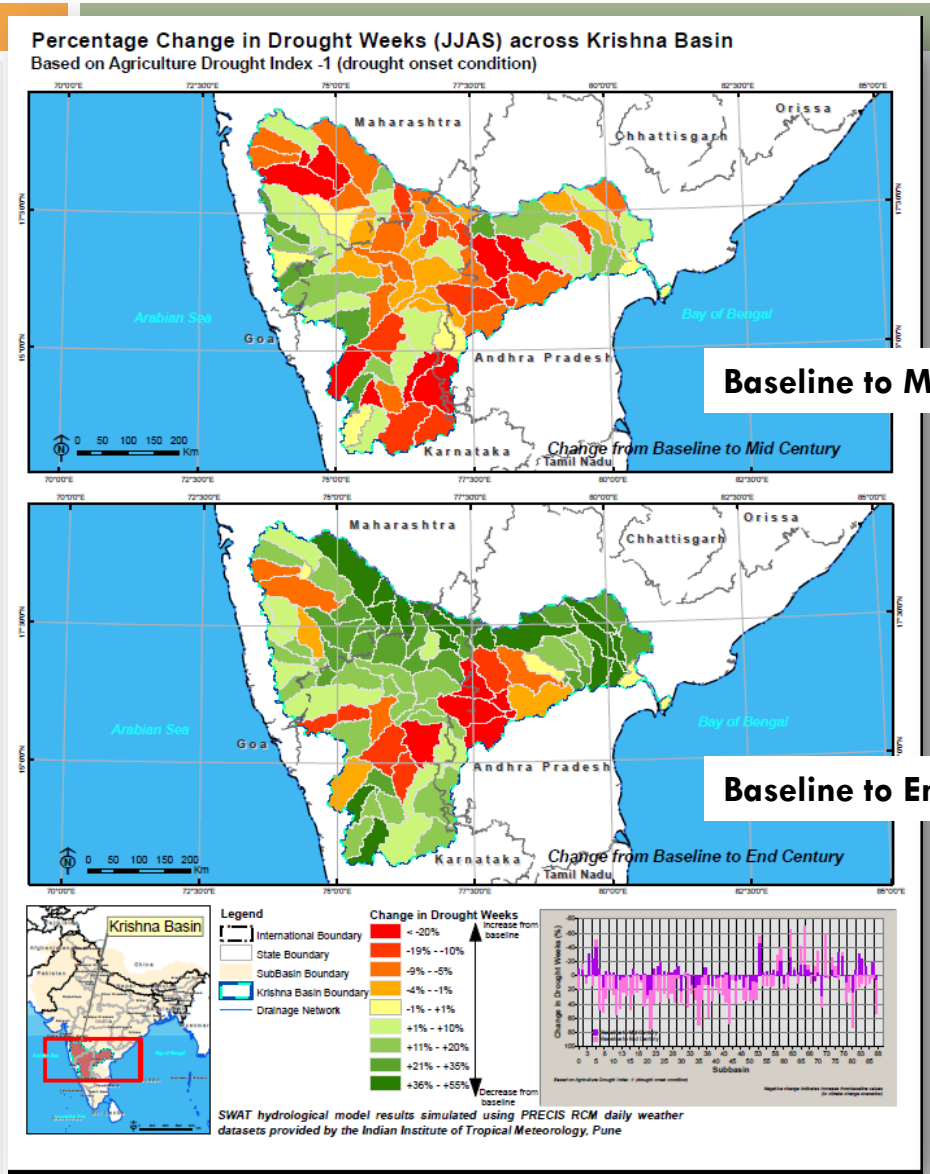
Vulnerability Assessment – Drought & Flood

- Soil Moisture Index to monitor drought severity
  - focuses on the agricultural drought where severity implies cumulative water deficiency
  - weekly information has been derived using daily SWAT outputs to incorporate the spatial variability
- Daily outflow discharge taken from the SWAT output
  - Maximum daily peak discharge has been identified for each year and for each sub-basin
  - analysis performed to identify those basins where flooding conditions may deteriorate in the GHG scenario

Drought Analysis

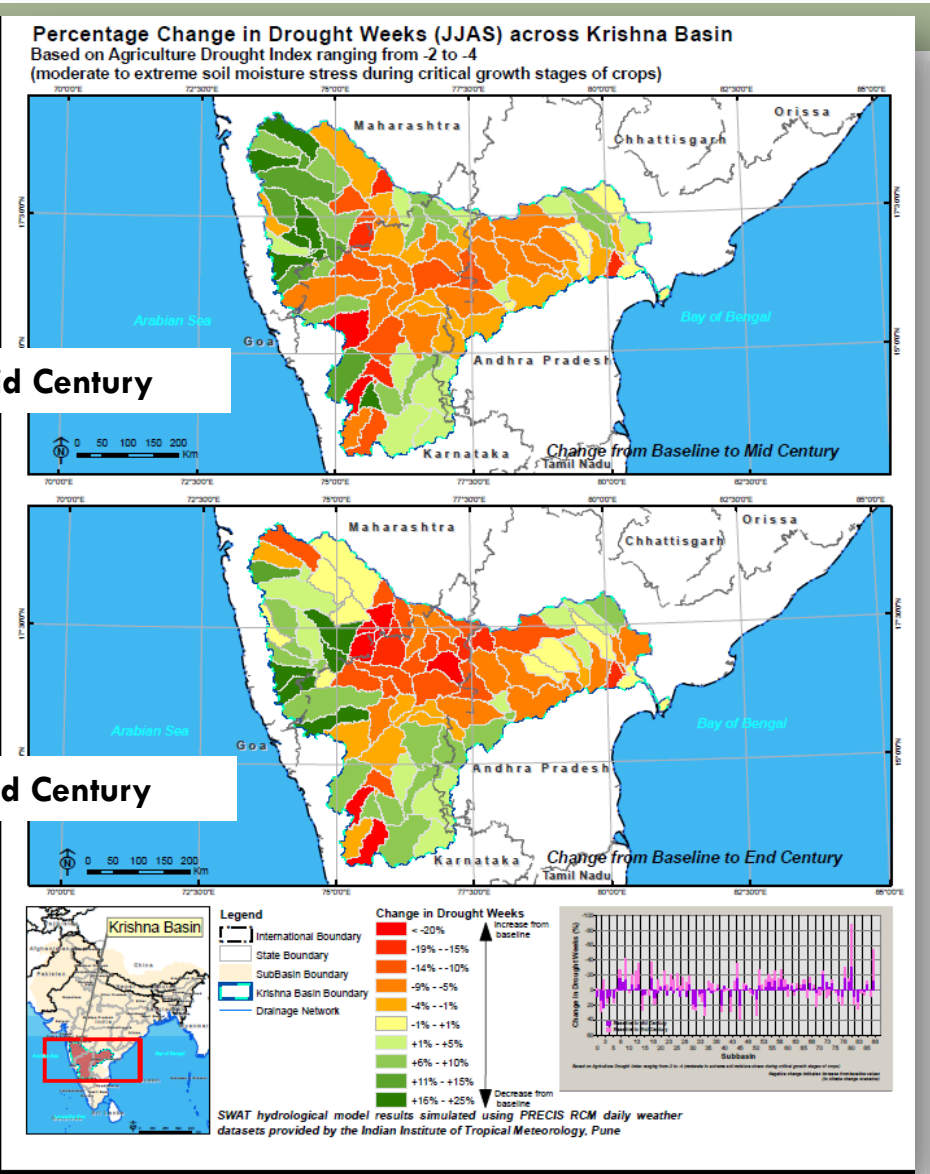
- Soil moisture index developed (Narasimhan and Srinivasan, 2005) to monitor drought severity using SWAT output to incorporate the spatial variability
  - to focus on the agricultural drought where severity implies cumulative water deficiency
  - Weekly information has been derived using daily SWAT outputs which in turn have been used for subsequent analysis of drought severity
- The severity of droughts effects is proportional to the relative change in climate
  - if a climate that usually has very slight deviations from the normal experiences a moderate dry period, the effects would be quite dramatic
  - On the other hand, a very dry period would be needed in a climate that is used to large variations to produce equally dramatic effects
  - Scale 1 (Index between 0 to -1) represent the drought developing stage and Scale 2 (Index between -1 to -4) represent mild to moderate and extreme drought condition.
- Soil Moisture Deficit Index (SMDI) was calculated for 30 years of simulated soil moisture data
  - from baseline (1961-1990), MC (2021-2050) and EC (2071-2098) climate change scenarios

Change in Drought Weeks - Spatial Distribution in Krishna Basin



Baseline to Mid Century

Baseline to End Century



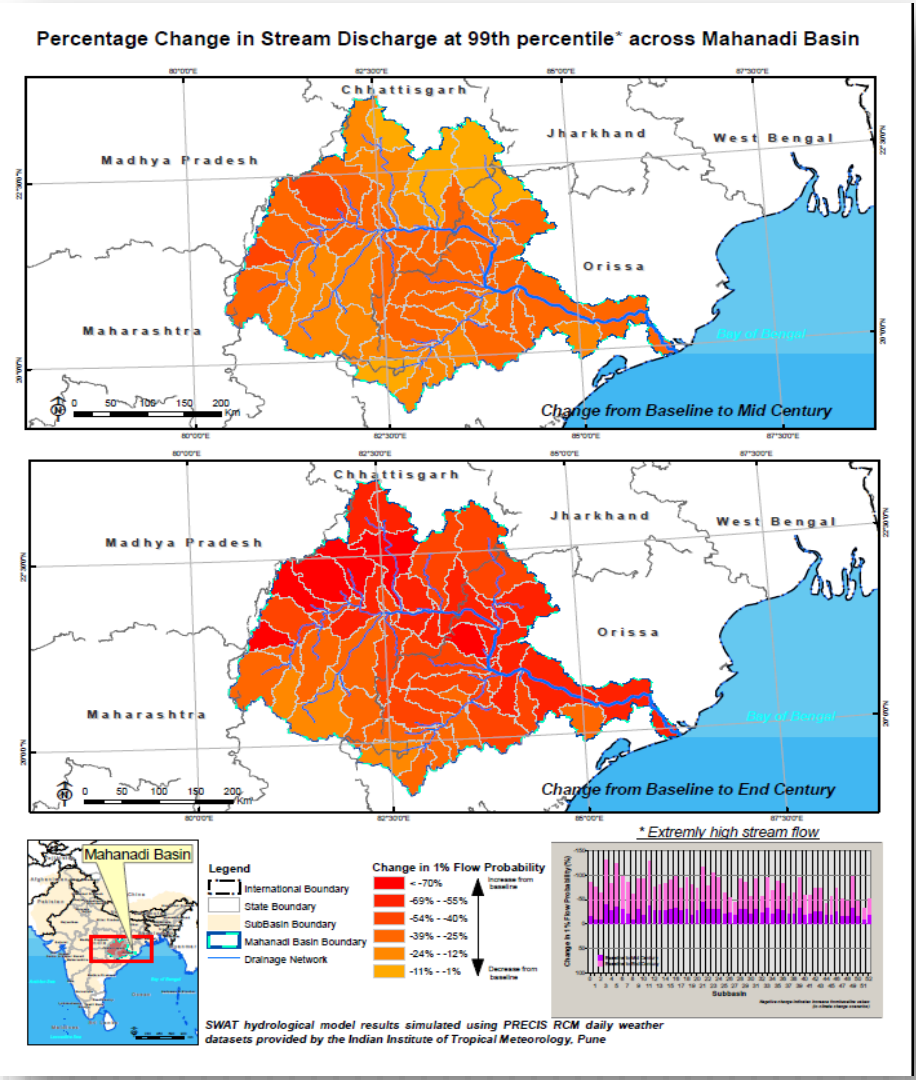
Interpretation

- the negative percentage value indicates the increase in probability of drought weeks , whereas, the positive value would indicate otherwise.
- the change from current condition to mid century show increased drought like condition (onset of drought) for all. However the long term scenario shows the improvement in the drought onset conditions
- the areas which may fall under moderate to extreme drought conditions (drought index value between -1 to -4) show the increase in severity of drought from baseline to mid century and end century scenario

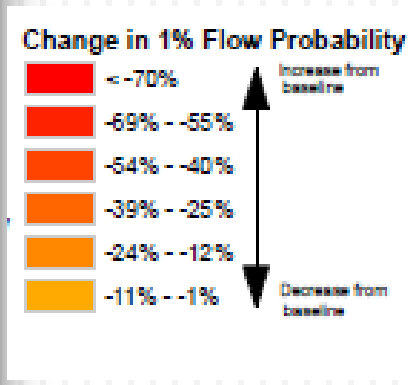
Flood Analysis

- The vulnerability assessment with respect to the possible future floods has been carried out using the daily outflow discharge taken for each sub-basin from the SWAT output
- These discharges have been analysed with respect to the maximum annual peaks
- Maximum daily peak discharge has been identified for each year and for each sub-basin
- Analysis has been performed to identify those basins where flooding conditions may deteriorate under the GHG scenario
- Change in the magnitude of flood peaks above 99th percentile, from flow duration curves have been plotted for the Mahanadi river basin for baseline (1961-1990), MC (2021-2050) and EC (2071-2098).

Flood Analysis for Mahanadi Basin - Change in Extreme Flow



- Spatial variation in Change in stream discharge at 99th percentile from Baseline to Mid-Century and Baseline to End-Century



Interpretation

- the negative percentage value indicates the increase in probability of floods , whereas, the positive value indicates otherwise.
- the change is indicated in this map in shades from peach to red. the spread of red across the map indicates increase in maximum peak discharge for entire basin
- It is predicted, in mid-Century daily peak discharge may increase by approximately upto 40%, meanwhile by end-century the discharge can be 50 to 70% more of what it is in the baseline period.

Uncertainties

- Uncertainties in Climate Simulation
- Assumptions and Coarseness of the Data
  - Landuse has been coarse
  - detailed data on the agricultural land use and the cropping pattern has not been used
  - Soil type and profile has also been scanty
  - Water bodies including reservoirs were not incorporated due to lack of data on their capacities and the operation rules

Thank You