Spatio-temporal changes in extreme events over Godavari Basin : Risks and Opportunities

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Context

In a non-stationary climate conditions, frequency of Extreme rain events (EREs) are expected to increase.
Identification and implementation of appropriate management action to mitigate the impacts of EREs is crucial step in adaptation strategies and to contribute to secure the livelihoods and disaster prevention.

*The **objective** of the study is* to examine the spatial and temporal changes in the extreme rainfall events (EREs) across the Godavari river basins of India.

Basin level "Spatio Temporal Variability of Extremes"

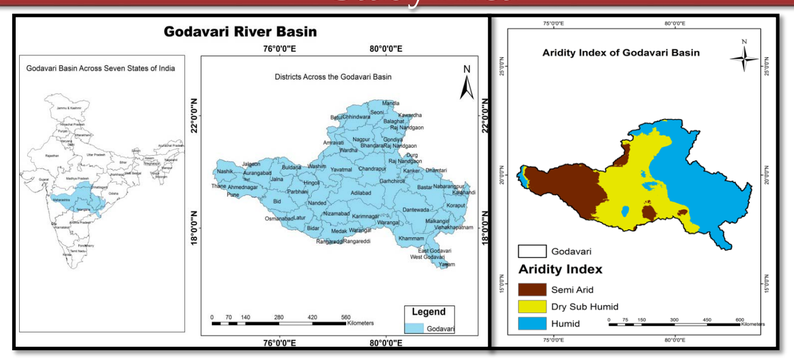
⇩

Vulnerability to extremes

⇩

National and State action plan on climate change ⇦ Location specific Adaptation Strategies ⇨ District level adaptations plan

Study Area



- Godavari river basin is the third largest drainage basin (3,12,812 Sq.km) in the Indian sub-continent, which drains into the Bay of Bengal.
- The total area of river basin is spread across seven states: Maharashtra (48.6%), Andhra Pradesh (4.5%), Telangana(18.8%), Karnataka (1.4%), Orissa (5.7%), Chhattisgarh (10.9%), and Madhya Pradesh (10.0%).
- The climate of the basin is Semi-Arid, Sub-humid and Humid in nature.

Data & Methods

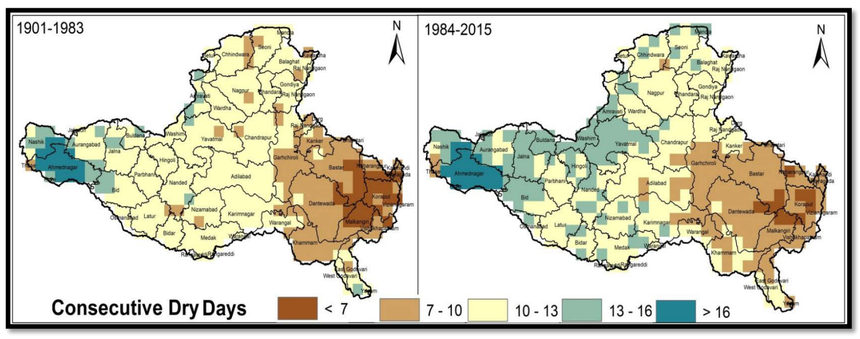
- Daily rainfall data of monsoon months (June to September) from 1901-2015 at high spatial resolution (0.25° × 0.25°) prepared by India Meteorological Department (IMD, Pai et al 2014) is used to analyse the spatial and temporal patterns of extreme rain events.
- The time period is divided into two sub periods (1901-1983 and 1984-2015) to understand changes in climate indices referring to extreme events.

Climate Indices used in the study to understand spatio temporal changes across basin

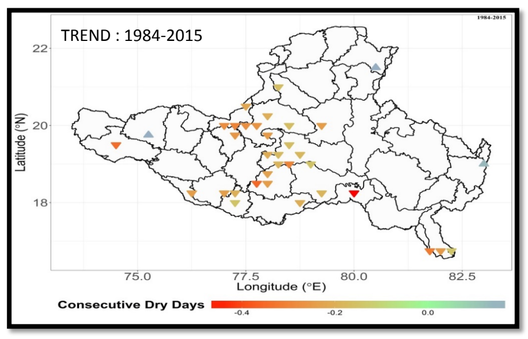
Consecutive Dry Days (CDD)	➡	**Maximum length of dry spell**
Consecutive wet days (CWD)	➡	**Maximum length of wet spell**
Simple Daily Intensity (SDI)	➡	**Daily precipitation amount greater than 1mm on wet days**
Highest one day precipitation (Rx1)	➡	**Daily maximum 1-day precipitation**
Rainfall > 10mm (R10mm)	➡	**Number of days with daily precipitation larger than 10 mm.**
Rainfall > 20 mm (R20mm)	➡	**Number of days with daily precipitation larger than 20 mm.**

Mann-Kendall and Student's T test are used to calculate trend and difference in two periods mean

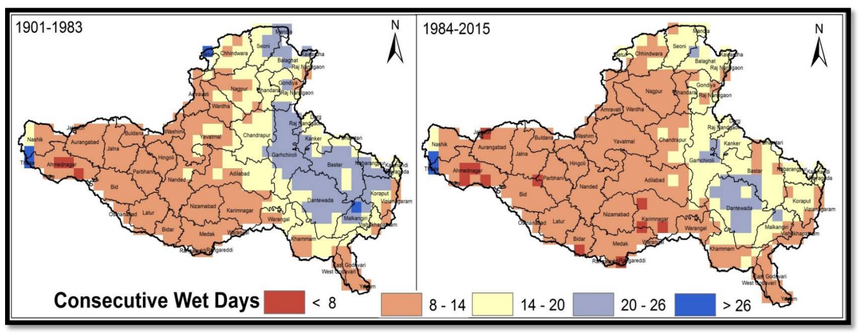
Results



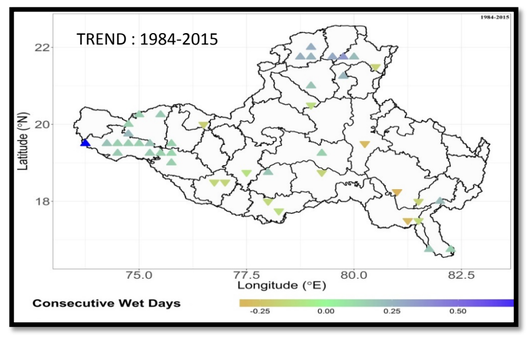
Temporal changes during the later periods (1984-2015) showed that area having 13-16 CDD increased in central part of basin.



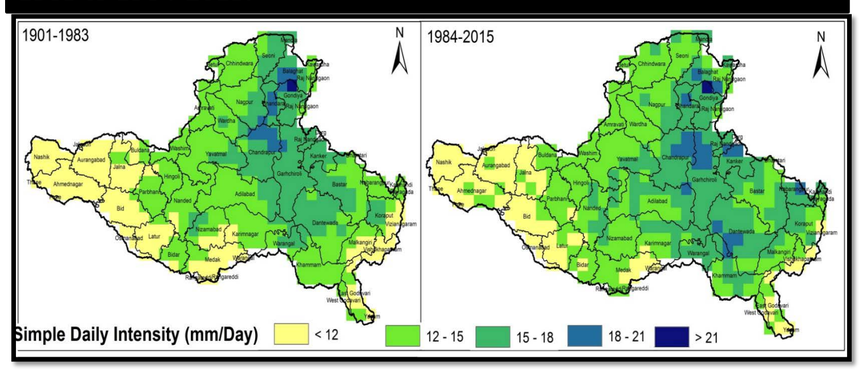
The CDD showed a decreasing trend in the central regions in the period 1984-2015.



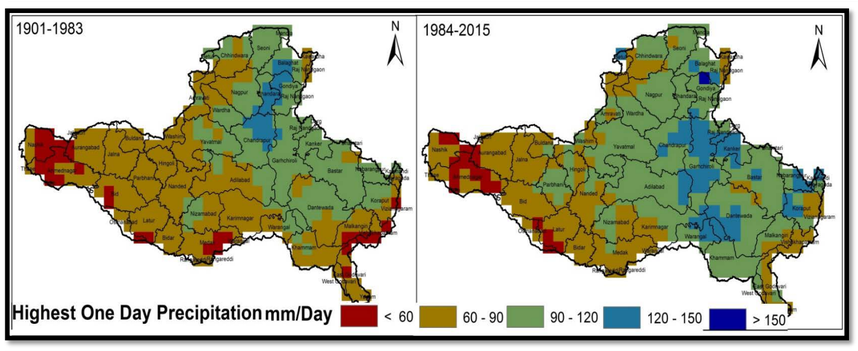
The areas in the eastern region with average high rainfall have CWD decreased from 20-26 days to 14-20 days between 1901-1983 to 1984-2015.

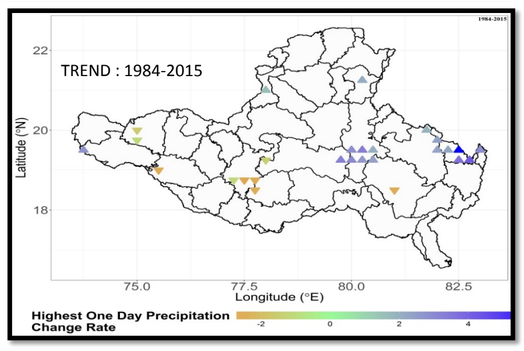


In the years 1984-2015, this increasing trend of CWD was observed mostly in the western region of the basin



The intensity of daily rainfall has increased from 15-18mm to 12-15 mm over the western region having average low rainfall.





Area receiving highest one day precipitation has increased in the eastern part of the basin in year 1984-2015.

Difference in means of 1901-1983 and 1984-2015 for various extreme precipitation indices for selected districts of each region.

Region	Months	Rx	SDI	CWD	CDD	10MM	20MM
Ahmednagar (Western region of basin, low rainfall zone)	July	0.2	0.42	**-0.96 ***	0.59	-0.33	-0.18
	Aug	**7.31 ***	**2.78***	**0.54***	0.39	-0.51	**0.39***
	Sep	-2.63	0.13	-0.2	-1.37	0.17	-0.04
Yavatmal (Central region of basin, Medium rainfall zone)	July	0.44	1.03	**-1.76***	1.24	**-1.72***	**-0.82***
	Aug	**12.9***	**1.95***	-0.8	1.0	-0.26	-0.3
	Sep	**-14.81***	**-2.55***	0.82	**1.74***	**-1.54***	**-1.02***
Balaghat (Eastern region of basin, High rainfall zone)	July	3.46	1.24	**-2.68***	0.32	**-2.31***	**-1.52***
	Aug	**-15.27***	**-2.39***	1.16	0.38	**-1.67***	**-1.54***
	Sep	1.24	-0.09	**-1.24***	**1.94***	**-1.36***	**-0.81***

**** 5% level of Significance***

There are month wise changes in extreme events. For example, Ahmednagar district (located in low rainfall region of the basin) showed an increase in extreme rain events (in August) whereas Balaghat district (in the "high rainfall(eastern) region" of the basin) showed decrease in the extreme rainfall indices such as SDI, CWD and Rx1 (in July, August & September)

Important Take Away

- There are changes in extreme rain events happening across the basin which has implications on local level adaptation plans.
- Significant changes observed in extreme events in the monsoon months (June to September) which affect the crop growth stages and yield. Then accordingly district level crop contingency plan need to be review.
- It is important to understand changes in EREs at specific locations while operationalizing the respective state action plan for climate change and to safeguard against disasters resulting from changes and to capitalize on potential opportunities .

Reference:
Pai, D.S., Sridhar, L., Rajeevan, M., Sreejith, O.P., Satbhai, N.S. and Mukhopadhyay, B., 2014. Development of a new high spatial resolution (0.25× 0.25) long period (1901–2010) daily gridded rainfall data set over India and its comparison with existing data sets over the region. Mausam, 65(1), pp.1-18

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