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DROUGHT DETECTION AND ASSESSMENT OVER KRISHNA RIVER BASIN WITH SPI AND SPEI INDICES

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INTRODUCTION

Drought is slowly evolving natural disaster and lasts for longer duration of time by creating a huge impact on lives of the individual and Nation. Global drought assessment was primarily based on drought indices. The present study compares the precipitation based drought index, Standardized Precipitation Index (SPI), with precipitation & temperature based drought index of Standardized Precipitation and Evapotranspiration Index (SPEI) for the major drought years of Krishna river basin. The SPI and SPEI values were characterized in terms of drought areal extent, severity, frequency and duration for the major drought years over the basin. The SPEI has identified the drought years as more severe compared to SPI as it accounts for the temperature variability in the drought estimation.

OBJECTIVE

- To evaluate the variability of Standardized Precipitation Index (SPI) and Standardized Precipitation Evapotranspiration Index (SPEI) drought index.
- To analyze the characteristics of SPEI and SPI in order to capture various drought years over the basin.
- To study the historical drought years in terms of areal extent, severity, frequency and duration over Krishna river basin, which is a semi-arid river basin in India.

Figure: Study Area: Krishna River Basin

METHODOLOGY

SPI (Standardized Precipitation Index)

Precipitation data-set is fitted to gamma distribution, which is then transformed into a standard normal distribution so that the mean SPI for that particular region becomes zero. The gamma distribution cumulative function is given as follows:

$$f(x) = \frac{1}{b^a \Gamma(a)} \int_0^x t^{a-1} e^{-t/b} dt$$

Where, Γ(.) is the Gamma function, a and b are shape and scale factors respectively

SPEI (Standardized Precipitation Evapotranspiration Index)

Three-parameter log-logistic distribution is used to fit the accumulated monthly difference between precipitation and PET (Vicente-Serrano et al., 2010). The probability density function (pdf) (f(x)) and cumulative distribution function (CDF) of distribution is:

$$f(x) = \frac{\beta}{\alpha}\left(\frac{X-\gamma}{\alpha}\right)^{\beta-1}\left[1+\left(\frac{X-\gamma}{\alpha}\right)^{\beta}\right]^{-2} \qquad F(x) = \left[1+\left(\frac{X-\gamma}{\alpha}\right)^{-\beta}\right]^{-1}$$

where α, β and γ are the scale, shape and origin parameters respectively.

RESULTS

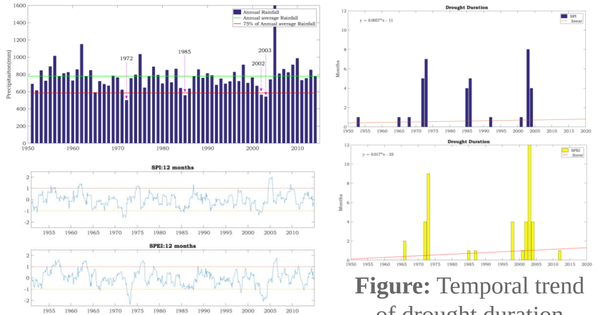

Figure: Drought years and SPI & SPEI accumulated of 12 months

Figure: Temporal trend of drought duration

Year	Drought type	SPI	SPEI
1972	Moderate	21.55	15.51
	Severe	24.13	34.48
	Extreme	25.86	28.73
1985	Moderate	23.27	29.02
	Severe	23.56	16.38
	Extreme	11.20	4.88
2002	Moderate	28.73	35.63
	Severe	15.80	34.19
	Extreme	4.88	12.06
2003	Moderate	19.54	12.35
	Severe	23.56	16.38
	Extreme	19.25	50.86

Table: Percentage areal extent in Krishna basin.

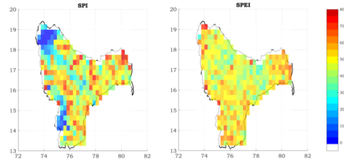

Figure: Spatial drought categorizations based on SPI and SPEI at 12-month scale.

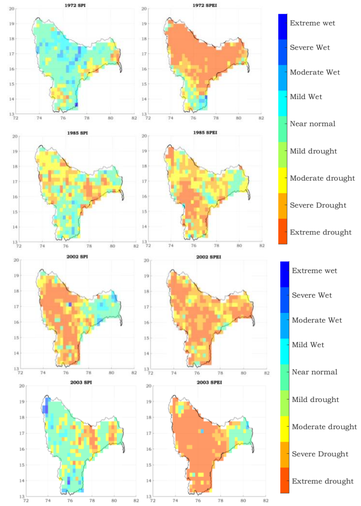

Figure: Spatial drought categorizations based on SPI and SPEI at 12-month scale.

DATA-SETS

Temperature 1 degree (1951 - 2014) IMD	Precipitation 0.25 degree (1901 - 2015) IMD

CONCLUSION

- SPEI performs better than SPI as it accounts for temperature variability.
- Drought frequency for the basin based on SPI is greater than the SPEI.
- In 2003, moderate drought last for a complete year (SPEI) whereas for (SPI) it has lasts for about 8 months.
- As SPEI can account for the atmospheric water demand accounting for both precipitation and evapotranspiration can prove to be a promising drought monitoring tool at river basin scale.