Data Article

Rainfall Variability During El Nino, La Nina and Neutral Years Over Karnataka

ABSTRACT

The El Niño-Southern Oscillation (ENSO) is a recurring climate pattern involving changes in the temperature of waters in the central and eastern tropical Pacific Ocean. The three phases of the El Niño–Southern Oscillation (ENSO) namely the neutral phase, El Niño and La Niña oscillations. El Niño refers to the above-average sea-surface temperatures that periodically develop across the east-central equatorial Pacific. It represents the warm phase of the ENSO cycle. La Niña refers to the periodic cooling of sea-surface temperatures across the east-central equatorial Pacific. The state of Karnataka is located on a table land in the angle where the Western and Eastern Ghat ranges converge into the Nilgiri hill complex. 41 year (1980-2020) average annual rainfall of Karnataka collected from the rain gauge station located under the farm universities of Karnataka and, SST and SOI data collected from NOAA were used to study the rainfall variability while ENSO events. The El Niño events will deviate the rainy winds towards eastern pacific region causing lesser rainfall on Indian sub-continent or draughts in some years, but when it comes to Karnataka El Niño events have given above average rainfall. There were 8 episodes of excess rainfall and 6 episodes of deficient rainfall during the 14 El Niño episodes, and 3 episodes of excess rainfall and 8 episodes of deficient rainfall during the 11 La Niña episodes. The remaining 16 episodes were neutral years, with 10 episodes having excessive rainfall and the remaining 6 having deficient rainfall. Hence the El Niño episodes is good when compared to La Niña episodes over Karnataka.

Key words: *Rainfall, El Niño–Southern Oscillation, El Nino, La Nina and Karnataka.*

INTRODUCTION

Climate variability is the way aspects of climate (such as temperature and precipitation) differ from an average. Climate variability occurs due to natural and sometimes periodic changes in the circulation of the air and ocean, volcanic eruptions, and other factors (Ajithkumar et al., 2015). The El Niño-Southern Oscillation (ENSO) is a recurring climate pattern involving changes in the temperature of waters in the central and eastern tropical Pacific Ocean and have direct effect of Indian monsoon. Depression in the western pacific regions or higher sea surface temperature (SST) at eastern Pacific Ocean will create La Niña events which have positive effect on Indian monsoon. El Niño events is quite opposite of La Niña which depression over eastern pacific region and higher SST temperature at western pacific region. La Niña coinciding with Southwest monsoon brings excess rainfall on Indian sub-continent causing floods in some years (Singh et al.,2005). Likewise, El Niño events will deviate the rainy winds towards eastern pacific region causing lesser rainfall on Indian sub-continent or draughts in some years (Mooley, 1997). The state of Karnataka is located on a table land in the angle where the Western and Eastern Ghat ranges converge into the Nilgiri hill complex (Halikatti et al., 2010). The impact of ENSO over Karnataka has been showed in this study.

MATERIALS AND METHODOLOGY

The Karnataka is located between 11.5°N and 18.5°N latitudes and 74°E and 78.5°E longitudes and has a series of uplands with an average altitude of 610 meters above sea level. The monthly rainfall data for a period of 41 years (1980-2020) were collected from the rain gauge station located under the farm universities of Karnataka. The collected data was checked for errors and analysed for annual rainfall. Average rainfall for 41 years was found to be 1300 mm. The climate analysis centre of the National Oceanic and Atmospheric Administration (NOAA), Washington, DC, USA, prepared SST and SOI values utilised in this investigation. Based on these data the El Niño and La Niña anomalies were examined and compared with mean rainfall of that particular year.

RESULTS AND DISCUSSION

El Niño and La Niña episodes identified on the basis of specific criteria applied to sea-surface temperature (SST) anomaly off Peru Ecuador Coast following Quinn *et al*. (1978) presented

in Table 1. Based on the above criteria, there were 14 El Niño episodes, 11 La Niña episodes and remaining 16 years identified as neutral year during the 41 years study period (1980-2020).

There were 8 episodes of excess rainfall and 6 episodes of deficient rainfall during the 14 El Niño episodes, and 3 episodes of excess rainfall and 8 episodes of deficient rainfall during the 11 La Niña episodes (Bhalme et al.,1990). The remaining 16 episodes were neutral years, with 10 episodes having excessive rainfall and the remaining 6 having deficient rainfall presented in Table 2.

When compared between all the Southern Oscillations (ENSO), the neutral year episodes showed higher average rainfall (1334.9 mm) succeeded by El Niño episodes with a rainfall of 1314.3 mm were higher than normal rainfall and La Niña episodes with a rainfall of 1234.6 mm were less than normal rainfall presented in Table 3.

CONCLUSION

During the El Niño episodes, many years we got good rainfall with compare to La Niña episodes. And with the normal rainfall of karnataka El Niño episodes having better rainfall even this causes drought year to the India but it is good for Karnataka.

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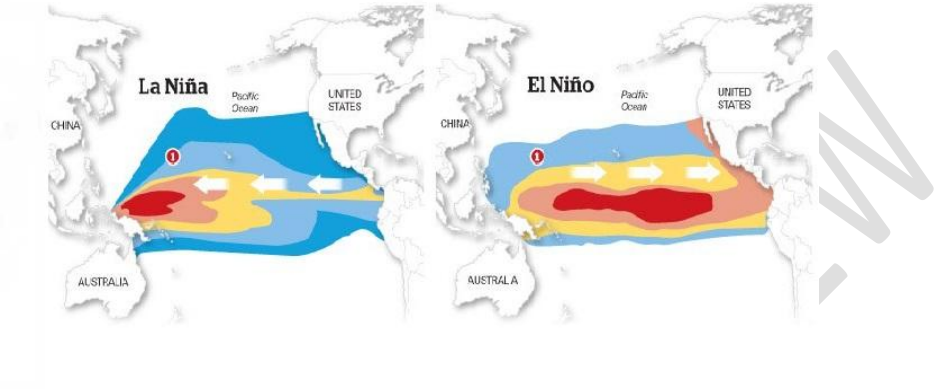

Fig 1: Regions of ENSO events in Pacific Ocean (Source: Shakeel Anwar, 2017)

Table 1. Southern Oscillation (ENSO) episodes (1980-2020) of Karnataka

Southern Oscillation (ENSO)		
El Niño phases	**La Niña phases**	**Neutral phases**
1980	1984	1981
1983	1985	1982
1987	1989	1986
1988	1996	1990
1992	1999	1991
1995	2000	1993
1998	2001	1994
2003	2008	1997
2005	2011	2002
2007	2012	2004
2010	2020	2006
2016		2009
2018		2013
2019		2014
		2015
		2017

Table 2. Southern Oscillation (ENSO) episodes with yearly rainfall, percent change in the rainfall from 41 years average (1300 mm) and Excess (E) or Deficient (D) rainfall											
El Nino Years				**La Nina Years**				**Neutral Years**			
Year	**Rainfall (mm)**	**% Change from mean**	**E/D**	**Year**	**Rainfall (mm)**	**% Change from mean**	**E/D**	**Year**	**Rainfall (mm)**	**% Change from mean**	**E/D**
1980	1355.6	4.2	E	1984	1249.5	-4.0	D	1981	1449.8	11.4	E
1983	1351.4	3.9	E	1985	1051.9	-19.2	D	1982	1307.2	0.5	E
1987	1104.8	-15.1	D	1989	1178.6	-9.4	D	1986	1176.3	-9.6	D
1988	1268	-2.5	D	1996	1369.4	5.3	E	1990	1286.1	-1.1	D
1992	1473.2	13.2	E	1999	1313.8	1.0	E	1991	1435.4	10.3	E
1995	1244.8	-4.3	D	2000	1323.8	1.8	E	1993	1305.5	0.3	E
1998	1400.4	7.6	E	2001	1177.8	-9.5	D	1994	1537.5	18.2	E
2003	965	-25.8	D	2008	1292.2	-0.7	D	1997	1437.1	10.5	E
2005	1476.9	13.5	E	2011	1311.7	0.8	D	2002	958.8	-26.3	D
2007	1514.8	16.4	E	2012	1054.4	-19.0	D	2004	1209.9	-7.0	D
2010	1475.2	13.4	E	2020	1258	-3.3	D	2006	1292	-0.7	D
2016	1289.5	-0.9	D					2009	1451	11.5	E
2018	1180	-9.3	D					2013	1356.7	4.3	E
2019	1300	0.1	E					2014	1343.3	3.3	E
								2015	1567.2	20.5	E
								2017	1244.3	-4.4	D

Table 3. Southern Oscillation (ENSO) episodes with Normal rainfall		
The Normal rainfall of karnataka is 1300		
El Nino Years	La Nina Years	Neutral Years
1314.3	1234.6	1334.9
> N	**< N**	**> N**