# Some aspects of the weak rainfall spells of the Indian summer monsoon 2018

Sujata K. Mandke [1, *]
[1] Indian Institute of Tropical Meteorology, Ministry of Earth Sciences, India
*amin@tropmet.res.in

## 1. Introduction

During summer monsoon season from June to September (JJAS), rainfall over Indian region exhibits large intra-seasonal fluctuations between active and weak spells. Intense weak/dry spells of rainfall are referred to as breaks during the peak monsoon months of July-August (Ramamurthy, 1969). Despite extensive research on breaks in Indian summer monsoon (ISM) (Krishnan et al. 2000, Gadgil and Joseph, 2003, Rajeevan et al. 2010), the links of monsoon variability over Indian region to that over the Indian ocean and the Pacific are not adequately understood. This topic is addressed in the present study for weak/break rainfall phases during JJAS 2018. All weak/lull/break spells are referred as weak spells.

## 2. Data

(i)Daily merged satellite gauge rainfall data (0.25°x0.25°) (Mitra et al. 2009) (https://www.imdpune.gov.in/Seasons/Temperature/gpm/Rain_Download.html) (ii) Daily un-interpolated Outgoing Longwave Radiation (OLR) (2.5°x2.5°) data provided by the NOAA/OAR/ESRL PSL, Boulder, Colorado, USA., downloaded from https://psl.noaa.gov/data/gridded/data.uninterp_OLR.html. (iii) Daily wind and geopotential height at 200hPa from NCEP/NCAR reanalysis (Kalnay et al., 1996).

## 3. Results

The important features of rainfall anomalies over India and Indian ocean (Fig. 1) for weak rainfall spells during JJAS 2018 (14-21June (WS1), 27July-7August (WS2), 9-20September (WS3), 24-30 September (WS4)) identified based on the criteria by Rajeevan et.al. (2010) are: (i)There are large differences in rainfall anomaly pattern of four weak spells. WS2 and WS3 are the long intense events. (ii)Rainfall anomaly pattern of WS2 over India closely resemble the composite rainfall anomalies associated with breaks based on (1888–1967) (Ramamurthy, 1969), which is characterized by large negative anomalies over monsoon core zone (MCZ;18°-28°N, 65°-88°E), negative anomalies over west coast, while positive anomalies over northeast India in association with the northward shift of the monsoon trough to the foothills of the Himalaya. WS2 and WS3 pattern are similar over India except for the absence of increased rainfall over the foothills in WS3. (iii)Rainfall anomalies of opposite sign over MCZ and Equatorial Indian Ocean (EIO) in WS4 is indicative of the mutual competition between convection over India and EIO (Sikka and Gadgil,1980). Out-of-phase OLR anomalies over MCZ and Northwest Pacific Ocean (NWPO) (Raman, 1955) are linked with the occurrence of WS1 and WS4 (Fig. 2). A quadrupole structure comprising of positive (negative) OLR anomalies over the Indian region and equatorial west Pacific (EIO and NWPO) (Gadgil and Joseph, 2003) is observed during WS1 and WS4 (Fig. 2). Enhanced convection over foothills of the Himalaya and large parts of tropical Pacific Ocean possibly caused WS2 (Fig. 2). Influence of the intrusion of deep trough in the mid-latitude westerlies into India in the upper troposphere (Ramaswamy,1962) on formation of WS3 is evident (Fig. 3).

## References

- Gadgil, S. and Joseph, P.V., 2003. On breaks of the Indian monsoon. Proc. Ind. Aca. Sci. (EPS), 112, 529–558
- Kalnay, E., et al., 1996. The NCEP/NCAR 40-year re-analysis project. Bull. Amer. Meteorol. Soc. 77, 437–471.
- Krishnan R, et al. 2000. Dynamics of breaks in the Indian summer monsoon; J. Atmos. Sci. 57, 9, 1354– 1372.
- Mitra, A.K. et al. 2009. Daily Indian precipitation analysis Formed from a merge of Rain-gauge Data with the TRMM TMPA Satellite-derived rainfall estimates, J. Meteor. Soc. Japan, vol. 87A, 265-279.
- Raman, C. R. V.1955. Breaks in Indian southwest monsoon and typhoons in southwest Pacific. Cur. Sci., 24, 219–220.
- Rajeevan, M, et al. 2010. Active and Break Spells of the Indian Summer Monsoon, J. E. S. S. 119,3, 229–247.
- Ramamurthy, K., 1969. Some aspects of ‘‘break’’ in the Indian southwest monsoon during July and August. Forecasting Manual, IMD publication, FMU, Rep. 4, 18.3.
- Ramaswamy C. 1962. Breaks in the Indian summer monsoon as a phenomenon of interaction between the easterly and the subtropical westerly jet streams. Tellus 14, 337–349
- Sikka D. R., Gadgil, S., 1980. On the maximum cloud zone and the ITCZ over India longitude during the southwest monsoon. Mon. Wea. Rev., 108, 1840–1853.

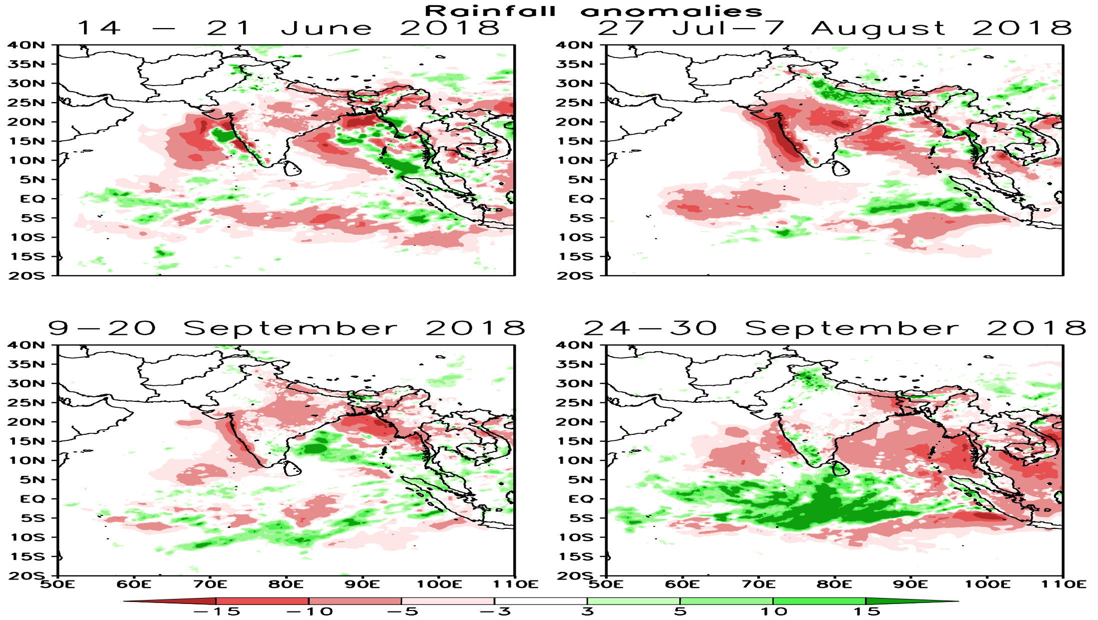


**Figure 1:** Spatial distribution of rainfall anomalies. Top left (Weak spell 1), top right (weak spell 2), bottom left (weak spell 3), bottom right (weak spell 4)

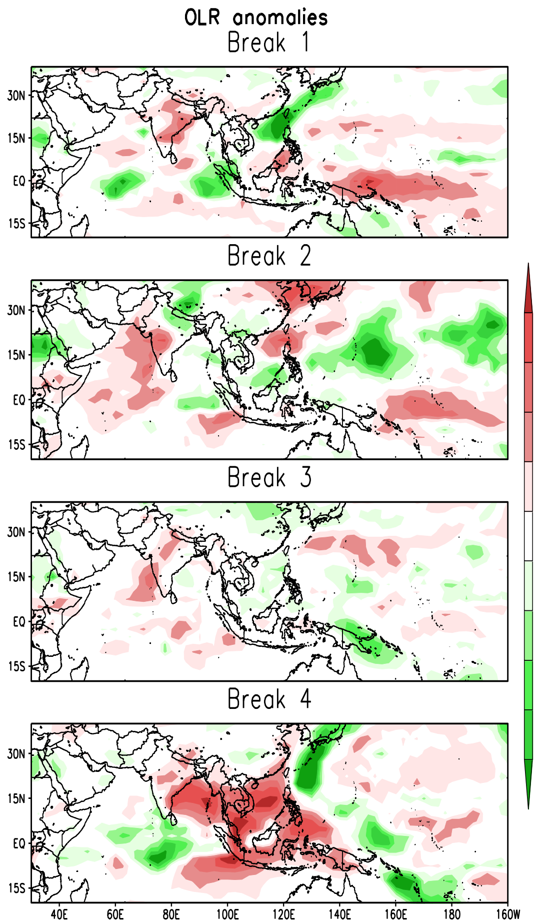


**Figure 2**: Spatial distribution of OLR anomalies over tropical Indo-Pacific. From top to bottom (weak spell 1, weak spell 2, weak spell 3, weak spell 4) respectively.

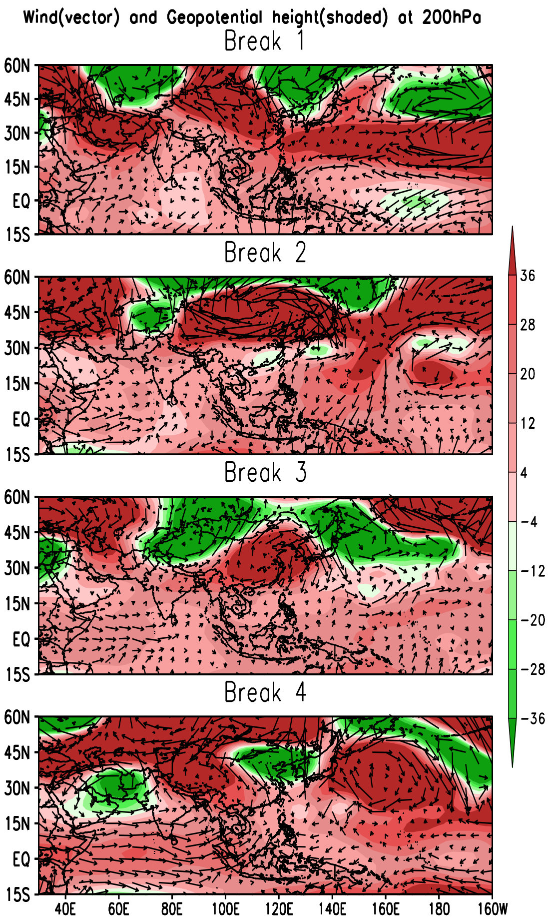


**Figure 3**: Spatial distribution of Wind (vector) overlaid by Geopotential height at 200hPa (shaded) over tropical Indo-Pacific. From top to bottom (weak spell 1, weak spell 2, weak spell 3, weak spell 4) respectively.