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Use of Meridional Wind Index at East Coast of India for Monitoring Drought and Flood Monsoon Conditions over Indian Region

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Abstract

In this paper, the relationship between daily meridional winds (v) at 200 hPa taken from NCEP/NCAR, over the domain (15°N to 25°N and 80°E to 95°E) at east coast of India and daily rainfall during the Indian Summer Monsoon (June-September) has been studied. Analysis is carried out for fifty three (1951-2003) years of data. The twenty days composite rainfall and meridional wind for the 10 drought and 8 flood monsoon years have been analyzed. The twenty days variations of the southerlies (northerlies) meridional wind in the upper troposphere during the monsoon at east coast the of India and twenty days rainfall activity goes hand in hand in drought (flood) monsoon years From the analysis, it is observed that during the drought (flood) years southerlies (northerlies) persist over this domain in monsoon season.

Introduction

A major proportion of the annual rainfall over most parts of India is received during a short span of 4 months from June to September, known as the Southwest or the summer monsoon season. The summer monsoon rainfall averaged over the whole of India is found to be stable over the past 125 years, with no long-term trend, but is dominated by high inter-annual variability. This variability in monsoon rainfall occasionally leads to large-scale droughts and floods over different parts of the country, resulting in serious reduction in agricultural output and affecting the national economy. In view of the critical influence of such variability, adequate forecasting of monsoon rainfall would be of profound importance for policy-making and planning of mitigatory efforts. This variability is generally attributed to the slowly varying surface boundary forgings of sea surface temperature, soil moisture, snow cover and the circulation features of the upper-troposphere (200 hPa May meridional wind over India) and the mid-troposphere (April 500 hPa ridge along 75° E).

Insufficient, untimely and unevenly distributed monsoon rainfall leads to meteorological drought over the country during the main kharif cropping season. It is known that the occurrence of drought is due to insufficient rainfall in time and space. However, it is still difficult to quantify the conditions that lead to the onset of drought. The early prediction of drought and its spatial extent has a very important role in Indian economy. No known method exits to predict reliably occurrence, continuation, cessation or recurrence of drought. The present scientific knowledge is insufficient for accurate and early prediction of drought, so it is necessary to understand the causes of drought and hence lead to better predictions. Many scientists studied the extreme monsoons and their association with large-scale regional and global perturbation in atmospheric and oceanic circulation. Sikka (1980, 1999); Rasmusson and Carpenter (1983); Rajeevan (1993); Goswami and Xavier (1966); Goswami *et al.(*2003) Fasullo and Webster (2002); Gadgil *et al.* (2002); Gadgil *et al.* (2004); Kalsi *et al.* (2004); Krishnan *et al.* (2006); Joseph *et al.* (1981;1999) and Bhat (2006).

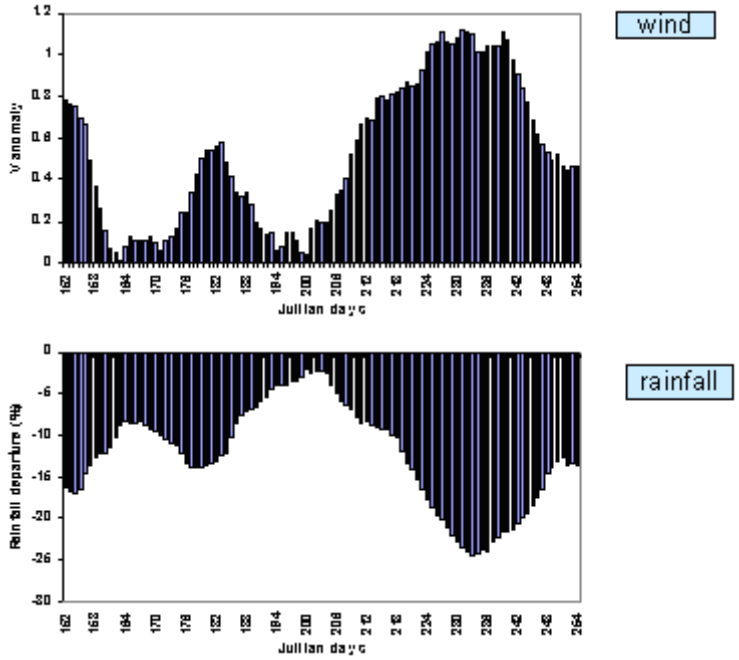

Fig.1 (a): 20 days running meridional wind (V) anomalies at 200 h Pa level for 10 drought monsoon years.

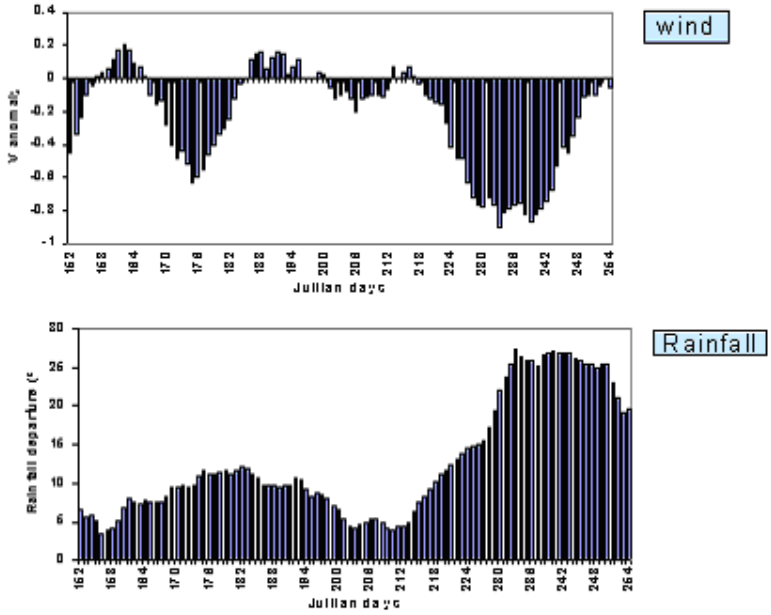

Fig.1 (b): 20 days running meridional wind (V) anomalies at 200 h Pa level for 8 flood monsoon years.

Data and Methodology

Daily grid point meridional wind (v) data at 200 h Pa level taken from NCEP/NCAR for a period from 1 June to 30 September (122 days) for 53 years (1951-2003) are considered. The data over the domain15°N to 25°N and 80°E to 95°E is used for the analysis. Daily All India monsoon Rainfall (DAIMR) are taken from daily gridded rainfall data published by Indian Metrological Department (IMD) based on 1803 stations (Rajeevan *et al.,* 2006) for the same period and years. The simple moving average and correlation analysis methodology is used for the analysis. Daily averages meridional winds in the domain are calculated for 122 days (1 June-30 September) for the 53 years. Daily meridional wind anomalies for each day and for each year are calculated by taking mean from the base period 1951-2003.

Discussions

To see the daily variation of meridional wind anomaly in flood and drought years the 20 days moving averages of ECMWI anomalies for the period 1 June to 30 September calculated for 10 drought (1951; 65, 66; 68; 72; 74; 79; 82; 85; 86; 87 and 2002), and 8 flood years (1956; 59; 61; 70; 75; 83; 88 and 94). Similarly, daily all ISMR anomalies for same drought and flood years are also calculated. Comparisons of this analysis are shown in Fig. 1a and 1b. From the figure, it is seen that the trends in southerlies and the subdued activity of rainfall goes hand in hand in almost all the drought years. It may be seen that the southerlies occurring in the upper troposphere in July and August in the large- scale monsoon failure show considerable persistence. Therefore, the persistence of the southerlies meridional at 200 h Pa components of winds in the upper troposphere may be useful for monitoring the large-scale monsoon failures. The composite meridional wind anomalies at 200 h Pa for these drought and flood years also calculated over the domain mention above. It is observed that during the drought (flood) years southerlies (northerlies) persist over this domain in monsoon season. Composite divergence field anomaly at 200 h Pa for these extreme years also calculated over the above domain. It is seen that the large scale convergence (divergence) is observed in the southern Bay in drought (flood) years which suppressed the synoptic scale activity and that may leads to major drought condition vice versa. No depression formed in the year 2002 for the first time in past 180 years while two depressions were occurred in 2003 may be contributing normal rainfall. In major drought 2002 total number of synoptic scale disturbances (including low pressure systems, upper air cyclonic circulations; depressions etc.) are 21 and in normal monsoon 2003 they are 24 included 2 depressions.

Conclusions

(1) The twenty days variations of the southerlies (northerlies) meridional wind at 200 hPa during the monsoon period (June-September), at east coast in the upper troposphere and twenty days rainfall activity goes hand in hand in drought (flood) years. Similar result also holds good for individual drought and flood years.

(2) The twenty day tendency of the variation of meridional wind at 200 hPa in domain mention above will gives some clue for next coming twenty days rainfall activity.

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About the author

Mr. Dugam Surendra Sidram is a scientist of Indian Institute of Tropical Meteorology, Pune. He has over 30 years experience in LRF study. He has successfully completed study on 'Monsoon variability in relation to NAO and ENSO and its use for predicting monsoon rainfall over smaller spatial and temporal scale'. He has over 50 research papers to his cradit and guided several students for M.Sc. project.