



## **The Indian Summer Monsoon onset revisited: new approach based on the analysis of historical wind observations**

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The Indian Summer Monsoon onset is one of the meteorological events most anticipated in the world. Due to its relevance for the population, the India Meteorological Department has dated the onset over the southern tip of the Indian Peninsula (Kerala) since 1901. The traditional method to date the onset was based in the judgment of skilled meteorologist and because of this, the method was considered subjective and not adequate for the study of long-term changes in the onset.

A new method for determining the monsoon onset based solely on objective criteria has been in use since 2006. Unfortunately, the new method relies –among other variables- on OLR measurements. This requirement impedes the construction of an objective onset series before the satellite era. An alternative approach to establish the onset by objective methods is the use of the wind field. During the last decade, some works have demonstrated that the changes in the wind direction in some areas of the Indian Ocean can be used to determine the monsoon onset rather precisely. However, this method requires precise wind observations over a large oceanic area which has limited the periods covered for such kind of indices to those of the reanalysis products.

In this work we present a new approach to track the Indian monsoon onset based solely on historical wind direction measurements taken onboard ships. Our new series provides an objective record of the onset since the last decade of the 19th century and perhaps more importantly, it can incorporate any new historical wind record not yet known in order to extend the series length. The new series captures quite precisely the rapid precipitation increase associated to the monsoon onset, correlates well with previous approaches and it is robust against anomalous (bogus) onsets. Although no significant trends in the onset date were detected, a tendency to later than average onsets during the 1900-1925 and 1970-1990 periods and earlier than average onsets between 1940 and 1965 have been found. Our results show a relatively stable link between the ENSO cycle and the onset date; however this relationship is weaker in decades characterized by prevalent La Niña conditions. Furthermore, it was found that the link between the Pacific Decadal Oscillation (PDO) and the onset date is limited to the phases characterized by a shift from negative to positive PDO phases.

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