Role of Atmospheric Parameters Over the North Indian Ocean on the Monsoon Onset Over Kerala

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Objectives

- To identify the Monsoon Onset over Kerala (MOK) using the circulation and humidity features over north Indian Ocean and especially over the South Eastern Arabian Sea (SEAS).
- Compare these MOK with the previous estimates.

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Onset of Monsoon

Ananthakrishnan et al (1967) mentions the following synoptic situation for onset of monsoon over Kerala.

- Formation of a low pressure system in the AS & BB triggers the onset of monsoon.
- Heavy convection, squally weather and rough seas or swell from southwest with moderate to strong winds from southerly to westerly direction.
- The strengthening and deepening of lower troposphere west winds over extreme south peninsula and Sri Lanka.

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In order to identify the MOK we look at the following atmospheric parameters

- Cross Equatorial Flow at 850 hPa averaged over the region (5°S-5°N; 45°E-55°E)
- Zonal Wind at 850 hPa over the region (10°N-20°N; 70°-80°E).
- Midtropospheric humidity at 500 hPa over the SEAS region (8°N-15°N; 70°-75°E).
- Zonal Wind averaged over SEAS at 850 hPa.
- Integrated columnar Water vapor averaged over SEAS.

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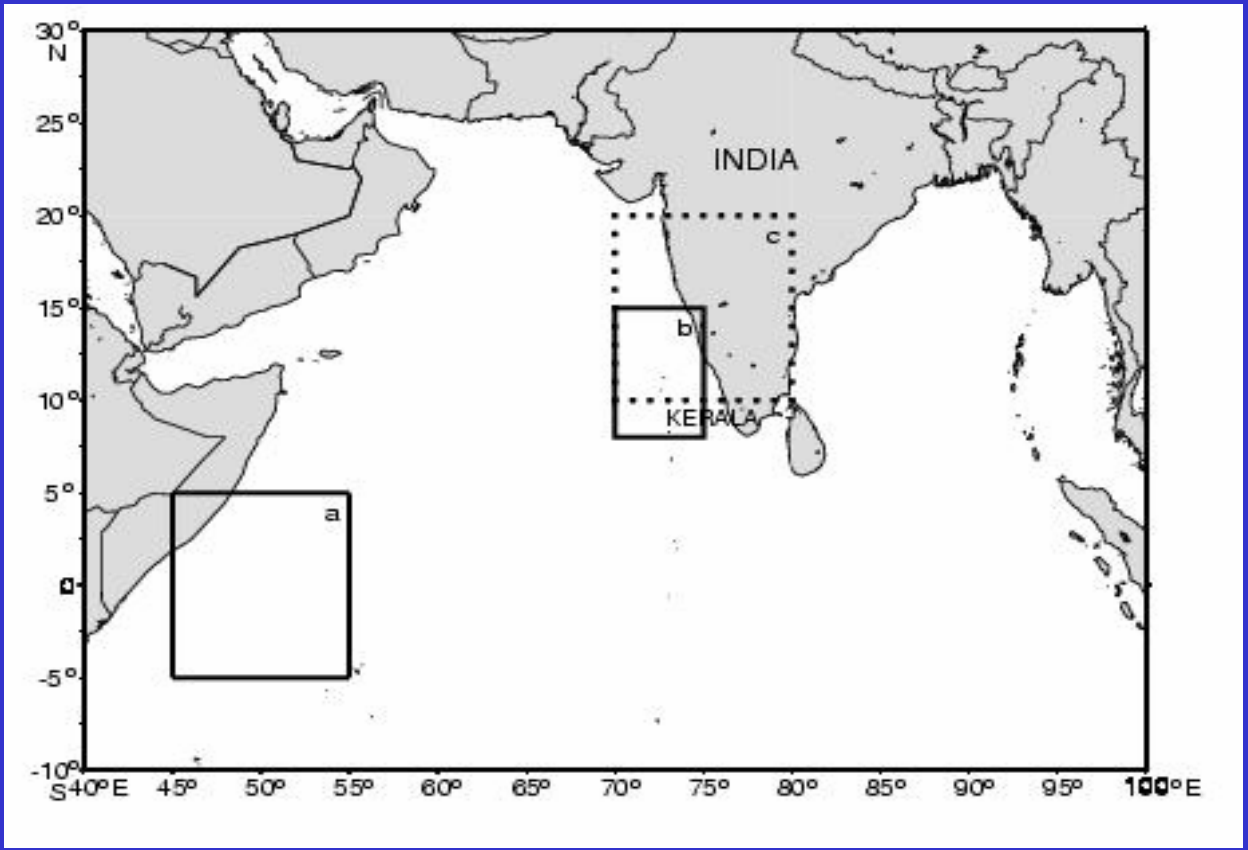

Boxes used for computing the various atmospheric parameters

a) CEF b) SEAS c) ZONAL

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Data

- The zonal and meridional winds at 850 hPa and integrated columnar water vapour and relative humidity at 500 hPa were obtained NCEP/NCAR Reanalysis data for the study period (1970-1998).

- MOK dates were taken from IMD, Ananthakrishnan and Soman (1988), Fasullo and Webster (2003) and Joseph et al, (2005).

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Previous Studies

- During the MOK, the atmospheric humidity is high upto 500 hPa (Rao, 1976). Further the relative humidity (RH) at 500 hPa, greater than 50% (Gray, 1979), is also an important parameter for cyclogenesis. According to Ananthakrishnan et al., (1967) the formation of low pressure systems in Arabian Sea and Bay of Bengal is conducive for the MOK. Krishnamurti et al., (1981) have described the formation of an ‘onset vortex’ prior to the MOK.

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Previous Studies

- In order to check the hypothesis of Ananthakrishnan et al (1967) on the formation of the low pressure systems or the ‘ onset vortex ‘ formation over the SEAS area, we looked at the RH at 500 hPa for the study period. According to Gray (1979) RH > 50% at 500 hPa is conducive for the formation of the low pressure systems or cyclogenesis or monsoon onset vortex formation.

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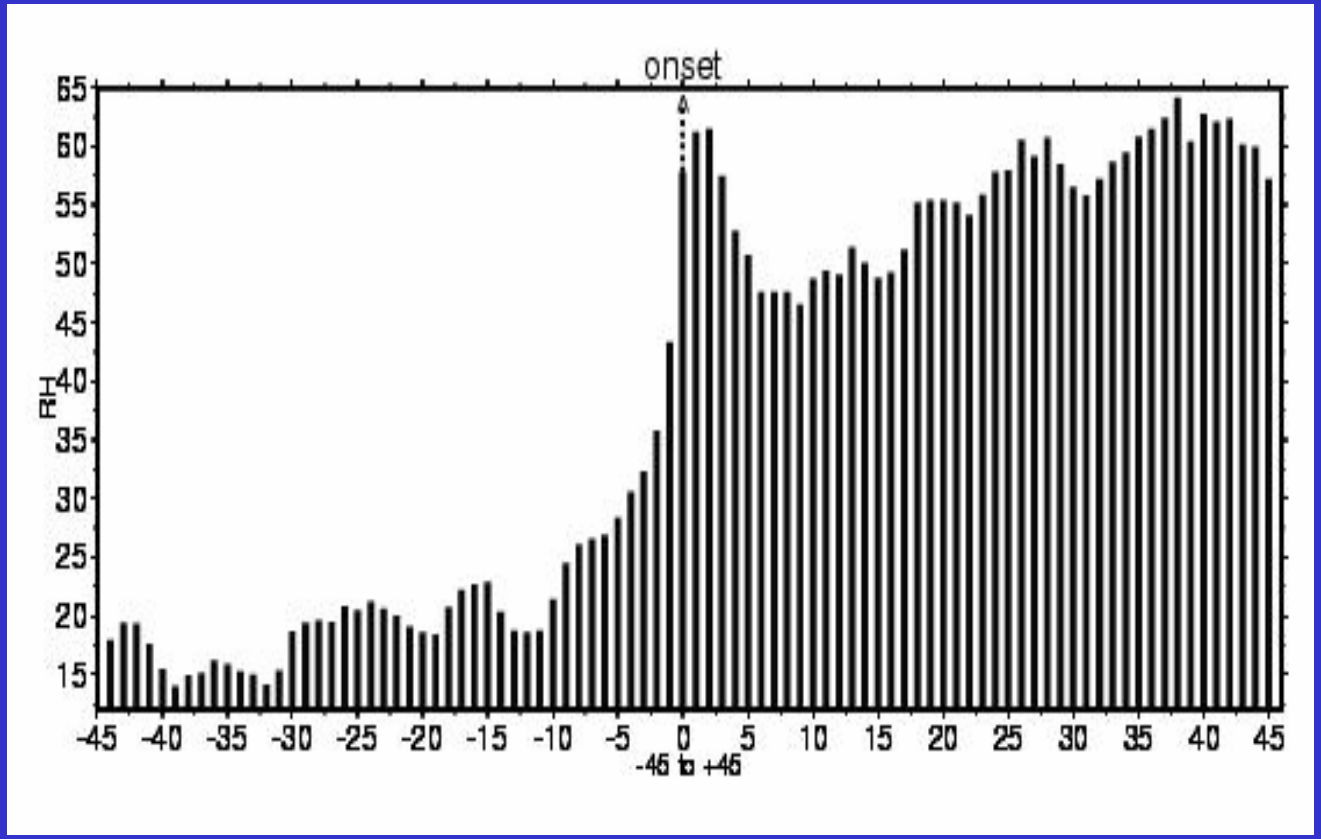

Composite of RH for the study period with onset date (marked as 0 day)

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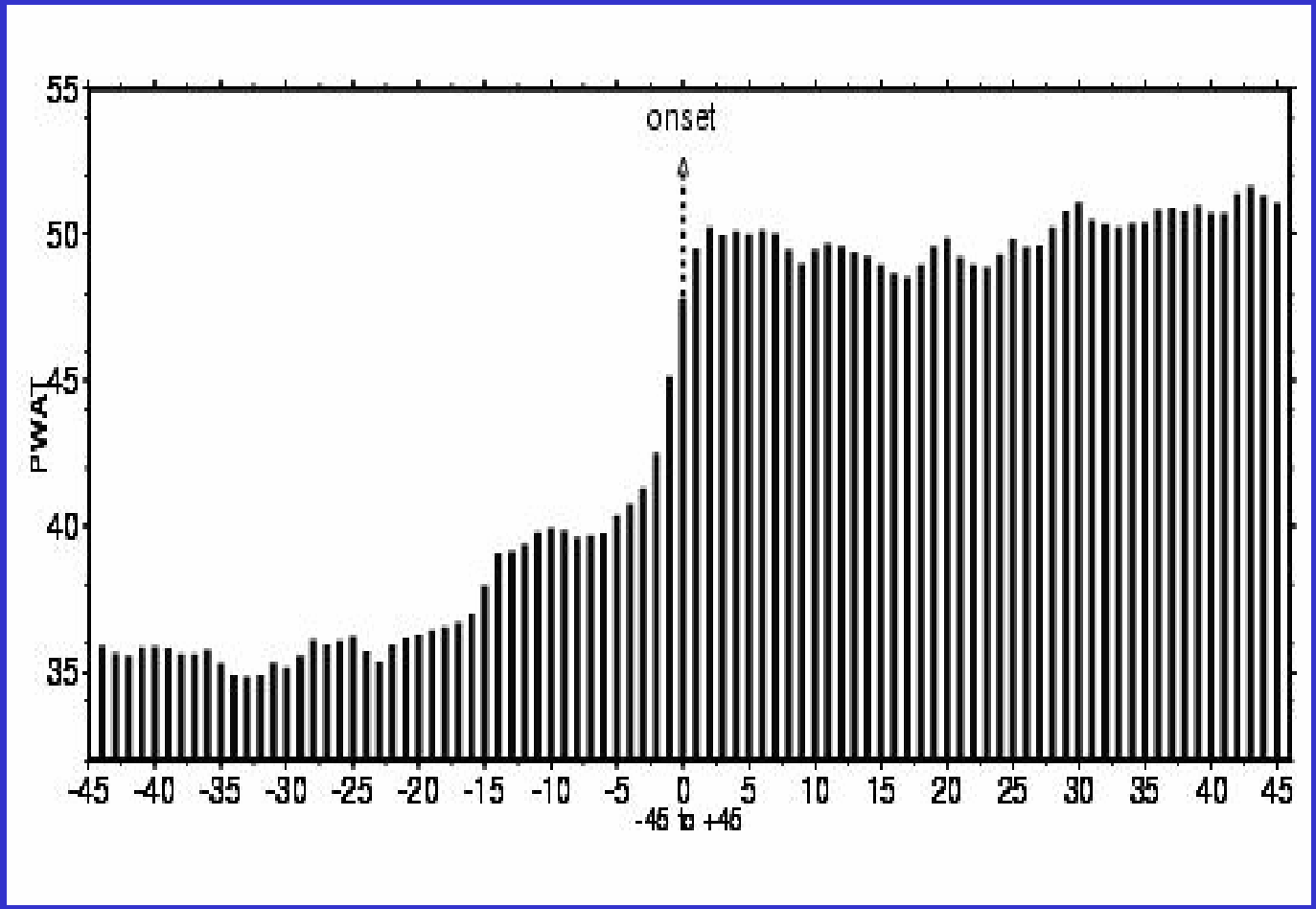
Previous Studies

- Pearce and Mohanty (1984) have shown that there is a gradual build up of moisture over the Arabian Sea using 4 years of data.

  In order to look at the role of the integrated columnar water vapour we have looked at the role of the PWAT over the SEAS region for the period – 45 days to + 45 days with 0 day as the monsoon onset date using the composite analysis.



Composite of PWAT for the study period with onset date (marked as 0 day)

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Previous Studies

- Ramesh Kumar et al (1986) have shown that the surfacing of the 27°C isotherm off the Somalia coast coincides with the MOK. This we feel could be the result of the strengthening of CEF, which develops as the LLJ which heralds in the formation of MOK.

  In order to look at the role of the CEF on the MOK, we have analysed the daily meridional winds at 850 hPa over the region (5°S-5°N; 45°E-55°E).

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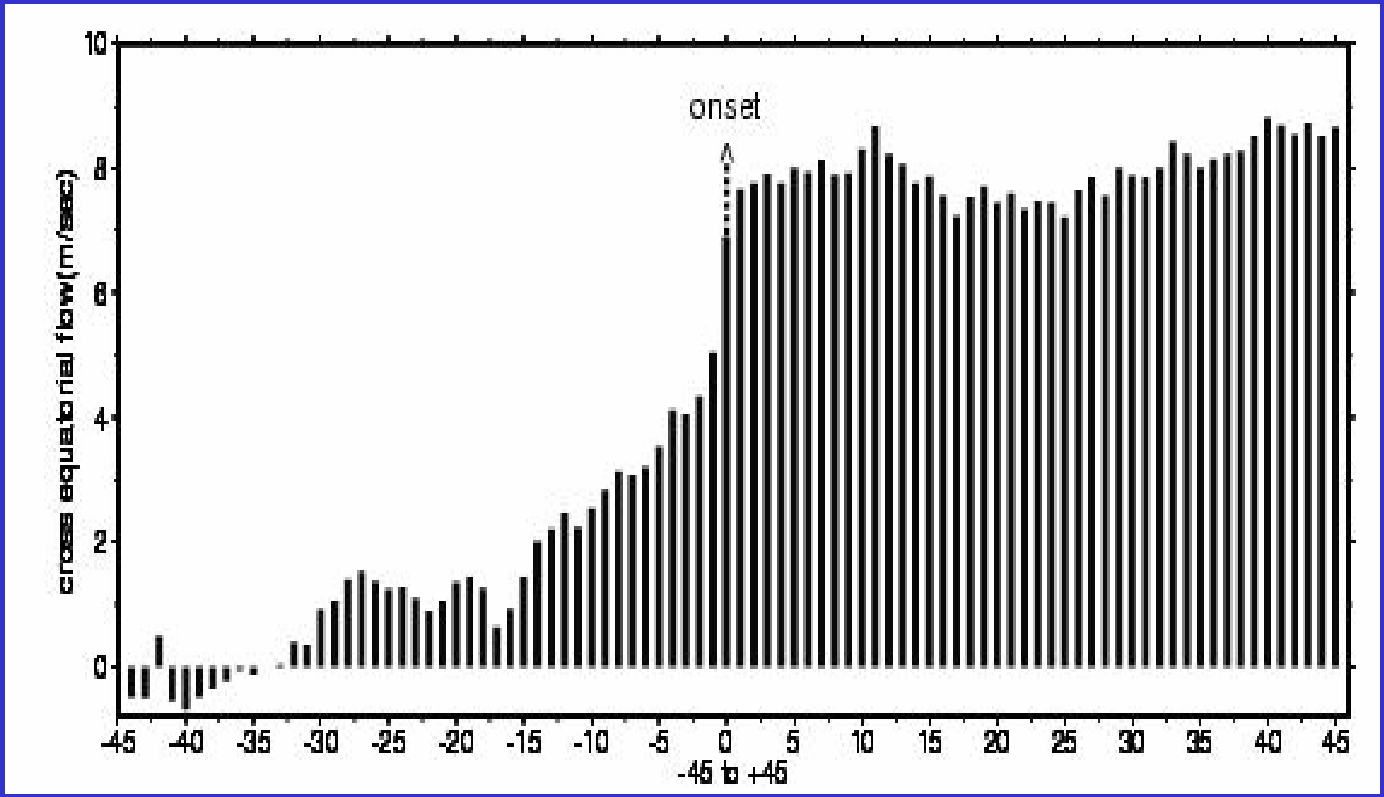

Composite of CEF for the study period with onset date (marked as 0 day)

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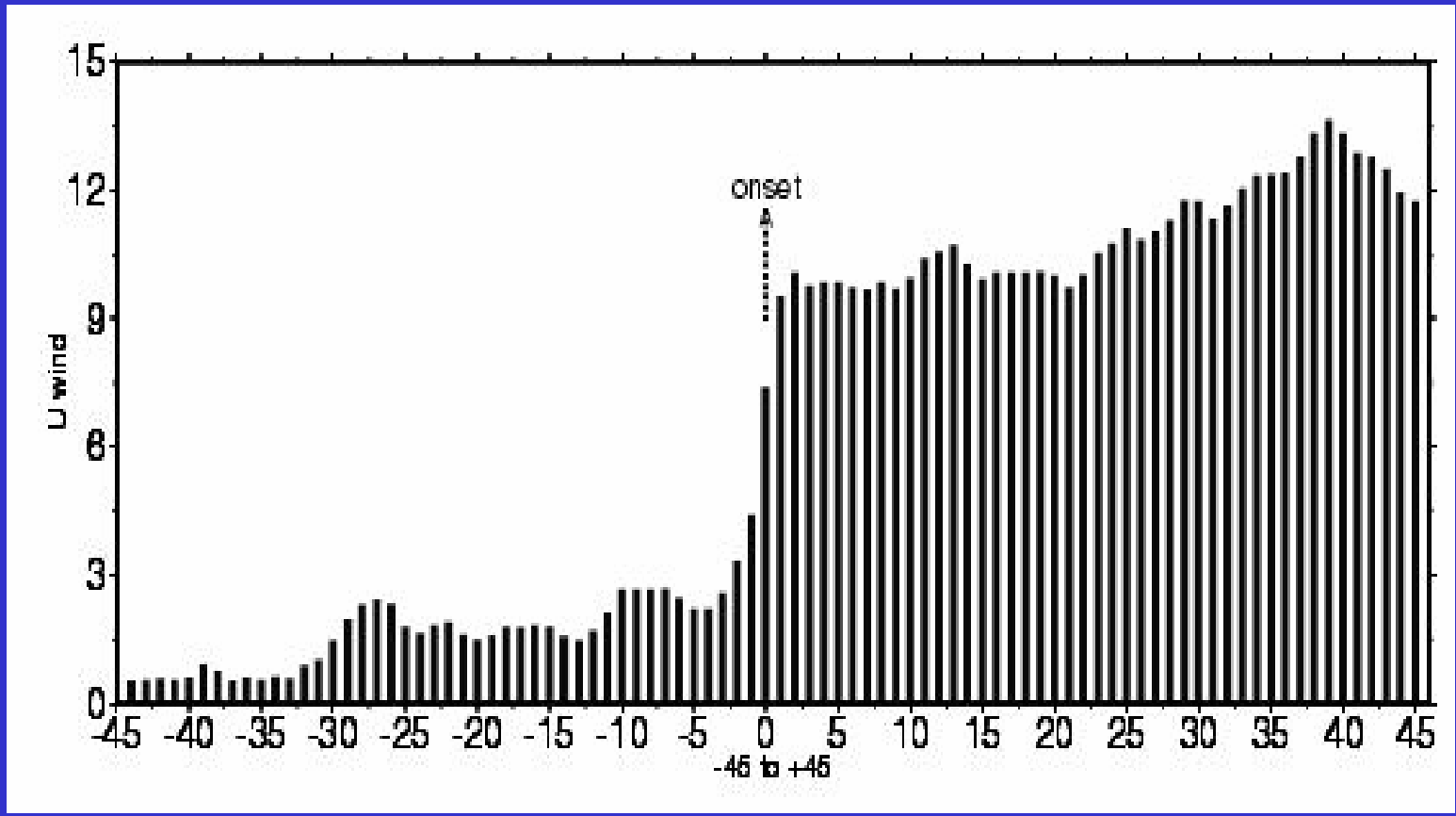
Previous Studies

- Joseph et al (2005) have shown that the Zonal wind is an important parameter for identifying the MOK.
- We have used two indices of the Zonal wind, one over a large area (10°N-20°N; 70°E-80°E, called ZONAL) and another over the SEAS area (which we refer as UWND).



Composite of ZONAL for the study period with onset date (marked as 0 day)

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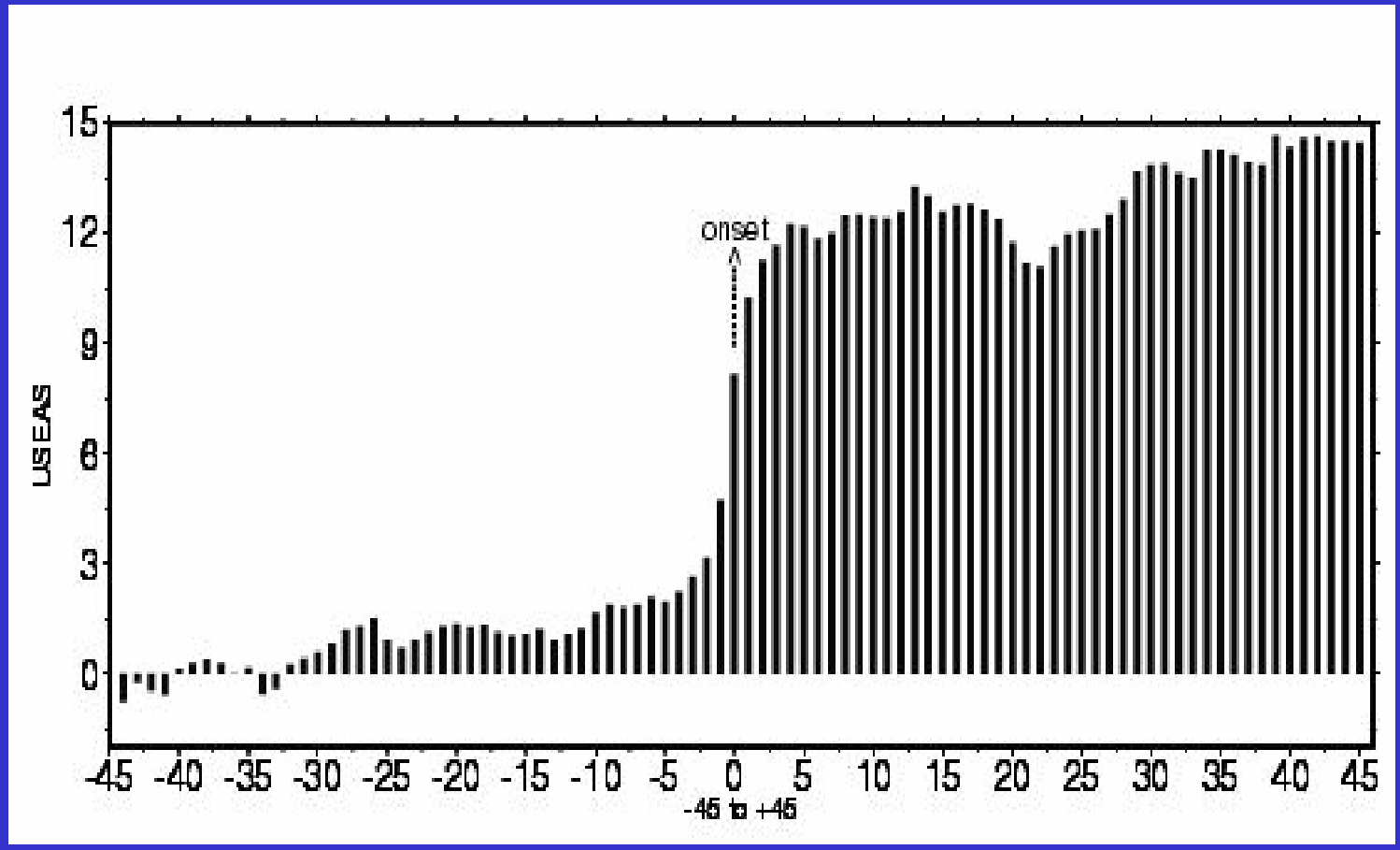

Composite of UWND for the study period with onset date (marked as 0 day)

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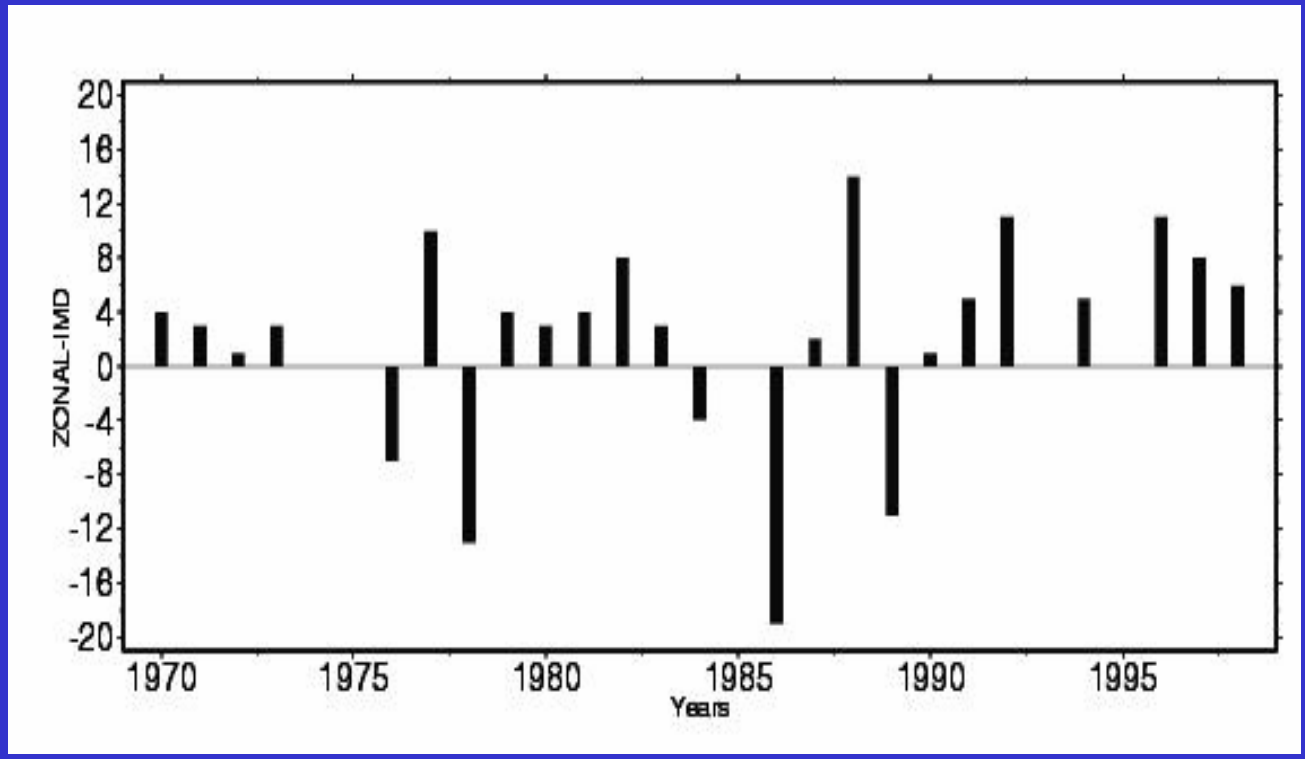

Difference in days between the new MOK (ZONAL) – IMD MOK (days) for the year from 1970 to 1998.

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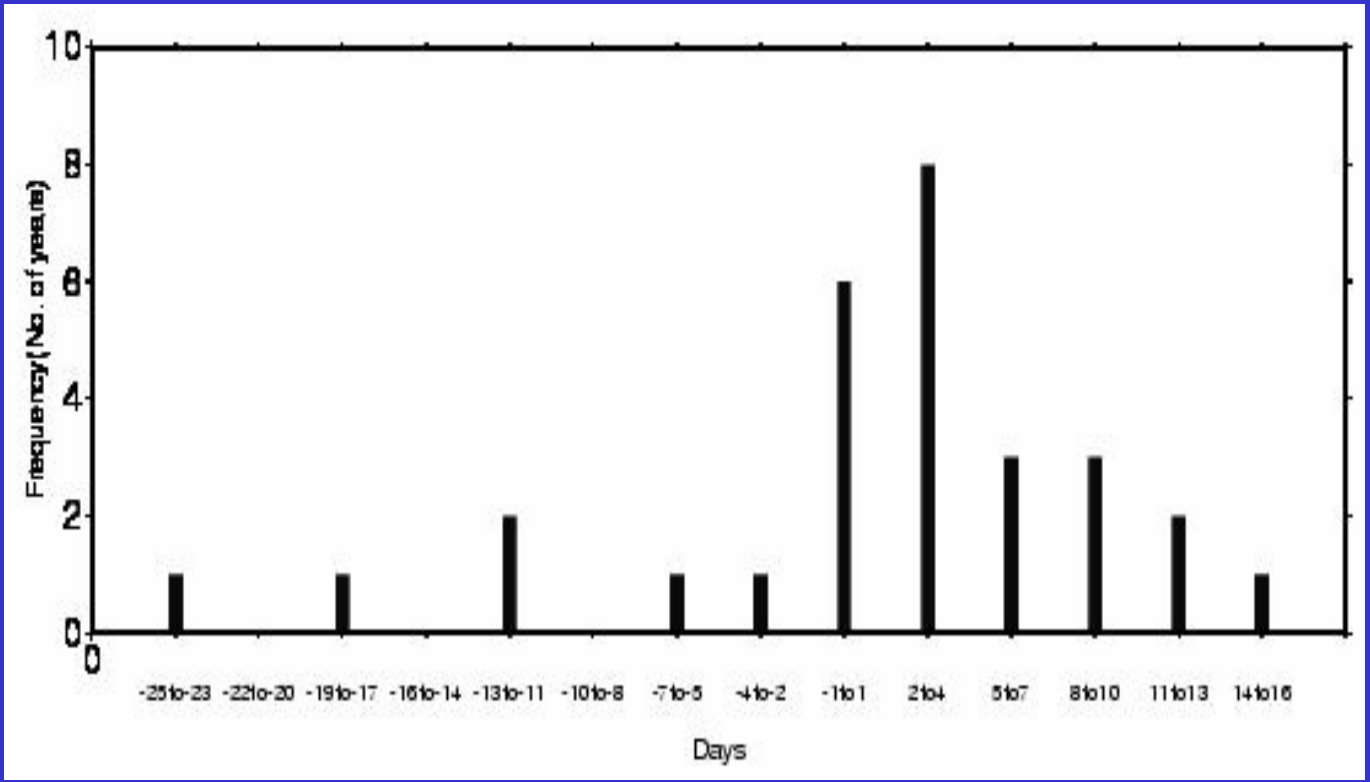

Frequency in number of years versus the new MOK (ZONAL) – IMD MOK (days).

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Correlation coefficients between MOK as obtained from various atmospheric parameters and previous estimates.

Parameter	IMD	FW03	AS88	J05
CEF	0.52	0.53	0.44	0.43
RH	0.36	0.18	0.38	0.37
PWAT	0.51	0.59	0.52	0.37
UWND	0.45	0.36	0.60	0.51
ZONAL	0.57	0.47	0.55	0.56

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Conclusions

- The RH at 500 hPa had the least correlation with the MOK of the previous estimates indicating the insignificant role of the cyclogenesis and ‘onset vortex’ on the MOK as envisaged by the earlier studies.
- The ZONAL wind has the best correlation among all the atmospheric parameters.
- Amongst the circulation and humidity fields over the SEAS, PWAT had the best correlation.

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Acknowledgements

- The NCEP/NCAR Reanalysis data was obtained from Kalnay et al (1996).
- Freeware was used for the analysis.
- Dr.P.V.Joseph, CUSAT, Kochi for his useful suggestions.

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Thank You

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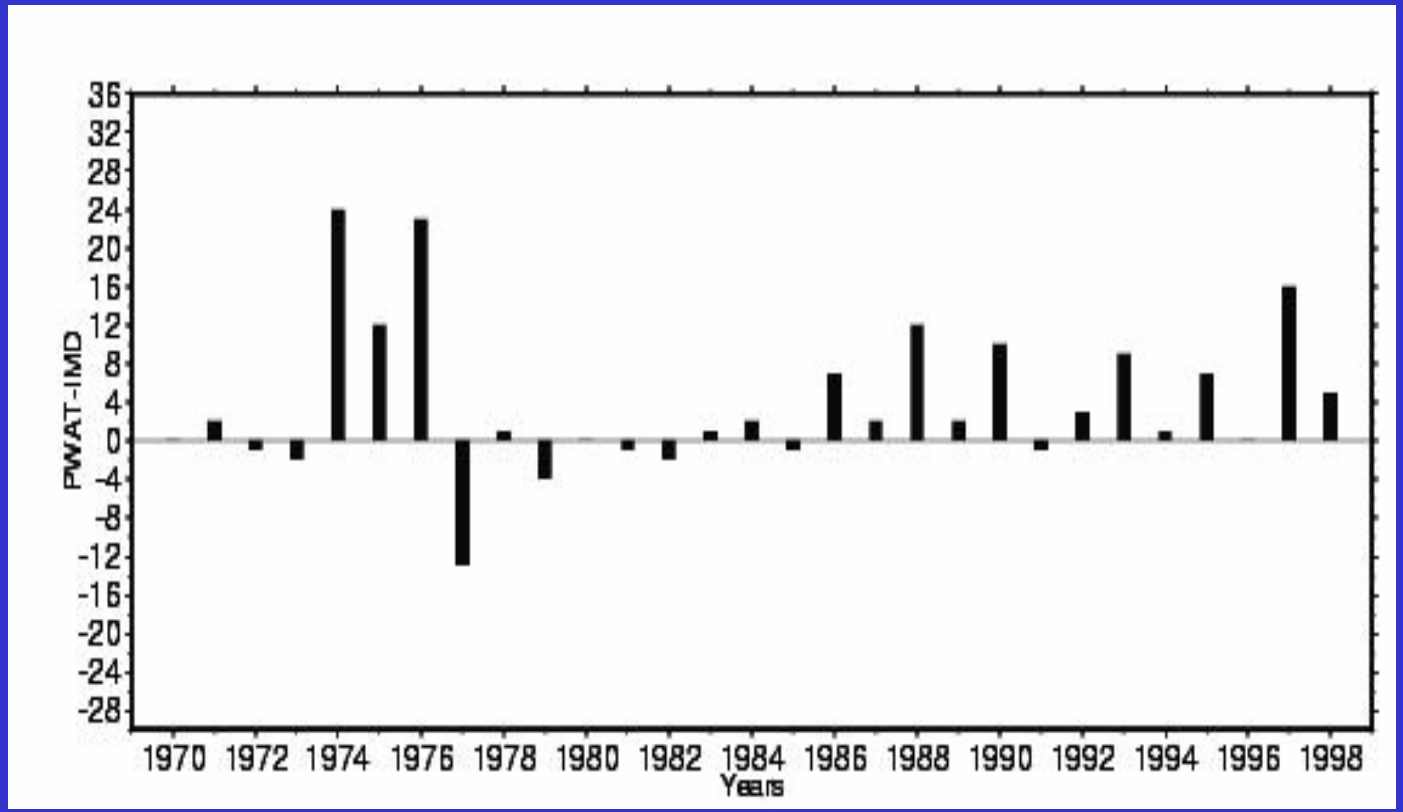

Difference in days between the new MOK (PWAT) – IMD MOK (days) for the year from 1970 to 1998.

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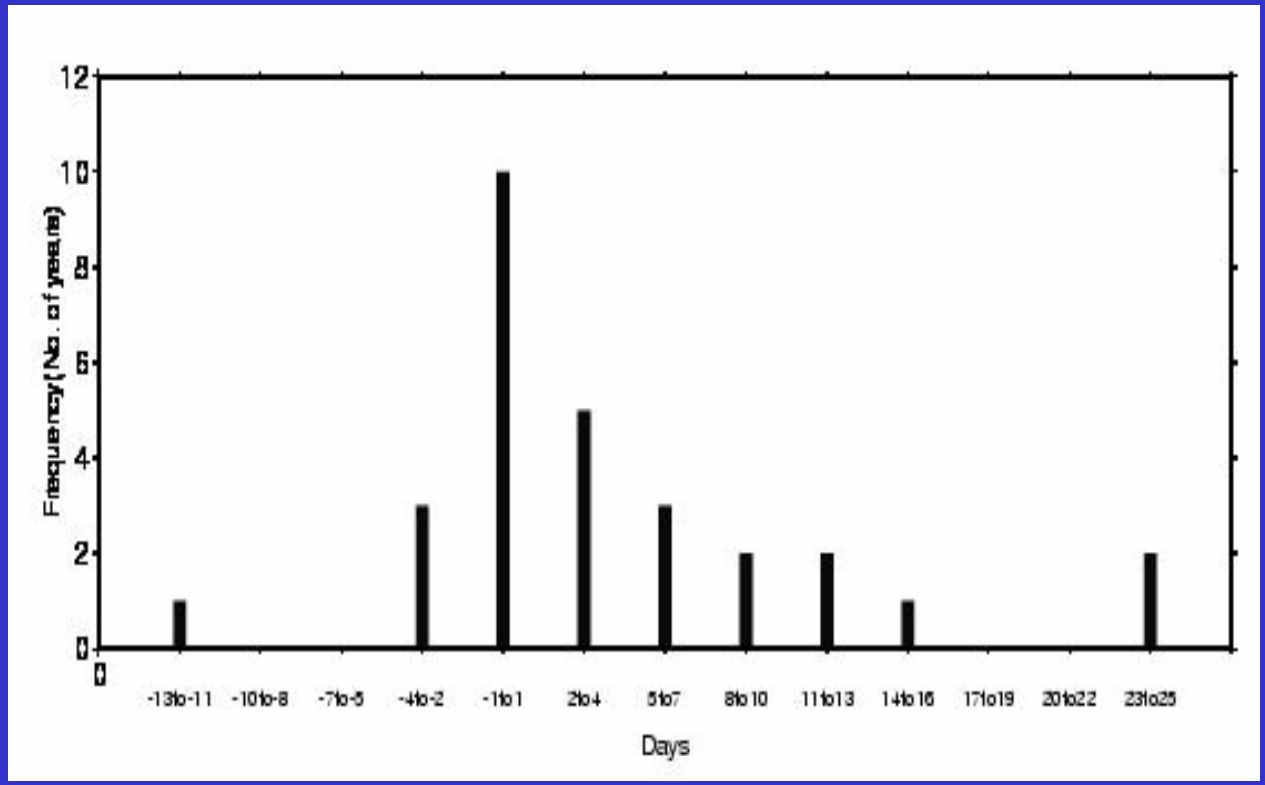

Frequency in number of years versus the new MOK (PWAT) – IMD MOK (days).

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Year	IMD	ZONAL	CEF	PWAT
1970	26 M	30 M	27 M	26 M
1971	27 M	30 M	30 M	29 M
1972	18 J	19 J	17 J	17 J
1973	04 J	07 J	28 M	2 J
1974	26 M	26 M	17 J	19 J
1975	31 M	31 M	09 J	12 J
1976	31 M	24 M	22 J	23 J
1977	30 M	09 J	06 J	17 M
1978	28 M	15 M	03 J	29 M
1979	13 J	17 J	12 J	9 J
1980	01 J	04 J	24 M	1 J
1981	30 M	03 J	19 M	29 M
1982	01 J	09 J	01 J	30 M
1983	13 J	16 J	15 J	14 J
1984	31 M	27 M	28 M	2 J

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Year	IMD	ZONAL	CEF	PWAT
1985	28 M	28 J	26 M	27 M
1986	04 J	16 M	05 J	11 J
1987	02 J	04 J	30 M	4 J
1988	26 M	09 J	20 M	7 J
1989	03 J	23 M	29 M	5 J
1990	19 M	20 M	23 M	29 M
1991	02 J	07 J	29 M	1 J
1992	05 J	16 J	06 J	8 J
1993	28 M	28 M	01 J	6 J
1994	28 M	02 J	30 M	29 M
1995	05 J	11 M	03 J	12 J
1996	03 J	14 J	04 J	3 J
1997	09 J	17 J	20 J	25 J
1998	02 J	08 J	15 M	7 J

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