

TROPOSPHERIC WAVE DISTURBANCES
IN EAST AFRICA

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A B S T R A C T

The present study identifies and describes wave disturbances in East African troposphere in terms of their periods, intensity, horizontal and vertical characteristics during three major seasons of the year 1973.

The upper wind data of 1200 GMT for the period March through December 1973 were analysed for Dar es Salaam ($06^{\circ} 50'S$, $39^{\circ} 12'E$), Nairobi ($01^{\circ} 18'S$, $36^{\circ} 45'E$) and Entebbe ($00^{\circ} 03'N$, $32^{\circ} 27'E$), located in East Africa. The data were grouped according to seasons, March to May, June to September and October to December. The seasons March to May and October to December in East Africa are commonly referred to as "long rains" and "short rains" respectively. The season June to September is characterised by relatively dry weather.

It is now well known that during the northern summer, there is an easterly jet over West Africa in the neighbourhood of 600 mb level with mean maximum speed of 7 ms^{-1} . This is known in literature as West African jet stream. This jet is also known to provide some energy to the easterly waves over West Africa through barotropic and baroclinic/CISK processes. The data over East Africa also showed an easterly wind maximum in the neighbourhood of 500 mb, sometimes lowering to 550 mb level during the three seasons of the study. The mean maximum intensity over the equator was observed to be near 7 ms^{-1} during the season March to May 1973 at 550 mb

level. It was present though variably weaker (3 ms^{-1}) with a primary maximum of nearly 6 ms^{-1} at 500 mb over the region 5° - 6° S during the northern hemisphere summer, June to September 1973. During part of the southern hemisphere summer, October to December the core over the equator had maximum intensity of the order of 5 ms^{-1} while a primary maximum of 8 ms^{-1} near 500 mb level appeared over the region 5° - 6° S. It appears as if this feature of easterly maximum in the neighbourhood of 500 mb level is a permanent feature over the whole of equatorial Africa throughout the year. Its role in the energetics of the easterly waves over equatorial Africa needs to be investigated further.

In the upper troposphere above 250 mb level, an easterly wind maximum in the neighbourhood of 150 mb associated with the tropical easterly jet was observed. The maximum intensity in the order of 8 ms^{-1} occurred during the northern hemisphere summer, June to September 1973.

Spectral analysis was carried out for the seasonal time series of meridional and zonal wind components at the three stations at levels 850, 700, 600, 500, 400, 300, 250, 200, 150 and 100 mb. The power spectral peaks observed at these levels could be grouped into seven divisions namely, 2-3.5, 3.7-5, 5.7-8, 9, 10, 12-15 and 17-22 days. The 2-3.5 days peak was observed at all the three

stations at all levels in all the three seasons. The peak was observed to explain substantial variance of both zonal and meridional winds at all levels. The 3.7-5 days peak was observed at all the three stations at all levels in all the three seasons. The peak was observed to explain substantial variance of both zonal and meridional winds at all levels. The 3.7-5 days peak was observed at all stations in most of the levels. It was observed that the percentage variance explained by this period range varied significantly from station to station and from level to level. The power peak in the period range 5.7-8 days was observed at all stations, in all seasons, in most of the levels with maximum intensity in the lower and upper troposphere. The 9 days peak was observed to be most dominant in the meridional wind component at levels 700, 600, 300 and 250 mb over Dar es Salaam, with maximum intensity at 300 mb level in the season October to December 1973. The 10 days peak was noted only in one of the seasons, June to September 1973, being most dominant over Dar es Salaam at 600, 500 and 400 mb levels. In this power spectral peak, most of the percentage variance was found in the zonal wind component. In the period range of 12-15 days, a 12 days peak with maximum intensity at 100 mb level over Entebbe and Nairobi was observed in the meridional wind component during the season October to December 1973. The spectral power peak in the period range 17-22 days in the meridional

wind was observed at single station, Dar es Salaam, at 150 mb level in both seasons March to May and October to December 1973, while it appeared only over Entebbe and Nairobi at 250 mb level during June to September 1973.

The other characteristics of the wave disturbances of the forementioned period ranges were obtained from cross-spectral analysis of inter-station meridional wind component.

The wave disturbance with period range 2-3.5 days, had horizontal zonal wavelength of about 20° longitude and moved from east to west with phase speed of 7° longitude/day at 700, 600, 500, 400, 250, 200, 150 and 100 mb levels. The horizontal wavelength for the period range 3.7-5 days was about 25° longitude and phase speed was 6° longitude/day from east to west at 700, 600 and 400 mb levels. The wave with period 5.7-8 days had a horizontal wavelength of about 20° longitude and phase speed of 3° longitude/day from east to west at 700, 400 and 250 mb levels.

The wave disturbances in the period range 2-3.5 days and 3.7-5 days displayed appreciable vertical coupling.

In case of the wave disturbances associated with three major period ranges namely, 2-3.5 days, 3.7-5 days and 5.7-8 days, it was noted that their axes were either nearly vertical or tilted slightly westward with height.

The series of daily rainfall in East Africa during four seasons of 1976 were subjected to spectral analysis technique. As in the wind field same features were noted in the rainfall fluctuations with period ranges of 2-3.5, 3.7-5, 5.7-8, 9, 10, 12-15 days. Most of the disturbances were predominant with maximum intensity in the lower and middle tropospheres below 400 mb.