SOME MESOMETEOROLOGICAL ASPECTS OF NAIROBI STORMS

BY

URBAN B. LIFIGA

A thesis submitted in part fulfilment for the degree of Master of Science in the University of Nairobi.

ABSTRACT

This is a study of mesoscale characteristics of tropical precipitation over a Nairobi network site (13.5 km x 9.5 km). The site had twenty self-recording raingauges and one radiosonde station. The raingauges were spaced from $1\frac{1}{2}$ km to 4 km apart.

For the purpose of the study, four rainfall episodes each with a fall of 70mm or more, per day, at one of the recording gauges in the network were selected. The selected episodes were chosen from different seasons namely, the cool dry season, the short rains the warm dry season and the long rains.

From minute by minute rainfall, ten-minute data sets were compiled at each gauge and ten-minute rainfall maxima deliniated on a network chart. The profiles clearly indicated the number of discrete cells, their duration and time seperation between them. It was found that most gauges were affected by multi-cellular clouds. However the heavy rainfall of 22-23 April 1970 came from two cell outbursts. The life time of the cells varied from 20 minutes to 155 min with a mean value of 60 min.

The study of the cell motion using isochrones upper tropospheric winds and superimposed precipitation profiles showed that the two precipitation cells of 22-4-70 moved very slowly while during the remaining episodes cells appeared to move with the 700-500 mb layer winds. The city centre was found to be the birth/intensification place of several precipitating cells.

The total cell precipitation was compared to the total rainfall at a raingauge and the cell contribution was about 76% of the total rainfall.

The horizontal size of two cells was estimated; one had an approximate diameter of $1\frac{1}{2}$ km while the other was elliptic in shape with axes of 3 km and 1 km respectively.

The role of horizontal wind divergence, moisture flux divergence, vertical motion and wet bulb potential temperature in the production of mesoscale precipitation was studied and it was found to be of the same effect as in the synoptic scale rainfall. Considering the profiles of $\nabla\cdot\vec{V}$ and $\nabla\cdot q\vec{V}$ it was observed that close resemblance existed between the two but on occasions there were dissimilarities which were attributed to the fact that the component $\vec{V}\cdot\nabla q$ is not always small compared to $q\,\nabla\cdot\vec{V}$

Consideration of precipitation and the water budget in the atmosphere, by using the equation developed by Fulks (1935) and also Bannon (1949) showed that (a) the water vapour term, $-\frac{1}{g}\int_{p_u}^{p_G}\frac{\partial q}{\partial t}dp$ was small, 1 to 2 orders of magnitude compared to either the rainfall term or the evaporation term. (b) Because of the insufficient data we cautiously hypothesised that during day time precipitation, the role of vertically integrated moisture flux divergence term is small and evaporation term balances the precipitation term while during night time precipitation, the role of evaporation is small and the vertically integrated moisture flux divergence balances precipitation.