1B.4 # THE SIGNIFICANCE OF AFRICAN EASTERLY WAVES ON CONVECTION

Ademe Mekonnen*
SUNY at Albany, Albany, NY

1. INTRODUCTION

Composite analyses suggest that there is a coherent relationship between African easterly waves (AEWs) and convection and associated rainfall (e.g. Reed et al. 1977). However, we still lack a quantitative description of the significance of wave activity on convection. Past studies also show the presence of large interannual variability in rainfall. The present study aims to investigate the significance of AEWs on convection and how this varies in space and time (seasonally and interannually).

To achieve this objective, analysis of variance and spectral methods are carried out on a high resolution (3-hourly, 0.5^o by 0.5^o grid) brightness temperature, T_B, of Cloud Archive User Service (CLAUS) data, for the period 1984-94.

2. RESULTS and DISCUSSION

Spectral analyses at multiple representative locations over tropical Atlantic and across Africa, from Dakar to western Ethiopia and over equatorial regions, have revealed dominant peaks in the range of 2-5 days periodicity (not shown). Motivated by this, 2-5 days band pass filtering was carried out on T_B. Figure 1a shows the 2-5 days filtered variance of T_B. Peak filtered variance over the Atlantic is confined between 5^o to 10^{o}N, while over land this stretches from about 15^{o}W to 35^{o}E and 7^o-15^{o}N. The axis of maximum variances shown in fig. 1a is consistent with the disturbance tracks near deep convective regions in the ITCZ seen in previous studies. Also, locations of maxima match well with the 600mb relative vorticity tracks seen in Thorncroft and Hodges (2001; their fig. 2). Another maximum centre that emerged from this study is the one located over equatorial Africa between 4^{0}S and 5^{0}N.

In fig. 1b, it is seen that ratios of 20 to 30% cover most regions of summer time convection over land, and 25% to 30% over the ocean within the ITCZ, indicating a significant contribution from 2-5 days variability. These are also regions in West Africa and the Atlantic where we expect to see signature of AEWs. Gu and Zhang (2002), using OLR data, found about 15% contribution from 2.5-10 days time scale, which is somewhat less but comparable to the results found here. Differences may be attributed to low resolution (2.5^o by 2.5^o) of the OLR data. Percentage ratio over the highlands are less than 15%, indicating the dominant role of intradiurnal variance there.

* *Corresponding author address*: Ademe Mekonnen, Dep't of Earth and Atmospheric Sc., Univ. at Albany, Albany, NY 12222. email: <ademe@atmos.albany.edu>

Computation of normalized indices for 2-5days variance and mean T_B across land and over the ocean, for JAS over 1984-94, shows strong interannual variability (not shown). Most years characterized by high 2-5 days variances are associated with stronger than mean annual convection. However, there are instances in which this is not always the case, indicating the importance of other time scales on the mean.

To highlight variability in the 2-5 days timescale, two extreme years, 1988 and 1984, have been selected for further study. The filtered time- longitude Hovmuellers (cross-section at 10^o-15^{o}N) for August shows marked contrasts (fig. 2): very coherent westward propagating 2-5days filtered disturbance in 1988, and much less coherent and weaker structures in 1984. A rough estimate shows these disturbances have a wavelength in the range of 2500 to 3000 kms and move with an approximate speed of 12-13 ms^{-1}, typical AEW wave length and phase speed scale. As seen in fig. 2a, most of August 1988 disturbances can be tracked as far east as 35^{0}E over western Ethiopian highlands, indicating a potentially important role for this region in the intitiation of synoptic scale disturbances.

Further analysis is being carried out to assess, in more detail, the nature of the 2-5 day disturbances including the relationship between AEWs and mesoscale systems (MCSs). Preliminary investigation for these years shows that the disturbance signal in 1988 is associated with marked and coherent AEW structure over West Africa (based on ECMWF analyses; not shown), whereas in the east the AEWs are very weak or non-existent.

3. CONCLUSIONS and FUTURE WORK

We have shown that the 2-5 days variance peaks in deep convective regions over land and over ocean in the ITCZ. Significant (20-30%) contribution to the total variances come from 2-5 days time scale over regions where we expect to see AEWs in West Africa and over the Atlantic. Fig. 1a shows multiple maximum variance centers over eastern Atlantic and over land. Future work will include detailed analyses of indices based on those regions and structures of disturbances (fig. 2) to further our knowledge of the interannual variability.

Filtered T_B analysis shows marked coherent disturbance structures in some years (e.g. 1988) and weak structures in others (e.g. 1984). The question as to what these structures represent will be considered in future work. To further our understanding of the significance of AEWs on convection and their relationships, detailed work on waves and their relationship with MCSs will be considered.

4. ACKNOWLEDGEMENT

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5. REFERENCES

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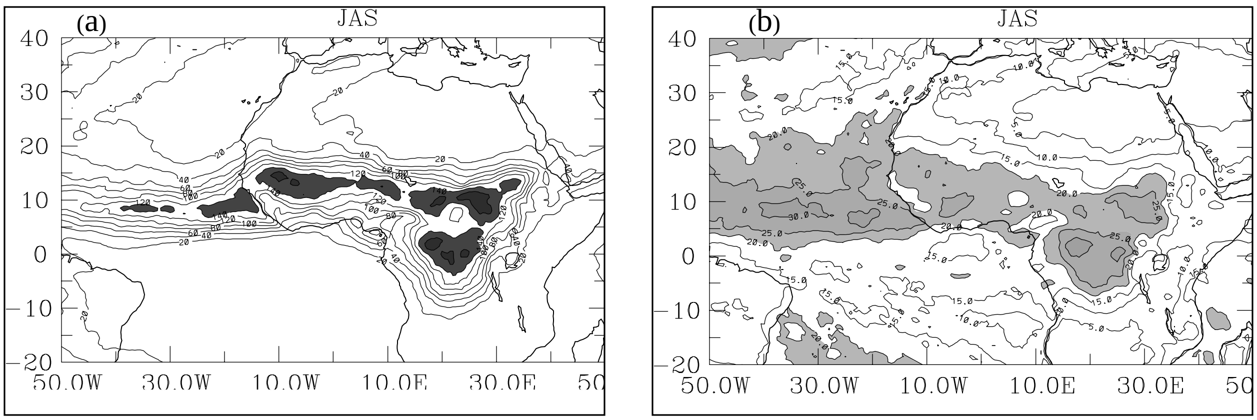

Fig. 1: (a) 2-5days filtered variance (>140K^2 shaded); (b) Percentage ratio of 2-5days variance to total variance (>20% shaded)

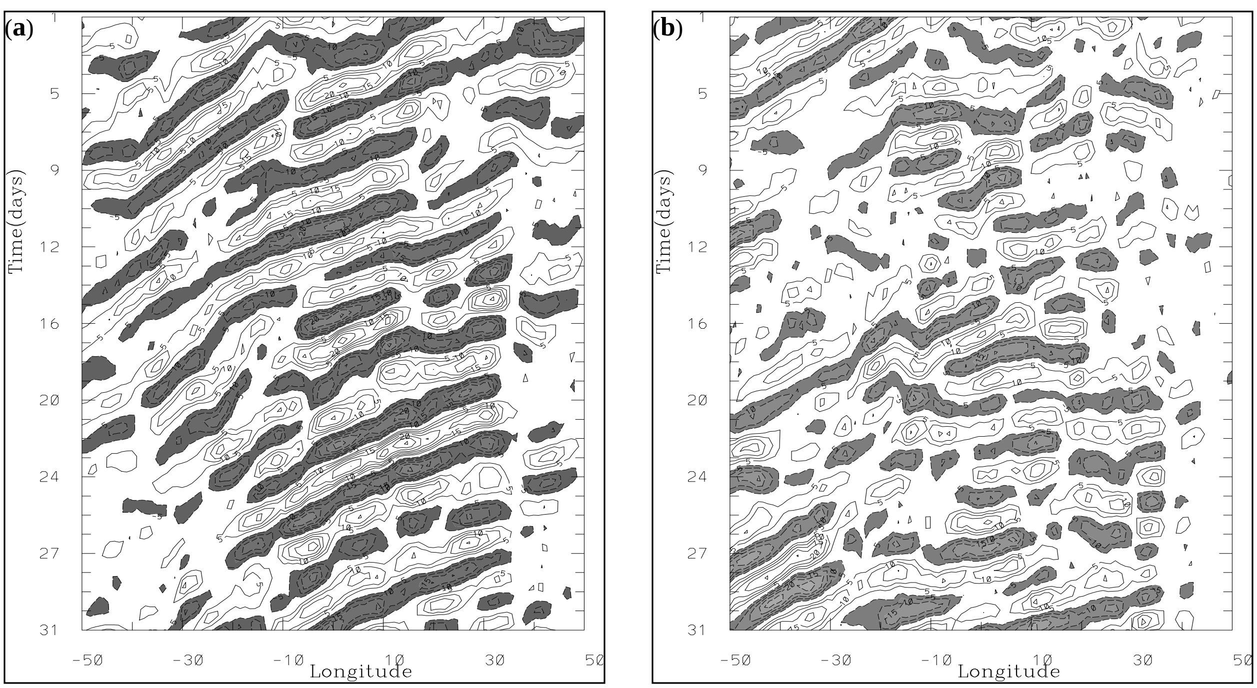

Figure 2: 2-5 days filtered T_B (at 10-15N) for August: (a) 1988; (b) 1984. Contour values < -5K are shaded