3.B.4 THE INTRA-SEASONAL VARIABILITY OF CONVECTION IN THE WEST AFRICAN MONSOON

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1. INTRODUCTION

Past researches have stressed out two dominant summer intra-seasonal modes of variability experienced by the West African Monsoon regime. One of them, defined using precipitation data filtered between 10 and 60 days, is a 15 days periodicity low-level westward-propagating waves over the Sahel (Sultan & Janicot, 2003). The other one, defined using OLR-NOAA filtered in between 20 and 200 days data after removing annual harmonics, is geographically a more "equatorial" mode that includes also the complete African ITCZ area of West and central Africa (Matthews, 2004). It is stationary and has a periodicity around 40 days. The main objective of this study is to revisit these results to provide a synthetic overview of the monsoon intra-seasonal variability of the West and Central Africa during the summer monsoon (June to September).

2. INTRA-SEASONAL VARIABILITY OVER WEST AFRICA

To achieve this goal a statistical approaches has been used. First, a 10-25-day bandpass filter was applied on NOAA interpolated Outgoing Longwave Radiation (OLR) data as daily deep tropical convection proxy. As only the summer intra-seasonal variability is of interest, the June to September period was extracted each year (1979 to 2000) before the statistical analysis. Then, an Empirical Orthogonal Function (EOF) analysis has been performed over the domain shown in Fig.1.

The leading eigenvector and the two next are accounting for respectively 10.24%, 8.75% and 5.58% of the variance. They are well separated from their neighbouring according to the North's criteria. Other statistical analysis methods such as rotated EOF, Temporal-EOF, and Extended-EOF analysis provided results comparable to the classical EOF analysis. This enables to provide a satisfactory level of confidence in relation to the results detailed hereafter. Indeed, after multiplication by the square root of their respective eigenvalue, two well-defined types of mode emerged.

The dominant one is a stationary mode located on the equator. In the lagged correlation map patterns (Fig 1.a), a clear stationary deep convective anomaly over the equatorial belt is developing and decays in a similar manner (not shown).

The two next principal components are both propagating westward along the Sahelian band. Combined together, they are associated with a cyclonic/anticyclonic circulation patterns at the monsoon level (not shown). A wet-dry composite was done over the period 1979 to 2000 with the 10-25-day bandpass filtered OLR data and PC1, PC2 or PC3 time series maximum and minimum as reference (not shown). A mean periodicity of 14 days is established for each mode. A study on the year 1992 has also highlighted such variability on easterly waves activity over the Sahel (Redelsperger et al., 2002). Moreover, another index-based study done on 10-60-day bandpass filtered Sahel rainfall index, confirmed such variability and called it a "suprasynoptic" intraseasonnal variability mode (Sultan and Janicot, 2003).

The same statistical approach was performed on OLR data at two other filtering ranges: 10-60-day and 25-60-day. In both cases, spatial patterns resulting from the EOF analysis were comparable to the ones of Fig.1, with obviously distinct development growth for PC1 and propagation speed for PC2 and PC3. At low frequency, the mean periodicity is between 30 and 35 days, which agrees with Matthews (2002) Madden-Julian Oscillation dominant mode of intra-seasonal variability. At 10-60-day, both 14 and 30/35 days mean periodicity stand out with the 14 days signal amplitude remaining the leading one.

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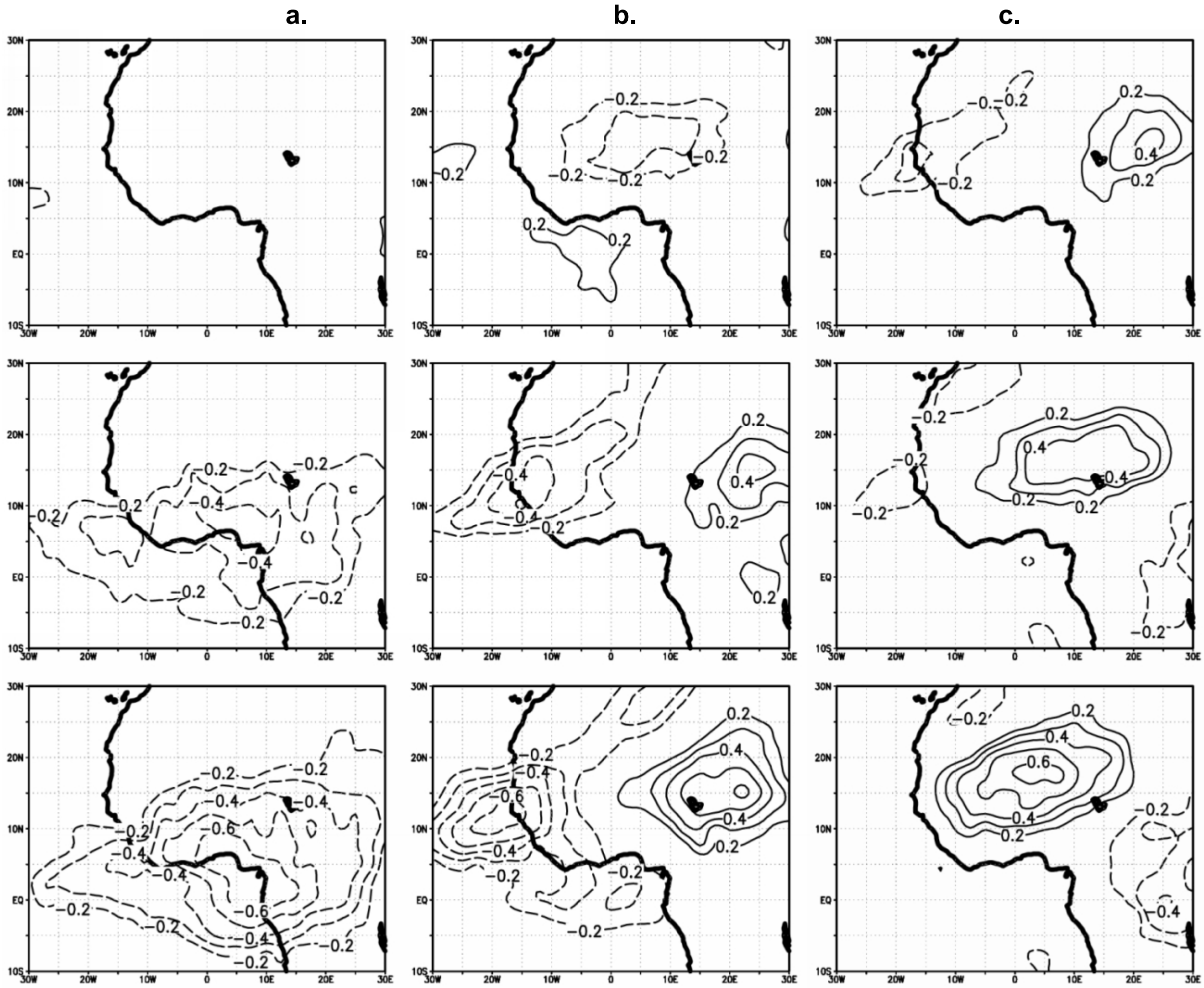

Figure 1: Lagged correlation coefficient patterns map between 10-25-filtered OLR PCs and filtered OLR field: (a) PC1 (b) PC2 (c) PC3. From top to bottom results are presented at t0 - 4 days, t0 - 2 days and t0. Only the summer period (June-September) from 1979 to 2000 is considered. Contour intervals are plotted every 0.1; negative contours are dashed and correlation in between –0.2 and 0.2 is omitted.

3. CONCLUSION

Hence, it appears two distinct modes of intra-seasonal variability over West and Central Africa during northern summer, one stationary (PC1) on the equator, and the other one (PC2 and PC3) propagating westward over the Sahel. These structures have a specific temporal evolution, where two main wave frequencies are bounded together (14 and 30/35 days periodicity) and interact in a manner that must be understood. The challenge of this on-going study is to improve sufficiently our knowledge so that a high-quality forecast system could be implemented and developed.

4. REFERENCES

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