11B.5

INTERANNUAL VARIABILITY OF STORM TRACKS OVER WEST AFRICA AND THEIR RELATIONSHIP WITH ATLANTIC TROPICAL CYCLONE ACTIVITY

Susanna Hopsch[1]
University at Albany/SUNY, Albany, NY 12222

1. INTRODUCTION

Thorncroft and Hodges (2001, hereinafter TH) used automatic tracking techniques to identify coherent vorticity structures over West Africa and the tropical Atlantic. Their study indicated the existence of two dominant source regions, the first was south of about 15^0N in the rainy zone, with a track density maximum just offshore of the West African coast. The second was located north of 15^0N on the fringes of the Sahara. The present study extends this analysis by considering the relationship between the storm tracks over West Africa and the Tropical Atlantic in more detail. Figure 1 shows the mean May-to-November 850hPa track density based on the 40-year ECMWF Reanalysis (ERA40). Consistent with the findings of TH, it is clear that the two source regions provide the majority of storm tracks that track over or across the Atlantic. Two questions we want to address in this work are:

- •What are the relative roles of the northern and southern storm tracks on Atlantic Tropical Cyclone activity
- •What is the interannual variability of these storm tracks and does this impact Atlantic Tropical Cyclone variability

2. METHODOLOGY

In this analysis ERA40 data from the ECMWF for the entire period from 1958 to 2002 is used to generate storm track statistics, following the approach by TH. The technique requires that positive vorticity anomalies need to fulfill certain criteria with respect to longevity and propagation to be considered for tracking (see TH for details). In order to examine the importance of various geographic regions with regard to storm tracks, the systems passing over these areas were extracted and statistically analyzed. For example, tracks propagating over a predefined latitude segment were counted both on a seasonal and monthly timescale. Also, each track was tested on whether it entered the main development region (MDR) over the tropical Atlantic (Goldenberg and Shapiro, 1996), to see whether periods of enhanced (decreased) storm track activity over these key regions and the MDR coincide with periods of increased (decreased) tropical storm activity.

1. Corresponding author address: Susanna B. Hopsch
Dept. of Earth and Atmospheric Sciences, University at Albany, SUNY
1400 Washington Ave., Albany, NY 12222
E-mail: hopsch@atmos.albany.edu

3. CLIMATOLOGY

The total number of storm tracks coming off the West African Coast according to their respective latitude is shown in figure 2. Also given in that figure is the overall number of systems, which propagate into the MDR. All tracks had to pass through a longitude strip from 10^0 to 20^0W in order to be counted. It is confirmed that there are two dominant storm tracks (as also suggested by TH and figure 1), with a very strong contribution from latitude segments from 10^0 to 15^0N (the southern storm track), and another peak contributing latitude segment from 20^0 to 22^0N (the northern storm track) approximately. While there is a bimodal distribution of the number of tracks coming off the West African Coast both overall and particularly in July through September (seasonal cycle not shown here), it is found that the storm tracks emanating from the heat low region (20^0-25^0N) rarely enter the MDR, whereas the tracks from the main providing latitude segment (10^0-15^0N) often do so. For comparison, approximately 75% of the southern tracks continue to the MDR compared with only 20% of the northern tracks. It will also be shown that typically, the activity starts in May and continues through November. The northern storm track is most active during July and August, whereas the southern storm track shows the highest level of activity from July through September.

4. INTERANNUAL VARIABILITY

It is often assumed that the number of Easterly Waves coming off the West African Coast is relatively constant (Goldenberg et al., 2001). The present analysis shows that there exist large variations of activity for the tracked features over the tropical Atlantic Ocean. Figure 3 shows the box-plot of the entire time series for all tracks passing through longitude 10^0 to 20^0W, and latitude bands of 5^0, starting at 5^0N. The boxes show the 25^{th} percentile, median, and 75^{th} percentile, and the whiskers show the minimum and maximum values in the time series. An example for the overall variability is given by the number of systems coming off the West African coast, and shows big differences from one year to another (indicated by size of the box and length of the whiskers). The variability in the southern track and northern track are both large. For example, the number of systems leaving the West coast in the southern tracks varies from 7 to 19.

Interestingly, although a much smaller percentage of the northern systems reach the MDR, it too is characterized by marked variability. Future work will investigate in what way this variability is relevant for TC variability.

5. CONCLUSIONS

It is found that the southern storm track provides most systems that enter the MDR and therefore maybe more likely to get involved in Tropical Cyclone genesis, since most Atlantic Tropical Cyclones are formed in the MDR. There exists large variability in both the number and location of storm tracks that come off the West African Coast and move over the Atlantic Ocean. Future work will consider causes of this variability and whether this impacts TC variability downstream.

ACKNOWLEDGMENTS

This research is supported by the National Science Foundation (Award Number: 0138290). The author would like to acknowledge Kevin Hodges for providing the track data and software package, and Chris Thorncroft for advisement and encouragement.

REFERENCES

Goldenberg, S. and L. Shapiro, 1996: Physical Mechanisms for the Association of El Nino and West African Rainfall with Atlantic Major Hurricane Activity. *J. Climate,* **9,** 1169-1187

Goldenberg, S., et al., 2001: The Recent Increase in Atlantic Hurricane Activity: Causes and Implications. *Science,* **293,** 474-479

Landsea, C. and W. Gray, 1992: The Strong Association between Western Sahelian Monsoon Rainfall and Intense Atlantic Hurricanes. *J. Climate,* **5,** 435-453

Thorncroft, C. and K. Hodges, 2001: African Easterly Wave Variability and Its Relationship to Atlantic Tropical Cyclone Activity. *J. Climate,* **14,** 116-1179

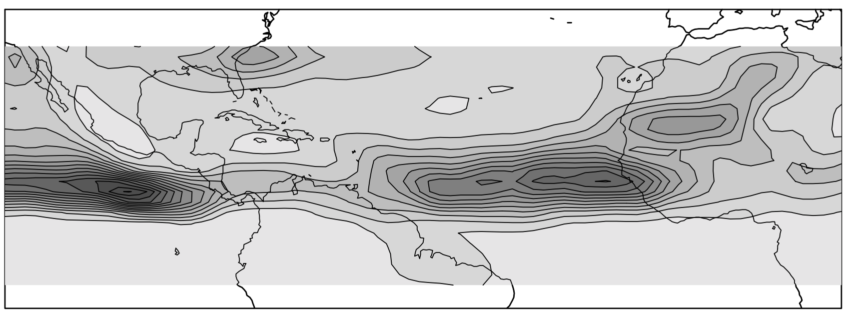

Figure 1: Track density $((10^6\ km^2 Month)^{-1})$ of 850hPa positive vorticity anomalies from the ERA40 data set for all tracks in the entire time series from 1958 to 2002 (May through November). The gray scale is from light (lower values) to dark (high values), contours every 0.8 units starting from 0. The strong contribution from systems coming off West Africa from 10^0 to 15^0N is apparent.

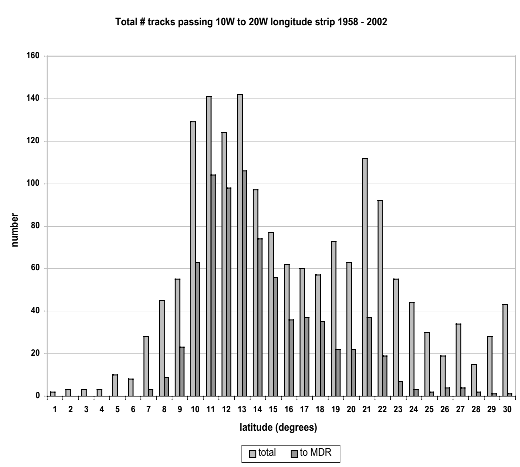

Figure 2: Number of storm tracks passing through longitude 10^0 to 20^0W and number of storm tracks that further continue to MDR (light and dark gray respectively) versus latitude. See text for details.

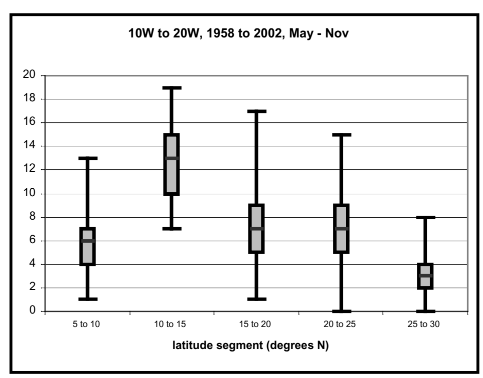

Figure 3: Box plots of tracks passing through longitude 10^0 to 20^0W, and latitude as shown. The panel shows the number of features in total. Note the big interannual variation in number, as indicated by the length of the whiskers. See text for more information.