17C.7 PINHOLE EYES IN TROPICAL CYCLONES

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1. INTRODUCTION

While tropical cyclone (TC) track forecasts have continued to improve over the past decades, intensity forecasts have not significantly improved in 30 years (AMS Council 2007). The problems with intensity forecasts include large errors in cases involving rapid intensity change. In recent years several TCs that underwent rapid intensification developed a very small eye in the process, often referred to as a 'pinhole' eye. Understanding the processes and environmental factors involved in the development and maintenance of pinhole eyes could assist in prediction of TC structure and intensification.

This project develops an observational climatology of pinhole eyes. The climatology examines pinhole eyes occurring in TCs in the Atlantic Basin over the period 1989-2006. For this study pinhole eyes are defined as those eyes with a diameter smaller than 10 n mi, representing less than ten percent of the eye size measurements available in aircraft reconnaissance fixes. A combination of aircraft reconnaissance fixes, operationally-estimated size parameters, and synoptic data is used to examine the size and intensification properties of pinhole cases, as well as their large-scale environment.

2. METHODOLOGY

This project primarily relied on three different datasets: the extended best track (EBT, Demuth et al. 2006), the aircraft reconnaissance data from the National Hurricane Center fix files, and the environmental parameters compiled for the Statistical Hurricane Intensity Prediction Scheme (SHIPS, DeMaria et al. 2005). The EBT adds operational estimates of various TC size parameters to the traditional location and intensity information retained in the best track dataset. The EBT includes this information every six hours for all named storms in the years 1988-2006. The aircraft reconnaissance (AR) data in the fix files includes information about intensity, location, and various TC parameters, including size estimates, during AR missions over the period 1989-2006. The SHIPS dataset includes information on TC environment, in six hour increments, over the period 1982-2006.

To examine the characteristics of TCs with pinhole eyes, a threshold for the designation of a pinhole eye needed to be chosen. To choose the threshold the AR eye diameter estimates were used. The AR included 2076 eye diameter estimates, as shown in Figure 1. These estimates occurred in 99 different TCs over the 18-year period. We chose to define pinhole eyes as the smallest 10% of all AR eye diameter estimates. To deal with the peaks at 5 n mi increments, the threshold for pinhole eyes was defined as those eye diameters less than 10 n mi, which includes less than 10% of the total eye diameter estimates.

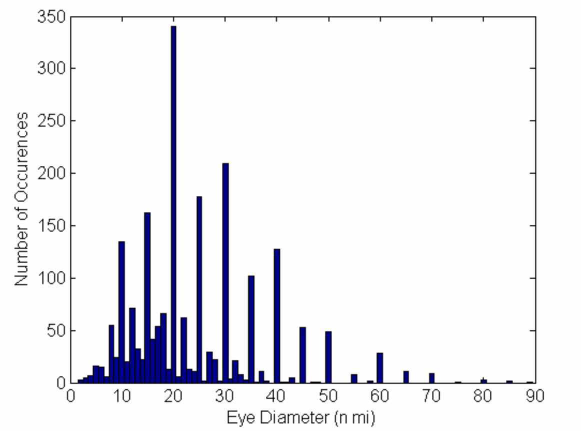

Figure 1. Histogram depicting the number of eye diameter estimates made by AR, stratified by the size of the estimate and binned in 1 n mi increments.

3. RESULTS

While pinhole eyes made up less than 10% of the total sample of eye diameter estimates, those estimates were spread out amongst 38 of the 99 TCs represented in the AR data. The larger the number of eye diameter estimates in a given TC, the more likely a pinhole eye would be observed during the TC's lifetime, including two-thirds of TCs with over 50 estimates (see Figure 2).

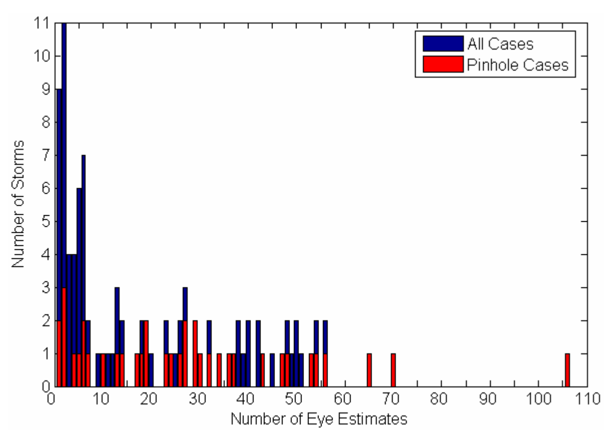

Figure 2. The number of TCs with AR eye diameter estimates, stratified by the number of eye diameter estimates per TC.

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Half of the TCs that reached major hurricane intensity on the Saffir-Simpson scale had at a pinhole eye for at least one eye diameter estimate. Of the TCs with a pinhole eye, approximately 60% reached major hurricane intensity. Pinhole eyes were observed to occur throughout the Atlantic hurricane season, with the most pinhole eye estimates occurring in October. Figure 3 shows the spatial distribution of the eye diameter estimates in the AR data. While pinhole eyes were observed throughout much of the AR area, they were more numerous further south and west in the Atlantic Basin, representing a higher percentage of the eye diameter estimates in the Caribbean Sea and Gulf of Mexico.

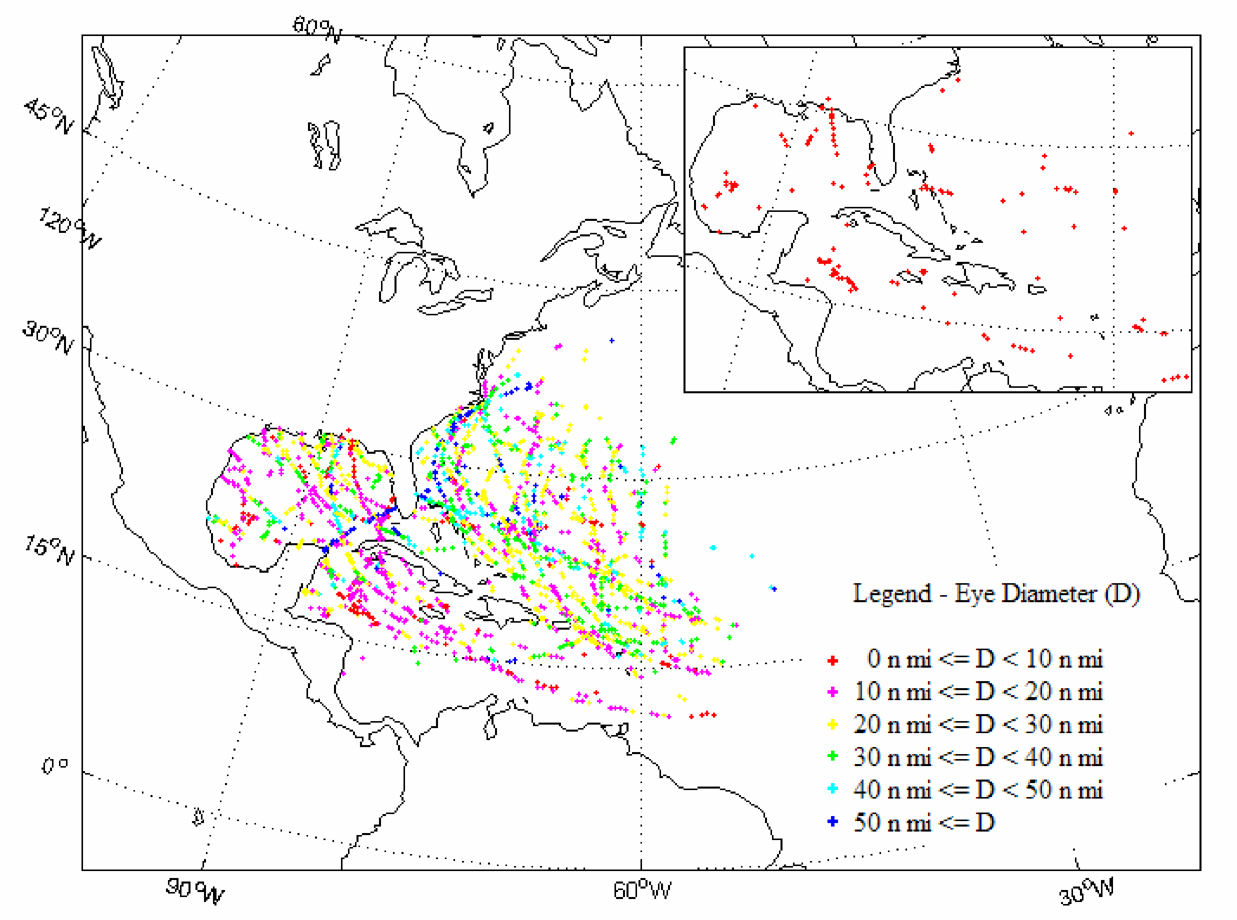

Figure 3. Map depicting location of eye diameter estimates obtained by aircraft reconnaissance in the Atlantic basin. Inset shows eye diameter estimates of less than 10 n mi.

Additional results will be shown at time of presentation, covering in more detail the intensification and large-scale environment of TCs with pinhole eyes.

4. ACKNOWLEDGEMENTS

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