7A.1 **The early days of the Dvorak technique at the National Hurricane Center**

Max Mayfield
NOAA/NWS /NCEP/National Hurricane Center, Miami, Florida

1. INTRODUCTION

The National Hurricane Center (NHC) tracks all tropical cyclones in the Atlantic and eastern Pacific basins. The application of satellite derived location and intensity estimates using the Dvorak (1973) technique at NHC began in the 1970s. In fact, even today, the technique continues to be the primary (and often sole) method used at NHC for estimating the intensity of tropical cyclones located east of 55°W longitude, or those not threatening land.

In the very early days, the position and intensity estimates of tropical cyclones at NHC were based on the subjective interpretation of very limited satellite imagery. Basically, the technique consists of assigning a number which corresponds with the cloud pattern and the intensity of the cyclone. In those early days, neither animation capabilities nor color image enhancement were widely available, and objective methods were not developed. Figure 1 shows the original chart for determining the preliminary intensity from cloud feature measurements. Initially, there was little expertise in applying the technique and the errors in both location and intensity estimates were large. This is in contrast with today's better estimates. Brown and Franklin (2002) indicated that nearly half of Dvorak satellite-based intensity estimates fall within 7 kt of reconnaissance-based best track values, and only in 10% of the cases there are differences of 20 kt or more. The success of the technique is widely known. However, the intention of this paper is to show examples of limitations of the Dvorak analyses at NHC primarily during the early days.

2. Examples

One typical example of a limitation in applying the technique occurred during Hurricane Hugo in 1989. Figure 2 shows the final best track wind speed and minimum pressure graphics of Hurricane Hugo. The figure includes observations and satellite intensity estimates. Note that the subjective Dvorak classification at 1800 UTC 15 September (marked with an arrow) corresponded with a cyclone of maximum winds of 115 knots and a minimum pressure of 948 mb. Data from a reconnaissance hurricane aircraft indicated that the maximum surface winds reduced from flight level at that time were 140 knots with a minimum pressure of 919 mb.

Corresponding author address: Max Mayfield, NOAA/NWS/TPC/, 11681 SW 17th Street, Miami, FL 33165. e-mail:Max.Mayfield@noaa.gov

Another potential limitation of the technique is noted when it is applied to rapidly weakening tropical cyclones over cool waters. This is commonly observed in the eastern North Pacific basin where the majority of tropical cyclones move from very warm waters to cool waters rather quickly. The typical example was Hurricane Jimena during September 1991. Dvorak classifications using infrared images on 29 September indicated a 127-kt hurricane. The thunderstorm activity dissipated 24 hours later and because the technique is heavily based on the amount of convection, analysts were not able to provide the cyclone's intensity using infrared images.

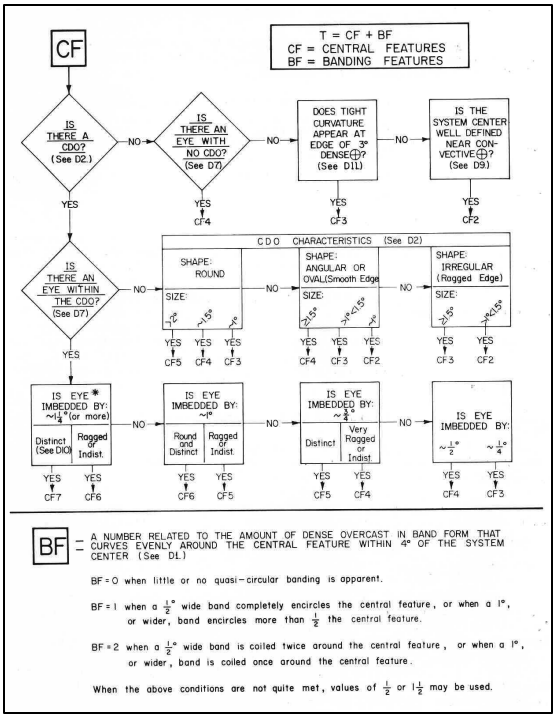

Fig.1. Original chart for determining the preliminary intensity from cloud feature measurements.

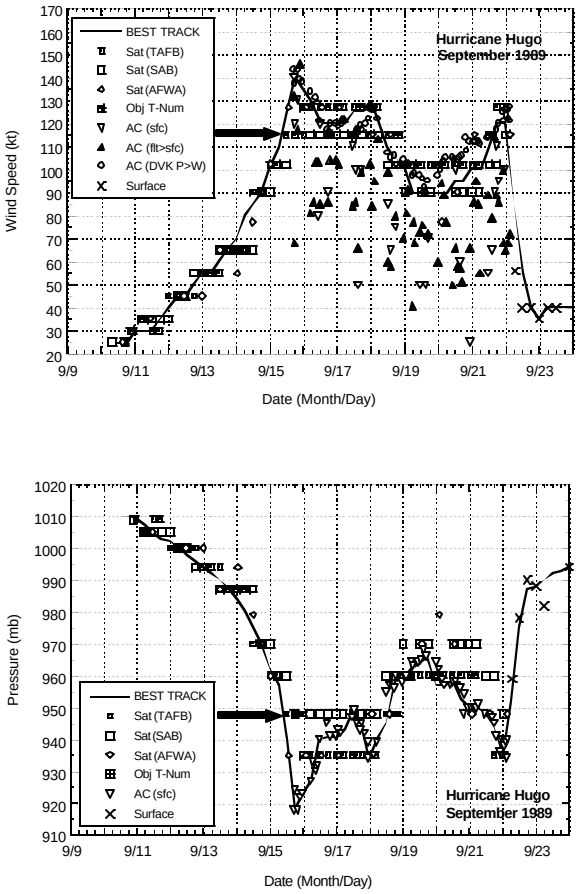

Fig.2. Selected wind observations and best track maximum sustained surface wind speed and pressure curves for Hurricane Hugo, September 1989. Aircraft wind observations have been adjusted for elevation using 90%, 80%, and 80% reduction factors for observations from 700 mb,

3. REFERENCES

Brown, D., and J. Franklin, 2002: Accuracy of pressure-wind relationships and Dvorak satellite intensity estimates for tropical cyclones determined from recent reconnaissance-based "best track" data. *Preprints, 25th Conf. Hurr. Trop. Meteor., San Diego, Amer. Meteor. Soc.*

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