5D.5 AIRCRAFT DATA FROM RAPIDLY-MOVING HURRICANE JUAN SOUTH OF NOVA SCOTIA

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1. INTRODUCTION

Over the past four years the Meteorological Service of Canada (MSC) has become involved with aircraft research into hurricanes and particularly hurricanes undergoing extratropical transition (ET) (Jones et al. 2003). Flights have been arranged and conducted by the National Research Council using the Convair-580 aircraft. The MSC has been recently funded by the Search and Rescue secretariat of Canada to continue research and public awareness into extreme weather related to hurricanes and ET storms affecting Canada. The first of such flights was into Hurricane Michael in October 2000, which provided a view of a hurricane undergoing rapid ET (Abraham et al. 2004). In 2001 another mission was conducted through decaying Tropical Storm Karen over Nova Scotia. In September 2003 the remnants of Hurricane Isabel were sampled by the aircraft over southern Ontario and shortly thereafter Hurricane Juan raced toward Nova Scotia providing another opportunity for a mission into that storm. This document presents a brief summary of the data collected from Hurricane Juan.

2. SYNOPTIC OVERVIEW OF JUAN

Hurricane Juan formed in a weakly baroclinic environment to the southeast of Bermuda on 23 and 24 September, 2003. An upper-level low induced the formation of a surface frontal wave north of the Bahamas. That wave moved to the northeast and became the seedling for Juan with subtropical-like development initially. Tropical depression status was declared at 12 UTC 24 September then tropical storm strength shortly thereafter at 00 UTC 25 September. Juan became a hurricane around 12 UTC 26 September. A map of the storm track appears in Fig. 1.

Juan moved slowly northward over a large upper ocean heat content anomaly that likely helped intensify the storm to 46 m s^{-1} (90 kts) by the evening of 27 September. The storm was moving northwestward by that time as it was being deflected by a strong high pressure system to the northeast. On 28 September Juan accelerated along a northward track on a bee-line for Nova Scotia. Although Juan was weakening during that accelerating period, the surface wind speeds remained at or above 44 m s^{-1} (85 kts) up until landfall just west of Halifax, Nova Scotia. This was due to the large translational speed of the storm. Juan maintained hurricane status as it crossed Nova Scotia in three hours and diminished to tropical storm strength as it was exiting Prince Edward Island. The storm then continued rapidly north-northeastward through the Gulf of St. Lawrence with strong tropical storm-force winds.

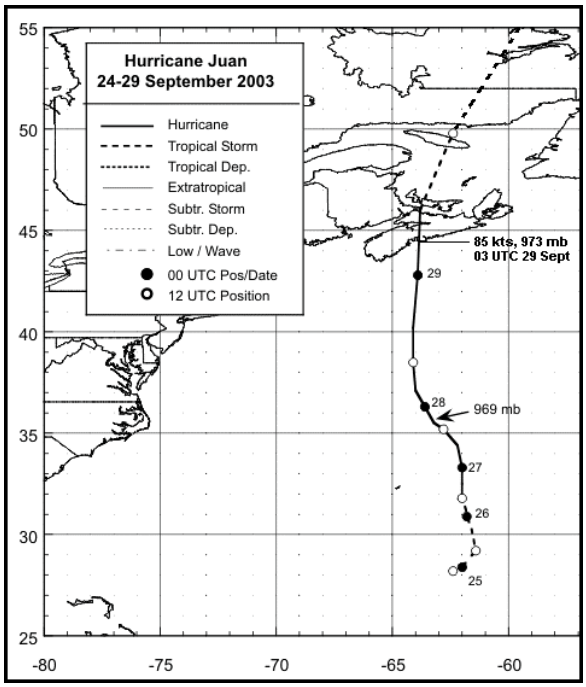

Fig. 1 Hurricane Juan storm track (adopted from the NHC)

3. DESCRIPTION OF THE FLIGHT

The Convair aircraft flew into Hurricane Juan starting from the Halifax International Airport, flying south directly toward the eye of the storm. A map of the flight track and dropsonde deployment locations is shown in Fig. 2. There were two eye penetrations – one on the south-bound leg near sonde #4 and another on the northeast-bound coastal leg near sonde #17 just before the storm made landfall. A total of 25 dropsondes were released. A 35-GHz radar with upward- and downward-pointing antennae provided a continuous cross section of the storm's precipitation.

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The crew did not return to Halifax due to hurricane conditions, but instead continued toward Newfoundland and recovered in Stephenville.

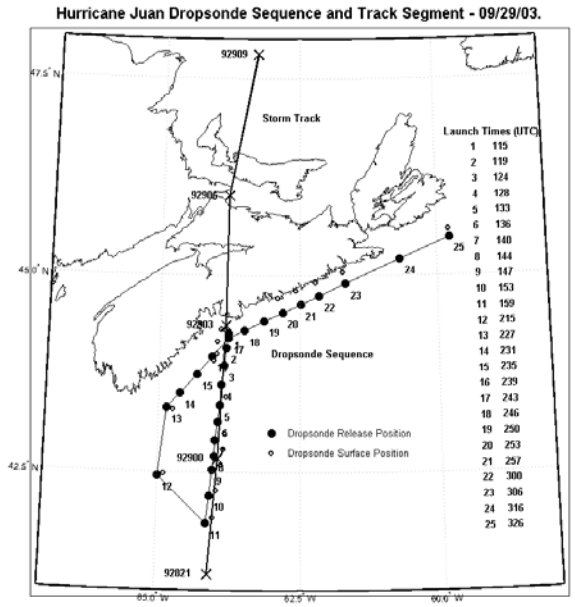

Fig 2. Convair flight and dropsonde release pattern with Hurricane Juan track segment. Format for storm track time labels is MDDHH UTC.

4. FLIGHT DATA

A cross section of wind speeds measured by dropsonde data appears in Fig. 3 for the coastal leg shown in Fig. 2 (sondes 13 to 25). The wind field is highly-skewed to the east (right) side of the storm which was translating northward at 15 m s^{-1} (30 kts). We also note a very deep layer of high winds not unlike those found in the ET of Hurricane Michael in 2000 (Abraham et al. 2004). Data are missing from the maximum wind core due to problems with GPS tracking the sondes, however, ground-based Doppler imagery confirmed wind speeds of 57 m s^{-1} (110 kts) at the top of the boundary layer (BL). Large BL shear was also observed in the sonde data outside of the maximum wind core. Winds at the surface (10 m) were typically only 55% of the top-of-BL winds. However, surface winds were about 75-80% of the top-of-BL winds in the vicinity of the maximum wind region on the south side of the storm.

Radar and thermodynamic data from the sondes (not shown) suggest that Juan was tilted toward the north and show that convection and precipitation had significantly diminished on the south (upshear) side of the storm.

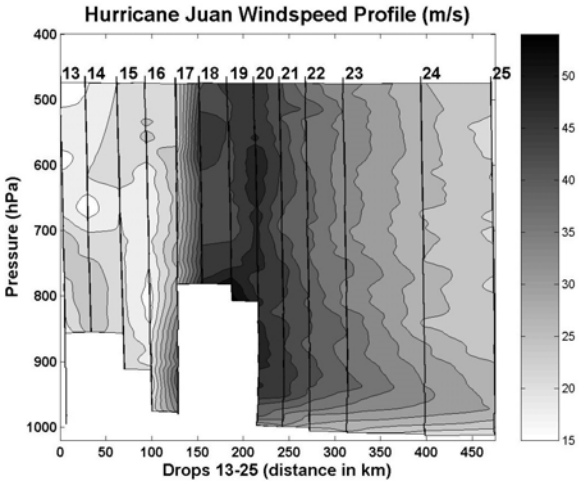

Fig. 3 Cross section of wind speeds determined from dropsondes 13-25 in Fig. 2. Sonde trajectories denoted by vertically oriented lines. The storm center axis is in the vicinity of sonde #17 and the storm motion is into the page.

5. CONCLUSIONS

Hurricane Juan was a case of a rapidly-moving hurricane making landfall in Nova Scotia. The Convair aircraft sampled this highly-asymmetric storm which was possibly in its early stage of extratropical transition as evidenced by the highly asymmetric wind and moisture patterns. Dropsonde data confirm the large shear in the BL winds away from the storm core with lesser shear in the core wind field. These data give as a better picture of the structure of a rapidly-moving hurricane and will prove useful in future studies related to this and similar storms. For example, the data may be useful for determining how Juan maintained such a strong intensity over relatively cool waters (18^{o}C).

6. REFERENCES

Abraham, J., W. Strapp., C. Fogarty, and M. Wolde, 2004: Extratropical transition of Hurricane Michael: an aircraft investigation. *Bul. Amer. Meteor. Soc*. (in review).

Jones, S. C., and coauthors, 2003: The extratropical transition of tropical cyclones: forecast challenges, current understanding, and future directions. *Wea. and Forecasting*, **18**, 1052–1092.

For additional data and imagery of Hurricane Juan: http://www.novaweather.net/Hurricane_Juan.html