

MAPR Wind Profiler Observations of Tropical Storms for the CPS Project.

William O.J. Brown¹, Bruce Albrecht², S.A. Cohn¹, S. Donaher²

¹ National Center for Atmospheric Research / Earth Observing Laboratory, Boulder, Colorado, USA,
wbrown@ucar.edu

² University of Miami / Rosenstiel School of Marine and Atmospheric Science, Miami, FL, USA

1. INTRODUCTION

The National Center for Atmospheric Research (NCAR) operated an Integrated Sounding System (ISS[1]) in Miami, Florida, for the CPS (Clouds and Precipitation Study) for August and September 2008. The study, being lead by PIs from the Rosenstiel School of Marine and Atmospheric Science (RSMAS) at the University of Miami, used a variety of vertically pointing radars and disdrometers to examine tropical precipitating clouds. The NCAR ISS used the MAPR (Multiple Antenna Profiling Radar), a highly modified 915 MHz wind profiler capable of making very rapid wind measurements using spaced antenna techniques [2]. The ISS also included a CL-31 ceilometer, GPS radiosonde sounding system and a surface meteorology station. During the course of the two-month study, rain bands from tropical storms as well as from many smaller storms and squalls, were observed.

The MAPR ISS was sited the RSMAS Center for Southeastern Tropical Advanced Remote Sensing (CSTARS) satellite ground station in south-western Miami. RSMAS deployed W and X band vertically pointing radars, and their co-PIs from North Carolina State University and McGill University deployed a video disdrometer and a Metek X band micro-rain radar and other instruments.



Figure 1: The NCAR MAPR wind profiler at CPS.

2. TROPICAL STORMS

Four named tropical storms passed nearby producing many rain bands over the MAPR site. The first, tropical storm Fay, was the closest storm, passing approximately 120km to the west of the site. Approximately 20 rain-bands from Fay passed over the site. Other storms that produced rain at the site were Hurricanes Gustav, Hanna, and Ike.

Figures 2 and 3 show satellite images of Fay and profiles of winds as measured by MAPR. In figure 2, Fay was 200 km to the southwest, and MAPR winds were from the southeast. Twenty-four hours later, in figure 3, Fay was 130 km to the northwest and MAPR winds were from the southwest. This time was when Fay reached its peak intensity. As expected, the profiler observed the typical cyclonic winds associated with tropical storms.

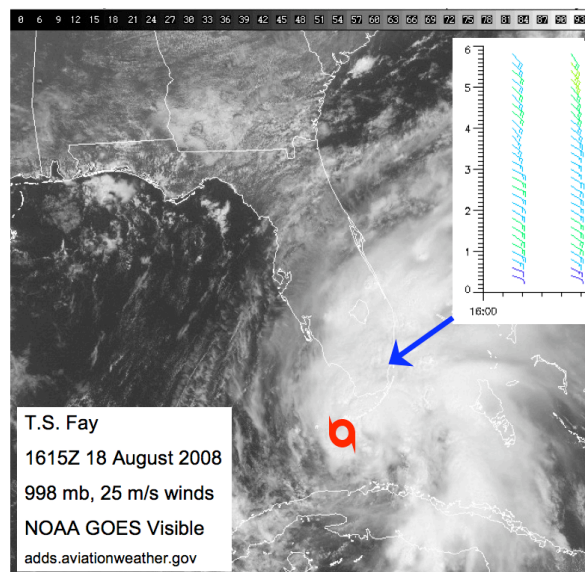


Figure 2: GOES Visible image of tropical storm Fay at local midday on 18 August. The blue arrow indicates the location of MAPR, and MAPR winds over one-hour as a function of height (km) are shown in the insert. NOAA National Hurricane Center estimates of central winds and pressure are shown lower right.

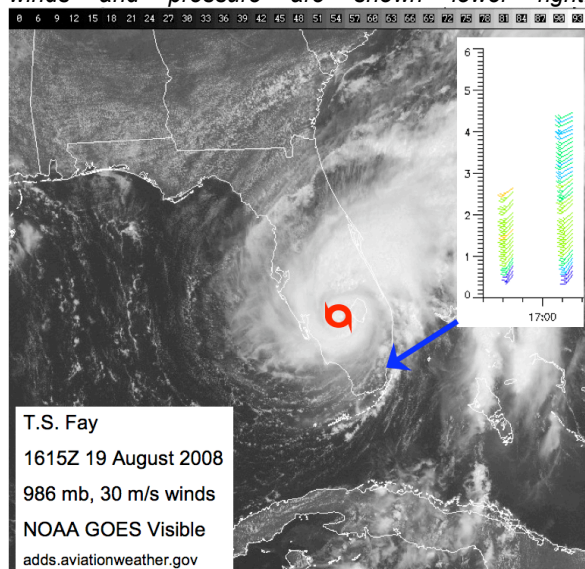


Figure 3: GOES Visible image and MAPR winds at midday on 19 August.

3. HIGH RESOLUTION WINDS

The MAPR wind profiler uses spaced antenna techniques to measure winds at a much faster rate than traditional Doppler Beam Swinging (DBS) wind profilers. Another advantage of spaced antenna techniques is that the radar is continuously observing in the vertical beam (and not pausing to sample in an oblique direction as with DBS) so that rapid changes in reflectivity can be observed. Figure 4 shows an example of rapid observations. A significant wind shear can be seen, with veering of the winds with height. The profiler observed wind gusts up to 30 m/s (100 kph). The National Weather Service issued tornado and strong wind warnings for nearby areas as the rain-band associated with this event passed over (figure 5).

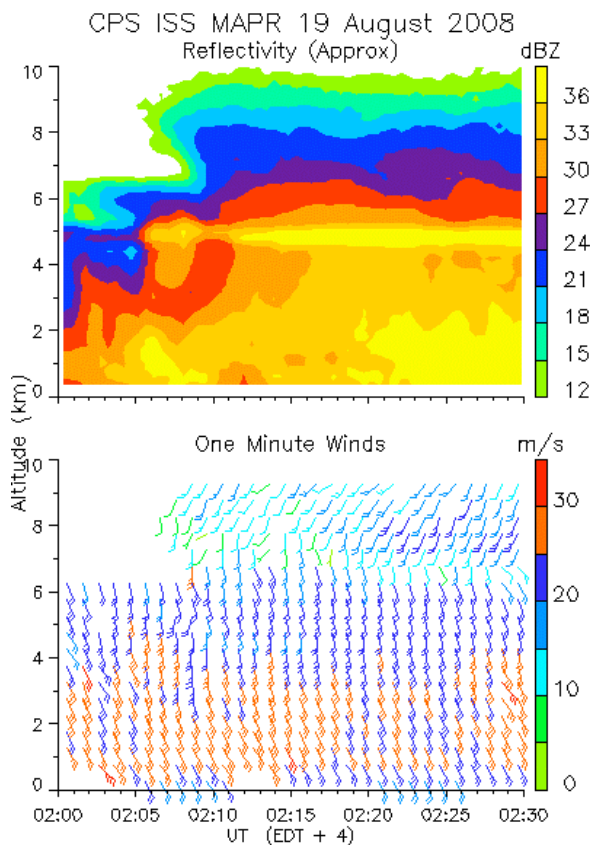


Figure 4: MAPR wind profiler observations for 30-minutes from 2 UTC in August 19. The upper panel shows approximate reflectivity and the lower panel shows wind barbs (one minute averages, color coded by speed) as functions of altitude.

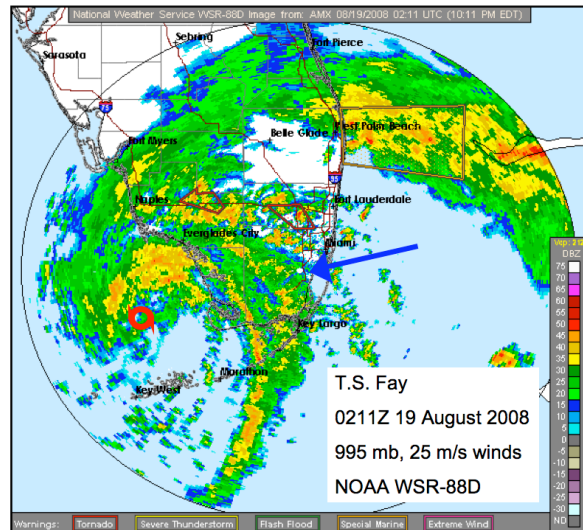


Figure 5: Miami NOAA NEXRAD scanning radar reflectivity at 2:11 UTC on August 19. The red and orange boxes indicate National Weather Service wind, tornado and heavy sea warnings. The radar is approximately 2 km from the MAPR site (blue arrow). The eye of Fay was about 170 km west of the site.

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REFERENCES

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