P1.5 UTILIZING A LOCAL DATA ASSIMILATION AND PROGNOSTIC SYSTEM TO AID WITH THE TIMING, PLACEMENT, AND IMPACT OF SHORT-RANGE TROPICAL WEATHER HAZARDS

Justin J. Mosely* and Scott M. Spratt
NOAA / National Weather Service, Melbourne, Florida

1. INTRODUCTION

Tropical Storm Nicholas (2003) formed over the eastern tropical Atlantic during mid October and moved generally northwest over the open ocean for approximately a week, then weakened to a tropical low on 23 October due primarily to increasing wind shear (Bevin, 2003). Between 23 October and 1 November, the tropical low meandered across the Western Atlantic Ocean. On 1 November, the remnants of Tropical Depression Nicholas began to move southwest towards the Florida peninsula. During this time, the shallow disorganized warm-core low continued to gradually evolve toward a more cold-core feature. As the system approached and moved across Florida, an opportunity existed to examine a recent locally-configured mesoscale data assimilation and short-term prognostic system for utility in providing enhanced guidance to forecasters.

2. MODEL LOCAL CONFIGURATION

The analysis and forecast system (Advanced Regional Prediction System; ARPS, and the ARPS Data Analysis System; ADAS; Xiu, et al. 2001) has proved beneficial in support of fire weather (Blottman et al. 2003), aviation, and hazardous weather forecast operations (Case et al. 2002).

ARPS/ADAS was locally configured Melbourne National Weather Service Office (WFO MLB) to ingest a plethora of high resolution, non-traditional data sets, including observations from 44 Kennedy Space Center wind towers, five 915-MHz boundary layer Doppler Radar Wind Profilers (DRWP), a 50-MHz DRWP, 30 Florida Automated Weather Network (FAWN), and a network of Automated Position Reporting Systems (ARPS) WXNET sites. In addition, other data include level II radial velocity and reflectivity information from several Florida Weather Surveillance Radar 1988 Doppler (WSR-88D) sites, Geostationary Operational Environmental Satellite (GOES-12) 1-km resolution visible and 4-km infrared imagery, METAR surface, buoy, C-MAN, ship reports, Aircraft Communications Addressing and Reporting System (ACARS) reports. The ADAS domain covers most of Florida and was configured to produce analyses every 15-min with a 4-km horizontal resolution, using the 40-km Rapid Update Cycle (RUC) for information. Four ARPS cycles are run daily over the same domain and resolution as ADAS to produce 9-hr forecasts.

*Corresponding author address: Justin J. Mosely
NOAA/NWS Forecast Office, 421 Croton Road
Melbourne, FL 32935 email: justin.mosely@noaa.gov

This study will assess the advantages obtained from mesoscale analyses on 3 November 2003 and a 9-hr forecast initializing at 0300 UTC as the remnants of tropical cyclone (TC) Nicholas traversed the Florida peninsula.

3. MODEL EVALUATION

The impact of high-resolution local data assimilation was examined in a post-analysis mode and compared with other available analyses and short-range forecast guidance (e.g. WSR-88D, LAPS, RUC) as the remnant low approached central/south Florida. In general, fields such as surface moisture convergence were found to correspond well with areas of enhanced near-shore convection and the evolution of strong transport winds correlated well with gusty surface winds associated with showers. ADAS/ARPS also handled positioning of the low to mid level circulation of the tropical low better than traditional model analyses and RUC forecasts, which helped to increase forecaster confidence of impending local hazards to the marine and aviation communities. Although the system was poorly organized overall, local impacts were pronounced and ADAS/ARPS output with high resolution data assimilation demonstrated and ability to aid forecasters toward a positive enhancement of short-term forecasts.

Specific attention is drawn to a strong northeast to southwest orientated outer rainband that moved onshore Cape Canaveral (CC) around 0600 UTC, as shown by the WFO MLB WSR-88D radar (Fig. 1). The ARPS 3-hr forecast of surface moisture convergence, verifying at 0600 UTC, accurately depicted the rainband approaching the coast near CC (not shown). In addiction, an increase of winds to 30-35 kt was predicted in the 850-650 layer, along with a realistic depiction of the rainband orientation and position (Fig. 2). At 0606 UTC, the CC shuttle landing facility (KTTS) reported a brief convective wind gust to 30 kt as the rainband moved onshore.

Although a surface circulation center was not well defined, ADAS analyses did depict a weak, east-west elongated low pressure region which moved onshore south of Ft. Pierce (KFPR), and continued inland to Lake Okeechobee. The ARPS forecast for 0930 UTC likewise indicated a 1011 mb center over southeastern Lake Okeechobee. ARPS also accurately depicted the greatest speed convergence within the northeast quadrant of the low, from approximately KTTS to KFPR (not shown). Meanwhile, RUC forecasts correctly depicted an intense vorticity maximum at 925 mb, but consistently displaced the center much too far south.

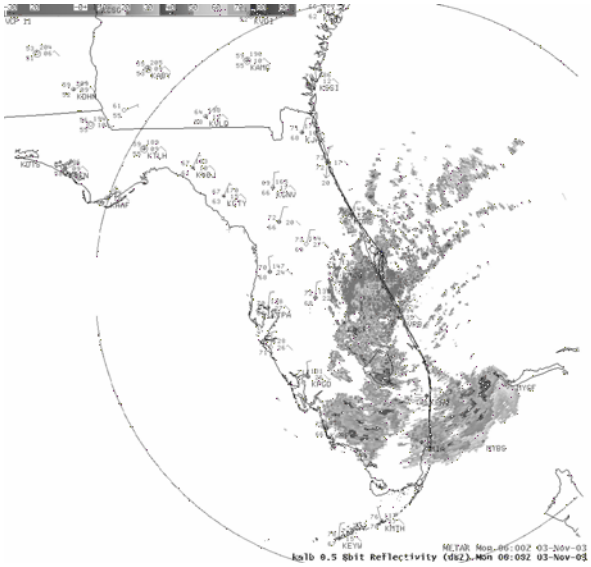

Fig. 1 NWS Melbourne WSR-88D reflectivity image at 0606 UTC 03 November 2003.

Another item of interest was an observed temporary trend of improved organization of the remnant tropical low as it approached and crossed the peninsula, albeit slight. Radar time lapses indicated an increase of curved rainband structure, particularly over the Atlantic, over the eastern semi-circle of the circulation. In addition, a better defined surface circulation became evident in surface analyses as the low reached southeast Florida. Further support of the trend is suggested in experimental cyclone phase space diagrams proposed by Hart (2003). This brief transition stage appeared well correlated with a period of strong surface wind gusts along the east central Florida coast as the circulation passed.

4. CONCLUSIONS

By supplementing traditional data, analyses, and forecasts with local high-resolution diagnostics and prognostics such as ARPS/ADAS, forecasters can add value to a variety of forecast products. As shown in this case, utilizing ARPS/ADAS as an additional piece of guidance, the short-term forecaster can better identify favorable regions for enhanced convection and associated strong surface wind gusts. A close examination of analysis and forecast fields can also help to portray subtle, but important changes in the vertical structure and organization of tropical entities.

A wide assortment of ARPS/ADAS output will be shown at the conference to illustrate the utility of high-resolution diagnostics and prognostics for support of short-range forecast operations during the passage of TC Nicholas remnants. Examples will depict similarities and differences between short-term forecast fields and observational data. Finally, comparisons will be made between ARPS and RUC forecasts to highlight potential benefits realized from initializing with a dense data array.

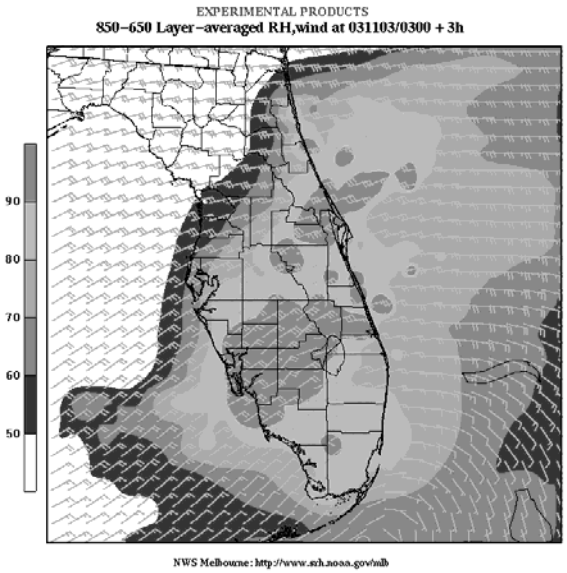

Fig 2 ARPS 0300 UTC 03 November 2003 forecast valid at 0600 UTC. 850-650 mb moisture (shaded) and wind barbs (kt).

5. REFERENCES

Bevin, J., cited., 2003: Tropical Cyclone Report - Tropical Storm Nicholas. [Available online from http://www.nhc.noaa.gov/2003nicholas.shtml].

Blottman, P.F., J. Pendergrast, S.M. Spratt, and D.W. Sharp, 2003: High Resolution Diagnostics and Short Term Prognostics in Support of Fire Weather Forecast Operations at NWS Melbourne, FL. Preprints, 5th Symposium on Fire and Forest Meteorology, Orlando, FL, Amer. Meteor. Soc., CD-ROM, JP2.4.

Case, J.L., J. Manobianco, T.D. Oram, T. Garner, P.F. Blottman, and S.M. Spratt, 2002: Local Data Integration over East-Central Florida Using the ARPS Data Analysis System, Wea. Forecasting, 17, 3-26.

Hart, R.,2003: A cyclone phase space derived from thermal wind and thermal asymmetry. Mon. Wea. Rev., 131, 585-616.

Xue, M., and and Coauthors,, 2001: The Advanced Regional Prediction System (ARPS)—A multi-scale nonhydrostatic atmospheric simulation and prediction tool. Part II: Model physics and applications. Meteor. Atmos. Phys., 76, 143–165.