An Operational Local Data Integration System (LDIS) at WFO Melbourne

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1. Introduction

A Local Data Integration System (LDIS) has been implemented at the National Weather Service (NWS) office in Melbourne, Florida (Case and Manobianco 2001). The LDIS was configured with the assistance of the NASA Applied Meteorology Unit (AMU, Ernst and Merceret 1995). This effort was undertaken to integrate the various data sets in proximity to the Kennedy Space Center (KSC) and east-central Florida, and to generate products that may enhance short-range (less than 6-hr) forecasts. Through the use of effective visualization techniques, these integrated data sets will assist forecasters in diagnosing the state of the atmosphere at the mesoscale in near real-time. This paper will describe the LDIS setup and configuration, along with example forecast applications.

2. Real-Time Data Ingest

Certain data sets available to the Melbourne forecasters are unique when compared to what is available at other NWS offices, due to the relatively dense network of instrumentation supporting the U.S. space program in the vicinity of Cape Canaveral. Data from the KSC meso-network include: 44 wind towers, five 915-MHz boundary-layer Doppler radar wind profilers, and a 50-MHz radar wind profiler. Other data available for ingest into LDIS include 1-km GOES-8 visible and 4-km infrared imagery, METAR surface reports, and Melbourne (KMLB) WSR-88D Level-II radial velocity and reflectivity fields.

3. LDIS Configuration

LDIS uses the Advanced Regional Prediction System (ARPS) Data Analysis System (ADAS, Brewster 1996, Carr et al. 1996) to generate the analyses. ADAS is available from the Center for Analysis and Prediction of Storms in Norman, Oklahoma. ADAS is configured to produce analyses on two nested grids with 10-km and 2-km horizontal grid spacing. The domains for the 10-km and 2-km grids are shown in Fig. 1. The outer 10-km domain covers much of Florida, with the exception of the panhandle and extreme south Florida. The 2-km grid covers much of the Melbourne WFO forecast area. The ADAS analysis cycle is run every 15 minutes, with the start of the cycle occurring 14 minutes after the valid time to allow retrieval of the various data sets from a remote server, and to account for inherent latencies of data such as satellite imagery. On average, output is available 16 minutes after the actual valid time.

ADAS was configured to use the 40-km Rapid Update Cycle (RUC) model forecasts (Benjamin et al. 1998) for background fields to the 10-km analyses. The RUC 3-6 hr forecasts are linearly interpolated in time every 15 minutes to provide a background field for the 10-km analyses. Subsequently, the 10-km analyses are spatially interpolated to provide a background field to the 2-km analyses.

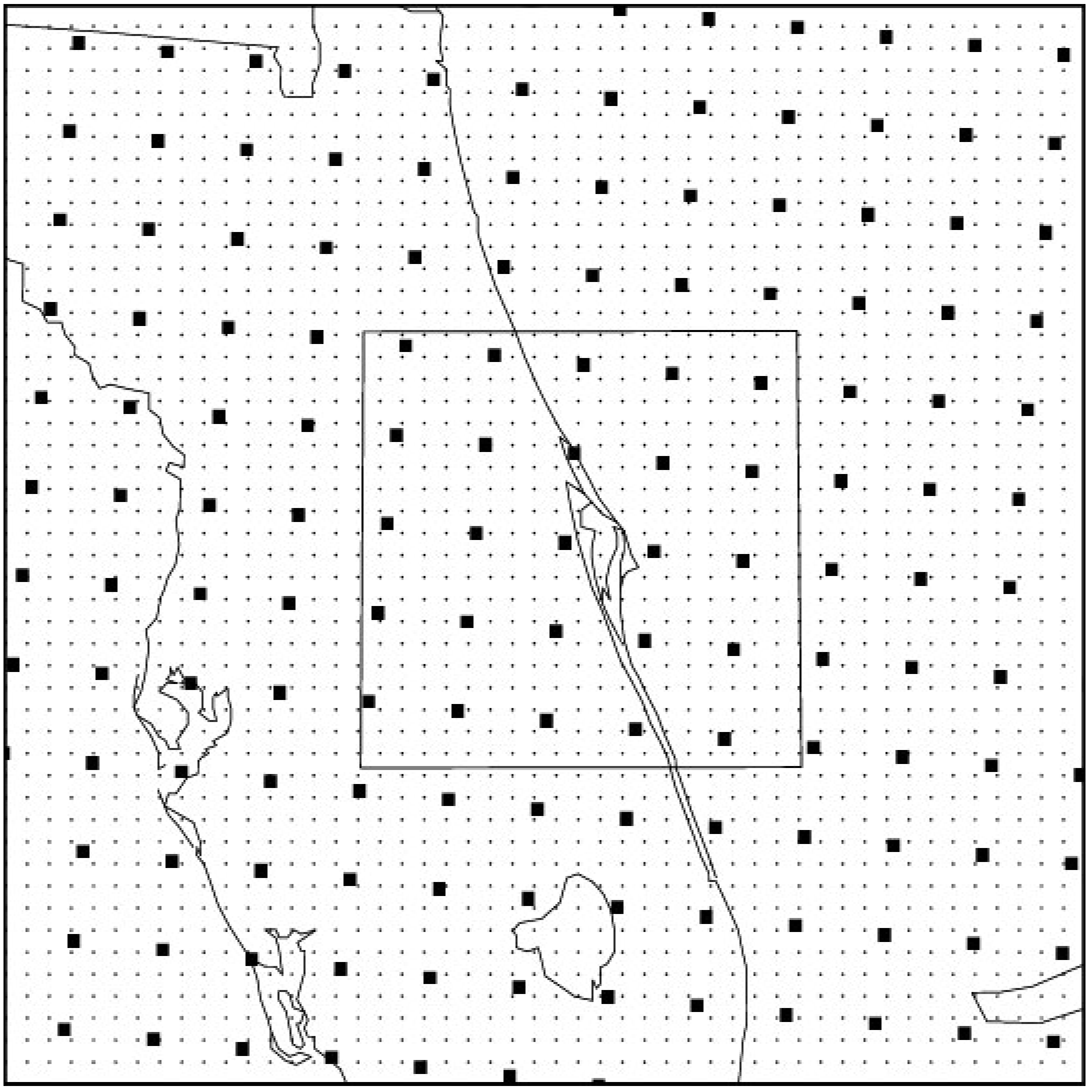

Figure 1. The horizontal extent of the ADAS 10-km domain is shown along with the 2-km ADAS domain nest over east-central Florida and adjacent coastal waters. The 10-km grid points (small dots) and 40-km RUC grid point locations (squares) are also provided.

Surface observations, meso-network tower winds, profiler data, as well as visible and infrared satellite imagery are collected for assimilation into the ADAS every 15 minutes. These data originate from the NASA/NWS Spaceflight Meteorology Group (SMG) Meteorological Interactive Data Display System (MIDDS, Rotzoll et al. 1990) at the Johnson Space Center in Houston, Texas. At present, the data are routed to the Melbourne WFO via a server at the NWS Southern Region Headquarters in Ft. Worth, Texas, using multiple-scheduled FTP sessions. This indirect communication process is mandated by NASA security concerns, and while it adds some delay to the receipt of data, computational savings are achieved locally by having the data pre-processed at the SMG.

High resolution Level-II Melbourne WSR-88D data are incorporated into the ADAS analyses via two independent workstations. One workstation collects the Level-II base data from the Radar Data Acquisition unit and re-distributes it through a local Radar Interface and Data Distribution System (RIDDS, Jain and Rhue 1995), designed by the National Severe Storms Laboratory. A second workstation retrieves data from RIDDS through the UCAResearch Unidata Local Data Manager (LDM), using software developed under the Collaborative Radar Acquisition Field Test (CRAFT). CRAFT allows for the real-time compression and transmission of WSR-88D base data across the Internet (Droegemeier et al. 2001). The file system containing the Level-II data ingested by LDM is mounted so that the workstation running ADAS can access and re-map the radar data to each analysis grid.

4. Visualization and Forecast Applications

Once the ADAS cycle is completed, each analysis is converted to GEneral Meteorological PAcKage (GEMPAK) formatted files that can be accessed by workstations networked throughout the office. Forecasters can then utilize the GEMPAK Analysis and Rendering Program (GARP) graphical user interface to view pre-defined horizontal gridded analysis fields, cross sections, multiple gridded macros, and associated time animations.

The high temporal and spatial resolution surface wind analyses, particularly within the 2-km grid, will better assist forecasters with the placement and movement of mesoscale boundaries. Knowledge of these features is especially important during the Florida wet season when sea- and lake breeze and outflow boundaries are primarily responsible for the forcing of diurnal convection. Additionally, thermodynamic diagnostics (e.g., CAPE, LI and K-index) and local severe weather applications such as microburst day potential index (Wheeler and Roeder 1996) combined with the wind analyses will likely aid short-term forecasts of convective initiation and severe weather potential.

Sharp and Hodanish (1996) stated mesoscale low-level boundaries must be considered by east-central Florida forecasters during both pre-storm analysis and radar assessment in order to improve the early detection of supercell thunderstorms. In certain situations, severe weather warning decisions may be made with more confidence and/or more timely by coupling the knowledge of the near storm environment gained by ADAS analyses, in combination with conventional diagnostic methods. The precise location and past movement of mesoscale boundaries, along with depiction of the local trend of key thermodynamic parameters gained from ADAS, may help improve the probability of detection (POD) and false alarm rate (FAR) statistics for severe weather warnings.

The identification and placement of low-level boundaries and moisture trends are also imperative to NWS forecasters when providing spot forecasts for fire weather support to land management agencies and fire fighters. Specific location and timing of mesoscale features, and the wind speed and direction associated with these features, can have significant impact on fire resource management, threats to property, and the safety of personnel working a fire.

Routine examinations of the analyses are also expected to benefit the short-term marine and aviation forecast programs. A more detailed current depiction and evolution of wind flow along the Atlantic coastal plain should allow forecasters to refine short-term marine forecasts. Likewise, improved visualization of the wind fields may result in a more accurate adjustment of the nearshore and offshore forecast segments. In addition, cloud forecasts may also experience positive gains resulting from the forecasters' visualization of detailed cloud cover, cloud base, and ceiling evolutions provided by the complex cloud scheme of ADAS (Zhang et al. 1998).

5. Future Iniatives

The configuration of ADAS and the routine generation of real-time analyses were completed at the Melbourne NWS office during the spring of 2001. The current post-configuration task involves familiarizing the entire operational staff with using the integrated data analysis package to support various forecast programs. This effort will further prepare the staff for assimilating current conditions following an organized process, as opposed to viewing disparate data sets and integrating them manually to form a mental picture of the atmosphere (McPherson 1999).

Analysis fields will continue to be examined in an operational environment through the remainder of 2001, and optimization of the ADAS configuration package will be performed to improve reliability and operational usefulness. GEMPAK and GARP scripts will also be customized to offer greater display functionality. Additional data sets will be evaluated for potential inclusion into the ADAS analyses. Integrating WSR-88D Level-II data from surrounding sites, especially Tampa, and perhaps eventually the FAA's Terminal Doppler Weather Radar in Orlando, would be helpful in providing additional low-level velocity and reflectivity data to the 10-km and 2-km ADAS grids. Sensitivity studies suggest GOES -8 satellite soundings may have a significant impact on analyzed moisture and temperature fields (Manobianco and Case, 1998). Despite the significant time lag required in receiving the satellite soundings and their availability only in cloud-free regions, they may provide significant improvements to the analyses in areas devoid of thermodynamic profiles.

Currently, ADAS analyses are displayed on a workstation separate from AWIPS, the primary NWS meteorological data integration system. Conversion of the ADAS analyses to NetCDF format for ingest into AWIPS is an important objective. Once ADAS analyses are incorporated into AWIPS, direct comparisons can be made between ADAS and the Local Analysis and Prediction System (LAPS, McGinley 1995), which is the AWIPS platform analysis package.

A Web-based display system is also desired in order to share ADAS output with surrounding NWS offices, the USAF 45th Weather Squadron at Cape Canaveral, and local emergency management officials. Such Web-based graphics could be converted from ADAS GEMPAK files for posting to the NWS Melbourne Web site. Finally, the ultimate goal is to implement the ARPS numerical weather prediction model into forecast operations, in combination with the ADAS analyses. The existing ADAS analyses could be cycled with the ARPS prediction model to run a local four-dimensional data assimilation system over east-central Florida.

6. References

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