18.2 **Severe Weather Parameter Reanalysis Project at the Storm Prediction Center**

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1. INTRODUCTION

Real-time observations have always been essential to forecasters at the Storm Prediction Center (SPC), formerly the National Severe Storms Forecast Center (NSSFC). Historically, these data were plotted by hand and subjectively analyzed. Today's modern computer systems have facilitated the use of objectively analyzed gridded meteorological fields in an operational setting. This includes a variety of severe weather parameters that have been developed and refined over the decades. The history of the objective analysis programs dating back over 30 years at the SPC and NSSFC can be found in Bothwell et al. (2002).

By early 1997, the NSSFC (now the SPC) forecast operations were transferred to Norman, OK. At that time, the operational forecast computer system changed from the Man-computer Interactive Data Access System (McIDAS) to the National Center AWIPS system (NAWIPS). NAWIPS core software was based on the Generalized Meteorological Package (GEMPAK; desJardins et al. 1991). In addition, this change occurred during the time the Rapid Update Cycle version 2 (RUC2; Benjamin et al. 1998) began producing hourly analyses and forecasts. This lead to the development of the NAWIPS SurFaCe Objective Analysis (**SFCOA**) for the **N**MAP2 display system at the SPC (called **SFCOAN**).

2. DATA AND METHODOLOGY

The SFCOAN at the SPC is GEMPAK-based and uses a two-pass Barnes objective analysis of the surface data. It also uses the short-term forecast from the RUC [now replaced by the RAPid Refresh (RAP; Benjamin et al. 2007)] surface fields (temperature, humidity, pressure, u and v wind components) on a 40-km grid as a "first guess" for the surface objective analysis. The model data are also used as a quality control measure and observations that depart more than a preset difference from the background field are excluded from the analysis.

The SFCOAN program also merges the surface objective analysis with an analysis field from the RUC/RAP (time matched to the surface data) above the surface (in 25 mb vertical increments). The result is a high resolution, three-dimensional "best-guess" state of the atmosphere. With a complete thermodynamic and kinematic profile, a virtual sounding is available at every grid point. Sounding analysis routines are used to calculate numerous stability and shear fields at every grid point, which can then be plotted in a planar view for overlaying with satellite, radar, or other imagery/data in NMAP2, or on the SPC "Mesoanalysis" web page:

http://www.spc.noaa.gov/exper/mesoanalysis/.

3. THE "REANALYSIS"

While much of the data since 2003 has been archived on a 40-km grid, many of the most recently added fields are not available for the full archive period. Since 2002, over 60 new fields have been added. As such, the archive does not have a complete record of derived fields. See Figures 1 and 2 show an example of the original formulation of the significant tornado parameter (STP; Thompson et al. 2003) and the more recent effective-layer version of the STP (Thompson et al. 2012), respectively. Also, Fig. 3 shows an example of new fields for diagnosing favorable QLCS mesovortex environments.

The RUC decreased in horizontal grid spacing to 20 km in 2002 (Benjamin et al. 2002). To provide a complete record of the highest-resolution analysis, the 20-km RUC/RAP archive

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available from the National Severe Storms Laboratory (NSSL) was available for use in this "reanalysis". While a pure reanalysis (e.g., NARR; Mesinger et al. 2006) uses a stationary, single model, that option was not available for the hourly dataset needed for this work. Ultimately, running the latest diagnostic code on the archived RUC/RAP analyses will result in a higher-resolution (i.e., 20-km grid vs. current 40-km grid) archive with all derived fields.

Increased bandwidth and faster processors have recently allowed the SPC to operationally run a 20-km version of the SFCOAN in real-time. The finer horizontal grid spacing allows for better resolution of strong gradients that are often present in the pre- and post-convective environments. As models move to higher resolution, older grids with lower resolution (or "legacy" grids) may be retired. Thus, the SPC will be well positioned to move to an operational version of SFCOAN with 20-km grid spacing in the future (all RAP grids received at the SPC are currently post-processed from the original/native 13-km grid to the respective 20- and 40-km versions).

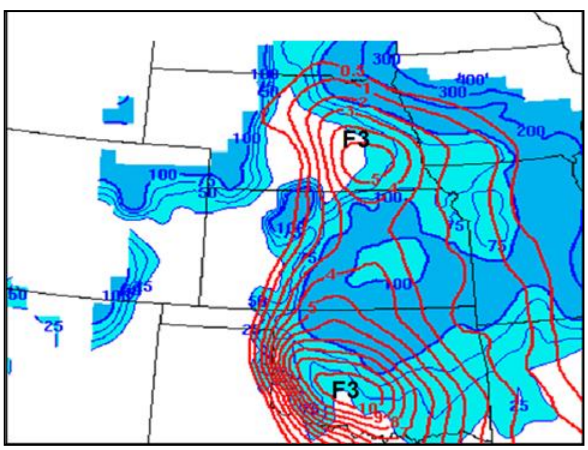

Figure 1. Significant tornado parameter (STP; contours), mixed-layer CIN (blue fill), and the strongest tornado locations at 22 UTC on 9 October 2001.

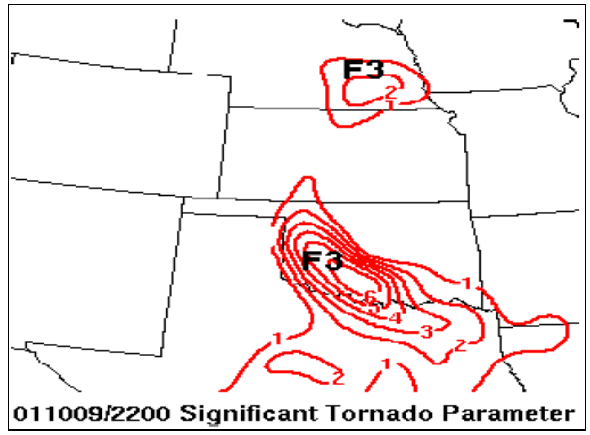

Figure 2. Same as Fig. 1, except for STP effective-layer version.

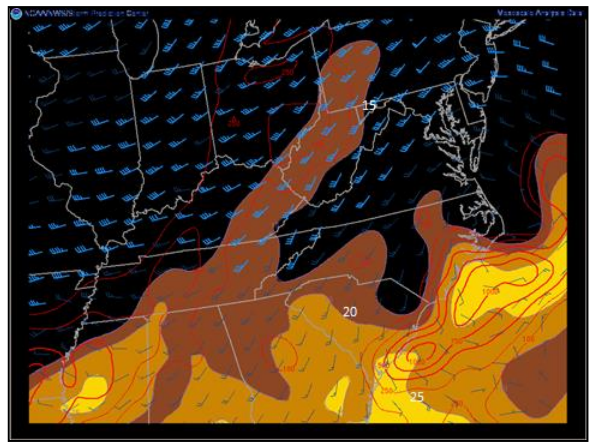

Figure 3. Example of new parameters to identify favorable QLCS mesovortex environments at 16 UTC on 28 October 2014. Most-unstable CAPE is shown in thin red contours. The maximum theta-e difference in the lowest 3-km AGL is shown in color fill (only numbers decreasing with height are shown in the color fill), and the 0-3km bulk wind difference.

4. SUMMARY

Significant changes and additions to SFCOAN have occurred over the years rendering the current 40-km grid archive incomplete. By using the RUC/RAP archive (2002-current), the SPC will have a complete 20-km hourly archive of all derived parameters when processing is completed in early 2015. This archive can provide a climatological basis for each field. The reanalysis will also represent a consistent, long-term dataset that can be combined with other datasets (e.g., SPC Tornadic Storm Database 2003-2013; Smith et al. 2014) for effective data mining. It will also be available for interested research partners.

Finally, as newer fields are added or refined in the future, the framework is now in place to add new fields to the entire long-term dataset.

5. ACKNOWLEDGEMENTS

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