



A Realtime Weather-Adaptive 3DVAR Analysis System with Automatic Storm Positioning and On-demand Capability



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Research objectives

- Create realtime weather-adaptive 3DVAR analyses at high horizontal resolution & high time frequency with operationally available radar data from the 88D network.
- Use the analysis product to help detect supercells and determine if these analyses can improve forecasters' awareness of the hazardous weather threat.

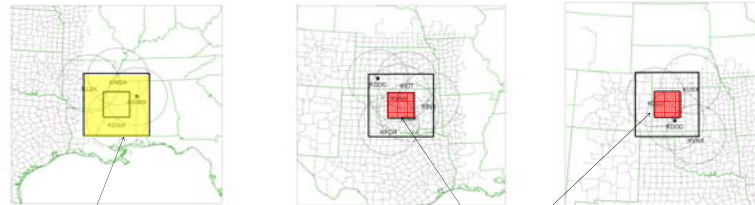
Introduction

A real-time, weather-adaptive 3DVAR system (based on ARPS 3DVAR) has been developed recently for Warn-on-Forecast project (WoF) to incorporate all available WSR-88D radar observations within an analysis domain that could be hit by severe weather, including tornadoes, hails and strong damage winds. The unique features include: (1) The system has the ability to automatically detect and analyze severe local hazardous weather events at 1km horizontal resolution every 5 minutes. (2) The analysis can also be performed with on-demand capability in which end-users (or forecasters) set up the location of the analysis domain in real time based on the current weather situation. (3) The analysis product can help forecasters identify strong circulations imbedded in thunderstorms so that the accuracy of warnings for hazardous weather threats may be improved. Although still in the early development stage, the system performed very well during the spring of 2010 and 2011. Many severe weather events were successfully detected and analyzed. In 2011, the system was used by the NWS forecasters as one of the official projects of the NOAA's HWT Experimental Warning Program.

Model Parameter Settings and Data

- ◆ Model resolution : dx=dy=1000; dz=500
- ◆ Model grid: nx=ny=203 nz=31
- ◆ Use WDSS-II real-time 2D composite reflectivity product to automatically choose possible severe weather location.
- ◆ Use NCEP NAM NWP product (0-6 hrs) as the background for analysis.
- ◆ Available radar data from national 88D network.

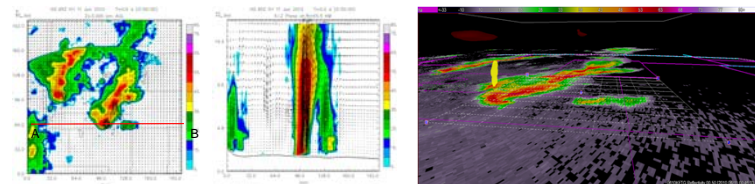
Example Domains



Outer domain of 400x400 km is used to identify 88Ds to be used

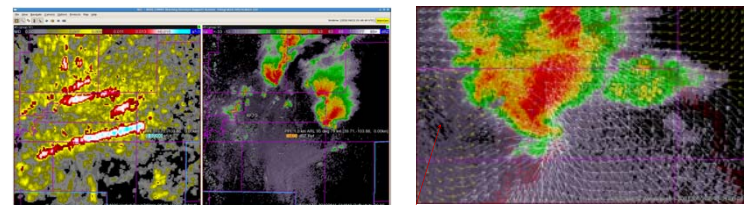
Inner domain of 200x200 km is used for 3dvar analysis

Display of June 10th, 2010 CO 3DVAR Analysis



Hori. at z=3 km AGL; vertical slice (Through AB)

Yellow column is an isosurface of Vor. at 0.02 s⁻¹ and the dark red areas are Div. above 0.01 s⁻¹



Composite vorticity track

Reflectivity at 1.5^o

Mesohigh

Wind vectors near surface overlaid with Z at 0.5^o

Future work

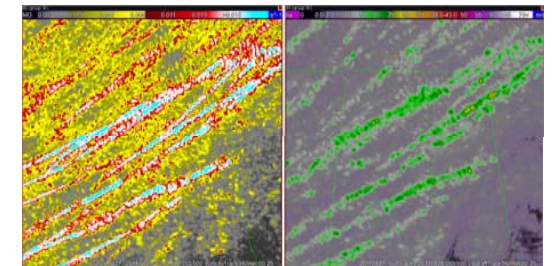
- ◆ Further improve the efficiency of the program to cover big analysis domains.
- ◆ We have a plan to do very short term model forecasts with WRF, or ARPS model which will be initialized using ARPS-3DVAR program (two interfaces with WRF model ARPS2WRF and WRF2ARPS already exist).
- ◆ Surface data including dense mesonet in some states will be included in the analysis in the future.

The work was supported by NOAA's Warn-On-Forecast project .

Why are supercells so important?

- 90% of supercells are severe (Burgess 1976; Burgess and Lemon 1991; Bunkers et al. 2006, 2009).
- Early identification of supercells imbedded in storm clusters may be critical for early warnings to save lives and potentially reduce property damage.

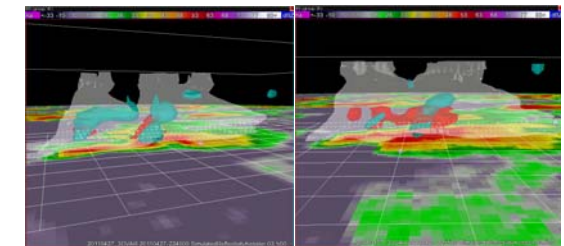
Apr 27th 2011 South Plain Tornado Outbreak (361 people died in 7 states)



Composite vorticity track

Vertical velocity track from 3DVAR

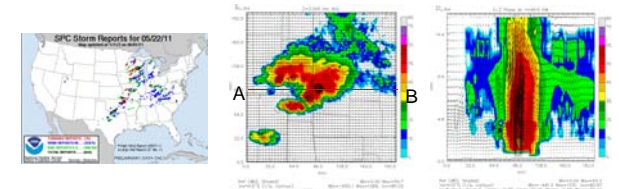
Apr 27th 2011 Tuscaloosa/AL Tormadic Supercells



Isosurface for V>0.015s⁻¹ (teal) and Ref>55dbZ (red) at 2240Z

2255Z

May 22nd 2011 Joplin/MO Tornado case (160 people died; \$3billion damage)



SPC storm report

Hori. at z=3 km AGL; vertical slice (Through AB)