

Requirements White Paper for Enhanced D2D Capability to Support Storm Structure and Atmospheric Analysis

Requirement

Detailed analysis of three-dimensional storm structure and evolution using WSR-88D base products (vs. volume or algorithm-derived products) has been a critical operational practice for issuing timely and accurate severe and tornado warnings since the implementation of the WSR-88D. Prior to AWIPS, forecasters used simple 4-panel “User Functions” on the Principle User Processor (PUP) display to examine 4 different elevation slices for a single volume scan and for a single base product (i.e., Base Reflectivity alone), as well as animations in time of single elevation slices. It was also possible to step forward or backward in time once a 4-panel was displayed, but this was extremely slow. Choosing the proper slices to display in a 4 panel was challenging, especially if storms were at various distances from the radar, since there could always be something important missed in between any four chosen slices.

With the implementation of AWIPS and D2D, forecasters gained the ability to combine both reflectivity and velocity images when displaying 4-panels or animating single slices. In addition, animation became much faster. Procedures could be set up like User Functions to display various combination of 4-panels, and since there were multiple panes, several of these combinations could be pre-loaded for swapping into the main pane. Tear-away menus also proved useful for quickly monitoring the latest slices to arrive in the system, which could then be displayed and animated immediately. The creation and display of vertical cross-sections also became more efficient compared to the PUP. Finally, the ability to animate (or manually step) reflectivity and/or velocity in *space* with the “All Tilts” feature made three-dimensional storm structure analysis much more effective still, allowing all slices from a radar volume scan to be viewed quickly, and features could be easily correlated vertically. However, a drawback with “All Tilts” is that only a single volume scan can be displayed with no opportunity to analyze evolutions in time. One can display a previous “All Tilts” scan, but that has to be swapped in separately or compared in a different pane or D2D.

If D2D could be enhanced so that stepping or animating in both time and space were possible simultaneously with the “All Tilts” feature, this would allow the most thorough and efficient *four-dimensional* assessment of storm structures possible in D2D (given the current capabilities of the radar hardware). All elevation slices of both reflectivity and velocity/storm relative velocity for a single volume scan could be examined quickly, and any particular slice could be stepped or animated in time to see important evolutions. The application should support paired 8 bit products and, if resources permit, be able to substitute standard level IV products where 8 bit data is missing (i.e. not on RPS list).

The proposed enhancement was described as “All Tilts/Enhanced D2D Capability in recent OB4 requirements. We propose the capability be described as: The 4D Visualization and Analysis Tool (4DVAT). We believe this description better reflects the comprehensive nature of

the tool, as described in detail below. The supporters of this white paper view this as a critical enhancement to AWIPS, that should be added to D2D as soon as possible.

Description of Recommended Enhancement

It is recommended that the current forward and backward animation controls be limited for stepping forward and backward in *time* only. A *new* set of controls should then be created for stepping up and down in *space* on the D2D control button bar (or other appropriate location). These controls should, at the very least, include manually stepping up and down one slice at a time, as well as going straight to the lowest slice or to the highest slice. Ideally, animation in space (looping) should also be allowed. If full looping in space were invoked, then any looping in time would have to be terminated (and vice versa). In fact, it might be a good idea to disable the other set of controls if looping in one reference frame was taking place (for example, in order for the user to even begin using the vertical controls, looping in time would have to be stopped first). In addition, if the user were to step up to the 8.7 deg slice (as an example), they could then animate or step through in time only for this slice. If the user stepped back to three volume scans previous, they could then step up and down in space for that particular volume scan. Ideally, if a user left the slice on 8.7 degrees (as an example), then when the next 8.7 slice came in it would auto-update. However if the user left the controls on the latest time and also the highest vertical slice, then images would update with each new slice that comes in. The application would have the capability to use a “virtual volume scan” mode such that the latest partial volume scan could be mixed with slices from the previous volume scan thereby creating a full volume of data. In this mode each “old” slice would be replaced as newer slices arrive. This capability might be selected under the load mode option of D2D. (Insight into virtual volumes may be found at: www.spc.noaa.gov/publications/lynn/virvol.pdf)

At least four new buttons are envisioned: 1) a “lowest slice” button (double down arrow with bar at bottom), 2) a “step down” button (single down arrow), 3) a “step up” button (single up arrow), and 4) a “highest slice” button (double up arrow with bar at top). See Figure 1 for an example of what the D2D screen *might* look like with the new buttons added on the right (if room). If looping in space is also allowed as a separate function, there would obviously need to be an additional looping control button, which should look a little different from the current looping control button used for animation in time (to avoid confusion). If there is not enough room to add these new control buttons to the D2D button bar, then they could be added to a pull-down menu (that would *have* to be tear-away) under the “Tools” or “Options” menus, or perhaps from within the radar menus themselves (the buttons would still have to separately tear away). There may not need to be a new “Frames” button added, as the total number of available frames in the vertical should ideally be loaded by default (i.e., 9 frames for VCP 21, 14 frames for VCP 11, and 5 frames for VCP 31 and 32). The application should be flexible enough to support the number of vertical frames in any new radar VCPs that are planned for future ORPG builds.

Temporal loop length should be at least 4 frames, and longer if resources permit. For example, if a minimum of 4 frames in time were allowed with the combined display of 8-bit products, then it is expected that resources would allow a longer frame count with the standard products. It is desirable to allow display of both 8-bit and standard products in the same vertical loop,

depending on which are available in the AWIPS database, rather than two separate applications (one for those 8 bit slices that happen to be available, and another for the standard products).

In addition, controls for the stepping or animating in the vertical *should be added to the keyboard* (using the up and down arrows as an obvious example) as many forecasters find the keyboard control much easier than mouse clicking during active weather.

It would also be very helpful if an indicator bar could be added somewhere in a corner of the D2D window or perhaps in the status window to show the relative position in time and space of the current frame (an x-axis for time and a y-axis for the vertical).

Finally, the new vertical stepping or animation controls could also conceivably be used with model data and upper air displays, where the next available vertical level of exactly the same data would be displayed when the up-control button was selected. Again, the frame count would default to whatever the number of available levels are when the data are loaded. It has also been suggested that these new “vertical” controls could be used to step through the various satellite channels.

Questions about these capabilities can be addressed to Steve Keighton, Science and Operations Officer at WFO Blacksburg VA (stephen.keighton@noaa.gov 540-552-1613) or David Andra, SOO WFO Norman, OK (david.andra@noaa.gov 405-366-6586), but the following individuals have also provided input and endorsement:

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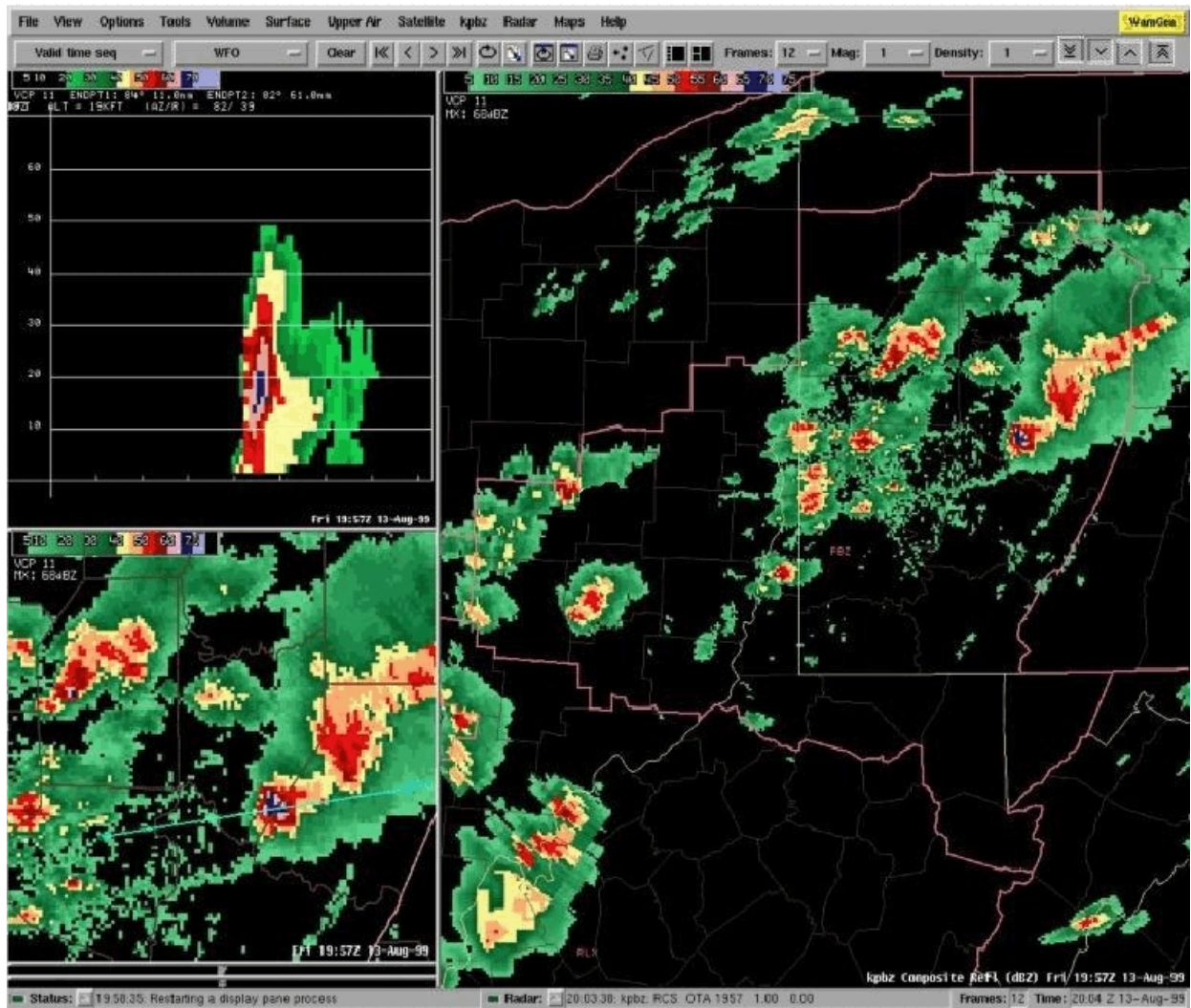


Figure 1 - Vertical control buttons added to right side of menu bar as an example.