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Interactive comment on "3-D visualization of ensemble weather forecasts – Part 1: The visualization tool Met.3D (version 1.0)" *by* M. Rautenhaus et al.

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Overview: This paper (still reading Part 2) brought back memories of our attempts to introduce 3D visualization to the NWS in the U.S. back in the early 2000's. The author's accurately described some of the difficulties we encountered with the software we used, which was essentially a version of the University of Wisconsin's Vis5D packaged to have the look and feel of the NWS operational system known as AWIPS. I include some more comments related to our activities below.

General comments: Overall the paper is well written and quite thorough in first describing the overall background of 3D visualization and some of the issues that have

been encountered in trying to implement it with forecasters. Following this is a detailed description of the computer resource requirements and the various algorithms. Not being involved in this aspect of our own work (but rather the meteorological application and assessment of 3D visualization) I found this portion somewhat difficult to follow at times, though I suspect others working in this area might better appreciate these sections.

Specific comments:

p. 2103, lines 18-20: When we were working on D3D 2000-2004 Jordan Alpert of NOAA/NCEP gave us a presentation where he showed a clever way of using Vis5D to display ensemble data. His work is described in the references below, though not actually illustrated very well in these. I have a correspondence initiated to see if he had done anything further, which I can pass on when I comment on Part 2. Essentially, as I recall, individual ensemble forecasts at a given level, say for example 500 mb height, were loaded into horizontal planes and then one could quickly peruse all the ensemble forecasts by moving the plane up and down in the vertical (the vertical axis in this application then not representing height). Isosurfaces could also be made for some fields, for example an isosurface of a one inch accumulated precipitation value could reveal timing and other differences or similarities amongst the various members. A reference of his work includes the following, available at the web site https://ams.confex.com/ams/annual2003/webprogram/19IIPS.html

Alpert, J.C., 2003: 3-dimensional animated displays for sifting out medium range weather events. Pre- prints, 19th International Conference on Interac- tive Information and Processing Systems for Meteorology, Oceanography, and Hydrology, Long Beach, CA. Amer. Meteor. Soc., Paper 15.2.

p. 2108/line 20 onto the next page: This is a nice summary of our work with D3D. It should also be noted that during the peak of development around 2003 (following the forecast exercise on D3D in Boulder) there were several presentations at the IIPS

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meeting (and other meetings) noted in the reference above from NWS forecasters. FYI, I list some references here. It seems that one very significant issue that prevented further progress towards D3D in NWS operations was that at the same time (early 2000s) forecasters were transitioning to a Graphical Forecast Editor (GFE) system of issuing forecasts, which represented a very large change in how forecasts were prepared and distributed to the Public. The emphasis on GFE during this time was really an overwhelming issue of competition that was difficult to overcome, in my opinion.

References for presentations by NWS forecasters on D3D:

Barjenbruch, D.B., E. R. Thaler and E. Szoke, 2002: Operational applications of three-dimensional air parcel trajectories using AWIPS D3D. Preprints, Interactive Symposium on AWIPS, Orlando, FL. Amer. Meteor. Soc. J136-J138.

Hayes, J.C., J. W. Cannon and J. Watson, 2002: Applying D3D in an operational environment. Preprints, Interactive Symposium on AWIPS, Orlando, FL. Amer. Meteor. Soc. J124-J125.

Johnson, J.R., 2002: Numerical model visualization using the FSL D3D: A paradigm shift for operational forecasters. Preprints, Interactive Symposium on AWIPS, Orlando, FL. Amer. Met. Soc. J126-J130.

Nietfeld, D., 2003: The synoptic environment of the 11 April 2001 Central Plains tornado outbreak viewed in three dimensions. Preprints, 19th International Conference on Interactive Information and Processing Systems for Meteorology, Oceanography, and Hydrology, Long Beach, CA. Amer. Meteor. Soc., Paper P1.1.

Watson, A.I., J. D. Fournier, T. P. Lericos, and E. J. Szoke, 2002a: The use of D3D when examining tropical cyclones. Preprints, Interactive Symposium on AWIPS, Orlando, FL. Amer. Meteor. Soc. J131-J135.

Watson, A.I., T. P. Lericos, J. D. Fournier, and E. J. Szoke, 2002b: Better understanding of QG theory through the use of D3D. Preprints, Interactive Symposium on AWIPS,

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Orlando, FL. Amer. Meteor. Soc. J227-J232.

I should also note that while we were not successful in implementing D3D into NWS operations, there is an interesting radar analysis software package that is run at many NWS WFOs on an ordinary PC, called GR2 Analyst. You might want to check it out, at http://www.grlevelx.com/gr2analyst_2/ One of the display options is a 3D isosurface display of radar reflectivity (actual data, not model output).

p. 2109, lines 3-5. Unfortunately when Bill Hibbard retired it did seemed like Vis5D development did not continue, though it was replaced by VisAD. However, looking at their homepage at http://www.ssec.wisc.edu/∼billh/visad.html this may also be no longer in development, though I am not sure.

p. 2114, lines 20-27 to line 1 p. 2115. The shadow idea as a way to geolocate to the surface seems like a very clever innovation. As the authors noted, we had attempted a easily movable map to try and geolocate the isosurface, but the shadow method requires no further manipulation. Fig. 3 is pretty interesting illustrating the use of two vertical cross-sections at once, but it was not clear how each could be moved, or perhaps I missed this part.

p. 2116-2117 – Normal Curves section and Fig. 8. The idea of the normal curves is another interesting concept. Unlike the shadows, however, this one seems looks like it could be kind of tricky to interpret. It sounded like they are generated at discrete intervals in space, but was not sure what defines their spacing. Among the concepts discussed in this paper, I think this one might be the most problematic for forecasters. I do appreciate however the effort to convey more quantitative information. One method we used (within Vis5D) was the vertical probe, with its output on a separate height vs. value (or values, multiple fields could be displayed) plot. It appears you have such vertical probes as well, but I do not believe they also involve a separate display window for the output.

p. 2126-2130, Section 5: I found this section somewhat difficult to follow, but acknowl-

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edge that I do not work in this area in terms of generating such statistics (rather than interpreting them). As noted on lines 18-23 p. 2130, most statistics are done on pressure levels (or at the surface), rather than model levels, where interpreting the results seemed more difficult.

Table 1: why 34 s (is there a typo here?) for advancing one time step for ensemble mean? Are the ensemble mean fields calculated and stored ahead of time, or are they calculated each time on the fly and hence it takes a long time? Such a time delay would be hard for forecasters to deal with.

Technical Corrections:

Fig. 7 caption – do you mean “different camera positions”?

P 2122 – lines 11-12, awkward wording, perhaps change to “This allows for computation of the . . .”

P 2126 line 5 “to be” change to “from being”

p. 2129 line 6 “. . . at only a few . . .”

Interactive comment on Geosci. Model Dev. Discuss., 8, 2101, 2015.