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AN ON-DEMAND USER INTERFACE FOR REQUESTING MULTI-RADAR, MULTI-SENSOR TIME ACCUMULATED PRODUCTS TO SUPPORT SEVERE WEATHER VERIFICATION

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1. INTRODUCTION

In an attempt to aid National Weather Service (NWS) forecast personnel in verification of severe weather, several multi-radar, multi-sensor based products developed recently at the National Severe Storms Laboratory (NSSL) within the Weather Decision Support System – Integrated Information (WDSSII, Lakshmanan et al. 2007) have proven to be very useful. NSSL has developed, processed and provided products such as gridded Maximum Expected Size of Hail (MESH) and Rotation Tracks (time accumulated maximum rotational velocity) to several NWS Forecast Offices on an experimental basis, in both real-time and post-event scenarios. Feedback on these products have been favorable.

In 2007 NSSL began archiving these CONUS scale gridded geospatial products. In post-event situations, NSSL users were able to retrieve these products to examine the event as a case study, or, in many cases, to aid NWS personnel in post-event assessment, such as tornado damage surveys. The process the retrieve and parse out subsets of these products was done manually.

For 2008, a new Web interface is available that allows users (e.g., NWS Post Storm Data Acquisition teams) to select an areal subdomain of the CONUS grid, as well as a temporal subdomain of the daily archived products. These data will also be served outside of the NWS for users, such as Emergency Management (EM) personnel to use.

2. MOTIVATION

NWS Weather Forecast Offices (WFO) are responsible for verifying their severe weather warnings, a necessary task that consumes a non trivial amount of manpower. Immediately following a damaging severe weather event, EM personnel must quickly inspect their community in order to aid in rescue efforts and prioritize cleanup and recovery. In both cases time and resources are at a premium. For the forecaster, verification tools usually consist of reviewing severe weather reports as points and "connecting the dots". When there is time to do so, a forecaster could replay the radar data to give a better idea of where to make probing phone calls, or to send survey teams. These efforts take considerable time and can introduce uncertainty in location and time of the event. Wind damage assessment requires a "quick response" to the affected areas since rapid clean-up removes important clues necessary for verification. Furthermore, rarely does the EM have access to these resources.

NSSL has developed products that are intended for aiding in realtime warning forecasts, but would aid both of these user-groups after the event has passed. The MESH (Ortega and Smith 2006) and Rotation Tracks products have been used by research meteorologists as well as some operational forecasters for several years now. Both products have been successfully employed as verification tools. The strength of these products is that 1) they are multi-radar, multi-sensor in nature thereby reducing undesirable effects encountered by single radars (cone-of-silence, terrain blockage, etc.) 2) they depict areal coverages, or "swaths" instead of points, and 3) they are graphical and geospatial in nature allowing the user to quickly assess what areas deserve immediate focus and what areas can be reserved for a later time, if available. Up to now, these products have been available in a few NWS offices, and more recently as overlays in GIS applications such as GoogleEarth.

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Figure 1. Example of Rotation Tracks product produced by WDSSII and displayed in Google Earth.

While the MESH and Rotation Tracks are available across the CONUS for any day the shortcoming was that they were limited to these spatial and temporal scales and as a limited number of output types. For arbitrary events (usually based in severity and/or availability of NSSL personnel to "manually" extract subsets of the CONUS data), these products were made available to NWS staff as they prepared for damage assessment. One such case was the tornadic event that occurred across parts of the Upper Midwest on 18 October 2007. NSSL set up a temporary website to host the Rotation Tracks and MESH data for this event and informed affected and neighboring NWS Forecast Offices of these data [http://ewp.nssl.noaa.gov/18oct07/]. Here are some samples of the feedback we received for the Rotation Tracks product this event:

(ICT): "I appreciate the heads up to the web site. I have used it many times for surveys."

(IWX): "These tracks are great! Does the data get generated and archived on a regular basis at the URL you provided? I'd like to incorporate this into our post event procedures, particularly pre-survey planning."

(MPX): "Thank you for doing this. Even though I'm a WCM at an office that was not affected (I'm in Minneapolis), this looks fantastic. I suspect it will be a big help to all the offices that were affected. I've no idea what kind of workload this requires, so is this something that CIMMS/NSSL often does, or do you generally do this only for big outbreaks?"

There is now a new user interface that allows anyone to request a particular date, time and duration, as well as a select an area and these products will be tailor made to the user's request. This greatly facilitates the use of these products to users inside or outside the NWS community and provides them in more manageable file sizes and formats. Users can now overlay these geospatial products onto GIS applications and match affected areas with streets and buildings. This advantage should allow users to focus their resources where needed.

3. ABOUT THE PRODUCTS

Both the Rotation Tracks and MESH products are born out of the WDSSII algorithm platform, though in slightly different ways. This section will briefly describe how the products are produced. For a more descriptive background, the reader is encouraged to review the references.

3.1 MESH

The MESH product begins by merging the reflectivity data from all of the CONUS NEXRAD radars to a three dimensional (lat/lon/ht) grid (Lakshmanan et al. 2006b). A modified version of the NSSL Hail Detection Algorithm (HDA) (Witt et al. 1998, Stumpf et al. 2004) is then run on this grid producing a MESH grid at 60 second intervals. Then, the maximum MESH value at each gridpoint (of a 1 km^2 horizontal grid) is plotted over a chosen time period in order to create the areal "swaths" of MESH.

3.2 Rotation Tracks

For the Rotation Tracks product, the processing is different. First, the velocity data for each radar is run through a Linear Least Squares Derivative (LLSD) filter (Smith and Elmore 2004), creating an azimuthal shear field. A 0-3 km layer (or data from the 0.5° elevation scan, if it is greater than 3 km ARL) of the azimuthal shear fields from each radar across the CONUS are then combined and the maximum value at each 250 m^2 gridpoint is plotted over the time period.

4. NEW WEB INTERFACE

http://ondemand.nssl.noaa.gov

Since NSSL is producing and archiving these products, and they have proven to be useful, we needed a way to serve the data "on demand" without relying on the availability of someone's schedule. A web page was developed to give users an interface to select their data at any time (> 1 hr) after the event has occurred, at any location within the CONUS. Once the user has entered his or her input, an automated process would take that input and parse out the desired data and deliver it in the format that he/she requested. The spatial request is aided by using the open source GIS application developed at the University of Minnesota known as MapServer. Once the data request is completed, the MapServer application allows the user to preview their data before downloading it.

5. AN EXAMPLE

Step 1: Visit http://ondemand.nssl.noaa.gov

Step 2: Enter in your desired event begin date/time and end date/time (in UTC), select your area, product(s) [Rotation Tracks and/or MESH], and output format(s). Enter your email address so you can be notified when your request is completed, and to receive a copy of your submission. See Figure 2.

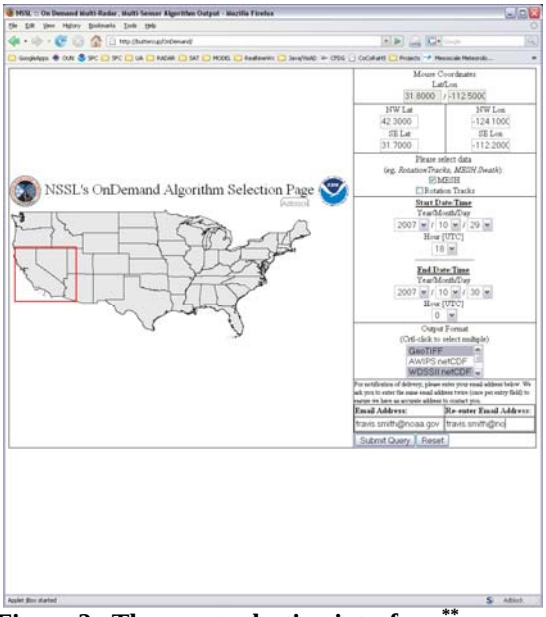

Figure 2. The event selection interface.**

Step 3. Visit your temporary results page. [Note, these data will be available at your temporary results page for 7 days from your submission. After that, you will need to resubmit your request.] The interactive results page will contain your submission information. It will also let you know if your data are not yet ready (Figure 3), or when your data are ready (Figure 4). When your data are ready a link will be provided to download a compressed .zip file containing each of your requested output file formats. Also, once the data are ready, you will be able to pan and zoom on the map to view your data in greater detail (Figure 5). You can also toggle between the products you requested (if more than one).

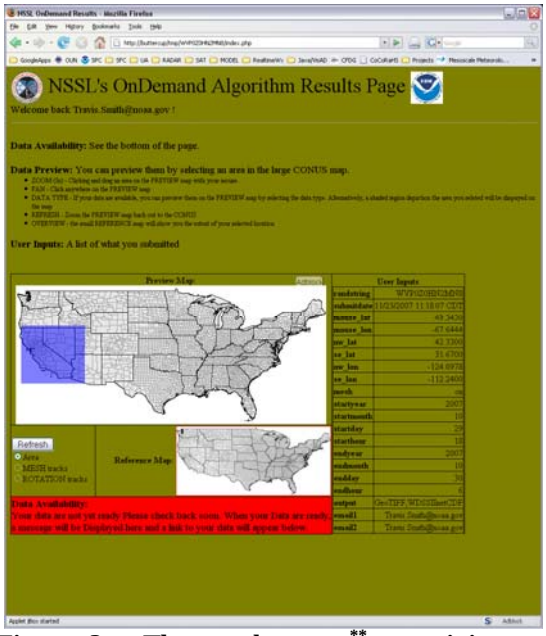

Figure 3. The results page containing an interactive map, data availability and submission information. Notice the panel at the bottom will be red and an associated message will inform the user that their data are not yet ready.**

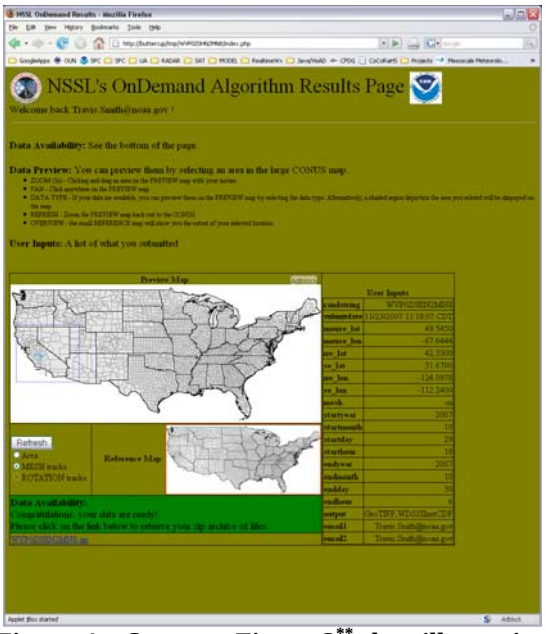

Figure 4. Same as Figure 3[**], but illustrating when data are ready and available.

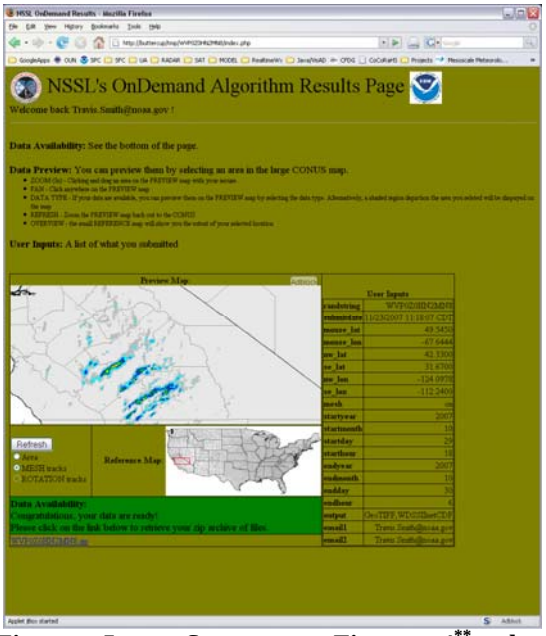

Figure 5. Same as Figure 4[**], but demonstrating the interactive map (zoomed in on MESH swaths in central California.

[**] *Note: use the URL in this manuscript, not the one in the figure.*

6. CONCLUSION

These data have the capability to greatly enhance the rapid-response verification of severe hail and tornado events. This short-term verification support system has the capability to improve the NWS severe weather verification goals as cited by the Government Performance Review Act (GPRA), as well as enhance the efforts of responders to hazardous weather incidents. Finally, the long-term data archival of these products will substantially augment the severe weather climatological analysis activities at NCDC.

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