11B.4 WEATHER RADAR DATA SERVICE'S AT NOAA'S NATIONAL CLIMATIC DATA CENTER

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Abstract
NOAA's National Climatic Data Center (NCDC) is responsible for acquisition, archive, and dissemination services for weather radar data products and information from both civilian and military radar systems. The primary radar data products archived at NCDC are part of the Weather Surveillance Radar 1988 Doppler network, commonly known as Next Generation Radar (NEXRAD). There are 159 NEXRAD sites throughout the United States and selected overseas locations. NCDC also archives Environment Canada radar data from 31 sites across Canada and recently 45 weather radar sites from the U.S. Department of Transportation known as Terminal Doppler Weather Radar (TDWR). Data ingest for the radar networks mentioned above are in near real time and over one petabyte of data resides in the archive. NCDC provide web services for direct access to these data. In addition, NCDC provides a free software application, the Weather and Climate Toolkit (WCT), for data display and translation. The WCT allows visualization and data export of weather and climate data from unique sources such as Radar, GOES Satellite and Models as well as generic NetCDF and OPeNDAP resources. This paper describes weather radar services available at NOAA's NCDC.

NCDC Radar Archives
The NCDC ingests and archives weather radar data and products on a daily basis in near real time (~10 second latency). The volume scan data (level II) include three moments: reflectivity, spectral width and mean radial velocity. The archives include 1.2 Petabytes of level II data and increases at 672 gigabytes/day (245.3tb per year). The Level III derived products (approximately 36 products) comprises 25 terabytes and increases at 4 Gigabytes/Day (1.5 TB per year). NCDC also archives: NOAA's Regional & ConUS Radar-based Precipitation Mosaic (Multi-sensor product), the Radar Integrated Display with Geospatial Elements Mosaics (RIDGE), and NOAA's 3-D Reflectivity and National Mosaic Quality Precipitation Estimation product at 1km resolution. Over the next two years the implementation of dual polarization radar technology are expected to increase the archives by 2.2 terabytes a day. NOAA long-term plans include moving towards phased array radar technology potentially increasing daily data ingest by approximately 10.9 terabytes a day.

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Dissemination statistics
In 2009 via the NCDC radar resources web page 138 Gigabytes of radar data were accessed on average per day and 150.2 million tar'd radar data files were retrieved which totaled 50.4 terabytes. Retrieval times for data orders through direct web access over the last 6 months averaged 7minutes.

Web Access
Weather radar data are available at no cost via the NCDC radar resources web page. Go to URL: http://www.ncdc.noaa.gov/oa/radar/radarresources.html for NCDC radar services information. The online inventory can be accessed at URL: http://www.ncdc.noaa.gov/nexradinv/ (See Figure 1). As much as four terabytes of data have been accessed monthly through the NCDC radar resources web page.
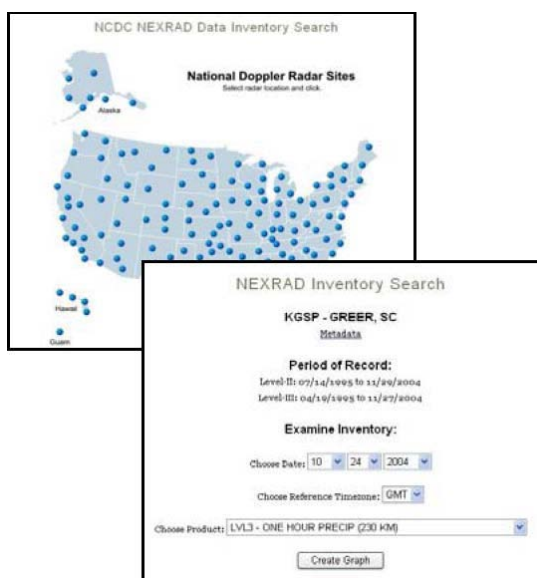

Figure 1. NEXRAD web page inventory

Weather & Climate Toolkit
NOAA's Weather and Climate Toolkit (WCT) is an application that provides simple visualization and data export of weather and climatological data archived at NCDC. The Toolkit also provides access to weather/climate web services provided from NCDC and other organizations. The Viewer provides tools for displaying custom data overlays, Web Map Services (WMS), animations and basic filters. The export of images and movies is provided in multiple formats. The Data Exporter allows for data export in both vector point/line/polygon and raster grid formats.

Current data types supported by WCT:

* NEXRAD Radar Data (Level-II and Level-III)
* GOES Satellite AREA Files (see figure 2)
* U.S. Drought Monitor Service (from the National Drought Mitigation Center)
* Generic gridded NetCDF support (see figure 3)
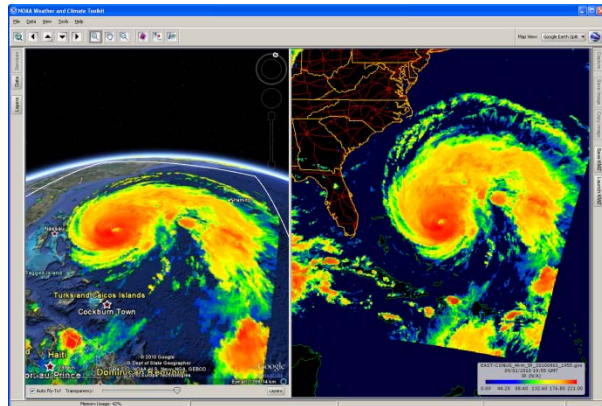* OPeNDAP support for Gridded Datasets

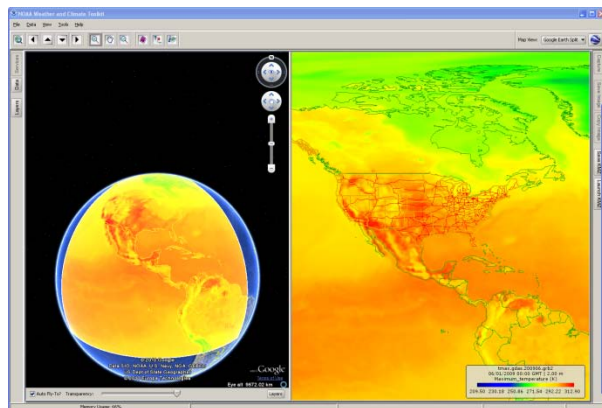**Figure 2**. Hurricane Earl - Gridded GINI format satellite data

Figure 3. Climate Forecast System Reanalysis (CFSR) model Data - Gridded GRIB format

Samples of several display and analysis features include: 1) Saving images and animations in multiple formats (see Figures 3, 4), 2) Simple math operations, smoothing, and filtering of the data, 3) Display range rings and custom markers, 4) Custom map backgrounds using client side data and/or OGC compliant Web Map Services (WMS); and 5) Blending radar data with other data.
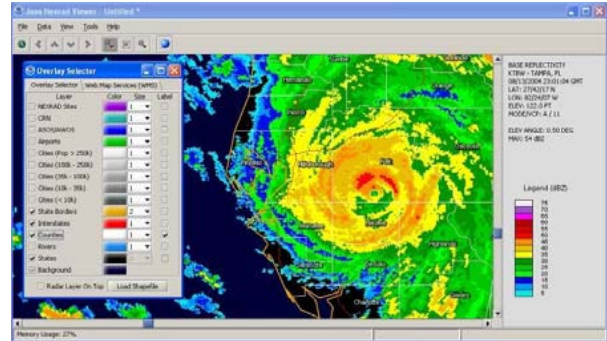

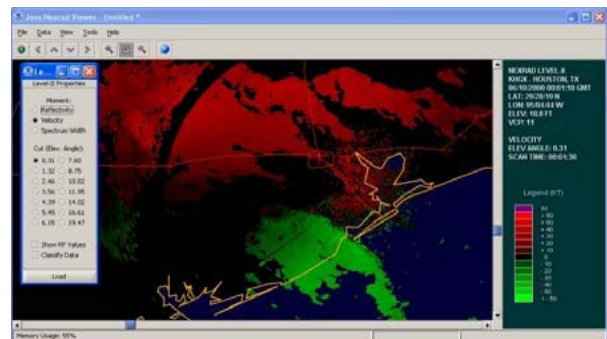
Figure 4. Screenshot of Radar Viewer with Overlay Selector

Figure 5. Screenshot of Radar Viewer with Level-II Data

New WCT feature supports 3-D Google Earth
Radar imagery can now be visualized in 3-D in both the internal Google Earth viewer and with exported KMZ files. The Radar image is draped on a 3-D model of the height of the center of the Radar beam. The elevation exaggeration can be selected in both the internal viewer and the exported KMZ as well (see figure 6)
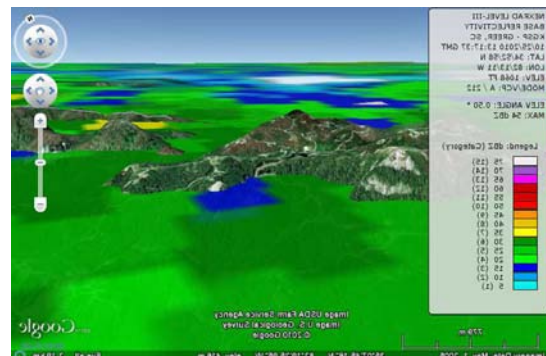

Figure 6. 3-D radar image in Google Earth

REFERENCES

Ansari, S., C. Hutchins, S.A. Del Greco, N. S. Stroumentova, and M. Phillips, 2009: The Weather and Climate Toolkit. *89th AMS Annual Meeting, combined preprints CD-ROM, 12-16 January 2009, San Antonio, TX, 25th Conference IIPS [International Conference on Interactive Information and Processing Systems for Meteorology, Oceanography, and Hydrology]*, American

Meteorological Society, Boston, Mass., File 6A.4 (January 2009).

Del Greco, S.A., 2003: A History for WSR-88D Level II Data Services at the National Climatic Data Center, Preprints, *31ST International Conference on Radar Meteorology, 6-12 August, Seattle, Washington, Amer. Meteor. Soc., 902-906.*

Appendix A

1. ESRI Shapefile: For information:
http://www.esri.com

2. Open Geospatial Consortium (OGC): For information:
http://www.opengeospatial.org/

3. Simple Binary: Floating point binary grid file with ARC/INFO header file containing grid specifications.

4. Well-Known Text (WKT): For information:
http://dev.mysql.com/doc/mysql/en/GIS_WKT_format.html

5. NetCDF (network Common Data Form): For information:
http://my.unidata.ucar.edu/content/software/netcdf/ind ex.html

6. ARC/INFO ASCII Grid: For more information:
http://www.geotools.org/ArcInfo+ASCII+Grid+format

7. GINI Format for AWIPS Satellite Data, For information:
wxp.unisys.com/Appendices/Formats/GINI.html

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