6A.4 THE WEATHER AND CLIMATE TOOLKIT

Steve Ansari*, Chad Hutchins, Stephen Del Greco
NOAA National Climatic Data Center, Asheville, North Carolina

Nina Stroumentova
STG Inc., Asheville, North Carolina

Mark Phillips
University of North Carolina Asheville / National Environmental Modeling and Analysis Center
Asheville, North Carolina

ABSTRACT

The Weather and Climate Toolkit (WCT) is free, platform independent software distributed from NOAA's National Climatic Data Center (NCDC). The WCT allows the visualization and data export of weather and climate data, including NEXRAD Radar, GOES Satellite, NOMADS Model and surface in-situ data. By leveraging the NetCDF for Java library and Common Data Model, the WCT is extremely scalable and capable of supporting many new datasets in the future [4; 6]. In addition, the WCT provides access to remote web services for instant access to products such as the Drought Monitor, NEXRAD reflectivity mosaics, multi-sensor precipitation totals and the Severe Weather Data Inventory.

The WCT Viewer provides tools for custom data overlays, Web Map Service (WMS) background maps, animations and basic filtering. The export of images and movies is provided in multiple formats. The WCT Data Exporter allows for data export in both vector polygon (Shapefile, Well-Known Text) and raster (GeoTIFF, ESRI Grid, VTK, Gridded NetCDF) formats [Appendix A]. These data export features promote the interoperability of weather and climate information with various scientific communities and common software packages including ArcGIS, Google Earth, MatLAB, etc…

1. INTRODUCTION

NCDC archives many diverse datasets including, but not limited to, station observations, Radar, Numerical Model, and satellite. These data are in many different complicated binary formats and represent different abstract data types such as point, time series, grid, radial and swath. While access to the raw datasets is relatively easy, integration of the data into user software and applications is often extremely difficult. Custom software must be written to decode or parse the data into formats that common formats and software packages can read. Furthermore, these formats and software packages are different for each major scientific genre including Engineering, Atmospheric Science, Hydrology and Environmental Science. By providing conversion and data export tools, easy data access and integration is available to an increased audience.

The Weather and Climate Toolkit is the successor to the Java NEXRAD Tools, a successful visualization and data export tool for NEXRAD Radar data [1].

2. DATA

The WCT is based largely on the Unidata NetCDF for Java API [4]. The NetCDF for Java API supports the direct reading of native formats including GRIB, NEXRAD and HDF into Common Data Model feature types such as time series, radial, grid, etc. The WCT provides visualization and data export support based on these abstract feature types [6].

The current available release provides support for the following data formats:

- NEXRAD Level-II
- NEXRAD Level-III
- GOES AREA Files
- XMRG MPE

Users may access data on any remote HTTP or FTP server in addition to local disk. Special support is provided for NCDC HAS orders, CLASS orders and THREDDS catalogs.

Development is under way to support all feature types and therefore allow integration of any gridded, point, timeseries, swath or radial NetCDF (or readable) file into the WCT.

3. SERVICES

Remote data services are supported, providing access to data available through web services. Current data services include the NIDIS U.S. Drought Monitor [3] (Figure 7).

Development is under way for the addition of access to the NOAA Severe Weather Data Inventory, NEXRAD Mosaic archive, the National Operational Model Archive and Distribution System (NOMADS), NCDC Climate Data Online and multi-sensor precipitation totals [2, 5]. In addition, users will be able to add their own service using web service standards such as WMS and OPeNDAP.

* *Corresponding author address:* Steve Ansari, 151 Patton Ave., Asheville, NC 28801; e-mail: Steve.Ansari@noaa.gov.

4. VISUALIZATION

Simple 2D visualization is provided for all supported datasets. The WCT includes pre-packaged data for common map layers including states, counties and cities (Figure 1, 2, 3, 4 and 5). Custom data may be added using any NAD83/WGS84 Shapefile. Background maps can be added using Web Map Services (WMS) (Figure 6). Predefined WMS background maps for USGS Topo Maps, Aerial Photography, Landsat, Landcover and Shaded Relief are included. A NAD83 lat/long grid is used as the basis for all visualizations. This allows greater interoperability with the Web Map Services. Datasets are remapped for each view extent using a nearest neighbor resampling method, if needed. Basic filtering and smoothing functionality is provided.

Users may save images to common file formats (such as JPEG, GIF, PNG) and also produce KMZ files for visualization in Google Earth or other virtual globe software (Figure 8). Animations are supported with output in Animated GIF and AVI formats in addition to KMZ.

5. EXPORT

The WCT supports the export of data to several common scientific formats. Spatial and attribute filtering is provided (Figure 10), allowing users to extract subsets of the original data. Currently supported export formats include:

- Point & Polygon Shapefile
- Point & Polygon Well-Known Text
- Raw NetCDF (native data structure)
- Gridded NetCDF (remapped if needed)
- Arc/Info ASCII Grid
- GeoTIFF

These export formats are readable by many software packages including Geographic Information System (GIS) applications, mathematical and statistical analysis software, engineering software and meteorological analysis tools.

Command-line batch processing is supported for all data export capabilities.

6. CONCLUSION

The Weather and Climate Toolkit (WCT) provides easier access to NOAA weather and climate datasets. As free, platform independent, standalone software, the WCT reaches a large audience of diverse users. By providing visualization and export capabilities, users are able to easily integrate the data into their own applications. The WCT is built upon scalable, open source and community-driven NetCDF software which allows for flexible future development. These benefits, to many user communities, exemplify the overall NOAA mission.

7. REFERENCES

1. Ansari, S., and S.A. Del Greco, 2005: GIS Tools for visualization and analysis of NEXRAD Radar (WSR-88D) Archived Data at the National Climatic Data Center. *85th AMS Annual Meeting, combined preprints CD-ROM, 9-13 January 2005, San Diego CA, 21st Conference IIPS [International Conference on Interactive Information and Processing Systems for Meteorology, Oceanography, and Hydrology]*, American Meteorological Society, Boston, Mass., File J9.6, 9 pp. (January 2005).

2. Ansari, S., and S.A. Del Greco, M. Phillips, 2008: A geospatial database and climatology for severe weather data. *88th AMS Annual Meeting, combined preprints CD-ROM, 21-25 January 2008, New Orleans LA, 24th Conference IIPS [International Conference on Interactive Information and Processing Systems for Meteorology, Oceanography, and Hydrology]*, American Meteorological Society, Boston, Mass., File 5A.10, (January 2008).

3. Drought Monitor Website: http://drought.unl.edu/dm/monitor.html

4. NetCDF for Java API Website: http://www.unidata.ucar.edu/software/netcdf-java/

5. NOMADS Website: http://nomads.ncdc.noaa.gov

6. Unidata Common Data Model tutorial: http://www.unidata.ucar.edu/software/netcdf/workshops/2008/njcdm/index.html

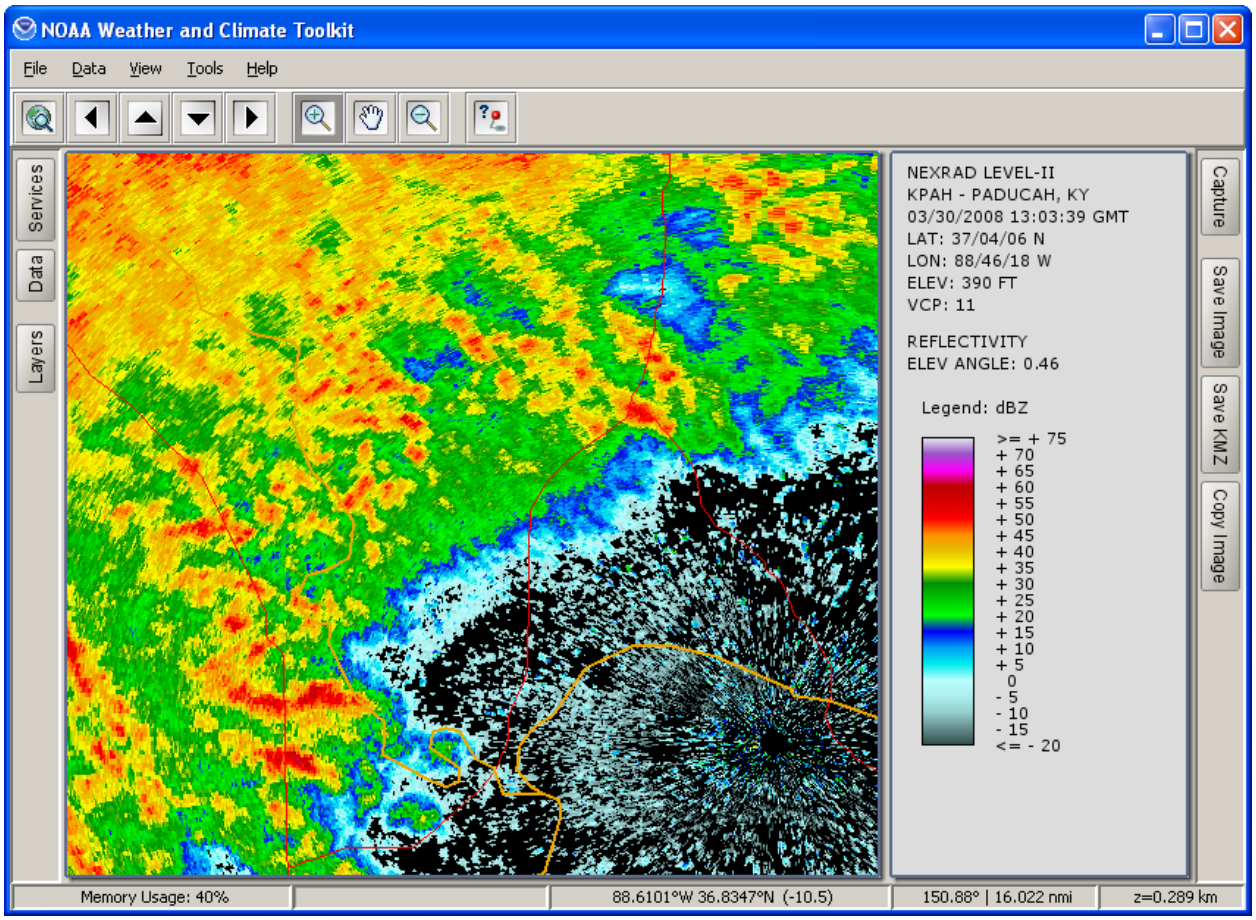

Figure 1. NEXRAD Super-Res Reflectivity Data

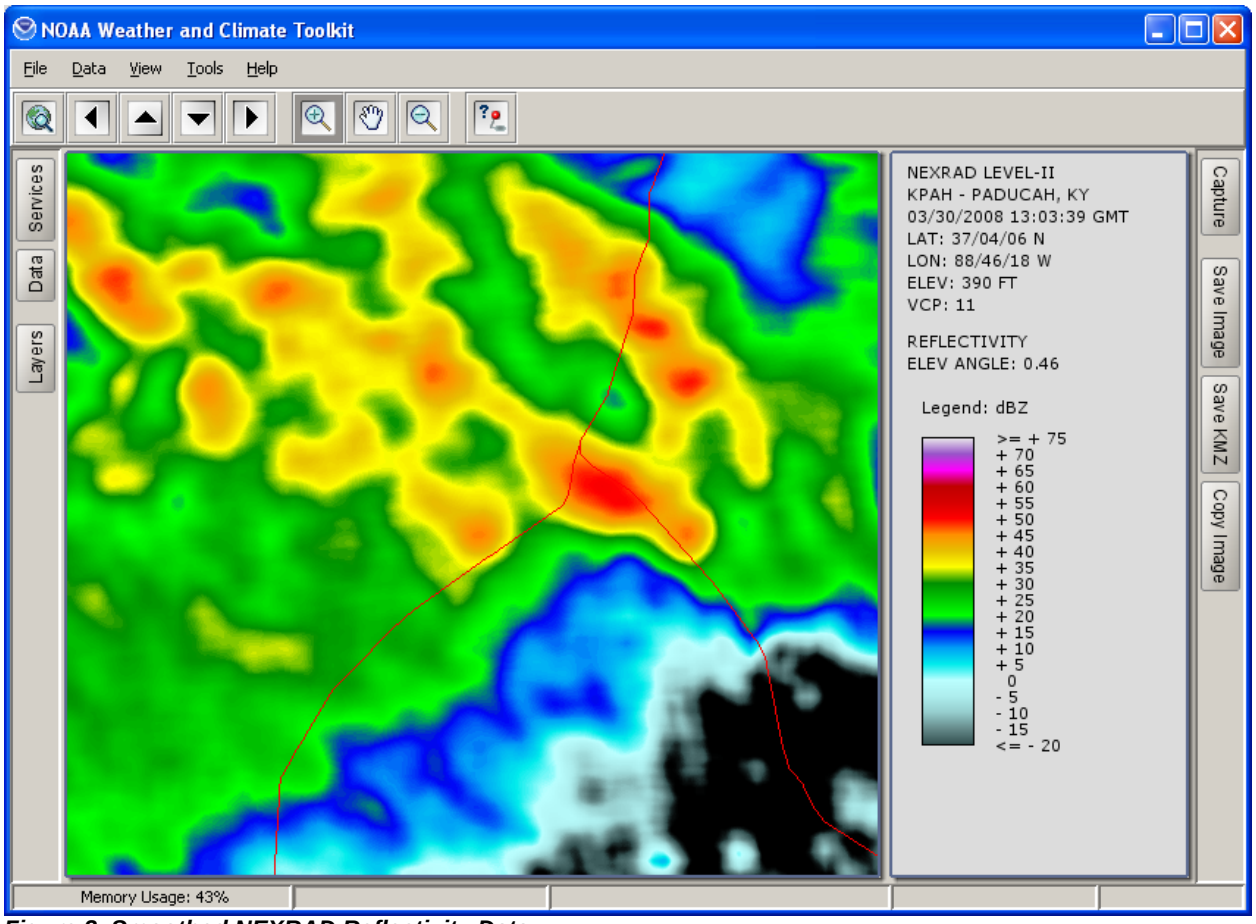

Figure 2. Smoothed NEXRAD Reflectivity Data

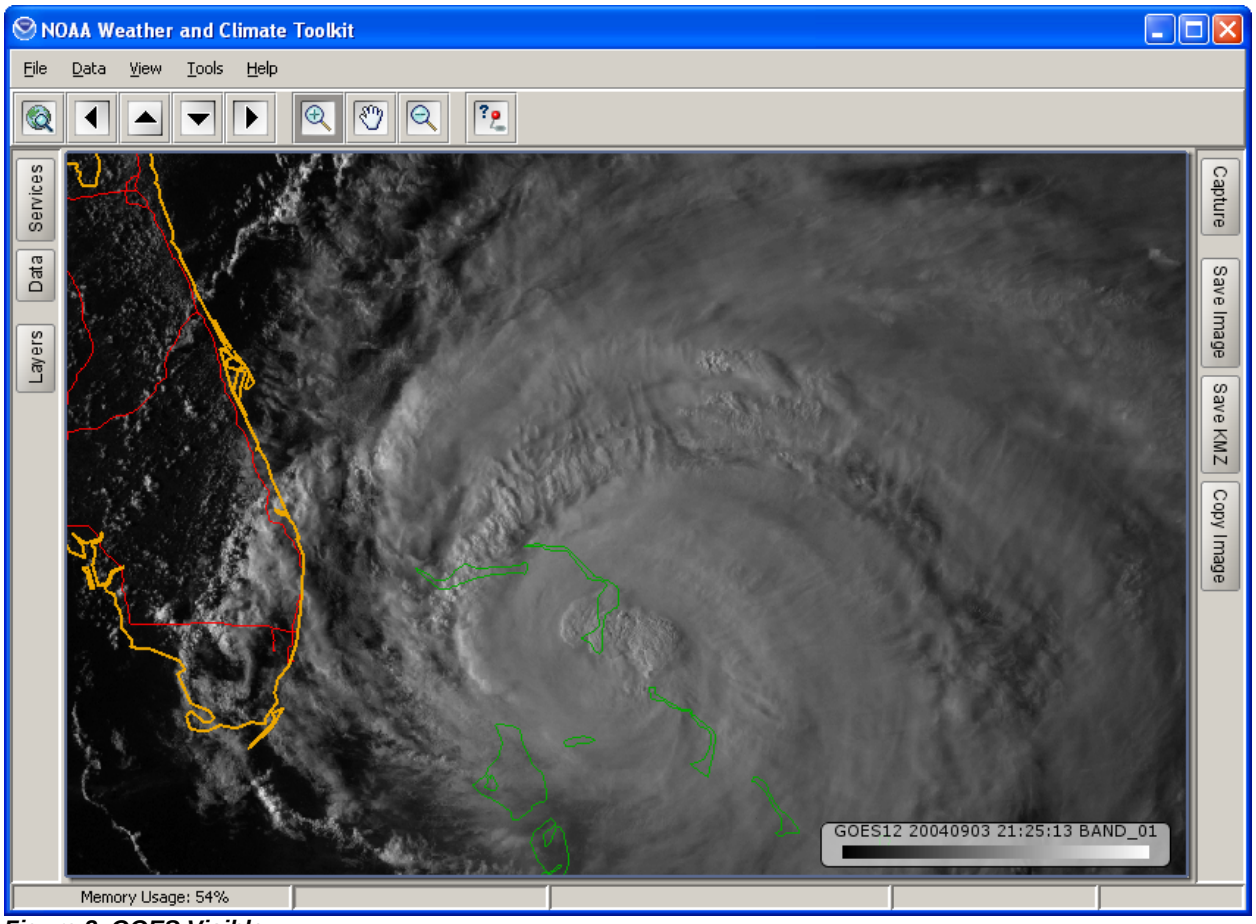

Figure 3. GOES Visible

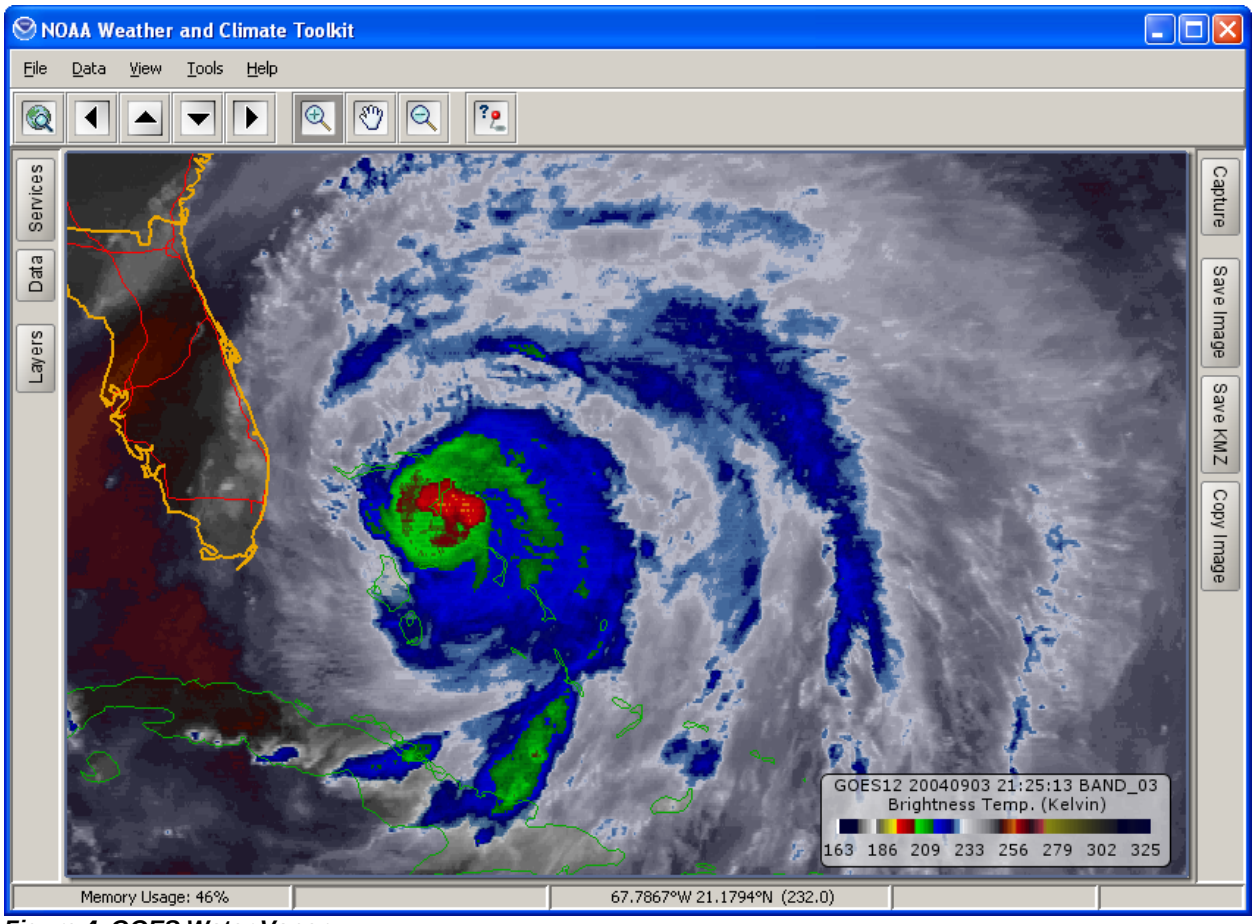

Figure 4. GOES Water Vapor

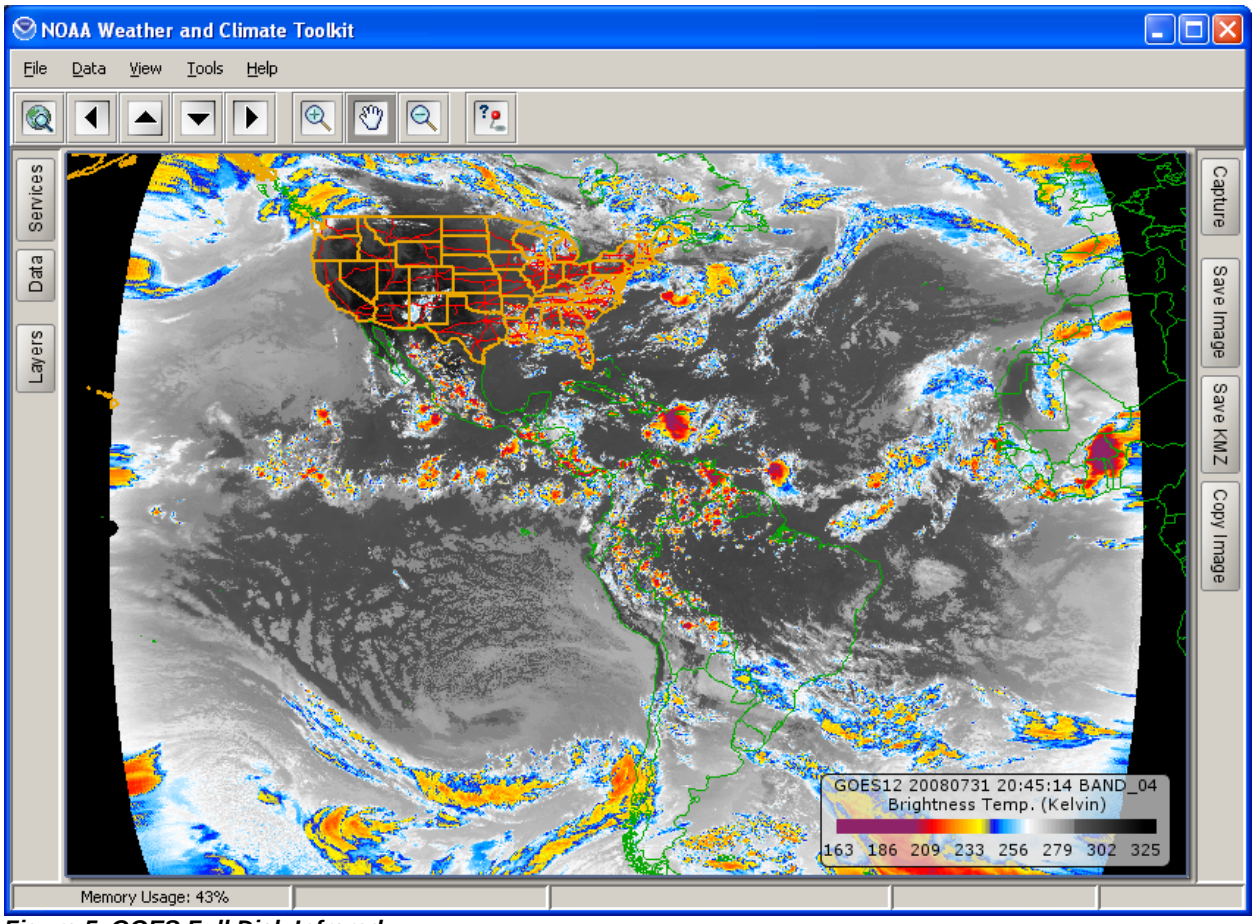

Figure 5. GOES Full Disk Infrared

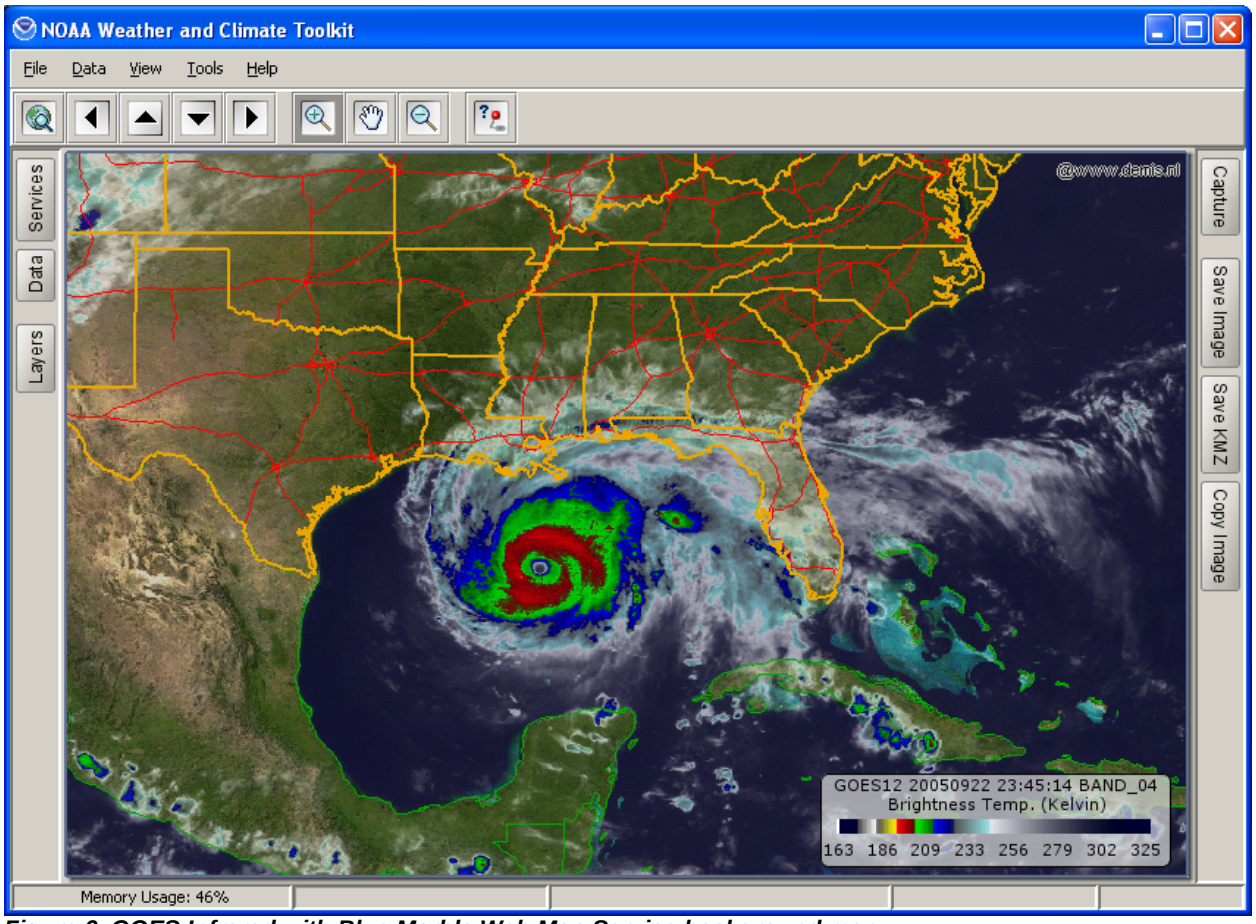

Figure 6. GOES Infrared with Blue Marble Web Map Service background map

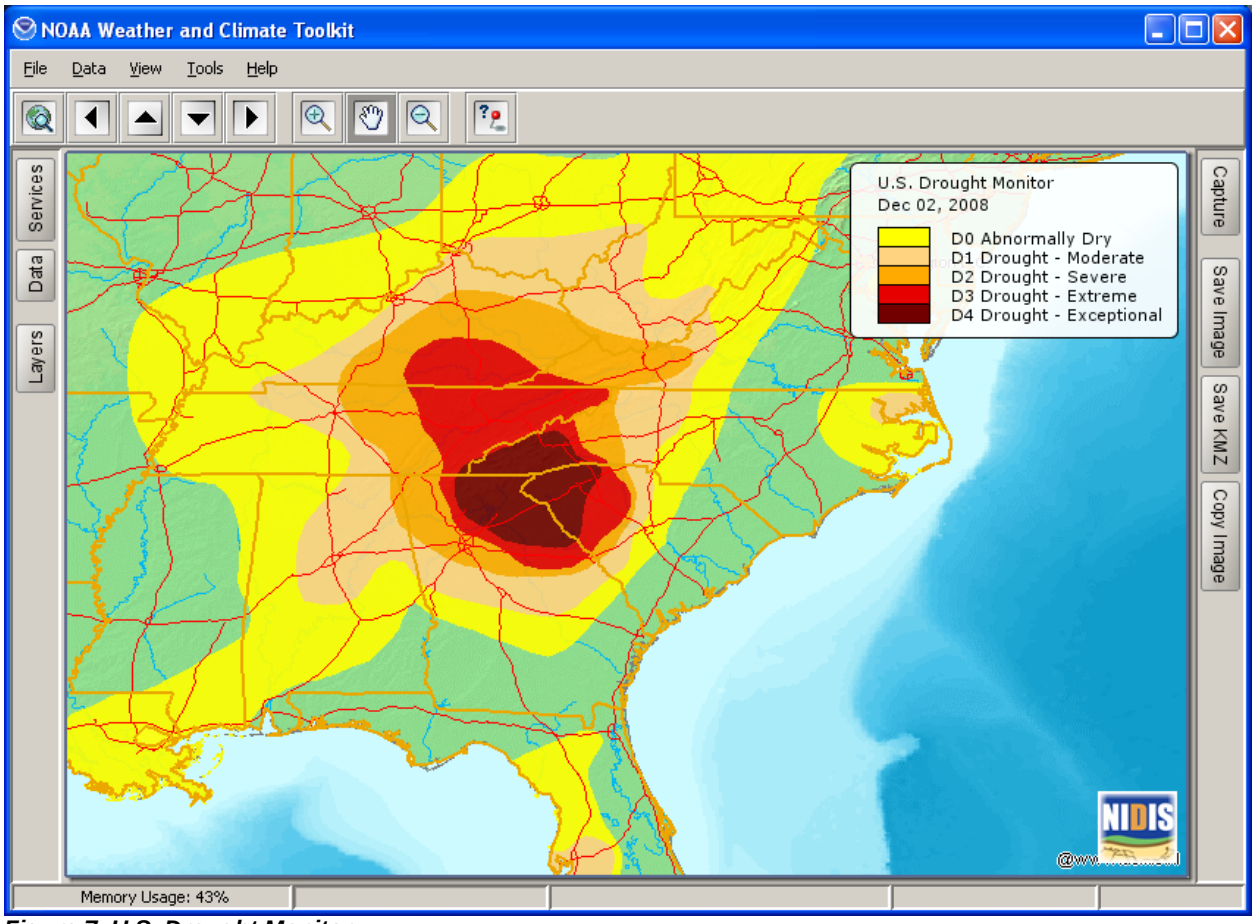

Figure 7. U.S. Drought Monitor

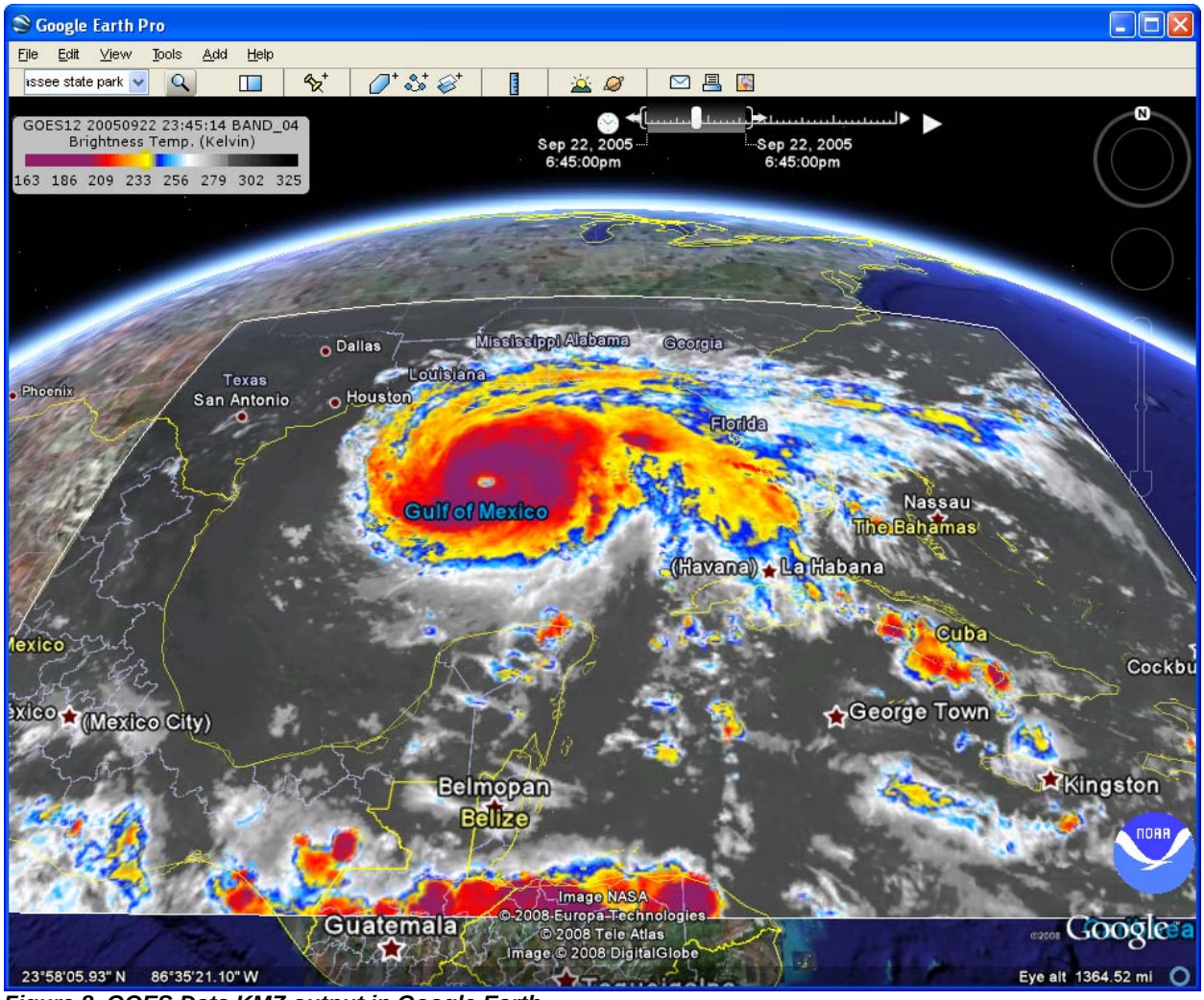

Figure 8. GOES Data KMZ output in Google Earth

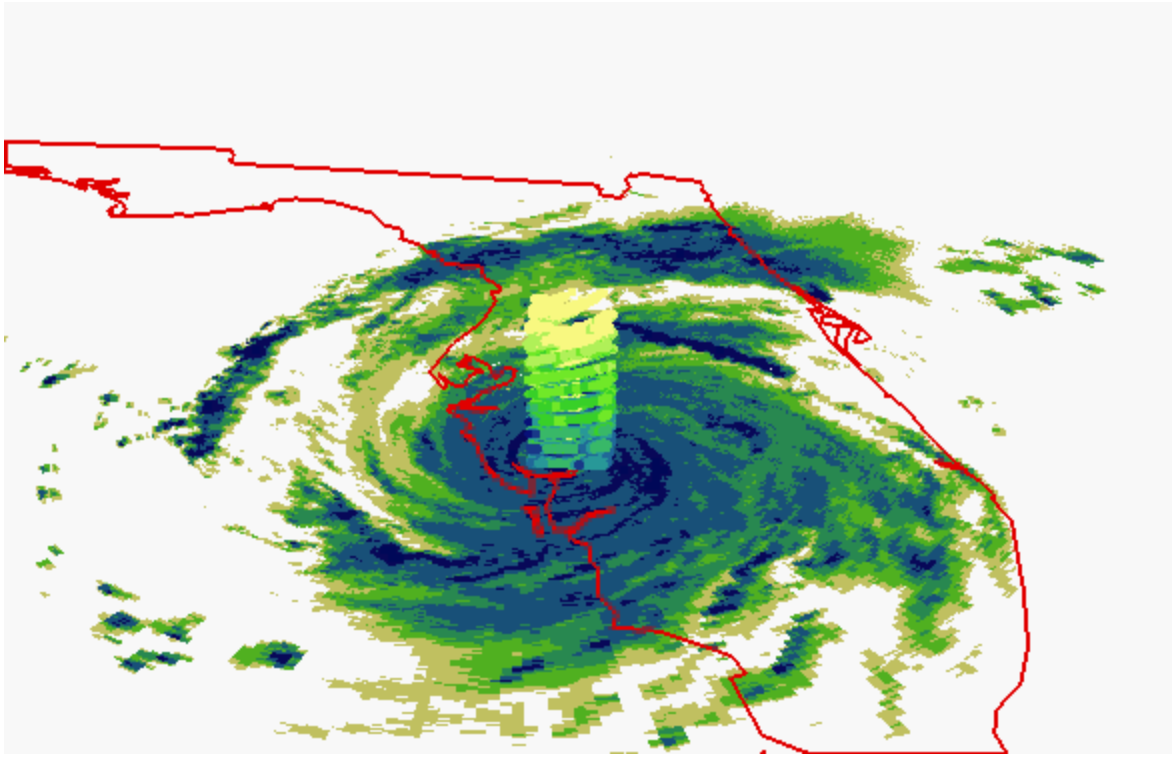

Figure 9. NEXRAD Level-II Shapefile (point and polygon) export in ArcGIS

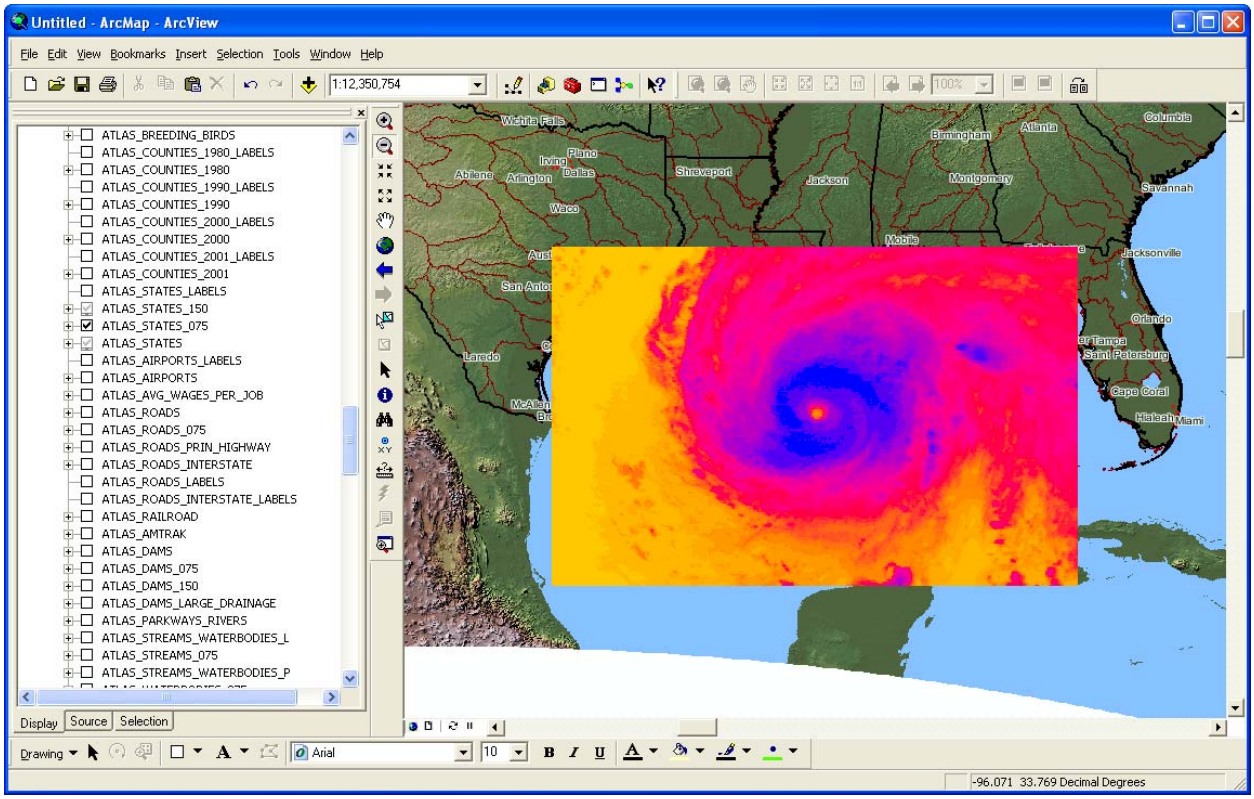

Figure 10. Spatial Subset of GOES Infrared Data in ArcGIS

APPENDIX A

1. ESRI Shapefile [1]: “A shapefile stores nontopological geometry and attribute information for the spatial features in a data set. The geometry for a feature is stored as a shape comprising a set of vector coordinates.” For more information: http://www.esri.com

2. Well-Known Text (WKT): An ASCII text representation of geometry data. Defined in the OpenGIS Consortium “Simple Features for SQL” specification. For more information:
http://dev.mysql.com/doc/mysql/en/GIS_WKT_format.html or
http://publib.boulder.ibm.com/infocenter/db2help/index.jsp?topic=/com.ibm.db2.udb.doc/opt/rsbp4120.htm

3. NetCDF (network Common Data Form): “NetCDF (network Common Data Form) is an interface for array-oriented data access and a freely-distributed collection of software libraries for C, Fortran, C++, Java, and perl that provide implementations of the interface. The netCDF software was developed by Glenn Davis, Russ Rew, Steve Emmerson, John Caron, and Harvey Davies at the Unidata Program Center in Boulder, Colorado, and augmented by contributions from other netCDF users. The netCDF libraries define a machine-independent format for representing scientific data. Together, the interface, libraries, and format support the creation, access, and sharing of scientific data.” For more information: http://my.unidata.ucar.edu/content/software/netcdf/index.html