

The Integrated Data Viewer

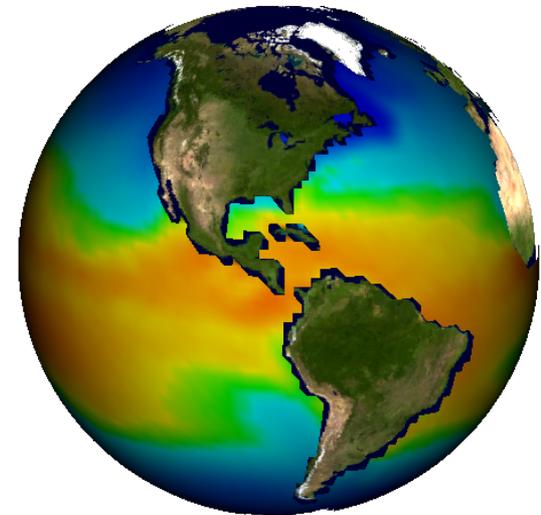
A 3D visualization and analysis tool for atmospheric and oceanic research and education



Unidata/UCAR
Boulder, CO

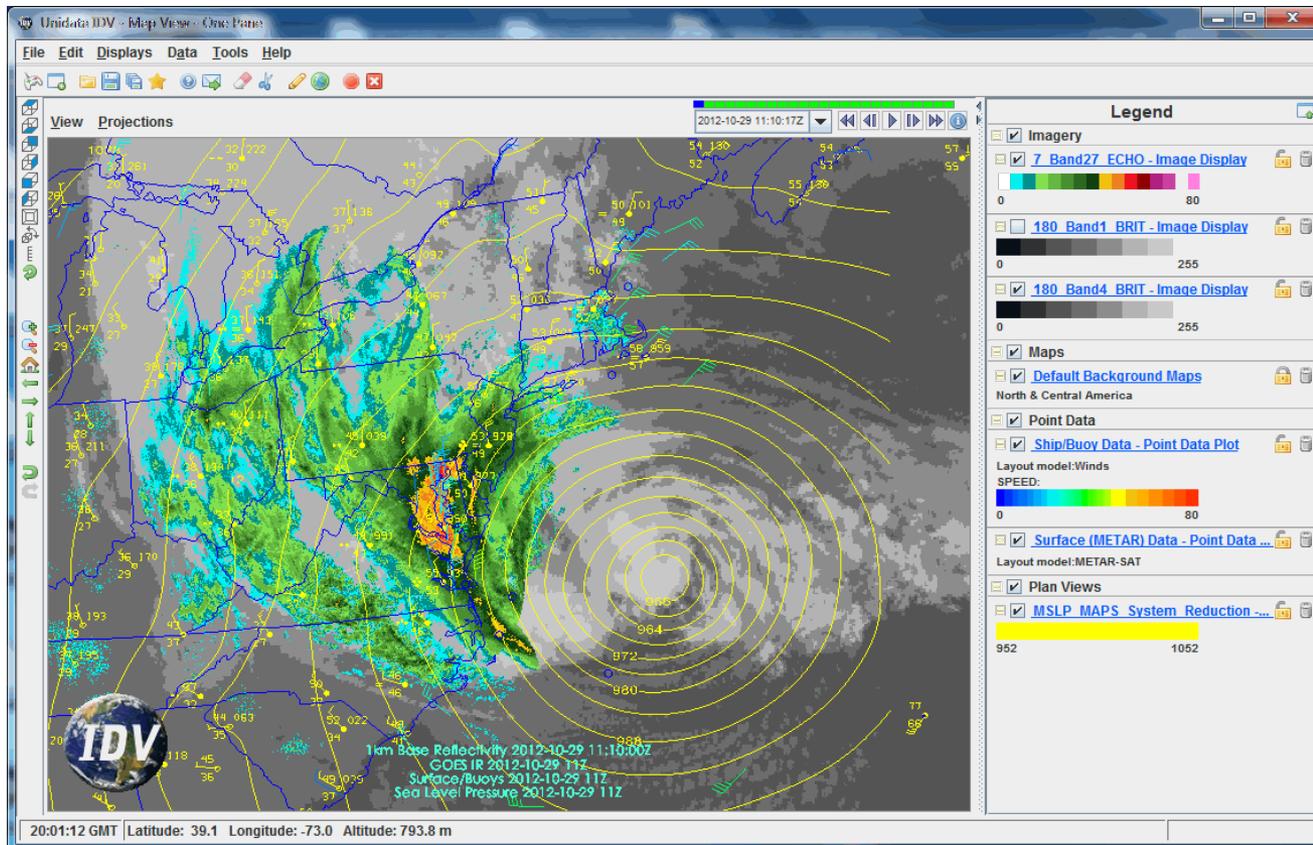
Integrated Data Viewer (IDV)

- Unidata's visualization and analysis tool for atmospheric data
- Java™ framework and application
- Integrated 2D/3D displays of a wide range of data
- Built on VisAD library



IDV is an Integrator

- Integration of data from disparate data sources



IDV Integrates Diverse Data Sources

- Data Types:
 - Gridded data
 - Satellite imagery
 - Radar data
 - Point observations
 - Balloon soundings
 - NOAA Profiler Network winds
 - ACTF tropical storm
 - GIS data
 - Quick Time movies
 - Web Cams
- Supported Formats:
 - netCDF/HDF
 - GrADS
 - GRIB
 - ADDE
 - Vis5D
 - KML (Google Earth)
- Access Methods:
 - Local files
 - HTTP and FTP
 - ADDE and TDS servers
 - RAMADDA

ADDE = Abstract Data Distribution Environment

TDS (THREDDS) = Thematic Realtime Environmental Distributed Data Services

Challenges of Integration

- Challenges of supporting and integrating many different data sources:
 - Different data formats
 - Different time frequencies
 - Different spatial projections and coverage
- Solutions provided by the IDV:
 - Data model (CDM and ADDE)
 - Auto projection converting
 - Time matching
 - Adaptive Resolution (AR) and Match Display Region (MDR)

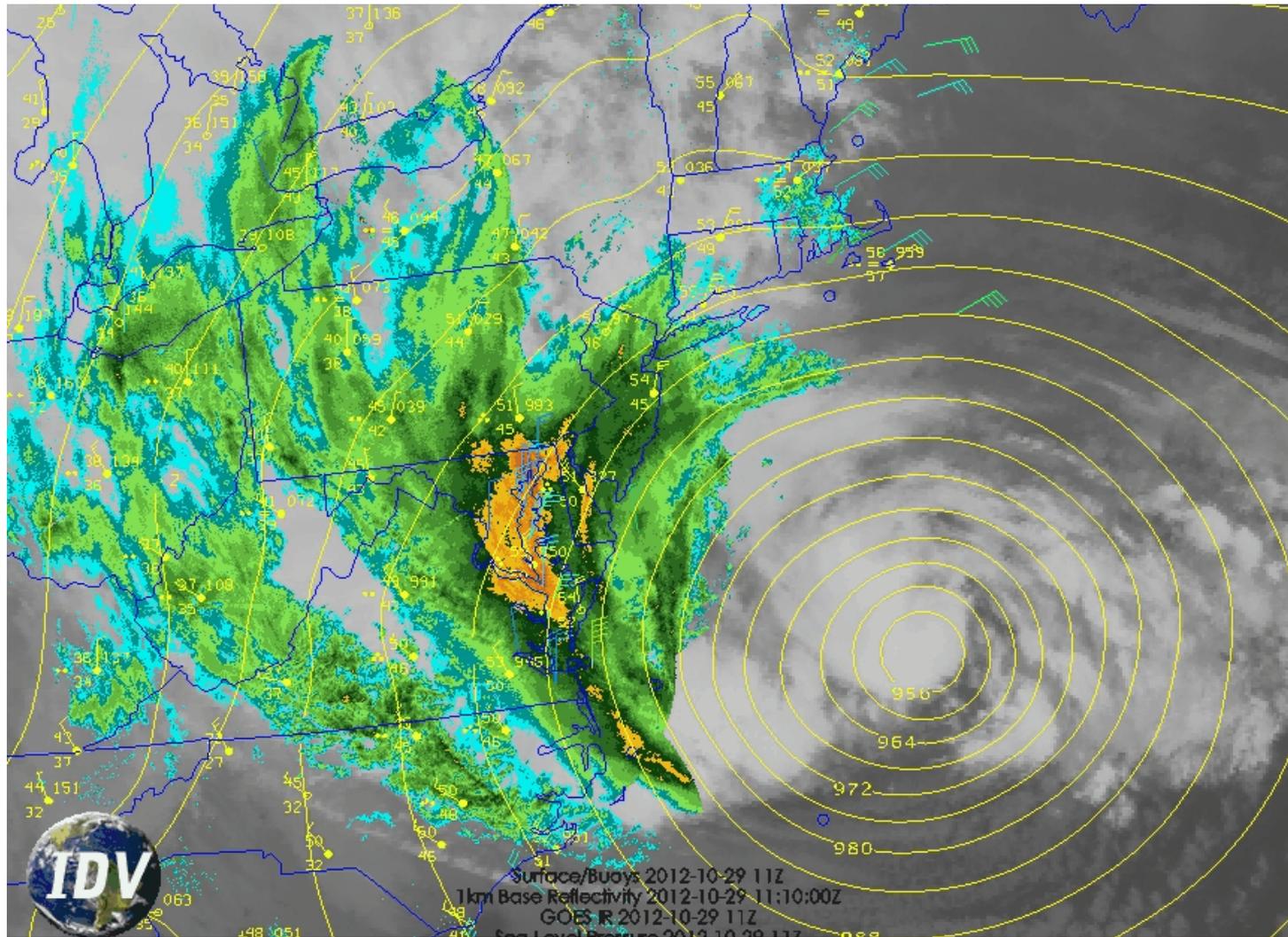
Time Matching

- The IDV can match display times. This is done by first setting a **time driver** based on a display or a predefined animation time set, and then setting a display to **Use Time Driver Times**. A display can be set as the time driver or to use time driver times.

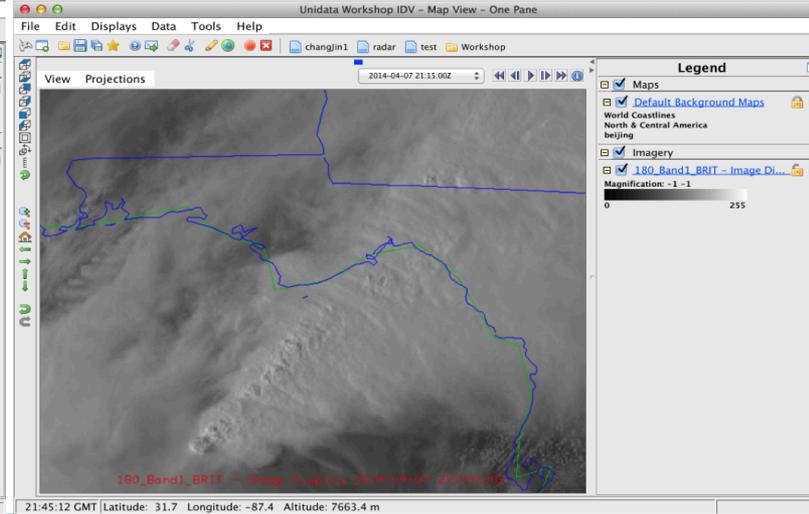
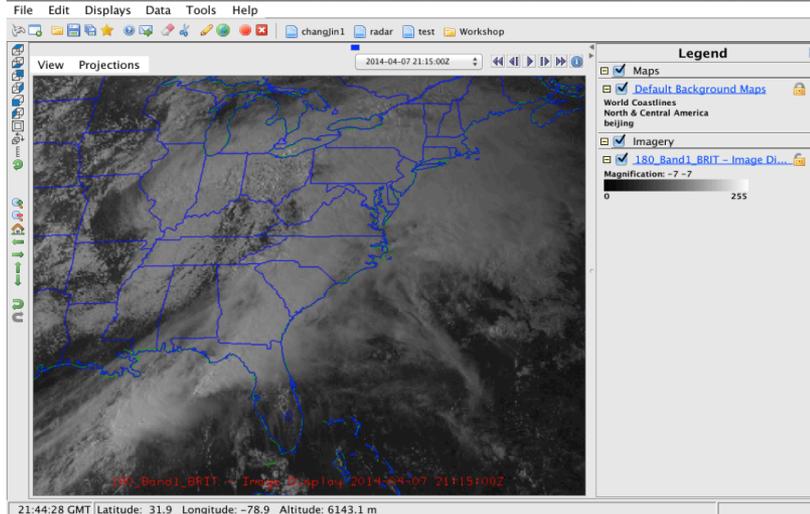
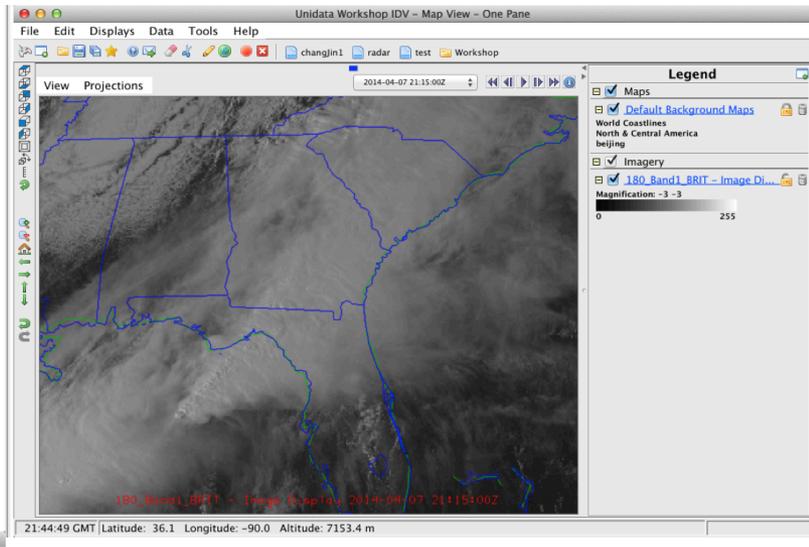
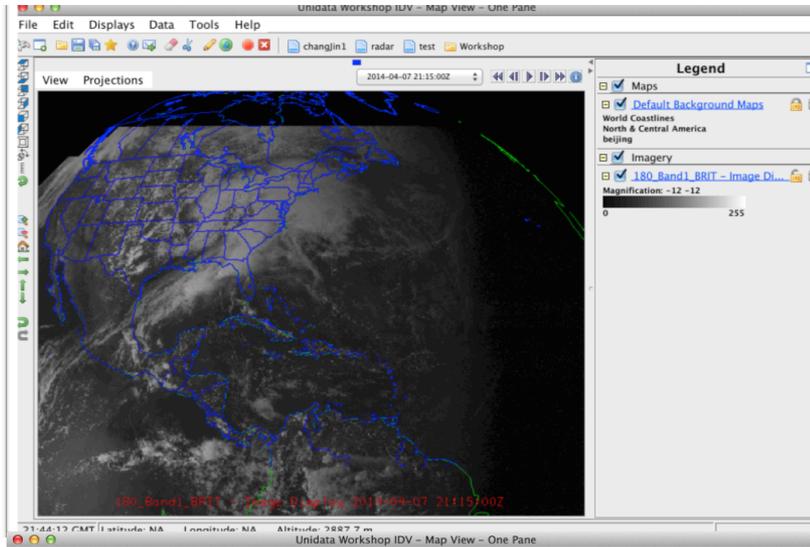
Adaptive Resolution and Match Display Region (AR/MDR)

- **Adaptive Resolution** (AR) dynamically adjusts the data sampling of the imagery dataset based on the resolution of the display view window.
- **Match Display Region** (MDR) automatically spatially subsets the display area in the map view window.
- Designing a **display region** on a view window, the IDV can use this design region to request the data from local files or remote data servers, or **existing bundles** and create display.

Time Matching



Adaptive Resolution and Match Display region



IDV - an interactive visualization and analysis tool

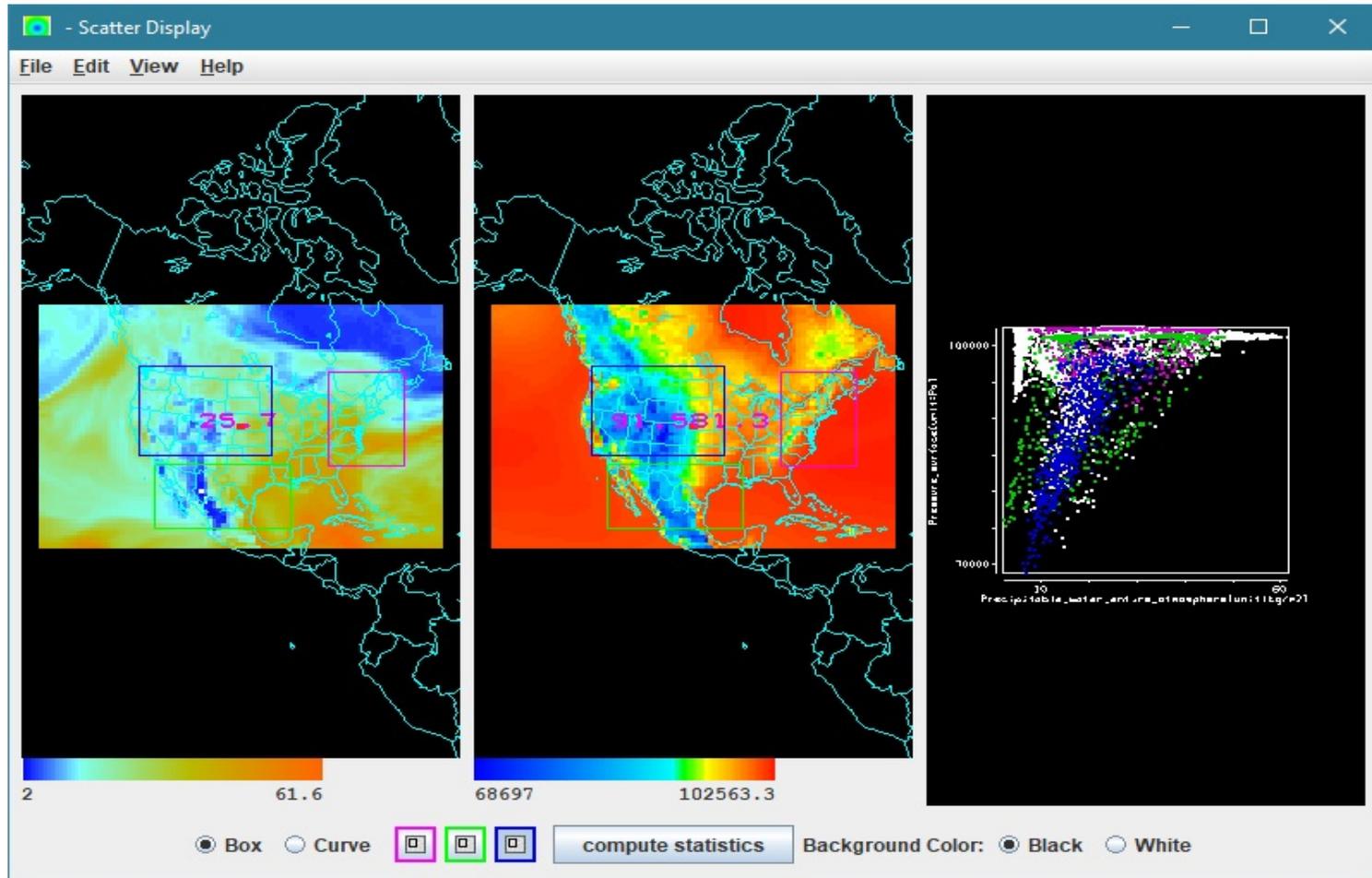
- General purpose 2D/3D displays
- Exploration of data details
- Quantitative analysis

Data Analysis

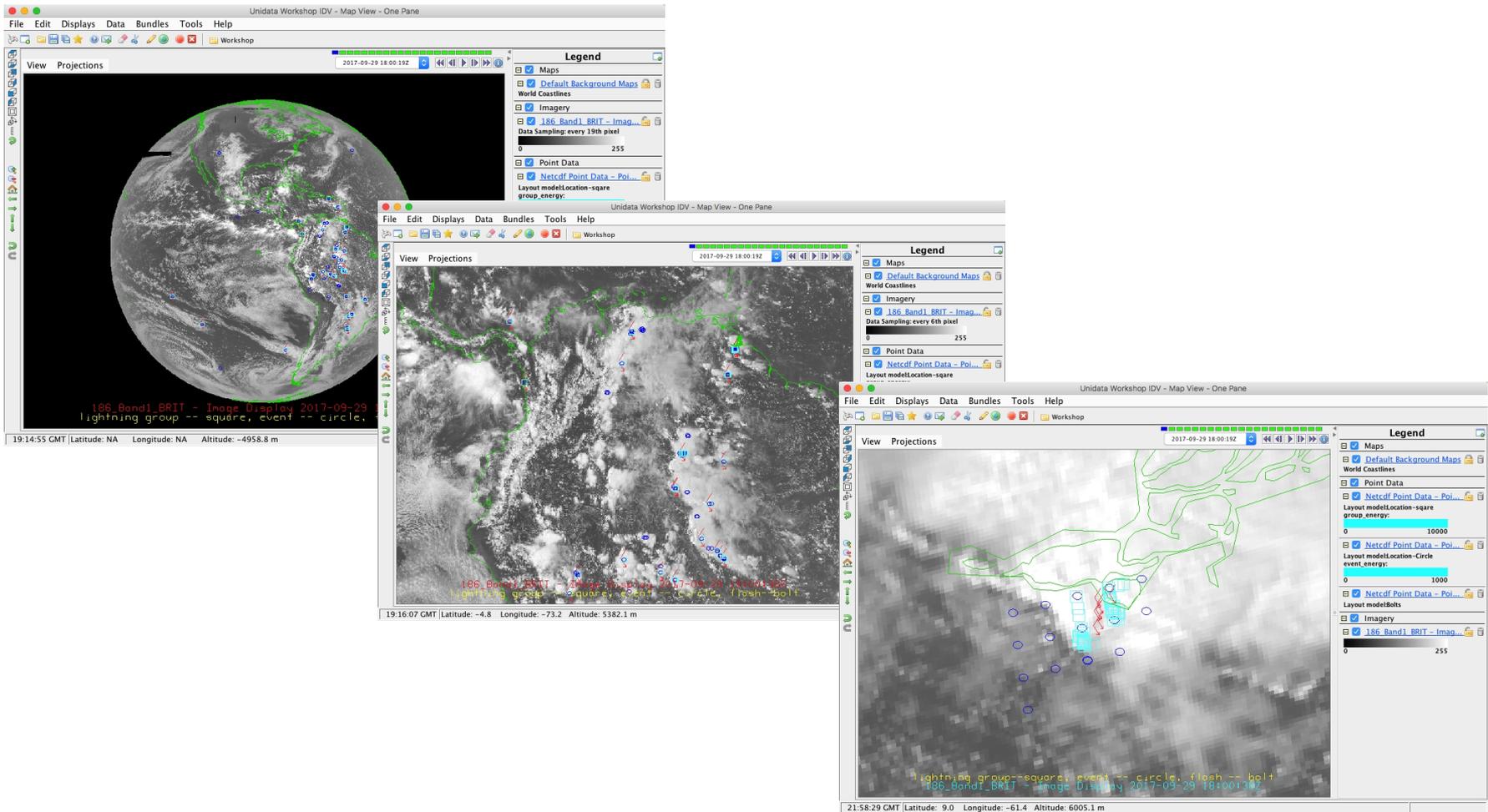
- Formulas and computation using Jython
- Interactive and script based generation of:
 - Images - JPEG, GIF, PNG, PDF, PS
 - Movies - Quick Time, animated GIF
 - Google Earth KML/KMZ

The image displays several software windows and a diagram. The 'Formula Editor' window shows the configuration for the NDVI formula. The 'Jython libraries' window shows a list of available libraries and a code editor with a function for converting dBZ to rainfall rate (R). The diagram at the bottom shows the Unidata IDV logo, which is used to generate 'IDV Scripting' and 'Images, Movies, KML/KMZ'.

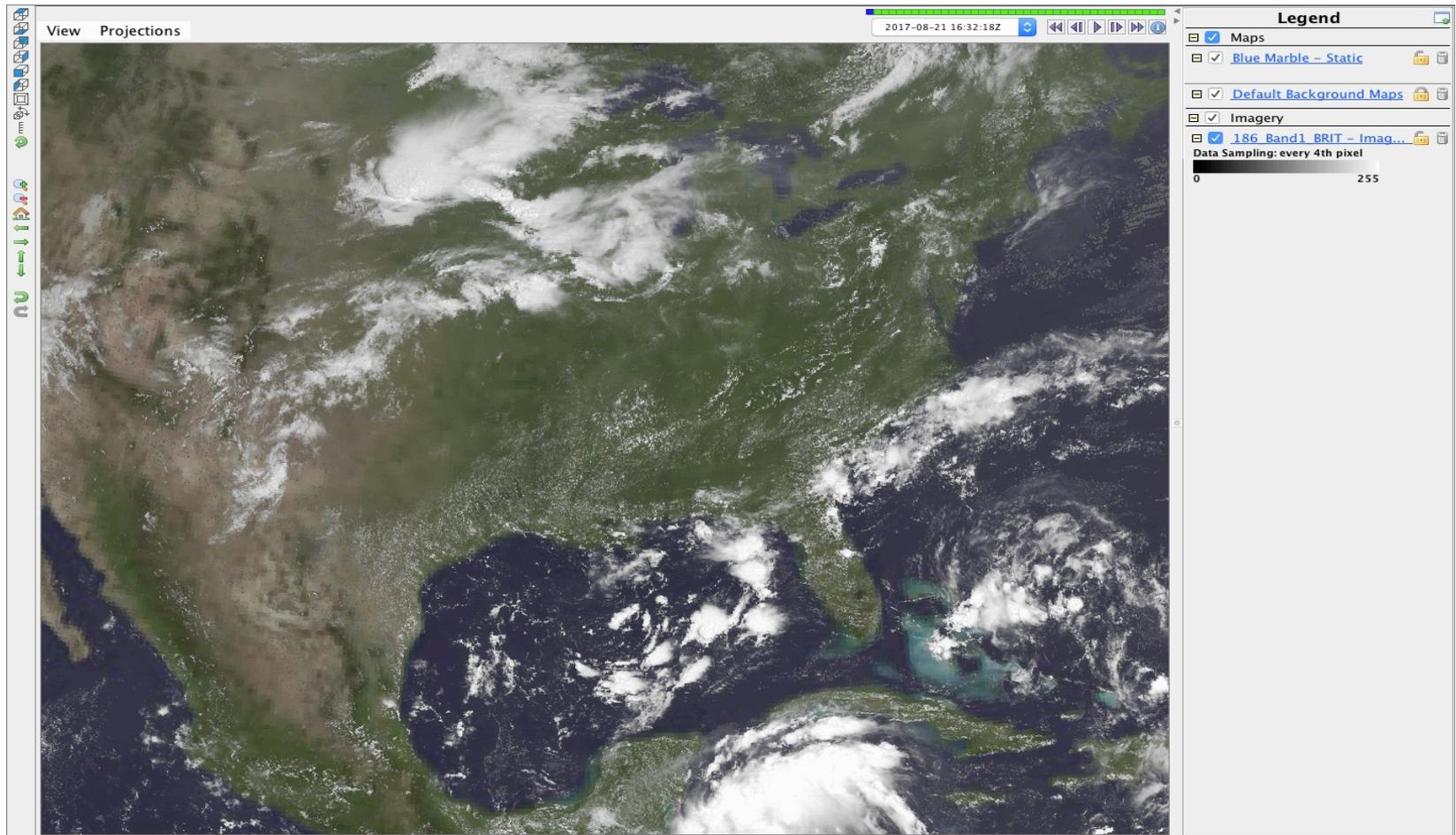
Scatter Analysis



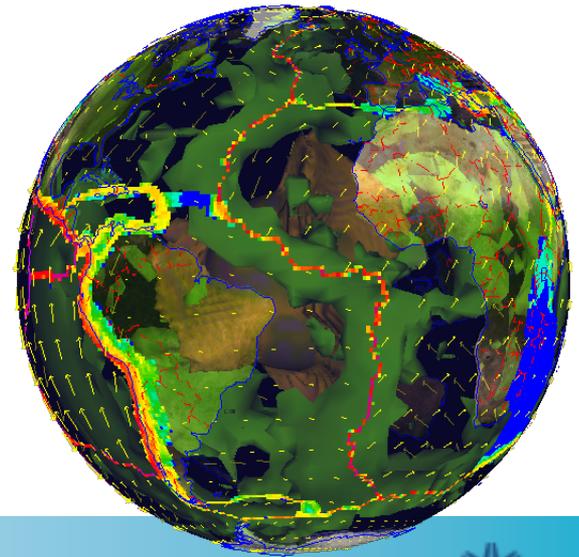
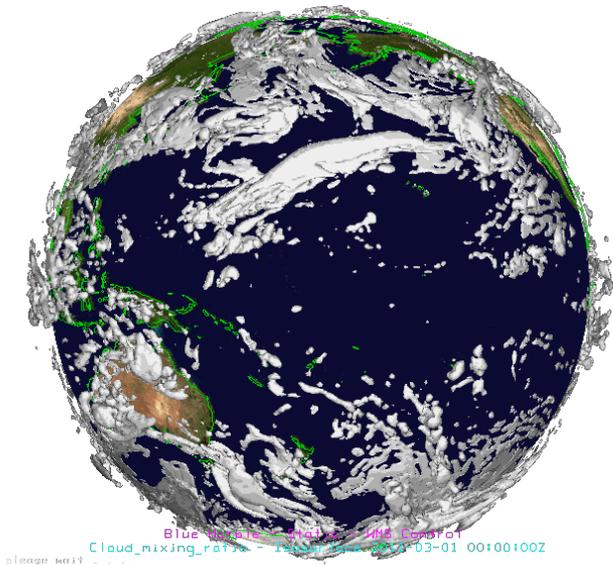
GLM Lightning Display



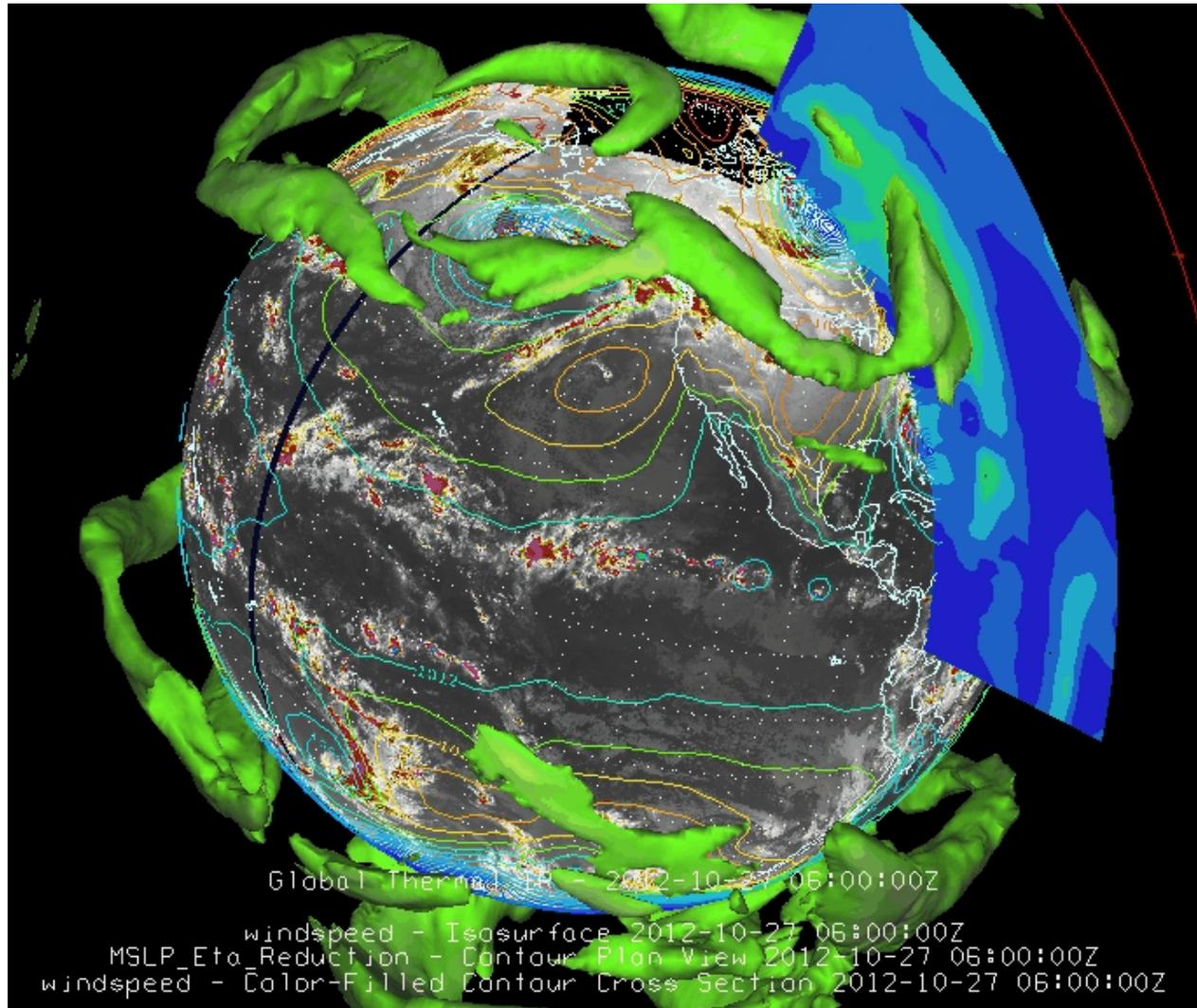
2017 Eclipse



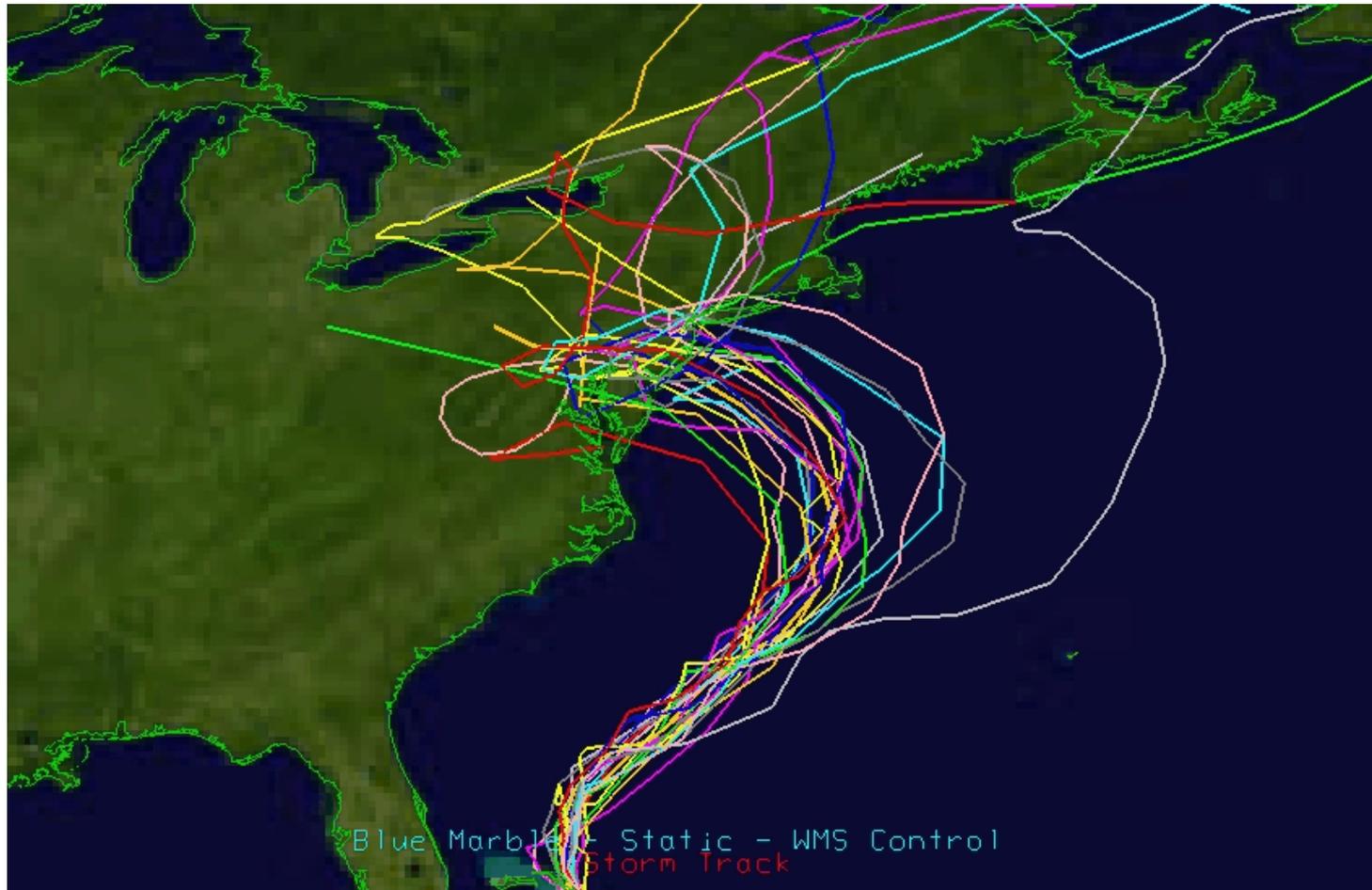
IDV Example: 3D Globe View



IDV Example: 3D Globe View of Sandy

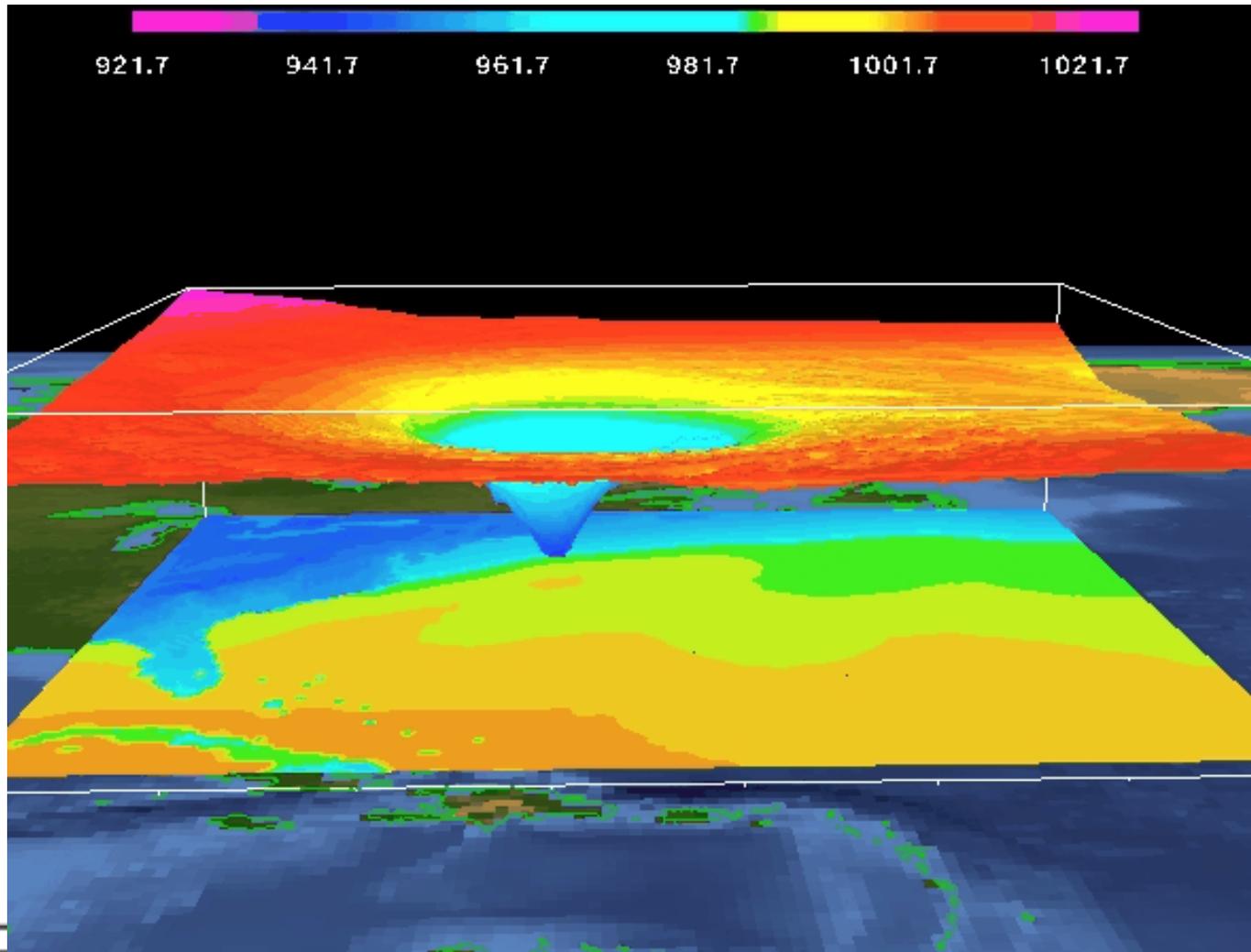


IDV Example: Sandy storm tracks

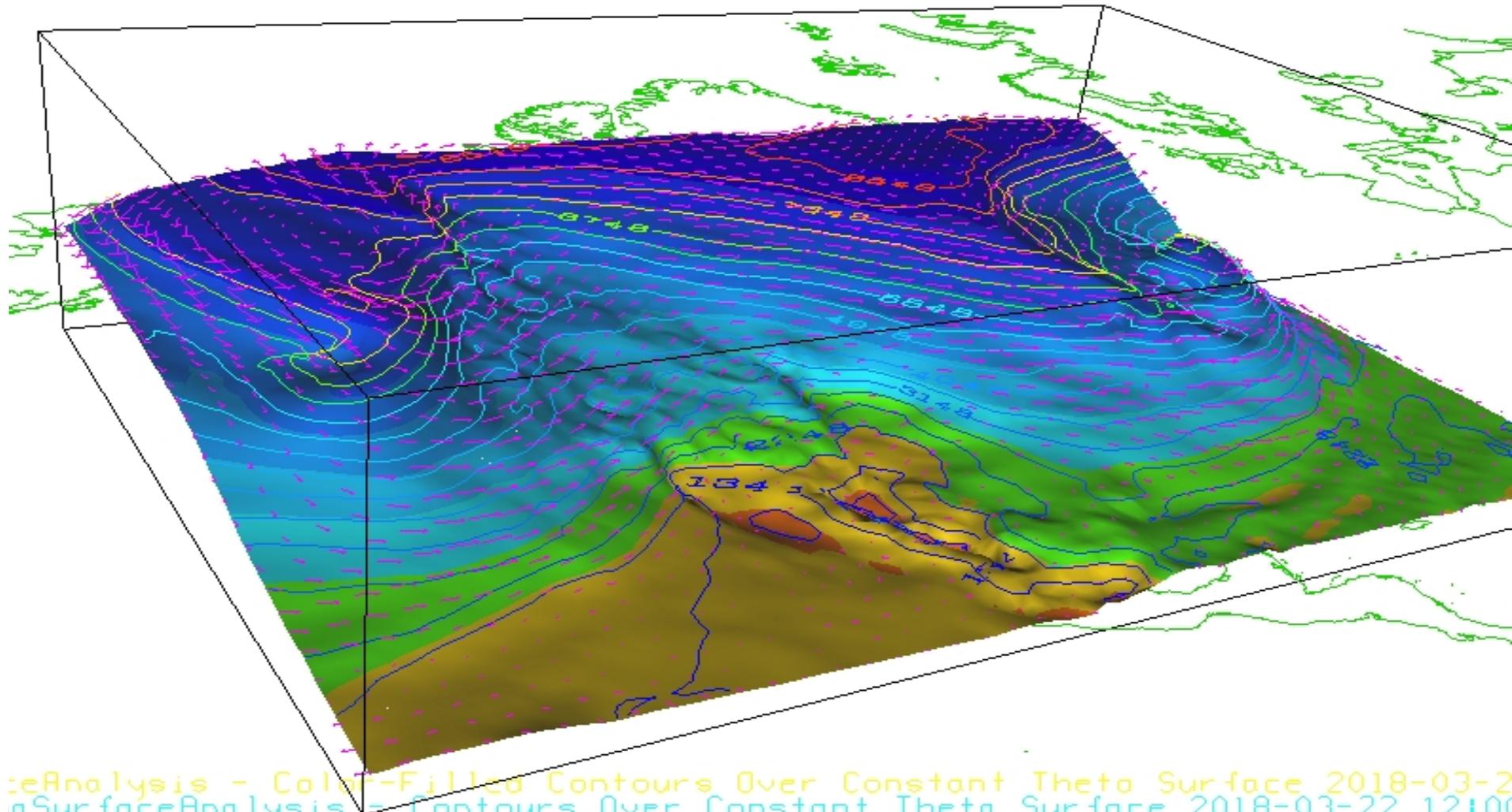


IDV Example: 3D Display

- 3D views of Sandy WRF output: PMSL and temperature

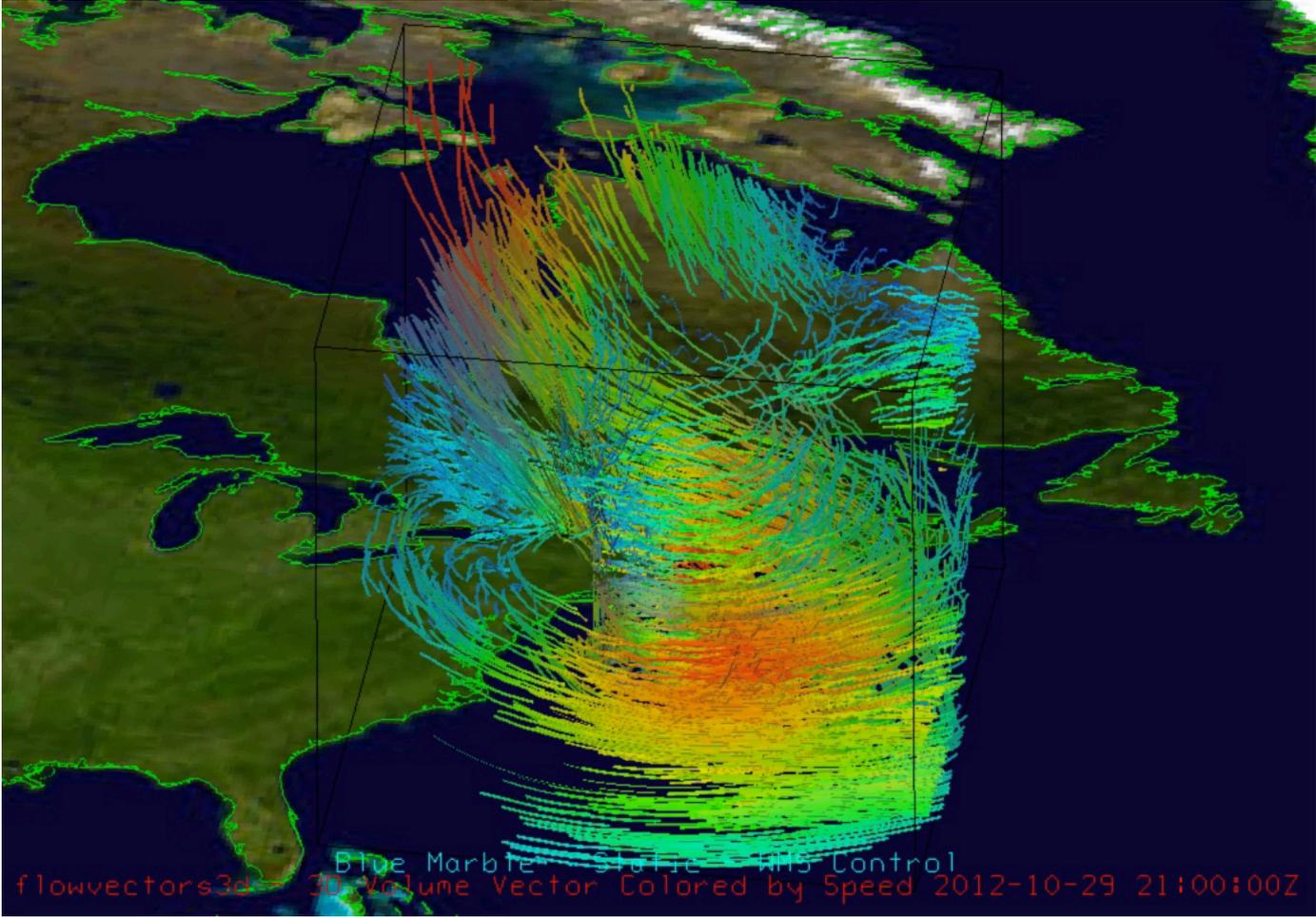


3D Isentropic Analysis

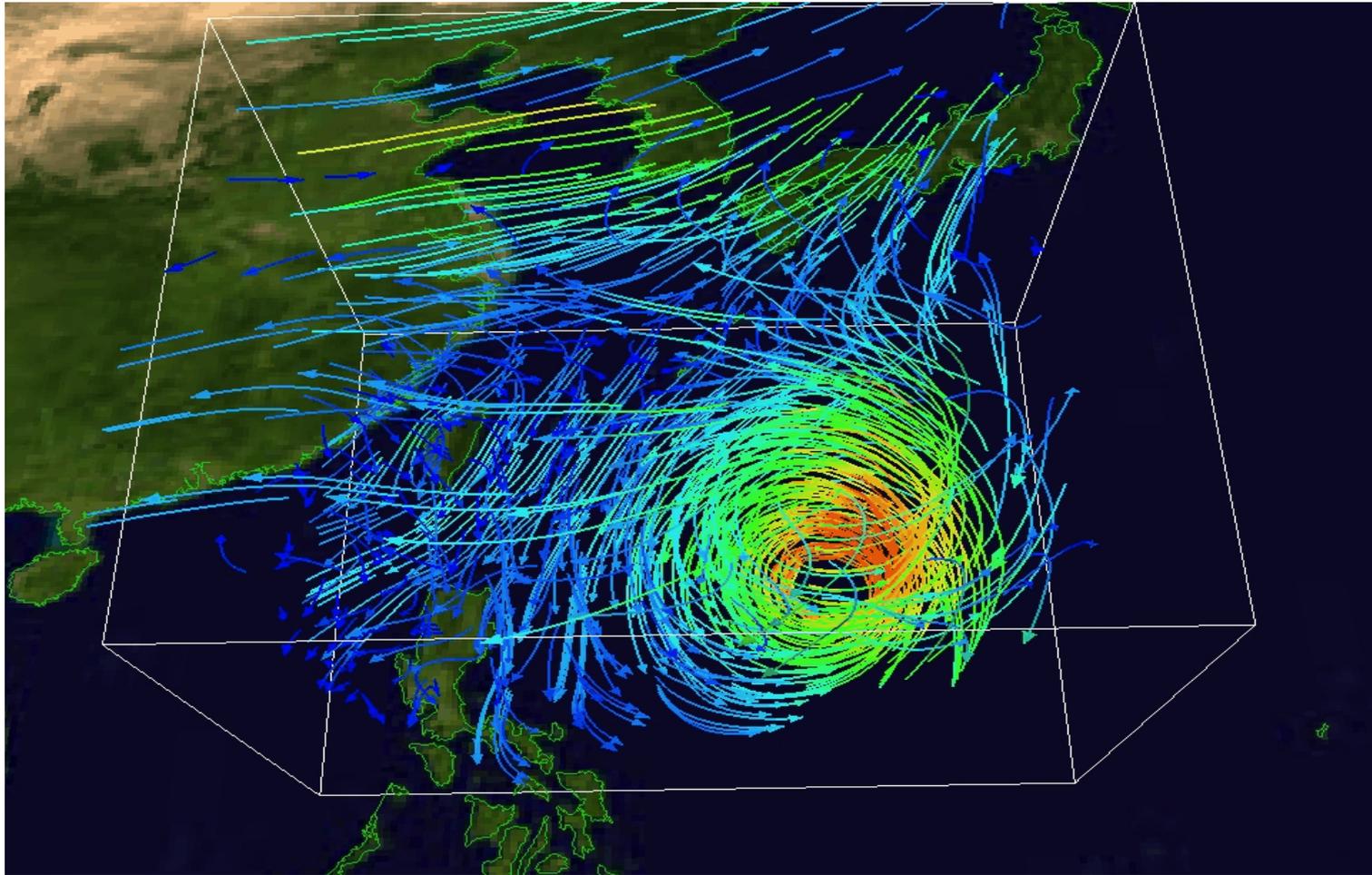


3D Isentropic Analysis - Color-Filled Contours Over Constant Theta Surface 2018-03-22 12:00:00
3D Isentropic Analysis - Contours Over Constant Theta Surface 2018-03-22 12:00:00
3D Isentropic Analysis - Vectors Over Theta Surface 2018-03-22 12:00:00

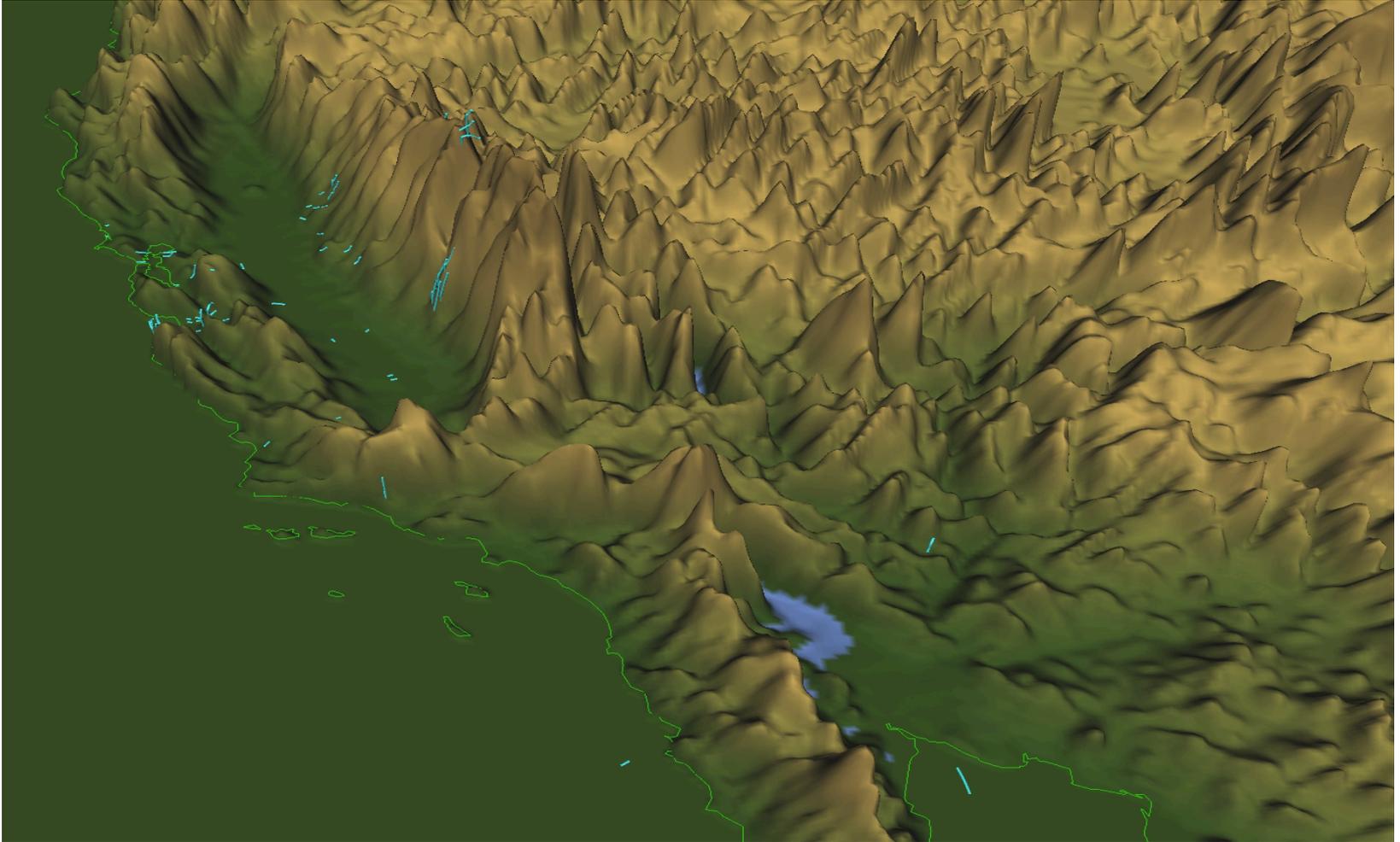
IDV Example: 3D Volume Trajectory of Hurricane Sandy



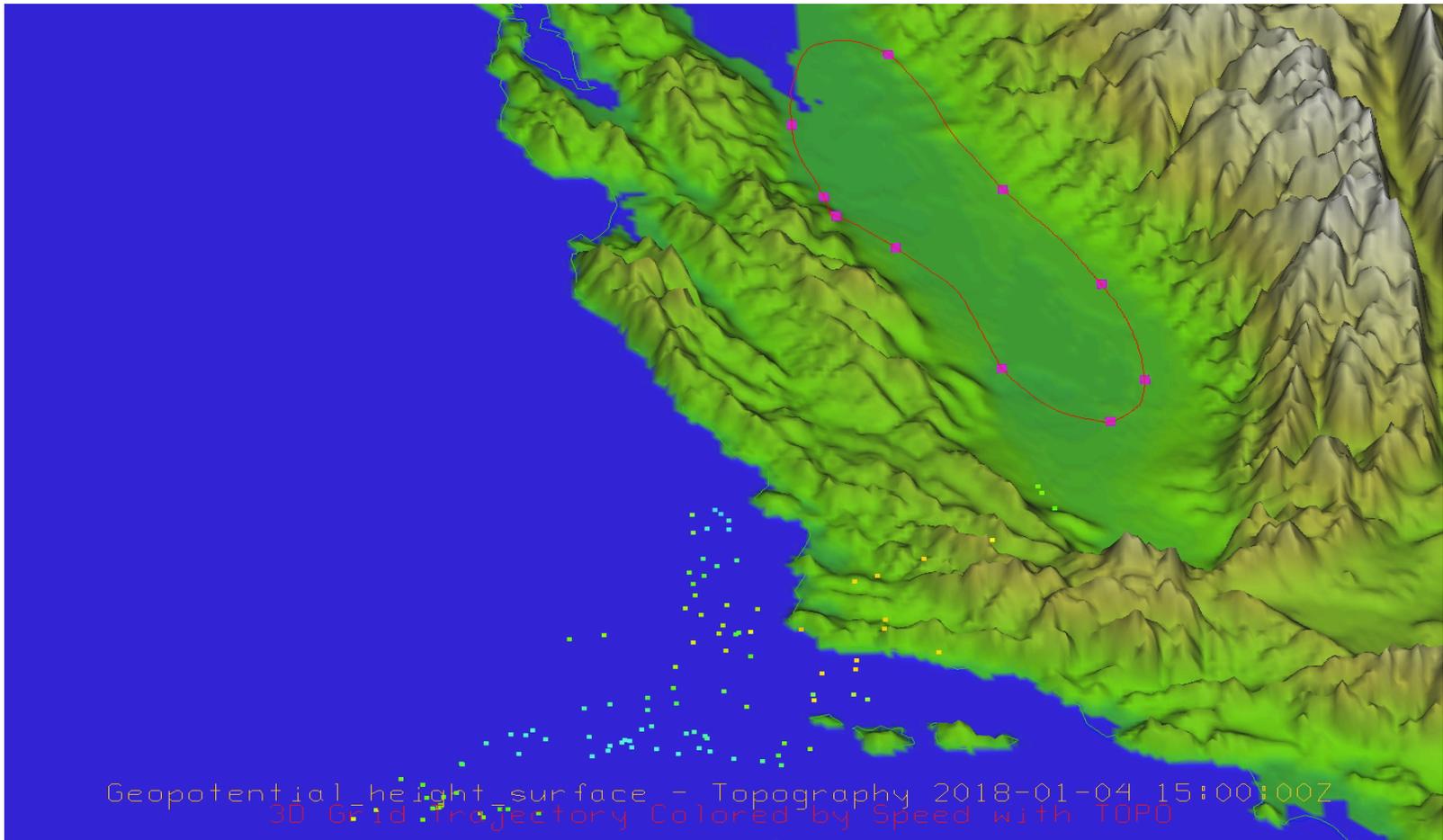
3D Streamline of Hurricane Florence



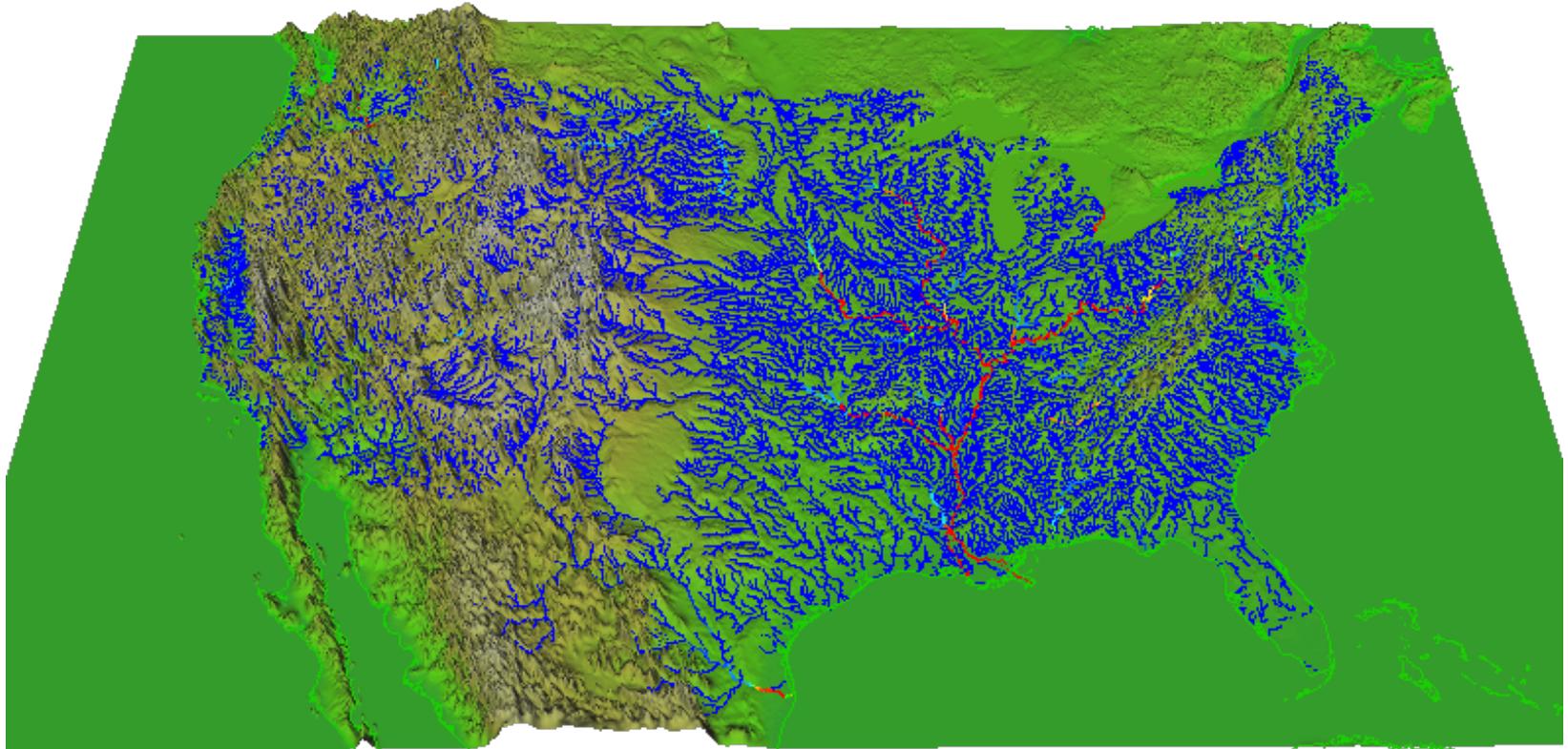
Trajectory with Topography



Backward Trajectory Display

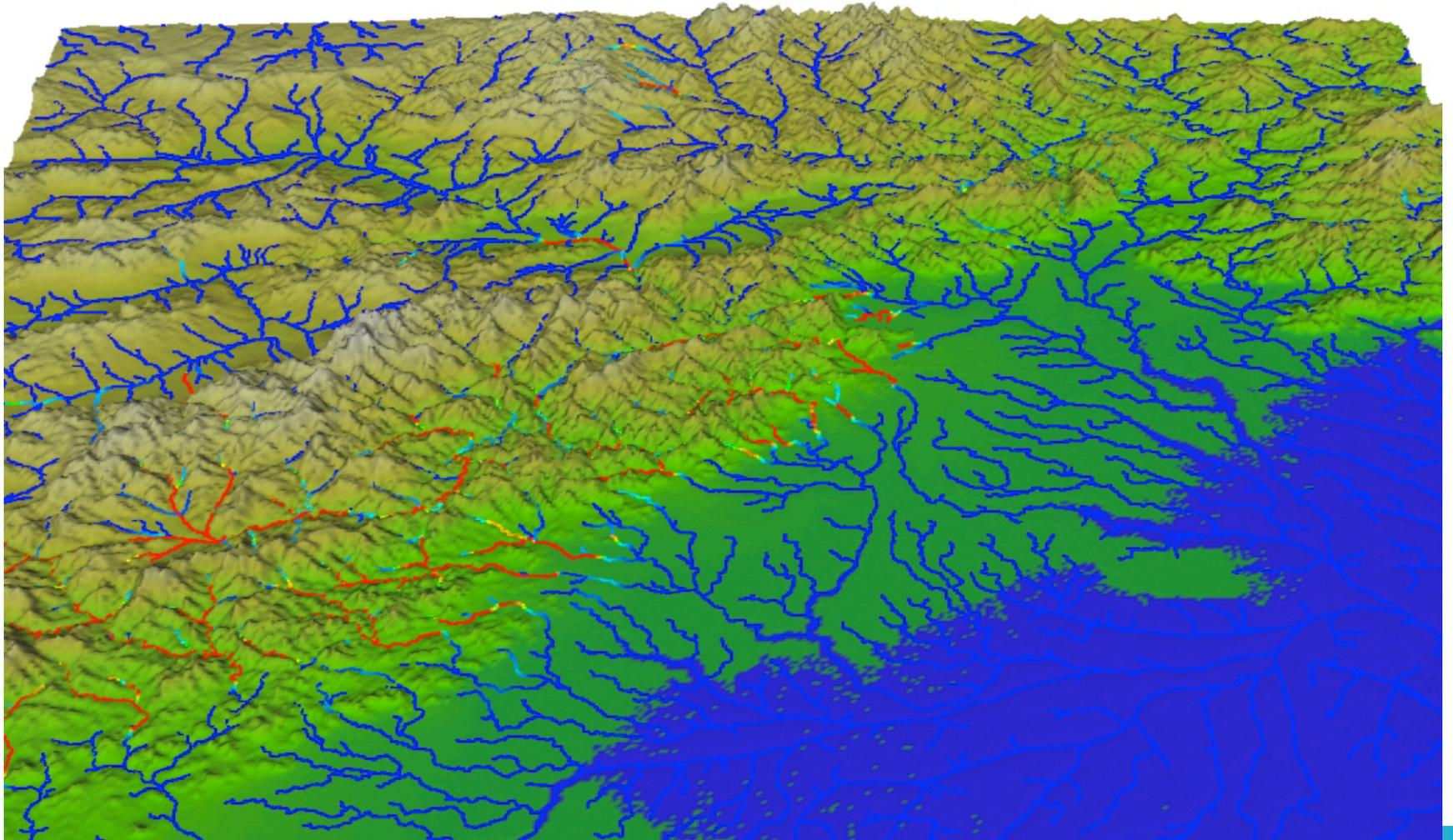


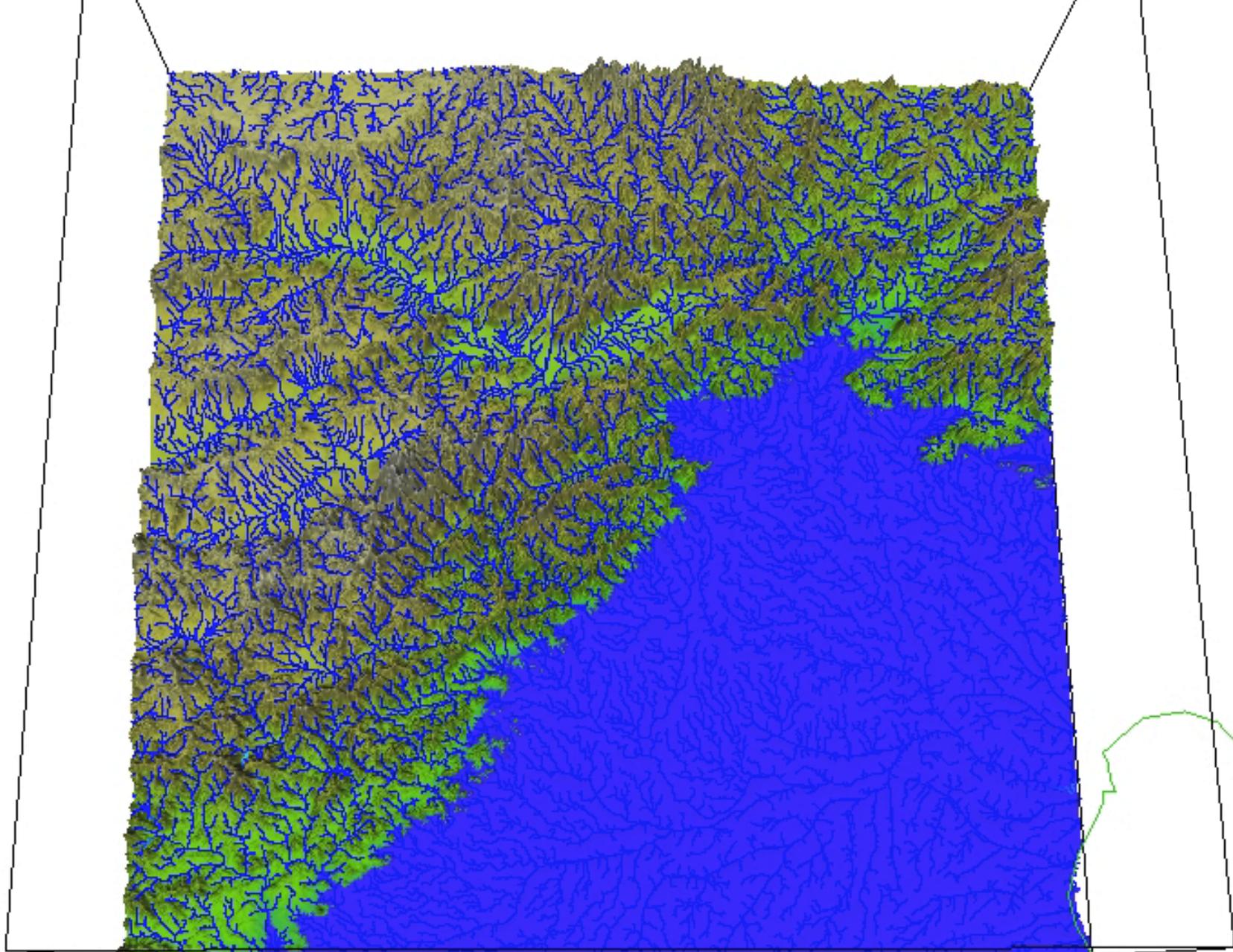
Stream Flow over Topography



streamflow - Point Cloud 2017-06-02 01:00:00Z

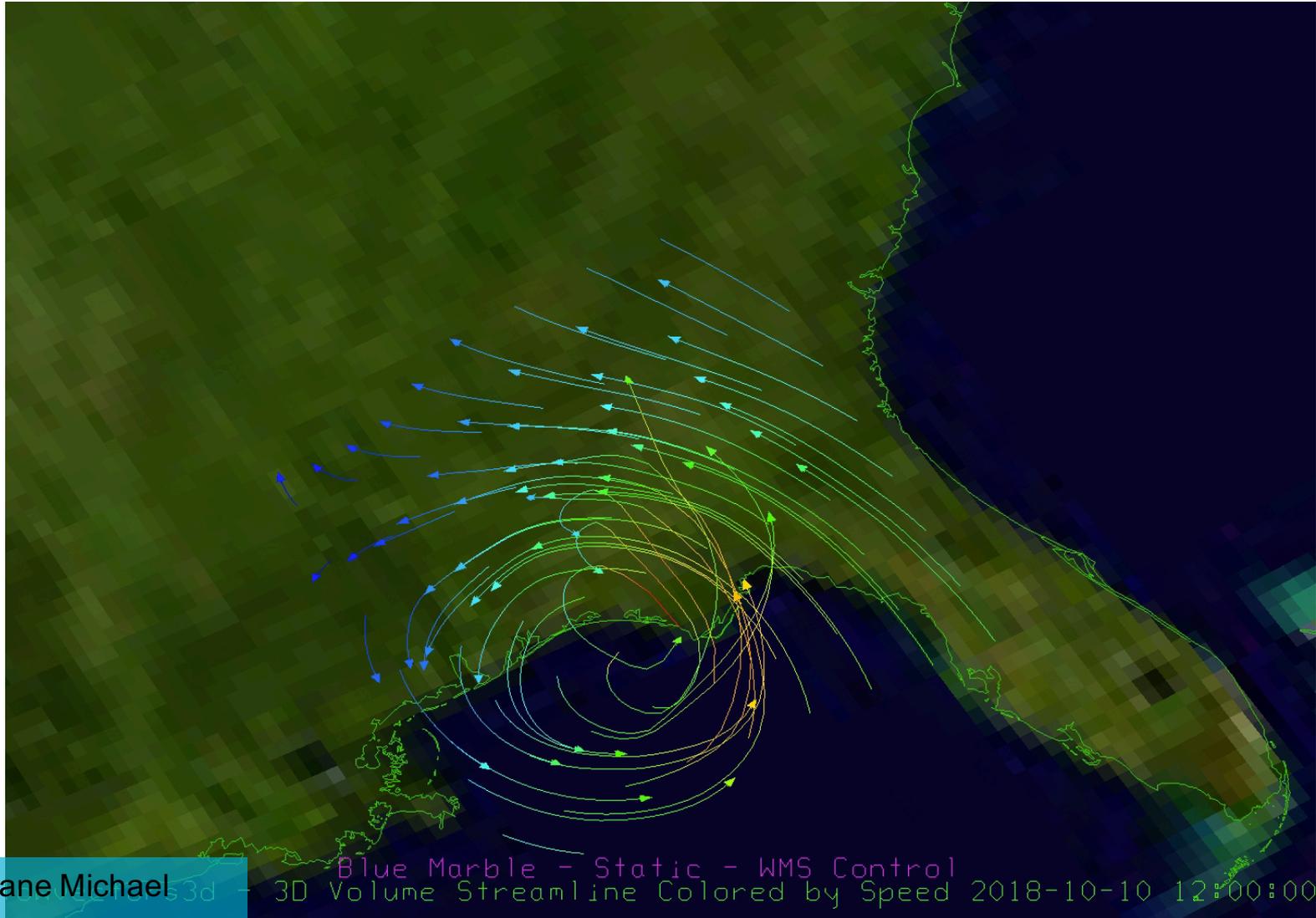
WRF Hydro Stream flow with TOPO

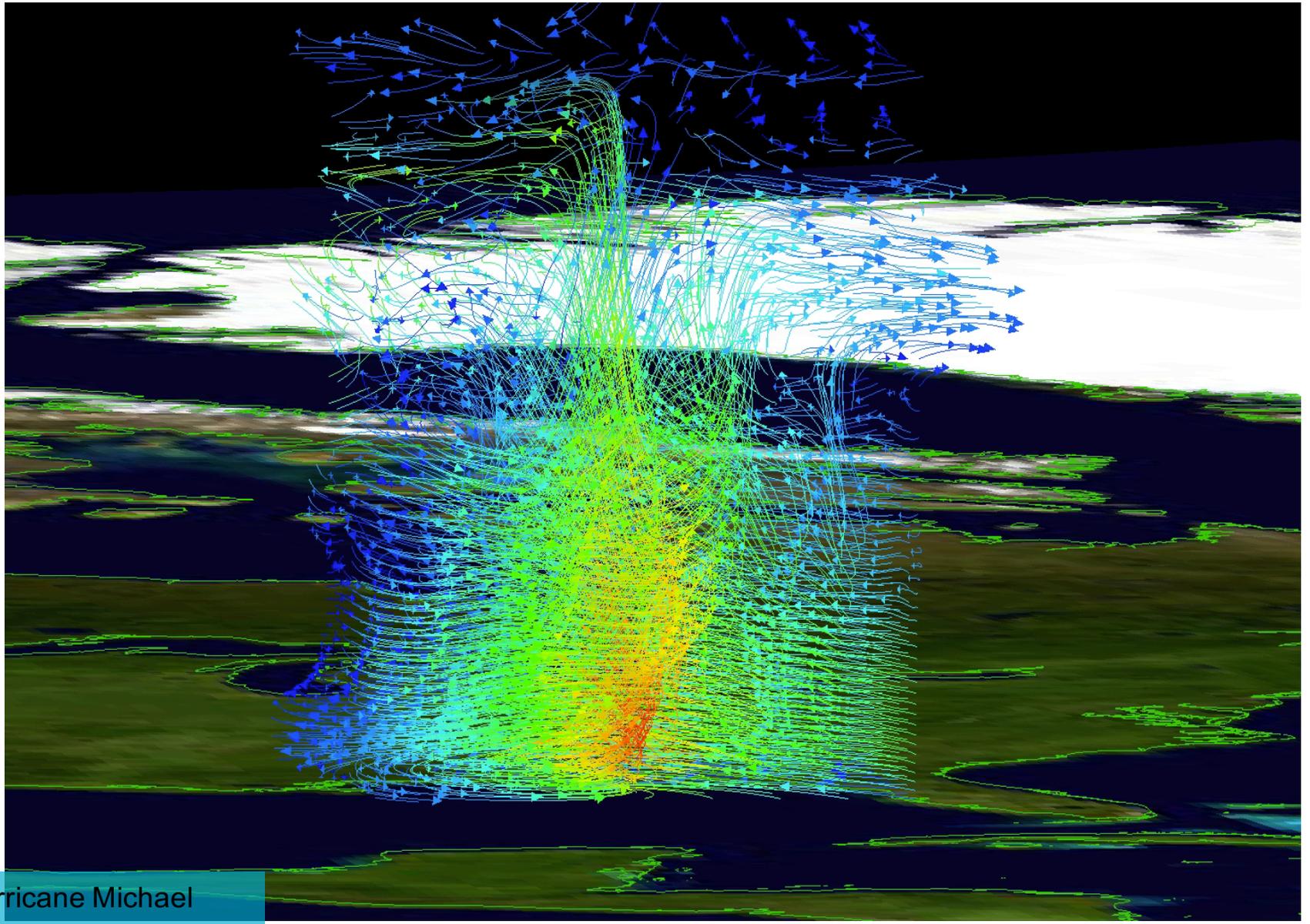




streamflow - Point Cloud 2012-07-21 12:00:00Z
TOPOGRAPHY - Topography

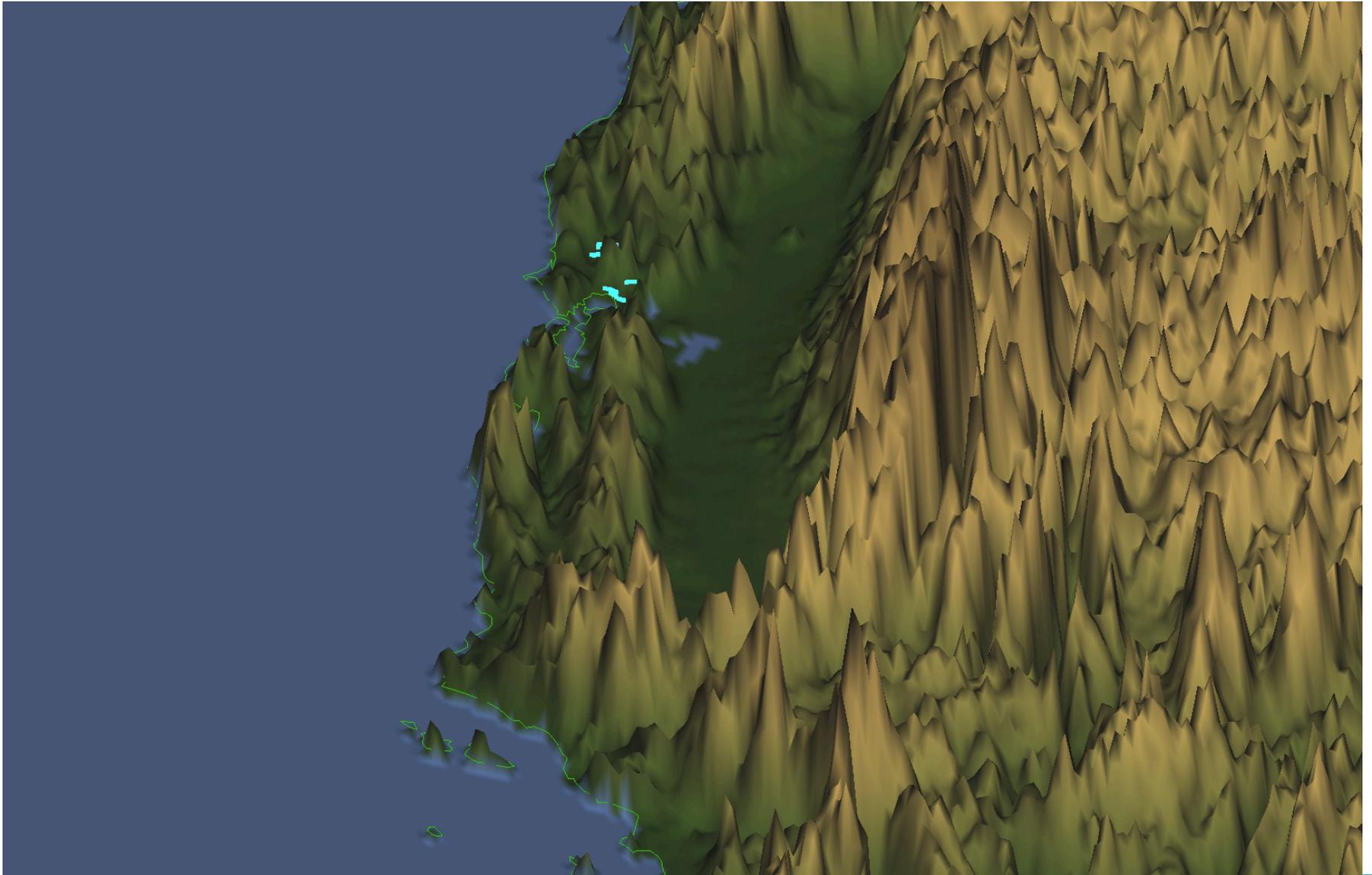
3D streamline initiated from XY plane



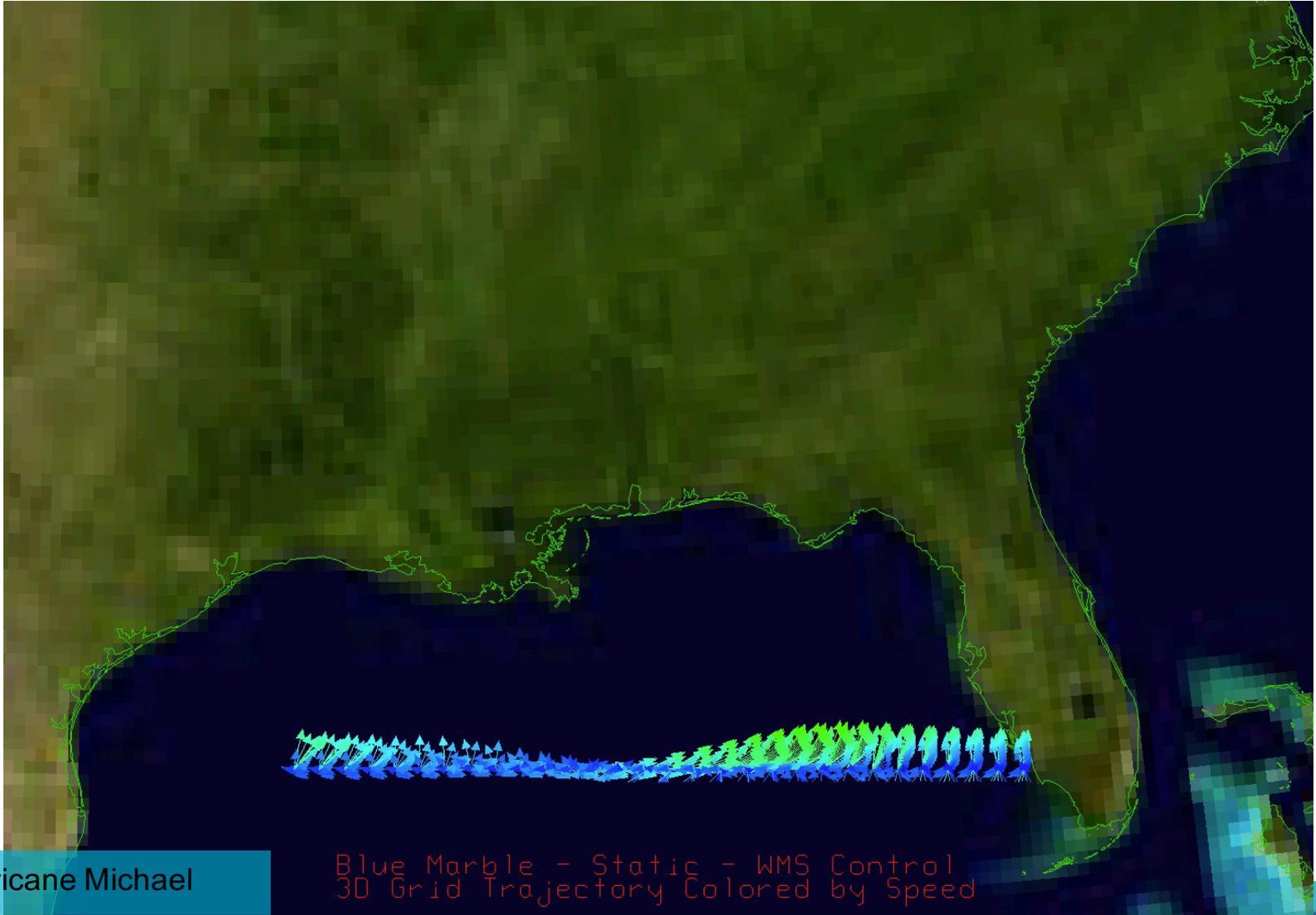


Hurricane Michael

a new parcel is initialized at each time step.



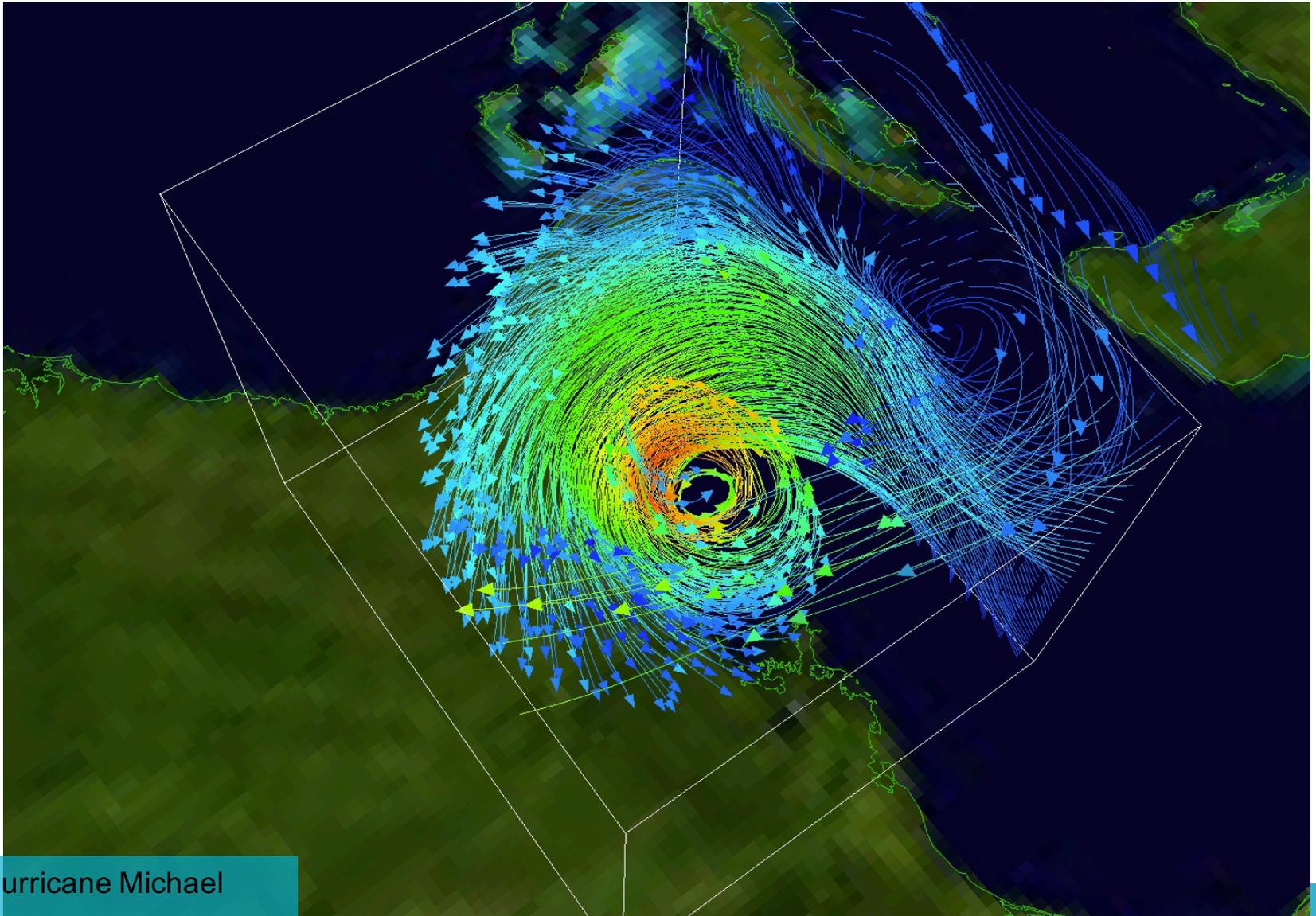
3D trajectory initiated from XZ or YZ plane



Hurricane Michael

Blue Marble - Static - WMS Control
3D Grid Trajectory Colored by Speed

3D Streamline initiated from XZ or YZ plane



Hurricane Michael

Classroom machine

- module load idv

- runIDV

DRILSDOWN: IDV in Jupyter

localhost:8888/notebooks/Jupyter/Untitled.ipynb?kernel_name=python3

File Edit View Insert Cell Kernel Widgets Help Trusted Python 3

```
In [2]: %reload_ext drilsdown
```

iPython-IDV Control Panel

Resources: The Mapes IDV Collection List

Search for: SKEdot Case Study or folder Gridded data files All

Run IDV Make Image Make Movie Save Bundle Publish

Clear Outputs Commands Help

Search Results: SKEdot

Precip_ZSKEDot_99999_0032	Load bundle	Set URL	Subset Bundle
Skedot Simple for a month	Load bundle	Set URL	Subset Bundle
ZSKEDot_99999_00326_200_1	Load bundle	Set URL	Subset Bundle

```
In [3]: %make_image -capture legend
```

World Loastines

- MERRA-2 Reanalysis
- MERRA-2 tavg_wind_stream...
- MERRA-2 wind_streamlines...
- MERRA-2 tavg_rainrate - C...
- MERRA-2 rainrate - Color-S...
- MERRA-2 tavg pw contours...
- MERRA-2 tavg pw - Color...
- MERRA-2 pblh - Color-Sha...
- MERRA2 column vapor tqv...
- MERRA2 T2m - Color-Fille...
- MERRA2 SLP - Contour Plan...
- MERRA2 10m winds truew...
- 3D Topography
- topo - Topography
- MERRA-2 Cross-Sections
- Instantaneous dTdt - Cont...
- Instantaneous theta - Cont...
- tavg_omega - Contour Cros...
- Instantaneous epv - Color...
- MERRA-2 tavg RelVort - Co...
- MERRA-2 2D truewindvect...
- Satellite datasets
- acsum_TRMM_3B42_rain - ...
- GridSat_IR - Color-Shaded P...
- TRMM 3B42 rain - Color-S...

DRILSDOWN: extending & linking these already powerful systems

- Jupyter \leftrightarrow IDV comms (from Python shell):
 - Control Panel
 - `.from_zidv()` method for *xarray* package
 - get zipped-up IDV-fetched data hyperslabs into Python
 - `.to_idv()` method “ “ “
 - send *xarray* dataset into IDV for co-visualization w/ others
- Add functionality within the IDV
 - Mapes IDV collection plugin (functions, datasources, ...)
- Add functionality within RAMADDA (and its server)
 - nbviewer, Case Study digital object, more services....
 - easier code-driven automatic publish
 - (trying to) make notebooks *active on server* (JupyterHub)

IDV: a collaborative visualization and analysis tool

- XML configuration and bundling allows collaboration with others
- Direct access to RAMADDA server, allows both downloading and publishing
- Use THREDDS catalogs of data holdings for discovery and usage metadata
- Client-server data access from remote systems

IDV and RAMADDA

- The IDV can generate images and bundles that can be published to RAMADDA, and RAMADDA can also run the IDV to post images on the web
- The IDV and RAMADDA enable users at partnering institutions to contribute and easily share data holdings and products
- The IDV and RAMADDA empower the community with the ability to create and deploy innovative data services in a collaborative, social network style

IDV Benefits

- In Classroom/Research:
 - More sophisticated presentation of concepts with real data
 - Better prepares students entering the geoscience career field
- In Operation:
 - Easy data accessibility
 - High level of interaction with data
 - High efficient image rendering
 - Platform independence allows for real-time collaboration

Summary

- IDV, when combined with other Unidata technologies, provides efficient data access, effective data usage, and reduces data friction
- IDV enables analysis, integration, and visualization of heterogeneous geoscience data
- IDV enables real-time collaboration

For more information

- IDV Homepage:
 - <http://www.unidata.ucar.edu/software/idv>
- Download IDV package:
 - <http://www.unidata.ucar.edu/downloads/idv/index.jsp>
- IDV Support
 - Support-idv@unidata.ucar.edu

Unidata is one of the University Corporation for Atmospheric Research (UCAR)'s Community Programs (UCP), and is funded primarily by the National Science Foundation (Grant NSF-1344155).

