Visualize the high resolution model output with 3-D Adaptive Resolution in the IDV

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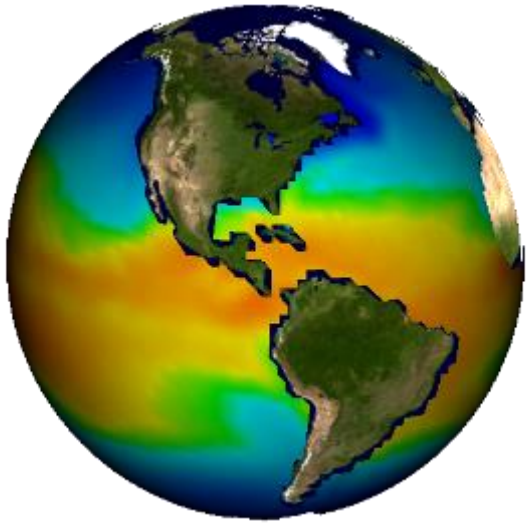
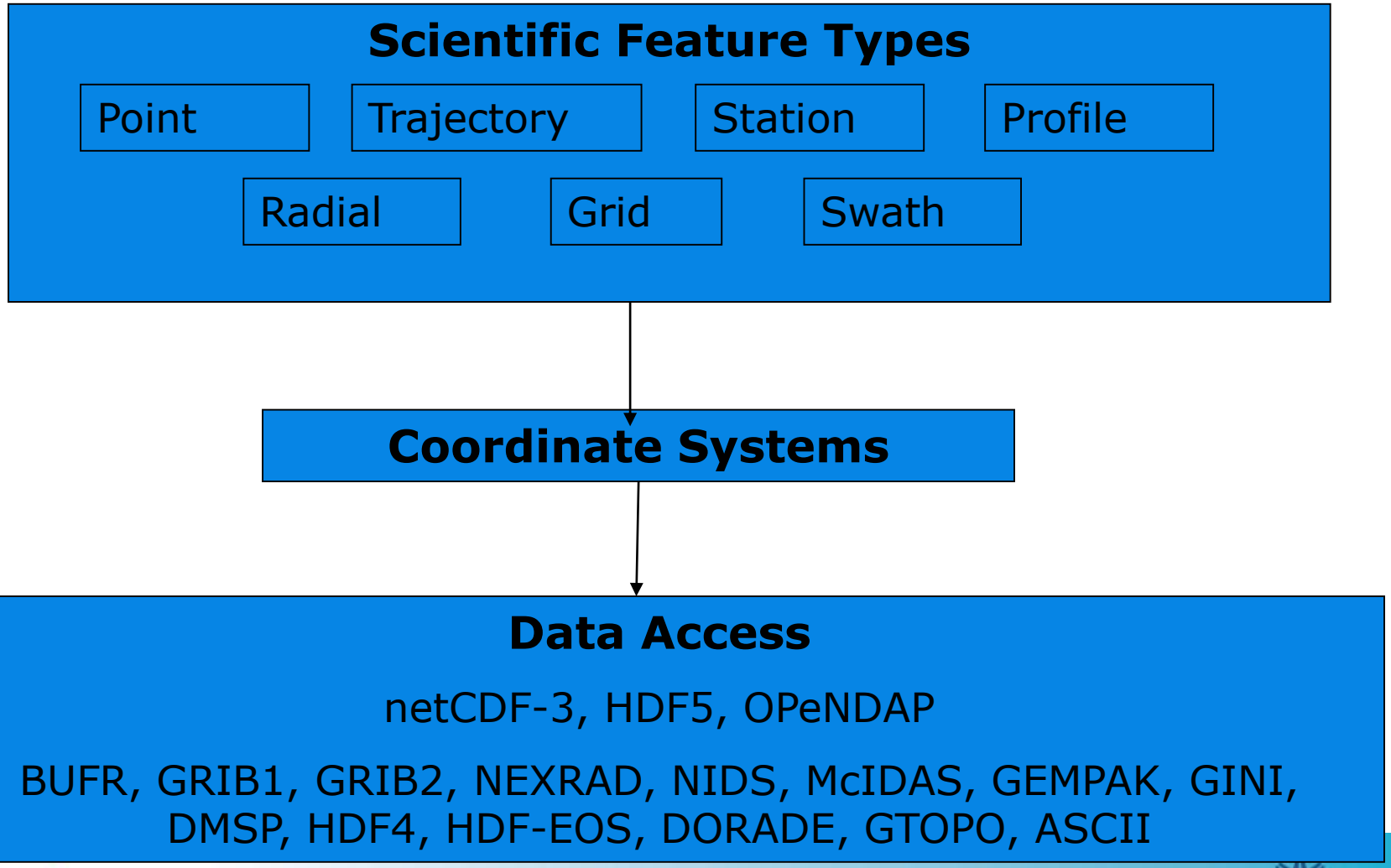
Integrated Data Viewer (IDV)

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



Common Data Model



VisAD Data Model

- A Java Component for interactive analysis and visualization of numerical data.
- VisAD objects: data object, display object, cell object, user interface object, and data reference object.
- All data objects have a MathType, which indicates the type of mathematical object that it approximates.
  - The output of a weather model may be described using the MathType:

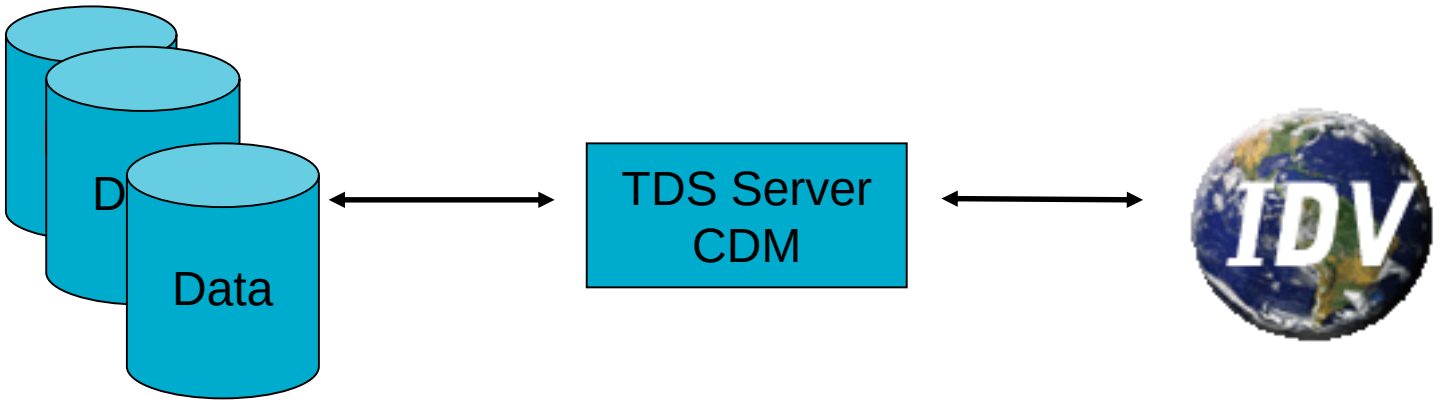
    (time -> ((lat, lon, alt) ->(temperature, pressure, u, v, w)))
- Designing a Typical VisAD Application
  - Creation of the data object
  - Creation of the display object
  - Adding interaction and functionality

CDM and VisAD

Client-Server architecture

- ADDE: satellite, station observation, and radar level3 product
- THREDDS Data Server (TDS): gridded model output and radar level2 & level3
- RAMADDA: geoscience content management system.

Workflow of high resolution model output



Challenges of Integration

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

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.

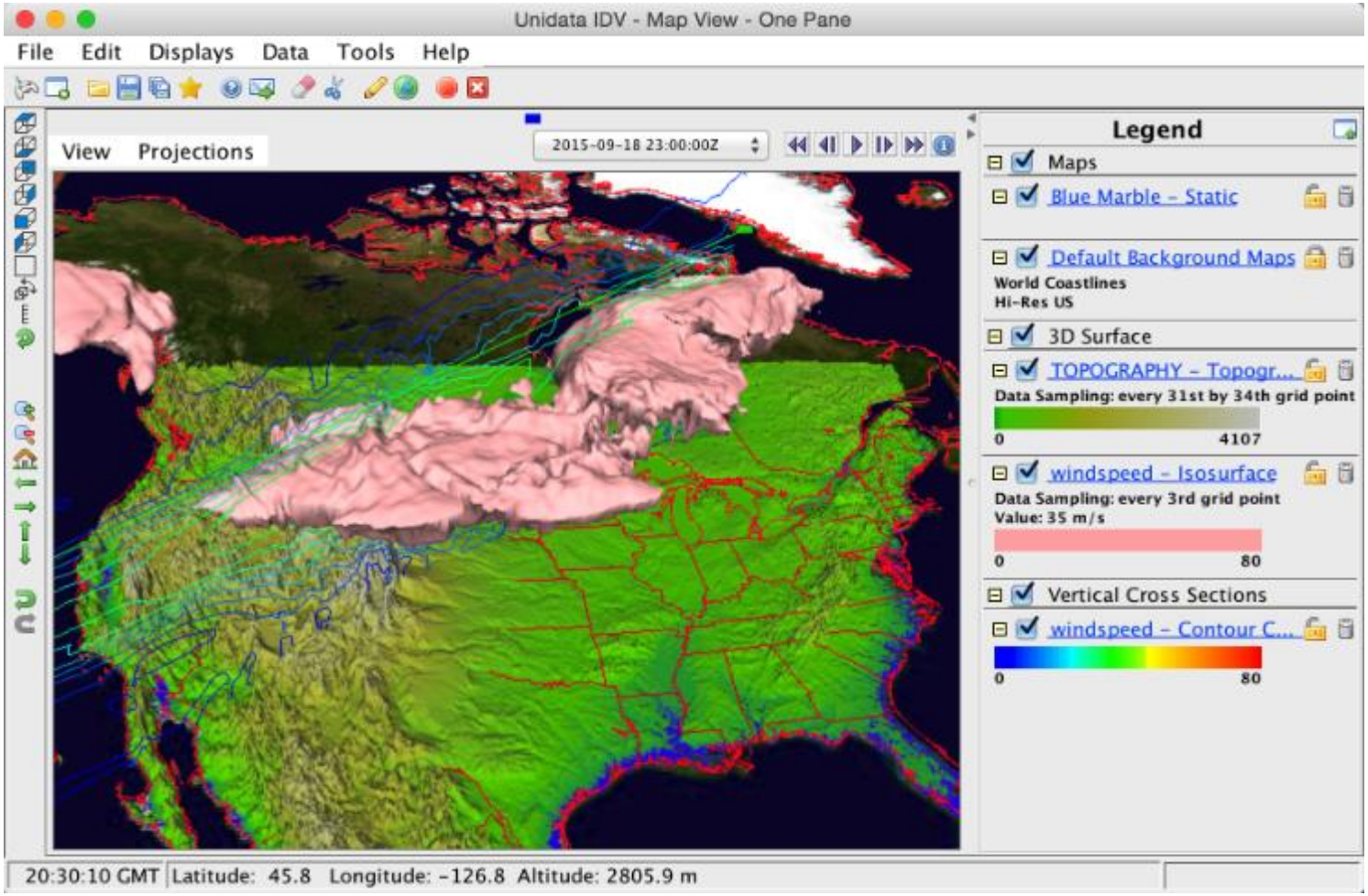
Advantages of AR/MDR

- Progressive access of data.
- Highly interactive and greater performance.
- More efficient use of client and server system resources.
- Easily open a bundle to new area of interest.

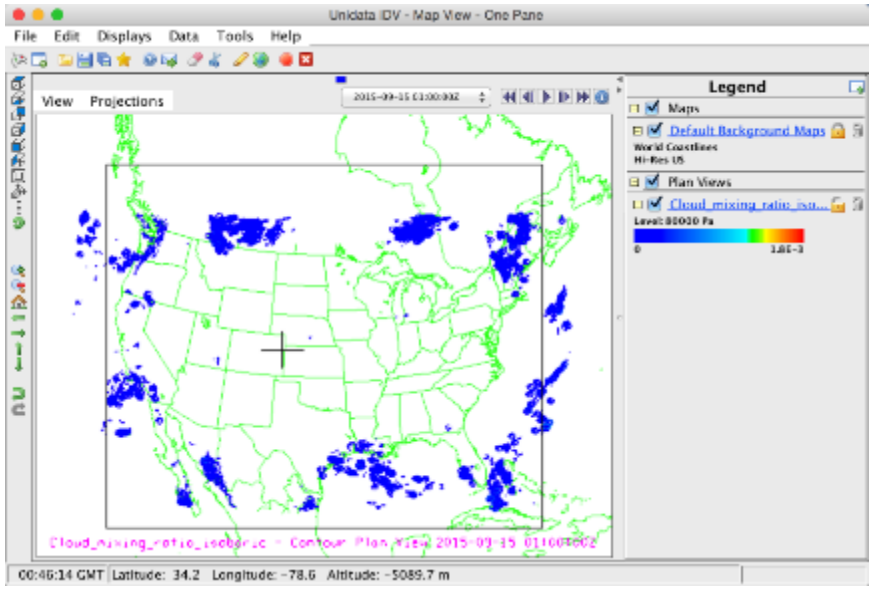
High Resolution Model

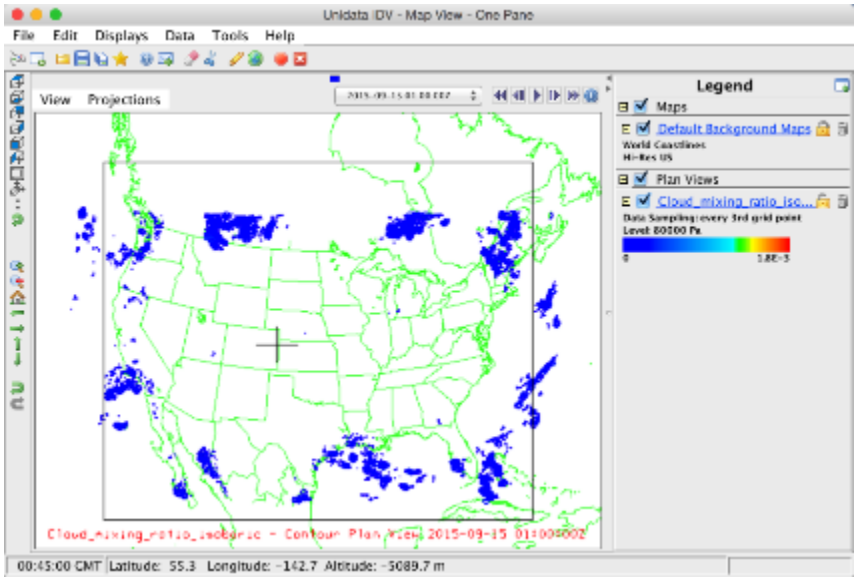
- HRRR CONUS 3km
  - Resolution: 3 km
  - Size: 1799 X 1059 X 40
  - Time: every 60 minutes
- TOPOGRAPHY
  - Resolution: 250 meter
  - Size: 18432 X 15360

HRRR CONUS 3km WRF



HRRR CONUS 3km WRF

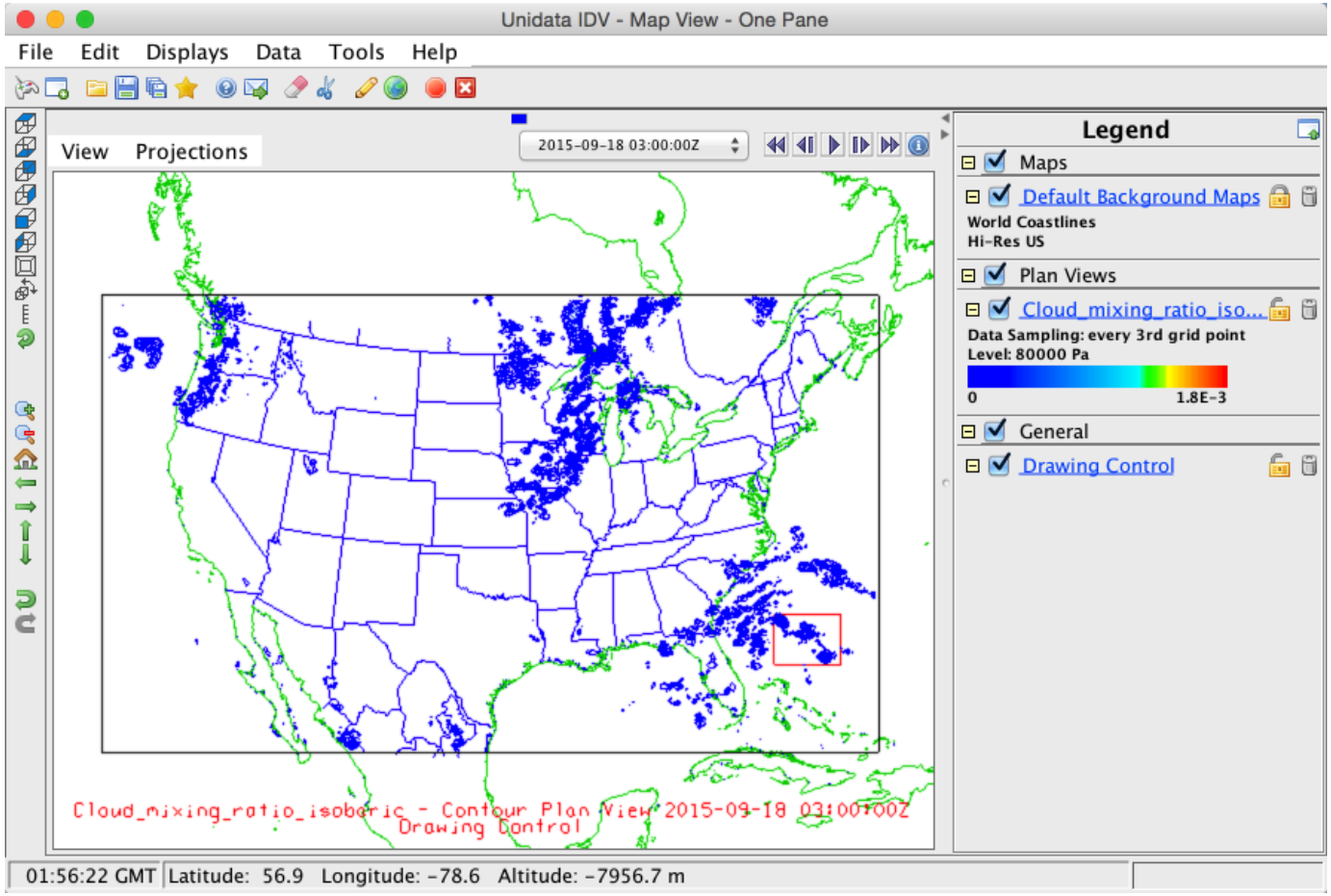




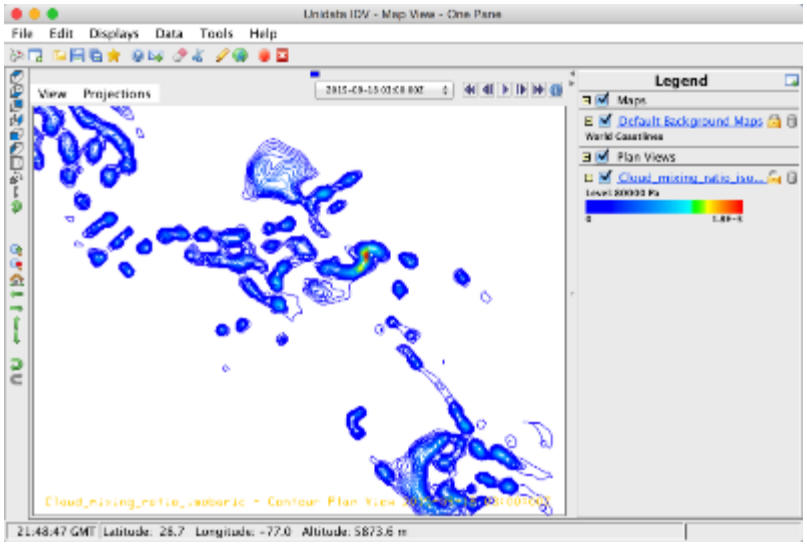
Case Study 2

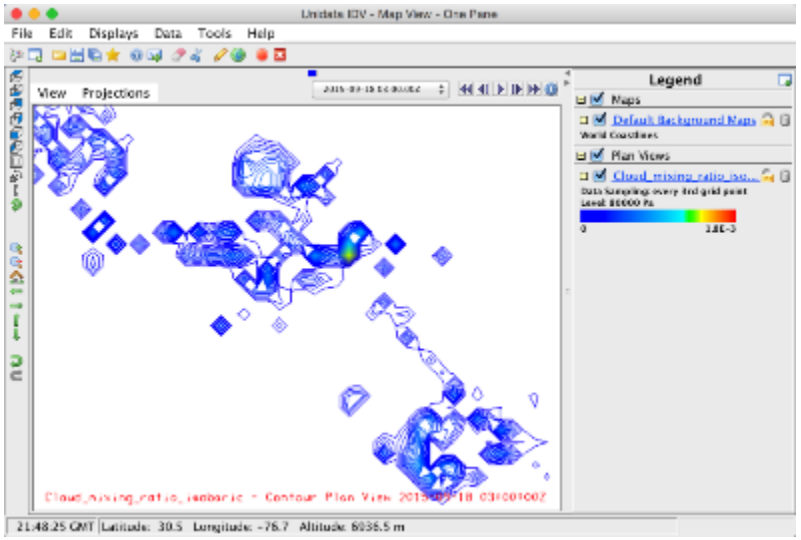
- Loading cloud mixing ratio from HRRR model with reduced size: 599 X 353 and full resolution: 1799 X 1059, the quality of the image with the lower resolution is not compromised.

HRRR CONUS 3km WRF

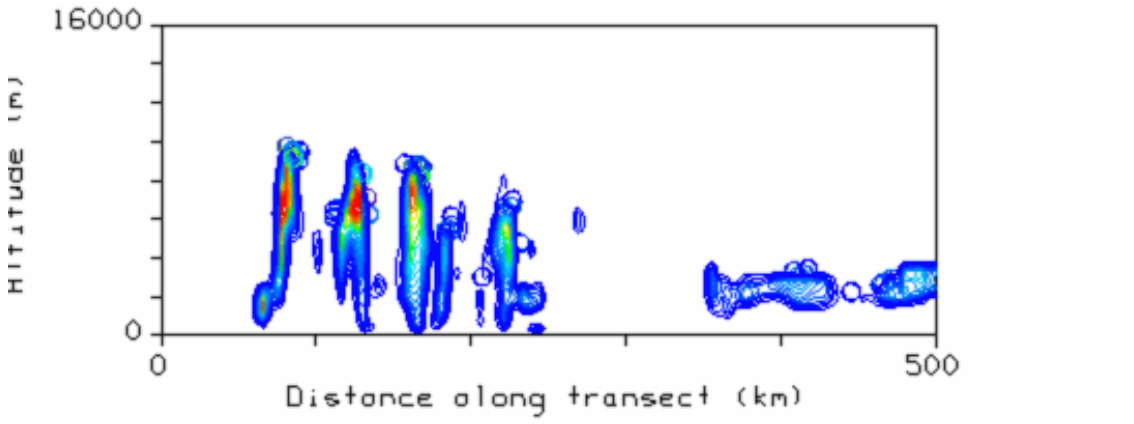


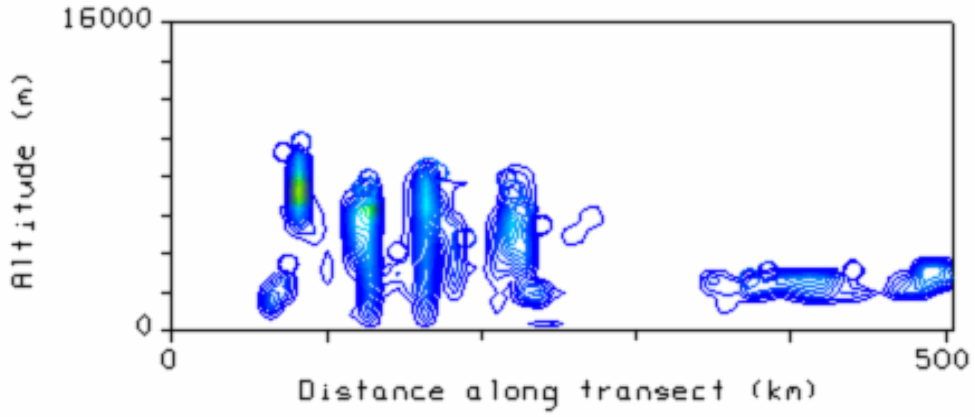
HRRR CONUS 3km WRF





CrossSection

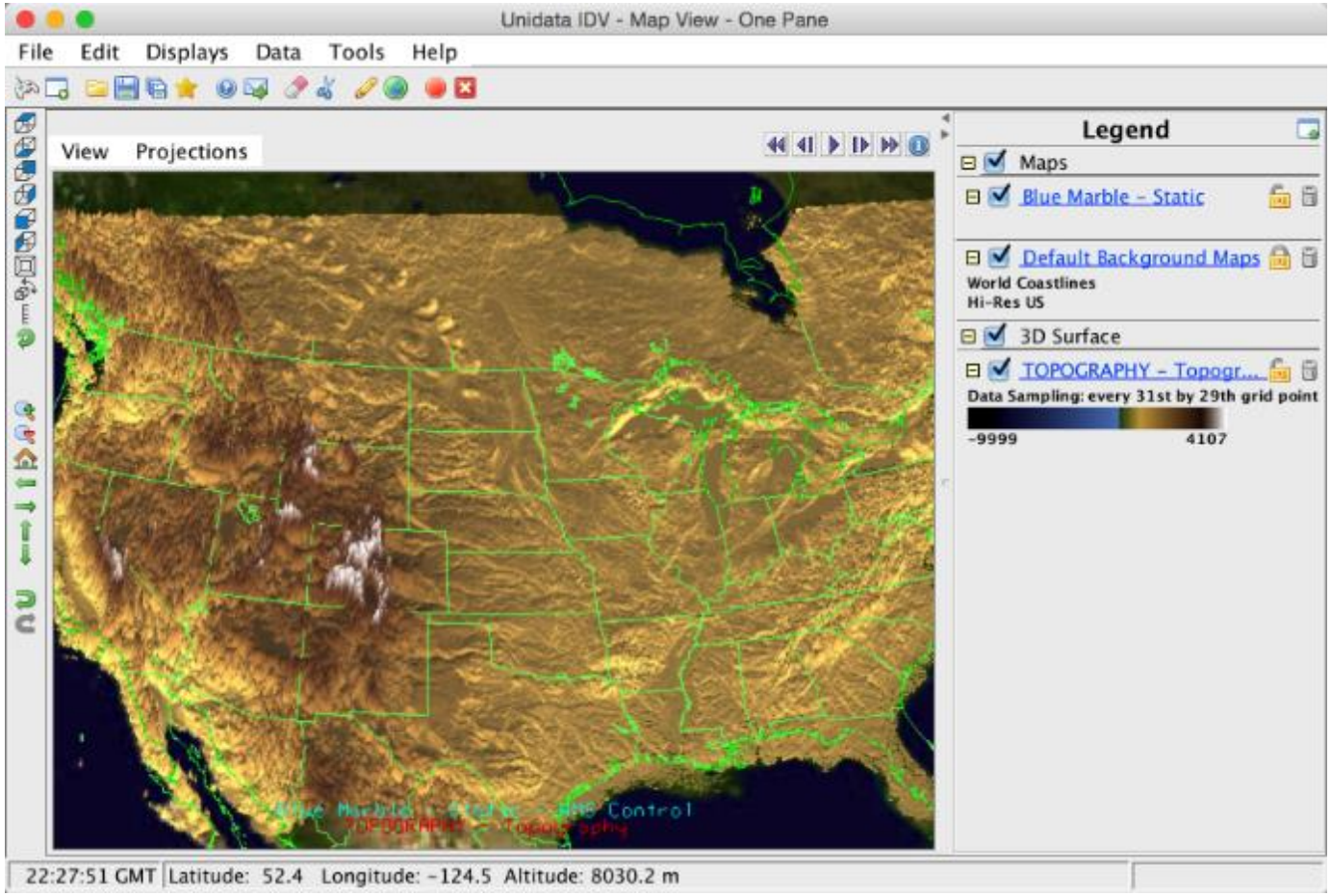




Case Study 2

- With Adaptive Resolution to zoom in area of interested, we can capture better horizontal and vertical structure of the convective cell.

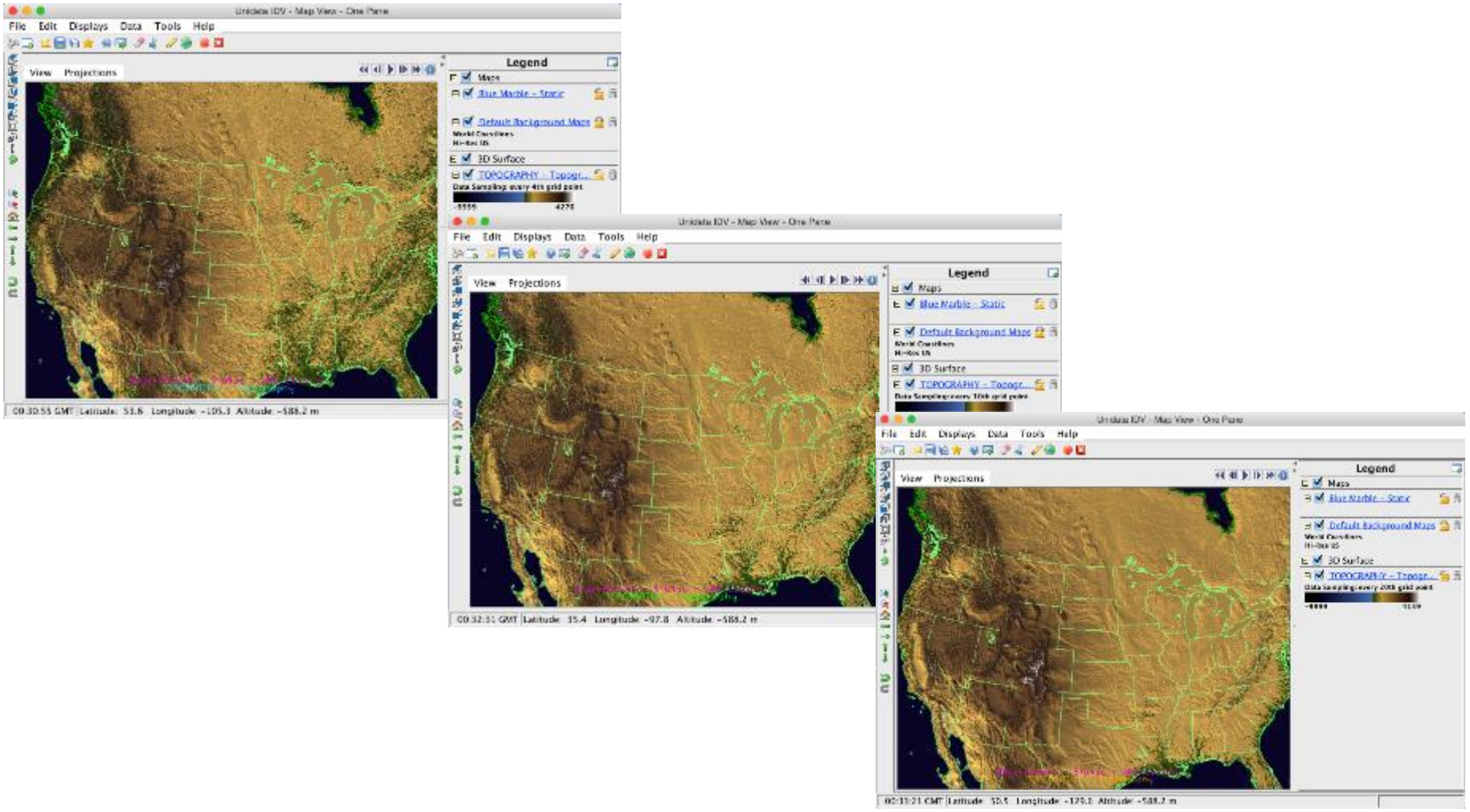
3D TOPOGRAPHY



Case Study

- Loading topography dataset with full resolution 18432 X 15360 into the IDV, results in a "Java Heap Space" error. It is impossible to create a single frame display in full resolution on a machine with 8 gigabytes of memory allocated to the IDV.

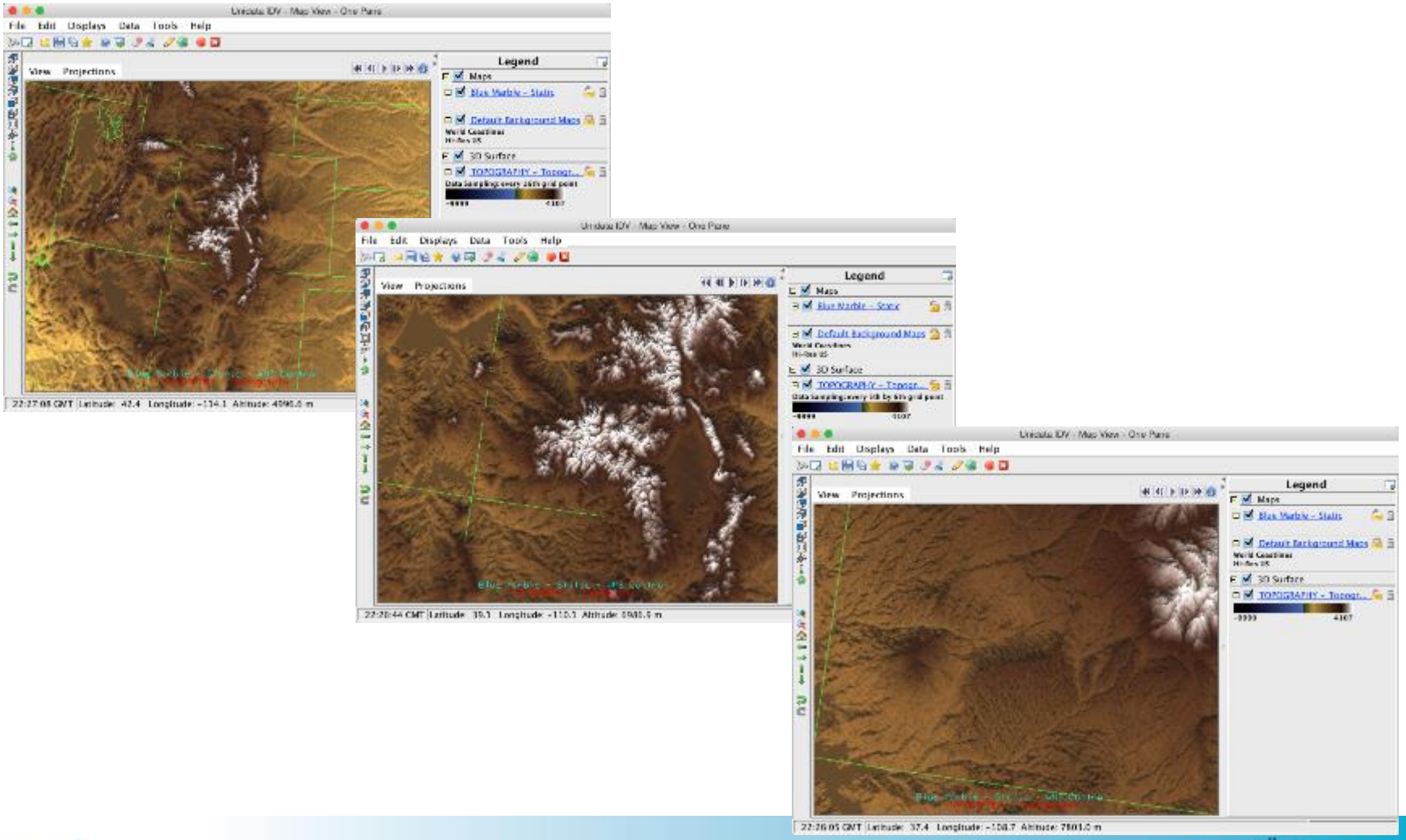
3D Topography



Case Study

- Loading Topography dataset with data sampling 4, 10, and 20, the quality of the resulting images with minor difference of the vegetation coverage in the south east region, but the general quality is not compromised.

3D TOPOGRAPHY



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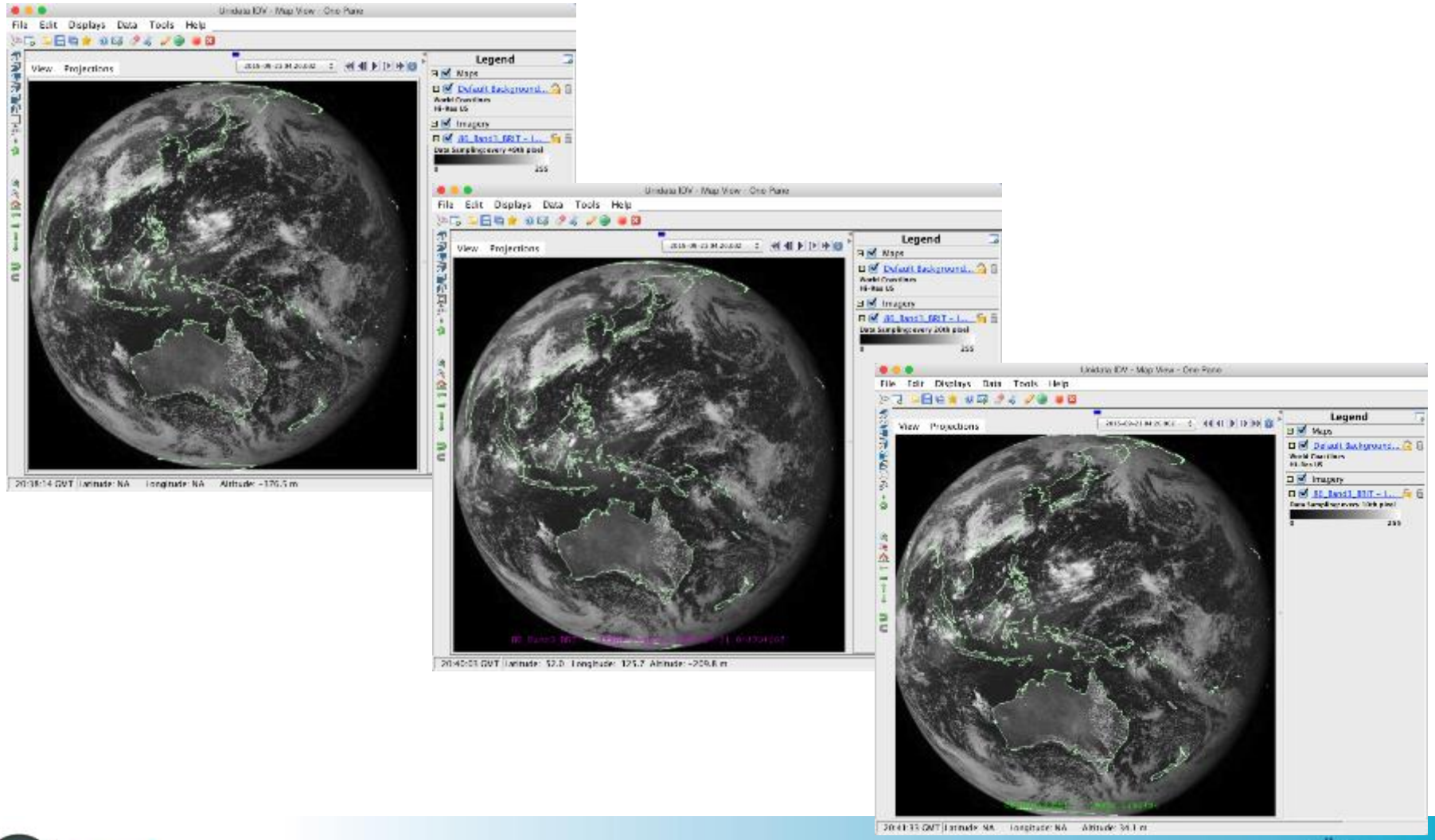
Case Study

- With Adaptive Resolution to zoom in area of interested, which is south west corner of the Colorado, more details structure of the vegetation coverage in the south east region, which can not be seen before even with higher resolution data.

Satellite Imagery



AR area of interested

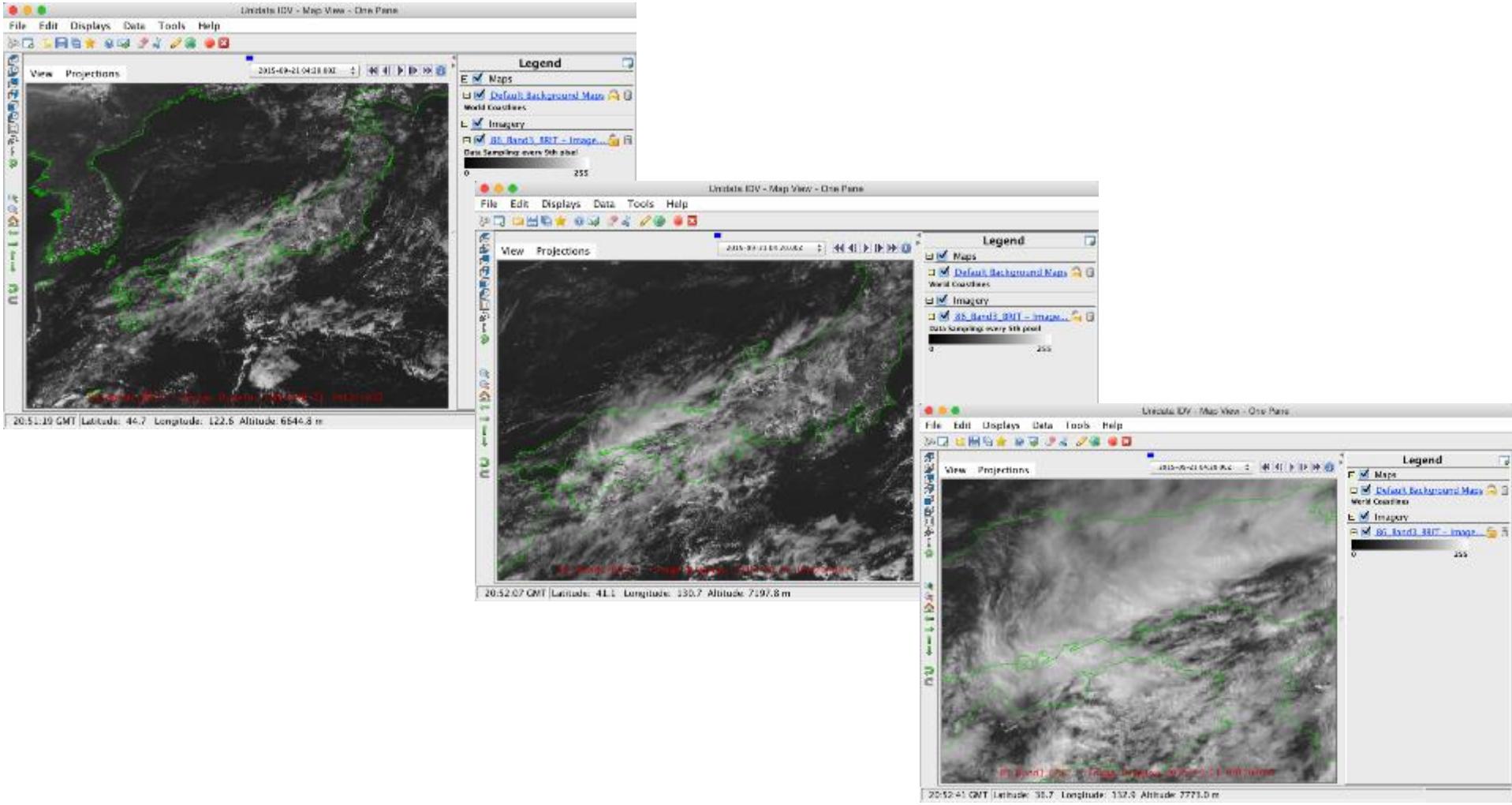


Image quality and data sampling

- Image quality is limited by the screen resolution.
- If there is more than one data point for each pixel on screen, then the higher details information will be condensed to the smaller screen and there will be no improvement of the image quality.
- Rendering higher quality images beyond screen resolution is a waste of resources and may result in poor performance.

Adaptive Resolution versus Wavelet-enable Progressive Data Access

- Both apply linear progressive data access to deal with large dataset.
- Wavelet requires converting data into wavelet format.
- AR/MDR does not perform any format conversion.
- Wavelet only available for gridded datasets.
- AR/MDR can be applied to both gridded and point datasets.
- Wavelet is a powerful tool in dealing with static research datasets.
- AR/MDR is more effective in dynamic weather and climate datasets.

Summary

- AR/MDR is available for satellite imagery, gridded data and point data.
- AR/MDR improves the IDV performance and reduces memory usage significantly.
- AR/MDR reduces unnecessary data transferring over the internet.
- Quality of the resulting images based on Adaptive Resolution is not compromised.

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).