Data Converter for Volumetric Air Quality Data

Lane Harrison, Mentor: Dr. Aidong Lu
{ltharri1, alu1}@uncc.edu

Lane Harrison,
UNC Charlotte

Introduction

In order to create 3D visualizations of scientific data, it is most effective to have individual binary files of a volumetric data as input into the visualization software.

My task was to design a user-friendly converter that would convert a group of large data files into individual volumetric binary files.

Background

"CMAQ is a 3D gridded atmospheric chemistry and transport modeling system that simulates ozone, acid deposition, visibility, and fine particulate matter throughout the troposphere."
--CMAQ website

The air quality data from the CMAQ model is in a binary scientific data format called NetCDF, which conforms to the IO-API standards to ensure modules in CMAQ can work with each other.

CMAQ is a 3D model. However, most visual analysis tools that work with this data generate 2D images. We seek to develop a 3D visual analysis method for this data so environmental scientists can better see what is going on in the atmosphere (i.e. from where pollution is coming).

Research

- Investigated the CMAQ model.
  - Developed a general understanding CMAQ and its modules
  - IO-API standards and interface
  - NetCDF data format
- Studied the data itself
  - Found methods to access the data
  - Extracted the header and defined its attributes by searching IO/API standards
- Determined the best method to use in the converter, chose between:
  - Modifying a 2D visual analysis tool's data access methods (PAVE)
  - IO-API Interface
  - NetCDF Interface
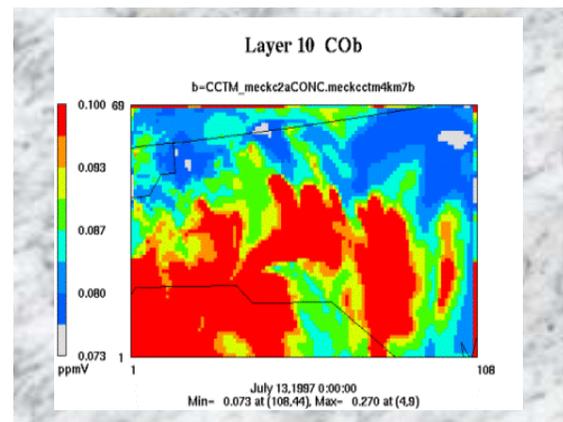
2D PAVE Output Carbon Monoxide

Impact

- **Designed Two Converters, Both:**
    - **Convert multiple datasets under one directory**
    - **User can specify variables to convert**
    - **Individual file names are made from the filename, variable, date and time-step**
- **GUI Converter**
    - **More user friendly**
    - **Handles most common variables in the file**
    - **User can choose varying time-steps to convert.**
    - **Output to text or binary.**
- **Script-driven converter**
    - **For converting multiple CMAQ files (batch processing)**
    - **User defines in text file:**
        - **Input/Output Directory**
   - **Variables**
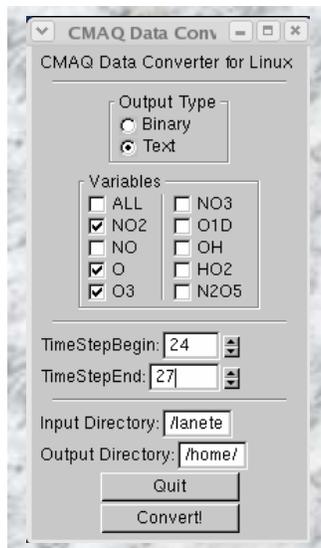
CMAQ Converter GUI Version

Conclusions

- Skills Learned:
    - Extensive note-taking and reviewing habits
    - Programming documentation practices
    - Programming in Linux
    - Makefiles and solving link problems
    - Efficient/Reusable program design
- Topics Researched
    - Atmospheric Models
    - Scientific data formats
    - Programming interfaces and libraries
    - Data-Structures
    - 2D and 3D Visual analysis tools

Future Work

I Plan to use NetCDF functions to dynamically generate the variables in the GUI, so future CMAQ datasets with different variables will run with our converter.
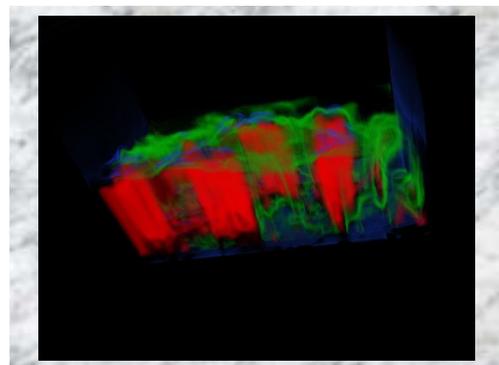
3D from the Dataset above, all Layers