ColoradoView: UV/B Project

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UV-B project webpage: http://uvb.nrel.colostate.edu/UVB/index.jsf

Project Overview

The overall goal of the UV/B project is to measure and geographically quantify the UV-B irradiance reaching the earth's surface in the USA. There are 36 actual sites spread throughout the USA measuring UV-b radiation on the ground to assess its impact on agriculture. To enhance the data collected from these monitoring sites and create a better national model of UV-B radiation, it is being supplemented with satellite data from the Ozone Monitoring Instrument (OMI). Specifically, we used OMUVBd data, a data product measuring surface UV irradiance and erythermal dose based on ozone levels, cloud cover, and various light wavelengths reaching the surface and reflected back to the sensor. For more detailed information on OMUVBd datasets visit:
http://disc.gsfc.nasa.gov/uui/datasets/OMUVBd_V003/summary#documentation and
http://disc.sci.gsfc.nasa.gov/Aura/data-holdings/OMI/documents/v003/OMUVBd_README_V003.pdf

Internship Goals

There are only 36 sites monitoring actual UV radiation reaching the earth's surface for the ColoradoView UV-B monitoring project, spread unevenly throughout the country. This is not enough to accurately interpolate data values between the monitoring sites. The internship is meant to help solve this problem by obtaining and creating usable data to help create accurate representations of UV-B light hitting the earth's surface. Relevant variables towards the goal include cloud thickness, erythermal data, and irradiance at 4 varying wavelengths for as many days as possible between 2005 and 2014.

Methodology

This project required the use of many batch programs, command prompt to run said batch programs, the Geospatial Data Abstraction Library (GDAL), and Terrset. OMUVBd datasets contain many more variables than necessary for this project. My tasks included downloading all available OMUVBd data for the USA, extracting the relevant variables for use in the UV-B project models, generating .csv files for use in compiling datasets, and compiling data into week chucks/composites for easier use in modeling and viewing. Mike wrote all batch files used in processing and I tested them for functionality and ease of use before proceeding with workflow.
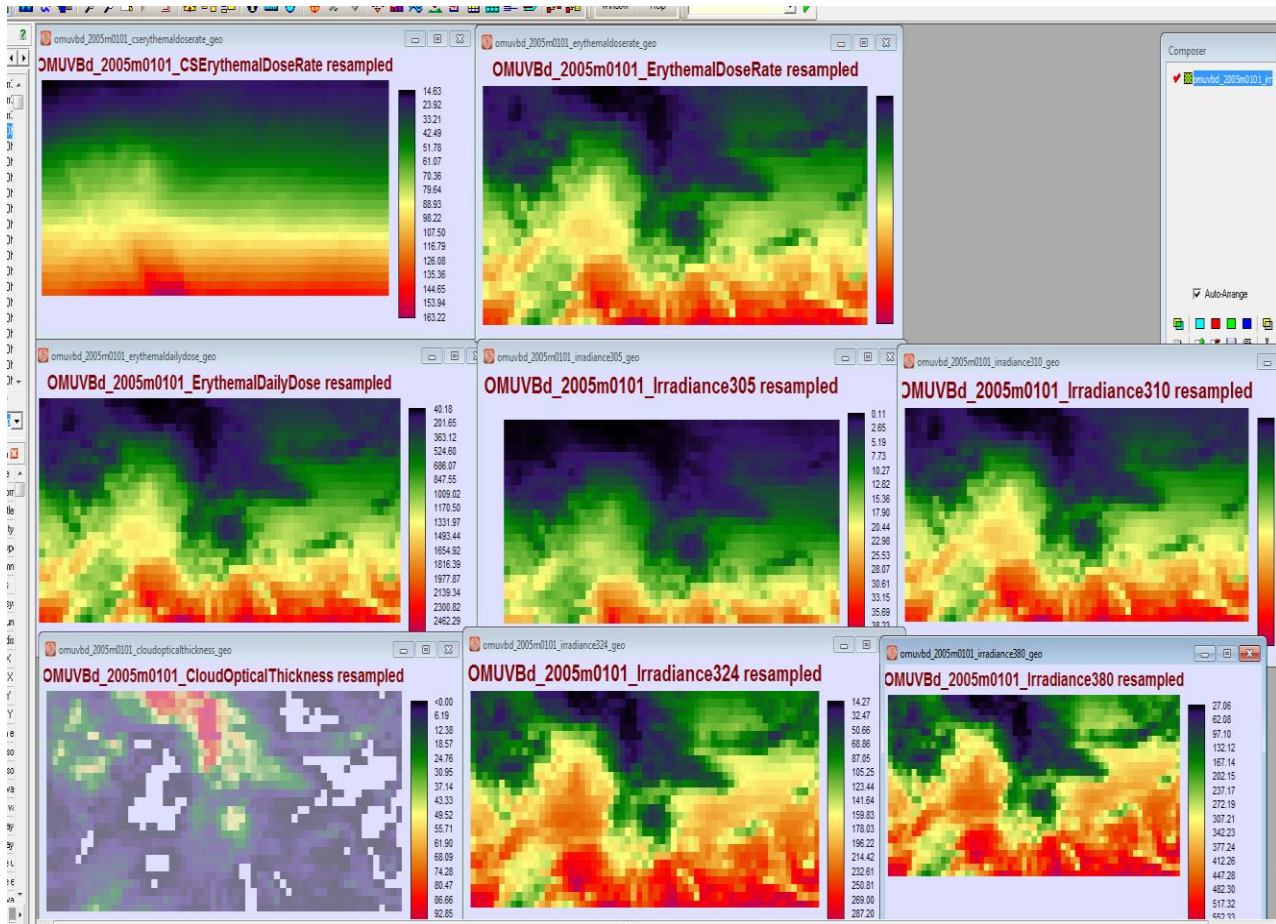
Because of the large amount of data files and necessity of them to be in the correct folders for using the batch files in processing, data management is also important and requires moving data into appropriate folders.

Workflow

1) Obtain data

a. Download relevant variables for all available OMUVBd data from
http://mirador.gsfc.nasa.gov/ , available every day of the year starting in 2005.
   i. There are 8 needed variables: "cserythermaldoserate", "erythermaldailydose",
   "erythermaldoserate", "cloudopticalthickness", "irradiance 305", irradiance
   310", "irradiance 324", and "irradiance 380" which can be selected during
   download.
   ii. The OMI sensor collects data on a daily basis, resulting in many thousands of
   files per year. Batch processing is necessary to proceed in an organized manner.
b. Detailed instructions on methodology to download data found in the "how to download
OMI data" instructional file.

2) Convert data to raster
a. OMUVBd datasets come as NetCDF files and must be converted into raster format for
Terrset/Idrisi and GDAL processing.
   i. This is done via a series of steps calling batch executable files in a command
   prompt window working with data on a yearly basis.
   ii. The first batch file run is "maketranslate_UVBdusa," which creates batch files
   used by GDAL to convert each of the 8 variables from step 1 into raster format.
   Batch files created are:
      1. Transclidthck.bat, transcseryth.bat, transeryth.bat, transerythdaily.bat,
      transirr305.bat, transirr310.bat, transirr324.bat, transirr380.bat
   iii. Calling each of the above 8 batch files in command prompt converts all variables
   from downloaded years of OMUVBd NetCDF data into raster format.
b. Detailed instructions on this step can be found in the "how to process OMI data"
instructional file

3) Apply correct projection (geographic, lat/long)
a. "Maketranslate_UVbdusa" also creates a macro files used in Idrisi (tool within Terrset)
called "resampO3.iml". It resamples all raster files created in step 2 from rows and
columns into the correct projection for the UV/B project.
b. Open Terrset and enter "Run Macro" in the dialog box in the top right. This opens the
"Run Macro" dialog box where resampO3 can be selected and run.
c. Complete details on these processing steps can be found in the "how to process OMI
data" instructional file

4) Data Management
a. The conversion to raster and projection conversions create many extra files that need to
be placed in the correct folders to proceed.
b. All .xml, .rdc, .rst, and _geo files must be placed in their correct folders
c. Full instructions on placement are found in the "how to process OMI data" instructional
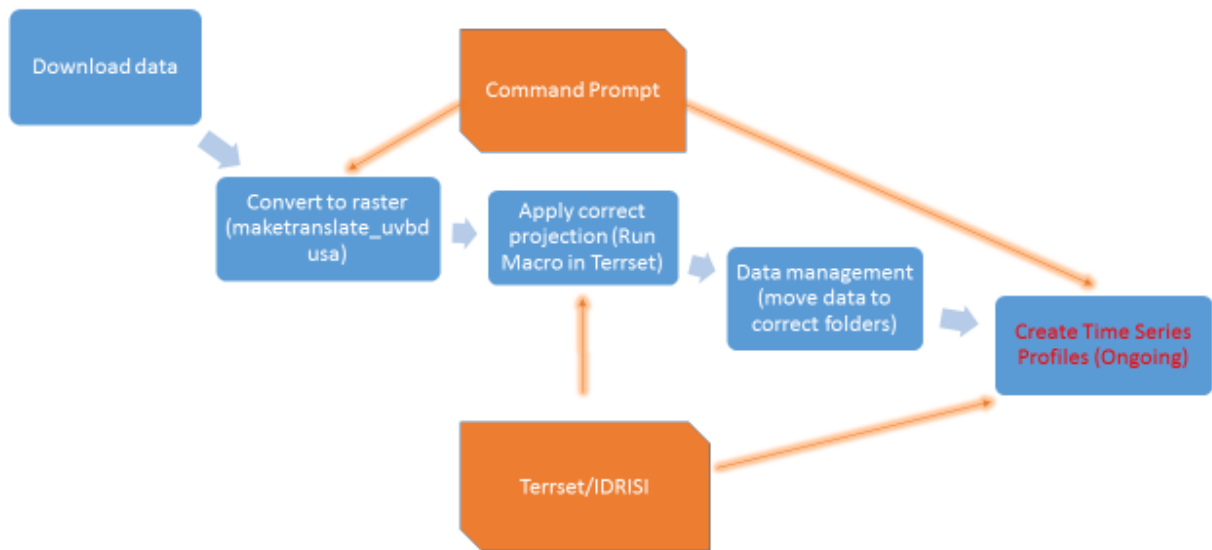file

Example of each variable after being converted and displayed in Idrisi for January 1st, 2005 (steps 1-3):

5) Creating Time Series Profiles (TSP) (NOTE: This section is ongoing) :
    a. TSP's are used to display changes over time in data as well as compile and average data into different time frames. For example averaging cloud cover in 2007 from daily values on a monthly basis and displaying 12 images for easier viewing of change.
    b. Command prompt is used to call the program "makergf_uvbdusa" for each of the 8 data variables used in the UVB project. It creates raster group files (.rgf) of all values for each year for each variable.
        i. These files are used to create time series profiles from the .rgf files via another executable file called from command prompt. It will create a time series file as .csv's (comma separated value files) of all the data values for each variable for each year.
    c. In command prompt, call the program "profile_uvbd" to create .csv's for each variable by year all at once. The resulting .csv data will be used to create time series image files of the data values.

Diagram of work flow

Instructional Materials

Detailed instructions on downloading the relevant data and processing it as discussed in this report can be found in the ColoradoView/2016/UV-B/Help Sheets folder on the L:\ drive. The document names are:

1. Instructions to download OMI data.doc
2. How to process OMI data_USA.doc

Final Reflection

Overall, this project has benefited me through exploration of a new software (Terrset) and using batch files to process large amounts of data. While I have used ArcGIS model builder and python to automate processes in the past, I have never worked with a data set this large (tens of thousands of files) outside of Arc. I would further benefit from more exploration of Terrset/Idrisis and batch file creation and the use of command prompt to automate processes when Arc is not the best option.

1. Benefits to the society and other researchers: The data created from this project will be used to scientists involved in the project to supplement the existing UV-B data to create a better and more accurate picture of UV light hitting the earth's surface. At present, the data is not compiled and there are individual files for every variable for every day of every year. This needs to be compiled into week long or month long intervals for each variable to increase usability and practicality of data and data management.

2. Challenges faced: The primary challenges I faced was learning a new software and solving batch file code problems. This project required on the job testing of the batch files to process the large amount of data and my knowledge of coding was often too limited to know how to fix it. I would often test the code, find the problem and describe it, then report the problem back to Mike so

he could fix it. Learning Terrset and Idrisi was not too difficult except in understanding some of the terminology but the help files and data for the software are quite extensive and usually solved any usability problems I faced. If this failed, researching via forums on the internet solved larger issues.

3. Recommendations and limitations: It is important to understand the use of the Terrset and Idrisi toolbox, utilizing the help file for each tool when necessary. Additionally, a basic understanding of command prompt is necessary to run several programs. Searching the internet for command prompt help is a great way to get up to speed.