A Comparative Analysis of Field Spectroscopy and NEON Atmospherically Corrected Airborne Reflectance Data

Catherine Clark (Junior, University of Michigan)         Mentors: Josh Elliott (AOP), Leah Wasser (Education/Data Products), Nathan Leisso (AOP)

Background and Problem

The National Ecological Observatory Network (NEON) is constructing an Airborne Observation Platform (AOP) that will provide high resolution RGB, LIDAR, and hyperspectral data over NEON field sites located across the United States. The AOP payload includes the NEON Imaging Spectrometer (NIS) that provides more than 420 bands of high resolution data across a spectral range of 380 nm to 2510 nm. NEON atmospherically corrects its hyperspectral remote sensing data using ATCOR-4, a method that calculates surface reflectance and temperature based on geocoded and orthorectified imagery. A challenge in atmospherically correcting the remote sensing data is ensuring that the airborne spectra are as minimally affected by the atmosphere as possible. This study compared field spectra to NEON atmospherically corrected airborne derived data to identify ways in which NEON could reduce uncertainty caused by a number of atmospheric variables.

Study Area

Figure 1. The Ocklawaha-Selby Biological Station and surrounding area, located 26 miles east of Gainesville in Putnam County, Florida. Leaf-level spectra were collected with an ASD handheld spectrometer. Airborne remote sensing data were acquired using the NEON hyperspectral imaging spectrometer.

Defining Regions of Interest

In order to compare the airborne data to the field spectra, we determined regions of interest (specifically over the Tractor tarp and walking transects) in ENVI, and matched the location where the field spectra were collected to specific pixels in the spectrometer data (Figure 2).

Determining Variables and Improving the Corrections

In order to link the field spectra with the remotely sensed data, we plotted the airborne data from the defined regions of interest against the ASD data (Figure 3). By comparing the plots to an atmospheric absorption spectrum, we were able to determine what variable might cause noise at that wavelength, and thus we knew which variables to alter in NEON’s processing code. These plots indicated that uncertainty was most often caused by the water vapor content of the air.

It was determined that the Integrated Water Vapor (IWV) model introduced the most uncertainty into the processing code. Not utilizing the model decreased noise in the spectra by 25.8% in the 540 nm region, 41.7% in the 1130 nm region, and 77.2% in the 2500 nm region. These were regions that we determined were most affected by the atmospheric water vapor content. The fact that the reflectance data did not improve with the IWV model indicates that the sensor is indeed calibrated correctly. Further, not utilizing the IWV model in the processing code yielded lower reflectance values, which caused the visualization in ENVI to be brighter. These lower reflectance values were closer to the ASD derived values than NEON’s previously atmospherically corrected data values.

The Spectral Angle Mapper (SAM) Classification

SAM determines spectral similarity by calculating the angle between spectra, and treating them as vectors with dimensionally equal to the number of bands. Without the IWV model, the average angle decreased from 0.856813 to 0.756912 radians, a 10.8164% change.

Figure 4. This histogram demonstrates how the average radian data value decreased when the IWV model was not utilized.

Advantages and Disadvantages of Interpolation

In addition, we investigated the advantages and disadvantages of interpolation. Although this feature produces a much smoother model, we determined that the scientific community should receive the preserved, authentic data instead of calculated, interpolated data.

Conclusions and Future Directions

This analysis demonstrates that the uncertainty in NEON’s atmospheric corrections was most often caused by the water vapor content of the air, and that the reflectance data was sensitive to the IWV model, indicating that the airborne sensor is indeed calibrated correctly. This analysis also outlines the inherent differences between field-collected spectra and NEON’s atmospherically corrected airborne derived reflectance data. Future studies could build off this research by examining other variables that might introduce uncertainty into NEON’s processing code, as well as into other atmospherically corrected data outside of NEON, and the significance of these variables in the data product. Future data users can use the information in this poster to understand how and why uncertainty is introduced into atmospherically corrected reflectance data.

Contact Information: cclark@umich.edu

www.neoninc.org

Other Variables Tested

We also investigated other variables that might have introduced uncertainty into the processing code. However, these variables did not produce a significant change in the atmospherically corrected spectra.

© 2013 National Ecological Observatory Network, Inc. All rights reserved. The National Ecological Observatory Network is a project sponsored by the National Science Foundation and managed under cooperation agreement by NEON, Inc. This material is based upon work supported by the National Science Foundation under the following grants: DE-0986968, DE-1120100, DE-1303209 and DE-1303207. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.