Opportunistic Validation of Vegetation Indices from MODIS and VIIRS
Using NEON AOP Hyperspectral Imagery

*Kamel Didan1,2, Armando Barreto1,2, Ezzuldin Naji1,2, Baishali Baruah1,2
1 Vegetation Index and Phenology Lab, 2 BE Dept., The University of Arizona
*didan@email.arizona.edu

Introduction
Vegetation Indices are one of the most widely derived and used satellite remote sensing products for studying the land surface vegetation composition, health, and productivity (with a record +12,000* publications). With a time series spanning more than 35 years at different spatial, temporal, spectral, and radiometric characteristics (AVHRR, MODIS, VIIRS), it becomes critical to characterize and regularly validate this invaluable data record. While in-situ observations remain the most accurate validation approach, the associated footprint is very limiting. The alternative is to consider scaling opportunistic data and images from alternate sensors (hyperspectral, drones, etc.). Supported by statistical analysis techniques this should offer a reasonable approach.

NEON AOP
The National Ecological Observatory Network (NEON), with its Airborne Observation Platform (AOP) collects annual hyperspectral imagery at very high spectral resolution from 20 eco-climatic domains located across the US. The hyperspectral data consists of 428 bands in the range 380 - 2510 nm at 1 meter spatial resolution. This offers great opportunity for validating higher order products and coarse and medium resolution based remote sensing data.

Objectives
This hyperspectral NEON AOP dataset presents a unique and long term opportunity for validation of coarser resolution sensors. However, working with these big data is challenging due to their size and the complex dataflow required (stitching, resampling, convolution, and post-processing, etc.). In this work we developed a workflow and set of tools aimed at assisting users take advantage of this rich data:
- Develop an application for the preprocessing of NEON hyperspectral data (mosaicking, spectral convolution and spatial resampling)
- Evaluate and use this data for validation of MODIS and VIIRS

Sensors & Data specs

<table>
<thead>
<tr>
<th>Sensor</th>
<th>Date Range</th>
<th>Resolution</th>
<th>Spectral Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>MODIS</td>
<td>1981-2020</td>
<td>250m</td>
<td>0.5 - 2.5nm</td>
</tr>
<tr>
<td>VIIRS</td>
<td>2000-2019</td>
<td>750m</td>
<td>0.5 - 2.5nm</td>
</tr>
</tbody>
</table>

VIP NEON-AOP DataExplorer
We developed an online tool for the exploration and preprocessing of NEON AOP hyperspectral data. The tool main features are:
- Data file access and metadata browsing
- Visualization: Single band, Composites, FCC, True color, and Ancillary
- Pixel spectral signature extraction
- Mosaicking to custom spatial extent
- Spectral convolution using default sensors RSR or custom user defined SRS
- Spatial resampling and Subsetting
- Output reformating

Results
We tested the tools and used the data from 5 sites to validate MODIS and VIIRS data. The NEON dataset were spectrally and spatially convolved to create a simulated MODIS/VIIRS dataset for the selected sites. We assessed the correlation between these sensors for NDVI/EVII2 and surface reflectance data.

Conclusions
The high spectral and spatial resolution of NEON AOP data provide useful and accurate ground truth data to support validating synoptic coarse resolution remote sensing. While NEON data is only available once a year, during peak growing season, it does provide additional and dense field data to support the design of a solid validation protocol. Our effort aimed primarily at reducing the tasks and resources required to process the NEON AOP data and provided an rich online environment directed at serving the land product validation community. We plan to improve this tool and make it open to the public.

http://vip.arizona.edu
http://www.neonscience.org/