COLLEGE OF SCIENCE
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Research Horizons Day

Statistical Comparison between Various Atmospheric Correction Methods and the LibRadtran Package

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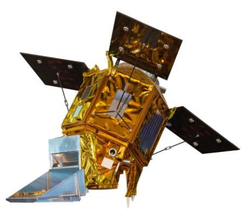
Overview

This study investigated the use of LibRadtran to calculate "pixel-size" spectral profiles of the Earth's surface to understand and improve atmospheric corrections of satellite imagery. LibRadtran is a publicly available library of radiative transfer packages used in studies from a variety of scientific fields to compute radiance values, irradiance values, and actinic fluxes in different spectral regions. While widely used as a package for calculating the transfer of radiation within Earth's atmosphere, few studies have compared its results to other atmospheric models more prevalent in remote sensing such as QUick Atmospheric Correction and Dark Object Subtraction. Utilizing the *uvspec* model within LibRadtran, atmospheric profile data from local ozonesonde flights, and satellite measurements from Sentinel-2A and Sentinel-5P TROPOspheric Monitoring Instrument, several spectral profiles were produced for different land types, including forest, concrete, grass and water.

Data

Satellite



Sentinel 5-P
Parameter: NO2
Resolution: 7km

Sentinel 2A
Parameter: Land
Resolution: 10m

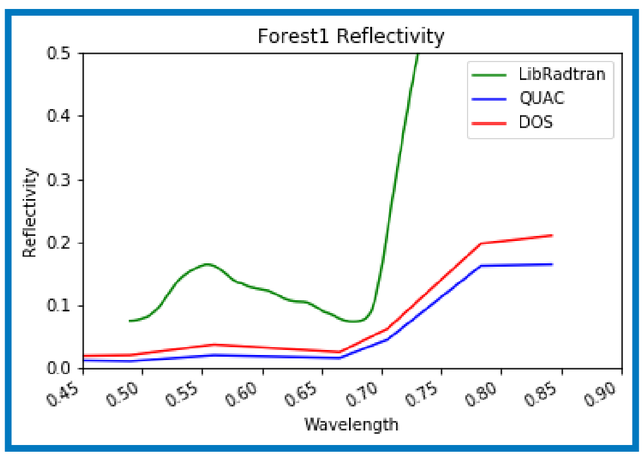
Ozonesonde

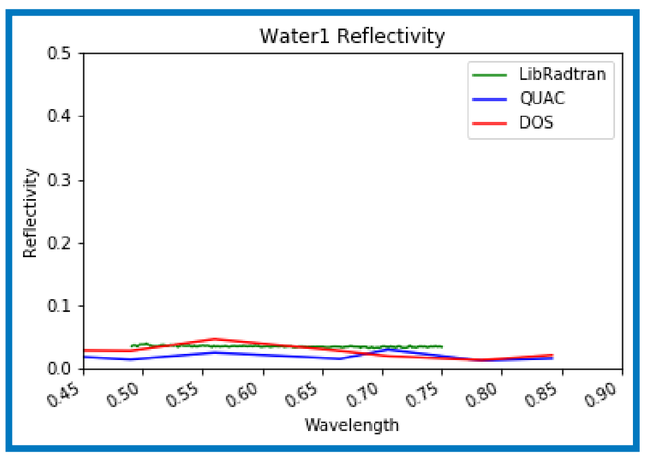
- Height (km)
- Pressure (mb)
- Temperature (K)
- Air Density (cm-3)
- Ozone (cm-3)
- Water Vapor (cm-3)

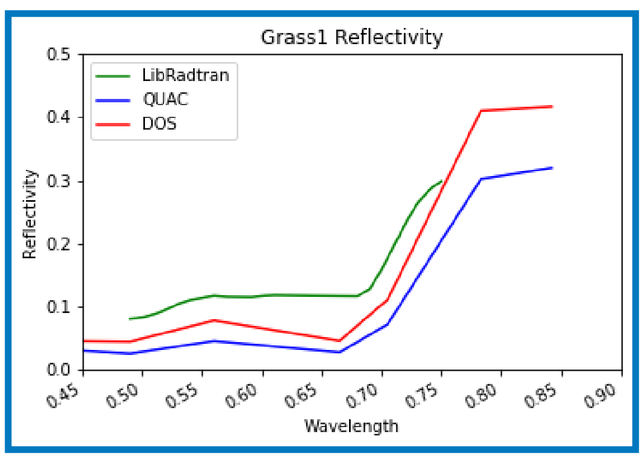
Methodology

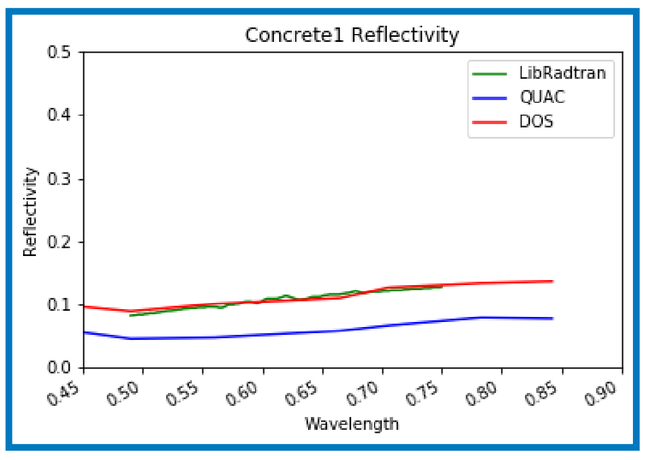
Software	Processing	Analysis
Systems Tool Kit ArcGIS Pro Sentinel Application Platform Google Earth Engine ENVI Python	LibRadtran Dark Object Subtraction QUick Atmospheric Correction	Graphical Comparison Analysis of Variance (ANOVA)

Results - Reflectivity Comparison









Results - ANOVA

QUAC v DOS	F-value	P-value
Grass	0.327	0.578
Concrete	**9.051**	0.011
Forest	0.232	0.639
Water	2.676	0.128

QUAC v LibRadtran	**F-value**	**P-value**
Grass	0.951	0.358
Concrete	**8.432**	0.019
Forest	3.003	0.121
Water	2.314	0.167

DOS v LibRadtran	**F-value**	**P-value**
Grass	0.064	0.806
Concrete	0.079	0.785
Forest	**2.371**	0.162
Water	1.875	0.208

Conclusions

An Analysis of Variance showed that the radiance means of each method vary heavily depending on the land cover type. Concrete and forest varied the most when compared to LibRadtran calculations. These results suggest that the spectral profiles calculated by LibRadtran rely heavily on the albedo profiles specified, which can differ from the "ground-truth." Further investigation into the model's weight on the atmosphere parameters is imperative in determining LibRadtran's effectiveness and accuracy when correcting satellite imagery.

Questions

How much does the atmospheric set up affect the calculation of reflectivity? To what extent does the atmospheric set up vs. the albedo input impact the calculated reflectivity?

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