Linking Seasonal Foliar Chemistry to VSWIR-TIR Spectroscopy across California Ecosystems

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Abstract:
The synergy between the reflected solar spectrum (Visible Near Infrared/ Short Wave Infrared or VSWIR) and the emitted spectrum (Thermal Infrared or TIR) for identifying plant species' foliar chemistry has been largely unexplored. In the 2013 spring and summer seasons, fresh leaves from sixteen common shrub and tree species were sampled from locations ranging from the Sierra Nevada mountains, the Central Valley, and coastal Santa Barbara. Partial Least Squares (PLS) regression analysis with leave-one-out cross validation was used to relate spectral response at wavelengths from 0.3 µm to 15.4 µm to laboratory measured biochemical concentrations of nitrogen, lignin, and cellulose. For each biochemical component, three PLS regression models were fit using different portions of the spectrum: VSWIR spectrum (0.3 - 2.5 µm), TIR spectrum (2.5 – 15.4 µm), and the entire spectrum (0.3 – 15.4 µm). Using the TIR spectrum for prediction, the relationship between predicted biochemical values versus laboratory measurements was especially strong for all three biochemical constituents. The combination of VSWIR and TIR increased the R2 of regression models compared to VSWIR spectrum regression alone, signifying that the incorporation of TIR data would improve discrimination of these components. Although the incorporation of TIR wavelengths improved discrimination, high coefficients of the PLS regression suggests that the VSWIR wavelengths were the primary predictor used for identification of biochemical properties. Nevertheless, strong relationships with the thermal spectrum imply that wavelengths in the TIR spectrum will further improve the prediction of biochemical concentrations.

Bio:
Susan Meerdink is a MA/PhD student in the UCSB Geography Department. She holds degrees in both Ecology and Geographic Information Sciences from the University of Northern Iowa. During her undergraduate career, Susan was a recipient of a scholarship from the NASA Space Grant Consortium where she worked on various remote sensing applications such as identifying possible climatic factors that influence the geographic shift and spatial fidelity of Taimyr calving grounds. Her current research focuses on using remote sensing techniques to determine foliar chemistry and biophysical properties as they deviate seasonally and across California ecosystems.