USE OF SPECTRAL ANALOGY TO EVALUATE CANOPY REFLECTANCE SENSITIVITY TO LEAF OPTICAL PROPERTY.

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Abstract

The spectral variation of canopy reflectance is mostly governed by the absorption properties of the elements, hence the leaves, since their intrinsic scattering properties show very little spectral variation. The relationship between canopy reflectance and leaf reflectance measured at the red edge over sugar beet canopies was used to simulate canopy reflectance from leaf reflectance spectra measured over the whole spectral domain. The results show that the spectral analogies found allows accurate reconstruction of canopy reflectance spectra. Explicit assumptions about the very low spectral variation of leaf intrinsic scattering properties are thus indirectly justified.

The sensitivity of canopy reflectance (ρ_c) to leaf optical properties can then be investigated from concurrent spectral variations of canopy ($\partial\rho_c / \partial\lambda$) and leaf reflectance ($\partial\rho_l / \partial\lambda$):

$$\frac{\partial\rho_c}{\partial\rho_l} = \frac{\partial\rho_c}{\partial\lambda}\left(\frac{\partial\rho_l}{\partial\lambda}\right)^{-1}$$

This expression is strictly valid only when the optical properties of the soil background or of the other vegetation elements such as bark are either spectrally flat or do not contribute significantly to canopy reflectance. Simulations using the SAIL and PROSPECT models demonstrate that the sensitivity of canopy reflectance to leaf reflectance is significant for large vegetation cover fractions in spectral domains where absorption is low. In these conditions, multiple scattering enhances the leaf absorption features by a factor that can be greater than 2.0. To override the limitations of the SAIL model for the description of the canopy architecture, we tested the previous findings on experimental data. Concurrent canopy and leaf reflectance spectra were measured for a range of sugar beet canopies. The results show good agreement with the theoretical findings. Conclusions are drawn about the applicability of these findings, with particular attention to the potential detectability of leaf biochemical composition from canopy reflectance sensed from space.