Author: Vern Vanderbilt (First Author)
NASA Ames Research Center
Moffett Field, CA 94035-1000
Email: vern.c.vanderbilt@nasa.gov

Remotely sensing the photochemical reflectance index (PRI)

In remote sensing, the Photochemical Reflectance Index (PRI) provides insight into physiological processes occurring inside the leaves in a stand of plants. Developed by Gamon et al., (1990 and 1992), PRI evolved from laboratory measurements of the *reflectance* of individual leaves (Bilger et al.,1989). Yet in a remotely sensed image, a pixel measurement may include light from both *reflecting* and *transmitting* leaves.

We conducted laboratory experiments comparing values of PRI based upon polarized reflectance and transmittance measurements of water and nutrient stressed leaves. We illuminated single detached leaves using a current controlled light source (Oriel model 66881) and measured the leaf weight using an analytical balance (Mettler model AE 260) and the light reflected and transmitted by the leaf during dry down using two Analytical Spectral Devices spectroradiometers. Polarizers on the incident and reflected light beams allowed us to divide the leaf reflectance into two parts: a polarized surface reflectance and a non-polarized 'leaf interior' reflectance.

Our results underscore the importance when calculating PRI of removing the leaf surface reflection, which contains no information about physiological processes ongoing in the leaf interior. The results show that the leaf physiology information is in the leaf interior reflectance, not the leaf transmittance. Applied to a plant stand, these results suggest use of polarization measurements in sun-view directions that minimize the number of sunlit transmitting leaves in the sensor field of view.

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