Title: Estimating the relative water content of leaves in a cotton canopy

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Abstract:
Remotely sensing plant canopy water status remains a long-term goal of remote sensing research. Established approaches to estimating canopy water status — the Crop Water Stress Index, the Water Deficit Index and the Equivalent Water Thickness — involve measurements in the thermal or reflective infrared. Here we report plant water status estimates based upon analysis of polarized visible imagery of a cotton canopy measured by ground Multi-Spectral Polarization Imager (MSPI). Such estimators potentially provide access to the plant hydrological photochemistry that manifests scattering and absorption effects in the visible spectral region.

Twice during one day, +/- 3 hours from solar noon, we collected polarized imagery and relative water content data on a cotton test plot located at the Arid Land Agricultural Research Center, United States Department of Agriculture, Maricopa, AZ. The test plot, a small portion of a large cotton field, contained stressed plants ready for irrigation. The evening prior to data collection we irrigated several rows of plants within the test plot. Thus, ground MSPI imagery from both morning and afternoon included cotton plants with a range of water statuses.

Data analysis includes classifying the polarized imagery into sunlit reflecting, sunlit transmitting, shaded foliage and bare soil. We estimate the leaf surface reflection and interior reflection based upon the per pixel polarization and sun/view directions. We compare our cotton results with our prior polarization results for corn and soybean leaves measured in the lab and corn leaves measured in the field.

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