Using digital camera for measuring leaf inclination angle in crops

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Leaf angle distribution (LAD) is a key parameter for simulating radiation transmission through a vegetation canopy and for characterizing canopy structure. It plays an import role in controlling energy and mass exchange in ecosystems [1]. In most studies, however, LAD is assumed to be spherical as the actual LAD is difficult to estimate. Recently, a simple and reliable method to measure LAD based on digital photography was developed and validated for various broadleaf tree species [2, 3]. The canopy structure and leaf shape for many common agricultural crops differ significantly from that of broadleaves. The performance of this promising LAD measurement method in crops has not been investigated yet. Thus, we present here our results on applying the digital camera LAD measurement protocol in an agricultural field in Viikki, Helsinki.

Nikon D1x camera on a tripod was used for taking photographs. The camera was levelled using a bubble level in the flash shoe of the camera. Seven species were measured. Five to six photographs were taken for each species with a distance about 1 m between crop and camera lens. To record the shape of the leaves, we scanned 20 fresh leaves of each species in the field using a portable document scanner. We also recorded the LAI and average leaf angle using the LAI-2000 plant canopy analyser. Leaves oriented approximately perpendicular to the viewing direction were selected from the photographs and the angles were estimated by angle measurement tool in ImageJ software. For straight and flat leaves, angles could be measured directly. However, the long, narrow and curved leaves angles could be only for leaf sections. Later, the leaf angle distributions for these species were reconstructed using the measured leaf shapes.

After the data processing, leaf inclination angle distribution functions were built for all species. The photographically determined LADs were compared with those determined from LAI-2000 measurements. Finally, the functions were used in radiative transfer simulations of Viikki test fields and the modelled canopy reflectance factors were compared with those measured using an ASD Handheld field spectroradiometer and an airborne AISA imaging spectrometer in 2011.

References:

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