Conference Agenda

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Pos 1: Poster Session 1
Time: 30/Aug/2022: 5:30pm-7:00pm · Location: Foyer

Live Poster Presentation

Can smartphone photography support the deployment of TreeTalker-based below canopy spectroscopy?

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Existing functional links between structure and biochemistry at the leaf and canopy levels imply that canopy structure, when utilised as a proxy, may generally facilitate the usage of spectroscopy for tracking canopy biogeochemical traits over large geographical extents.

The ITTNet network is a unique and unprecedented example worldwide, with 30 sites distributed across a transect from Sicily to the Alps. About 600 trees are monitored near real-time at these sites using low-cost multi-sensor devices called "TreeTalkers". Such devices are based on the Internet of Things (IoT). The parameters measured embrace environmental variables and ecophysiological ones – including canopy spectral signatures – at the single-tree level. At every measurement site, 20 individual trees are equipped with a device. The TreeTalker is rigged with two in-factory calibrated AMS chips (ams-OSRAM AG), the model AS7262 for the visible range and the model AS7263 for the near infra-red range (TT+manual ver. 3.2, Sept. 2020). Each chip can measure six bands. The AS7262 (central wavelengths: 450, 500, 550, 570, 600, 650) has a full width at half maximum (FWHM) of 40nm, while the AS7263 (central wavelengths: 610, 680, 730, 760, 810, 860 nm) has an FWHM of 20nm. The spectrometers were oriented at 20 degrees zenith angle, and all the sites were binned to a nearby spectrometer measuring solar irradiance outside the canopy.

For the interpretation of under canopy spectroscopy, the first step is to characterise the canopy cover within the instrument's field of view. A suitable solution for this purpose is using a terrestrial laser scanner (TLS). However, TLS data acquisition and processing are costly and time-consuming procedures. Therefore, we compared TLS measurements and smartphone-based photography for every installed TreeTalkers within a subset of sites from the ITTNet network. The selected sites included broadleaf and needleleaf tree species. We carried out the TLS campaigns and the synchronous acquisition of canopy images during full leaf development.

The smartphone solution showed to be capable of providing TLS comparable canopy structure metrics (e.g., gap fraction), and therefore, it was demonstrated to be a low-cost alternative. Thus, about half of the variability between single-tree spectra could be explained by the differences in canopy structure at the single-tree level. Hence, smartphone-based canopy photography has shown to be a practical approach which is scalable across the whole ITTNet network and beyond. Indeed, this was the first necessary step for supporting the identification of single-tree level spectral features and exploiting below canopy spectroscopy for retrieving canopy level biogeochemical traits and ultimately linking *in-situ* observations with top of canopy reflectance.