Towards better understanding of species-specific leaf optical traits: fluorescence variations in the National Arboretum of Westonbirt, United Kingdom

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Objectives

Leaf-level, smallest scale at which chlorophyll fluorescence can be measured in vivo, is a crucial bridge in understanding relation between optical data (remotely-sensed also from space) and plants physiological behavior (also at molecular level). Remotely-sensed fluorescence is a combination of signals emitted by leaves, shoots and branches of various species within a wide field of view. Therefore, an urgent need arises to collect optical measurements from diverse biomes, ecosystems and concerning diverse species. The full interpretation of remotely-sensed data requires collaboration of researches from different measuring scales. Within this SSV, we combine leaf-level (visitor) and remote sensing (host) measurements. Our **objective 1** is to measure leaf-level reflectance and chlorophyll fluorescence, gas exchange and pigment composition of species present at the *Westonbirt National Arboretum*, United Kingdom. With those measurements, the database of optical characteristics of species with various leaf morphologies and ecological niches will be expanded (**Objective 2**). We will further combine the data acquired during SSV with results from Finnish boreal forest (2017), Spanish Mediterranean forest (2018) and tropical forest of Costa Rica (2020). The cross-comparison of all the results will help us to test the hypothesis that leaf optical properties vary independently of species-specific features across different biomes (**Objective 3**). In addition, by combining leaf-level (visitor) and remote sensing (host) simultaneous analysis, we might reach better understanding of the relation between different scales of optical measurements (**Objective 4**).

Methodology

In this SSV, we will combine my leaf-level optical measurements with analysis carried out by the host – expert in remote sensing. At leaf-level, I will carry out measurement of reflectance and chlorophyll fluorescence (both spectral and pulse-modulated), as well as of gas exchange and pigment composition. For the same species stands, the host will provide hyperspectral analysis with remote sensing techniques.

Data

We will look at a selected range of 10 to 15 species, characteristic to the ecosystem of United Kingdom and representing contrasting geometries or morphologies. By comparing different scales, we will move towards better understanding of species-specific traits and their impacts on remote sensing retrieval. In addition, the results of the SSV will be cross-compared with data from Finland, Spain and Costa Rica. Importantly, in all the cases the same protocol – Optical Chamber – is implemented, increasing the comparison value of the results from different biomes. Finally, the outcomes of all the campaigns, including the SSV, will be published in open-access journal as part of my PhD thesis. “Elucidation of leaf optical traits across species and biomes” (tentative title) is planned to be submitted by the end of the year 2020. The article will benefit from SSV with an additional perspective of remote sensing implementation. The leaf-level and remotely-sensed data connection, investigated during the SSV, might potentially lead to more precise interpretation of optical signals. The findings of SSV will be presented on a seminar at Forestry Department, University of Helsinki.