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Remote sensing of vegetation light use efficiency: exploring new formulations robust to variations with canopy depth

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Remote sensing of pre-visual stress indicators offers great potential to better understand the response of vegetation to climate extremes. However, linking spatial scales from leaf to canopy remains a challenge due to canopy structure and view-sensor geometry effects on the optical signal. Specifically, how and at which scales does the photochemical reflectance index and solar induced chlorophyll fluorescence relate to light use efficiency and productivity across vegetation types?

To help answer these questions we developed a remote sensing capability mounted in-situ on a flux tower in the Tumbarumba tall canopy (40m) Eucalypt forest, Australia. Daily hyperspectral and thermal imagery have been acquired since 2015 to monitor forest dynamics at the canopy scale. Combined hyperspectral and thermal imagery enable monitoring of the regulated and non-regulated absorbed energy pathways. Similar to the FLEX mission concept flying in tandem with the Sentinels, we observe the visible, near-infrared, and thermal regions of the EM spectrum to build up a more complete picture of canopy composition and function. Concurrent field campaigns were conducted to establish leaf-level relationships between reflectance, fluorescence yields, pigments and gas exchange. Here, one aspect of our research has focused on exploring the relationships between spectra and pigments to determine the optimal wavelength combination for the photochemical reflectance index (PRI).

We will discuss results which indicate a different formulation of the traditional 531nm and 570nm wavelengths used for PRI is more robust to samples measured throughout the canopy profile in our tall forest. Significant correlations between various pigment concentrations and branch height were also observed which has implications on the remote sensing signal at the canopy scale.