Project acronym: SPECDOC

Project title: Linking chlorophyll fluorescence from the leaf to the satellite for improved monitoring of boreal forest carbon dynamics

Project leader: Troy Magney, NASA Jet Propulsion Laboratory, Pasadena, USA

Discipline: Earth Sciences & Environment

Station(s): Hyytiälä Forest Research Station (Finland)

The impact of climate change on the carbon source-sink strength of high-latitude ecosystems is highly uncertain. The primary motivation for this research is to improve our understanding of the terrestrial carbon sink capacity of boreal forests through improved quantification of photosynthesis via chlorophyll fluorescence. Chlorophyll fluorescence is the re-emission of photons during the process of photosynthesis, however, the controls on this complex process – particularly at increasingly large spatial scales – are highly uncertain. A proper understanding of the mechanisms driving chlorophyll fluorescence and how re-emitted photons escape the photosynthetic machinery and travel through canopies, eventually reaching satellite remote sensing systems is highly uncertain. We plan to use a novel leaf level measurement system in conjunction with tower- and satellite- based remote sensing measurements to better understand the spectral and mechanistic properties of chlorophyll fluorescence.

The primary research objective is to: Investigate how fluorescence yields from both traditional active fluorescence (broadband, traditionally measured at the leaf scale) and passive fluorescence (spectral, now measured at the satellite scale) co-vary during the spring recovery of photosynthesis. Accomplishing this task will help to (1) Bridge a needed gap in understanding the mechanisms driving the relationships between photosynthesis and remote sensing data in boreal ecosystems; and (2) Link the spectral emission of fluorescence with that measured at the canopy and satellite scale (part of multi-disciplinary campaign at Hyytiala Forest Research Station in 2017) to improve our understanding of timing and spatial variation of CO2 uptake at high latitudes.