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CHANGE IN PHOTOSYNTHETIC CAPACITIES OF EARLY SUCCESSIONAL ECOSYSTEM AFTER WILDFIRES IN INTERIOR ALASKA

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Wildfire is a major disturbance in boreal forests in interior Alaska. We have measured carbon dioxide and water fluxes at a black spruce forest on permafrost (UAF-Mature; Ueyama et al., 2014) and two scars burned at 2010 (CR2010) and 2004 (PF2004; Iwata et al., 2011) in Alaska in order to understand the variations of carbon dioxide and water exchange associated with vegetation recovery after wildfires. We inferred ecophysiological parameters of a BigLeaf model coupled photosynthesis (Farquhar et al.,1980) and stomatal conductance (Ball et al.,1987) sub-models by inverting eddy covariance data (2011-2014 at UAF-Mature, 2012-2014 in CR2010 and 2013-2014 in PF2004). Inferred parameters were maximum carboxylation (Vc_{max25}) and maximum electron transfer rate (J_{max25}) at 25℃ and stomatal conductance parameters (m and b in the Ball-Berry model). First, we inferred bulk parameters for an ecosystem scale (values per ground area), and then down-scaled the parameters into a leaf scale (values per leaf area) using leaf area index (LAI) and a radiative transfer model.

Inferred bulk parameters of Vc_{max25} and J_{max25} seasonally varied and showed maximum values in summer. The bulk parameters showed seasonal and interannual variations probably due to environmental conditions, phenology, and photosynthetic capacities of individual leaves. The bulk parameters of Vc_{max25} in summer at UAF-mature (93 ± 8μmol m^{-2} s^{-1}) was larger than those at CR2010 (49 ± 8μmol m^{-2} s^{-1}) and PF2004 (39 ± 16μmol m^{-2} s^{-1}). The different values in the bulk parameters could be caused by varieties in species composition, LAI and photosynthetic capacities associated with vegetation recovery. Considering LAI in summer (1.8±0.2 m^2 m^{-2} at UAF-Mature, 0.9±0.3 m^2 m^{-2} at CR2010 and 1.1±0.2 m^2 m^{-2} at PF2004), we estimated that Vc_{max25} per unit leaf area might have a similar range among the three sites during the summer period.

Ball et al., 1987: In Progress in Photosynthesis Research, pp.221-224.
Farquhar et al., 1980: Planta, 149, 78-90.
Ueyama et al., 2014a: Global Change Biology, 20, 1161-1173.
Iwata et al., 2011: SOLA, 7, 105-108.