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Spatial scale-dependent characteristics of the fraction of absorbed photosynthetically active radiation

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The fraction of absorbed photosynthetically active radiation (FAPAR) is a ratio of absorbed PAR to incident PAR in plant canopies and is an important vegetation parameter and is widely used for the gross primary production estimation. The absorbed PAR and incident PAR are both spheradiances (actinic fluxes). The FAPAR definition that ignores the horizontally incident PAR component (FAPAR1d) results in unrealistic FAPAR estimates in heterogeneous forest when looking at high spatial resolution. We investigated the spatial-scale dependence of the relationship between FAPAR1d and the normalized difference vegetation index (NDVI) in highly heterogeneous Alaskan black spruce forest. We collected most of the necessary forest structural datasets used for three-dimensional radiative transfer simulation. At high spatial resolutions (0.1 m), FAPAR1d reaches 6. As the pixels are merged, it converges on the domain-average values. To estimate a domain-average FAPAR from satellite data, 5-meter or coarser resolution is required in sparse forests, depending on the canopy structural conditions and solar geometry.

Keywords: remote sensing, polar region, radiative transfer