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Snowy backgrounds enhance the absorption of visible light in forest canopies

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The fraction of radiation absorbed in forest canopies depends on the amount and angular distribution of the solar irradiance reaching the top of the canopy as well as the fraction of this irradiance that is transmitted through the canopy gaps and reflected back to the vegetation by the background. We show that the presence of snow on the forest floor systematically enhances the fraction of absorbed Photosynthetically Active Radiation (PAR) radiation. This observation derives from results of the application of an inversion method conducted using both MODIS and MISR broadband visible and near-infrared surface albedo products available during a full seasonal cycle. The core of the inversion method that relates the observed albedos with a radiative transfer flux model capitalizes a Bayesian approach. The inversion package generates Probability Density Functions (PDFs) of the flux model process parameters as well as PDFs of the scattered, transmitted and absorbed fluxes by the vegetation and the background layers, respectively. The current investigation addresses complex geophysical scenarios involving snow occurrence in mid and high-latitude evergreen and deciduous forest canopy systems mapped from the ESA-MERIS Globcover project . It reveals that this absorption enhancement affects evergreen and deciduous forests of the boreal zone, wherever and whenever snow covers the forest floor. Theoretical investigations based on 3-D modelling of radiation transfer in realistic forest scenarios support these observations and indicate that the absorbed fraction of PAR can even exceeds the fraction of downwelling radiation from the Sun that is intercepted by the trees. The radiative responses of evergreen needleleaf forests to sudden and drastic changes in ambient conditions in particular those imposed by the occurrence and melting of snow will then be illustrated.