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Ground-truthing for phenological observations by using satellite remote sensing in terrestrial ecosystem in Alaska

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Satellite remote-sensing is an useful tool to detect seasonal and interannual variations in sub- and Arctic terrestrial ecosystems with a high spatio-temporal resolution. However, from the *in situ* ecological research view point, the satellite remote-sensing approach has not been sufficiently tested and validated by ground-truthing. We examined the relationships between seasonal patterns of camera-based canopy surface indices, eddy-covariance-based gross primarily productivity (GPP) and satellite-observed vegetation indices at a daily time step by performing field studies in an open canopy black spruce (*Picea mariana*) forest in Alaska. The ratio of the green digital number to the total digital number, green-excess index, hue (in the hue, saturation, and intensity colour model), GPP, satellite-observed normalized difference vegetation index (NDVI), enhanced vegetation index (EVI) and green-red vegetation index (GRVI) showed bell-shaped seasonal patterns (increasing in spring and decreasing in autumn) and their correlations were detected. Although the upper layer of forest is fully covered by evergreen black spruce, canopy surface images mainly detected seasonal changes in forest-floor vegetation (*Sphagnum* moss and shrubs) and snow cover on the forest floor. These facts suggest the importance of the seasonal patterns of forest canopy and floor status for the observations of satellite-remote sensing in sparse boreal forest in Alaska. Further consideration of parameters such as the degree of canopy openness and the seasonal changes in forest-floor vegetation will therefore be required to accurately detect the intra- and interannual phenological changes in sub- and Arctic ecosystems by using the satellite remote-sensing approach.

Keywords: satellite remote sensing, ground-truthing, phenology, Alaska