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Spectral properties of subarctic plants for remote ecosystem assessment

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Multispectral and hyperspectral satellite images are increasingly used to identify properties of vegetation, its state, dynamics and productivity. Arctic vegetation is sensitive to changing habitat conditions related to both natural causes (in particular climatic trends), and human impact (both direct and indirect, e.g. associated with air, soil and water pollution).
Change in the state of individual plants and of vegetation cover in general enables their use as indicators of natural and anthropogenic processes, manifested in satellite images through change of their spectral reflectance properties. These processes can be studied by identifying significant links between spectral properties of objects in satellite images and corresponding properties of plants, recorded in situ.
We focus on the spectral signatures of subarctic plants dominating treeline ecotone ecosystems to assess the feasibility of mapping the spatial structure and dynamics of vegetation using multispectral and hyperspectral satellite imagery. Our model objects are tundra plants and ecosystems in both natural and technogenically disturbed environments in the central part of the Kola Peninsula, Russia.
We conducted ground spectroradiometry with two spectroradiometers: ASD FieldSpec 3 Hi-res (350-2500 nm range with resolution from 3 to 10 nm) and SkyeInstruments SpectroSense 2+ (bands centred at 480, 550, 680, 840 nm, 50-130 nm wide) for samples of different species: Betula pubescens S.L., B. tortuosa, Picea abies, Betula nana, Ledum palustre, Vaccinium uligimosum, V. myrtillus, V. vitis-idaea, Empetrum hermaphroditum, Cetraria islandica (L), Flavocetraria nivalis (Cetraria nivalis), Alectoria ochroleuca, Cladonia arbuscula S.L., Hylocomium splendens and Pleurozium Shreberi.
The results demonstrate the ability of green vegetation to selectively reflect solar radiation, depending on the species composition and state of the plants. Our results will be included in a spectral library of northern plants, and will help to develop techniques to use 4-channel and hyperspectral ground-based measurements jointly with multispectral and hyperspectral satellite images to study the state and dynamics of northern vegetation.
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