An Assessment of Multiangular MISR Data for Tree Cover and Height Mapping in the Tundra-Taiga Transition Zone

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Reliable land cover data over the tundra–taiga transition zone is required for environmental monitoring and modelling from the regional to the circumpolar scale. Tree cover and height are important variables to characterize this ecotone. The continuous fields of these variables would, for example, enable the delineation of the forest extent according to the different criterion and provide valuable data for land cover change detection. However, the applicability of visible to near-infrared remote sensing data is typically hampered by the pronounced reflectance of undergrowth vegetation because of the sparse tree cover and by the spectral confusion between the forest and non-forest vegetation. Directional information provides one additional data source for land cover mapping. Multi-angle Imaging SpectroRadiometer (MISR) has nine viewing angles and four spectral bands at 275 m and 1.1 km resolutions. This study examined if percent tree cover, percent coniferous and broadleaved cover and height can be predicted more accurately using multiangular MISR data than nadir-view MISR data. The study area was located in northernmost Finland. The variables were estimated using neural networks, which were trained and assessed by the high-resolution biotope and forest inventory data. The estimates were also compared to the global MODIS percent tree cover product at 500 m resolution. The estimation errors were lower when using all the spectral-angular MISR data than when using single band nadir, multispectral nadir or single band multiangular data. RMSE of the tree cover reduced from 7.8% (relative RMSE 67.4%) to 6.5% (56.1%) at 275 m resolution, and from 5.4% (49.2%) to 4.1% (36.9%) at 1.1 km resolution, when multispectral nadir data were used together with multiangular data. RMSE of the tree height estimates reduced from 2.3 m (44.3%) to 2.0 m (37.6%) and from 1.8 m (35.4%) to 1.3 m (25.4%), respectively. The largest errors occurred when shrub cover was dense and in mires, but multiangular data improved estimates also in those cases. The accuracy of coniferous and broadleaved tree cover estimates was considerably lower. Regional training data also produced good estimates in comparison to the global MODIS product. The results suggest that directional information from multiangular observations has potential to improve the tree cover and height mapping over the tundra–taiga transition zone and hence provide more accurate data for land cover change detection.