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Habitat mapping using hyperspectral images in the vicinity of Hekla volcano in Iceland

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Hekla, one of the most active volcanoes in Iceland, has created a diverse volcanic landscape with lava flows, hyaloclastite and tephra fields. The variety of geological formations and different times of formation create diverse vegetation within Hekla‘s vicinity. The region is subjected to extensive loss of vegetation cover and soil erosion due to human utilization of woodlands and ongoing sheep grazing. The eolian activity and frequent tephra deposition has created vast areas of sparse vegetation cover. Over the 20th century, many activities have centered on preventing further loss of vegetated land and restoring ecosystems. The benefit of these activities is now noticeable in the increased vegetation and woodland cover although erosion is still active within the area. For mapping and monitoring this highly dynamic environment remote sensing techniques are extremely useful.

One of the principal goals of the project ‘Environmental Mapping and Monitoring of Iceland with Remote Sensing’ (EMMIRS) is to use hyperspectral images and LiDAR data to classify and map the vegetation within the Hekla area. The data was collected in an aerial survey in summer 2015 by the Natural Environment Research Council (NERC), UK. The habitat type classification, currently being developed at the Icelandic Institute of Natural History and follows the structure of the EUNIS classification system, will be used for classifying the vegetation. The habitat map created by this new technique’s outcome will be compared to the existent vegetation maps made by the conventional vegetation mapping method and the multispectral image classification techniques.

In the field, vegetation cover, soil properties and spectral reflectance were measured within different habitat types. Special emphasis was on collecting data on vegetation and soil in the historical lavas from Hekla for assessing habitats forming over the millennia. A lava-chronosequence was established by measuring vegetation and soil in lavas formed in 2000, 1991, 1980-81, 1970, 1947, 1913, 1878, 1845, 1766-68, 1693, 1554, 1389-90, 1300, and 1206, representing surfaces of age 15–809 years. Results showed that vegetation cover established rather quickly on the lavas where mosses and lichens already created a full cover after 24 years. The cover remained stable and mosses were the dominant plant group for centuries, unless where tephra fall had occurred or where eolian deposition prevailed. The colonization of vascular plants on the lava was slow except at sites of eolian deposition and tephra fall. Dwarf shrubs and shrubs were rare or even absent on the lavas formed during the last century but their cover increased with increasing age of the lava fields. The older lava fields featured a variety of vegetation classes, indicating different rates and pathways of succession depending on altitude, proximity to eolian sources, land use and other factors. The many similarities yet big contrasts in the habitats featured within the Hekla region pose a challenge for creating a habitat map of the area, testing the potency of the hyperspectral data and classification techniques to the fullest.