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The landscape evolution at Hekla volcano, Iceland: Integrating remote sensing data from the past 70yr

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Hekla volcano is one of the most active volcanic systems in Iceland and has erupted ∼23 times since the settlement of Iceland in AD 874. Hekla is known for its mixed eruptions producing both explosive tephra deposits and effusive lava flows leaving a volcanically diverse landscape behind. The volcanic activity of Hekla has had a huge impact on the surrounding landscape and has changed the vegetation patterns and the depositional/erosional environments in different ways. Furthermore it has affected the human settlement since the occupation of Þjórsárdalur and in the past farms have been abandoned, destroyed or affected by tephra fall or by lava flows from Hekla, e.g., in AD 1104, 1389, 1436, 1693, 1725, and 1845.
To understand the linkage between volcanic units, topography, vegetation patterns, erosional and depositional changes and in the end abandonments a cross-disciplinary study monitoring the temporal and spatial changes on a big scale, along with spatial modelling is necessary.

In the project "Environmental Mapping and Monitoring of Iceland by Remote Sensing (EMMIRS)", the Hekla area is one of the two remote sensing supersites that are investigated. A benchmark repository is created, which consists of high spatial and spectral resolution data sets (LIDAR, hyperspectral and aerial photos), which were collected through an aerial survey in the summer 2015 by the Natural Environment Research Council (NERC) UK. This repository is used for both high-resolution ecological and geological mapping including classification of lava flows, their surface morphology as well as distribution of tephra deposits.

Furthermore, a temporal remote sensing archive is created stretching back to 1945. This archive allows decadal reconstruction of the landscape by construction of digital elevation models, DEMs (ca. 5m/pixel), and ortho-photos (0.5-1m/pixel) using historical aerial stereo photos. These historical DEMs serve as pre and post-eruption DEMs for the five mixed Hekla eruptions (1947-48; 1970, 1980-81, 1991, 2000) and allow unprecedented estimation of lava flow thickness and lava flow volume.
The pre-emplacement topography also constitutes the computational domain for lava flow modelling and the lava volume is another critical parameter. These parameters are derived for five Hekla eruptions and along with observational data they provide a unique possibility to calibrate the lava flow models to Hekla and correlate lava flow morphology with lava flow modelling.