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Unleashing the archive of aerial photographs of Iceland, 1945-2000. Applications in geosciences

Joaquín M. C. Belart[1], Sydney Gunnarson[1], Etienne Berthier[2], Amaury Dehecq[3], Tómas Jóhannesson[4], Hrafnhildur Hannesdóttir[4], and Kieran Baxter[5]

[1]National Land Survey of Iceland, Akranes, Iceland
[2]Université de Toulouse, LEGOS (CNES/CNRS/IRD/UT3), Toulouse, France
[3]IGE, Université Grenoble Alpes, CNRS, IRD, Grenoble INP, Grenoble, France
[4]Icelandic Meteorological Office, Reykjavík, Iceland
[5]University of Iceland's Research Centre in Hornafjörður, Höfn, Iceland

The archive of historical aerial photographs of Iceland consists of ~140,000 vertical aerial photographs acquired between the years 1945 and 2000. It contains an invaluable amount of information about human and natural changes in the landscape of Iceland. We have developed a series of automated processing workflows for producing accurate orthomosaics and Digital Elevation Models (DEMs) from these aerial photographs, which we're making openly available in a data repository and a web map visualization service. The workflow requires two primary inputs: a modern orthomosaic to automatically extract Ground Control Points (GCPs) and an accurate DEM for a fine-scale (sub-meter) alignment of the historical datasets. We evaluated the accuracy of the DEMs by comparing them in unchanged terrain against accurate recent lidar and Pléiades-based DEMs, and we evaluated the accuracy of the orthomosaics by comparing them against Pléiades-based orthomosaics. The data are becoming available at https://loftmyndasja.lmi.is/. To show the potential applications of this repository, we present the following showcases where these data reveal significant changes the landscape in Iceland in the past 80 years: (1) volcanic eruptions (Askja 1961, Heimaey 1973 and the Krafla eruptions, 1975-1984), (2) decadal changes of Múlajökull glacier from 1960-2023, (3) Landslides (Steinsholtsjökull 1967, Tungnakvíslarjökull 1945-present) and (4) coastal erosion (Surtsey island).