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Countrywide surface models from historical panchromatic and true color stereo imagery – a retrospective analysis of forest structures in Switzerland

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Countrywide surface models from historical panchromatic and true color stereo imagery – a retrospective analysis of forest structures in Switzerland

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Remote sensing methods allow the acquisition of 3D structures of forests over large areas. Active systems, such as Airborne Laser Scanning (ALS) and Synthetic Aperture Radar (SAR) and passive systems, such as multispectral sensors, have been established to acquire 3D and 2.5D data of the earth's surface. Nationwide calculations of surface models with photogrammetric methods from digital stereo aerial images or ALS data are already in operation in some countries (e.g. Switzerland, Austria, some German states).

The availability of historical stereo aerial images allows the calculation of digital surface models from the past using photogrammetric methods. We present a workflow with which we have calculated nationwide surface models for Switzerland for the 1980s, 1990s and 2000s. Current surface models are available from the National Forest Inventory (LFI) Switzerland.

In the context of the Swiss land use and land cover statistics, the Federal Office of Topography (swisstopo) scanned and oriented the analogue black and white stereo aerial photographs with a mean scale of ~1:30'000 of the nationwide flights of 1979 - 84 and1993 - 1997 with 14 µm. The true colour image data from 1998 – 2007 were scanned for the production of the orthoimages swissimage by swisstopo. All these data – the scanned images and the orientation parameters - are also available to the National Forest Inventory (NFI). Within the framework of the NFI, we developed a highly automated workflow to generate digital surface models (DSMs) from many thousands of overlapping frame images covering the whole country. In total, more than 25'000 individual stereo models were processed to nationwide surface models. For their normalization, the digital terrain model of Switzerland 'swissAlti3D' was used. As the image orientation in some areas showed high vertical inaccuracies, corrections had to be made. Data from the Swiss land use and land cover statistics were used for this purpose. At places with constant surface cover since

the 1980s (e.g. grassland), correction grids were calculated using the digital terrain model and applied to the surface models.

The results are new data sets on the 2.5D surface of Switzerland from the 1980s, 1990s and 2000s with a high spatial resolution of 1 m. It can be stated that the completeness of the image correlation in forested areas was quite satisfactory. In open areas with agricultural land, however, the matching points were often reduced to the road network, as the meadows and fields in the scanned SW stereo aerial images had very little texture.

This new historical, nationwide data on the horizontal and vertical structure in forests now allows their analysis of changes over the last 40 years.