



UNIVERSITÄT  
BERN

OESCHGER CENTRE  
CLIMATE CHANGE RESEARCH

## Processing Line for Monitoring Glacier Outlines and Snow Area Extent by Means of Sentinel-2 Data

Gabriele Schwaizer (gabriele.schwaizer@enveo.at), Johanna Nemec, Helmut Rott, Thomas Nagler  
*ENVEO IT GmbH, Austria*

Glaciers are important climate indicators and water storages. The melt water from glaciated areas is an important water resource for human consumption, irrigation and hydropower generation. While total glacier areas are changing gradually as response to variations of regional climate, the extent of snow area during the ablation period is subject to rapid changes driven by atmospheric forcing. The regular observation of snow area extent at the end of the ablation season, which on the multi-year average is a proxy for the accumulation area, can be used as indicator for estimating the impact of annual changes in climate forcing on glacier mass balance.

Glacier areas from optical satellite data have been widely mapped based on Landsat, SPOT, and other high resolution optical satellite data, applying different methods. Data bases from different sensors and years, used for generating glacier inventories, show considerable differences in completeness and detail for the different global glacier regions. The first Sentinel-2 satellite of the European Copernicus programme, launched in June 2015, provides a new comprehensive data base, combining high resolution with an increased spatial coverage and 13 bands in the VNIR and SWIR spectral range. At clear sky conditions, large glaciated areas can be observed by one scene. The improved repeat observation frequency, which will be further increased with the second Sentinel-2 satellite (planned to be launched in 2017), enhances the chances to acquire clear sky images at the end of the ablation period.

We exploit the spectral capabilities of the multispectral instrument (MSI) on board of the Sentinel-2A satellite to improve the processing chain for retrieving glacier outlines as well as for mapping the extent of snow areas. We implemented an automated processing chain, including topographic and atmospheric correction applied to the spectral top of atmosphere reflectances, and combine multiple spectral bands and auxiliary data to generate an interim product on glacier area extent. The aim of the automated classification is to minimize the efforts for manual corrections of glacier areas, as e.g. by identifying debris-covered ice. Based on the corrected spectral bands and the generated glacier outlines, a semi-automated processing chain is applied to identify the snow and ice areas on glaciers. We demonstrate the application of the processing line for monitoring glacier outlines and snow area extent for two Sentinel-2 scenes over the Austrian Alps, acquired on 15 August 2015 and 27 August 2016. The output is used to update the Austrian Glacier Inventory, including glacier outlines and snow/ice area extent in late summer.