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A comparison of glacier classification with Sentinel 2 MSI and Landsat 8 OLI

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The recently launched Sentinel 2 satellite with its sensor Multi Spectral Imager (MSI) offers unprecedented possibilities for automated and much more precise glacier mapping at global scales than other freely available sensors (e.g. the commonly used Landsat). With its 10 m spatial resolution in the VNIR bands (20 m in SWIR) and the large swath width of 290 km it will theoretically be possible to map all glaciers in a country such as Switzerland or Austria in a single day. The higher repeat frequency also offers better chances for a cloud free acquisition in a comparably short end-of-summer time-window. As the spectral ranges of the VNIR and SWIR bands of MSI and the Operational Land Imager (OLI) on Landsat 8 are very similar, glaciers (clean ice and snow) can be mapped automatically with previously applied methods such as the TM3/5 (OLI4/6, MSI 4/11) band ratio.

In this study a Sentinel 2 precursor dataset (from the commissioning phase) acquired on August 29, 2015 over the Swiss Alps is used to map glaciers with the band ratio method mentioned above and compared to outlines derived from a Landsat 8 OLI scene of the same region acquired only 2 days later (on 31.8. 2015). Additional to the classic red/SWIR band ratio, we have also used the 15 m resolution panchromatic band of OLI instead of the red band to map glaciers. Before the high-resolution band ratios were calculated, the SWIR bands of OLI and MSI were resampled with a bilinear interpolation to a two-times higher spatial resolution. The ratios were applied to the raw digital numbers of all bands without any further correction and threshold values were manually selected.

First results show that the red/SWIR ratio for MSI required an additional threshold in the blue band for accurate mapping of snow and ice in shadow, whereas this was not required for OLI. In general, all outlines overlap within the geometric accuracy of the orthorectification, but the 30 m outlines from the OLI red/SWIR ratio were generally found outside of the 15 and 10 m outlines from the OLI and MSI. This is basically a consequence of the full consideration of mixed pixels when using the 30 m red/SWIR ratio. For the same reason narrow debris bands (medial moraine) on glaciers are classified as glacier ice with 30 m OLI bands but not with the 15/10 m OLI/MSI bands, thus requiring a higher work-load for manual editing. On the other hand, with the 10 m resolution MSI sensor the debris-covered parts are much better visible and a higher accuracy and consistency for the manual mapping can be achieved.