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Aufeis in the Upper Indus Basin – time-series analysis for the detection of seasonal cryosphere components under climate change

In the semi-arid high mountains of the Upper Indus Basin, meltwater supply from the cryosphere is vital for irrigated agriculture and hydropower generation. A neglected cryosphere component that might be crucial for local irrigation systems is *aufeis*, which appears as a sheet-like formation of ice layers, created by successive and laminated freezing of flowing water. This study aims to redress the lack of knowledge about this seasonal phenomenon by creating an inventory of *aufeis* and analysing their spatial distribution, including the role of topographical parameters.

The analysis is based on a Landsat time-series using imagery from 2010 to 2020, supported and validated by several field campaigns carried out between 2014 and 2020. In total, 8274 images covering 22 Landsat tiles over an area of 166,000km² were used and processed with the Google Earth Engine platform.

In total, more than 3700 *aufeis* fields in the whole Upper Indus Basin were detected, covering an area of about 298 ± 38 km². The spatial distribution of their occurrence indicates a distinct elevation range between 4000 and 5500 m a.s.l. and is marked by a pronounced longitudinal increase to the east. In contrast to the western part of the UIB (Gilgit-Baltistan), where only some few and small *aufeis* fields can be detected, 65% of the *aufeis* covered areas (195 ± 23 km²) exist on the Tibetan Plateau. Our database fills an important research gap and will help in further cryosphere studies in the UIB and beyond.