4.4. Slope instabilities in a changing high mountain environment: 16 years of monitoring the rock fall area at Mittlerer Burgstall, Austria

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Abstract: In June 2007, an extensive rock fall releasing a volume of appr. 450,000 m³ occurred at the Mittlerer Burgstall (2903 m.as.l.), near Pasterze Glacier, Austria. This extraordinary event was the initial event to establish a comprehensive monitoring network since 2007. This monitoring activities comprise continuous monitoring (ground temperature monitoring, since 2007), annual to sub-annual repeat measurements (terrestrial laserscanning until 2021; unmanned aerial vehicles/ UAV 2021) as well as geophysical campaigns (electrical resistivity tomography/ERT in 2020). In addition, in 2022 and 2023 small scale (1:2000) geological mapping was carried out in order to get a better understanding of geological preconditions in terms of fracture system and foliations. Results from annual surface deformation analysis derived from TLS and UAV surveys propose that the processes leading to the event of 2007 are not completed yet. The entire SE ridge of the Mittlerer Burgstall is still moving towards NE showing average movement rates of 23 - 93 cm/a between 2019 and 2022. During the period

2007 to 2022, the mean annual ground temperature at the surface and at depth (10 and 55 cm) changed from predominantly slightly negative to predominantly positive suggesting warm permafrost conditions. Such thermal conditions are in general suitable for deforming rock masses. In addition, the ERT campaign in September 2020 revealed for the mountain summit plateau of Mittlerer Burgstall a several meter thick unfrozen layer covering both near-surface permafrost lenses as well as massive permafrost at greater depth suggesting degrading permafrost conditions. We conclude that the movement of the block mass seems to be an interaction of the persisting block slide also affected by the ongoing melting of an adjacent glacier part of the Pasterze Glacier, which formerly acted as stabilizer of the now deglaciated rock face.