



Two contrasting soil movements contributing to the advance of solifluction lobes in the Swiss Alps

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Movements of stone-banked lobes developed on a limestone slope were observed for 12 years with strain probes and painted lines. Frost heave, soil temperature, moisture and snow depth were also monitored. The lobes are located below the permafrost limit but subject to deep seasonal frost penetration (1–2 m). The long-term monitoring demonstrates that, despite the same soil condition, two kinds of mass movements contribute to the advance of the lobes. Slow, normal solifluction that follows seasonal frost heave by 4–5 cm and subsequent thaw settlement occurs annually over the whole lobes with a mean surface rate of 4 cm a⁻¹ and the movement base at about 40 cm. This process constantly advances the lobes, preserving the thickness of the mobile layer until reaching a concave break of slope or a braking vegetation or rocks. On steeper slopes located just below a late-lying snow patch, the normal solifluction process is often superimposed by rapid, shallow mudslide up to 20 cm thick. The rate of surface movement varies spatially, in places exceeding 2 m per event. Mudslides are likely triggered by supersaturation of soils below or beyond a melting snow patch. The transported sediments are deposited on the surface of the lower part of the lobe, which results in a lobe with a gentle surface and a high, steep frontal slope.