Drivers and Estimates of Terrain Suitability for Active Layer Detachment Slides and Retrogressive Thaw Slumps in the Brooks Range and Foothills of Northwest Alaska, USA

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Active layer detachment sliding and retrogressive thaw slumping are key modes of upland permafrost degradation linked with climate trends, ecosystem impacts, and permafrost carbon release. In the Brooks Range of northwest Alaska, they are widespread, with distribution associated with multiple landscape properties. Covarying terrain properties, including surficial geology, topography, geomorphology, vegetation and hydrology, are key drivers of permafrost landscape characteristics. However, these inter-relationships as drivers of terrain suitability for active layer detachment (ALD) and retrogressive thaw slump (RTS) processes are poorly understood in this region. We empirically tested and refined a hypothetical model of terrain factors driving ALD and RTS terrain suitability, then generated terrain suitability estimates across the region. Terrain data were examined against locations of 2,492 ALDs and 805 RTSs using structural equation modelling and integrated terrain unit analysis. Factors significant for model fit substantially constrained region-wide terrain suitability estimates, suggesting that omission of relevant factors leads to broad overestimation of terrain suitability. Mapped estimates of terrain suitability were used to quantify and describe suitable landscape settings. 51% of the region is estimated suitable terrain for retrogressive thaw slumps, compared with 35% for active layer detachment slides, and 29% of the region estimated suitable for both.