



Are damages to infrastructure at high elevation in the French Alps related to permafrost warming?

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Ski resorts have been extensively developed in the French Alps over the past four decades and several hundred ropeway transport systems have been installed on permafrost. Due to current climatic change, the vulnerability to destabilization of these infrastructures may increase. There is indeed a high risk for developing instabilities. A better understanding of the processes involved is thus needed. This study investigates the relation between permafrost and infrastructure stability, trying to understand the evolution of this phenomenon over the past decades. This was done by following a two steps analysis in the framework of the EU POIA Project PermaRisk. First, the infrastructure elements built on modelled permafrost areas were inventoried at the French Alps scale in order to get an overview of the possible vulnerabilities. Then, this study presents a detailed historical inventory of damage to infrastructure over the past three decades in different geomorphologic contexts.

Overall, in the French Alps, there are about thousand infrastructure elements located in permafrost areas. In this study, 12 infrastructures (24 infrastructures elements) were identified as having been affected by repeated instances of disruption and deterioration and most of the damage recorded were in areas where permafrost degradation was fully expected (ice-rich terrain at relatively low elevations). Infrastructure recovery costs may be significantly high, making this issue a relevant process to be took into account in the design process.