Geophysical Research Abstracts
Vol. 19, EGU2017-7417, 2017
EGU General Assembly 2017

The triggering factors of the Móafellshyrna debris slide in northern Iceland: intense precipitation, earthquake activity and thawing of mountain permafrost

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On the 20th of September in 2012, a large debris slide occurred in the Móafellshyrna Mountain in the Tröllaskagi peninsula, central north Iceland. Three factors are likely to have contributed to the failure of the slope: intense precipitation, earthquake activity and thawing of ground ice. The weather conditions prior the slide were somewhat unusual, with a warm and dry summer. From the 20th of August to the 20th of September, about 440 mm of precipitation fell in the area, where the mean annual precipitation at the nearest station is around 670 mm. The slide initiated after this thirty day period of intense precipitation, followed by a seismic sequence in the Eyjafjarðaráll graben, located about 60 km NNE of Móafellshyrna Mountain, a sequence that started on the 19th of September. The slide originated at elevation of 870 m a.s.l. on the NW-slope of the mountain. The total volume of the debris slide is estimated around 500,000 m3 and that its primary cause was intense precipitation. We cannot exclude the influence of the seismic sequence as a secondary contributing factor. The presence of ice-cemented blocks of talus immediately after the debris slide shows that thawing of ground ice could also have played an important role as a triggering factor. Ice-cemented blocks of talus have been observed in the deposits of two other recent landslides in northern Iceland, in the Torfufell Mountain and the Árnesfjall Mountain. The source areas for both the Móafellshyrna and the Torfufell slides are within the lower elevation limit of mountain permafrost in northern Iceland but the source area of the Árnesfjall slide is at much lower elevation, around 350 m a.s.l. The fact that there are now three documented landslides which are linked to ground ice-melting suggests that discontinuous permafrost is degrading in Iceland, consistent with the decadal trend of increasing atmospheric temperature in Iceland due to climate change. This study highlights that ground ice thaw could represent a new source of hazard in Iceland. The knowledge of the detailed distribution of mountain permafrost on the island is poorly constrained, making it is hard to predict where the next hazardous slide could occur in the future – therefore a making this a priority for future research.