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Using glaciers to identify, monitor, and predict volcanic activity

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Many (about 250) volcanoes worldwide are occupied by glaciers. Often glaciers are regarded as problematic for volcano monitoring, since glacier ice potentially masks evidence of volcanic activity. The most devastating volcanic eruptions of the last 100 years involved volcano-glacier interactions. The 1985 eruption of Nevado del Ruiz killed 23000 people, and the 2010 eruption of Eyjafjallajökull led to the closure of many European airports. Therefore, it is imperative to minimize these impacts on society by improving methods for monitoring of glacier-clad volcanoes. Amongst several methods, optical satellite remote sensing techniques are perhaps most auspicious, since they frequently have a relatively high temporal and spatial resolution, and are mostly freely available. They often clearly show the effects of volcanic activity on glaciers, including ice cauldron formation, ice fracturing and glacier terminus changes potentially due to subglacial melt or subglacial dome growth. This study has the objective to link pre-, syn- and post-eruption glacier behaviour to the type and timing of volcanic activity, and to develop a satellite based predictive tool for monitoring future eruptions. Despite several studies that link volcanic activity and changing glacier behaviour, the potential of using the latter to predict the former has yet to be systematically tested. Our approach is to observe how glaciers responded to past volcanic events using mostly, but not exclusively optical satellite imagery, and to build a database of examples for potential automated detection and forecasting on a global scale.