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Permafrost long-term monitoring network

WP6 Permafrost and Natural Hazards
Action 6.1 – Method sheet

Global Positioning System (GPS)

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General information	
Category	Geodetic Surveying
Background	
Basic principles	
Technology	The Global Positioning System (GPS) is a space-based global navigation satellite system (GNSS) that provides reliable location and time information in all weather and at all times and anywhere on or near the Earth when and where there is an unobstructed line of sight to four or more GPS satellites. We used differential GPS techniques (Ashtec Z-Extreme 12 channel L1 and L2) and Ashtec Z-Max.
Data processing	The Ashtec instruments were equipped with GART 2000 software which allowed calculation of coordinates (horizontal displacement and direction) *in situ*. One receiver (reference station) is positioned at a fixed survey location not on the surface of the rock glacier, whereas the second receiver (rover) is used to measure the different survey markers on the rock glaciers by real time kinematics (RTK). This method has several advantages including rapid measurements and a high accuracy of <1 cm.
Possible applications	
Why?	Determination of surface displacements and elevation changes
What?	Glaciers, rock glaciers, landslides,
Where?	Grassland, bare, not available in forested areas
Main results	
- RapiD measurements (real time data availability of coordinates) - Map of morphological changes concerning displacement and elevation - Determination of flow velocities of mass movements (glaciers, rock glaciers, landslides)	
Main advantages	
- High precision (mm) - Low installation and maintenance efforts - Measures range: mm-km - Data availability: real time - Measurements even possible when cloudy or during rainfall, snowfall - If the GPS instruments are available the costs are low. 2 – 3 persons are necessary to carry the equipment. Depending on the topography up to about 150 points can be measured per day.	

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Main disadvantages/problems

- Data processing is complex
- Very low temperatures (below -10°C) may cause technical problems (energy support)
- Highly specific software

References

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Reference station positioned at a fixed survey point in front of the Reichenkar rock glacier (Tyrol, Austria), a typical tongue-shaped, 1400m long, ice-cored active rock glacier connected to a debris-free cirque glacier.

Rover used to measure the survey markers on the Reichenkar rock glacier by real time kinematics (RTK)