

# GeoGuard: low-cost GNSS sensors for the continuous monitoring of landslides and structures

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The United Nation Office for Disaster Risk Reduction warned that economic losses from landslides, floods, earthquakes, and drought will continue to escalate unless businesses take action to reduce their exposure to disaster risks. Structures can suffer structural deterioration due to aging, misuse or lack of proper maintenance. In addition, they are subject to exposure to natural hazards such as landslides, floods, and earthquakes. Traditional visual inspection techniques are both time consuming and expensive. They are also qualitative and can only assess outward appearance. Structures and natural hazard control and management are becoming one of the key issues in the approach to sustainable development of modern countries. In this framework, structural health monitoring is representing one of the most valuable approaches for the decision-making process. Global Navigation Satellite System (GNSS) technology can provide position information with accuracy to a few millimeters in near real-time. However, the widespread adoption of GNSS monitoring is hindered by the high cost of dual-/multi-frequency geodetic GNSS receivers.

In 2015, through a partnership with the Italian company Softeco, GReD started GeoGuard, an innovative end-to-end service for the continuous monitoring of landslides and structures by means of single-frequency GNSS low-cost receivers and antennas. GeoGuard provides accurate positioning with centimeter-level accuracy in near real-time, or millimeter-level accuracy for daily/sub-daily solutions. The GNSS network observations are processed by means of both Bernese software, and an ad-hoc evolution of goGPS, a free and open source positioning software package developed by the GReD team. A software platform was developed for the management of a GNSS positioning service, and for the visualization and delivery of results. Currently, GeoGuard uses GPS L1 observations for its operational activities; however, promising results are being obtained with the addition of Galileo E1 observations, especially for sites with limited sky visibility, and to improve the accuracy of sub-daily (e.g. hourly) solutions. Currently, the GeoGuard service is operational on two landslides, a highway bridge, a dam, and two penstocks.

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