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The Gardiola landslide: evolution and reactivation threshold definition through eight years of continuous monitoring activity

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Following heavy rainfalls and due to the particular meteo–climatic conditions occurred on October 16th, 2000, the north western part of Italy was interested by widespread landslides and flood phenomena. In particular a landslide phenomenon was triggered along the left side of Val Germanasca that exposed the Provincial Road No. 169 to risk. The extent of the unstable volume (about 700,000 cubic meters) could have led, in case of failure, to a natural damming of the valley that could have been followed by a dam-break flood. Thus the urgent need to monitor the evolving phenomenon and to assess all the available actions to be taken in order to mitigate the risk.
After the installation of a first provisional monitoring system, a permanent monitoring system, able to follow the phenomenon evolution, was set up. The system was progressively expanded and it is still running. The monitoring network is made up of an automatic total station and a network of wire – extensometers. This coupled measuring system was designed to make monitoring possible even in bad atmospheric conditions Then the monitoring network was expanded with the addition of a borehole inclinometer and a piezometer. Continuous monitoring brings added value for both emergencies management and the study of the dynamical evolution of the phenomenon. As far as phenomena that are subject to seasonal reactivations are concerned, the use of monitoring systems brings a significant improvement of knowledge. This proves to be even more useful during the risk mitigation phase than during the study of the evolutionary trends of the phenomena. The case of Gardiola demonstrated how a careful analysis of the phenomenon makes possible an effective management of the most critical moments, together with a careful design of effective and not expensive mitigation works. Data provided by the monitoring system allowed the realisation of less expensive and less invasive facilities that work only during the acme of the phenomenon. On the contrary the monitoring system allows a careful surveillance during the year, which increases in case of heavy rainfalls. This system is therefore effective in order to manage and get through critical phases, when it may be necessary a continuous monitoring. Moreover, the large amount of data gathered in eight years of continuous monitoring, has been used to define a relationships between displacements and rainfalls and to recognise a new landslide sector now particular active.