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Hydrologically induced slope deformations detected by GPS and clinometric surveys in the Cansiglio Plateau, southern Alps

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Changes in groundwater or surface water level may cause observable deformation of the drainage basins in different ways. We describe an active slope deformation monitored with GPS and tiltmeter stations in a karstic limestone plateau in southeastern Alps (Cansiglio Plateau). The observed transient deformation clearly correlates with rainfall. Both GPS and tiltmeter equipments react instantly to heavy rains displaying abrupt offsets, but with different time constants, demonstrating the response to different catchment volumes.

The GPS movement is mostly confined in the horizontal plane (SSW) showing a systematic tendency to rebound in the weeks following the rain. Four GPS stations concur to define a coherent deformation pattern of a wide area (12x5 km^2), concerning the whole southeastern slope of the plateau. The plateau expands and rebounds radially up to a few centimeters after rain, causing only small vertical deformation. The effect is largest where karstic features are mostly developed at the margin of the plateau, where a thick succession of Cretaceous peritidal carbonates faces the Venetian lowland.

A couple of tiltmeters installed in a cave at the top of the plateau, detect a much faster deformation, that has the tendency to rebound in less than 6 hours. The correlation to rainfall is less straightforward, and shows a more complex behavior during rainy weather.

The different responses demonstrate a fast hydrologic flow in the more permeable epikarst for the tiltmeters, drained by the fractures concentrating around the cave, and a rapid tensile dislocation of the bedrock measured at the GPS stations. In the days following the rain, both tiltmeter and GPS data show a tendency to retrieve the displacement which is consistent with the phreatic discharge curve. We propose that hydrologically active fractures recharged by rainfall are the most likely features capable to induce the observed strain variations.