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A new method to detect changes in displacement rates of slow-moving landslides using InSAR time series

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Slow-moving landslides move downslope at velocities that range from mm year^{-1} to m year^{-1}. Such deformations can be measured using satellite-based synthetic aperture radar interferometry (InSAR). We developed a new method to systematically detect and quantify accelerations and decelerations of slowly deforming areas using InSAR displacement time series. The displacement time series are filtered using an outlier detector and subsequently, piecewise linear functions are fitted to identify changes in the displacement rate (i.e., accelerations or decelerations). Grouped accelerations and decelerations are inventoried as indicators of potentially unstable areas. We tested and refined our new method using a high-quality dataset from the Mud Creek landslide, California, USA. Our method detects accelerations and decelerations that coincide with those previously detected by manual examination. Second, we tested our method in the region around the Mazar dam and reservoir in Southeast Ecuador, where the time series data were of considerably lower quality. We detected accelerations and decelerations occurring during the entire study period near and upslope of the reservoir. The application of our method results in a wealth of information on the dynamics of the surface displacement of hillslopes and provides an objective way to identify changes in displacement rates. The displacement rates, their spatial variation, and the timing of accelerations and decelerations can be used to study the physical behavior of a slow-moving slope or for regional hazard assessment by linking the timing of changes in displacement rates to landslide causal and triggering factors