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Inversion of deformation fields time-series from optical images, application to the long term kinematics of slow-moving landslides

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Slow-moving landslides are one of the major risks in mountainous areas. They are the cause of a lot of damages, both material and human as they can at any time exhibit sudden acceleration phases and flows that are generally difficult to predict. Landslide kinematic is driven by, inter alia, precipitation and water infiltration, river erosion, earthquakes and human activities. Complex interactions have been observed between climatic forcing and earthquakes. However, observations of these complex interactions on slow-moving landslides are very few, restricting the comprehension that we have on involved mechanisms. In this context, it is necessary to monitor slow-moving landslides over time. We propose to answer this problematic by studying slow-moving landslides over a long time period in the Colca valley, Peru, affected by both earthquakes and rainfalls. We will base our study on the 30-years long SPOT1-7/Pleiades archive, that confronts us with (1) low dynamic of images, (2) difference of pixel resolution between all acquired images and (3) long time span in between images leading to ground surface changes. To overcome these three limitations, this study proposes an adaptation to optical images of a method originally used for InSAR time-series analysis. This method uses the full redundancy of information to derive robust time-series of displacement from deformation fields. The retrieved displacement time-series obtained on the three largest landslides of the area are robust and coherent in time. The developed method allows decreasing the displacement uncertainties by approximately 25%. Eventually, we discuss the impact of the different forcing on the three main landslides of the region.