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Measuring short-term surface deformation from the correlation of multiple Pleiades very-high resolution satellite images

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The recently launched Pleiades satellite constellation enables image acquisition of VHR resolution images with unprecedented short intervals of up to one image per day at submetric spatial resolution. The resulting enhanced availability of VHR optical images offers new opportunities for the frequent monitoring of small scale surface deformation induced by slow-moving landslides, whereas the agile acquisition geometry also poses new challenges for the application of digital image correlation (DIC) techniques. Since the satellite tasking does not allow for selecting specific view angles, it remains challenging to separate apparent parallax shift from real surface displacement with a single image pair. Additionally, at very-high spatial resolutions errors in the DEM used for orthorectification typically induce a stronger bias relative to the absolute pixel size.
In this study, we applied DIC to characterize the surface deformation of three large landslides (La Valette, Poche, Super-Sauze) located in the Barcelonnette basin (Southern French Alps) from a triplet of Pleiades satellite images acquired in 2012. Image correlation was performed using a hierarchical approach operating on the first order derivate of the image. To evaluate the impact of view angle differences and orthorectification errors DIC measurements were applied on two pairs recorded at different geometries using different available DEMs for orthorectification. The respective obtained displacement vectors were compared with dGPS measurements. Current limitations resulting from variable view angles and the quality of the DEM used for orthorectification, as well as possible strategies for a joint inversion of 2D displacement vectors from measurements at two different view angles are being discussed.