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Deformation responses of slow moving landslides to precipitation in the Northern Apennines (Italy).

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Slow moving landslides are a frequent feature in the Northern Apennines of Italy and one of the main landscape forming agents. Among the most common landslide types are complex earth flows that occur in chaotic clay-shales and complex rock slides in highly fractured flysch. We present the results of an InSAR-based survey in the Reno and Panaro river catchments, which are located South of Bologna and Modena in the Northern Apennines of Italy. We processed Envisat and Cosmo-SkyMed radar data using the Stanford Method of Persistent Scatterers (StaMPS) and documented movement on 62 deep-seated landslides. These landslides were compared to the regional landslide inventory that contains information about the type of landslide, its state of activity and the lithological characteristics of the host rock. Of the landslides found using InSAR, 42 % correspond to active landslide bodies in the regional inventory, while 48 % are mapped as dormant and 10% are not previously mapped. InSAR-derived landslides often do not correspond to the exact extent of mapped landslide bodies. InSAR results show two recurring styles of deformation: (1) earthflows involving chaotic clay-shale units that exhibit steady state displacement, or exhibit long-term (multi-annual) accelerations and decelerations, or (2) complex landslides in flysch units that are characterized by distinct increases in displacement rate following periods (weeks-to-months) of intense precipitation. Such differences in behavior might be due to inherent differences in the mechanical and hydraulic characteristics of the material in relation to the specific climatic forcing experienced during the observation period (2003 and 2015). Flysch units are relatively more fragile and have higher permeability when compared to clay-shale units. Hence the deformation response to the precipitation is likely faster and characterized by more abrupt accelerations and decelerations.