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Considerations on regional continuous Sentinel-1 monitoring services over three different regions

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In 2016, a first worldwide continuous monitoring was proposed and implemented over the Tuscany Region (central Italy). It was the first application of SAR (Synthetic Aperture Radar) images for continuous monitoring of on-going ground deformations and, thanks to a PS (Permanent Scatterers) time-series data-mining for identifying changes in the trend, i.e. sudden accelerations or decelerations. The data-mining algorithm was devoted to automatically recognize trend variations higher than a velocity threshold in a determined time span. The continuous monitoring approach benefits from the launch, in 2014, of the Sentinel-1 constellation that allows having a constant flux of images every 12 days (halved to 6 days since 2016 considering the twin satellite at 180° on the same orbit). Two years after Tuscany, in April 2018, the Valle d'Aosta Region, north-western Italy, implemented a similar system to monitor its territory. The challenge was to apply the same approach, with very few changes adopted, in a region with completely different geological and geomorphological features, also considering the snow and glacial covering in winter. In fact, the Tuscany territory is characterized by wide plains, gentle slopes, and mountainous ridges limited to the eastern border in concomitants with the Northern Apennines. Consequently, the ground deformation phenomena in Tuscany are related to active and dormant landslides and subsidence phenomena, mainly due to groundwater extraction and, less commonly, geothermal activity. Valle d'Aosta Region, on the contrary, is almost all characterized by steep slopes with a central close valley. For this reason, the ground deformations to recognize and monitor are almost totally related to landslides, DSGSDs (deep-seated gravitational slope deformation) or rock glaciers. Then, a year later, in July 2019, the continuous monitoring was activated also over the Veneto Region, North-East of Italy. Its territory has partially similar characteristics to Tuscany, in the southern portion, and to the Valle d'Aosta features, in the northern part. Considering the geological and geomorphological properties, the detected ground deformations from Veneto Region share many similarities with the ones from the other two regions. These three laboratories were critically investigated, and after one-year of life, the benefits and the drawbacks of this approach over different environments were highlighted. For all the regions, separately (i) the spatial distribution of the anomalies regions, considering the slope, the aspect, the land cover, and the height, (ii) the persistency of the anomalies along time, (iii) and the correspondence between highlighted moving areas and known inventories, were investigated. At the end, considerations about the benefits evidenced by the use of this approach, considering also the good feedback of the regional administrative personnel, and the required improvements were critically taken into account.