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Local scale of ground deformation along faults in area and vicinity of one possible Einstein Telescope location

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The Einstein Telescope area was a research site of a project called Ground Deformation from Meteorological, Seismic and Anthropogenic Changes Analyzed by Remote Sensing, Geomatic Experiments and Extended Reality (GERMANE), which aimed to analyze ground deformation hazards induced by meteorological changes and seismotectonic conditions in eastern Belgium, western Germany and the south-eastern Netherlands. Within the project we proposed and applied an approach based on various Synthetic Aperture Radar Interferometry (InSAR) processing methods to detect and measure ground motions in time series. We focused on the Persistent Scatterer Interferometry (PSI), Small Baseline Subset (SBAS) and Parallel Small BAseline Subset (P-SBAS) methods. An important issue was that the current neotectonic activity in the target area was not well known, but through spatiotemporal analysis of ground deformation we investigated behavior along NW-SE trending normal faults, where karst also develops, as well as along Variscan NE-SW trending thrust faults. Time series analyzes were performed along Gueule fault and Gulp fault, which cross the Einstein Telescope area in the Pays de Herve (Belgium) and Heerlerheide fault in the Roer Valley Graben (Germany). We calculated the relative double difference (RDD) of Line of Sight (LOS) displacements to estimate relative deformation of one point with respect to the other. Additionally, we detected regression lines with Bayesian information criterion (BIC) that enables to choose the model which represents better the set of data points corresponding to specific InSAR techniques in double difference. In results, annual velocity rates of the benchmarks extracted along the Gueule and Gulp faults were less than -2mm/yr – which are insignificant value. However, comparing the velocity values for the extracted benchmarks along the faults, it can be seen that the Gulp fault is characterized by slightly higher annual velocities than the Gueule fault. Our time series analyses results along the Heerlerheide fault indicated that its eastern face is uplifting with velocity rates of up to 8 mm/yr. The obtained InSAR results are very small and can be described as insignificant, therefore we cannot find increased seismic activity of the analysed faults, especially the Heerlerheide and Gueule ones, as old mining activity may be responsible for the observed deformation. In sum, the faults crossing the Einstein Telescope area do not show significant displacements, which confirms the initial hypothesis of their low seismotectonic activity. Therefore, we consider the possible Einstein Telescope location as being relatively stable.