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# Feasibility study on the use of Sentinel-1 data for the identification and change detection of badlands in Spain

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Badlands are a typical landscape in the Prepyrenees. They are characterized by steep slopes with sparse vegetation and are therefore vulnerable for erosion induced by heavy rainfalls. The erosion influences the sediment budget in the surrounding river catchments. In the study area, located at the Ésera river catchment, high erosion rates at the badlands are mainly expected in autumn and spring according to much rainfall at that time.
The objective of this study is the usage of remote sensing techniques to identify badlands at a regional scale and to detect changes at a local scale. The common methods for classification and change detection in remote sensing are often based on optical data. However, clouds may prevent the visibility of the Earth, which makes it impossible to detect changes with optical data. On the contrary, radar sensors are a data source independent of clouds. Therefore this study focuses on the use of Sentinel-1 radar data.
In the first step the amplitude and coherence information from multitemporal Sentinel-1 data from August to December 2016 were analyzed regarding their potential to distinguish different land cover types. Based on it, a classified image of the study area was derived with the maximum likelihood algorithm. For comparison a second land cover classification was run with one multispectral dataset of Sentinel-2 from a similar acquisition time. The mean spectral signature of the badlands carried out from the SAR data appears to be distinguishable from other classes, but the signature has the highest standard deviation. Hence the classification result from the Sentinel-1 dataset has a lower accuracy then the result from optical data. A RGB-composite from Sentinel-2 was used to compare the classification results visually.
Differential interferometric SAR (DinSAR) is a common approach to quantify displacements and the feasibility for the detection of subsidence at badlands was investigated in a second step. As the coherence is high for the badland landscape, a small baseline subset (SBAS) was produced from ten Sentinel-1 SAR-images acquired between August and December 2016. A sensitivity analysis, considering the looking direction and aspect of the slopes, demonstrates the challenges at detecting small scale displacements.