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The Dúdar landslide: a huge slope instability associated to active tectonics in the NE border of the Granada Basin (SE Spain)

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The Dúdar landslide is located at the eastern border of the Granada Basin (South Spain), which is a Neogene-Quaternary intramontane depression located in the central part of the Betic Cordillera. The mean landslide area is about 380 ha and can be regarded as one of the largest landslides developed in this part of the cordillera.

The landslide development was controlled by the great altitude differences between the Aguas Blancas and Darro rivers, which in turn are the consequence of the tectonic activity of the NW-SE striking normal faults of the northeast border of the Granada Basin and the related NE-SW directed-folds. This tectonic activity produces uplift of the footwall block developing unstable slopes. In the northwest margin of the Aguas Blancas River, slope instabilities are also determined by the relative bad geotechnical quality of the materials involved, which are mainly marls and silty sediments with gypsum interlayers. As for other large landslides located in the Granada Basin (e.g. Güevéjar landslide), the most likely triggering factor seems to be a great earthquake. Nevertheless, there are not historical data for such event but probably occurred prior to 1400, which is the date of the first historical records of the Dúdar village, located in one side of the landslide. In addition, the active faults in the NE border of the Granada Basin can potentially generate earthquakes with magnitudes greater than Mw=6.0, making the Granada Basin one of the most seismically active regions of Spain.

In this work, we have carried out a geomorphologic description of the Dúdar landslide with the aid of a high-resolution digital elevation model (DEM) derived from LIDAR data. We have analysed the significant changes that the landslide caused in the drainage system of the Aguas Blancas and Darro rivers. These modifications comprise river diversions and active incision within the body of the landslide, making it susceptible to future reactivations.

Finally, a stability back-analysis of the Dúdar landslide has been performed to identify the mechanism of failure and the most-likely triggering factors: water saturation and seismicity. We have found that the presence of water can be not regarded as the triggering factor of the Dúdar landslide. By the contrary, our calculations indicate the Dúdar landslide could be triggered by a low-to-moderate magnitude earthquake (Mw 5.0-6.5), which could very likely be associated with the rupture of one of the active faults present in the Granada Basin, located very close to the landslide.