Geophysical Research Abstracts
Vol. 18, EGU2016-13662-1, 2016
EGU General Assembly 2016

4 years of high-resolution LiDAR erosion monitoring of an elementary gully in the badlands of SE France (Draix)

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The black marls outcrops of Draix (SE France) are an ideal site to study multiple erosional processes such as rain splashing, sheet erosion, concentrated flow erosion and micro-landslides. Their erosion constitute an important contribution to the bedload and suspended load of the Durance river basin, which can affect human infrastructure such as hydroelectric dams, irrigation systems and in general river maintenance. The badlands response to climatic events is thus crucial for long term management of those human endeavours.

The topographical changes resulting from those different processes can be quantified and localized in both space and time, with repeated LiDAR acquisitions of high-resolution topography (up to 10 pts per cm2). To avoid shadowing induced vy vegetation or topography's curvature, an instrumented individual gully (named Roubinette) is equipped with a 4 m high scanning tower. It is small enough (400 m2) that the LiDAR can acquire it with no shadowing and in one scan, reducing merging and alignment errors. Seasonal acquisitions have been carried out since 2011, constituting a comprehensive dataset of the gully's evolution.

The aligned scans are then converted to square grids and compared vertically to obtain DEMs of differences (DoD). Concentrated flow erosion, volume remobilization inside the secondary gullies and micro-landslides are easily detected by the DoD. Diffuse erosion is detected using a space-time filter to improve detection level accuracy. Combined with local meteorological data, photographic monitoring and sediment trap content data, a sequence of events can be reconstituted between each acquisition.