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Comparing results from actual and virtual linear scanlines in fractured sandstones of the Marnoso-Arenacea Formation, Northern Apennines, Italy

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Three-dimensional photogrammetric techniques arecommonly used to generate high-resolution digital outcrop models suitable to complement stratigraphic and structural field studies. This is particularly true for near vertical outcrops were direct data collection is very difficult to perform, provided that the data are reliable. To check whether fracture attribute data acquired from photogrammetric digital outcrop models can be effectively integrate field data, we performed a multisource data acquisition programme on the master joint set affecting the Langhian part of the Marnoso Arenacea Formation, a foredeep siliciclastic turbidite succession widely exposed in the external sector of the Northern Apennines. We selected an about 90 m high vertical cliff in a meander of the Santerno River, which was surveyed by both terrestrial and drone-aided photogrammetry to produce two different digital outcrop models of the same strata. Moreover, field data were collected in the same strata along river bed exposures few hundred meters upstream. Comparison of master joint attributes, namely orientation, spacing and height, collected along linear scanlines in the field and in the two digital outcrop models shows quite comparable results, particularly when FSI (*Fracture Spacing Index*) values are considered. Sensitivity tests of the impact of the number of data on the statistical results from photogrammetric scanlines, where hundreds of measurements can be collected along each scan line, were also performed. Our results provide further support to the effectiveness of the integration between field and photogrammetrically-obtained structural data to study fracture densities in partially accessible exposures. Given the large data numbers that can be collected in digital outcrop models, once validated in the field, photogrammetric data allow robust statistical analysis to be performed on fracture attributes.