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Gully erosion and landslide reactivation in the Central Italian Apennine: new data from dendrochronology and quantitative geomorphology

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The Central Italian Appennine area is widely affected by "calanchi" badlands, whose main geomorphic agent is the water runoff on the widespread clayey lithologies: in the study area (geomorphosites of Crete di Arbia, Asciano, Siena) the Pliocene clay constitute an ideal substratum for the development of water erosion landforms and gravitational processes. The integrated approach between dendrogeomorphology and quantitative geomorphology has allowed monitoring and reconstructing the development of these badland landforms. Most of the rapidly evolving slopes of the area underwent strong conifer reforestation. For dendrogeomorphology analysis sampling has been performed on 67 trees of the Pinus Pinea, Cupressus sempervirens and Thuja occidentalis species, on slopes affected by gravitational movements and water erosion, in order to identify annual ring growth anomalies, compression wood and exposition of roots. The main goal was reconstructing the correspondence between the trees indications and the estimated denudation rates due to surface running water erosion and mass movements. A general trend of negative anomalies has been identified through relatively cross-dated chronologies, in correspondence of multi-years compression wood periods, even if trees local behaviours are not unusual. During the 90's the Pinus Pinea shows a continuous growth reduction and in the same period a systematic increase in mass movement diffusion was recorded during geomorphological surveys. Thus since 1993 several monitoring stations on badland slopes have been equipped with erosion pins. Quantitative data from monitoring stations, compared to pluviometric series, indicated another critical phase of denudation in 2003, that was supported by dendrochronological data.
The integrated approach allowed obtaining continuous series of data by direct monitoring and precious information for the period preceding the field measurements. This kind of approach, applicable in many contexts, could be particular helpful in predicting future evolution of slopes, with special regards to geomorphosites.