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Rainfall simulations on steep calanchi landscapes: Generating input parameters for physically based erosion modelling

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Calanchi landscapes in central Italy have been subject to geoscientific research since many years, not exclusively but especially for questions regarding soil erosion and land degradation. Seasonal dynamics play an important role for morphological processes within the Calanchi. As in most Mediterranean landscapes also in the research site at Val d'Orcia long and dry summers are ended by heavy rainfall events in autumn. The latter contribute to most of the annual sediment output of the incised hollows and can cause damage to agricultural land and infrastructures. While research for understanding Calanco development is of high importance, the complex morphology and thus limited accessibility impedes in situ works.

To still improve the understanding of morphodynamics without unnecessarily impinging natural conditions a remote sensing and erosion modelling approach was carried out in the presented work. UAV and LiDAR based very high resolution digital surface models were produced and served as an input parameter for the raster and physically based soil erosion model EROSION3D. Additionally, data on infiltration, runoff generation and sediment detachment were generated with artificial rainfall simulations – the most invasive but unavoidable method. To increase the 1 m plot length virtually to around 20 m the sediment loaded runoff water was again introduced to the plot by a reflux system. Rather elaborate logistics were required to set up the simulator on strongly inclined slopes, to establish sufficient water supply and to secure the simulator on the slope but experiments produced plausible results and valuable input data for modelling.

The model results are then compared to the repeated UAV and LiDAR campaigns and the resulting digital elevation models of difference. By simulating different rainfall and moisture scenarios and implementing in situ measured weather data runoff induced processes can be distinguished from gravitational slides and rockfall.