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Spatio-temporal development of rill vegetation in the Hühnerwasser Catchment

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The artificial catchment "Hühnerwasser" was built in a post-mining landscape, as a field experiment to observe and monitor early-development ecosystems at hillslope scale. Early on, rain-induced rill and channels formation was observed, followed by vegetation growth in between rills, and later on inside the rills.
In this work, we aim to describe the temporal evolution of the spatial distribution of rill vegetation. In general terms, we hypothesize four different encroachment patterns might occur: (1) The vegetation spreads from the top of the rills downstream. The underlying hypothesis would be a higher establishment probability due to a lower velocity of surface runoff and therefore less transport probability compared to downstream rill segments. (2) The vegetation starts growing downstream and moves upwards. In this case we can hypothesize that the spatial distribution of the vegetation is dominated by water availability, which is higher or more stable downstream. (3) The vegetation encroaches from the sides into the rills, meaning that inter-rill vegetation governs vegetation encroachment inside the rills. (4) If no patterns are detected it might mean that the encroachment process depends strongly on very local conditions, or perhaps that the underlying assumption of an initially homogeneous seed distribution is false.
To investigate the rills formation and rill vegetation encroachment processes, rills and vegetation patches inside these rills were identified and digitized from aerial photographs of the catchment from 2007 to 2012. Different vegetation types were identified based on the colour and texture of the patches. The geometrical properties of the rill segments and vegetation patches were used to define how the different vegetation types have distributed in space and how this distribution has changed over time. Rill mapping reveals a large increase of rill area from 2007 to 2008 and only a small rise from 2008 to 2009. Starting in 2010 dense vegetation prevents a precise mapping of the rills in the aerial photographs, so we assume that there is no change in rill area from 2009 to 2012.
In 2007 vegetation covered only 1.4% of the rill area. There is only a small increase of this area in 2008 compared to the later years. In 2012 more than 50% of the rill area is covered by plants. Ten different vegetation types have been identified in the aerial photographs, starting with two types in 2007. By 2012 nine types are spotted in the rills of the catchment. Some of these vegetation types show an encroachment from up- to downstream (e.g. Tussilago farfara), some from down- to upstream like Phragmites australis, whose creeping rhizomes can also promote such spreading. Others reveal no patterns. To better assess and identify the underlying processes leading to these encroachment processes shown by the different vegetation types further data analysis –e.g. comparison with ground based vegetation mapping– and process-based hydrological modelling is necessary to fully explain these observations and assessing additional competition effects, which may be at play.