Early-warning signals in ecogeomorphology: the example of a hillslope system Derek Karssenberg, Faculty of Geosciences, Utrecht University, the Netherlands, d.karssenberg@geo.uu.nl

Introduction





shift towards lower regolith thickness occurs.



Regolith thickness remains relatively constant up to a biomass threshold below which runoff initiates soil wash and rill, gully formation (above). Due to reduced regolith thickness, infiltration capacity reduces increasing runoff and soil wash, resulting in a positive feedback.

Main finding

Increase in variance and temporal correlation length of regolith thickness and runoff are leading indicators for soil degradation and can thus be used for forecasting.

Early-warning signals in regolith thickness



of system variables increases towards the shift.



As expected from theory (top figure), variance in regolith thickness (above, blue line) increases well ahead of the shift. Also, the ratio between short and long range variation over time (above, red line) decreases, indicating critically slowing down of the system.

Early-warning signals in runoff

A similar increase in variance is found for runoff, both in temporal variance of the total runoff from the plot (below, left) and in temporal variance in runoff at grid cells (below, right). The latter is partly caused by high dynamics in the rill system when wash erosion starts.



References Scheffer et al., 2009. Early warning signals for critical transitions. Nature 461 (7260): 53-59.



Rate of recovery is smaller close to the shift (see above). As a result, under a constant perturbation (added random noise), the variance