

## ***Interactive comment on “Analysis of the drought resilience of Andosols on southern Ecuadorian Andean páramos” by V. I niguez et al.***

### **Anonymous Referee #1**

Received and published: 14 December 2015

### Summary

The authors analyse the behaviour of two catchments in terms of the resilience i.e. the time needed to recover a pre-drought state of water content, doing so on the basis of a dataset for two catchments, and using a model calibrated and validated on the basis of soil moisture and discharge data. The authors conclude that the moisture content in one catchment recovers quicker, and that recovery in another catchment takes more time. This is argued to be the result of differences in the big soil water storage capacity of the Andosols and a low evaporative demand due to the altitude and the typical vegetation. These results are then suggested to show the high resilience to droughts of the Paramo ecosystem, or of the Andosols, or of a catchment.

An issue for discussion The authors define resilience as the time needed for the soil

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to recover to its pre-drought state of water content, once rainfall has started to exceed vegetation demand. I wonder if the authors could just as easily have called this the effective (or maybe maximum?) drought length everywhere in their paper.

What I would like to raise as an issue for discussion based on this paper is the merit of using the concept of resilience in hydrology – be it at a point scale (the waterbalance of a soil, in this case ), or at catchment scale (a catchment predominantly covered by a vegetation type, paramo).

The idea that a catchment can be resilient is used in other references (e.g. Geris et al. 2015, Fryirs et al. 2015). Other than that resilience is most often used in ecology where it refers to mechanisms by which a population, or a species, or an ecosystem can recover from adverse conditions (or remain relatively stable in terms of its state variables while environmental conditions vary). This recovery or this stability is due to a process which is internal to the species, the population, or to the ecosystem – e.g. higher birthrates after a catastrophic event, or higher partitioning to roots by a plant during drought.

Does this make any sense for a catchment? One might consider a catchment as being less- or more- resilient if there is a mechanism (a dynamic process) as integral part of the system (i.e catchment/paramo/andosoil) which restores behaviour over a longer or shorter time to that of the original non-disturbed situation.

An example for resilience in catchment behaviour could be vegetation regrowth in case of a clearcut. An example of a process which causes a catchment to react less sensitive to variation in environmental condition is peat bog swelling and shrinkage (“mooratmung”), which tends to stabilize actual evaporation. The combination of weathering (chemical) and erosion (physical) could also characterize catchment resilience. These examples –when acceptable- suggest that resilience is a concept characterizing the strength of a dynamic feedback process (natural restoration).

However, in their paper the authors do not discuss the concept of resilience, nor do they

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make this concept operational, nor do they discuss how it could vary between catchments. The authors are also not consistent in their use of the notion of resilience – they analyse resilience in terms of the dominant soil, in terms of the dominant vegetation, or in terms of the catchment.

A second issue for discussion: The authors claim that their point measurements are well predicted by the model. I worry that this result is overly optimistic given that scaling moisture contents allows for a constant offset and a constant relative error ?

Literature Geris, J; Tetzlaff, D; Soulsby, C. 2015. Resistance and resilience to droughts: hydrogeological controls on catchment storage and run-off response. *HYDROLOGICAL PROCESSES* 29(21): 4579-4593. Fryirs, K; Lisenby, P; Croke, J. 2015. Morphological and historical resilience to catastrophic flooding: The case of Lockyer Creek, SE Queensland, Australia 2015. *GEOMORPHOLOGY* 241: 55-71

Please also note the supplement to this comment:

<http://www.hydrol-earth-syst-sci-discuss.net/12/C5629/2015/hessd-12-C5629-2015-supplement.pdf>

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Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 12, 11449, 2015.

## HESSD

12, C5629–C5631, 2015

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