

Interactive comment on “Effective rainfall: a significant parameter to improve understanding of deep-seated rainfall triggering landslide – a simple computation temperature based method applied to Séchilienne unstable slope (French Alps)” by A. Vallet et al.

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We would like to thank Referee #2 for his/her interest in the topic and for valuable comments to improve the manuscript. For the concerns shared with Referee #1, we invite Referee #2 to read answer we published to his/her comments. Although English was already proofread by a professional, we will send the revised manuscript to another grammar expert. A point-by-point response to the comments is as follows:

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“The first problem with this paper is that the title suggests that it is about effective rainfall and deep-seated landslide, but this relationship is only considered superficially”

→ We propose to change the title to ““Effective rainfall: a significant parameter for deep-seated landslide studies – A parsimonious computation method applied to Séchilienne unstable slope (French Alps)” (see answer to referee 1 for more details).

“There is also a lot of repetition in this paper which needs to be rectified.”

→ Manuscript will be revised to improve structure flow.

“The conclusion is not really a conclusion and needs to be improved. The authors need to try and emphasize the relevance of the research and discuss in detail how the effective rainfall is an important parameter for understanding landslides. You also need to state any shortcomings of the research.”

→ Conclusion will be modified and shortcomings research will be added (effective rainfall threshold, model and prediction, characterisation and quantification of water input/displacement output relationship, possible application for shallow landslides as remarked by Dr. Brocca).

“The term evapotranspiration is used incorrectly in places in this paper. Evapotranspiration means the same as total evaporation and is the sum of open water evaporation, soil evaporation, canopy and litter interception, and transpiration.

→ We understand that the evapotranspiration definition of the manuscript is not clear and even wrong. However equations used for this study are evapotranspiration methods as demonstrated by references cited in the manuscript. Evapotranspiration in this paper is considered as the sum of all physical (evaporation) and physiological (transpiration) phenomena. Therefore, interception is included in evaporation in this calculation, as suggested in the cited references. Revised manuscript clarifies evapotranspiration definition.

“Interception is an important component of evapotranspiration and is not considered

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adequately in this paper.” “It is stated that in other studies interception is disregarded. The authors need to critique the problem of not considering interception as it is an important variable. Interception can be as much as 10% of gross precipitation in a grassland and considerably higher in forests.”

→ This is a mistake we made. By integrating the crop coefficient (after referee 3 review) reference crop evapotranspiration (ET₀) is converted to actual evapotranspiration (ET_c) which is a lump parameter including potential transpiration (T_p), potential soil evaporation (E_p) and canopy interception evaporation (INT) (Verstraeten et al., 2005). Revised manuscript integrated these corrections. So the 6 methods used to estimate evapotranspiration integrate canopy interception. In addition, in our method, AWS takes implicitly into account the influence of canopy reservoir and vegetation.

“reference crop evapotranspiration” should be changed to “reference crop evaporation”. This needs to be corrected throughout the document.”

→ As a consequence, all these technical corrections were not taken into account.

“What is “raw rainfall”? is it the same as gross precipitation/rainfall. Therefore, is effective rainfall the same as “net precipitation/rainfall”?”

→ Indeed, raw rainfall matches with gross rainfall. Effective rainfall depends on the science domains, in hydrogeology it matches with the net part which infiltrate to the aquifer (deep percolation/infiltration). For example, in field irrigation, effective rainfall is the part of the total rainfall which can be used by the plants. We proposed to change “raw rainfall” to “gross rainfall” and to keep effective rainfall.

“The vegetation at the study site needs to be described in more detail as this is important information in terms of effective rainfall.”

→ Forest is mainly composed of beech (*Fagus sylvatica*) and spruce (*Picea excelsa*) trees which can be associated occasionally with ash (*Fraxinus*) and sweet chestnut (*Castanea sativa*) trees. Pastures are anthropogenic and constituted of grass. Revised

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manuscript will mention vegetation type.

“This sentence is incorrect. Soil is not the first recipient of rainfall. Vegetation is the first recipient of rainfall and that is why canopy interception is considered a threshold process as only once the canopy storage has been fill can subsequent processes take place, unless there is a significant amount of direct throughfall.”

→ We completely agree with your comment. In hydrogeology we are used to consider that the first interface is the soil (separate total rainfall into runoff-infiltration-evapotranspiration). This point will be clarified.

“I am not sure why “(conditional statement)” is there. Please explain.”

→ We understand that “conditional statement” means nothing outside of the context. It stands for the conditional statement implemented in the soil-water-balance for runoff estimation (runoff coefficient is applied only if AWS is fulfilled). This point will be clarified.

“is one auger hole for each geology/vegetation zone enough. Please expand on why not more samples were taken.”

→ We choose to perform only one auger hole per type in order to have an order of magnitude of the AWS and to spatialize at watershed scale (GIS composite). Sensitivity analysis was then used to assess the AWS influenced and to select the AWS best interval of solutions for our site. This was down because it is time effective and less complex than to map soil on the whole watershed which will have a low ratio accuracy/complexity.

“add a reference at the end of the sentence “air temperature: : to elevation”.”

→ This phenomenon is known as “lapse rate” (Jacobson, 2005)

“Please explain what antecedent cumulative rainfall is. I am only familiar with antecedent soil moisture etc..” → Antecedent cumulative rainfall of day j matches with

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the sum of rainfall amount on the period from day $j-n$ to day j ($n \gg 1$). Sum can coupled with a decay factor as we did in the study to take into account that an old rainfall event displays less impact than the most recent on groundwater hydrodynamic due to drainage process.

“Please explain how the runoff coefficient was determined.”

→ The runoff coefficient was determined with a runoff coefficient abacus based on vegetation type and slope angle. We associate for each vegetation/slope type a runoff coefficient which we estimate for the whole watershed thanks to GIS composite method. Explanation will be added in the revised manuscript.

All the other proposed technical corrections have been taken into account for revised manuscript.

References:

Jacobson, M. Z.: Fundamentals of Atmospheric Modeling, Cambridge University Press., 2005. Verstraeten, W. W., Muys, B., Feyen, J., Veroustraete, F., Minnaert, M., Meiresonne, L. and De Schrijver, A.: Comparative analysis of the actual evapotranspiration of Flemish forest and cropland, using the soil water balance model WAVE, Hydrol Earth Syst Sci, 9(3), 225–241, doi:10.5194/hess-9-225-2005, 2005.

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