Prof. Nunzio Romano
Editor, HESS

First of all, thank you very much for your valuable time and efforts in reviewing our paper. We extracted your specific comments and below we explain what changes were made to the manuscript in light of these comments.

Comment # 1: The connection between the "gravity/capillary partitioning" and Dr. Beven's macroporosity debate, albeit intriguing, is definitely questionable, and I would like if this part might be left out or a bit reduced in the final version of your work.

a) *The following paragraph in the previous version (page 5, paragraph 2),*

> Moreover, although RE is probably an appropriate model for unsaturated flow at the local scale, it is questionable whether it is an appropriate physical model for watershed and large-scale applications (Beven, 1995; Harter and Hopmans, 2004; Beven and Germann, 2013). Also using this equation for plan elements that are in the order of 10^1–10^3 m, makes the implicit assumptions that the vertical dynamics of soil moisture at the local scale is scale-invariant (up to the limit of the plan element area). To the contrary, field measurements show that soil hydraulic conductivity and pore properties related to the soil retention curve (of Ψ) vary significantly both in the horizontal and vertical (Gelhar et al., 1992; Rubin, 2003; Zhang et al., 2004). Further more, the review paper of Beven and Germann (2013) argues that the use of RE to model field soil should not be considered physics-based but rather a convenient conceptual approximation.
> They explain that the Darcy and RE have dominated soil physics in the last few decades because of the ready availability of numerical models based on these formulations, despite the convincing evidence that their underlying assumptions, and carefully controlled experimental setups, are inappropriate for natural conditions. They highlighted the importance of macropores and suggested the use of soil structure with at least two flow pathways. Models that use such structure are the 1-D model of Gerke and van Genuchten (1993), the 1-D model MACRO (Larsbo et al., 2005), and the 1-D or 2-D/3-D model HYDRUS (Šim˙unek and van Genuchten, 2008). In these three models, the soil column is composed of a macropore and a matric compartment, with the water flow in the matric compartment still solved using RE. The inclusion of macropore pathways is dependent on available direct and indirect information on their density and connectivity across the basin. The matric compartment still needs to be characterized in distributed models.

was revised and shorten to the following (red texts above were removed):

> However, it is questionable whether RE is an appropriate physical model for watershed and large-scale applications (Beven, 1995; Harter and Hopmans, 2004; Beven and Germann, 2013). Also, using this equation for plan elements that are in the order of 10^1–10^3 m, makes the implicit assumptions that the vertical dynamics of soil moisture at the local scale is scale-invariant (up to the limit of the plan element area). To the contrary, field measurements show that soil hydraulic conductivity and pore properties related to

the soil retention curve (of Ψ) vary significantly both in the horizontal and vertical (Gelhar et al., 1992; Rubin, 2003; Zhang et al., 2004). Furthermore, the review paper of Beven and Germann (2013) argues that the use of RE to model field soil should not be considered physics-based but rather a convenient conceptual approximation. They highlighted the importance of macropores and suggested the use of soil structure with at least two flow pathways. Models that use such structure are the 1-D model of Gerke and van Genuchten (1993), the 1-D model MACRO (Larsbo et al., 2005), and the 1-D or 2-D/3-D model HYDRUS (Šim˙unek and van Genuchten, 2008). In these three models, the soil column is composed of a macropore and a matric compartment, with the water flow in the matric compartment still solved using RE. The inclusion of macropore pathways is dependent on available direct and indirect information on their density and connectivity across the basin. The matric compartment still needs to be characterized in distributed models.

b) The following paragraph in the previous version (page 7, lines 16-18),

> ... and agree with the arguments of e.g. Beven and Germann (2013), as discussed above, that recommend the use of models with a dual–pore soil structure ...

was revised to (page 7, line 12-14)

> ... and following the recommendation of e.g. Beven and Germann (2013), to use a model with a dual–pore soil structure ...

Comment # 2: Even the part in the introductory section about the "scale mismatch" (between vertical and horizontal spatial discretizations) should be a bit lowered, at least allowing for various successful applications of RE in many different situations. Solving RE is always demanding and this comes from both physical and numerical problems. Uniform soil profiles are an exception in real life or only computation abstractions. Layered soil profiles are instead the rule and they (with the complex soil layer sequences) do regulate the evolution of vadose zone processes. These facts should perhaps be discussed a bit in the introduction, instead of invoking scale issues.

a) The following paragraph in the previous version (page 5, paragraph 1),

> Based on the foregoing discussion, the scales mismatch between the vertical and horizontal discretization of DHMs (millimeters to centimeters in the vertical soil column vs. tens to hundreds of meters in the horizontal) leads to two main problems: (1) solving the local scale vertical soil moisture dynamics based on RE is computationally demanding; and (2) such fine vertical discretization increases the number of parameters to calibrate, and state variables to initialize.

was incorporated in page 4 paragraph 2 of the new version (line 20-23, 28-30) and the scale issue was not reiterated as before.

b) *The following paragraph in the previous version (page 5, last paragraph),*

> Models based on Richards' formulation are useful when the vertical profile of soil moisture is desired especially when the soil column is significantly heterogeneous. However, information about the vertical soil structure is often not available and highly uncertain where available.

was expounded to:

> Nonetheless, models based on RE are useful when the vertical profile of soil moisture is desired especially when the soil column has complex layer sequences or the soil properties are not vertically homogeneous, which are common in real life. Also as mentioned, RE-based models are perhaps appropriate for hillslope-, plot-, and other small-scale applications, especially when information about the vertical soil structure is available.