REPLY TO COMMENTS FROM REVIEWER 1

1. *The authors assume an upper crust thickness of 5 cm based on some previous studies. My experience is that the crust is usually thinner – but that would be a function of soil type and rainfall history. What are the implications of this assumption of 5-cm crust thickness? Would it change the estimation of K1s for each event? A brief discussion would help put this aspect in proper perspective.*

We agree that the seal thickness, Z_c, adopted in this study has to be better justified and the effects of different values of Z_c on the estimate of the "optimal" K_{1s} value for each event have to be investigated. Therefore, in the revised paper, Section 3 "Experimental results and their analysis", the following changes will be made::

(a) Page 6203, lines 14-17 become:

"The basic quantity to be assessed in order to perform the conceptual simulations for a sealed vertical profile is the depth of the crust layer, Z_c, that along the lines discussed by Mualem and Assouline (1989) and Mualem et al. (1993) has been set equal to 5 cm. In any case, a sensitivity analysis of results to the sealing layer thickness has been also carried out."

(b) Page 6210, at the end of Sect. 3, we add:

"Lastly, the influence of variations in sealing layer thickness on the results above discussed has been investigated considering Z_c in the range 0.5-5 cm. The lower value is very close to the most common experimental results (see, for example, Sharma et al., 1981; Fohrer et al., 1999) and was frequently used in order to test a few specific models for infiltration in crusted soils (see, for example, Hillel and Gardner, 1970; Ahuja, 1983). The upper limit is linked, as pointed out by Mualem and Assouline (1989), with the extension of the region where changes in soil properties might be considered relevant, particularly under conditions of unsaturated surface. Values of the order of some centimetres were adopted by Mualem et al. (1993) and Assouline and Mualem (1997) for different soil types. In spite of the wide variability in sealing layer thickness reported in literature was explained by Assouline and Mualem (2000) through the different resolution used in measuring the soil bulk density, the uncertainty in seal thickness justifies the necessity to quantify its role in this study. For each representative event of Table 2, using the same procedure adopted with Z_c=5 cm we have simulated the soil moisture vertical profile both with Z_c=0.5 and 2 cm. Even though within the limits determined by the lack of measurements of water content above Z_c=5 cm, the observed shape of $\theta(z,t)$ appears to be reproduced fairly well independently of Z_c but with the optimal value of K_{1s} that changes considerably with the seal thickness. In particular, our results, synthesized in Table 3, indicate that for a specific event the unit area hydraulic resistance of the sealing layer, defined as Z_c/K_{1s}, remains unchanged while K_{1s} increases by a factor 10 from Z_c=5 cm to Z_c=0.5 cm. This trend of K_{1s} is determined by the fact that a given observed cumulative infiltration has to be reproduced by a more compacted seal when a thinner thickness is involved. In any case, to some extent the experimental moisture content at the depth of 5 cm appears to be simulated better by adopting Z_c=5 cm."

(c) The following table is also added:

Table 3. Variability of the calibrated saturated hydraulic conductivity, K_{1s}, and hydraulic resistance (Z_c/K_{1s}) for different hypothetical seal thicknesses, Z_c. All the events of Table 2 influenced by a sealing layer are considered.

	event number (see Table 2)							
	2		3		4		6	
Z_c (cm)	K_{1s} (mmh^{-1})	Z_c/K_{1s} (h)	K_{1s} (mmh^{-1})	Z_c/K_{1s} (h)	K_{1s} (mmh^{-1})	Z_c/K_{1s} (h)	K_{1s} (mmh^{-1})	Z_c/K_{1s} (h)
0.5	0.007	714	0.005	1000	0.003	1667	0.012	417
2.0	0.028	714	0.020	1000	0.012	1667	0.048	417
5.0	0.070	714	0.050	1000	0.030	1667	0.120	417

2. *How was the initial pressure head (or initial soil water content) estimated for each event as listed in Table 2. Was this value calibrated for each event separately?*

This value was not obtained by calibration. We will modify the description in the paper in order to clarify better. Thus:

(d) Page 6207, lines 7-13 become:

"Each event started from a condition of initial soil moisture that, using the measurements available, in the soil part between 5 and 35 cm has been approximated as invariant with depth. In addition, in the hypothesis of vertically homogeneous soil with constant ψ_i, the shape of the curve $\theta_i(z)$ in the top soil, that is between the soil surface and 5 cm depth, has been represented by the same value of θ_i used at larger depths, while under the condition of sealed soil by the constant value giving continuity of ψ_i at the interface."

3. *I agree with the authors that ET would perhaps not play a significant role for the short duration (~ 48 hrs) for each simulation, and would be more significant for continuous simulations. However, with the shallowest measurement made at the 5-cm depth, I am not sure if the significance of ET would be significantly captured from experiments.*

We note that under natural conditions measurements of soil moisture content by a TDR technique at a smaller depth are really not possible. In any case, our sentence in Section 4 "Conclusions" is supported by computations specifically carried out for examining the role of evapotranspiration. Therefore, in the revised paper we will add the following sentence:

(e) Page 6210, just above the paragraph of point (b):

"Furthermore, we note that by neglecting the evapotranspiration our results experienced minor changes."

4. *The authors seem to imply that K1s should vary continuously with time (see page 6202, line 9, for e.g.). However, the value of K1s is kept constant during each event, but allowed to vary from event to event. This needs to be clarified in the abstract and introduction.*

We agree and in the revised paper we will clarify the variation in time of the quantity K_{1s} in the following way:

(f) Page 6200, lines 14-20 become:

"In particular, because of the considerable variations in the shape of the moisture content vertical profile as a function of time, a generalization of the existing models should incorporate a first approximation of the variability in time of the saturated hydraulic conductivity, K_{1s}, of the uppermost soil. This conclusion is supported by the fact that the observed shape of $\theta(z,t)$ can be appropriately reproduced by adopting the proposed approach with K_{1s} kept constant during each rainfall event but considered variable from event to event, however the observed rainfall rate and the occurrence of freeze-thaw cycles with high soil moisture contents have to be explicitly incorporated in a functional form for $K_{1s}(t)$."

(g) Page 6202, lines 1-14 become:

"The main objective of this paper is to address the above issues through continuous measurements of the basic quantities determining the evolution of $\theta(z,t)$ and direct observations of the same function performed by a Time Domain Reflectometry (TDR) system. In this context, in order to quantify the possible errors generated by an inappropriate choice of the modelling, the effectiveness of a model based on the assumption of a vertically homogeneous soil (Corradini et al., 1997) with time invariant saturated hydraulic conductivity is compared to that of a model for a two-layered soil (Corradini et al., 2000). The latter is applied considering a sealed soil with the upper layer characterized by a saturated hydraulic conductivity, K_{1s}, time-varying as a stepwise function and the underlying layer that keeps the properties of the parent soil. The quantity K_{1s} is determined by calibration as a constant within each specific study period (event), while the associated variability from event to event is investigated by examining the link with the experimental values of the hydrometeorological variables observed in a selected study plot of Central Italy. This can be considered a first approximation since K_{1s} is really time-dependent also during a specific event (see also Assouline and Mualem, 2000) when we assume, for the sake of simplicity, a constant value. On this basis the main lines to follow for a further development of the pre-existing models are also given."

5. *The authors leave us with the conclusion that K1s needs to be modified with time to represent crust formation. However, they do not offer a method for accomplishing this. Does it mean, that at present, we must calibrate for K1s for event-based models thus offering no predictive ability?*

This objection will be addressed in the revised paper as follows:

(h) Page 6211, at the end of Sect. 4, we will add:

"In conclusion this work, putting together measurements of some hydrometeorological variables, observed moisture vertical profiles and a conceptual modelling for their simulation in "isolated" events, addresses the problem concerning the realization of a model for a continuous prediction of $\theta(z,t)$ in bare soils by identifying its basic structure and the main elements to be used in developing a functional form for K_{1s}. In order to obtain a solution of the last problem it is required to extend this investigation with calibration of K_{1s} for event based models to a much larger number of events observed in study plots with different soil characteristics."

Overall, I think this is a good paper as it raises some fundamentally important questions and identifies future areas of research. The writing of the paper can be improved to make the message sharper, but perhaps that could be accomplished at the editorial level.

We will consider this suggestion in the paper revision.