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Hydrology and Earth System Sciences Discussions

Interactive comment on "Modeling evaporation processes in a saline soil from saturation to oven dry conditions" *by* M. Gran et al.

Anonymous Referee #2

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In this manuscript, the evaporation process from soil saturated by salt solution under non-isothermal condition was studied. The authors tried to describe the water content, temperature and salt concentration profiles through the soil column numerically which were compared against some experimental data.

Although this type of analysis is not new as it has been already discussed in many previous studies, the manuscript was well-written.

Major comments:

âĂć Considering the previous studies on this topic, it is difficult to determine where this manuscript is taking the readers? In other words, it is not clear to me what were the main development and advantages of this work compared to the numerous previous

studies related to the liquid, vapor and salt transport in unsaturated zone? The authors must clearly clarify the steps they made in this manuscript.

âĂć Page 9, line 5-15: The described process is not physically correct, though by adjusting some fitting parameters, you might have obtained a reasonable agreement…Why do you set the enhancement factor 1.2 in the top 1.5 cm and 8 below? Is the top layer dry? If this is the case, then why just the Fick's law of diffusion is not enough to predict the diffusive flux (the enhancement factor was originally introduced to use in the case of partially wet conditions and it approaches 1 under dry condition)? On top of that, why do you consider two layers? It is well established (experimentally, analytically and numerically) that when there is liquid continuity between the receding drying front and the evaporation surface, liquid vaporization occurs at the surface resulting in preferential salt deposition toward the surface. You can describe salt distribution and deposition patterns by evaluating the competition between the diffusive and convective salt transport via Peclet number. I do not want to put words in your mouth, but there are some recent papers addressing this very exact problem without invoking any fitting parameters (see e.g. Huinink et al., 2002; Pel et al., 2002; Sghaier et al., 2007; Guglielmini et al., 2008 ; and Shorki et al., 2010).

âĂć Page 10, line 22-27: All of these observations are expected and have been described in the references mentioned above. Besides, salt concentration does not "drop sharply". There is no discontinuity in salt distribution. If you had a lower Peclet number, the concentration profiles would decrease more gradually, because diffusion would be more comparable with convection...

âĂć Figure 1: It is well established that during stage 1, liquid vaporization occur at the surface (i.e. the vaporization plane is pinned at the surface). So, the illustrated conceptual picture is correct only if the authors refer to the stage 2 evaporation (which is not the case, since the columns were initially saturated).

Minor comments:

âĂć Page 5, line 3-12: During evaporation from porous media, dissolved salt in water is transported by capillary liquid flow toward evaporation surface where it accumulates, whereas diffusion tends to homogenize concentrations in space. You must appreciate the salt diffusive transport and not just talk about advection. Besides, does the evaporation front mean the interface between the saturated and unsaturated zone or do you mean the interface between unsaturated and dry zone? Where was it shown that the front is very narrow? What does “very narrow” mean quantitatively? The width of the front depends on the pore size distribution of the porous medium and can be quantified by the Bond number.

âĂć Page 5, line 18: How do you simulate the changes in water activity for high salt concentration?

âĂć How did you obtain equation 7? (and by the way, what is S0,min?)

âĂć In one hand you talk about pore scale processes (e.g. page 8, line 6-7: “water isolated in the meniscus that can not flow”), in the other hand you use a set of equations which are for macroscopic description...

âĂć Page 15, line 10: What exactly are the new insights?...

âĂć Figure 3, salinity profiles: what is the elapsed time for the experimental data?

References

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