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Hydrology and Earth System Sciences Discussions

Interactive comment on "A model for hydraulic redistribution incorporating coupled soil-root moisture transport" *by* G. G. Amenu and P. Kumar

Anonymous Referee #1

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This paper reports on an interesting study concerning the modeling of hydraulic redistribution in a semi-arid area. The text is well-written and pertinent to the aims of the Journal, being so worthy of publication. My expertise is not properly hydraulic engineering and modeling , so I will comment mainly the physiological aspects and the water relations between soil and plant studied in this paper.

My major remarks regard the assumptions of the model used by the Authors.

Page 3721, line 28. Authors write: “This is true both during wet and dry seasons”. I think that this is not true because different plant species can have different stomatal regulation during a period of drought. It can happen that during a period of water deficit some species (usually the drought tolerant ones) continue to transpire and photosynthesize also at very low values of water potential and while other species (drought avoiding) stop transpiration by closing stomata. Authors should be more precise and relate this sentence to the species effectively studied in the paper.

Page 3722, line 8. I can understand the assumptions and simplifications for the model explained at page 3730, line 26 but the concept of hydraulic redistribution (HR) is not clear in the text. If I understood well, HR should allow the water to go from the soil into the roots and vice versa and it is driven by water potential gradients between roots and soil. But the water hardly go out from the roots to the soil because soil water potential is usually much higher than that of root system and there are several barriers for the entering/exit of water in the root system (please see the next point).

The Authors write at page 3727, line 9, “water goes through complicated pathways in entering the root xylem from the soil media”. In fact, water and minerals can normally travel relatively freely through the permeable cell wall matrix of the root cortex (apoplastic route) but this route is blocked by the Casparian strip. In order to reach the xylem, water and minerals must instead take a highly-regulated cytoplasmic (symplastic) route. It is also true that many Angiosperms have a hypodermis with another Casparian band (exodermis), which is located in mature regions of the primary roots but only when this latter contains external cells that are in good condition. Moreover, the symplastic route involves special openings between adjacent cell walls called plasmodesmata, and transmembrane protein channels called aquaporins or water channels, that open and close in response to external signals like drought. When the exodermis is present, it represents an important, exterior control point for water and solute uptake. For example, water absorbed by an epidermal cell, and that travels radially inwards towards the xylem by a symplastic way, must before cross the epidermis, the exodermis, various cortical cells, the endodermis and the pericicle, before finally passing from the living cells of the pericicle to the dead ones of the xylem. The Authors should concentrate on the comments of these arguments to give a more complete

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picture of the soil-plant continuum.

Page 3728, line 6. What about the processes of cavitation and embolism that interrupt water columns and so also the transmission of the tension along them?

Discussion: do the Authors have any data on the relative contribution of apoplastic and symplastic water pathways and on the existence of apoplastic barriers such as the Casparian bands in exo- and endodermis or suberised lamellae in some the species studied?

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