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Interactive comment on "Capillary rise affecting crop yields under different environmental conditions" *by* Joop Kroes et al.

Anonymous Referee #2

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General Comments: The manuscript titled "Capillary rise affecting crop yields under different environmental conditions" reports estimated upwards water fluxes in a variety of soils and their potential contributions to three select crops. This study relies on computer model simulations to estimate upward water fluxes for 72 soil scenarios using 44 years of weather data. The authors use empirical data from seven field sites in The Netherlands ranging in number of years (up to 22 years) to calibrate and validate one semi-physics-based model. The authors chose to use the Soil-Water-Air-Plant (SWAP) model integrated with the plant growth World Food Studies (WOFOST) model. The calibrated and validated model is then used to simulate crop growth under three lower-boundary conditions scenarios for 72 soil scenarios which were based on soil information in a national soil database. This study is interesting and it is quite apparent that the authors have invested a large amount of time and effort into this simulation study. However, several major issues exist that, unfortunately, extend beyond what can be fixed without a complete overhaul of the analysis. These major issues include 1) how the simulations were carried out based on the authors definition of capillary rise, 2) the lack of partitioning capillary rise into the various fates (flux into the plant root, loss via soil surface evaporation, change in soil water storage, subsequent loss to deep drainage), and 3) novelty in regards to new scientific insights on capillary rise in soil. Due to these major issues, I recommend this manuscript be released back to the authors.

Specific Comments: Major Issue 1) The authors define capillary rise as "the upward flux across the root zone which can be either caused by upward flow from deeper soil layers or from soil water recirculation near the bottom of the root zone". This definition is a vague and incomplete. Capillary rise is associated with waters within a water-tables capillary fringe. Therefore, the author's justification for including unsaturated soil water redistribution (which is a function of soil water matric and gravitational potential energies) in the upward direction at a somewhat arbitrary depth is not clear. Precipitation or irrigation waters that infiltrate into the soil and then taken up by the plant roots are always governed by soil water potential energy gradients. Therefore, what is the benefit of lumping unsaturated soil water redistribution with soil water held in the capillary fringe? Additionally, by restricting their estimates to water fluxes across a somewhat arbitrary boundary, the soil water redistribution in the upward direction within the developing root zone is excluded. I encourage the authors to ask themselves, what is the benefit or usefulness of separating upward water fluxes in these two zones? Based on the authors new diagram (Figure 2 in the authors reply to reviewer 1's comments), the bottom of the root zone appears to be held constant in regards to where upward water fluxes are calculated even though the depth of the plant root zone is a function of time. Finally, this definition also excludes soil water that is held within a water table's capillary fringe that may not have previously crossed below the root zones lower most boundary; therefore also excluded from the calculation.

Major Issue 2) The authors estimate the upward flux of water across the lower-most plant root boundary. However, it is not clear how the authors then partition how much of this upward water flux is then used by the crop, is lost via evaporation at the soil surface, contributes to changes in the soil water storage component, or is subsequently redistributed below the lower-most plant root boundary. This partitioning is essential to gain a mechanistic understanding of upward water flux effects on crop grown. For instance, does the upward water flux mostly contribute directly to the amount of water taken up by the crop or mostly to changes in soil heat fluxes/thermal regimes and thus influence on microbial nutrient cycling?

Major Issue 3) Soil water redistribution in any direction is already incorporated into physics based soil-plant-atmosphere models since this is governed by gradients in soil water potential energies. They authors do not state what is new or useful by intentionally altering the model code to restrict upward water flow when a soil water potential energy gradient exist. Such artificial restrictions do not represent physical reality. Additionally, the authors reference many studies in the manuscripts introduction that already quantify capillary rise and the contributions to crop yields and deep drainage. These studies already provide data and evidence to address the author's research questions stated in line 116 and 117. Therefore, the novelty of a model simulation based study to contribute to the already vast literature on capillary rise appears to be minimal. I suggest the authors rework this manuscript to focus it on research questions pertaining to hydrologic modeling approaches and submit the work to a more specialized journal.

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