CC1:

The manuscript is well written, with interesting results. The conclusions can be further strengthened by addressing the following concerns.

(1) The anisotropic ratio for the hydraulic conductivity (K_x/K_z) was set as 1 for the CH and DH cases, but it was set as 10 for the VH case, without any justifications. At least, the authors should perform sensitivity tests using the ratio of 10 for the CH and DH cases and using the ratio of 1 for the VH case, and briefly discuss the results.

Similarly, it is unclear what this ratio is for the LWW case and what the justification is (as dx = 1 km here versus 10 m for the three idealized cases).

Response: The average slope of VH case is much lower than CH and DH cases, such that the lateral flow rate of VH case is low given the same hydraulic conductivity. We used a higher anisotropic ratio of the hydraulic conductivity (K_x/K_z) for the VH case to accelerate the lateral water movement for the comparisons. In the revised manuscript, we have tested the sensitivity of the model results to the anisotropic ratio with 1 and 10 and added discussions, please see Figure A5 and line 288-295

The anisotropic ratio has a close relationship with soil property because the presence of clay has a strong effect on anisotropy due to its platy mineral form and its low permeability as a unit. The anisotropic ratio for the LWW case is assigned as 10 referred from Fan et al., (2007) based on the primary soil property of LWW. The detailed relationship between anisotropic ratio and soil property can be referred from Table 2 in Fan et al., (2007). We add those details in the revised manuscript. Please see line 242-244

(2) The authors proposed the lateral fluxes for both unsaturated and saturated flow in Eq. (14). To understand the importance of such fluxes, the authors should compare the magnitudes of lateral flux versus vertical fluxes for the unsaturated zone and saturated zone separately for the three idealized cases.

Response: We calculated the lateral fluxes for both unsaturated and saturated flows and presented the results in a new Figure 8 for the benchmarking problems and Figure 14 for the LWW. The saturated lateral flow plays a more dominant role than unsaturated lateral flow. Hydraulic conductivity is nonlinearly dependent on soil saturation conditions and varies significantly with soil properties. The scale difference of the hydraulic conductivity between unsaturated flow and saturated flow is the primary reason for the magnitude difference between unsaturated and saturated lateral flux.

(3) For the TWW case, while it is probably acceptable not to compare the results with observed streamflow, the authors should at least compare runoff time series between the two simulations. For instance, how does the lateral flux affect the timing of peak runoff?

Response: We added the comparisons of runoff time series in Figure A7. Including the lateral flux decreased the peak runoff and increased the lower runoff. In addition, the timing of peak runoff is not changed in ELM_lat.

Minor comments:

(4) Line 189: porosity is 0.43 but soil moisture is greater than 0.43 in Fig. 5. Clarify.

Response: The porosity was incorrectly reported in the original manuscript and the correct porosity should be 0.467. We have fixed this error in the revised manuscript. Please see line 189

(5) Line 219: explain how you obtain the atmospheric forcing data at 1 km grid size from the original 1/8 degree data.

Response: The atmospheric forcing was not downscaled from the original 1/8 degree to 1 km, so the resolution of the forcing data is coarser than the surface data. We have clarified this in the revised manuscript at line 223.

(6) Line 225: revise "Google Earth Engine (Gorelick et al. 2017)" by "Google Earth Engine (GEE; Gorelick et al. 2017)"

Response: We have corrected it in the revised manuscript at line 230.

(7) Provide and briefly discuss the correlation between Fig. 8b and Fig. 8c. Also provide simple statistics (e.g., root mean square errors) in each panel in Figs. 10 and 11.

Response: we provided the correlation between Fig.8b and Fig.8c and added discussions, please see line 305-308

And we added the RMSE (root mean square errors) in each panel in Figs 10 and 11(Now Figs 11 and 12).

References:

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