Dear referee,

We thank you for these additional comments about the updated version of our manuscript. The modifications for taking into account these comments are included in the attached version, highlighted in green. Please find below our answer to the points you raised.

Best regards,

The authors.

1. L58: this sentence is still confusing. Do you mean something like “and thereby covers 55% of the total global permafrost area”? Please clarify

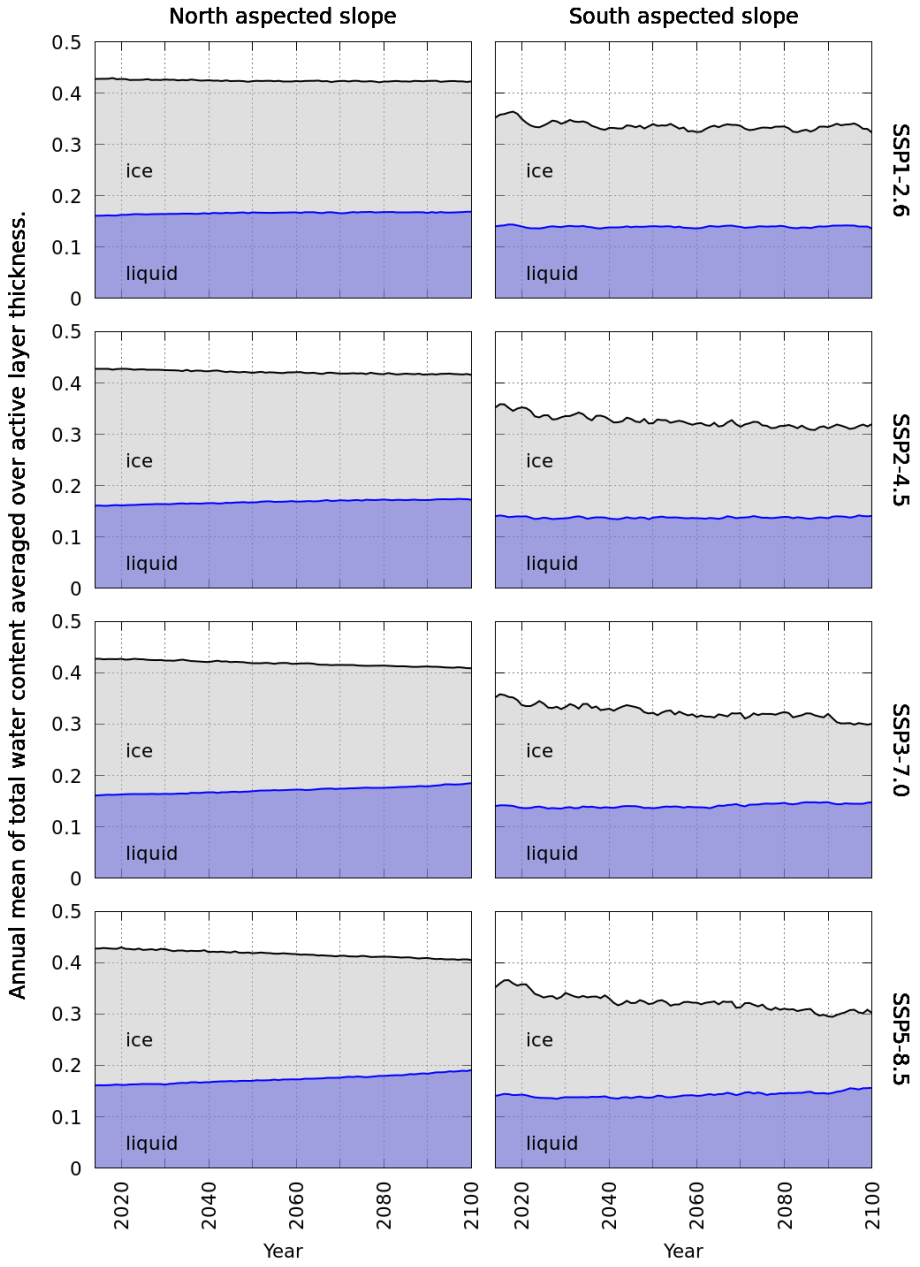
The sentence is clarified by including the proposed wording.

2. L95: the abbreviation CMIP6 shows up in the main text here for the first time, but you only define it for the first time in L213, please adjust.

The abbreviation is expanded in the introduction and reminded in the section 2.4.

3. Fig. 10: Rev #2 had a good suggestion to better illustrate the water content with varying active layer depths. This is a valid comment, especially considering the differences in ALT between NAS and SAS. I agree with the authors that it is not meaningful to use maximum ALT as a reference depth, but an additional plot (maybe in the Supplementary Material) showing a time series of the liquid and ice content within the thaw depth (depth until T < 0°C, changes throughout the season) would be interesting. This could be done for the present conditions, a year in the middle of the century and by the end of the simulation (or in the equilibrium simulations). This would be important to interpret the availability of liquid water throughout the season to better align it with the growing season.

We do agree that illustrating the liquid water available in the active layer is a key element to provide insight into possible future vegetation evolution.
The additional figure below shows the evolution of the annual mean of the total water content, partitioned into ice and liquid, averaged over the active layer (different for each year, scenario and slope), as proposed by Rev#2. However, the combined change in both the water content and the integration thickness (the ALT) makes the interpretation difficult, thus we did not include this Figure in the submitted material.
In order to quantify clearly the change in liquid water available for vegetation uptake, we plotted the evolution of the integral of the liquid water content over the surficial thawed layer (above the T=0°C isotherm). This proxy of liquid water availability is thus expressed in meter. This plot is made for each scenario and slope, for the years 2014, 2050 and 2100. The resulting figure (Supplementary material, l 250) shows both an increase of the maximum liquid water available during the year (up to +64 % in NAS and up to +61% in SAS, obtained under SSP5-8.5, compared to the present value), and an extension of the period of availability of liquid water during the year (up to +39 days for NAS, and +35 days for SAS, obtained under SSP5-8.5, compared to the present value). A quantitative summary of these results is given in the additional table below. This figure is added to Supplementary Material D – Seasonal change in liquid water available for vegetation uptake, and referred to in the results section (l 446 -447) and in the discussion section (l 508-510).



Additional figure: Annual mean of total water content [m3 of water / m3 of soil] partitioned into liquid (blue) and ice (grey) water content averaged over the active layer in different climate projections.

Variables	Annual value in present climate	Change from present values in projections to 2100			
		SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Maximum liquid water content available (NAS)	19.6 cm	+3.0 cm +15 %	+4.7cm +24 %	+10.1cm +52 %	+12.6cm +64 %
Maximum liquid water content available (SAS)	27.5 cm	+2.5 cm +9 %	+4.5cm +17 %	+10.7cm +39 %	+16.7cm +61 %
Days with more than 1cm of liquid water available for vegetation uptake (NAS)	140 days	+10 days +7 %	+18 days +13 %	+31 days +22 %	+39 days +28 %
Days with more than 1cm of liquid water available for vegetation uptake (SAS)	152 days	+ 7 days +5 %	+14 days +9 %	+28 days +18 %	+35 days +23 %

Additional table: quantitative summary of changes in liquid water availability between current conditions and the four climate projections for 2100 used in this study.

4. Fig. 10: The figure caption is not very informative as it is. Maybe change it to something like "Annual mean of total water content [m 3 of water / m3 of soil] partitioned into liquid (blue) and ice (grey) content...."

The caption is modified using the proposed wording.

5. L455-458: The explanation of the processes driving moisture distribution is still insufficient in my opinion. They are not explained in the subsequent text. Rather, a direction of water movement is given but without explaining what is causing it. This still needs work.

The presentation of Figure 11 has been rewritten (l 459-468) in order to put forward a hypothesis regarding the processes driving moisture distribution in the slopes of Kulingdakan watershed, with a focus on the role of the contrast of rooting depth between SAS and NAS. Rooting depth has been previously identified as a key control on the thermo-hydrological regime in the active layers of the study site (Orgogozo et al., 2019), and thus proposing an interpretation of the water fluxes based on it seems reasonable to us.

6. L503-506: The discussion on the water flux changes is insufficient given the description of the results. With a more careful description of this in the result section, the discussion can be improved accordingly.

The discussion of the water fluxes changes has been slightly extended (l 511-512 and l 516-520), putting forward the impact of the drying of the root layers.

Supplement:
L185: What is the reference for the geothermal heat flux boundary condition?

The reference is added in the supplementary material as well (Duchkov et al., 1997).

L237: The text is copied from the response letter. Please remove “This comparison will be added to the supplementary material.”

This residual from the response letter is removed.

Generally, I find the referencing to the Supplementary Material hard to follow. With some restructuring, the references to the individual text parts can be improved (e.g., not starting with

Supplementary Material B in L130 and more clearly stating which part of it refers to what is being said in the main text).

The names of the parts are included in the body of the text when references are made to the supplementary materials.