Dear Natalie Ceperley, thank you for your review and very constructive comments.

Reviewer: Although the word boreal is mentioned, we aren't introduced to the specifics of why it matters or a clear definition, situation on the globe.

Authors: We will add a few sentences to the introduction highlighting: (i) the extent of the boreal forest (*i.e.*, one of the largest biomes in the world), (ii) the importance of water fluxes from boreal forest on the global water and energy cycle and (iii) the few studies that have shown large variation in the partitioning of the water balance in these ecosystems (i.e., *ET* represent 45–85 % of incoming *P* in boreal forests).

Reviewer: As someone who has never worked in this part of the world, I have never heard of Krycklan and the term "boreal" does not automatically invoke an idea of what the issues / steaks / interest is regarding the water balance and evapotranspiration. The location is an extremely valuable part of this research and story, please introduce it well.

Authors: Similar to the answer above we will added text about the boreal biome, but also better highlight the high latitude location of our study site. This is a geographic area where relatively much less research has been conducted on the role of *ET*, which is an especial important omission as climate change will affect these northern latitude ecosystems more strongly than temperate and tropical biomes. Additionally, more references about the study location will be provided, which will help guide the reader to find additional studies that have previously used this well-established study site.

Reviewer: it is a stylistic choice to consider ET as a "loss", I might vary the term more and use flux ? Who loses ? Couldn't it also be seen as a positive flux for the ecosystem and the atmosphere? If indeed you want to maintain this language so strongly, you need to define your balance equation early on in terms of what is "positive" and what is "negative".

Authors: We agree that *ET* is a water flux and that it may be misleading, and potentially confusing, to consider *ET* as a “loss”. We will therefore carefully go through the manuscript and replaced “loss” with *ET* and its component fluxes. We will also rephrased the first sentence in the introduction to now describe the movement of water in terrestrial ecosystems as inputs and outputs.

Reviewer: you mention groundwater recharge, carbon cycle, stream flow, but you never come back to answer any applied question regarding water use

Authors: We mentioned streamflow, groundwater recharge and ecosystem carbon cycle at the end of the first paragraph in the introduction to highlight the important role that ET has on other water balance components as well as the ecosystem carbon cycle. In doing so, we are stressing the importance of understanding the magnitude and drivers of ET, which is the focus of the manuscript. In the discussion, we compare the magnitude of ET to stream flow as well as discuss how a future climate could affect the overall water budget and carbon balance in boreal forests.

Reviewer: "quantifying the magnitude and drivers of transpiration and evaporation are crucial to better understanding the spatiotemporal variation of water fluxes in terrestrial ecosystems." => do you do this in your discussion?

Authors: We acknowledge that this study does not directly investigate the abiotic drivers (i.e., environmental factors) influencing *ET* and its different flux components (*i.e.*, transpiration and evaporation). However, this was beyond the scope of the current study and is something we will address in a separate manuscript. The focus of this study was to evaluate the closure of the water budget, which is rarely done in a single study, and compare the magnitude of different water balance components during the growing season. We will rephrase this sentence to make this clear. In the discussion, we highlight the relative importance of transpiration and evaporation as well as compare these vertical water fluxes to measured horizontal water fluxes (*i.e.*, stream runoff). In doing so, we believe that this study provide a better understanding of how water moves in the boreal forested landscape during the growing season.

Reviewer: the review of ET partitioning research and ET in general seems quite limited. Stable isotopes are mentioned as the only tool that is not used in this paper, while there are others. I believe there are quite a few reviews that discuss the history of evaporation and evapotranspiration research out there, for example Gabriel Katul et al. 2012: EVAPOTRANSPIRATION: A PROCESS DRIVING MASS TRANSPORT AND ENERGY EXCHANGE IN THE SOIL-PLANT-ATMOSPHERE-CLIMATE SYSTEM in the Reviews of Geophysics. This gives a history of evaporation and transpiration research which starts much earlier than when you claim the interest started.

Authors: We agree that there is a rich history of evaporation and evapotranspiration research and will add a few sentences in the introduction to highlight this history. We will also delete the sentence that mentions how stable isotopes can be used to partition *ET* as this approach is not used in our study and is just one example of the many different approaches that can be used to partition *ET*.

Reviewer: Your entire approach neglects ground water recharge and deep soil leakage. Perhaps this is negligible at your site, but you need to address this. I believe that presenting your water balance equation in the introduction would help you articulate the assumptions. Additionally are bare ground and open water 100% non existent in your site? You need to address that there might be spatial variations in evaporation and transpiration and that your measurements are still at the point scale. You mention that the vegetation cover is homogeneous, but is it that homogeneous that you can ignore spatial variation?

Authors: We will add a paragraph in the methods section that describes how we partitioned the water balance based on empirical measurements. In doing so, we now include information on how we calculated "ground water recharge" and/or "deep soil leakage", which is what we call "*ds/dt*" in Figure 5.

We will provide a high resolution (17 cm2 pixels) aerial photo of the C2 subcatchment and surrounding area to more clearly show the homogenous vegetation cover at our site. Additionally, when describing the study site we will now mention that that C2 subcatchment

is (i) completely covered (99.9 % canopy cover; Laudon et al. 2013) with a mixed forest stand (ii) there is no bare ground, and (iii) aside from the small (< 0.5 m wide) headwater stream, there is no open water.

Reviewer: Why only 1 growing season ? And why only growing season? I understand there are limitations based on available data / instruments etc. But I still think you should argue why this time frame is relevant for your questions and tell us what happens the rest of the year. I suppose you have some measurements the rest of the year.

Authors: We acknowledge that it is unfortunate that our study period is only one growing season, but this this is the time period in which all measurements were available, namely empirical measurements of canopy transpiration and evaporation of precipitation from canopy trees. However, previous work from a nearby site has shown that there is little vegetation activity during the winter months (Tor-Ngern et al., 2017) and we have previously shown that evaporation of intercepted snow in the tree canopy represents 30% of winter precipitation at our site (Kozii et al., 2017). Partitioning the water balance during the growing season is more complicated, as trees are actively transpiring water during this time period resulting in a major water flux pathway that needs to be understood in more detail. Consequently, we know less about the movement of water in boreal forest during the active growing season, which is the focus of this study.

We will include daily hydro-meteorological variables for the entire 2016 year in Figure 2, to more clearly show the strong seasonality in stream runoff and environmental conditions affecting transpiration (*i.e.*, freezing temperatures). We will also include a sentence in the discussion section that highlights our previous work on evaporation of intercepted snow in canopy trees and, in turn, shows that evaporation of intercepted precipitation in canopy trees is the largest ET flux component when expressed on an annual time scale.

Tor-Ngern, P., Oren, R., Oishi, A. C., Uebelherr, J. M., Palmroth, S., Tarvainen, L., Ottosson-Lofvenius, M., Linder, S., Domec, J. C., and Nasholm, T. (2017) Ecophysiological variation of transpiration of pine forests: synthesis of new and published results, Ecological Applications, 27, 118-133.

Kozii, N., Laudon, H., Ottosson-Lofvenius, M., and Hasselquist, N. J. (2017) Increasing water losses from snow captured in the canopy of boreal forests: A case study using a 30 year data set, Hydrological Processes, 31, 3558-3567.

Reviewer: Figure 1 - I think the map of Sweden would benefit from some latitude lines or the arctic circle. What is the shading of the C2 Map? What is the elevation / variation? How does land cover change? You say the altitude of the outlet but not of the highest point. Please provide some proof that the land cover is sufficiently homogeneous. Or discuss how it is not - for this is where your uncertainty come from. How many points are you measuring meteorological data at? Put it on the map. Where was the EC station? This should be on the map.

Authors: We will make changes to Figure 1 to better show: (*1*) where exactly this study was done (*i.e.*, showing the arctic circle), (*2*) the elevation and variation in elevation within the C2 subcatchment, (*3*) the homogenous forest cover within the C2 subcatchment, (*4*) the location of the ICOS tower, where eddy covariance and other meteorological measurements are being

made, (*5*) the location of the nodes where sap flow measurements are being made and (*6*) the location of where canopy throughfall was measured.

Reviewer: l 190: write equations as their own line, it is hard to follow in text.

Authors: All equations will be written in their own line.

Reviewer: if possible add TF to map

Authors: We will included the location of the throughfall measurements to the map in Figure 1.

Reviewer: there is some work on the statistics of measuring through fall with rain gauges, this might help you estimate the uncertainty.

Authors: We are a little confused with this comment. What we did was measure throughfall at 25 locations. We also characterized the canopy structure above each throughfall collector (*i.e.*, a two-meter horizontal distance for each collector) based on spatial canopy density data acquired from airborne laser scanning (ALS). We then looked at correlations between different canopy attributes and *IL*. We found that overall median height (ElevMADmedian) had the highest correlation with measured seasonal interception losses and could explain 77% of the variation in IL. To quantify the uncertainty of the event-based *IL* estimated from measurement, we grouped the 25 throughfall rain gauges into 5 groups based on the ElevMADmedian and calculate standard deviation for each group and event. The weighted average obtained as a result of the groupwise standard deviations (IL_STD) gave us an indication of the uncertainty of the *IL* for the entire C2 subcatchment. We will rewrite this section to make this clearer in the methods section.

Reviewer: write out how the weighting calculation was done, this isn't very clear. Do you have a reference that TF is directly correlated with canopy density in this forest type?

Authors: Please see our response to the previous comment.

Reviewer: L205 put a table of those metrics and the correlations in the supplementary material.

Authors: The FUSION software provided us a total of 121 different canopy metrics. We assessed the correlation between *IL* and all 121 canopy metrics. We will include a new table in the supplementary material, but in this table we only present the 10 canopy metrics that had the highest correlation with seasonal *IL*.

Reviewer: through fall / interception is probably not as linear as you say. Often it depends on rainfall intensity and wind etc. I think showing this data would be a valuable contribution to the field and complement your paper.

Authors: We agree that throughfall/ interception for a single rain event cannot be predicted based solely on canopy metric, because as you mentioned throughfall/ interception also strongly depends on rainfall intensity, wind, etc. However, we want to stress that our estimates of *IL* are for the entire growing season and assessing how environmental factors (*i.e.*, rainfall intensity, wind speed, etc…) was beyond the scope of this study. However, in Figure 4b, c we present information on how rainfall intensity affect *IL*, and show a non-linear relationship between precipitation (*i.e.*, rainfall intensity) and *IL*. We now discuss how *IL* depends on rainfall intensity in the discussion section. Note that in the APES –model used in this work, rainfall interception depends on canopy storage capacity (linearly related to leaf area in the canopy layer), initial storage at the onset of rainfall event and rainfall intensity. The evaporation from wet leaves depends on microclimatic conditions (*i.e.*, wind, radiation, temperature etc.). Thus, in model simulations the rainfall frequency and intensity and temporal variations of weather conditions are accounted for.

Reviewer: Figure S2 could be on your primary map.

Authors: We will remove Figure S2 and now include the location of the nodes where sap flow was measured in the map of the C2 subcatchment in Figure 1

Reviewer: L 294 : solved ?

Authors: We have reworded this sentence. The sentence now reads as follows: "In our model, we used measured soil moisture and soil temperature at the depth of 0.05 m as lower boundary conditions."

Reviewer: L366 => T used a majority of available water.

Authors: We will rewrite this sentence to make it clear that transpiration was the largest water flux component during the study period.

Reviewer: L 374 => they include

Authors: We will replace "it includes" with "they include".

Reviewer: L 376 => observed data ?

Authors: We will rewrite this sentence to make it clear that we are comparing modeled estimates to measured data.

Reviewer: L 385 => area represents or areas represent

Authors: We will change "areas represents" to "areas represent".

Reviewer: figure 5 => incoming precipitation wasn't modeled, was it ? Understorey => Understory

Authors: Precipitation was not modelled. However, we understand how this could be misunderstood in Figure 5. We will place precipitation in the middle of the figure with arrows going to both the "measured" (left side) and "modelled" (right side) partitioning approaches. Additionally, we will use the abbreviation of *ET* flux components in the figure as suggested by reviewer #2.

Reviewer: L 438 - this is a long sentence

Authors: We have rewritten this sentence. The sentence now reads as follows: "Our findings clearly highlight the important role canopy trees play in the boreal hydrological cycle during the growing season, and stresses the need to better understand the effect of trees and their response to forest management practices and a changing climate."

Reviewer: comparing => compare

Authors: We have rewritten this sentence as suggested in the previous comment.

Reviewer: Maybe go one step further with a thought experiment. For example, based on our measurements, if all trees were removed from entire subcatchment, we would expect discharge over this period to go up by X%.

Authors: We agree that it is interesting to assess how changes in forest stand structure could influence the movement of water at our study site. Although we do not speculate how the removal of all trees would influence stream discharge, we do assess how changes in forest stand structure (i.e., leaf area index; LAI) could influence *ET* and its flux components. In the discussion section, we have a paragraph where we discuss the potential consequences of how changes in forest stand structure, as a result of forest management practices, could affect the way water moves through boreal forests.

Reviewer: this would have been interesting in introduction (with citations and further precision). In the introduction, could you have shown us an annual hydrograph and situation your study within that? (I know you showed a little bit of a hydrographic, but it wasn't the whole year).

Authors: We will change figure 2 to include environmental data and the hydrograph for the entire 2016 year. We will also include dotted vertical lines in the figure to clearly show the study period used in this study.

Reviewer: Figure 6 - It is hard to believe these are lines.

Authors: We are a little confused about this comment. In Figure 6, we present the results of model simulations in which we ran the APES model where LAI was changed from 1 to 7 m^2

m^{-2} at 0.5 intervals. In doing so, we show how changes in LAI influences *ET* and it flux components. We explain this in the discussion section where we say: "*To assess how forest management practices may influence the overall magnitude of ET as well as the relative importance of the different ET flux components we ran the APES model with a range of canopy LAI values; from 1 to 7* m^2 m^{-2}." We will now place the two panels in Figure 6 next to each other to more clearly show how changes in LAI influences *ET* and its flux components.