Dear Miriam Coenders-Gerrits, thank you for your review and very constructive comments.

Main concerns:
Reviewer: L146: the author only consider the growing season. I think it's important to emphasis throughout the paper.

Authors: We agree that this is an important point to emphasis and will make sure to highlight this throughout the manuscript. We will also make a change to the title to emphasis that this study only considers the growing season. The new title will read as: "Partitioning growing season water balance within a forested boreal catchment using sapflux, eddy covariance and a process-based model"

Reviewer: L176: I am happy to see that below EC-system latent heat is considered. However, equation 1 is only valid once the forest is homogeneous since the footprint of the ECsystem and the below canopy latent heat are different. How 'homogeneous is your forest? Please elaborate. –

Authors: The C2 subcatchment is completely covered (99.9% forest cover) by an old growth (> 100 yr.) mixed forest stand. We will now include a high-resolution aerial photograph of the C2 subcatchment in Figure 1c that shows the homogenous forest cover within the subcatchment. We will also added some text in the methods section to better describe the homogenous nature of the forest stand within the C2 subcatchment.

Reviewer: L199: the TF-sampling was done on 'event-base'. Please elaborate on how this was done. Did you run into your forest after rain ceased? Or did you do daily observations? How did you defined 'an event'?

Authors: We collected water from individual rain gauges immediately after rain ceased and thus each rainstorm represents an 'event'. During the study period that corresponded to 26 rain events. We will add a sentence to the methods section that describes how water was collected from individual rain gauges immediately after each rain event and therefore estimates of *IL* were made on an event basis.

Reviewer: L207: How did you tested whether ALS had the highest correlation with seasonal interception loss?

Authors: We used the FUSION software to characterized the canopy structure above each throughfall collector (*i.e.*, a two-meter horizontal distance for each collector), which is based on spatial canopy density data acquired from airborne laser scanning (ALS). The FUSION software gave us a total of 121 different canopy metrics that describes the canopy structure. We then looked at the correlation coefficient between season IL for each of the 25 *TF* collectors and all 121 canopy metrics. We found that ElevMADmedian had the highest correlation with measured seasonal interception losses and could explain 77% of the variation in *IL*. We will add some text to the methods section to make this clear. We will also include a table in the supplementary material that show the 10 canopy metrics that had the highest correlation with seasonal *IL*, as suggested by reviewer #1.

Reviewer: L220-285: Please have a look at the recent technical note by Larsen et al 2019. Would it be necessary to compensate your sapflow measurements as well? Not doing this could mean an overestimation of your transpiration.
Authors: Thank you for bring this paper to our attention. The paper by Larsen et al. (2019) highlights the concerns of probe misalignment when using heat pulse sensors for sap flow measurements. In our study, we used the heat dissipation approach and it is unclear if probe misalignment has the same effect, or has any effect, and if it has an effect whether the proposed correction based on heat pulse sensors would work for heat dissipation sensors. Employing the correction therefore may increase the error.

In our study we accounted for known sources of variation associated with radial, azimuthal and trees size in an attempt to minimize errors association with our calculations of transpiration. Although we employed the same coefficients when calculating transpiration we believe this has a minimal effect because the approach we used has previously been shown to produce reasonable results, especially in conifers, based on comparisons with eddy covariance and mass balance approaches (Oren et al. 1998; Schäfer et al. 2002; Ward et al. 2008; Oishi et al 2008; Tor-ngern et al. 2018; Ward et al. 2018)).

Oren R, Phillips N, Katul G, Ewers BE, Pataki DE (1998) Scaling xylem sap flux and soil water balance and calculating variance: a method for partitioning water flux in forests. *Annales des Sciences Forestieres* 55:191-216
Schäfer KVR, Oren R, Lai CT, Katul GG (2002) Hydrologic balance in an intact temperate forest ecosystem under ambient and elevated atmospheric CO_2 concentration. *Global Change biology* 8: 895-911
Ward EJ, Oren R, Sigurdsson BD, Jarvis PG, Linder S (2008) Fertilization effects on mean stomatal conductance are mediated through changes in the hydraulic attributes of mature Norway spruce trees. *Tree Physiology* 28: 579-596.
Oishi AC, Oren R, Stoy PC (2008) Estimating components of forest evapotranspiration: A footprint approach for scaling sap flux measurements. *Agricultural and Forest Meteorology* 148: 1719-1732
Tor-ngern P, Oren R, Palmroth S, Novick K, Oishi A, Linder S, Ottosson-Löfvenius M, Näsholm T (2018) Water balance of pine forests: synthesis of new and published results. *Agriculture and Forest Meteorology* 259:107-117
Ward EJ, Oren R, Kim HS, Kim D, Tor-ngern P, Ewers BE, McCarthy HR, Oishi AC, Pataki DE, Palmroth P, Phillips NG, Schäfer KVR (2018) Evapotranspiration and water yield of a pine-broadleaf forest are not altered by long-term atmospheric [CO_2] enrichment under native or enhanced soil fertility. *Global Change Biology* 24: 4841-4856. DOI: 10.1111/gcb.14363

Reviewer: section 2.3: a better explanation of the modelling principles of APES, would help the reader. For example showing model-scheme.

Authors: We will reorganize and streamline Section 2.3 to provide a better overview of the modeling principles of APES. The reader can find a Figure of the model scheme in Launiainen et al. (2015), which we cite when describing the model.

Launiainen, S., Katul, G. G., Lauren, A., and Kolari, P. (2015) Coupling boreal forest CO_2, H_2O and energy flows by a vertically structured forest canopy – Soil model with separate bryophyte layer, Ecological Modelling, 312, 385-405.

Reviewer: section 2: I think it would help to make a schematic picture (a bit like figure 5) of how you define ET and its subcomponents.

Authors: We acknowledge that it is a little unclear on how exactly we define and quantify *ET* and its flux components. We will therefore add a paragraph to the beginning of section 2 that clearly explains how we calculated *ET* and it individual flux components. We could also include a schematic picture if it is deemed necessary.

Reviewer: L376-380: be careful with your definitions of transpiration, evaporation and evapotranspiration. ETu is a combination of forest floor interception, understory transpiration (mosses) and soil evaporation and is thus not only 'evaporation' as said in L378. Also the role of soil evaporation is not explained. Is soil evaporation relevant in your study site? Why/why not.

Authors: We have carefully gone through the manuscript to make sure we are consistent with our definitions of transpiration, evaporation, and evapotranspiration. Additionally, we will change *IL* to *Ic* throughout the manuscript to make it clear that we are talking about evaporation of intercepted precipitation in the tree canopy. In this specific case (L376-380), we will rephrase this sentence to be clear that we are talking about *Ic* and understory evapotranspiration (*ETu*).

At our site, soil evaporation is negligible as there is no bare ground within the C2 subcatchment. We will make this clear in the method section when describing the study site by stating that the understory consists of a continuous layer of bilberry (Vaccinium myrtillus), lingonberry (Vaccinium vitis-idaea), and mosses (Pleurozium schreberi and Hylocomium splendens) with no bare ground."

Reviewer: Section 4: the discussion and conclusions are merged into one section. I think it would be better to split this. And/or merge the discussion with the results section. But for sure make a separate section for the conclusions only where you are only answering to the research objective.

Authors: We will make a separate section for the conclusions.

Specific (minor) comments:
Reviewer: L31: redundant to mention "and being roughly 7 times greater than stream runoff". This is the same info as saying ET is 85

Authors: We will remove "and being roughly 7 times greater than stream runoff" from the sentences.

Reviewer: L44: Maybe better to mention the spread in global ET. This is ca 55-80

Authors: We will now include the spread in global *ET*.

Reviewer: L71: after e.g. a comma.

Authors: We will add a comma after e.g.

Reviewer: L128: unit of annual rainfall is mm/year.

Authors: We will include yr^{-1} in our units of annual rainfall.

Reviewer: L157-165: variables like P, Q, dS, etc should be in italic.

Authors: We will italicized all water balance components (i.e., *P*, *Q*, *ET*, *T*, *IL*, *ETu*, and *ds/dt*) in this section and throughout the manuscript.

Reviewer: L165: I prefer to rename dS into dS/dt, since dS is the storage change per time.

Authors: We will change ΔS to ds/dt in this section as well as throughout the manuscript.

Reviewer: L172: details => detail.

Authors: We have rephrased this sentence as suggested by reviewer #3. The sentence now reads as follows: "A detailed description of the EC data processing and quality control can be found in Chi et al. (2019)"

Reviewer: Fig S1: the unit of P is mm/y. Furthermore, I would change instead of showing Q/P, showing ET/P. Since this the focus of the paper.

Authors: We will change the units of P to mm yr^{-1} as well as now show ET/P in Figure S1.

Reviewer: L337-342: This is a result.

Authors: We agree that L337-342 can be interpreted as a result, but we consider this finding as a test of the validity of the model at our study site. As the APES model was able to represent individual components of the surface energy balance reasonably well, it gives us confidence on the model's predictions of *ET* and its flux components. This information is only used as a model check and thus we choose to present it in this section and as a supplementary figure.

Reviewer: Fig3c: why showing IL+ETu? Why not only ETu? This would more sense in my view.

Authors: We agree that it would be nice to directly compared daily values of "measured" and "modeled" *ETu* during the study. However, this was not possible because canopy interception loss (I_C) were determined on an event-basis, and not on a daily basis. The "measured" data presented in Figure 3c is the difference between *ET* and canopy transpiration, which is I_C + *ETu*. We will rewrite the figure caption to make this clearer.

Reviewer: Section 2/fig 3: explain how ETu is 'measured'. It's calculated as ETu=ET-IL-T, right? Please add this equation and elaborate on the fact that ETu is thus not independent of the other measured components.

Authors: Understory evapotranspiration (*ETu*) was not directly measured in this study, but instead was calculated as: $ETu = ET – I_C – T$. Moreover, because I_C was estimated on an event basis, our estimate of *ETu* was for the entire growing season. We will add text in the method section that better describes how *ETu* was calculated.

Reviewer: Figure 5: I would add the percentages as well. Furthermore, be consistent in the naming of ET and its subcomponents. Would it not be better to use here the abbreviations?

Authors: In Figure 5, we now include the percentage of individual flux in relation to total *ET*. We did not include the percentage of individual flux components in relation to incoming *P*, as we believe this may cause confusion and would make the figure more difficult to understand. However, the values of total *P* and individual water pathways are presented in this figure, which makes it possible to also determine the percentage of different water pathways in relation to total *P*. Additionally, we now use the abbreviation for the different *ET* flux components in Figure 5.