

Dear Dr. Loes van Schaik,

Thank you for considering our study for publication in HESS. We appreciate the time the two peer-reviewers invested in providing valuable feedback for our manuscript and we are glad to hear that our study is evaluated positively by both reviewers. As outlined in the responses to each of the comments during the public discussion phase on HESSD, we addressed each comment very carefully and also provide for each comment what changes have been done in the revised manuscript or a reasonable explanation to the reviewer's observation. Please see the reviewer's comments and our responses below.

We hope that the editor agrees that the changes we have done fully address the reviewer's comments and that the manuscript can therefore be accepted as it is.

Thanks for your time and best wishes,

Juan

#### **Response to reviewer 1 (Dr. Alejandro Gonzalez-Ollauri)**

The reviewer's comments are in normal font and **the authors' responses are in bold font.**

I found your study very interesting and sound. I particularly liked your experimental design and the approaches followed to showcase the results. Well done! I think your study will be a good contribution to the field of stemflow and will animate discussion.

**We would like to thank Dr. Alejandro Gonzalez-Ollauri for all his comments and time spent reviewing the article. We are glad to hear that he sees the timeliness of the messages conveyed in our paper.**

However, I am suggesting some major revisions of the text to help convey the message more clearly and to contextualise the study a bit better. I am also suggesting to slightly tone down some of the claims and to stress/clarify the limitations to the study. You will find my comments and revision suggestions in the attached document. I hope you do not find my comments too harsh, as it was my intention to be as constructive as possible. You will also see that in some sections of the manuscript I am just highlighting text without providing any comments. I encourage the authors to pay attention to these and rephrase the text as appropriate.

**Many of the reviewers' comments and suggestions are welcomed to improve the article, and we have improved the manuscript accordingly. But, there are also comments with which we disagree, and where we disagree, we provide a thorough explanation. Given the large number of comments added by the reviewer, we have tried to respond concisely and directly to all of them.**

**All commentaries are listed below:**

1) may play

**Change accepted.**

2) was any surface runoff observed? Interference with the CS616 in terms of runoff infiltration? Soil moisture before the experiment was conducted? Soil type?

**Surface runoff was not observed during the experiment. We will add a statement saying that there was no surface runoff. Soil moisture before the experiment was measured and is shown in Figure 5 and 6, and soil type is described in section 3.1.**

3) this finding is a bit trivial - the isotopes and dye were travelling together - yet, it may have been interesting to assess isotopes concentration in zones where colorant was not present?

**- It is not necessarily trivial when it is understood that in dual-tracer infiltration experiments one tracer can travel farther/extended than the dye other. See:**

**Nobles et al. (2010) - <https://doi.org/10.1016/j.jhydrol.2010.03.014>**

**Schwen et al. (2014) - <https://doi.org/10.1016/j.jhydrol.2014.09.028>**

**Luo et al. (2019) - <https://doi.org/10.2134/jeq2018.03.0091>**

**- Indeed, we have the isotopic data of zones where no dye was observed. We refer the reviewer to Figure S5 in the Supplementary Material.**

4) is there any supporting evidence for this finding?

**A decrease in dye concentration and deuterium isotopic composition is owing to dilution and mixing of infiltration waters with soil water. This is a physical process that has been demonstrated some time ago for both Brilliant blue dye (e.g., [https://doi.org/10.1016/S0016-7061\(00\)00027-6](https://doi.org/10.1016/S0016-7061(00)00027-6)) and deuterium (e.g., [https://doi.org/10.1016/0022-1694\(94\)90159-7](https://doi.org/10.1016/0022-1694(94)90159-7)).**

5) please, delete or replace 'heavily'

**Change accepted. "heavily" will be deleted.**

6) surface runoff has not been mentioned above, see my previous comment,

**By demonstrating that stemflow significantly affects soil moisture, we suggest that it would also affect surface runoff in some locations and in events of high intensity or long duration when the soil becomes saturated. However, we never observed surface runoff in the studied plot (flat area with well-structured soils).**

7) last sentence is unclear - my understanding is that the authors are striving to gain insights into the soil hydrological processes regulated by stemflow funnelling not the other way around?

**Yes, that is correct. Thank you for your comment. We will rewrite this sentence to convey the message correctly.**

8) I like the monitoring setup. Yet CS TDRs measure the average SWC between 0 and 30 cm below ground. So, if the probes were vertically inserted in the ground, then it would be hard to detect changes in SWC produced by stemflow-derived preferential flow. this could be better sensed with capacitance meters or with the CS TDRs deployed horizontally. I think this is a limitation to the study and was wondering if the authors could comment on this?

**As described in section 2.2 of M&M, we installed one set of TDR probes inserted vertically measuring average SWC across the length of the probe (0-30 cm in this case).**

**We consider that if matric flow occurs, the increase in humidity recorded by the probe will be greater than if preferential flow occurs, since only part of the probe will be affected by an**

increase in SWC in the occurrence of preferential flow. We could have installed the sensors also horizontally, that is true, but this would average the water contents in horizontal direction, possibly missing vertical preferential flow pathways. We think both approaches have advantages and disadvantages, not none is necessarily better than the other.

9) sentence unclear - please, rephrase. Also, throughfall not defined

**We will include the definition of "throughfall", which makes the message of the present sentence much clear.**

10) not clear from the information provided above

**We disagree. Some general examples have been described above that clearly describe the effects of stemflow on the biogeochemistry and ecohydrology of vegetated ecosystems.**

11) this sentence is awkward, please rephrase. Rainfall gets channeled/concentrated/funnelled around the branches and stem, but it does not get transformed

**Change accepted. "turns" will be replaced by "concentrated" as suggested by the reviewer.**

12) funnelling process

**Change accepted.**

13) citation(s) needed - given that studies on this have been carried out in the past

**In this short paragraph we are just defining the concept of "stemflow double funnelling" which was introduced by Johnson and Lehmann (2006). Studies on the subject are cited in the following paragraph where specific examples are given.**

14) please, rephrase - i would avoid saying well-known here - there is some evidence that it happens, yet there are not theories, models underpinning the double-funnelling process. Also, it does not happen in every tree, soil, rainfall event...(although there is not data published on this)

**From the sentence: "While the concept of the double-funnelling phenomenon is well known, clarification of the underlying mechanisms is more challenging" we are referring to the concept/definition, but not to theories or models that as the reviewer states have not yet been developed.**

**Also, we do not understand how the reviewer states that it does not happen in all trees because so far there is no study that proves the non-existence of stemflow double funnelling, and obviously it does not happen in all rain events since there must be enough rainfall to generate stemflow that can infiltrate into the soil (the degree of infiltration will depend on the soil physical properties such as permeability, texture, hydrophobicity, etc. and topography; i.e. the slope). To address to the reviewer's comment, the following text will be added: "Once stemflow occurs, its underground infiltration is governed by a complex interplay of soil physical properties, terrain slope and root architecture."**

15) stemflow double funnelling - English/grammar should be revised throughout the manuscript - i will try to stick to the science/message, yet i will highlight where revision of the text should be considered

**We agree with the reviewer. Thanks for the observation. We will change "double funnelling" by "stemflow belowground funnelling"**

16) please, delete ones

**Change accepted.**

17) please, see my comment above - it should be interesting that the authors stress here and in the Discussion that it is not yet clear or understood under which eco-hydrological conditions stemflow double-funnelling occurs.

Personal communication: i have been monitoring this process for years in over 10 trees growing on the same slope, and it is still unclear why sometimes it happens and sometimes simply doesn't -i.e., most of the stemflow results in surface runoff.

**The following sentence will be added within the paragraph: "Once stemflow occurs, its underground infiltration is governed by a complex interplay of soil physical properties, terrain slope and root architecture"**

18) vadose zone not introduced

**Although "vadose zone" is a basic term in hydrology, we will change "vadose zone" by "unsaturated zone" which is a clear definition.**

19) where?

**From the previous sentence it is clear that we are referring to the soil.**

20) where?

**"within the soil" Will be added.**

21) under which conditions?

**The conditions under the experiment was performed are described throughout section 2.**

22) verb missing

**Yes, "being" will be added.**

23) why was this representative?

Given that tree architectural traits are key to understand stemflow yield, could the authors provide some detail on these?

**This study is not focused on stemflow production and its biotic or abiotic factors, but rather on the stemflow infiltration into the soil by means of an artificial experiment.**

**The following sentence will be added "This tree is representative of the plot's diameter at breast height (DBH) distribution and is situated on a flat area in an old abandoned agricultural terrace. Further, it has sufficient space around it for the placement of all the hydrometric equipment."**

24) why this rate?

**This rate reflects the average time stemflow is generated during a 50 mm event according to the monitoring data prior to the experiment. We have mentioned that in the text. For the sake of clarity, this text will be deleted here as it is mentioned in one of the paragraphs below.**

25) how was this achieved?

**The plot is located on a flat area within a hill. We have modified the sentence to clarify this.**

26) why this arrangement was chosen?

**45 degrees means that all cardinal and intercardinal directions will be monitored with reference to the tree, and 10 cm and 30 cm indicated different distances from the tree bole, so that changes in SWC can be monitored.**

27) to where?

**"as close as possible" to the intended position according to the monitoring design.**

28) who? what?

**"They" refers to the TDR probes described in the previous sentence. "They" will be changed to "The TDR probes".**

29) you mean horizontally? otherwise, this is not clear. If these probes were deployed at the specified depths, how was it possible? Please ,clarify

**Two years prior to the experiment, TDR probes of different lengths were installed vertically at different depths. Holes the size of the distance between the TDR probe external rods were made manually with a soil auger, once the hole had the selected depth the TDR probe was stuck into the not disturbed soil. The text will be modified for clarification.**

30) to sample or to measure? were samples collected in the piezometers? Also, could you please explain the rationale for installing the probes at those locations?

**Yes, both to measure and sample. Thanks for the observation. The piezometers were installed in two opposite locations to measure and sample groundwater, in order to detect changes in groundwater level or dye presence in water samples respectively.**

31) same as above

**Similarly, the mini-piezometers were in proximity to the TDR probes locations in order to monitored changes in water level together with the presence of colored water in the shallow soil layer.**

32) depth to the ground (z) is not clear, nor the text below. please clarify/rephrase

**We have a mesh above ground level, and we measure the depth (or distance) from each intersection of the mesh to the ground. We will change the text to "Vertical distance (z) from the mesh intersection to the actual ground surface was measured, using the mesh level as the reference plane"**

33) Sentence too long and hard to follow. please, rephrase or break into several sentences

**The sentence will be modified.**

34) where? right at the base of the tree bole or at some distance following surface runoff

**We refer at the base of the tree. The sentence will be clarified.**

35) this can be quite high in some soils. Please, provide information/data on porosity, bulk density and texture to iilustrate this better

**All these data are shown in section 3.1.**

36) this is redundant - i also think that this paragraph should come before. You could split this section into experimental setup and monitoring setup?

**- We will change "at a flow rate of 7 L h<sup>-1</sup>" to "at the established flow rate".**

**- We don't think splitting into two sections is useful, because the text would become repetitive as the "experimental" section will require details of the "monitoring" section.**

37) citation or more detail needed

**The following citation (Cayuela et al., 2018 - <https://doi.org/10.1002/eco.2025>), from which the experimental data were obtained, will be added.**

38) is this concentration standard?

**Yes, it is. For more details check: <https://doi.org/10.2134/jeq1994.00472425002300050037x>**

39) please rephrase - sentence too long and hard to follow

**We will split the sentence, but it will not be rephrased, as we consider that the description of the method is clear.**

40) sometimes you just refer to experiment, now to dual-labelled water application - please, be consistent throughout. I suggest choosing a simple name to denote this experimental stage - e.g., stemflow experiment, so the reader can follow.

**The experiment refers to the whole process, from the installation of the materials, stemflow simulation with dual-labelled water, the excavation of the soil and the sampling. Therefore, here we refer only to the dual-labelled water application because this stage is prior to the excavation.**

41) why?

**We are not exactly sure what this question refers to. If we excavate more profiles, we can see the extent of infiltration and its redistribution in the soil matrix. Dozens of infiltration studies have used the same method (e.g., <http://dx.doi.org/10.1016/j.jhydrol.2012.08.048>, <https://doi.org/10.2134/jeq2018.03.0091>)**

42) why 40 cm?

**Since stemflow water influences the areas near the stem, we decided that 40 cm was a suitable distance to study stemflow infiltration and its redistribution in the soil matrix. But there is no specific reason to choose 40 cm, it could be 35 or 45 cm also.**

43) it is not clear from the text above that all trenches were excavate within one day. Also, excavating trenches under a tree is labour intensive, and it requires to be careful regarding roots and stones. I would be interested to hear how the authors managed to accomplish this.

**We excavated all the profiles in one day. In fact, it was a very laborious task, as the reviewer mentioned. We were a team of six people, and we have meticulously planned and organized the experiment and the tasks beforehand. Additionally, it is worth mentioning that the depth of the profiles was only 30 cm, but nevertheless roots and stones were encountered which made excavation difficult.**

44) this sentence reads like discussion - either delete, rephrase or move below in the paragraph.

Thanks for the observation. The sentence will be modified and moved below. Moreover, to make the paragraph clearer, the following sentence will be added at the beginning of the paragraph: "Photographs of the soil profiles were taken using a cell phone with a dual-lens camera system of 12MP (iPhone 11, Apple Inc., CA, USA)."

45) please, add a bit of detail on what this classification method does and to what aim it was utilised herein.

- The following text will be added: "The maximum-likelihood classification assigns each cell in the input raster to the class that it has the highest probability of belonging to."

- We also state: "used to classify dye-stained and non-stained areas"

46) I think all these indices are a great way of describing quantitatively preferential infiltration from image observation. Please, introduce why these indices were calculated - you may wish to add a sentence referring to this in the Section's opening para? Also, you may want to add something referring to this analysis approach in the Introduction Section?

- These indices were calculated because they are optimal for quantitatively describing preferential flow in soils according to the current literature. All the indices are introduced and justified by references (Flury et al., 1994; Van Schaik, 2009; Bargués-Tobella et al., 2014; Hatano and Booltink, 1992; Hatano et al., 1992).

We will replace the sentence "Six preferential flow indices were then derived from the digitized images" with "Digitized images were then further analyzed to quantify several preferential flow indices."

47) please, elaborate

We are not sure what the reviewer refers to here. "Total dye coverage is lower when there is a higher degree of preferential flow." seems clear to us.

48) how was TSA calculated?

Total stained area (cm<sup>2</sup>) is derived from total dye coverage (%) from the digitized images as illustrated in Figure 2.

49) what is the relationship between this and DC?

We do not quite understand the question. When the DC profile is intercepted several times by the total DC value, it indicates higher degree of preferential flow, when there is no preferential flow this value is lower or zero.

50) do you really have to mention this? i have seen this structure above, too, yet it may be better to describe what you did and then add citations as appropriate. This suggestion could improve the reading flow

Yes. The primary reason is that we have not developed the method of dye quantification, but followed the procedures and guidelines established in previous studies. In this study, the procedure of Forrer et al. (2000) was followed as described in the text.

51) Sentence unclear; please, rephrase

**When we take a soil sample with a ring, we have two sides (one external and one internal). The external side is the same as the one captured in the photographs. We will clarify this in the text.**

52) light? or UV-V

**Thanks for the observation. It will be changed to “UV-Vis” spectrometry.**

53) is this information relevant?

**Yes. The laboratory where the isotopic analysis was carried out must be described since each laboratory has different equipment and methods for analysis and validation.**

54) ignore my comment above on info re soil attributes

**Done.**

55) why not using those equations proposed for European soils?  
<https://bsssjournals.onlinelibrary.wiley.com/doi/full/10.1111/ejss.12192>

Also, given the amount of sensors deployed to monitor VSM and matric suction, why not using this information to fit a soil-water retention function and derive Ks?

**- This is a good point. We decided to use Rosetta because it is an often-used model and its version 3 is the most updated and improved version for pedotransfer functions. Regardless of which function is used, the Ks estimate is only used as an informative parameter in our study to show the relative changes in soil properties as a function of depth.**

**- Matric suction was not monitored in this study, so we cannot develop a water retention curve from our data.**

57) this reads a methods, please, consider to move to Section 2

**We disagree because in the text we are describing what we are showing in Figure 4, i.e., the results of the soil characteristics.**

58) delete this sentence and cross-reference results text and figure, so text flow improves.

**We do not agree, because this would unnecessarily lengthen the paragraph by adding (Figure 4a, Figure 4b, Figure 4c... etc.).**

59) citation needed

**Change accepted. The following citation (Rubio et al., 2008) will be added.**

60) could this be due to textural changes?

**No, not really, because the soil texture did not drastically change with soil depth (see Figure 4). It is most likely because of higher soil compaction in the subsoil.**

61) if there only are few studies, could you just mention them or more than just one here? or does this citation refer to a Review? if this is the case, does the latter study reflect more recent studies? I am at least aware of this one - Gonzalez-Ollauri et al. 2020. (<https://www.sciencedirect.com/science/article/abs/pii/S0022169419311837?via%3Dihub>)



**The citation (Carlyle-Moses et al. 2020) corresponds to the latest review of the topic where the study by Gonzalez-Ollauri et al. (2020) is also included. It will be modified as follows “(see the review by Carlyle-Moses et al. 2020)”.**

62) phasion? in any case, it is interesting that stemflow infiltrated the soil this way - could the authors comment on that this was because the studied tree was growing on flat ground?

I am pointing this out because stemflow only occurs on one side of the stem when trees are growing on a slope. I think this should be commented/discussed.

**- Thanks for this comment. We will add in the M&M section a sentence explaining that the tree is on flat ground.**

**- In the paper the effect of stemflow on trees growing on slopes will be discussed.**

63) how far from the tree bole this was?

**Thanks for the observation, unfortunately we did not measure the radius because it was not a perfect annulus, however we provided the stemflow infiltration area.**

64) this statement disagrees with the revision carried out by Van Stan et al. 2021 (<https://www.frontiersin.org/articles/10.3389/ffgc.2020.00061/full> ) and it should be acknowledged. It should also be acknowledged or at least suggested that this observation depends on soil moisture conditions. When the soil is dry, it can be expected a much larger radius (or so I have observed) due to soil's low capacity to infiltrate water under these conditions, thus stemflow resulting into surface runoff.

**- “Heterogeneous volumetric SWC around a tree, induced by stemflow.....” the present statement is not really related to the Van Stan et al. (2021) study which focuses on the estimation of stemflow infiltration areas, so we think it is difficult to compare these two studies.**

**- The following sentence will be added: “It should be noted that SWC response caused by stemflow infiltration can change depending on antecedent soil moisture conditions which could lead to different water flow dynamics (Kobayashi & Shimizu, 2007).”**

65) also, see my comment in Fig. 4 and above

Figure 4: soil moisture by the TDRs is averaged between 0 and 30 cm b.g.l, the soil porosity profile indicates that the soil profile was nearly saturated when the experiment was conducted (given that SWC was ca. 32 %). This has an important impact on the ability of the soil to let water through. Could the authors comment on this?

**We agree. Thanks for the observation. We have already added a sentence commenting on this issue in comment 64 above.**

66) i really like Figure 5 - a lot of information can be drawn from it. why stemflow mostly occurred in the direction observed? was there a relationship with the site's topography - see my comment above

**Thanks, we are happy to hear that the reviewer likes our Figure 5. In the last paragraph we suggest possible explanations for the phenomenon shown in Figure 5. There does not seem to be any relationship with micro-topography, as can be seen in Figure 1, the level changes are quite small in the infiltration area. Again, the tree is not located on a slope, but on flat ground.**

67) please, provide a radius above for the ring produced by stemflow, as it will help interpret this finding. Also, see my comments on this above - some studies (not all) seem to provide evidence on that a lot of stemflow ends up infiltrating away from the tree bole. 30 cm from the tree bole is relatively significant from the rhizosphere scale perspective. This having said, could the authors comment on it?

**Thanks for the observation, unfortunately we did not measure the radius because the stemflow infiltration area was not a perfect annulus. Yes, stemflow infiltrated away from the tree trunk, mainly by funneling into the coarse roots. Similar findings from other studies are also discussed (e.g., Carlyle-Moses et al., 2018, Tischer et al., 2020). We also argue in the manuscript that root architecture is the main driver of vertical and horizontal redistribution of stemflow water. Finally, some examples of the root architecture of Scots pine species are shown in Figure S2.**

68) can you really compare species without considering bark roughness? (in turn dependent on age?). could the authors comment on this, too?

also, sycamore and maple seems redundant, please delete maple

**- We will include the study by Carlyle-Moses et al. (2018) that analyzed stemflow in juvenile lodgepole pines. Since there are no more studies on pine species for comparison, it is feasible to compare our results with others of different species even if they are contrasting.**

**- Change accepted. "maple" will be deleted.**

69) please, make a reference to this in Section 2 when describing the experimental approach

**We don't think a reference to section 2 is needed here, because the methods have been described already and it should be obvious that we refer to our own experimental methods here.**

70) could not this be produced by surface runoff followed by matrix infiltration? is there any other supporting evidence within this study to support this statement? could the authors comment on this?

**- As we stated above, surface runoff was not generated during this experiment. Stemflow water infiltrated a very small infiltration adjoining the tree bole.**

**- Yes, we observed the presence of stained areas around the coarse roots during excavation at different distances (10 cm, 25 cm and 40 cm). In addition, this was also found in other studies (e.g., Spencer and van Meerveld, 2016).**

71) figure?

**We cannot add "figure" here because the figures must be indicated in order with the text, so we will add "(see section 3.5)".**

72) could the authors comment on why these species develop coarse roots in these directions?

**We are not sure how to answer this question. This question relates to forest ecology and evolutionary development of root morphology which we are not confident to discuss.**

73) please, see my comment in Fig. 6

Figure 6: this plot indicates that soil moisture mostly changed in the topsoil, which could be a result of stemflow ending up in surface runoff and then matrix flow. Unless the tree individual had lateral roots favouring stemflow water transport. Could the authors comment on this?

**Again, surface runoff was not generated during this experiment. Indeed, we have argued within the manuscript that lateral flow through the roots occurs transporting stemflow water in shallow and deeper soil layers.**

74) could you please elaborate on this? also refer to my comment in Fig. 6. While the authors are reporting the results very well, there is little discussion/interpretation of the results. I think the authors should consider to discuss the results in more depth without extending the length of the text substantially. I am aware this is not easy, yet it would help stress the relevance and impact of the study.

**Thanks for the observation the following sentence will be added: “Bypass flow, either by a macropore channel or root presence, leads to spatially irregular wetting of the soil profile with differing flow velocities that allow infiltrating water to move farther and reach deeper soil layers with minimal interaction with the bulk soil (Gerke, 2011)”**

75) these claims are arguable - figure 6 shows that changes mainly occurred within the first 10 cm of the soil - this has not been mentioned or acknowledged here at all. As shown in Fig. 6, SWC changes in depth are rather subtle and this should be highlighted here as well. Please, revise these claims and connect them better with what it is shown in Fig. 5 and 6. If my interpretation is wrong, please, explain better your findings here.

**After considering the reviewers comments, we will move this paragraph to the end of section 3.5 “Image analysis of stemflow stain patterns and preferential flow paths”. Together with the dye tracer data, our statement can be better supported. We now write:**

**“The non-uniform dye patterns and SWC heterogeneity around the tree during the stemflow experiment can be attributed to four factors: (1) preferential flow of stemflow on the trunk itself (as shown in Pinos et al., 2021). Although stemflow was evenly discharged around the trunk at a height of 1.3 m, preferential flow on the trunk was observed below this height; (2) non-uniform infiltration of stemflow into the soil and preferential flow in the soil due to the presence of coarse roots, that redistribute water flow both vertically and horizontally (Schwärzel et al., 2012), (3) the temporary presence of local perched water tables (Liang et al., 2011), and (4) heterogeneous soil structure (Metzger et al., 2017, 2021).”**

76) please, see my comment in Fig. 7

Figure 7: it is somehow interesting that the formation of perched water tables does not coincide with SWC dynamics in Fig. 5. I wonder if water accumulation shown in dark blue was due to the presence of stones? sudden changes in texture? Could the authors comment on this?

Does this figure suggest that most of the water flow through the profile? - given that water is not perching in most of the assessed locations.

However, it should be clarified that SWC TDRs measure the average profile moisture and the piezometers are only reading what happens at 30 cm b.g.l. Could the authors comment on this? I think this has some implications for interpreting the results.

- The number of stones was small, and no relationship between stones and water level was observed during the excavation. On the other hand, as can be seen in Figure 4, there are no abrupt texture changes in the profiles.

- Yes correct. Most of the water flow preferentially through the profile by the roots and macropores.

- We agree. One of the study limitations is that the maximum analyzed depth was 30 cm b.g.l. We have clarified this sentence as follows: "Taken together, piezometer and SWC measurements down to 30 cm belowground level demonstrate the great temporal and spatial heterogeneity of the soil-water dynamics of stemflow infiltration".

77) i think this statement should be revised or explained better - even though no response was noticed with the TDRs because soil was nearly saturated, changes should still be registered by the piezometers, given that the latter probes should be able to measure the hydraulic head when pore-water pressure is positive. Could the authors comment on this?

**We describe and discuss this observation in the previous sentence: "Even near-saturated locations (TDR probes swc-SE30 and swc-W30) received stemflow water, as indicated by the occurrence of blue water in nearby mini-piezometers wt-SE20 and wt-W20, respectively (Figure S3). However, no SWC response to stemflow was observed at these locations because the soil was already saturated."**

78) could the authors explain (or suggest) why this was the case?

**The following sentence will be added: "This result is likely due to water flowing rapidly through the preferential flow channels and not reaching a positive pore water pressure."**

79) this Section is a bit hard to follow - perhaps with the figure closer to the text, the information could be easier to digest. I am wondering if the authors could provide a better synthesis/message from what it was observed with the piezometers?

**Since the table and figures are at the end of the article, we understand that it is difficult for the reviewer to follow the text. However, the article will be formatted by the publisher when it is in production. We will shorten this paragraph to make it easier to understand.**

80) when looking at the figure, i actually undestood the oposite. Please, add a label/title showing the distance, so it is easier to interpret.

**Thanks for the observation. Change accepted.**

81) you should clarify the topographic conditions on which the tree individual is growing. In light of the observed pattern of stemflow, It seems like it was growing on flat ground. This must be made clear prior to comparing with other studies in which tree individuals are growing on slopes, and on which stemflow only tends to occur in one direction. Also, please, stress this point in the text.

**Yes, we have already addressed this issue by adding a new sentence in M&M. See previous replies on this issue.**

82) could the authors elaborate on this?

**We do not understand what is to be elaborated. It is evident that the greater the DC near the trunk, the greater the vertical infiltration, or in the opposite case, the greater the DC far from the trunk, the greater the horizontal infiltration.**

83) see my comment above - this should be made clear earlier

**Yes, we have already addressed this issue by adding a new sentence in M&M. See previous replies on this issue.**

84) this somehow contradicts what it was captured with the TDRs - see my comment above - could the authors clarify/explain?

I understood there was a response from sensors located away from the tree bole but then most of the dye was found closer to the tree bole - could the authors explain this?

Also, could be that the dye did not manage to make it far away from the tree bole due to filtration/adsorption/,,, and thus most of the dye was observed closer to the bole? could the authors comments on this?

yes, i want to believe that stemflow mostly leads to preferential flow and yet evidence has to be taken with care.

**- Yes, there was a response of sensors located away from the tree bole and most of the dye was found closer to the tree bole. We must stress that the dye only indicated the flow pathways by which water moved within the soil matrix and is not an indicator of SWC.**

**- Yes, the concentration of dye is reduced by sorption the further it travels in the soil. See Figure 10. However, the concentration used in this study was more than sufficient to detect preferential pathways. Several studies on different soil types have used a similar or lower concentration and found the dye at greater depths (e.g., <https://doi.org/10.1002/2013WR015197>, <https://doi.org/10.1002/hyp.7302>, <https://doi.org/10.1016/j.jhydrol.2010.03.014>). Therefore, it is not a limiting factor.**

85) citation needed

**Accepted. "Noguchi et al (1997)" will be added.**

86) see my comment in Fig.9

Figure 9: While it is clear that coarse roots channeled the dye, dye is also visible in sections of the soil profile where coarse roots are not present. This is quite clear in West, South images - could the authors comments on this?

**Yes, as described in the manuscript, the coloured water is mainly channeled through the coarse roots and macropores.**

87) and this is a great finding

**We thank the reviewer for his comment.**

88) citation needed - this should be introduced in Section 1 (intro) as it sets the basis for understanding under which soil conditions preferential flow may occur?

**- Accepted. "Beven and Germann (2013)" will be added.**

- **We do not necessarily agree with having this mentioned in the introduction. It is not necessary to add the bypass flow mechanism between macropores in the introduction section, but it is used as an interpretation for the coloration patterns we have found in the profiles.**

89) could the authors also stress here that topography has an important effect, too? and potentially. climate. as there is clear evidence that the soil water mass balance (which depends on climate) is a clear driver of vertical root distribution - please, comment.

**Yes. Thanks for the comments. We will add the following sentence to highlight the importance of the topography: "In addition, slope topography plays a key role in determining stemflow infiltration by diverting most of the stemflow water downslope through gravity, which can leads to overlandflow generation (Gonzalez-Ollauri et al., 2020)". Climate will not be added because different species are inherently different for each type of climate, so it is implicit when talking about different species.**

90) where? could you please be more specific here?

**Thanks for the observation. It will be changed to "In some near-stem locations"**

91) was root architecture mapped? or quantified? this claim is hard to undertake - or at least i did not find enough supporting evidence in the text above.

Yes, you observed flow bypassed the topsoil with the dye - (not really with the sensors, to my understanding, this is a limitation that should be clearly noted; see my comment above).

I think the findings should be organised/summarised better here - perhaps from the most relevant to the least, and also clarify the contribution of the findings to the current understanding of stemflow?

- **Mapping the root architecture is way beyond the scope of the present study. However, there are multiple studies on the root architecture of Scots pine in the literature. In Figure S2 we show some examples of these trees growing in flat terrain. Moreover, we observe some root architectural traits (as superficial horizontal large roots) during the excavation.**

- **Yes, we observe bypass flow mainly by analyzing dye patterns, and to lesser extent by one set of TDR probes placed at different depths. We do mention that dye staining is excellent tool to identify flow patterns, but cannot quantitatively determine flow.**

- **We summarize the main findings of the study in the last paragraph in form of implications. We do not want to summarize the results here, as this would be repetitive with the abstract.**

92) see my comment above - the study is very interesting, yet this seems to be overclaiming

**We don't believe we are "overclaiming". It is quite possible that more probes or improved designs could be used for study stemflow belowground funnelling much better, as well as simpler designs. However, we demonstrate with our experimental setup the stemflow infiltration dynamics, thus we consider that we don't overclaim when we stated that our design "delineates and quantifies stemflow belowground funnelling well."**

93) see my comment above - the study is very interesting, yet this seems to be overclaiming - dye observations somehow verify preferential flow but this was not clear with the TDRs. In fact, and assuming that i understood well, figs. 5,6 vs 8 contradict with each other a bit - and this should be made clear

**We do not think that Figs 5, 6, and 8 are contradicting each other. For the most part these figures support our conclusions of preferential flow along roots and differential infiltration of stemflow water into the soil matrix. There is, of course, noise in the data, and spatial variability caused different sensors to react differently, which makes it sometimes difficult to discern the general patterns.**

94) this claim should be revised/toned down, too - only one tree was studied, yet the authors are upscaling without referring to other environmental conditions/attributes influencing stemflow. In fact, the authors should refer to these factors more in the text, as indicated in my comments above.

**Our experiments with one tree clearly demonstrate that stemflow double funneling can occur in our Pine forest. Although we studied one tree only, there is no reason to believe that it will be different during a rainfall on more trees.**

**In the discussion, we added that: "The stemflow infiltration area found in this study should be interpreted with caution, as it corresponds to a specific amount (50 mm) and discharge ( $7 \text{ L h}^{-1}$ ) and to specific antecedent moisture conditions and soil physical properties, and we suspect that it may vary as any of these conditions change."**

95) figure needs some labels, so it is easier to follow. split figure 1 into 1a and 1b?, so it is easier to follow

**We will split in Fig 1a and Fig 1b**

96) please, explain further what the two figures are showing by adding more text/detail to the legend (Figure 2)

**We will change the caption to: "Top view of experimental plot with squares indicating the location of the vertical soil profiles excavated around the tree (left). Schematic of vertical soil profiles with dye patterns (right)."**

97) very nice way of portraying this

**We thank the reviewer for his comment.**

98) it is not clear what it is portrayed in black and grey, respectively. please, clarify by adding a legend? or more text in the caption text? please, add a title-label indicating the distance, too

**In the figure caption we explain the black and gray shades: "Dye coverage (black = soil-stained areas; grey = root-stained areas) of the different soil profiles. We will add a title-label indicating the distance of the profiles.**

## Response to reviewer 2

The reviewer's comments are in normal font and **the authors' responses are in bold font.**

The manuscript by Pinos et al. was interesting and pleasant to read. The study is methodologically sound and the manuscript is comprehensive. The results enrich the scientific discourse and fit very well within the scope of HESS. The figures are descriptive and well-chosen.

Despite the solid status quo, I think the manuscript would benefit greatly from major revisions on the discussion and related sections as described below. Furthermore, I address specific text passages under "specific comments". I hope that my input and investment will motivate the authors to put the finishing touches on their work, and I look forward to the revised version of the manuscript.

**We would like to thank reviewer #2 for all his/her comments and time spent reviewing the article. We are glad to hear that she/he sees the timeliness of the messages conveyed in our paper.**

General comments:

Title: The title would benefit from rephrasing toward being more precise by naming the main outcome of the study.

**We appreciate the observation. The title will be slightly modified as follows: "Routing stemflow water through soil via preferential flow: a dual labelling approach with artificial tracers". We believe that the new formulation of the title is the most appropriate.**

Abstract: The abstract does not yet do justice to the manuscript. It should not only contain the most important information, but also highlight the strengths of the study. Instructions for a good abstract can be found, for example, in "How to construct a Nature summary paragraph" and in Jean-luc Doumont's work (e.g. <https://www.principiae.be/pdfs/UGent-X-003-slideshow.pdf>). I recommend to tackle the revision of the abstract as the last step to benefit from the improvement of the discussion.

Discussion: The discussion overall appears somewhat unfinished and incoherent, and the main messages are not clear. Basically, the necessary elements are contained, but the discussion lacks elaboration of the key process-oriented findings. In addition, the discussion of methodological aspects could also be improved by not only evaluating the methods' success, but by highlighting and framing observations based on methodological strengths and weaknesses. This could take the authors farther away from a methodological and case study. In this regard, the authors should also rethink the structure of the discussion, which in the current version is oriented toward result groups. Instead, they could formulate stronger contextual subsections, for example on the three main findings (messages), and then summarize the results that support those messages. A mixture of contextual and methodological subsections is also conceivable (however, the most important content-related insights should be clearly recognizable). The restructuring would also allow for more meaningful subsection headings, which I recommend (as for the manuscript title).

Conclusion: As the conclusion depends on the discussion, it also needs additional work. See in the specific comments for more detail.



**Thank you for your comments, modifications have been added to the abstract, discussion and conclusion sections following the specific comments of reviewers 1 and 2.**

Specific and technical comments:

8: Start with the motivation instead of the research gap.

**We agree. The sentence has been modified to start with the study motivation.**

12: "50 mm of rainfall"

**Change accepted.**

21: "A set of metrics" sounds somewhat diffuse. Either specify or be more general (e.g. "analyses")

**"A set of metrics" will be change to "Our analyses"**

24: Delete "heavily"

**Change accepted.**

32: "Stemflow..." This sentence is difficult to read and the wording should be improved. In such cases, I will only write "rephrase" in the following.

**Thank you for your observation. Following the suggestion of reviewer 1 in the previous sentence the concept of throughfall will be added, which makes the message of the present sentence clear.**

37: "overland, preferential or subsurface flow" This combination is odd to me. Please reconsider what your point is.

**We change the sentence to: "overland, preferential or subsurface matrix flow".**

42: Naming something a key topic, more citations should be given to prove that.

**The citations of Levia et al. (2011) and Van Stan et al. (2020) are the latest published books on forest hydrology with emphasis on throughfall and stemflow effects. We do not think that more citations are needed.**

47: "Several experimental techniques both invasive and non-invasive..."

**Change accepted.**

47: "the double-..." As this study is about the belowground part of double funnelling, I find using the term in such context confusing and imprecise. Please keep this in mind throughout the manuscript.

**We agree with the reviewer. Thanks for the observation. We will change "double funnelling" by "stemflow belowground funnelling"**

76, 77: "catchment"

**It is plural, since Vallcebre is composed of four catchments.**

80: delete "throughout the year"

**Change accepted.**

80: "spring and autumn being the wettest season"

**Change accepted.**

88: delete "respectively" ("...stand density is x and basal area is y.")

**Change accepted.**

89: "representative" is a statistical term which should rather not be used out of statistical context. If it was indeed a statistical process leading to the selection of the tree, describe this process. Otherwise, I recommend using "exemplary" instead. Some words on the selection of the tree would be interesting also in that case and make the matter more clear.

**Thanks for the observation, "exemplary" will be deleted.**

109: The geometrical details of the installation remain unclear. Why are the depth intervals different? How were sensors installed vertically at depth?

**Thanks for the observation. The depth intervals were different because the probes had different electrode lengths. Details of the vertical installation of the sensors will be added.**

112: "measure" instead of "sample"

**We correct this to "to measure and sample"**

124: delete "what was done"

**Change accepted.**

136: Please check with HESS if this is the way they want online sources to be cited.

**There are no specific guidelines on how to cite this type of source.**

148: delete "closer to the tree"

**Change accepted.**

149: delete "throughout the day"

**Change rejected. It should be noted that all excavation and sampling was carried out in one day (the day after the experiment). The sentence will be modified for clear understanding.**

151: delete "roughness"

**Change accepted.**

154: replace ", and then transported to the laboratory" by "for transport"

**Change rejected. We think the original version is clearer.**

156: The justification is unnecessary because it is obvious and can be omitted. If desired, an abbreviated version can be retained in subordinate clause. Either way, the procedure should always be given first and then the reason, not the other way around.

**Thanks for the observation, the sentence will be modified and move below.**

159: What about the used camera? Since the photos had to be digitized, was it not a digital camera?

**Thanks for the observation. We will remove "digitized" from the sentence. In addition, the following sentence will be added at the beginning of the paragraph: "Photographs of the soil profiles were taken using a cell phone with a dual-lens camera system of 12MP (iPhone 11, Apple Inc., CA, USA)."**

167 and following: I would prefer using correct mathematical symbols and equations, meaning that one metric can not be symbolized by several letters (e.g. As instead of TSA). In any case, however, the quantities used in equations should be consequently printed in italics also outside of the equations.

**We agree that the symbols should be all in italic, in both equations and text. However, it is not true that math symbols cannot have several letters. There is no such rule, indeed, the Cauchy number is an example of a symbol that has 3 letters. We have changed to upper and lower letters as suggested: for instance: DC to Dc.**

200: "extracted by cryogenic extraction" repetition, rephrase

**We rephrased to "Soil samples were subjected to cryogenic extraction and ..."**

206: "on the area..." very diffuse formulation, maybe just too complicated, rephrase

**We rephrased the sentence to : "To characterize the soil at the experimental site, six vertical 30-cm depth profiles were dug in the vicinity (< 1 m) around the monitored tree."**

207: "no relevant..." What does that mean, what are the implications for this study? No change in soil physical properties does not mean that no differences in hydrological processes will occur or nothing interesting will happen below this depth?

**We chose 30 cm because it was the maximum depth chosen for the excavation of the soil profiles after the experiment. Yes, no change in soil physical properties does not mean no differences in hydrological processes. However, we do not expect to find different results at deeper depths in the vadose zone. We changed "no relevant" to "no significant".**

209: One steel cylinder sample per depth interval and profile?

**"Soil cores were taken with steel cylinders (100 cm<sup>3</sup>) in 5-cm depth intervals from the soil surface down to 30 cm" which means 6 steel cylinders per profile. We rewrote to: "Six soil cores were taken with steel cylinders (100 cm<sup>3</sup>) in 5-cm depth intervals from the soil surface down to 30 cm ..."**

220: Outliers are statistically defined. "Obvious outliers" do not exist. Please give more detail about the process.

**Thank you for your comment. It was our mistake here; outliers were not calculated. The sentence will be deleted to avoid confusion.**

223: Why was Rosetta chosen? There has been much discussion about the problems of PTFs and work invested on how to improve them. Using them, this should be addressed, especially when choosing maybe not the best suited PTF.

**-Rosetta is one of the most applied models and its version 3 is the most updated and improved version for pedotransfer functions. Regardless of which function is used, the  $K_s$  estimate is only an informative parameter of soil characteristics, and only used comparatively to show differences in  $K_s$  with depth.**

233: Please use WRB instead of US SoilTax. When using a classification system, do not forget the reference.

**We are actually not using US SoilTax, but the USDA Soil Texture Classification. This is not the same.**

235: "As..." rephrase

**We changed "As" to "Because"**

238: Please elaborate which metrics were attained using Rosetta and which measured directly and also discuss the values within this context.

**In the M&M section it is described what was measure directly and what was estimated with empirical equations and Rosetta. Only  $K_s$  was estimated with Rosetta.**

245: Please refer also to the amount/intensity of applied stemflow and the tree and soil characteristics it refers to in order to compare in an informed way.

**The following sentence will be added at the end of the paragraph: "The stemflow infiltration area found in this study should be interpreted with caution, as it corresponds to a specific amount (50 mm) and discharge ( $7 \text{ L h}^{-1}$ ) and to specific antecedent moisture conditions and soil physical properties, and we suspect that it may vary as any of these conditions change."**

246-247: Please, here also, give more details about the studies.

**We do not agree. This is not the focus of the study and details of these studies are also found in Carlyle-Moses et al. (2020) which is cited at the beginning of the paragraph.**

251: It would be great to have some measure of variance to being able to characterize and compare.

**Thanks for the suggestion, but as we only have one sensor per location and the water flow pattern is spatially variably, we do not have replicated measurements, and the variance for measurements cannot be calculated. Figure 5, Figure S1 and Table 1 provide an idea about the differences in water contents among sensors.**

258: "earlier" instead of "rather"

**Change accepted.**

259: Please set the maximum difference in SWC in relation to pre-stemflow values.

**This is what was done. "the maximum difference in SWC (i.e., difference between the max SWC and the pre-stemflow SWC" is shown in Table 1.**

264 ff.: Please give absolute additional to relative values.

**These values are listed in Table 1.**

270: "...driven by throughfall rather than stemflow during a stemflow dye tracer experiment using natural rain events" or similar - give detail about the study!

**The sentence will be modified according to the reviewer's suggestions.**

270: "Metzger..." Compare also Metzger et al. (2021) on stemflow infiltration areas - maybe that study would fit better here.

**Thanks for this observation. We will provide more details about the study of Metzger et al. (2021).**

270: "during rainfall events" Not during, but after rainfall. I think there is no explicit information about SWC during rain events, only about SWC increase, which was a little higher in the vicinity of tree stems depending on event size. Also, "vicinity" is defined as <1 m, which differs from the measure you seem to apply here (not defined explicitly).

**Change accepted. Thanks for this comment and correction. Also, we have already included "vicinity" definition in a previous comment.**

272: "because..." This is a good thought. Maybe you can find more references to compare stemflow infiltration with and without throughfall and go into more detail here.

**Thank you for this wonderful suggestion, however, we are not aware of any studies that analyze stemflow infiltration with and without throughfall. If the reviewer is aware of any, please let us know as it would be of great interest.**

276: "Thus,..." This is also an interesting point, which you should set in relation to the results of the other studies you mentioned above and the root architecture of their studied trees (being deciduous hardwood species). You should also check for other studies on (Scots) Pine and compare their results for water redistribution in the soil (e.g. Carlyle-Moses et al. 2018?).

**Thanks for the suggestion. This is discussed in more detail in section 3.5. We will include Carlyle-Moses et al. 2018 in the discussion.**

280: "SWC" Pre-stemflow, post-stemflow, and the difference? Please be more specific.

**Thanks for the comment. The sentence will be modified for better understanding.**

281: "For instance,..." This would be a safe indicator for bypass flow, yet it depends on the place of infiltration (did water infiltrate directly above the measured location? Otherwise, it could also be a stronger lateral flow component in the deeper soil (due to what)? Please elaborate more on this.

**We modified the sentence to: "However, there is indication of bypass flow, as shown by the faster response of deeper TDR probes, i.e., in the east profile the TDR probe at 30-60 cm and in the south profile the TDR probe at 30-40 cm reacted to the stemflow more quickly than the other probes did (Figure 6b, c, d)."**

283: "(1) preferential flow" This now reads like a summary, but was not mentioned before. It is especially interesting as you applied stemflow artificially and thus regularly around the tree stem. If you want to make this point, more information/discussion is needed.

The sentence will be rewrite as: **“(1) preferential flow of stemflow on the trunk itself (as shown in Pinos et al., 2021). Although stemflow was evenly discharged around the trunk at a height of 1.3 m, preferential flow on the trunk was observed below this height”**

284: “(2) preferential flow” In this point, it is unclear to me if this refers to infiltration (into the soil) or percolation (within the soil) or a mix of both. Especially, "infiltration...due to...coarse roots" sounds odd, because the roots are within the soil and not at the surface. Or do you refer to where the stem and the soil meet? Please rephrase to be more clear.

**We rephrased this sentence to be clearer: “(2) non-uniform infiltration of stemflow into the soil and preferential flow in the soil due to the presence of coarse roots, that redistribute water flow both vertically and horizontally (Schwärzel et al., 2012).”**

286: “water table” It would be nice to have a reference here as well.

**(Liang et al., 2011) will be added.**

290: “in...piezometers” How is “in” meant here?

**What we mean here is that the water in the lysimeters was blue. We are not sure what the reviewer means here, the sentence seems clear to us.**

294: “SWC” Please again also give absolute numbers.

**Again, what would be the point of adding these values? The absolute values are listed in Table 1.**

306: “Figure 8...” This reads bumpy as beginning of the section as well as only the sentence itself. I would recommend to begin the section with a statement (the most important and a rather general statement previewing what the section is about). A reference to the figure in brackets is enough.

**We modified the sentence to: “Dye coverage observed in the different soil profiles for the four cardinal directions show clear indications of preferential flow (Figure 8).”**

307: “Trend” Is it actually a (statistical) trend? Was a regression analysis made? If not, that would be great.

**Thanks for the observation. "trend" will be change to "pattern". No robust regression analysis can be performed since there are only three points for each profile, which represents insufficient data for this type of analysis.**

307 (“The distribution...”) – 313: I find this paragraph too long and the statement rather trivial. The flow mainly taking place laterally due to the low (non-existent) slope inclination can be said in one sentence and does not need to be compared with studies located on stronger slopes, because this is comparing apples with oranges.

**The sentences will be modified and shortened for better understanding as follows: “We observed the greatest dye coverage in the immediate vicinity of the tree (at 10-cm distance), which suggests that the majority of the stemflow infiltration water was directed vertically. This is likely a consequence of the flat area at our experimental site.” In addition, we disagree with the reviewer's comment "comparing apples with oranges". Relying on the observations**

**of reviewer 1, it is certainly valid and useful to compare our results with the few available in the literature on trees on slopes.**

316: Make clearer that these are pre-defined terms for those readers who skipped the methods section. You can use quotes and/or references.

**Thanks for the observation. We will refer to section 2.5.**

319: Please here refer to the thought I mentioned above: the location of the water input in horizontal reference to the measurement location. It is an important observation that the soil water flow directly below the input is more regular.

**The soil water does not necessarily have to flow directly below the input, but has more interaction with the soil closer to the tree trunk (10-cm distance) where direct infiltration is occurring.**

329 ff: "Increased..." This is an interesting thought referring to a potential ecological meaning and fate of stemflow. As the ecological aspect is often unclear in stemflow studies (except for double-funneling in more arid climates), I think it would be worthwhile to discuss this effect in more detail.

**Following the reviewer's suggestion, the following text will be added: "This is of great ecohydrological importance, as it may affect processes such as increased moisture, increased element deposition, and increased contamination in deeper soil layers, where increased dye-matrix interaction has been evidenced."**

331: "the soil matrix" The matrix... or the next-smaller pore fraction only. This is pretty much a question of continuity.

**The sentence will be modified as: "Moreover, the soil matrix between macropores (i.e., the next-smaller pore fraction)...."**

334 ff: This paragraph is a bit lost here and should go up to where I commented to have just this discussion. Also, there is room for differentiation here: Especially preferential flow does not only depend on the root network architecture, but also on soil physical and chemical properties (which themselves also are affected by tree species) and initial wetness.

**The previous paragraph mentioned by the reviewer refers to stemflow infiltration areas, here it refers to the belowground funneling process. The first sentence will be modified to include the soil properties mentioned by the reviewer.**

361: "The double..." You strongly refer to the double funneling phenomenon in the introduction and now shortly pick it up again here, but it is totally missing in the discussion. You want to work on your red thread. Chose you focus and signal words (can be double funneling or other) and make sure it is represented in all chapters relevant to content (abstract, introduction, discussion, conclusion).

**We agree with the reviewer. Thanks for the observation. We will change "double funnelling" by "stemflow belowground funnelling"**

366: "has proven to be" instead of "is"

**Change accepted.**

370 ff: The conclusion should wrap up the study in summarizing the most important aspects of the discussion and bringing them together to an overall outcome. This is neglected here, there is rather an unambitious "the method worked" and "further work is needed". I think you can really strengthen your paper by putting more effort into the conclusion (ideally after revising the discussion).

**Thank you for this comment. The two first paragraphs in the Conclusion section summarize the main results, as suggested by the reviewer. We will write the last paragraph (370ff) to bring the results together by pointing out the implications of this work, as follows:**

**"We conclude that root architecture of trees leads to preferential flow and thereby non-uniform distribution of water in the soil profile. The funnelling effect causes water to infiltrate along roots and macropores near the soil surface and deeper in the soil. Our results are in line with previous research and contribute a more general mechanistic understanding of belowground stemflow infiltration in forests. Most importantly, our results suggests that stemflow belowground funnelling is an important hydrological and ecological feature in humid Mediterranean forest catchments."**

376: "Further studies are needed" I would avoid this wording, it sounds a bit hackneyed.

**We deleted this sentence, please see our previous response.**

376 ff: The outlook is ok content-wise, but it reads a bit sloppy and more like a brainstorming. Please rephrase in a more focused, coherent and professional way.

**We deleted this sentence, please see our previous response.**

379: "hot topic" too much!

**We deleted this sentence, please see our previous response.**

570: Figure 1: Avoid red and green colored symbols within one figure for reasons of accessibility. The symbols could logically build on each other. The axis names could be more informative (e.g. "local x-coordinate"). All figures: Different units of length are used (mm, cm, m). It would be great to choose only one and use it consequently. It does not make sense to use a mm scale when the scale of interest is much larger.

**We will modify the colors (red and green and blue to black and magenta and green) and the axis names as suggested by the reviewer. The units will not be modified because most of the figures use cm but small scales like the one in Figure 1 cannot be represented by using cm.**

570-571: "photograph" instead of "picture", "stemflow application" instead of "stemflow set-up"

**Thanks for the suggestion. "photograph" will be used while "stemflow application" will not be used because the photographs represent the design or set-up but not the application.**

683: Figure 7: The color code of "no water level detected" is too hard to differentiate from the lower parts of the water level color scale. "No data" should be simply left plane and does not need to appear in the legend (it is more intuitive and matches the area in the middle and around the circles, where there is also implicitly no data).

**Good comment. The colors will change but "No data" will remain within the figure. We will use dotted areas to denote the no data sections.**



712: Figure 8: As cardinal directions are given directly in the figure as headings (the columns of the panel), it would be consistent to also give the profile distance in the figure (the rows of the panel) instead of in the figure caption. To make it less noisy, x-axis labels and names should be deleted where they are unnecessary (just like with the y-axis).

**Change accepted.**

750: Figure 10 would be even more consistent and self-explanatory if the first y-axis and the deuterium label in the legend would be in red (as the symbols, and as is for the brilliant blue). Maybe choose a slightly darker red in order to improve readability.

**First y-axis color will be changed.**