Anonymous Referee #1

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This manuscript presents evapotranspiration, soil moisture, isotopic variations, and travel time estimates from isotopic variations in the soil beneath grassland, shrubs, and trees in plots in Berlin during a drought. These are all valid analyses.

We thank reviewer 1 for their comments. We are pleased that the reviewer recognises that our study presents an "incredible amount of data" and that we carry out a "valid analyses" of these. We also appreciate the limited number of major and minor comments on technical aspects of the paper that we feel that we can easily address in review.

However, my main concern with this paper is that for some reason the authors motivate this work by discussing green infrastructure, mitigation of flood risk, urban growth, urban water demand, urban soil compaction, and the urban water cycle. All of these topics are quite peripherally related to the actual study that was conducted. The study that was conducted happens to be studying vegetated plots that are located in an urban area, but otherwise there is not evidence that the plots are affected by any of the urban processes that are discussed in the introduction. The plots are not irrigated, which makes the discussion of urban water demand seem off-topic. (This should be stated clearly up front – only in the discussion is it explicitly stated that the plots do not receive irrigation. The reader should know this immediately). The plots are not used to manage stormwater, which makes the green infrastructure and flood risk mitigation discussion seem off topic. The plots are not obviously affected by urban soil compaction. There are no interactions with urban infrastructure mentioned. It is not clear why the urban ecohydrology study framing is being used since it is not clear what urban process is actually being studied here. There is an incredible amount of data being presented but the motivation is comparatively lacking.

In retrospect we can see that our introduction is too broad and needs to be shortened and re-focused in revision. However, we were trying to set the issue of water partitioning in urban green space in the broader context of issues for urban water management. In this regard, we, like Berlin's water managers, view "green infrastructure" more broadly than technical structures, to include all green space affecting water partitioning.

In this regard, we see our work contributing to the growing (but still limited) number of studies assessing water partitioning in contrasting urban green space. Moreover, a

fundamental motivation was to use isotopes as tools to help in this, again because there are so few urban studies. While we see that introduction could cause confusion on the motivation of the work, we would argue that the title of the paper and the objectives of the study are actually quite clear.

Whilst the reviewer is correct that our plots are not irrigated, compacted or in receipt of storm drains, they are still typical of tree, shrub and grassland in managed urban green space in a major European city. Thus, they are not natural vegetation, have small dimensionality, and are subject to urban climate effects, artificial soil debris etc. Moreover, they are typical of the majority of Berlin's urban vegetation, in not being irrigated and not in receipt of storm runoff. They are clearly informative urban study sites that form part of the green infrastructure. We will emphasise these issues on revision.

Secondly, the discussion section has some text that is unsupported by the work presented. There is no evidence to suggest that irrigation is needed to support the trees that are currently not irrigated (L390-392). Making this sort of unsupported statement can have large water use implications, so this type of statement on increasing or beginning irrigation should be made carefully. Do the researchers believe that the trees will die if not irrigated? There was no data on the tree water stress to support this belief in this manuscript. The goal of urban irrigation is not to maximize ET or plant growth or plant yield but to keep species alive that humans want alive (e.g., urban lawns are irrigated to a level much below well-watered conditions for maximal ET by most residential irrigators because they irrigate based on visual plant stress (DeOreo 2016 – Residential End Use Study)). If the trees are not dying under currently non-irrigated conditions, then what reason is there to suggest that they should be irrigated to maintain them? This is also discussed in L414.

The reviewer is right that we have limited information on this and no proof, though we would highlight that our comments on the water-limitation on trees were suitably circumspect. But we do feel that the issue is worth raising in that it provides a potential explanation why the ET under trees was not significantly greater than form the grassland. The point we are making is that with climate change, vegetation that has been sustainable in the past, may no longer continue to be. However, we will be even more circumspect in revision.

Major Comments:

L100: State clearly and up front that the vegetation is not irrigated in SUEO.

We will include this information in the revised manuscript.

L1: The first sentence of the abstract raises questions and is confusing. Does 'green infrastructure' here refer to urban vegetation? Green infrastructure in other contexts is used to mean green stormwater infrastructure which in many cities is not heavily irrigated and therefore is not a major challenge to balancing domestic and industrial water demand. Also, are many urban areas having challenges in balancing domestic and industrial water demands, or rather in having a limited resource of water for all urban water use (both domestic (does this refer to residential indoor + outdoor or just residential indoor – I am not familiar with this terminology) and industrial).

We will rephrase this sentence in the revised manuscript. Though we already emphasized in our previous comments that we view urban green infrastructure in a broader sense, we will distinguish more clearly between urban technical green structures (e.g. green roofs) vs. more natural urban green spaces (e.g. parks) in the introduction.

L300 and throughout: Why is unorm used as a proxy for transpiration?

The calculation of transpiration would have required knowledge about the tree's sap wood area, usually obtained through drill cores and scaled up to a forest stand in terms of transpiration flux (in mm). However, as the property was a small, diverse botanic garden with conservation priorities, we were unable to take these cores. Moreover, given the heterogeneity in stand age and species composition, upscaling would have been highly uncertain. Rather than giving individual (absolute) values, normalizing sap flux velocity provided a more general overview of the transpiration dynamics throughout the growing season not only in one tree or tree species, but in an assemblage of trees typically found in urban areas. We will add the purpose of this normalization for both u_{norm} *and PET in the method section in the revised manuscript.*

L330 and L349: The authors are comparing their findings to other work looking at urban landscapes with isotopes. However, it doesn't makes sense to me to make these

comparisons because the other studies they compare to are irrigated – this seems fundamentally different since the irrigation introduces a different isotopic source and signature into the system and is completing altering the inputs to the soil-vegetation system. It would make more sense to me to compare the results from this study to other studies (non-urban or urban) that look at non-irrigated grassland vs. shrub vs. tree comparisons.

The reviewer questions the comparison of our work to other papers where isotopes have been used to assess the effects of urban irrigation. The issue here is that these are some of the very limited number of isotope studies in urban settings that we can actually compare our work to, and so help evaluate the potential of isotopes in urban ecohydrology. Of course, there are a plethora of isotope studies in more natural settings in a wide range of geographical regions, most of which are irrelevant to the study site. Hence, we refer to some of the studies more relevant to Berlin. On revision, we will search the literature for any very recent, potentially relevant studies.

L376-378: Why would observations of more natural vegetation water demands be used to inform strategies for irrigation needs in the future? If the vegetation is natural in this study, why have the entire motivation be pointing to urbanization?

For the context aspect of this study, please refer to our response on this topic in the previous paragraphs. That said, even if more natural vegetation in urban green spaces is not yet heavily irrigated in more temperate regions like Berlin, the increasing frequency of warmer and drier periods will likely require such measures in the future. By observing water use and partitioning in green spaces now, we believe that an improved understanding of these processes can inform on sustainable urban water management and irrigation strategies in the future. We will stress this more in the revised manuscript.

L377-378: It is inappropriately general to state this so broadly – that these are characteristics of 'urban trees'. This finding is not generalizable to this degree – these findings are currently specific to both the specific location and to the species studied (tree species have quite different ET from each other and relationships to water availability).

Please see our response to the previous comment.

Minor Comments:

L202-203: This is not evident from the plot. A marking at '0' or the absolute value of unorm would help.

We will add this "0" mark in Figure 2c.

L212: 'Slightly higher' seems to overstate the difference of only 2 mm – I would interpret this to mean they are effectively the same. What kind of error bars would these values have?

We will rephrase this; the reviewer is right, these differences are not statistically significant given likely uncertainty. For the uncertainty, this is the focus on a forthcoming paper which disaggregates the water fluxes using a physically-based ecohydrological model. This will be mentioned in the revision.

Figure 2: The x-axis should have marks for every month.

Thank you for the suggestion. We will change this.

Table 3: Clarify what sampling time period refers to.

This was not meant as a single expression, but rather referring to the top two rows: the sampling (1^{st} sampling in April, 2^{nd} sampling in May, etc.) and below the time period preceding the respective sampling, which was used for the calculation of the given means/SDs. To clarify this, we will add a line between these rows, to separate the information more effectively.

L224: The widest range for O, not for H.

Thank you for flagging this up. We will add this information.

L225: Clarify what across the entire soil profile refers to.

We will specify this.

L311: What type of memory effects? Storage? Stomata? Vegetation?

We will clarify this; we are referring to soil moisture storage.