Dear Editor and Reviewers

We would like to thank the editor and two reviewers for the detailed suggestions to improve our manuscript. In the following we provide detailed information about the changes as the referees propose it.

Editor

I would in particularly ask the authors to balance the statements and provide clear reasons while isotope and hydrometric studies do in general show a good agreement between isotope studies and hydrometric studies, but there is a general trend of overestimation of transpiration fraction of total evaporation when using the isotope method. Since the numbers of isotope studies are up to know also limited and several assumptions have to be made as well (e.g. evaporation of intercepted water, that is not considered in the isotope studies, but a very important component of the overall ET), the authors need to be careful in making too strong statements into the one or other direction.

In our manuscript, we stated that the transpiration fraction derived from the isotope-based method is in general close to the hydrometric method if the same climatic conditions and plants apply (P14L2-15, also in conclusion). The limitations and assumptions used in isotope studies, which may lead to overestimate the transpiration fraction are described in our manuscript: the Steady State Assumption (P16L14-15), no canopy evaporation separation (P17L2-5), different water uptake by trees (P17L19-21), assumption used in lake water (P18L8-10), bias in input data and its isotopic composition (P18L17-18). Moreover, in our conclusion we state that the comparison between different approaches is limited due to incomplete temporal and spatial resolution from the results.

Referee #1

1. The objective of the paper is unclear.

a. The title seems to indicate that the objective of the paper is to look at different ways to determine transpiration relative to surface moisture fluxes. The manuscript however focuses on isotope techniques, and the fact that they underestimate transpiration fluxes when compared to hydrometric measurements and land-surface models. Also, the term 'surface moisture flux' is somewhat misleading as one may expect it to include irrigation, precipitation, percolation etc. Isn't it clearer and more precise to replace 'surface moisture fluxes' with evapotranspiration?

We changed the title to: *"A perspective on isotope versus non-isotope approaches to determine the contribution of transpiration to total evaporation".*

b. The abstract seems to indicate that the objective of the paper is to compare transpiration determined using isotopes versus using other techniques and possible discrepancies. This is more in line with the discussion and conclusion of the manuscript.

This has been adjusted in the revised version. We stated that our objective is to provide a perspective on isotope-based method for disentangling the contribution of transpiration to the total evaporation flux compared with non isotope-based methods (P5L11-17).

c. The introduction however, states (L2587:10): "we provide a perspective on different approaches for disentangling the different fluxes contributing to the total evaporation." This seems to indicate all fluxes contributing to total evaporation are being investigated. But the rest of the introduction is focused only on transpiration.
We changed the sentence to: *"Here we provide a perspective on the isotope-based method for isolating the contribution of transpiration to the total evaporation flux"* (P5L11-12).

2. L2586:5 "Transpiration is the largest contributor to the water flux from continental areas." Replace 'water flux' with evapotranspiration. The way this sentence is currently formulated could also include, e.g., water flowing in rivers to the oceans.
We changed water flux to evaporation fluxes (P4L5).

3. Assuming that the objective is to determine transpiration as a fraction of total ET, the fact that you can determine soil evaporation as the difference between total ET and transpiration (Line 2586:19) seems to come out of the blue. If evaporation from the soil is of interest, then why not mention interception from the canopy as well, as both of these components are mentioned in L2586:1? Alternatively this sentence could be omitted.
We did not mention evaporation from intercepted water because in many isotope-based studies this component is neglected as it is found in many isotope-based method references. We changed the sentence to: *"Soil evaporation is then calculated from the difference of total evaporation and transpiration with the assumption that canopy evaporation is a small component and can be neglected"* (P4L19).

4. L2588:8-11: similar to comment #3. The heading of section 2 reads: "Methods to derive the transpiration fraction of total evaporation." A discussion of soil evaporation seems out of place, unless it is used to compute transpiration. That does not seem to be the case here.
We agree and removed the discussion on soil evaporation.

5. L2588:23, 2590:7, 2596:10: here and elsewhere, 'evaporation' is sometimes used to describe all evaporation fluxes from a surface, at other times it describes the process. Sometimes continental or total evaporation is used. Please define the terminology used.
We define evaporation as the total evaporation flux as described in the introduction. We describe this in the first sentence (P4L1) and use only the term evaporation in our manuscript to avoid confusion. Also more explanations about evaporation term are described in the last paragraph in the introduction section (P5L13).

6. L2589:4: Most lysimeters don't have a percolation meter; the 'losses' can be observed by weighing drainage water.

We change the sentence to: *"Evaporation is calculated from the weight change over time, corrected for precipitation gains and losses (e.g. drainage water and percolate water)"* (P10L11-12).

7. L2590, equation 4; if the main objective is to quantify transpiration, perhaps the equation for soil evaporation is not necessary.
We prefer to keep the soil evaporation equation since this is an important component of total evaporation.

8. Section 2.2, Isotope-based method. This section describes how transpiration can be estimated as a fraction of total evaporation. While section 2.3 describes the effect of canopy evaporation on total evaporation, this is not part of the discussion in the isotope section. Perhaps the reason isotope studies tend to overestimate transpiration is that they fail to correct for water lost through canopy evaporation?
Canopy evaporation is not discussed in section 2.2 (now 2.1) because with the isotope-based methods canopy evaporation cannot be examined separately. This indeed may be one factor contributing to the overestimation of the transpiration fraction. We discuss this in section 4: *"Also, the evaporation from intercepted water on canopy or litter, which is not taken into account in many isotope-based studies, may overestimate the transpiration contribution".* (P17L2-5).

9. L2594:8-9 "Global land models estimate the transpiration fraction to be less than 50%". This statement does not seem to concur with results shown in figure 1; where two studies are below 50%, one is about 50% and one is 80%. A fifth study, which may or may not be included in the term 'Global land model' is about 65%. It is unclear if 'Global land models' refer to the land-surface models that have global averages or to all the land-surface models. The figure describes land-surface models where some represent global averages whereas the text refers to global land models where some models represent global annual averages.
We re-wrote this paragraph in order to describe the figure in more detail according to your suggestions. We define a global land surface model as a model that has global average results. We stated that on average the global land surface models estimate the transpiration fraction approximately 50%, except a study from Miralles et al., (2011) (P12L7). The figure 1 caption has been changed according to the definition (P29). The new paragraph is:
"It is seen that in general, hydrometric and isotope-based methods give higher transpiration fraction values than the global land surface models. On average, the hydrometric method calculates transpiration fractions exceeding 50% while the isotope-based method produces transpiration fractions higher than 70%. Global land surface models estimate the transpiration fraction to be approximately 50%, except for a recent study from Miralles et al. (2011) (orange color in Fig. 1). However, these studies have generally been carried out at different locations, for different surface types, different climatic conditions, and different seasons".

10. Section 3. This section is supposed to show that the transpiration fraction of total evaporation determined by isotope studies is high compared to studies using other methods (based on the introduction to section 4: "What can explain

these systematic discrepancies between the isotope and non-isotope methods?"). This could be done in a more convincing manner.

a. While distinction is made between global averaged and non-global averaged studies, there seems to be a huge difference in scale between studies, which is not really discussed. This may affect comparison between studies.

We elaborate this in section 3 and explain that the difference in temporal scope between global land surface models and isotope-based results may explain the apparent underestimate of the transpiration fraction from global land surface models (P15L5-7). We also discuss the effect of different models to average the transpiration fraction (P18L22-25).

b. L2595:16-2596:9 describe how "Different plant types exhibit a different transpiration fraction under similar climatic conditions." The following paragraph (L2595:22-27) is confusing to me: "In China during summer, the maximum transpiration fractions of oaks and wheat are 96 and 80 %, respectively (Xu et al., 2008; Zhang et al.,2011). Hydrometric methods result in much lower transpiration fractions in Arizona US. A study from Cavanaugh et al. (2011) during summer in Shrubland area partitions transpiration fraction of 42–47 %. This is very low compared to an isotope-based study (85 %) in the same region although different plant types are examined." It appears that the fact that a shrub land area in Arizona has lower transpiration fractions compared to oaks and wheat in China is ascribed to the use of hydrometric versus isotopic measurements. Is that what the authors are trying to say? Especially considering that the Arizona data is over a whole season and the data from China is for transpiration at its peak? The comparison to an isotope based study without a reference does not seem very convincing either.

In this paragraph, we explain that different plants may have different transpiration fractions although the location and climatic conditions are the same. This is shown from few studies in US (Savanna woodland, grass, and steppe forest) and in China (oaks and wheat). It is also supported by Kool et al. (2014). However, a study from Cavanaugh et al. (2011) using hydrometric method shows a much lower transpiration fraction than the isotope-based method. This may not be a representative result since other studies in Europe and US using the same plants but different methods exhibit close results between the isotope-based method and the hydrometric method. In order to clarify the argument, we divide the paragraph into two paragraphs. In the first paragraph, we discuss the different transpiration fractions from different plant types with similar climatic conditions. Examples are given from the US and in China during summer (P13L13-26). In the second paragraph, we discuss the hydrometric results in comparison with the isotope-based method (P13L27-P14L17).

c. L2596:5-9. Comparison between hydrometric and isotopic measurements. The difference is 4% for transpiration (why mention evaporation?). What is the direction of the difference? Does it support the idea that isotopic measurements give higher transpiration than hydrometric measurements; or do the authors mean to say that the difference is quite small?

We removed the soil evaporation value from the text and used only the transpiration value (P14L13). The difference between midday and the periods before and after midday shows that first, the difference between the isotope-

based method and the hydrometric method during midday period is small (4% in Williams et al., 2004) compared to after and before midday. Second, it shows that the steady state assumption (SSA) used in the isotope-based method is only achieved during the midday period, meaning that the isotope-based method using the SSA assumption tends to have higher results. This is explained in the section 4 (L2597:24), now in P16L12-21 as:
"The steady state assumption (SSA) may produce a reasonable δ_L approximation at afternoon, when stomata are relatively open. On the other hand, plants do not transpire under SSA conditions during the night. The SSA may lead to an overestimation of the isotopic composition of leaf water compared to the measurements. Moreover, SSA is not satisfied in many field conditions when canopy climatic conditions are highly variable (Dongmann et al., 1974; Flanagan et al., 1991; Farquhar and Cernusak , 2005; Yepez et al., 2005). A failure to correctly calculate the isotopic enrichment of leaf-water precisely will produce a bias in the transpiration fraction analysis. Therefore the assumption of steady state non-fractionating transpiration flux and a fractionation of all remaining surface fluxes should be critically reassessed".

d. L2596:15 the paper of Schlesinger and Jasechko 2014 shows that isotope studies tend to yield higher values for transpiration fraction compared to studies using other methods and models. They might be used as a reference.
We add this reference in Figure 1 (P29).

e. L2596:16 Coenders-Gerrits et al 2014 show that Jasechko et al 2013 was overestimated; but they do it by using the same isotope data. This means that isotope data can be interpreted differently but is not necessarily overestimating transpiration. This is an important limitation and must be discussed.
We elaborate on this paper in section 4 (P18L17-21):
"Partitioning of evaporation using the isotope-based method on global scale is highly sensitive to the input data and its isotopic composition. Coenders-Gerrits et al. (2014) show that the transpiration fraction calculated using the same method as Jasechko et al. (2013) reduces to 50%-80% if the input data are different and to 35%-80% if the isotopic composition of transpiration is different".

f. L2596:25 "This systematic difference between isotope-based estimates and models. . ." The only obvious overestimation in transpiration fraction in isotope partitioning studies so far, seems to be the paper by Jasechko et al 2013.
We agree with this evaluation.

g. The study by Sutanto et al 2012 is the only study where the ability of HYDRUS-1D to estimate evaporation fluxes was tested, see Kool et al. 2014. To decide that isotope studies tend to overestimate transpiration based on a model that was not tested in any other way, seems a bad idea.
We removed this part.

11. L2597:7-10 Why do we need hydraulic conductivity calculations? There is no error in saturated soil. Saturated soil at the bottom of the lysimeter results in conditions that are different from field conditions.

Hydraulic conductivity calculations apparently are needed for soil-water models such as HYDRUS-1D. We agree that in principle we do not need hydraulic conductivity in the lysimeter method. We changed our sentence and wrote that the edge-flow water can produce a significant error in the calculation of water losses from the lysimeter (P15L17-20).

12. The conclusion is clearly written and represents the discussion in the article well. The conclusion states the fact that "a few studies that compare estimates of evaporation at the same location and conditions using the isotope-based and hydrometric methods show that the results are in fairly good agreement." (L2600:13-16). Perhaps the article could expand more on the fact that, while there is good agreement between isotope studies and hydrometric studies there is a general trend of overestimation of transpiration fraction of total evaporation when using the isotope method. Currently the supporting material is unconvincing.
This is related to comment 10 and we have discussed the issue of scale and different conditions in section 3. There we give few examples where the discrepancies between the two methods are small. An exception is the study by Cavanaugh et al. (2011), which the transpiration fraction calculated using hydrometric method is far too low compared to isotope-based method (P13L27-P14L17).

Referee #2
1. Section 2.1 and/or linked to section 4: It would be important also to clearly refer to the accuracy (or the lack of it) of sap flow measurements and discrepancies among different techniques. Kathy Steppe's paper in Agricultural and Forest Meteorology (2010; vol 150) would be an appropriate reference. Moreover it needs to be explained more clearly that sap flow measurements mainly work for woody species – it is said somehow in the table (representative only for one vegetation type) but it might be made clearer.
We added a short section on the accuracy of the sapflow method using different techniques according to Steppe et al. (2010) in section 2.1 (now 2.2) in P9L17-19. We also added a short discussion of the discrepancies between different sapflow techniques as one of the possible measurement errors in section 4 (P15L22-24). The disadvantage of the sapflow method in table 1 has been re-written, stating that the sapflow method is mainly used for woody trees (P28).

2. Section 2.2: For the reader not into stable isotopes, we might need a sentence in that section explaining why transpiration does not affect the isotopic composition of soil water. It might be trivial but helpful for a broader audience.
The explanation and references have been added in section 2.2 (now 2.1) in P5L26-P6L4:
"In contrast, transpiration does not modify the isotopic composition of the remaining groundwater since there is no isotopic fractionation during water uptake and transport in roots and stems (Ehleringer and Dawson , 1992; Kendall and McDonnell , 1998; Tang and Feng , 2001; Williams et al., 2004)".

3. Section 2.2. (p. 2592; line 3): Isn't it however more important to derive the isotopic composition of transpiration water under non-steady state conditions

than that of leaf water (δL)? I fully agree that this is linked and also described in the cited paper of Lukas Cernusak and Graham Farquhar. It would, however, be more clear in my opinion to state that directly: //just an example //: "According to Farquhar and Cernusak (2005) the degree of isotope enrichment of transpired water above source water under non- steady state conditions is related to the isostorage (i.e the leaf water content and its isotopic enrichment above source water) and its change over time in the leaf." This might also be linked more closely to the assessment of potential errors of the isotope method in section 4.
The isotopic composition of transpiration (δ_T) is calculated from the modeled values of leaf water enrichment (δ_L) either under non-steady state or steady state conditions. Thus in principle, the calculation of δ_T requires the calculation of δ_L. We agreed that δ_T changes over time during the day (P8L19-22, P16L9-12).

4. Section 3: I think it would be good to acknowledge here that the different numbers of studies applying the different methods might introduce a bias.
We included this in the second sentence in section 4 (P15L16-17):
"We have shown above that each technique has its own limitations and these may lead to biases in the results".