



EGUsphere, author comment AC2
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Reply on RC2

Jolanda J. E. Theeuwes et al.

Author comment on "Local moisture recycling across the globe" by Jolanda J. E. Theeuwes et al., EGU sphere, <https://doi.org/10.5194/egusphere-2022-612-AC2>, 2022

Dear Dr. Patrick Keys,

Thank you for taking the time to review our manuscript 'Local moisture recycling across the globe'. We very much appreciate your feedback as we believe they will help us to improve our manuscript. Below we will shortly respond to each of the general comments you wrote in your review. We will address the specific comments and the general comments in more detail when we get the opportunity to revise our manuscript.

- **"Drivers": I had some trouble with the word "drivers" being used to describe the role of e.g., CAPE, in LMR. While it's possible that some of the correlated variables could be causally related to LMR, there was no causal analysis completed (or a mechanistic explanation) as far as I could tell. Given that, it seems perfectly reasonable to say correlated phenomena (or similar) with regard to the variables that seemed to have convincing correlations with LMR, e.g., wetness or elevation.**

We agree on the point that a correlation between LMR and any other variable does not imply causality in our study and therefore, we understand that "driver" might not be the best word to use in our manuscript. We thank you for this contribution; we will use different terminology throughout our manuscript and think that the term 'factors' is more appropriate. Furthermore, we will highlight in our discussion or methods section that a correlation does not imply causality in our study.

In addition we will better implement our hypothesis into our manuscript. We will explain what processes we expect LMR to be part of using previous literature. This will support our decision what variables we included in our study. For each variable in our study, we can also highlight whether we expect a direct relation between this variable and local moisture recycling or whether this variable is a proxy.

- **LMR Definition: This is purely a suggestion, but I would strongly encourage the authors to frame the LMR idea conceptually first (which I think would force the authors to argue more clearly for the novelty of the idea), and then provide the specific way that they define it in the article (e.g., "LMR is _____, which we define here as _____"). The reason being that LMR could be a conceptually useful idea on its own, but others may make entirely different quantifications, or indeed develop a more robust geophysical definition later on. By distinguishing your conceptual contribution from the**

physical definition, you may give the concept more scholarly and applied longevity. Again, just a suggestion.

We very much appreciate this suggestion from the reviewer. We believe by framing LMR conceptually our proposal to study local hydrological impacts of land cover changes becomes clearer. This allows future studies to explore this novel concept of local moisture recycling using different definitions. We see how this indeed helps us to better highlight the novelty of our approach and we agree that by framing it as you suggest we better clarify the importance of moisture recycling locally regarding land cover change. Many thanks for this suggestion we will implement it in the introduction.

- **Expand the Introduction: Given the intended scope of this work, the introduction should be expanded to include discussion of past moisture recycling analyses that relate to the LMR idea. There are quite a lot of moisture recycling studies that examine: local recycling (though perhaps not at the global scale), the scale dependence of moisture recycling, and the role of different types of vegetation in the scale dependence of moisture recycling (e.g., van der Ent et al., 2014).**

To better highlight the novelty and aim we will expand the introduction and include more literature on studies related to moisture recycling. We will discuss the length scale of evaporation recycling in our introduction. We also will discuss its spatial patterns and explain its physical meaning. We will use this to clarify that the length scale is different from the local moisture recycling ratio and clearly show the added value of the local moisture recycling to the scientific community is. In our response to the community comment from dr. Ruud van der Ent we already did describe in more detail how we will implement the length scale in the introduction and discussion of our manuscript. Thank you for providing these examples.

- **Discussion of robustness of a 10-yr climatology: The current draft of the paper does not suitably discuss the appropriateness of the time scale associated with the Utrack dataset in the context of climate variation. Given that the authors are making claims about 'average rates', correlating with phenomena to determine their relationship (potentially causative) of LMR, etc., it is necessary to provide both a justification and a discussion (including of limitations) vis a vis a 10-year climatology. Given that there are inter-annual (e.g., ENSO, Indian Ocean Dipole) and decadal-scale (e.g., Pacific Decadal Oscillation), modes of climate variability that could be systematically affecting some of these results, it is necessary to explain the role of a 10-yr only analysis. Saying that the data are only available for 10 years is not really sufficient. Acknowledging this temporal limitation is critical also for making sure readers can appropriately interpret the results, which could change with a longer time series. Again — I recognize the authors have mentioned the topic of the length of record albeit briefly, but a more in-depth discussion is needed.**

We agree that the 10-year averaged data is not sufficient for a robust climatological analysis and will highlight this better in our manuscript. Our analysis, and the 10 years involved, are used for intra-variability (seasonality) within the year. However, trends in multi-year climate variation could affect our results. To discuss this point, we will compare our results with the results from Link et al. (2020), as that study has a longer time period. To enable a comparison, we will calculate local moisture recycling ratios at a spatial scale of 1.5 degrees from both the dataset by Link et al. (2020) and the dataset by Tuinenburg et al. (2020).

- **A 50-km definition: The authors select 50 km as the spatial scale of their LMR**

definition. A bit more discussion is needed to explain the logic and rationale of why such a blanket definition across the terrestrial surface is appropriate, and not an orographically-, latitudinally-, or biome-dependent definition. I'm not suggesting to change away from 50 km, but enough other research has found that moisture recycling ratios and spatial scales are associated with vegetation type, position on continent relative to prevailing winds, proximity to mountains, etc. that the authors need to support their 50km definition more strongly.

We opted for our definition of local moisture recycling as we needed a systematic definition of local moisture recycling as we focus on moisture recycling across the globe. We fully agree that factors such as orography, latitude and vegetation affect local moisture recycling. Therefore, the aim of our study is to contribute to the understanding of the relation between local moisture recycling and these different factors. However, we will better discuss the role of landscape characteristics on local moisture recycling and how this relates to the spatial scale of local moisture recycling.

To summarize, we will expand our introduction and discussion. The former to clarify the novelty of our research and the added value of local moisture recycling, and to better embed our work in current literature. The latter to highlight and discuss some assumptions of our analysis. Furthermore, we will conduct some extra analysis to improve the quality of our manuscript. We will do some additional spearman correlation analyses and we will make a comparison with the results from Link et al. We are grateful for the useful comments you provided to our manuscript. We believe they will help us to improve the quality of our work.

On behalf of all authors,

Jolanda Theeuwes