

Interactive comment on “The residence time of water in the atmosphere revisited” by Ruud J. van der Ent and Obbe A. Tuinenburg

J. Wei (Referee)

jwei@utexas.edu

Received and published: 19 September 2016

This paper revisited the issue of atmospheric moisture residence time, especially the estimation from an earlier study, by using two different models, one Eulerian and one Lagrangian. They argue that the estimation from the earlier study is not correct. The methods are sophisticated, but I feel that some issues are not clear to me. I hope the authors can clarify them and make the paper easier to understand.

I do not understand why the residence time estimated from a precipitation perspective, an evaporation perspective, and the age of atmospheric water are different (Fig. 2c-2e). Do they indicate the same physical characteristic? Are the differences caused by the different methods and imbalance of the hydrological data?

In the top of page 6, you criticized Läderach and Sodemann (2016) by arguing that

C1

horizontal moisture transport is irrelevant for the global average residence time. I think Läderach and Sodemann (2016) showed results of both with and without moisture transport, and both of them are about half of 8 days. So it is not clear to me what is main problem of the study of Läderach and Sodemann (2016) that leads to the estimated low residence time if your paper and their paper are talking about the same physical quantity (e.g., there are difference between the residence time and depletion time constants as shown in Läderach and Sodemann (2016)).

Other specific comments:

In the introduction, you reviewed many past studies on the residence time. It will be more clear and organized if you use a table to list all the residence time values.

Page 2, Line 3. “local moisture feedback” is not clear here and needs more explanation.

Page 2, Line 14-15. “No details were given whether these experiments were performed in summer or winter.” This statement is hard to believe for published papers.

Page 4, Eq.(1). Why the last term “ $Eg dt dt/2$ ” is different from other flux terms?

Page 6, Line 18, There should be a comma after “EAR-I data”

Page 6, Line 20. “the most likely value”. What is it?

Page 6, line 26-27. “In the precipitation perspective, the time from the previous evaporation is stressed, while in the evaporation perspective, the time to the next precipitation event is stressed.” Can you clearly explain what this means?

Page 8, Lines 4 and 17. Can you give some explanation why the residence time over the ocean is about 2 days lower than over land?

Page 7, Line 9. “amount of atmosphere”?

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., doi:10.5194/hess-2016-431, 2016.

C2