

## ***Interactive comment on “Apparent ecosystem carbon turnover time: uncertainties and robust features” by Naixin Fan et al.***

**Anonymous Referee #2**

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This paper describes a significant undertaking in a critical ecosystem property, i.e. terrestrial carbon turnover time. The dataset production process and the relevant points are described clearly in the paper. The dataset will be very interesting and useful to ecological modelers, although I did not have the chance to review the dataset because I could not download the dataset somehow. I recommend publishing the article in ESSD after addressing the minor issues listed below.

General comments: 1) The dataset can only be downloaded when the users registered on the website. After I registered, somehow I still cannot download the dataset. So, I only reviewed the manuscript not the dataset. Whether the original data and the process data used to derive the turnover time can also be downloaded from the link? This would be helpful for people trying to reproduce the data generation process or

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for those that would like to use original data or process data. 2) The turnover time was estimated assuming steady state, in which the efflux equals to the influx. While the reality is in non-steady state. The effects of this assumption on the estimation of turnover time should be discussed. 3) Was the high consistency of vertical structure of soil carbon storage caused by the consistent extrapolation model? i.e. same model parameters lead to the same vertical ratio? (P15L393) 4) How to compare the sensitivities of turnover times to precipitation and temperature? They have different units (P16L430). 5) The influence of other factors on turnover times are missing. Could you give further results or discussion? (P16L435) 6) The GPP only used one data source, i.e. FLUXCOM produced by Jung. There are also other sources of GPP such as the GPP generated using LUE model published in Nature Scientific Data. It would be interesting to see the change in uncertainty.

Specific comments: P6L188: The R and r is not consistent. P10L256: The vegetation biomass is missing in the first sentence. P14L378: “caused” should be “caused by”. P16L436: Why the relationship between turnover time and precipitation are different with previous studies? P16L447: Typo. Should be “state-of-the-art”. P19L570: The color of this reference is different from other parts of the manuscript. Fig. 1 and Fig. 2: It should be noted that the bottom diagonal subplot was the regression of row with column, i.e.  $y$ =row,  $x$ =column? Besides, what did the color around the origin represent? Fig. 3: Quantile range here is 25. Fig. 5: How to determine the turning point? It seems like not 0? Fig. 6: The lines in subplot c and f indicate? Terminology: The soil dataset provided by Sanderman et al 2017 was noted as S2017 in the text and the tables, while in the figures it was noted as Sanderman. Please be consistent through the manuscript. supplement-P2L32: CO<sub>2</sub> should be CO<sub>2</sub>. supplement-P3L59: The period was missing between “Table 2” and “All”.

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