

***Interactive comment on* “Global variability of belowground autotrophic respiration in terrestrial ecosystems” by Xiaolu Tang et al.**

Anonymous Referee #2

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I have read "Global variability of belowground autotrophic respiration in terrestrial ecosystems". In the manuscript, the authors estimated global belowground autotrophic respiration from 1980-2012, analyzed the temporal trend, and explored the dominant factors for autotrophic variability. Global autotrophic respiration is a big carbon exchange between the atmosphere and terrestrial, but was rarely studied in the past years. Global temporal and spatial variability of autotrophic respiration is clearly a timely and interesting topic. Generally, this manuscript is well organized and easy to follow. The results and conclusions are reasonable. The production (Global belowground autotrophic respiration shared in the figShare) is a contribution to the community and potentially can serve as a benchmark for ecosystem models, it will be useful also make the analysis (include the codes) public available to make the analysis reproducible. But

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I think the authors have to better address the limitation, weakness, and uncertainty of this study. In my opinion, some major limitation including:

1) The sample size of RA: there are much less annual RA comparing with annual Rs (less than 10%), even though the authors extended the RA dataset by new papers from China Knowledge Resource Integrated (CNKI) Database, the total samples is only 449. And the majority of the samples are from the forest, samples from wetland and shrubland are extremely lacking (only 5 observations).

2) How can you evaluate the quality of the RA data? Even though the authors conducted quality control on the RA data, but it does not guarantee the reliability of the RA data. We lack reliable methods to separate RA and RH, current ways (e.g., trend, gap, girdling, clip, and isotope) have their own problem. Further, usually RH is measured, and RA was calculated as the difference between RS and RH, which also bring uncertainties. All those issues were not addressed and discussed in the manuscript. If the data reliability cannot be guaranteed, the estimates, trend, and dominant factors should also be questioned.

Despite the above problems, I still think this study tend to address an important topic and may inspire more research in the future.

Specific comments Abstract

Line 22: (srdb v4) but later (line 97) you used (srdb version 4), be consistent.

Line 24: the unit for RA increasing trend should be Pg C a-2? Please see this paper: Ballantyne, A., Smith, W., Anderegg, W., Kauppi, P., Sarmiento, J., Tans, P., Shevliakova, E., et al. (2017). the warming hiatus due to reduced respiration. Nature Climate Change, 7(2), 148. <https://doi.org/10.1038/NCLIMATE3204> – 152.

Line 31-32: “the perspective that the parameters of global carbon stimulation independent on climate zones and biomes”. But already some studies said that the response of respiration to climate change differs in different regions. Huang, Jian-ping,

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Xiao-dan Guan, and Fei Ji. "Enhanced cold-season warming in semi-arid regions." *Atmospheric Chemistry and Physics* 12.12 (2012): 5391-5398. Jian, Jinshi, et al. "Future global soil respiration rates will swell despite regional decreases in temperature sensitivity caused by rising temperature." *Earth's Future* 6.11 (2018): 1539-1554. The response of respiration to climate differs in different periods: Ballantyne, A., Smith, W., Anderegg, W., Kauppi, P., Sarmiento, J., Tans, P., Shevliakova, E., et al. (2017). the warming hiatus due to reduced respiration. *Nature Climate Change*, 7(2), 148. <https://doi.org/10.1038/NCLIMATE3204> – 152. Jian, Jinshi, et al. "Future global soil respiration rates will swell despite regional decreases in temperature sensitivity caused by rising temperature." *Earth's Future* 6.11 (2018): 1539-1554. Introduction

Line 48: It is not accurate to say RA is the second largest source of carbon fluxes from soil because we don't know whether Ra is larger than Rh. And does the (Raich and Schlesinger 192) paper really say that? And in line 309 you said Rh account for 0.54-0.63, means RH > RA.

Line 54: there is a new study summarized global Rs estimates: Bond-Lamberty, Ben. "New techniques and data for understanding the global soil respiration flux." *Earth's Future* 6.9 (2018): 1176-1180.

Line 62-63: a citation needs to support this statement.

Line 63-64: need a citation.

Line 85: "linear of non-linear models" change to "linear and non-linear models".

Line 86: But in line 94, you said RF model can avoid overfitting. Zhao et al 2017 used ANN models; and Jian et al 2018 also include RF models. So you need to be concise to avoid inconsistent.

Line 95: Zhao et al. 2017 used ANN models, it is not appropriate to cite here.

Line 96: It is better also include the GitHub commit number of SRDB.

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Line 105: other environmental factors is too broad, please to be more specific.

Material and methods

A big point in this study is you compared your results with that from Hashimoto (2015), you need to talk about how you get the RA data of Hashimoto (2015). You directly used their data or you reproduced their estimates. If you reproduced, how and whether you used the same climate data as Hashimoto?

Line 110-112: are those papers from CNKI all in Chinese? How many studies and how many more data records you got from that? Please clarify that.

Line 122: Australia, Russia, Africa, and South America.

Line 145: The srdb v4 covered 1960-2017, why your study only covered 1980-2012?
Results

Line 224: '-4 – 4' change to '-4 to 4'.

Line 224-225: 'East Russia and tropical and Eastern regions in Africa' change to 'East Russia, tropical, and Eastern regions in Africa'.

Line 264-265: Usually anomaly was the difference between temperature/precipitation of corresponding year to the mean of a period (e.g., 1980-2012 in this study). But this should not change the results, if previous studies calculate anomaly like yours, please provide a citation to support.

Line 270-273: why in temperate zone/savannas/wetland there is no correlation between RA and temperature anomaly? That is interesting, usually, in tropical and sub-tropical regions, Rs is less correlated with temperature (and should be also true for the temperature anomaly). I think it worth to analyze in more details and try to explain the mechanism or maybe just because of the uncertainty.

Line 310-311: See also Lamberty 2018 Earth's Future paper. "New techniques and data for understanding the global soil respiration flux." Earth's Future 6.9 (2018): 1176-

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1180.

Discussion

Dominant factors: all you talked were about driving factors of RA spatial variability, right? Did you also analyze the dominant factors of temporal variability? Limitation and uncertainty: see my previous overall comment. In addition, Jian et al. "Constraining estimates of global soil respiration by quantifying sources of variability." *Global change biology* 24.9 (2018): 4143-4159 talked about uncertainty related to time-scaling and Rs upscaling. How about RA upscaling and timescale?

Author contributions

Line 445: 'to the review the manuscript' change to 'to review the manuscript'.

Interactive comment on Earth Syst. Sci. Data Discuss., <https://doi.org/10.5194/essd-2019-18>, 2019.

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