Response to reviewer 1#

Dear Dr. Bond-Lamberty,

Thank you very much for your encouragement, suggestion and comments. Based on your comments and suggestion, we revised our manuscript carefully and thoroughly. Please see, below, our point-to-point response.

Suggestion and comments from referees are marked in **Black**.

Responses to referee's comments are labelled in **blue**.

Cited changes made in the manuscript are marked in **red**.

Please do not hesitate to let us know if you have further questions and/or comments.

Sincerely,

Xiaolu Tang, Shaohui Fan and Wunian Yang, on behalf of all co-authors.

This interesting manuscript and dataset focus on global heterotrophic respiration (RH), using over 500 observations to produce a wall-to-wall global map over time. As the authors describe well, this is really important for understanding changes in the earth system, quantifying this poorly-constrained carbon flux, and benchmarking models. The ms is fairly well written and interesting; methods generally seem solid; references and discussion are well done. There are some problems (see detailed list below).

First, it's essential include the R code, and/or make it publicly available in a repository, for transparency and reproducibility reasons; see below.

Response: R codes are available on figureshare, and a new version of netcdf file include unit and area variables, was published as suggested. Please see the link: https://figshare.com/articles/Rh_720_360_1980_2016_nc/8882567

Second, although the discussion notes (395-) that one weakness of this dataset is the annual temporal resolution, it seems fair to note that a second is the half-degree spatial resolution. For many applications this is a significant limitation.

Response: thank you for your suggestion. We added this limitation in the discussion part as:

"Finally, we developed a global RH at a half-degree spatial resolution, which included a scale mismatch between the observations and global gridded variables. This could be a great challenge for spatial modelling and using global gridded variables with a finer resolution is encouraged to overcome this limitation (Xu and Shang, 2016). On the other hand, the study sites were globally distributed and there was a large climatic and edaphic gradient covering the major land covers and biomes, which should reflect a larger variability than the site-to-grid mismatch."

Finally, although the ms is very readable, there are many linguistic oddities and editing by a fluent English speaker would be useful. Overall, this is an excellent study documenting a dataset that will be valuable for many carbon cycle and earth science researchers. It needs moderate revisions in a number of areas.

Response: thank you. Our manuscript has already sent to a company for language improvement. Besides, we carefully revised the language again. See the language changes in revised version (with track change) and the language proof certification below:

MogoEdit

CERTIFICATE OF ENGLISH EDITING

This is to certify that the manuscript entitled

Spatial- and temporal-patterns of global soil heterotrophic respiration in terrestrial ecosystems

commissioned to us has been carefully edited by a native English-speaking editor of MogoEdit, and the grammar, spelling, and punctuation have been verified and corrected where needed. Based on this review, we believe that the language in this paper meets academic journal requirements. Please contact us with any questions.

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Gang Zhang

Dr. Gang Zhang
Founder & CEO of MogoEdit

Date of Issue
April 19, 2019

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Specific comments

1. Lines 43-44: remove this sentence perhaps? Awkward

Response: this sentence is the definition of RH, which could be important for readers to understand the manuscript. We kept this sentence and cited more appropriate references.

"Soil RH represents carbon loss from the decomposition of litter detritus and soil organic matter by microorganisms (Subke et al., 2006), accounting for one of the largest components of the terrestrial carbon cycle (Bond-Lamberty et al., 2016)"

2. L. 55-57 is basically repeated in 76-77; I'd remove it here

Response: we removed this sentence.

3. L. 74: perhaps “these approaches are beginning to be used” – the history of this is short

Response: we corrected this sentence as:

“Therefore, these approaches are beginning used in earth science”

4. L. 80-: but note Shao et al. (2013), http://dx.doi.org/10.1088/1748-9326/8/3/034034

Response: we agree and proposed that:

“although RH improvements in Earth System Models are required (Shao et al., 2013)”

5. L. 89-91: this sentence probably should be moved to end of previous paragraph?

Response: done!

6. What software was used for all analyses? What versions (e.g. what version of caret)? Where is the code available/deposited? These are all critical for transparency and reproducibility

Response: all data analysis were conducted in R and R codes are available at figureshare: https://figshare.com/articles/Rh_720_360_1980_2016_nc/8882567.

Caret version 6.0-80 (accessed on May 27, 2018), was used.

7. L. 183: the methods are a bit unclear–how was this R2 calculated? From the crossvalidation?

Response: yes, R2 means model efficiency, which was built from the 10-fold cross-validation.

8. L. 191-: changes over: : :? Space? Time? Clarify

Response: sorry, we mean “change over the time from 1980 to 2016”.

“However, the most variable changes in RH over the time from 1980 to 2016”

9. L. 220: wow, that’s a huge range

Response: yes, there was a huge range.

10. L. 276-: you should also address the 43.6 value calculated by Konings et al. (2019), http://dx.doi.org/10.5194/bg-16-2269-2019

Response: done! We cited the reference and compared the result.

“Globally, mean RH amounted to 57.2±0.6 Pg C a-1 from 1980 to 2016, 13.6 Pg C a-1 than RH from satellite-driven estimates (Konings et al., 2019) , and 6.4 Pg C a-1 higher than Hashimoto RH (Hashimoto et al., 2015). The differences between data-driven RH in this study and Hashimoto may be due to several reasons”

11. L. 311-314: interesting idea!

Response: thanks!

12. L. 333-335: maybe note this is *really* uncertain though

Response: we remove this sentence.

13. L. 348: perhaps clarify to “indicating that in our model, climate change did not”

Response: done!

14. L. 356-357: yes! Perhaps put in abstract?

Response: we have already stated that RH in boreal area increased over 1980 – 2016. Therefore, to avoid the repetition, we did not add this sentence in abstract.

15. L. 382: Xu and Shang (2016), http://dx.doi.org/10.1016/j.jplph.2016.08.007 , another really good reference here

Response: thanks and we cited this references as well.

16. L. 401-402: with respect, I think this (available on request) is not adequate; the R code should be deposited and open. See #6 above

Response: we added R code to the figureshare:
https://figshare.com/articles/Rh_720_360_1980_2016_nc/8882567

17. Figure 1 could be improved: lat/lon references, marginal histograms

Response: we improved the figure and added lat/lon references and changed the marginal as follows:

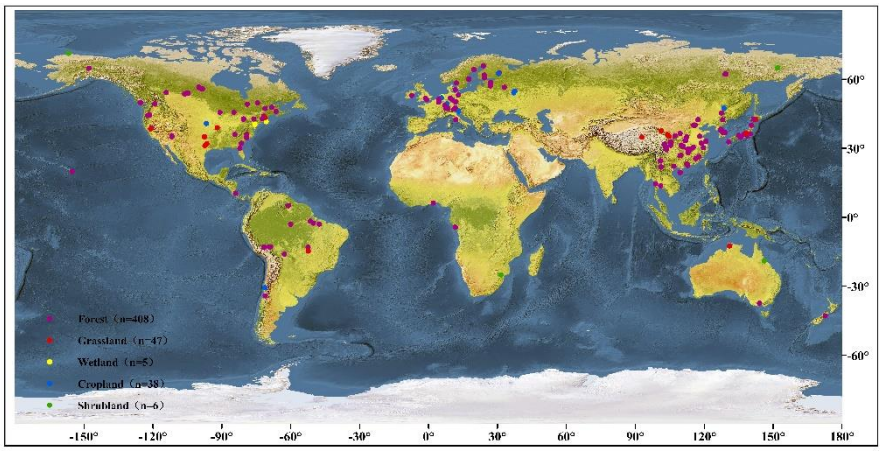

Fig. 1 Distributions of the study sites for RH observations.

18. Figure 5: are the errors bars based on annual flux over many years? Clarify

Response: we meant “standard deviation of annual RH from 1981 to 2010” and added this information in figure caption.

References:

Bond-Lamberty, B., Epron, D., Harden, J., Harmon, M. E., Hoffman, F., Kumar, J., McGuire, A. D., and Vargas, R.: Estimating heterotrophic respiration at large scales: challenges, approaches, and next steps, Ecosphere, 7, e01380, http://dx.doi.org/10.1002/ecs2.1380, 2016.

Hashimoto, S., Carvalhais, N., Ito, A., Migliavacca, M., Nishina, K., and Reichstein, M.: Global spatiotemporal distribution of soil respiration modeled using a global database, Biogeosciences, 12, 4121–4132, http://dx.doi.org/10.5194/bgd-12-4331-2015, 2015.

Konings, A. G., Bloom, A. A., Liu, J., Parazoo, N. C., Schimel, D. S., and Bowman, K. W.: Global satellite-driven estimates of heterotrophic respiration, Biogeosciences, 16, 2269-2284, http://dx.doi.org/10.5194/bg-16-2269-2019, 2019.

Shao, P., Zeng, X., Moore, D. J. P., and Zeng, X.: Soil microbial respiration from observations and Earth System Models, Environmental Research Letters, 8, 034034, http://dx.doi.org/10.1088/1748-9326/8/3/034034, 2013.

Subke, J.-A., Inglima, I., and Francesca Cotrufo, M.: Trends and methodological impacts in soil CO_2 efflux partitioning: A metaanalytical review, Glob. Chang. Biol., 12, 921-943, http://dx.doi.org/10.1111/j.1365-2486.2006.01117.x, 2006.

Xu, M. and Shang, H.: Contribution of soil respiration to the global carbon equation, J. Plant Physiol., 203, 16-28, https://doi.org/10.1016/j.jplph.2016.08.007, 2016.