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Interactive comment on "Global spatiotemporal distribution of soil respiration modeled using a global database" *by* S. Hashimoto et al.

S. Hashimoto et al.

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Dear Dr. Bond-Lamberty,

We greatly appreciate your constructive comments and suggestions. We revised the manuscript on the basis of your comments, and the responses to the Major and Minor comments are found below. According to the editorial instructions, the response is structured as follows: (1) comments from Referees, (2) authors' response, and (3) authors' changes in manuscript. Thank you very much.

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Major comments

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Comment 1: Code and data availability

Response: We placed the gridded output on a web page and mentioned it in the text. We wrote the code in C (please see the response to minor comment 3 below). The code is available from the corresponding author (S.H.) upon request.

Changes in manuscript: "The gridded outputs are available at http://cse.ffpri.affrc.go.jp/shojih/data/index.html"

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Comment 2: Possibility of using NDVI

Response: We added a reference to the possibility of using NDVI.

Changes in manuscript: "Estimation of RS by satellite remote sensing (e.g., normalized difference vegetation index, NDVI), which includes the vegetation information, may be a promising solution (Huang et al., 2013)."

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Comment 3: Deepen some points in Discussion

Response: We think that the discussion has been deepened thanks to the referees' comments, as shown in this response letters.

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Comment 4: Multi-year estimate

Response: We did not weight multi-year estimates in this study. We have added a mention of this fact along with a more thorough description of the data handling.

Changes in manuscript: "Annual RS in the SRDB was used for data-model synthesis. Some of the data points in the SRDB are based on multi-year observations, but the data were not weighted in this study. The each data point has the information of the year the study was performed or the middle year if the observation was conducted in multiple years, and we assumed the data were obtained in a year of observation (or in the middle year if multiple years) and linked to the climate data. For each data point, we ran the model using a monthly time step and calculated the annual RS. The air temperature and precipitation were derived from the CRU3.21 climate data (University of East Anglia Climatic Research Unit (CRU) [Jones Phil and Harris Ian], 2013). The spatial resolution of the climate data is 0.5°. Using the latitude and longitude information and the year of observation in the SRDB, we extracted the monthly climate data from the climate dataset. The number of data points used for model parameterization was 1638."

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Minor comments

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Comment 1. Page 4336, line 24: "availability is limited"

Response: Corrected.

Changes in manuscript: "availability is limited"

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Comment 2. P. 4337: it might be worth noting explicitly that while you're fitting a single global response model, because the model allows for variable response with changes in T and P, it gives a lot of flexibility (I think), i.e. Fig. 6

Response: We noted the flexibility explicitly, as suggested.

Changes in manuscript: "By modifying the temperature and precipitation functions, the model has an increased flexibility, and global parameters for the model were estimated."

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Comment 3. P. 4338, l. 1-: code availability? Did you use pre-written MCMC software, or write your own? Clarify

Response: We wrote the code with C, and analyzed the output using R. This information has been clarified in the revised manuscript.

Changes in manuscript: "The MCMC program was coded in C, and the statistical analyses of the output were conducted using R versions 3.0.2 and 3.1.0 (R Core team, 2013)."

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Comment 4. P. 4341, l. 12-14: this seems to be the opposite of what Figures 7 and 8 show? Check carefully

Response: Thank you for pointing out this error; it has been corrected.

Changes in manuscript: "but in the regions of high RS, RA was greater than RH; and in the regions with low RS, RH was greater than RA"

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Comment 5. P. 4341, l. 20-: It would be straightforward to calculate the CMIP5 Q10s (i.e. how global RH responds to air temperature anomaly) and compare it to your calculated values. That would be interesting (though not required here-just a thought)

Response: The Q10 values for RH in each ESM in the CMIP5 were reported in Todd-Brown et al. (2014). We have cited this study in the revised manuscript.

Changes in manuscript: "In addition, the Q10 value of each Earth system model in CMIP5 ranged from 1.4 to 2.2 (Todd-Brown et al., 2014); thus, the range of Q10 is wide enough and must contribute to the large variation in RH."

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Comment 6. P. 4343, l. 8-11: might put this in abstract

Response: As suggested, a rephrased version of this sentence has been added to the abstract.

Changes in manuscript: “Our study scaled up observed soil respiration values from field measurements to estimate global soil respiration and provide a data-oriented estimate of global soil respiration. The estimates are based on a semi-empirical model parameterized with over one thousand data points. Our analysis indicates that the climate controls on soil respiration may translate into an increasing trend in global soil respiration and emphasizes the relevance of the soil carbon flux from soil to the atmosphere in response to climate change. Further approaches should also focus on climate controls in soil respiration in combination with changes in vegetation dynamics and soil carbon stocks along with their effects on the long temporal dynamics of soil respiration. We expect that these spatiotemporal estimates will provide a benchmark for future studies and help to constrain process-oriented models.”

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Comment 7. P. 4343, l. 22: “temperature of a CRU”?

Response: Rephrased.

Changes in manuscript: “Because the air temperature simulated by the models in CMIP5 is well correlated with CRU surface air temperature (Todd-Brown et al., 2013),”

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Comment 8. P. 4345, l. 22-: I agree this is really interesting – why do nonlinear processes at small scales seem to produce linearity at large scales?

Response: A thorough modeling study that incorporates processes and focuses on changes in temperature sensitivity during scale-up, which is beyond the scope of this study, would be needed to answer this question. However, we think that the Kirschbaum (2012) partly explains this mystery. This study was already cited, but we have added further discussion to the revised manuscript. The citation is as follows:

“Kirschbaum, M. U. F. The temperature dependence of organic matter decomposition: seasonal temperature variations turn a sharp short-term temperature response into a more moderate annually averaged response, Glob. Change Biol., 16, 2117–2129, doi:10.1111/j.1365-2486.2009.02093.x, 2010.”

Changes in manuscript: “These apparent differences in temperature sensitivity have not yet been fully interpreted. Some studies have addressed this issue; for example, a modeling study (Kirschbaum, 2010) reproduced, in part, such changes in temperature sensitivity across scale that is introduced by seasonal temperature variations.”

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Comment 9. P. 4346, l. 16-18: not considered, but it *is* included implicitly, right? The SRDB includes observations (though not as many as we would like) on degrading permafrost

Response: The reviewer is correct. We have clarified this point in the revised manuscript.

Changes in manuscript: “In regards to boreal regions, the impact of permafrost melting, which is an important process in northern regions, was not explicitly considered in this study, although SRDB includes some data measured in permafrost regions.”

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Comment 10. Table S4: include estimate errors, if available

Response: When available, uncertainties have been added to the revised manuscript.

Changes in manuscript: Please see Table S4.

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Please also note the supplement to this comment:
http://www.biogeosciences-discuss.net/12/C2894/2015/bgd-12-C2894-2015-

supplement.pdf

Interactive comment on Biogeosciences Discuss., 12, 4331, 2015.