November 11, 2017

Dear Editor:

We are submitting responses to the referees' comments for our manuscript, "A temperature threshold to identify the driving climate forces of the respiratory process in terrestrial ecosystem" (MS No.: bg-2017-345). We greatly appreciate the referees' comments and suggestions about the manuscript, which will assist us to improve the quality of the manuscript significantly. The responses to the referee's comments are summarized as follows.

Referee #1:

The authors reported an analysis of flux data from 152 sites to establish an empirical relationship between plant respiration (R_e) and a number of selected explanatory variables. The authors used quantile regression to study how temperature (annual mean) and other meteorological factor affect R_e. The authors hypothesized that annual mean meteorological factors will affect the maximum achievable R_e. As a result, a quantile regression model is used to examine the changes of the 99th percentile of R_e as a function of various meteorological factors.

The statistical analysis has two fatal flaws.

When the interest is the maximum of R_e at a given temperature, 99th percentile is a poor substitute. In addition, quantile regression would be a poor choice for such extreme upper quantile. A regression model uses the general probabilistic assumption to quantify the distributional parameters. When a specific quantile is of interest, the quantile regression is appropriate, as long as the quantile is not extreme (e.g., 1 or 99%). Such extreme quantiles render conventional statistics useless as the behavior of extreme values should be modeled differently. This is a well known result originally by Gumbel (1935) (English translation, Statistics of Extremes, appeared in 1958). Recent interest in climate change effect further expanded the applications of extreme value statistics. When using quantile regression to model the 99th percentile, the resulting model is highly uncertain. This behavior is expected as we rarely observe extreme values. Extreme values follow a different probabilistic pattern; analyzing exteme values using conventional statistics models will likely lead to misleading results.

Response (R): The quantile regression is a way to estimate the conditional quantiles of a response variable distribution, which provides a more complete view of possible causal relationships between variables in ecological processes. Typically, the factors that affect ecological processes are not all measured and included in the statistical models used to investigate relationships between variables associated with those processes. As a consequence, there may be a weak or no any predictive relationship between the mean of the response variable distribution and the measured predictive factor. But there may be stronger, useful predictive relationships with other parts of the response variable distribution. In many ecological applications, the quantile regression has been applied to estimate rates of changes for functions along or near the upper boundary of conditional distributions of responses. Based on the literature (Kaiser *et al*., 1994; Terrell *et al*., 1996; Thomson *et al*., 1996; Cade *et al*., 1999; Huston, 2002), if ecological limiting factors act as constraints on organisms, the estimated effects of the measured factors are not well represented by changes in the means of response variable distributions because of potential limitations of the unmeasured factors. The response of the organisms cannot change by more than some upper limit set by the measured factors, but may change by less when other unmeasured factors are limiting. Therefore, the relationships of the upper boundary R_e rate vs. temperature and other micrometeorological factors can be evaluated at the three quantile levels (τ = 0.90, 0.95, 0.99), and the maximum realizable R_e rates can be represented using a 99*th* quantile piecewise linear regression.

Fitting R_e against MAT (or annual means of other factors) across the entire data can be misleading. When MAT ranges from -10 to 25℃, we are lumping cross globe (spatial) differences as a result of annual mean temperature. However, the inference is largely local. That is, the authors attempted to use regional differences to infer the effect of climate change at a local level. This could fall into the trap of the Simpson's paradox, which states that correlation measured in aggregated scale is not necessarily the same at individual level.
R: The datasets cover various ecosystems between 37°S to 79°N, and during the time period from 1991 to 2007. Semi-continuous observations of net ecosystem exchange (NEE) were obtained with the eddy covariance technique on a large number of experimental sits and ecosystem types. The datasets include many plant functional types and climate classes, which are sufficient to represent the large scale results. Thus, the FLUXNET, as the global network of ecosystem observations, is able to characterize whole-ecosystem behavior or function in terms of their exchange of matter and energy with the atmosphere and its variation in space and time. This dataset had been used to derive the global conclusion by many studies (Beer *et al*., 2010; Mehacha *et al*., 2010; Niu *et al*., 2012; Reichstein *et al*., 2014), and had been proven to be available and reasonable.

Reference

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Thank you very much for your assistance on our manuscript. Best regards.

Sincerely yours,

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