AC1 – Reply on RC1 (Anonymous Referee #1)

We respond below with original reviewer text in **black**, author comments in **blue**, and manuscript amendments given in **green**.

Dear. Editor

The current paper aims to parameterize i) allometric questions for aboveground biomass using an existing database and ii) an equation to estimate woody debris on the forest floor using data based on field survey, for Siberian *Larix cajanderi*. Authors demonstrate significant spatial variations of biomass of standing trees and woody debris estimates on the forest floor, depending on equations and parameters, comparing their estimated parameters with published ones. They come to the conclusion that the developed functions can be applicable to the species in Siberian forests. I consider that the paper would fail to fit within the journal's scope as well as may fail to attract a broad readership, because i) the study develops a tool, with no application of the tool, thus to fail to draw geo- or biological conclusion, ii) even the developed tools are only appliable at a relatively small scale, as no testing for the feasibility of a large scale application was made, while such tools for a large scale application already exist from national to continental scales, and iii) the estimated parameters were unjustly compared with published parameters, as to overfitting and comparing between different population distributions; for example, published equations were based on smaller and older trees, compared to the data set, based on which allometric questions were developed.

1A. We respectfully disagree with most elements of this assessment.

First, we do agree with the reviewer that pooling data from sites with different forest structure and stand age may not be desirable. We will therefore remove the site-common allometric equation from our revised paper.

We refer to our general response above as to why we believe that our paper fits well into the scope of Biogeosciences and why we are convinced that this is an important and timely contribution.

It is unclear what the reviewer refers to with overfitting as we have used state-of-the art statistical techniques that are commonly used to develop allometric equations. If the reviewer can explain in more detail what is meant with this comment, we would be happy to elaborate on this.

Here come specific comments.

L 15. "… at breast height (DBH)"

Depending on regions, the breast height differs. Specify the height (m).

1B. This is nominally at 1.3 m above the ground. We will add this is in the revision.

L51. “The line-intersect…”

Authors may begin a new paragraph before “The line- …”

1C. Thank you. We will do this in the revision.

2.1 Fine woody debris sampling

This section may be expanded and articulated. For example, papers that have been cited here (Sackett 1980; Van Wagner 1982; Nadel et al. 1997; 1999) articulate the formulation. Because the formulation is of great importance in the paper, it has to be well explained, and readers would not want to check back those papers to understand the formulation and meanings of parameters.

1D. Thank you for your comment. We will expand and articulate this session in the revision as follows:

L100: The line-intersect method is a widely used approach to quantify fine woody debris lying on the ground in a forest stand (Warren and Olsen, 1964; Van Wagner, 1968; Brown, 1971). It requires measuring the diameter of each piece of wood at its intersection with a sample line which can be considered as a strip of infinitesimal width containing a series of cross-sectional areas (Van Wagner, 1982). The sum of cross-sectional areas divided by the length of the sample line can then be converted to volume by multiplying both numerator and denominator by width. Fuel load is then obtained from Equation (1) by multiplying the volume by the specific gravity of wood as follows (Van Wagner, 1982):

$$W = \frac{\pi}{2} \times \sum d^2 \times \frac{\pi}{4} \times \frac{G}{L}, \quad (1)$$

where W is fuel load or weight per unit ground area, $\pi/2$ is a probability factor that allows to sum the cross-sectional areas as circles, d is piece diameter, $\pi/4$ is the factor required to convert d^2 into a circular area, L is length of sample line, and G is specific gravity in units of weight per unit volume. Equation (1) assumes that woody pieces are horizontal and does not account for ground slope. To minimize the bias related to tilted pieces that are less likely to be intercepted by the sample line, W can be multiplied by a correction factor equal to the secant of the piece tilt angle relative to horizontal (Brown and Roussopoulos, 1974). Similarly, a correction factor can be calculated from the ground slope angle as follows (Brown, 1974):

$$s = \sqrt{1 + (\tan slope)^2}, \quad (2)$$

where s is slope correction factor, $slope$ is ground slope (degrees). Consequently,

$$W = \frac{\pi^2 \times G \times \sec h \times \sum d^2 \times s}{8 \times L}, \quad (3)$$

where h is piece tilt angle (degrees). Measuring diameter on each intersected piece along a sample line can be tedious and time-consuming, especially if small pieces are abundant. In practice, FWD are tallied by diameter size class using a go/no-go sizing gauge, and the number of intercepts over the sample line is reported for each class (Brown, 1974; McRae et al., 1979). Therefore, the term $\sum d^2$ in

Equation (3) is replaced by $\sum_i n_i \times {D_i}^2$, where n_i is the number of intercepts over the sample line in the diameter size class i, and D_i is the representative class diameter (Van Wagner, 1982). The quadratic mean diameter (QMD) is generally used as the appropriate class diameter so that fuel load for any species and diameter size class i can be calculated as follows (Van Wagner, 1982; Nalder et al., 1999):

$$W_i = \frac{\pi^2 \times G_i \times \sec h_i \times n_i \times {\mathrm{QMD}_i}^2 \times s}{8 \times L}, \quad (4)$$

where W_i is the fuel load (t ha^{-1}) for the diameter size class i, G_i is the specific gravity (Mg m^{-3}) of the size class i, h_i is the piece tilt angle (degrees) of the size class i, n_i is the number of intercepts over the sample line in the size class i, s is the slope correction factor, L is the length of the sample line (m), and QMD_i is the quadratic mean diameter (cm) of the size class i given by

$$\mathrm{QMD}_i = \sqrt{\frac{{d_i}^2}{n_i}}, \quad (5)$$

Brown, J. K: A Planar Intersect Method for Sampling Fuel Volume and Surface Area, For. Sci., 17, 96–102, doi:10.1093/forestscience/17.1.96, 1971.

Brown, J. K.: Handbook for inventorying downed woody material, U.S. Dept. of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station, Ogden, Utah, Gen. Tech. Rep. INT-16, 24 pp., 1974.

Brown, J. K. and Roussopoulos, P. J.: Eliminating biases in the planar intersect method for estimating volumes of small fuels, For. Sci., 20, 350–356, 1974.

McRae, D. J., Alexander, M. E., and Stocks, B. J.: Measurement and description of fuels and fire behavior on prescribed burns: A handbook, Canadian Forestry Service, Great Lakes Forest Research Centre, Sault Ste. Marie, Ontario, Information Report O-X-287, 44 pp., 1979.

Nalder, I. A., Wein, R. W., Alexander, M. E., and de Groot, W. J.: Physical properties of dead and downed round-wood fuels in the Boreal forests of western and Northern Canada, Int. J. Wildl. Fire, 9, 85–99, doi:10.1071/WF00008, 1999.

Van Wagner, C. E.: The Line Intersect Method in Forest Fuel Sampling, For. Sci., 14, 20–26, 605 doi:10.1093/forestscience/14.1.20, 1968.

Van Wagner, C. E.: Practical aspects of the line intersect method, Canadian Forestry Service, Maritimes Forest Research Centre, Fredericton, New Brunswick, Information Report PI-X-12E, 11 pp., 1982.

Warren, W. G. and Olsen, P. F.: A Line Intersect Technique for Assessing Logging Waste, For. Sci., 10, 267–276, doi:10.1093/forestscience/10.3.267, 1964.

L130. Volume of a sample was first dried and then estimated. Would it underestimate volume of the sample due to shrinkage during drying?

1E. Thank you for your question. We followed the standard procedure (ASTM International, 2014). Yes, the sample may slightly shrink because of drying. We are interested in the volume of the dry matter (thus without moisture influences) and this procedure is consistently applied and reported within and across studies (e.g., Nalder et al., 1999).

ASTM International: ASTM D2395-14: Standard test methods for density and specific gravity (relative density) of wood and wood-based materials, ASTM International, West Conshohocken, Pennsylvania, United States, doi:10.1520/D2395-14, 2014.

Nalder, I. A., Wein, R. W., Alexander, M. E., and de Groot, W. J.: Physical properties of dead and downed round-wood fuels in the Boreal forests of western and Northern Canada, Int. J. Wildl. Fire, 9, 85–99, doi:10.1071/WF00008, 1999.

L 305. Figure 3.

I would recommend to add data points in the figures. Ranges of the independent variable

1F. Thank you. We agree and we will do this in revision.