

## ***Interactive comment on “Influence of wood density in tree-ring based annual productivity assessments and its errors in Norway spruce” by O. Bouriaud et al.***

**Anonymous Referee #1**

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**General comments** Tree rings are used for many questions, including the estimation of tree and forest biomass increment. The latter may be biased if not sufficient care is taken on tree selection and upscaling (addressed in the recent paper by Nehrbass-Ahles et al. cited). The present paper by Bouriaud et al. nicely shows that if inter-annual variation or short term biomass increment are of interest, accounting for inter-annual variation in wood density (WD) is quite essential. Since, at least in Norway spruce, WD is negatively correlated with growth, the inter-annual variation in biomass production is somewhat lower than in volume increment.

**Specific comments** One might stress a bit more for which kind of studies within-tree and inter-annual variation in WD is most relevant. Inter-annual variation is important  
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if production is related to climate (or other short-term) variation. Climate does get one short mention in the first and last paragraphs, but I feel this could be stressed more. If short-term variations in production is not the question, the radial increase in density is still important and will result in an error if only a site- or species specific mean density is used. This is not given as the objective of the study, but is still an important consequence of the study and data. Since the authors also measured axial variation in WD, it would be good to give an estimate of potential errors for not accounting for this or a method to estimate axial variation if WD is only measured from the tree base, as is generally the case with tree ring studies. An additional difference between productivity estimates via remote sensing or Eddy covariance and tree ring based approach is the carry-over effect from one year to the next in ring width and probably also WD. This is not what the study was designed to address, but should be mentioned in the discussion.

**Other/technical comments.**

Introduction page 5874/ line 13 “annual wood density was proved to be related to ring age or to tree diameter, with higher values close to the pith in many species” I believe it is much more common to see a radial increase in WD. “Molto et al., 2013” is not in references.

Methods 5876/4 “80 year old stand (SD  $\pm$  2.1 years)” It would be clearer as “80 ( $\pm$  2.1 SD) years” 5878/9 “The diameter was reconstructed based on the simple assumption of proportionality the of bark thickness to the diameter” – Delete “the”. It is unlikely that bark thickness increases linearly with diameter (bark is shed, wood is not), but the error of this assumption would be small. 5878/21 “several independent variables were tested, such as the diameter and the ring cambial age” – Please provide a full list of parameters tested, even if they were found not useful for the models. 5880/16 “The tree-level biomass increment estimations were the produce of the WD and the volume increment” – Should be “product” Why does, in scenario 3 and 4, WD scale with (ringwidth)<sup>0.5</sup> and 1/DBH<sup>0.5</sup>, and not another exponent? The exponent could

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have been taken from the RW : WD relationship in Fig. 1b and a similar one for WD : DBH, or include the exponent as a parameter to be estimated in the model.

Results 5883/1 “Variations in WD were mostly related to ring width with a linear correlation of 0.75” – The correlation in Fig. 1b is very strong, but apparently not linear, so fitting a nonlinear function would result in higher  $r^2$ . The same paragraph continues “Although not really linear, the decrease of WD with ring width had a rate of 0.48 kg m<sup>-3</sup> mm<sup>-1</sup>, meaning that density is divided by two when ring width is doubling.” If one assumes a negative linear correlation, the conclusion that density is halved when ring width doubles is wrong. Anyway, such a relationship is not seen in Fig. 1b and it would be good to fit a non-linear function and provide parameters. . 5883 /8 “did not lead to significant differences in the fit neither according” should be “either,” “Figure 6. Comparison of plot-level annual biomass increments and prediction intervals (a) for the 4 scenarios” - Fig. 6a has 13 panels with number of trees from 31 to 62. Why the variable nr. of trees, and where are the 4 scenarios? If the point of the 13 panels is to show the effect of n, this would be better to show in a n : variance correlation or something similar.

Discussion 5891 / 14 “but also because rings near pith anyway often miss when working with increment cores” should be “are often missed” 5892 / 6 “but the prediction errors at plot level compensated.” something missing here

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