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Interactive comment on "Time since death and decay rate constants of Norway spruce and European larch deadwood in subalpine forests determined using dendrochronology and radiocarbon dating" *by* M. Petrillo et al.

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The study deals with decay dynamics of coarse woody debris (CWD) of the conifer species Picea abies and Larix decidua in an alpine valley of Northern Italy. To study the decay dynamics of CWD the coarse wood of the two species was classified by morphological assessment into five classes. Wood samples were collected to assess the period of death by either cross-dating techniques comparing the tree-ring series of the dead trees with a specific master chronology developed by living trees (classes 1-3) or by radiocarbon dating (mainly classes 4-5). Additionally the authors determined

the contents of lignin and α-cellulose of the dated wood samples and estimated decay rate constants by mass losses using negative exponential regression models. Based on the ages of CWD, the authors estimate the half-lives for cellulose and lignin by a multiple exponential model resulting in considerably varying half-lives between the two species for cellulose and lignin, which was significantly higher in larch.

The study is an important contribution for a better understanding of the role of dead wood in the alpine forest ecosystems and their contribution and function in the nutrient and carbon cycles. However, I have some concerns, which the authors should address more in detail.

Major concerns:

Tree-ring chronologies from living trees: At each site (n=8) samples were collected from two radii of 5-6 trees (P. 14803, L. 6-8). Later in the paragraph the authors state a total sampling size of 83 wood cores (29 from larch and 54 from spruce). The authors should better describe how many trees (cores) from each species were sampled at each site. This is especially important for a comparison of the two master chronologies. The authors state at P. 14806 (L. 18-24) that larch seems to have a more sensitive growth than spruce and the positive and negative pointer years are not synchronous between both species. This might be also result of differences in leaf phenology (spruce is an evergreen species and larch a deciduous species) or an unequal distribution of sampled individuals among the different sites with varying climate conditions and exposition. Even if this is not the main focus of this paper it should be better explained. It also would be interesting to indicate the correlation coefficient between both master chronologies. In figure 3 the sample size should be indicated as number of trees not by the number of cores. As I understood the two cores have been cross-dated to a single tree curve which was used to produce the master chronology.

Dating CWD: The authors state on P. 14803 (L. 21/22) that a total number of 40 cross section of deadwood were obtained (28 from spruce and 12 from larch). The results of the dated deadwoods are presented in the Table 4 & 5 and Table A1. However, counting the numbers of dated larch trees in these tables indicates a higher sample size of a total of 23 trees. Table 5 indicates the results of the dated dead trees from CWD of classes 1-3 obtained by cross-dating techniques and some larch trees by radiocarbon dating. Additionally five dated dead larch trees are indicated in table A1 from the same decay classes. I suggest to present all data in one table. It would be also interesting to show if the two dating techniques (cross-dating and radiocarbon dating) come up to the same result. A comparison of the year of death indicated by cross-dating with the period of dead obtained by radiocarbon dating should be performed for those individuals where data are available to show if both dating techniques come up with the same result. In the case of differences this should be discussed (dating errors of both techniques).

Sampling of the coarse wood of both species was performed at eight sites ranging in altitudes varying from 1200 to 2000 m asl. Temperature varies along the altitudinal gradient and also rainfall increases about 60% from the lowest altitude to the highest altitude as indicated in table 1. I assume that decay rates of coarse wood might by higher at lower altitudes and vice versa. As climate conditions vary along this altitudinal gradient of 800 m, how is this correlated with the decay rates? At P. 14808 (L. 6-8) the authors applied a Kruskal–Wallis statistical test to assess the effects of the factors elevation, exposition, species and decay class on the decay constant values. It would be interesting to include also temperature and precipitation in this statistical analysis to see if they explain differences in the decomposition rates.

Radiocarbon dating: Due to the Suess effect samples dated of before 1950 AD have widely calibrated age ranges. For me it is not clear how the authors estimated the age range with the highest probability. The high variation of atmospheric radiocarbon due to the high amount of fossil burning during the industrial revolution results in up to five possible ages for one radiocarbon age in the period between 1640 and 1950, which makes it rather difficult to date the dead wood samples. The indicated probability of the calibrated AD with wide calibrated age ranges of up to 146 years is quite low for

most samples (50-60%). This must be better explained and discussed as the estimate of the age of CWD is essential for the estimated of half-lives for cellulose and lignin considering that the sample size for 14C-dating is quite low, the age ranges are high and the probabilities are relatively low.

Minor concerns:

Introduction: P. 14802, L. 1-2: The authors should indicate the wood chemical differences between both species.

Material and methods: P. 14804, L. 16/17: Please indicate which part of the dead wood was sampled to determine α-cellulose. Was this the outermost part of the sample (sapwood)?

Results: P. 14806, L. 14/15: Please indicate the range of GLK (means and standard deviation) of trees from the same species also considering different sites P. 14807, L. 3: Please indicate how many outliers were excluded from the chronology. Comparing the numbers of samples used to build up the chronology (table 4) with the total number of sampled tree I assume it is one tree of each species.

Table 3 contains wood density data of both species. As this table contains few data it could be dropped and information can be indicated in the text at an adequate place (introduction).

Table 4 contains information on the two master chronologies developed by living trees. As this information is already indicated in the text, this table could be dropped to reduce the amounts of tables in the manuscript. The data of inter-series correlation could also be shown as additional graph in figure 3 for segments of constant periods (25 years for instance). It also would be interesting to calculate the expressed population signal (EPS) for those segments for the two master chronologies according to Wigley et al. (1984), in order to quantify the degree to which samples represent the hypothetical noise-free chronology (EPS-values should achieve more than 0.85 which is a commonly applied quality threshold according to Wigley et al., 1984).

Figure 1 shows the eight sample sites indicated as “N”and “S”. Please indicate what does “N” and “s” stand for (north-facing and south-facing sites).

Interactive comment on Biogeosciences Discuss., 12, 14797, 2015.