

## ***Interactive comment on “Wildfire history of the boreal forest of southwestern Yakutia (Siberia) over the last two millennia documented by a lake-sedimentary charcoal record” by Ramesh Glückler et al.***

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I wish to submit a short comment on one part of the paper regarding the robust charcoal method originally described in Dietz et al. 2019 in PlosOne.

Incorporating uncertainties into proxy records, including both the age uncertainty and the uncertainty of the proxy itself, is important especially when comparing periods within a core and when comparing sites. It is overdue to include uncertainty in the analysis of individual sediment charcoal records. So, it is great to see this extension of

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the methods from the 'ensemble' approach from Blarquez et al.

My comment addresses the resampling methods used for estimating the uncertainty of the sediment accumulation rates. The robust method uses the age estimate of each sample (described as a mean and sd, but it could also be a PDF from an age-depth model), and selects ages from that PDF. Ages are generated independently for all samples, and only ages in adjacent samples that are in chronological order are retained. This results in some very slow sedimentation rates. This is acknowledged in the 2019 paper: "A comparison showed that robust fluxes were smoothed, but underestimated absolute mean fluxes due to strongly overlapping pdfage of adjacent samples at 1 cm sample resolution. Hence, we averaged the raw proxy and age values of three adjacent samples before robust flux calculation."

I am not sure how the averaging as described makes the CHAR influx values more comparable to the original influx values—did you average three samples in non-overlapping segments, thus increasing the age difference of adjacent composite samples? The presented robust CHAR values are small compared to the raw data. I do not see this averaging step in the supplied code.

When the PDFs of adjacent samples are overlapping ( $<2$  sd), the median age difference of the simulated ages is greater than the difference in the mean ages of the best-fit age-depth relationship. This is demonstrated in the attached figure. I think such small age differences occur in the majority of Holocene sediment records. The net effect is that as a core varies in sedimentation rate, the simulated sedimentation rate will have an increasing effect from the overlapping PDFs as the sedimentation rate decreases. This results in different effects of the analysis occurring in different parts of the same core. Variability in simulated sedimentation rates will not vary directly with the variation in the sedimentation of the best-fit age-depth model.

An alternative approach to simulating sedimentation rates: use the output from bacon or clam, which saves many simulated runs of age-depth relationships. These can be

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used directly in the robust char calculations. The advantage here is that the simulated age-depth relationships preserves the monotonic age-depth pattern. The necessary ages for using this approach are in objects saved by the bacon and clam programs. (objects called info, dat, or chron). Clam and bacon can apply age uncertainties to proxy records directly. However, you have more flexibility by using the set of simulated age-depth relationships.

```
Code for the attached figure: ad <- matrix(NA,nrow=101,ncol=2) k<-
1 for(i in seq(200,300,1)){ age.diffx <- (rnorm(10000,mean=i,sd=20)-
rnorm(10000,mean=200,sd=20)) ad[k,1]<-i ad[k,2]<-median(age.diffx[age.diffx>0])
k<-k+1 }
```

```
plot(ad[,1]-200,ad[,2],xlab="difference in best estimate of sample ages
(yr)",ylab="median of difference of simulated ages (yr)",xlim=c(0,100),ylim=c(0,100))
abline(a=0,b=1) text(x=10,y=90,"sd of each sample=20 yrs",pos=4)
```

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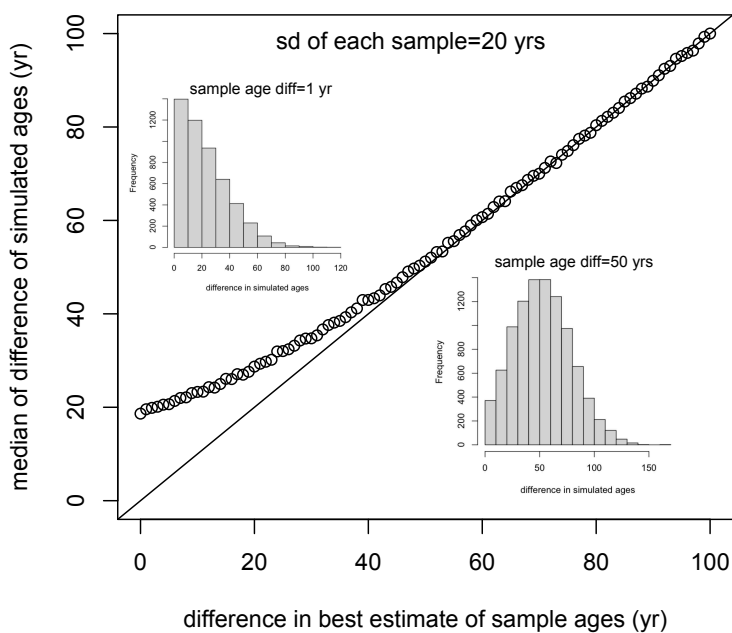


Fig. 1.

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