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Interactive comment on "Daily burned area and carbon emissions from boreal fires in Alaska" *by* S. Veraverbeke et al.

Anonymous Referee #2

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Overall Evaluation This manuscript presents the results of a study that develops and applies algorithms to predict fire emissions in Alaska to produce the Alaska Fire Emissions Database (AKFED) that will be updated regularly. The approach of AKFED is similar to that of the Global Fire Emissions Database (GFED), which is not surprising as both databases have been developed with one of the author's (James Randerson's) involvement. The strength of AKFED is that it is daily and will be updated regularly. I was also impressed with the amount of data that were pulled together into the development of the database. However, it was very disappointing to see that there really wasn't any difference in the regional estimates between AKFED and GFED3s (Table S3). No regional uncertainties are presented for either approach, so we don't know if AKFED has reduced uncertainty compared to GFED3s. In my opinion, the authors need to do a more complete job on identifying and quantifying the uncertainties in the

AKFED approach. The authors do try to address uncertainties in the Discussion, but I felt that there were some sources of uncertainty that were not adequately addressed in the manuscript. I breakdown these uncertainties into (1) conceptual uncertainties concerning controls, (2) uncertainties associated with possible aggregation errors, and (3) the proper quantification of uncertainty at regional scales. Some of these issues have been highlighted by the other reviewers, but here I provide my perspective. In my opinion, some of these issues will need to be addressed in the Results section, but others can be addressed in the Discussion section (I'll try to be clear about this below).

Conceptual Uncertainties Concerning Controls Similar to referee Kasischke, I was taken aback by the use of dNBR as an explanatory variable in this study given the importance of belowground carbon consumption to fire emissions and the difficulty for a spectral index like dNBR to address this issue. The authors explain this may be because of a correlation between above ground consumption and below ground consumption. I think that this is an important hypothesis to be stated in this study, as the data supporting it is rather limited. A fuller discussion of the use of dNBR is warranted in the Discussion section, as it brought out in the Kasishcke review. Clearly, a call for more data on the issue of the correlation between above and below ground consumption is needed. I was also quite surprised by the differences in the controls identified by this study and those identified by Genet et al. (2013, ERL), given that they were using the same basic data; the Genet et al. (2013) controls are similar to those of Barrett et al. (2010). Genet et al. (2013) indicated that the relative organic layer loss could not be adequately explained by a single regional model for black spruce, and that the data were better explained by developing separate models for flat lowlands, flat uplands, and slopes. Would uncertainties in AKFED be reduced by taking an approach similar to Genet et al. (2013)?

Uncertainties associated with possible aggregation errors Since the algorithms applied in AKFED are based on multiplicative non-linear regression developed at 30 meter resolution, I have a concern about the degree to which aggregation error has been dealt

with in the algorithms and how it might affect regional estimates. The authors bring up the issue of scale-dependency in section 5.2.1 of the Discussion (page 17600). However, the specific issue of aggregation error from the development of non-linear relationships at one resolution (30 m) and application of these relationships at another resolution (500 m) is not addressed as completely as it should be. I translation of Landsat dNBR and tree cover to MODIS dNBR and treecover (Supplementary Figure 5) will not solve this issue alone. I think readers just want to get a sense of whether this aggregation error issue is a major source of uncertainty or a minor source of uncertainty (an illustrative test case might help).

The proper quantification of uncertainty at regional scales Similar to the Kasischke review, I have a question about how pixel based uncertainty in consumption was quantified (equation 1, page 17954). There is not description of the components (aboveground and belowground) were calculated, or what it means. If it is the standard deviation of the prediction error, then I'm thinking it might represent a 68% confidence interval at the pixel level. But how is the prediction error estimated? I found it very naïve to state on page 17605 that "per-pixel uncertainties largely average out when scaled over larger areas". This is true if one just randomly samples the positive and negative "errors" from the pixel based estimates. I think a regional model ensemble approach needs to be employed to quantify regional uncertainties. One way to do this is a Monte-Carlo parameter sampling (based on the uncertainty of each parameter) and running the model over the entire region for each parameter set. Do this say 1000 times, and one gets a good idea of the uncertainty in emissions at the regional scale. I think this is an important thing to do in the Results, and it would be nice if it were done for GFED3s over the region as well. I think it is important for other approaches that are developed and applied at the regional scale to be able to compare not only the overall mean/median estimate of fire emissions, but also to have some context of uncertainty in the AKFED regional estimates in the comparison.

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