# Authors' preliminary comments to Referee no 1

The comments of the referee have been presented in *blue italic* below, and our response as plain black text. We have considered at this point only major comments of the reviewer, not the smaller specific comments.

First, we would like to thank reviewer no. 1 for the pertinent, useful and detailed comments on our manuscript. We would be very happy to write a revised version taking into account his/her comments.

*The paper presents recent developments implemented within an existing plume dispersion model for forest and pool fires, which aim to improve how the emissions source is parameterized within the modelling system. Given the sensitivity of plume rise and subsequent dispersion to source input parameters, estimation of buoyancy, mass and momentum fluxes is key to improving model prediction accuracy. Unlorturnaly, while this paper provides the means to estimate these parameters, it is missing key model evaluation to support the presented approach.*

The main aim of developing the source term module for the buoyant plume dispersion model was actually **to make the use of the overall model much easier**. The required input data for the refined model is indeed substantially simpler and easier to estimate, compared with those of the original model (i.e., the model without the source term module). **The main aim was not to obtain more accurate predictions** with the revised modelling system. This should be stated much more clearly in the revised manuscript.

However, we acknowledge the importance of the reviewer's statement. We could therefore inter-compare the results obtained using the source term model and those obtained using the original model (without the source term module), using RxCADRE data, and include these comparisons to the revised manuscript. We discuss this in more detail below.

Unfortunately, at the time of writing the manuscript we did not find any suitable datasets in the publicly available literature for evaluating separately the source term model directly against

experimental data. We therefore did what is possible in practise; i.e., we have evaluated the whole model (although not specifically the source term module) against the best available dataset.

Generally, it is fairly common in the literature that regarding large and complex models, not each and every module included in the overall modelling system will be separately tested. There might be several reasons for this, one of which is simply the lack of sufficient quality experimental data on that specific aspect of the model. In some cases, one has to satisfy to simply evaluate the whole model, including all the separate modules – although this process of course may not critically test all the modules included.

***General Comments***

*Moving away from static inputs towards a more physical model for fire source parameters is incredibly valuable. The authors present an approach for estimating various source properties derived from the classic MTT model, which in my view constitutes the main contribution of the paper. However, no attempt is made to actually evaluate this "source term model".*

*The inter-comparison study with RxCADRE data presented in the paper specifically excludes the source term model, focusing instead on the two previously-studied components of BUOYANT (plume rise and dispersion).*

This is correct. It should also be stated more clearly in a revised manuscript.

*While such results are still valuable, they do not substitute for proper evaluation of the derivations presented in Section 2 and, in the current state, provide no supporting evidence for the main contribution of the paper.*

*Fortunately, RxCADRE dataset is incredibly detailed and can be used to extend the evaluation to include the source term model. My recommendation for the publication of this paper would, hence, be contingent on the authors demonstrating the results for the following:*

We totally agree with the reviewer that RxCADRE is a useful dataset. It has also been well documented. We have re-checked the data and conclude that we could make some inter-

comparisons of the predictions obtained using the source term model and the original (generic input data) model. We would like to suggest that such comparisons would be included and discussed in the revised manuscript.

*Comparison of RxCADRE observations to:*
*BUOYANT model with **observations** as source inputs (this is essentially what's currently included in the paper), with more details included on methodology (as per comments below)*

This is a reasonable request and can be done.

*BUOYANT model with **old** source term parameterization (fixed parameters)*
*BUOYANT model with **new** source term model included*
*Operational version of BUOYANT (if different from above)*

The BUOYANT model makes it possible to evaluate strongly buoyant plumes in two alternative ways: (i) Using the source term model, as presented in the manuscript, or (ii) describing the source parameters to the overall buoyant plume model (without using the source term model). In the latter case, the input data is much more complex and much more difficult to evaluate. These two options could be compared for the RxCADRE data, as the reviewer suggests. However, at least in case of forest fires, experimental data for performing such an inter-comparison is not currently available in the available literature, except.

Both the operational version of the model (named as FLARE) and the original research model (named as BUOYANT) use an identical code for the dispersion and transport of a buoyant plume. The differences of FLARE and BUOYANT are:

(a) FLARE uses as default the presented source term model; it does not therefore allow the user to specify the source related input in the more complex format (as in the alternative (ii) in the above paragraph).
(b) The specification of the meteorological conditions in FLARE is determined by the used numerical weather prediction model, in BUOYANT, this can be done also in various other ways.
(c) Output of BUOYANT is more versatile and can be adjusted by the user, compared to FLARE.

(d) BUOYANT allows the user to post-process the model results at will. FLARE includes a standard format post-processing.

(e) FLARE can be used with a restricted set of web browsers, while BUOYANT is designed to be as platform independent as possible.

These differences should probably be presented more clearly in a revised manuscript.

*Lastly, Section 4 of the paper is dedicated entirely to an overview of an operational modelling system. It is my understanding that the system is supposed to be accessible online, however no links are provided in the paper (aside from those pointing to an offline archive of the Fortran source code for the BUOYANT model). My current review of Section 4 is, hence, fairly superficial. If the authors are unable to provide access to the model for peer-evaluation, my recommendation would be to exclude this section from the manuscript.*

We apologise for not specifying a link for the operational model version; this was an omission. We can and should provide the link for the reviewers. A slight problem is that the FLARE user interface has been currently coded only in Finnish. However, we suggest to provide the translations of the relevant texts to English as a separate document. There is only one or a couple of pages of text in this user interface. We therefore believe that this would give the reviewers a sufficient knowledge on the functioning of the software.

*… If the agreement was great, why would BUOYANT need improvement? What were the limitations? (specific comment)*

The limitations of the BUOYANT model include: (i) The model assumes a steady state in terms of emissions and meteorology. However, the user can easily conduct multiple runs with various values of the emissions and meteorological parameters, to evaluate the impacts of changing emission and ambient conditions. (ii) The current model version does not treat the impacts of phase changes of water in the plume (in particular, condensation and evaporation). (iii) The model adopts some values of model parameters according to the best available previous experimental and modelling studies. However, the values of these parameters could be found to be inaccurate in the future and may have to be refined.