Anonymous referee #1

The manuscript publishes the 3rd version of Vulcan dataset. The dataset is very meaningful for climate change research, the method is sound.

1. What is the advantage of your dataset compared with other datasets? Please explain it in the introduction.

We have added text in the introduction that directly responds to this query. Specifically we say "Vulcan is distinct from ODIAC in that it includes detail regarding combustion sector, combustion sub-sector (e.g. by vehicle class, building type), combustion process (e.g. boiler, turbine, engine), and a detailed fuel characterization (e.g. individual petroleum fuels, coal grade). Though reported here as gridded output, the underlying emissions content is quantified as individual point, line, and polygon source elements and as such, is distinct in potentially providing finer resolution in the future. Finally, unlike top-down inventories, typically produced at the global scale, Vulcan is constructed from the bottom-up, relying less on indirect spatial proxies (e.g. nighttime lights) and more on detailed mapping of physical entities such as roadways and factories."

2. What is the improvement and update to the previous versions? On page 3, line 15-16, you only said: "we report here on improvements in methodology, resolution, uncertainty estimation, . . .". Please explain the improvements in more detail. A table summarizing the improvements and comparing different versions of the project may help readers to understand your project better.

We are altering the manuscript to no longer make reference to previous version but write this as a standalone paper. Tracing the improvements and methods in previous versions is a large and potentially impossible task. Vulcan version 3.0 will stand alone and the manuscript will include all information related to its methods and results.

3. You use data from numerous public dataset (page 3, line 32). Is there any inconsistent of these datasets in terms of statistical scopes and methods? Will these inconsistencies affect the uncertainty of your accounting?

We are not entirely sure what is meant by this question. The data do come from many different sources and they will most often have differing levels of reliability, uncertainty, consistency, and so on. The will be imparted to the results in this manuscript, for sure, and we attempt to reflect that in the uncertainty analysis, but it is probably a simplification of the true uncertainty. The true uncertainty is challenging to quantify given the limitations in input data documentation and/or procedures. It must be noted that unlike other data products of a similar kind published in ESSD, Vulcan uses a wide array of regulatory data, which typically does not include careful documentation, release versioning, uncertainty estimation, etc. This makes it very difficult to have the same procedural documentation as might be found in global granular emissions efforts.

4. How you calculate the uncertainty? What is the method?

Perhaps it was missed but we include a section on uncertainty within each of the sub-sections to section "2.1 Data and processing". We have included more detail in each of these given the comments of other reviewers.

5. It seems not necessary to show territorial emissions per capita. There is a debate in the literature that territorial emission should be normalized per GDP, while consumption-based emissions that related to final consumption should be normalized per capita.

We generally agree that the choice of normalization is a critical conditioner to interpretation. We were not trying to make a particular policy or social science point when normalizing to population. Normalizing by population was done to offer a constrast to absolute magnitudes and emphasize why population-normalized values vary according to sector. A normalization by GDP is done and now included in the SI – it shows a very similar result.