General comment

Andela et al., present a novel and very important dataset of several important fire characteristics globally on a daily basis. This dataset will serve earth system and social scientists on topics ranging from (but not limited to) fire emission estimates in earth system modelling, feedback between fires and ecosystem, fire management and studies of socio-economic feedback of fires. The manuscript is well written and the underlying methodologies have been explained precisely. Being the first dataset of such kind, a complete validation was challenging. However the authors have used the available resources, e.g. VIIRS (globally for four different ecosystems) for burn date, MTBS in the US for the fire perimeter and a combination of both for the fire duration.

The dataset, however, has a large uncertainty for short fires (persisting for less than a day, for example, crop residue fires), which is acknowledged in the discussion. I have only minor comments regarding this manuscript and recommend publication of this manuscript in ESSD after the authors have addressed them:

We thank the reviewer for his/her constructive comments and thoughtful review. Please find our detailed response along with the suggested changes to our manuscript below. Note that we will upload the updated manuscript using track change (in response to both reviews) in a separate post.

Specific comments:

The methodology considers clusters of fires in a given fire season (12 months) as a starting point. What if the fires season is less than 12 months? For example, the same area is burnt twice after a gap of six months? As per my understanding, the local minima filter will only assign it to the later burnt date of the fire season. This will also have consequences on the estimation of fire duration and perimeter.

This is correct, we try to minimize the amount of pixels that burned twice during a single burning season by defining the burning season as "5 months before until 6 months after the month of maximum mean burned area" for each individual 10° x 10° MODIS tile. In most of the world (particularly areas that burn frequently) the fire season is quite clearly defined, e.g. wet and dry seasons in the tropics or cold winters and warm summers at higher latitudes; however, in regions without clear seasonality (e.g. always dry or wet), or some areas with both natural and cropland fires, our methodology is not ideal. In case there was overlap between two burning events we only retain the earliest burn dates. Therefore, a small fraction (<1%) of global burned area is effectively removed from our dataset, indeed affecting fire perimeters by reducing overall burned area. The advantage of our methodology is that we can produce user friendly global "annual" layers of fire behavior, both gridded at 500-m resolution, as well as in the form of shapefiles.

In response to this suggestion will more clearly explain these tradeoffs. In particular, we will rephrase lines 134-135 to: "This approach results in a small reduction of total burned area, but allows us to produce user friendly global annual layers in both gridded and shapefile format."

The authors conclude that this dataset is useful for emission modelling. In my opinion, the authors should also acknowledge the limitation of this dataset for use in atmospheric models for emission estimates from fires. The Global Fire Atlas does not take into account the smoldering stage of fires, which significantly contribute to gas and particle emissions. In this context, the work of Kaiser et al., 2011 should be mentioned, which uses the fire radiative power for emission estimates. Kaiser, J. W., et al. (2012), Biomass burning emissions estimated with a global fire assimilation system based on observed fire radiative power, Biogeosciences, 9(1), 527-554, doi:10.5194/bg-9-527-2012.

We fully agree with this suggestion, although our estimates of fire behavior may provide some first guidance on where smoldering may occur (e.g. slow multi-day fires), or where fires may burn more intensely (e.g. high speed), this is further modified by e.g. fuel loads and conditions. Moreover, it often remains unclear how the combination of fire behavior and fuels modify emissions factors (i.e. composition of emissions), and thus eventual emissions of different trace gasses and aerosols.

In the updated manuscript, we will discuss this in more detail. In particular, we will change lines 546-547 to "Large differences in fire behavior across ecosystems and management strategies may improve fire emissions estimates and emissions forecasting, particularly when combined with active fire detections to better characterize different fire stages including the smoldering phase (Kaiser et al., 2012)."

Page 4, line 155: What fraction of local minima is discarded after each iteration step? This information is important for optimization of the number of iteration (which was taken to be 3 in the present work).

During our development phase we had looked into this for a number of individual MODIS tiles, and found that 3 iterations may provide an optimal threshold across different ecosystems. We also found that forest fires may generally require more iterations than fast-moving grassland fires. In the updated manuscript we will include a new supplementary figure visualizing these tradeoffs, to support our decision of 3 iterations (Fig. 1 here).

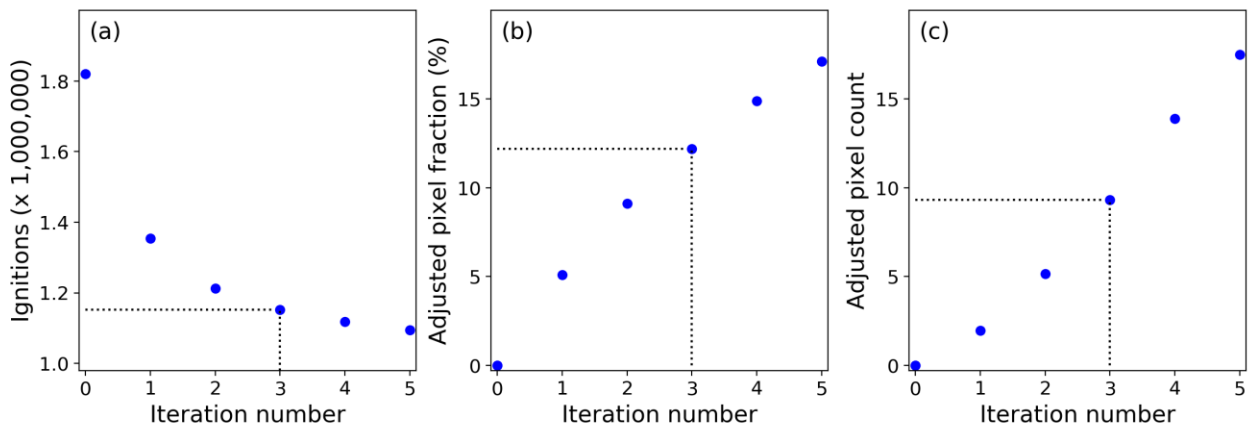

Figure 1 (new Fig. A2 in manuscript): **Tradeoffs between reducing local minima not associated with ignition locations and adjustments made to the global burned area product.** (a) Local minima (ignitions) detected within the daily 500 m global burned area data for 2015 after different number of iterations of the ignition point filter, (b) corresponding fraction of burned area pixels with adjusted burn date, and (c) corresponding number of burned area pixels adjusted divided by the reduction in ignition count. In this study, we used three iterations of the ignition point filter (indicated with the intermittent lines in figures a, b and c), and "0 iterations" refers to the original MCD64A1 col. 6 burned area data.

Figure 4: The horizontal axis legend (burn date (burned area minus active fires)) is not clear to me.

The horizontal axis indicates the difference in burn date between VIIRS active fire detections and the burned area datasets (MCD64A1 c6 and the adjusted burned area data by the Global Fire Atlas). This is calculated as the burn date of the burned area data minus the associated burn date of the (first) corresponding active fire detection. Thus, a negative number indicates that the burned area was detected before the active fire detection, zero indicates a perfect match, and a positive number indicates that the burned area was detected later than the first active fire detection.

We will change the x-axis label to "Difference in day of burn compared to VIIRS (days)" and change the y-axis label to "Pixel fraction".
Then, we will change the figure caption to: "**Per pixel global comparison of burn dates derived from the MCD64A1 burned area product, adjusted burn dates of the Global Fire Atlas, and VIIRS active fire detections (2012 – 2016).** (a) Forests, (b) shrublands, (c) woody savannas, and (d) savannas and grasslands. Negative values indicate pixels with a burned area day of burn earlier than the first corresponding VIIRS active fire detection, zero indicates no difference in day of burn between both datasets, and positive numbers indicate a delayed detection of burned area compared to active fire detections."

Figure 7: Please check the units in the middle panel (for ignitions).

Although we believe the units are correct, we appreciate that the units on this figure may be somewhat confusing. In particular because we state that burned area is the product of ignitions and size. We think the confusion arises because the exact surface area of a 0.25° grid cell varies with latitude, therefore we feel that for ignitions it makes most sense to report the "ignition density" per unit of area per year. In a similar fashion we report burned area as a fraction per year rather than in square kilometers per year.

For clarity, we will change the figure label "(b) Ignitions (km^{-2} yr^{-1})" to "(b) Ignition density (km^{-2} yr^{-1})". Also, we will further clarify this in the figure caption: "**Figure 8: Average global burned area (MCD64A1), ignition density, and fire size over the study period 2003 – 2016.** For any given area (a) burned area in km^2 per year would be the product of (b) ignitions per year and (c) fire size in km^2. However, because the size of a 0.25° grid cell varies with latitude we have converted the units of burned area to fraction (%) per year and of ignitions to number per km^2 per year for spatial consistency."

The discussion regarding fire direction on page 14 is relatively weak. The fire directions are highly variable depending on topographical features, prevalent wind field and fuel availability. What can one conclude from such variable fire direction and how this information is useful?

We had also anticipated a stronger effect of the dominant wind direction. Therefore, we think that variability in fire direction is an interesting finding on its own. As we show, landscape features and other factors play an important role in fire spread direction, leading to heterogeneous patterns of fire spread in all biomes. This finding may help improve global fire models, for example, since models often assume that fire growth can be described by relatively simple growth equations with homogenous fuel beds. Our work adds to an increasing body of evidence that landscape heterogeneity and associated variability in fuel conditions have a strong influence on global fire behavior across scales.

We will add an additional sentence to the discussion section to highlight to potential new insights for fire modeling (line 546):
"In a similar fashion, many models assume relatively homogeneous fuel beds, while our results suggest that landscape features and vegetation patterns result in highly heterogeneous fuel beds that form a strong control on fire spread (speed and direction)."

The Global Fire Atlas dataset is available for the year 2003-2016. Will this dataset be continuously updated? Given that the dataset is so important, the authors should provide information of update frequency and policy.

We aim to update the dataset annually, with a delay of about 1 year. Because of the "per fire year" processing the algorithm requires burned area data up to 6 months after the calendar year ends to process a given year while the burned area product (MCD64A1 col. 6) is also released with a few months delay.

We will also mention this in the “Data availability” section: “The data are freely available at http://www.globalfiredata.org in standard data product formats and updates for subsequent years will be distributed pending availability of MCD64A1 burned area data and associated research funding.”

Reference:

Kaiser, J. W., Heil, A., Andreae, M. O., Benedetti, A., Chubarova, N., Jones, L., Morcrette, J. J., Razinger, M., Schultz, M. G., Suttie, M. and van der Werf, G. R.: Biomass burning emissions estimated with a global fire assimilation system based on observed fire radiative power, Biogeosciences, 9(1), 527–554, doi:10.5194/bg-9-527-2012, 2012.