Dear Chris Elvidge, thank you very much for your valuable and constructive comments. We have followed most of your suggestions and we find that our paper is now generally improved.

In this document, your original comments are framed by a box and our answer follows.

Review of "Gas flaring activity and black carbon emissions in 2017 derived from Sentinel-3A SLSTR" The paper attempts to locate all the active gas flares of 2017 and estimate their flare gas volumes using nighttime data collected by the Sea and Land Surface Temperature Radiometer (SLSTR) instrument flown on-board the Copernicus satellite Sentinel-3A. The basic detection algorithm for the individual nights of data follows the VIIRS nightfire (VNF) method and appears to be solid. But the steps used to go from the individual nights of data to the annual summary are questionable and should be revisited.

1. The SLSTR results found 6232 flaring sites in 2017. This compares to over 10,000 flares reported by the VIIRS nightfire team for 2017 (https://eogdata.mines.edu/download_global_flare.html).

The section on the comparison with VIIRS Nightfire has been totally rewritten and is now at the end of the Results chapter. We now compare our results to the gridded detections and activity data for 2017 provided by the VIIRS Nightfire team.

We argue that both methodologies globally agree, in that they capture roughly the same flaring regions around the world. However, a closer look reveals that those regions are more populated by the VIIRS Nightfire results than by our own. We trace back that behaviour to small geolocation inaccuracies, the clustering of hot pixels in our algorithm (against the analysis of local maxima) and the VIIRS larger swath which provides more opportunities to detect a flaring site. We attempt to quantify the contribution of these factors to the observed difference in terms of flaring locations between both methodologies. Of the 10185 flaring locations produced by the gridding of the VNF data, 2964 are coincident with the flaring locations presented here, 1507 are adjacent and 1651 are less than 4 grid cells away, which can be interpreted as due to geolocation inaccuracies and the clustering of hot pixels. Finally, 4063 are "distant", i.e. more than 4 grid cells away from the closest SLSTR flaring location. A closer analysis reveals that our methodology also captures activity at those locations, though not enough to be classified as flaring following our criteria. This indicates a low activity and, indeed, the associated BCM in the VNF record is low (8.67 BCM, a few percent of the global total of 151 BCM).

In summary, we attribute different flaring locations in the datasets as follows:

- Adjacent (7.3 BCM in VNF): a mix of geolocation error and clustering
- A distance from adjacent up to 4 grid cells (3.1 BCM in VNF): a mix of clustering and intermittent operation
- Larger distances (8.7 BCM in VNF): intermittent operation and more detection opportunities by VIIRS due to larger swath.

2. Many flares are intermittent. The nightly flare detection data does not contain sufficient information to account cloud and solar contamination effects that could effect the annual flared gas volume calculation. Hence the annual characterization of flared gas volume should calculate the "duty cycle" or "percent frequency of detection" for each flaring site. The VNF team makes the calculation based on flare detection numbers in the set of nighttime cloud-free observations made of the site during the year. Because the nightly VNF product only contains the detections – the annual analysis includes an

inventory of the cloud state (cloudy or clear) for the nights lacking VNF collection that are free of solar contamination. The VNF method excludes both sunlit and cloudy observations in the calculation of flaring site duty cycle. The method reported in this paper (section 2.3 and Figure 2) is woefully inadequate and appears to have resulted in a drastic underestimation of annual flared gas volume in Russia. I suspect that the method in Figure 2 does not account for solar contamination outages during summer months – as shown below with VNF for a flare in northern Siberia.

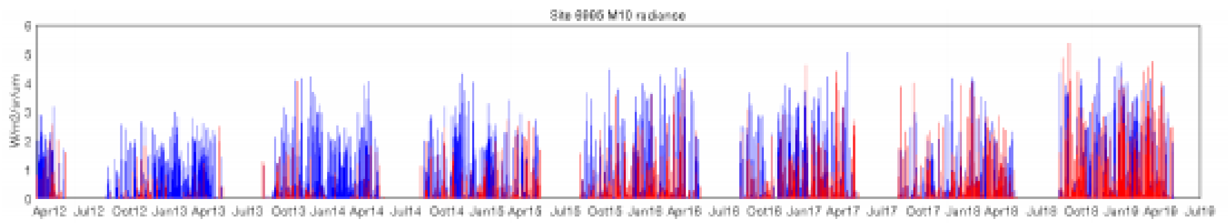

Fig. 1. Temporal profile VNF SWIR radiance for a flare in Siberia. Each year there is an outage period due to solar contamination.

We acknowledge that the method for correcting for variable observation opportunity is less sophisticated than the one employed in VNF. It should, however, be capable of partly correcting the effect partial and complete solar contamination. The underlying assumption is that SLSTR happened to observe a few gas flaring locations in mostly cloud-free condition during 2017. With almost continuous operation, these should be the locations with the largest numbers of detections. In this case, the numbers of detections are also estimates for the numbers of detection opportunities, including the effects of number of satellite overpasses and solar contamination. The number of satellite overpass times increases for higher latitudes; this should increase this largest number of detections for higher latitudes. On the other hand, the summer period during which more observations are contaminated with solar radiation is longer for higher latitudes. This has the opposite effect of reducing the largest number of detections for higher latitude. The latter effect appears to be stronger, given the behaviour depicted in Fig. 2. An additional error occurs due to the variability in average percentage of cloud cover, which the presented method approximates to be constant zonally and to vary smoothly meridionally. Therefore, the method is considered to be applicable with less effort but also less accuracy than a detailed recording of the detection opportunities for each flaring site. In particular, this method should improve the results when only information on hot spot detections but not on detection opportunity is available.

3. The paper lacks detail on the method used to discriminate clear versus cloudy observations. In addition, the paper makes several assertions that should be rechecked.

The discrimination of clear versus cloudy observations is performed based on the cloud mask in the SLSTR L1b product during the hot spot detection procedure, which is described in our earlier paper and simply applied in this one. We agree that a second processing of the SLSTR L1b products to calculate the detection opportunities for each flaring site based on its individual solar and cloud contamination would be a more accurate process. However, due to budget (the project has been over for more than 2 years now) and time (the main authors of the study are now in new positions) constraints, it is not possible for the authors to conduct this now. It should certainly be considered for possible further developments of the methodology.

4. The paper makes several claims that the "SLSTR-based methodology is able to detect smaller gas flares". No evidence is presented to back up this claim.

The claim was based on the night-time availability of a second SWIR channel. The statement was completed in the manuscript (see the answer to the next comment).

5. The paper state that the VNF product only uses a single shortwave infrared channel. This was the case for early VNF data. However, from January 2018 forward VNF from two satellites has included two SWIR bands.

We have updated the information in our manuscript (section 2.1 Hot spot detection and characterization): [referring to the comparison conducted in our previous paper] The results showed a good agreement of our hot source detection when investigating persistent hot spots with the advantage of the Sentinel-3A's SLSTR algorithm in detecting and quantifying smaller flares, due to the night-time availability of a second SWIR channel. Although this was the case at the time of writing our previous paper, from January 2018 VIIRS Nightfire uses two SWIR channels at night and the detections are conducted by two VIIRS instruments.

The reference to the outdated feature was removed from the end of the introduction.

My recommendation is that the paper undergo major revision and a second round of peer review prior to publication. The authors should make a specific comparison against the VNF product from 2017 to better understand difference between the SLSTR and VIIRS flaring sites and flared gas volumes. Are there specific geographic regions where one system detects more flares or more flared gas volumes? Since the instruments and detection algorithms are so similar, the authors should figure out the reason behind the discrepancies. To make a direct comparison of the combustion source detection limits with VNF, the authors can follow the methods outlined in https://www.mdpi.com/2072-4292/11/4/395

This crosschecking with VNF could lead to major improvements in the gas flaring results from SLSTR and a far better paper.

We have considerably revised our paper and have added several new analysis and figures to better illustrate the results of our work. In particular, we have added a comparison the VNF product from 2017 as recommended. The suggested further analysis along the lines of the paper recommended by the reviewer would certainly be worthwhile but is considered to be somewhat out of the scope of the present submission. In the Elvidge *et al.* 2019 paper, the authors analyze the hotspots retrieved using not only a SWIR channel as primary detection, but also a MWIR channel. In our present work, we focus on the detections achieved using the SWIR as primary channel.