Dear authors,
I reviewed the manuscript entitled "Gas flaring activity and black carbon emissions in 2017 derived from Sentinel-3A SLSTR". I found the basic idea interesting, considering the great potential the Sentinel missions will provide in the future, but in my opinion a hard work has to be done for make the analysis more consistent. The main doubt is you do not well know (and so you incorrectly use) the VNF dataset. The part inherent to the flaring sites detection is indeed confused. The topic of your paper is the characterization of flaring sites, in terms of gas flared volumes and black carbon emissions estimates. First, you improve the performances of your pervious work (Caseiro et al 2018) in detecting flaring sites, adding a temperature filtering. When you compare your results with VNF, you first use the 2012 VNF outputs (why not the 2017?) and then you take into account the combustion sources (https://ngdc.noaa.gov/eog/viirs/download_viirs_fire.html) identified by VNF instead of the flaring sites available at https://www.ngdc.noaa.gov/eog/viirs/download_global_flare.html for 2017 (the year of your analysis). I think it is a forcing applying the criteria developed in this work for SLSTR to select among the VNF combustion sources the flaring sites. The latter are directly provided by NOAA at https://www.ngdc.noaa.gov/eog/viirs/download_global_flare.html.

Below my suggestions/corrections.

Abstract

- We calculate the global flared gas volumes and black carbon emissions in 2017 by ~~(1)~~ applying (1) a previously developed hot spot detection and characterisation algorithm to all observations of the SLSTR instrument on-board the Copernicus 5 satellite Sentinel-3A ~~in 2017~~ and (2) ~~applying~~ newly developed filters for identifying gas flares and corrections for calculating both flared gas volumes (BCM) and black carbon emission (g/m^3) ~~estimates~~.
- The comparison of our results with those of the VIIRS N~~n~~ightfire data set indicates a good fit between the two methods.
- Please, remove the space at the beginning of the bracket (https://eccad3.sedoo.fr/#GFlaringS3, DOI 10.25326/19 (Caseiro and Kaiser, 2019))

Introduction

- Please, put the dot after the references: or convert the gas. (Rahimpour and Jokar, 2012; Emeka Ojijiagwo et al., 2016). This is the first case, I found many others in the paper.
- Improvements of flare gas recovery systems have~~s~~ been recommended …
- GF also impacts the environment on a wider scale through the emission of pollutants and greenhouse gases like carbon dioxide (CO_2), carbon monoxide, black carbon (BC)…
- Of particular importance is also the ~~black carbon (~~BC~~)~~ emission emitted by GF. BC is a known carcinogen (Heinrich et al., 1994) as well as a short-lived climate forcer (IPCC, 2013). BC strongly a~~e~~ffects environments such …
- Satellite remote sensing has been utilized for regional and global identification and characterization of GF~~.~~ (Casadio et al., 2012b, a; Anejionu et al., 2014; Faruolo et al., 2014; Chowdhury et al., 2014; Anejionu et al., 2015; Faruolo et al., 2018). The most prominent system is NOAA's VIIRS (here add NOAA acronym Visible Infrared Imaging Radiometer Suite) Nightfire (VNF) dataset (see https://ngdc.noaa.gov/eog/viirs/download_viirs_fire.html), developed by Elvidge et al. (2013, 2016) for the detection and characterization of combustion sources ~~based on previous work (Elvidge et al., 2001, 2007, 2009, 2013)~~ and leading to a globally consistent survey of gas flaring volumes available extending back to 2012 (https://www.ngdc.noaa.gov/eog/viirs/download_global_flare.html).
- We recently published an adaptation and extension of the VNF~~VIIRS Nightfire~~ algorithm with which observations of the SLSTR ~~instrument~~ (Sea and Land Surface Temperature Radiometer) instrument on-board the Sentinel-3A satellite~~s~~ have~~can~~ been analysed~~, too~~ (Caseiro 30 et al., 2018).
- The main advantages of using our hot spot detection and characterisation algorithm lie in the ability to detect and quantify smaller flares and the foreseen long term data availability from the series of Sentinel-3 satellites in the Copernicus program. Additionally, SLSTR observations (night-time overpasses at 10:00 PM) complement those of VIIRS (1:30 AM) by filling observation gaps in the time

series. I think the unique advantage your algorithm seems to offer, when compared to VNF, is its capability to identify smaller flares. Regarding the data continuity, also VIIRS is actually onboard two satellites (Suomi NPP and JPSS-1) and will also be flown on the JPSS-2 (launch in 2021), -3 (2026) and -4 (2031) satellite missions. You can rephrase this sentence, pointing out the potential of these algorithms, the possibility of integrating them as well as of continuously monitoring the phenomenon thanks to the long design life of satellite missions.

- Here, we describe a new dataset of global gas faring volumes (BC~~D~~M) and BC emissions (g/m3), which we have derived from all Sentinel-3A SLSTR observations in 2017. In detail, c~~C~~hapter 2 describes newly developed methods for identifying gas flares among the observed hot sources, correcting for intermittent observations opportunities, and dynamically determining appropriate BC emission factors from the observations. The results ~~of applying the hot source detection and characteristion algorithm plus the newly developed methods to all SLSTR observations of 2017~~ are presented in Chapter 3, the~~. Finally, our~~ conclusions are summarised in Chapter 4.
- While in principle the methodology used is based on the ~~Nightfire algorithm developed for VIIRS~~VNF
- We already tested the method using oil and/or gas producing regions within a limited timespan and compared the results to the VNF~~VIIRS Nightfire~~

2.1 Hot spot detection and characterization

Figure 1 should be improved, explaining the GF filter.

2.2 Hot spot classification

2.2.1 Volcano filter

- The data were~~as~~ filtered
- Many volcanoes do not consist of a single edifice, ~~but a volcanic field with~~ many individual eruptive fissures through which lava erupts may be present in a volcanic field~~.~~ (Siebert et al., 2010).

2.2.2 Discrimination of gas flares from other industrial hot sources

This paragraph is not completely clear. You are searching for a criterion to use for accurately detecting flaring sites. The starting point is your algorithm (Caseiro et al., 2018), to which you add a temperature filtering. I do not understand how you use the works of Elvidge et al. (2016) and Liu et al. (2018) in the definition of the temperature criterion. To this aim, you test several subsets. Can you explain what are these subsets? They are 8? They correspond the 8 columns in Table 1? Besides, I expected n_{Obs} was greater than n_{ObsHA}. Probably, it is more correct to use ≥ than >.

2.3 Determination of flared volumes and black carbon emissions

- Please, explain the terms BCMmin, BCMmax, BCMbest in this order, to facilitate the comprehension.
- The emissions of black carbon (BC) from gas flares are estimated using reported emissions factors (EF). It could be useful to specify the formulation applied for their computation.
- GAINS: please, extend the acronym.
- You define flaring site a site with a temperature above 1500K. Why do you compute the EFs for lower temperatures?
- With this methodology we estimate a wide range of possible activity (BCM) and BC emissions (g/m^3)
- Can you better explain this sentence, please? I do not understand it: “We conservatively assume that this range of possibilities represents 6 × σ, and report the uncertainty of the best estimates as 1 × σ”.

3. Results

3.1 Hot spots and flaring sites

I have concerns about this section. Your paper focuses on gas flaring, the previous one (Caseiro et al., 2018) on hotspots. For this reason, you can join Figures 4, 5, 6 using three colors for discriminating hotspots, high confidence hotspots and flaring sites. Besides, I do not understand why you compare the SLSTR global detections for 2017 with the VNF in 2012. The VNF data for 2017 are available; you indeed use them in section 3.3.

- Russia (985) and the United States (917) are the countries with the highest number of flaring locations (Figure 7).
- The time series of the cumulative number of the high accuracy observations for the most active flaring location (in Venezuela, see Section 3.4) is shown in Figure 8. It shows flaring activity throughout the year. In my opinion, it is not useful and interesting. Remove Figure 8.

I think 3.2 and 3.3 are subsections of 3.1: they become 3.1.1 and 3.1.2.

- Figures 10, 11 and 12 are not useful, in my opinion they could be removed. You can indeed add before Figure 9 and Figure 13, respectively, a global map (in color scale) showing the temperatures and RP values for the 6232 sites.
- Figure 9. Distribution of the average retrieved ~~hot spot~~ temperature (K) for the flaring locations
- The average temperature at the flaring locations approximately ranges from 950 K to 2250 K. This is slightly lower than the range reported by Liu et al. (2018) (please, can you specify the values) who used VIIRS Nightfire data, as expected from our previous study (Caseiro et al., 2018). It confirms the bi-modal distribution with modes around 1750 K and 1200 K that is has also been observed by VIIRS.
- The section "Comparison with VIIRS Nightfire" should be modified. As before explained, being the focus of your work the gas flaring, you should compare your results with the VNF flaring sites (available at https://www.ngdc.noaa.gov/eog/viirs/download_global_flare.html), avoiding to select these sites among the VNF combustion sources applying the criteria used for SLSTR.
- You never cite Figure 14 in the paper. The figure is not useful, as figures 10-12.

3.4 Flared volumes (new 3.2)

As before, you should use BCM data available at https://www.ngdc.noaa.gov/eog/viirs/download_global_flare.html for the comparison with your estimates in 2017. It would be interesting the map of the global distribution of BCMbest. In Figure 20 you could add the distribution derived by the VNF data elaboration.

3.5 BC emissions (new 3.3)

As for BCM, you can add a global map of BC emissions.

Conclusions

To reorganize based on new suggested analyses. In any case:

- The sentence "We present a new gas flaring discrimination procedure, based on two characteristics of gas flares: persistence and temperature" is not correct. This procedure is not new, being the one most used to identify gas flares. Respect to your methodology, you simply add a temperature filtering to improve the detection of flaring sites.
- "Additionally to the detection we present a way to assess the volume of flared gas": is not true. You apply a widely declared model developed by Elvidge et al (2016) to compute monthly flared volumes, adding a scaling factor, which takes into account the operation time of the sites.