Atmospheric Measurement Techniques Discussions

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Comment on amt-2021-345

Anonymous Referee #4

Referee comment on "Characterization of the MISG soot generator with an atmospheric simulation chamber" by Virginia Vernocchi et al., Atmos. Meas. Tech. Discuss., https://doi.org/10.5194/amt-2021-345-RC5, 2021

Review of "Characterization of the MISG soot generator with an atmospheric simulation chamber"

We performed some additional experiments useful to reply at specific Referee questions.

General comments:

Page 10 – Fig. 4 and the discussion around it: The particle mode diameter reported for ethylene flames is constant at ~175 nm. This is inconsistent with previously reported values of ~240 nm and up to 270 nm (Kazemimanesh et al., 2019). The same reference also reported an initial sharp increase in particle size and concentration with increasing ethylene flow rate, which eventually levelled off to a relatively constant value. This is in contrast to the trend seen in this paper. These differences must be noted and discussed in the paper.

We added the discussion about these differences, that probably depended on the different combustion conditions.

Line 292: Even if the direct comparison between our findings and results from previous works (Bischof et al., 2019; Kazemimanesh et al., 2019; and Moallemi et al., 2019) are not directly comparable (since feeding flows and global equivalence ratios are different), some similarities can be identified. Previous works observed that by increasing the fuel flow, the particle number concentration increases too, that is what we observed for propane. In addition, Bischof (2019) also reported that the particle mode diameter, with propane, did not depend on the global equivalence ratio, as we also observed, but for ethylene. Kazemimanesh (2019) showed a clear increase in mode diameter, corresponding to an increase of fuel flow rate, that reached a quite constant value (i.e., around 240-270 nm) for ethylene. This trend differs from our observations, since the mode diameter in our case turned out to be quite stable at about 175 nm independently on feeding flows. This difference is probably due to the global equivalence ratios used: while in (Kazemimanesh et al., 2019) global equivalence ratios are lower than 0.206, in our case they are higher than 0.213. In (Moallemi et al., 2019), instead, they observed an opposite behaviour for mode diameters: they retrieved that at fixed fuel flow, a higher air flow produced a slight decrease of the mode diameter. Both (Moallemi et al., 2019) and (Bischof et al., 2019) measured mode diameters < 200 nm, but they used different combustion conditions (i.e., lower global equivalence ratios resulting from higher air flow or lower fuel flow). We can conclude that, as expected, global equivalence ratio is the principal parameter affecting size distributions of soot particles.

Anyway, as request by RC2, we carried out experiments that replicate some of the conditions used in the previous works, so we will able to compare the same operative conditions used by (Kazemimanesh et al., 2019).

We replicated the following conditions: 9 lpm of air - 100 mlpm of fuel (ethylene) and 10 lpm of air - 100 mlpm (ethylene).

Table 1: Comparison between results of previous literature work and our replicated experiments.

	Kazemimanesh et al., 2019	**This work**
	Mode diameter (nm)	Mode diameter (nm)
Ethylene: 9 - 100	242	191 ± 8
Ethylene: 10-100	250	220 ± 9

In the revised text, we added:

Line 267: In addition, we reproduced some of the conditions investigated in the previous works obtaining a good agreement for the mode diameter and SSA figures (see Supplementary for details §3).

Line 498: The formation of superaggregates is related to high particle concentration in the exhaust line. This means that by diluting the MISG exhaust, the formation of these large aggregates can be alleviated. Kazemimanesh et al. (2019) and Chakrabarty et al. (2012) suggest that these superaggregates are formed at the stagnation plane of the flame tip, which seems more plausible. The authors should note and discuss these differences in the paper (not in the conclusions section).

This point has been raised by more than one Referee, and we agree that it is an interesting point to investigate. We will be able to answer to this question and add the results in the revised text after some extra experiments, by inserting a diluter between MISG and ChAMBRe as suggested.

We diluted the MISG exhaust just before the outlet of the generator, by adding an extra air flow, the ratio between dilution air and MISG generator was 4:1. No significant differences were observed in the super-micrometric range, suggesting that superaggregates are formed at the stagnation plane of the flame tip, as reported in Kazemimanesh et al. (2019) and Chakrabarty et al. (2012).

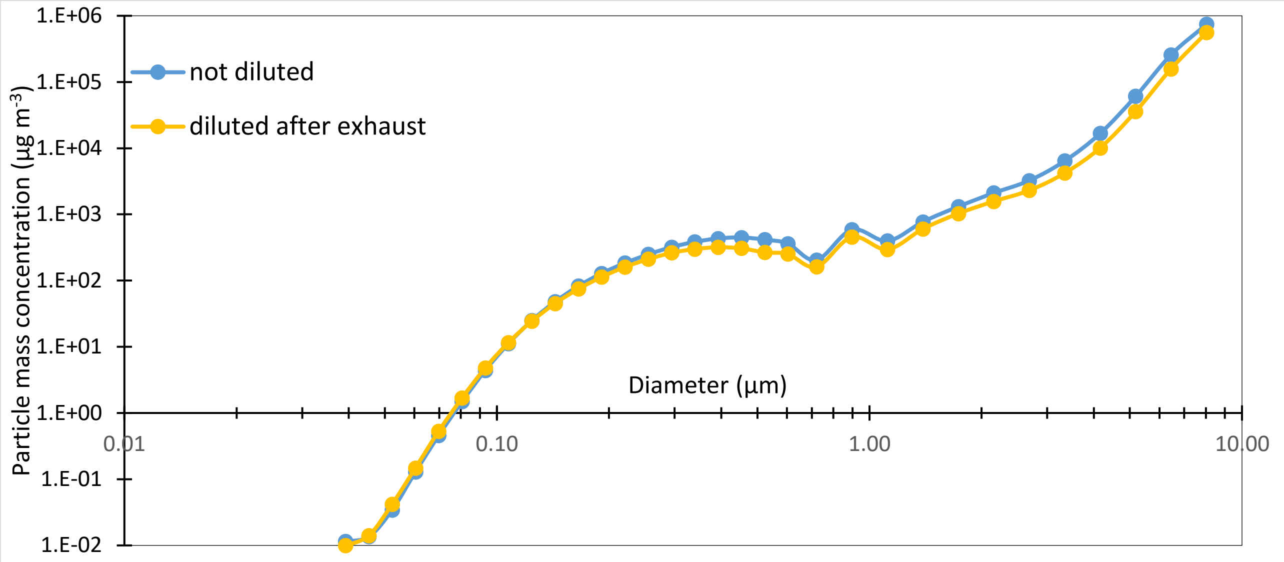

Figure 1: Comparison between mass size distributions measured by SMPS and OPS. The MISG was fuelled with 7 lpm of air and 127 mlpm of ethylene.

In the revised text, we added:

Line 309: ethylene combustion produced a limited number of big particles, likely super-aggregates, probably formed at the stagnation plane (Chakrabarty et al., 2012). This hypothesis was confirmed by dedicated experiments with the setup specifically modified in respect to the basic one (see Supplementary Fig. S.2).