

Review of amt-2020-482

Anonymous Referee #2

Referee comment on "Detection of ship plumes from residual fuel operation in emission control areas using single-particle mass spectrometry" by Johannes Passig et al., Atmos. Meas. Tech. Discuss., <https://doi.org/10.5194/amt-2020-482-RC2>, 2021

Review of Passig et al., Detection of ship plumes from residual fuel operation in emission control areas using single-particle mass spectrometry

This manuscript describes single particle composition measurements that identify ship exhaust using iron and vanadium in such particles. It is a nice study, and I don't think the authors would be surprised for me to say it is not earth-shattering news. In particular, the Ault et al. papers (properly cited here) already show the use of vanadium to see ship exhaust in single particles. What is new is being a little further from the ships and more important, that a different laser wavelength resonantly ionizes iron, making its signals large enough to be paired with the vanadium as a tracer.

I think this manuscript has a place but probably should be much shorter. It is always hard, especially for young authors, to leave out that nice bit of analysis you have done but that doesn't really contribute to the flow of the paper. There is a lot here that isn't on the rather more focused topic of "this is what we can do that isn't in previous papers". The descriptions of the background particles and their behavior in 3.1, 3.2, and 3.3 are much too long. The discussion of hygroscopicity isn't required – it isn't part of the tracking of ship exhaust. Further, some of the material actually detracts. Here are two examples: (1) I was questioning how much of the diurnal behavior (near line 235) is due to boundary layer influence. Then I realized that a paper about V and Fe in ship exhaust doesn't really need to discuss diurnal variation of OC-EC particles. (2) There are many other reasons than water that negative ions might appear (near line 155) and was about to write some review comments on this, but since V and Fe are only in the positive ion spectra the manuscript would be better off just not discussing negative ion spectra at all. These are just two examples.

Overall, I would suggest aiming for a manuscript about half as long rather than cutting a few sentences here and there.

Some technical points:

1) Figure 4 is a good use of ART-2a. Too often, people just use ART-2a cluster as simple quantitative tracers, something they are actually not that well suited for. I like the way the manuscript manually combines and separates the Fe-V clusters to see different behavior.

2) The manuscript could use some suggestions for a non-cluster algorithm of tracking ship exhaust. Something along the lines of "If Fe greater than x, V greater than y, some other ion less than z" you have a pretty good idea a particle is ship exhaust. Other researchers are not going to be able to duplicate your ART-2a categories.

3) Line 61 the mixing contrast between particles and gases is confused. In turbulent mixing and wind-driven transport particles and gases are carried together. Particles may be easier to measure at large distances because the compositions are more unique than a generic gas-phase tracer like carbon monoxide, not because gases "rapidly mix". The particles rapidly mix, too.

4) If feasible consider putting the zones with special fuel requirements overlaid on Figure 1.

5) Near line 184 I disagree that V⁺ and VO⁺ are obscured by organics – that is possibly but not at all usual.

6) Near line 190 and Figure 21. If the mean aerodynamic diameters for all of the accumulation mode particle classes are above 500 nm then either you don't have efficient optical detection down to 150 nm or your aerodynamic lens is not working well for smaller particles. The concentrator alone doesn't explain that.

7) Near line 314. It is better to delete the speculation about sulfate-driven dissolution if you can't measure it.