Comments on the "Comprehensive organic emission profiles for gasoline, diesel, and gas-turbine engines including intermediate and semi-volatile organic compound emissions" by Quanyang Lu et al.

General comments:

The paper compiled a comprehensive model-ready organic emission profiles covering four important mobile sources: on-road and off-road gasoline, gasoline-turbine, and diesel engines. Mass fractions of VOCs (volatile organic compound), IVOCs (intermediate-volatile organic compounds) and SVOCs (semi-volatile organic compounds) were determined and analyzed systematically. This work pointed out that proportions of IVOCs and SVOCs are relatively consistent with the fuel type. The fractions of IVOCs for diesel engines can be as high as 51.3% in the total organic mass. This work demonstrated the importance of quantifying the mass of IVOCs and SVOCs using the "correct" techniques in atmospheric models for SOA prediction, which provides important insights for modelers, inventory development and profile measurement.

The whole manuscript is well organized and clearly written. Data, figures and tables can generally support the argument. The main concern is on the unclear illustration of the phase state for the total organic matter, i.e., which part of the SVOCs and IVOCs are emitted at the condensed phase and can be classified as POA, and other parts as NMOG at a typical atmospheric condition? A linkage between the VBS volatility bins and the phase state in real world should be set up. Since the SPECIATE profiles (#4674 and #5565, #8750) were measured only for mass distributions of the gases, comparing these profiles with the "organic emission" profiles are not reasonable. Technically, the author is suggested to use the conjunction words more carefully to logically organize the sentences.

I recommend the manuscript to be revised considering the following comments.

Specific comments:

Abstract:

1. Line 18-19: Relatively large variances of the mass fractions for SVOCs are found for the diesel engines (3.1%-17.7%), even using the same fuel type, which means that the end-of-pipe control at least for the diesel engines can effect the mass distribution and cannot be neglected. The sentence of "this suggests that a single profile can be used to represent the emissions from sources operating on the same fuel" is not rigorous and cannot be supported by the main text. Please verify the sentence or specify the conditions.

Introduction:

2. Page 2: The abbreviations of IVOC, SVOC and LVOC should be explained when they appear in the main text for the first time. Please add them.

Methods:

3. Since there are several procedures in compilation of the profiles, mapping organics into the VBS, SOA evaluation and also technical details in this section, a diagram illustrating the whole processes would be useful to outline the method more clearly.
4. Page 3, line 14: You mentioned that "slightly different procedures were used to characterize VOC emissions" confuse me. Can you specify it more clearly? One summary sentence to describe the differences and how much effect on the VOC emissions will help the readers to follow.
5. Page 4, line 31: As my understanding, the SAPRC mechanism or the CB mechanism are only applied for the gas-phase VOC reactions in atmospheric models. For the organic emissions in the particle phase, they are treated as OM/POA. Please clarify the statement.
6. Page 5, line 10: Is C^* varying with the temperature? The calculated C^* in this paper is for T=298K? With the dilution of the vehicle exhaust, the temperature is supposed to decrease gradually to the ambient temperature, to what degree will the C^* change during this process? Can you add some illustrations on the variations of C^* and phase state of the organic compound with temperature, maybe in the supplement?
7. Page 5, line 15: "represents" should be "represent".
8. Page 5, line 27: Please add one or two summary sentences describing the comparison results and conclusions for Figure S1 (a-c).
9. Page 5, line 11: Please explain the abbreviation of "LDGV" when it first appears.

Results and discussion:

10. Page 7, line 9: Could you provide a table listing the calculated SOA mass yields for IVOCs in the supplement?
11. Page 7, line 24: You mentioned that there is also substantial breakthrough of SVOCs from the quartz filter indicated from Figure 1. I may miss some important features in Figure 1. Can you explain more on this "breakthrough" based on Figure 1?
12. Page 9, line 3: The author is suggested to be more careful to use the conjunction words. Since you don't discuss about the phase state for SVOCs or the partition status between gas phase and particle phase for SVOCs in the context, the statement of "the peak in this low-volatility mode is in the middle of the SVOC range" cannot support the following conclusion of "some of the organics are in the particle phase and some of them in the gas phase". More discussions on the partition between gas-

particle phases for IVOCs/SVOCs are needed.

13. Page 9, line 14: Aromatics is also important for this mode, especially for diesel engines.
14. Page 10, line 13: As my understanding, the traditional profiles are only for the gas-phase VOCs, which were measured using Tedlarbag / canister followed by GC-MS for hydrocarbons, and 2,4-DNPH followed by HPLC for carbonyls. OC is measured and corresponding emissions is assigned in the particle phase. It is not reasonable to compare the mass distributions between "total organic emission" and "gas-phase VOC". Only gas-phase emissions should be included in the comparison, or OC should be also included in the traditional profile to represent the total organic emissions.
15. Page 13, line 2: The individual organics can vary by location and season. Do the organic profiles developed in this work also vary with location, measuring technique, ambient temperature, etc.? In other words, what's the limitation of the developed organic emission profiles when implemented in atmospheric models? Can you add some discussion on limitation in Sect. 5 or in a new section?
16. Page 13, line 10: Based on your statement, the effective SOA yields can vary significantly among different studies. Can you provide a comparative table of the SOA yields derived from the various studies included in this paper in the supplement?
17. Page 14, line 5: Considering the high fraction (as high as 40%-50%) of evaporation for POA even at typical atmospheric conditions, how do you define the phase state for the whole volatility range (C^*) in your study?

Figures and tables:

18. Figure 1: Can you specify the phase state for each saturation concentration bin at typical atmospheric condition?
19. Figure 3: As illustrated above, comparing the total organic emissions profile (this work) with the gas-phase VOC emission profile (SPECIATE) is not reasonable. Please revise the figure.