Referee's Comment in Italic Font; Author's response in Blue without Italic Font.

(1) Lines 24-26, page 31154. Information on the total concentration of aromatic hydrocarbons with more than three methyl groups would be necessary.

Ambient concentrations of aromatics with more than three methyl groups is scarce. Nevertheless, aromatic hydrocarbons with more than three methyl groups contributes to a large portion of components in products such as gasoline and crude oil (Diehl, et al., 2005; Darouich, et al., 2006). Therefore, we will insert "Aromatic hydrocarbons with more than three methyl groups contributes to a large portion of components in products such as gasoline and crude oil (Diehl, et al., 2005; Darouich, et al., 2006). Therefore, we will insert "Aromatic hydrocarbons with more than three methyl groups contributes to a large portion of components in products such as gasoline and crude oil (Diehl, et al., 2005; Darouich, et al., 2006)" at Lines 26, page 31154 before "Moreover"

(2) Lines 12-14, page 31155. What is the definition of "methyl group branching ratio"? The terminology, "branching ratio", is often used for product branching ratio and would make readers confused.

Good point. We will replace "methyl group branching ratio" with "the increase of branched structure".

(3) Lines 17-18, page 31155. The expression, "aliphatic hydrocarbons", should be substituted with "alkane and alkene hydrocarbons" because Sato et al. (2011) reported that the SOA yield from aliphatic dinene compounds are found to decrease with increasing the number of methyl side chains.
Agreed. We will replace "aliphatic hydrocarbons" with "alkane and alkene hydrocarbons".

(4) Line 27, page 31158 – line 1, page 31159. The authors discuss on the results of product volatility parameter based on gas-particle partitioning model; however the authors conclude in the latter part of manuscript that particle-phase oligomerization plays important roles during SOA formation. Particle-phase oligomerization is not taken into account for the gas-partitioning model. Trump and Donahue (2014) reported that formation of oligomer-containing SOA particles can be interpreted by gas-particle partitioning model only if oligomer formation is reversible; however, present experimental results do not contain any evidences showing that oligomer formation is reversible. The product volatility parameters obtained by present fitting would not have physical meaning which is defined by the gas-particle partitioning model.

True. We will change the sentence "The more volatile parameters (K_{omr} ₂) are similar for all yield curve fits, suggesting that compounds of similar gas-particle partitioning parameters are formed from the photooxidation of all aromatic hydrocarbons studied." to "The higher higher-volatility partitioning parameter (Kom,2) in all yield curve fitting are assigned to a fixed value by assuming similar high volatile compounds are formed during all aromatic hydrocarbon photooxidation experiments."

Further, per the Trump and Donahue (2014) reference, it is suggested in that paper that reversible oligomerization is required to obtain low aerosol yields at low mass loadings consistent with the aerosol yields observed in this paper.

(5) Line 21, page 31159. Does "the methyl group number effect" mentioned here indicate the effect of methyl group number on SOA yield?

Yes. We will make the following change is suggested to improve clarity. We will change "that the methyl group number effect is greater than the effect of increasing k_{OH} " into "the effect of methyl group number on SOA yield is greater than that of the increasing k_{OH} on SOA yield, which is related to aromatic hydrocarbon oxidation process."

(6) Line 6, page 31161. The readers who do not belong to AMS community might not be familiar to "the AMS frag Table of Unit Resolution Analysis."

It is possible that reader is not familiar with AMS frag Table of Unit Resolution Analysis. Therefore, we will insert "which describes the mathematical formulation of the apportionment at each unit resolution sticks to aerosol species" after "the AMS frag Table of Unit Resolution Analysis".

(7) Lines 17-21, page 31170. As described in comment (6), product volatility parameters should carefully be interpreted when particle-phase oligomerizations play important roles during SOA formation.

Thanks for the suggestion. In this study, we are not sure about the reversibility of the oligomerization that occurs during the photooxidation of aromatic hydrocarbons. However, a reversible oligomerization process is suggested by Trump and Donahue, 2014. We will insert "especially at higher particle mass loadings" after line 19 "than oligomerization products (S_2)". We will also insert "by assuming the oligomerization process may be a reversible process (Trump and Donahue, 2014)" at the end of this sentence (Line 21) to make the discussion part more reasonable.

(8) Lines 2-7, page 31171. The authors describe that methyl groups inhibit oligomerization; however, ketones could proceed to aldol condensation and hemiacetal formation

(Jang et al., 2002). For readers' understanding, further explanations would be necessary.

It is a good point. Additional discussion is added in the manuscript. We will insert the following sentence after "when methyl groups are attached to both ends of an unsaturated dicarbonyl" at line 7 page 31171: "Oligomerization is possible for these ketones through reactions such as aldol condensation and hemiacetal formation (Jang et al., 2002) under acidic conditions. However, this is less favored for the current study in the absence of acidic seeds."

(9) Page 31189, Fig. 1. The curves of tetramethylbenzene and C10+ are extrapolated beyond the region of experimental data points. Extrapolated curves should be deleted. We agree and the extrapolation is deleted (New Figure 1 uploaded).

(10) The caption of Table S1. What kind of approximation method was used for the prediction of the pentamethylbenzene vapor pressure?

Good catch. Actually, the value "3.48e-2" is an experimental data for pentamethylbenzene vapor pressure at 20 degree C, which can be found in the Chemspider line below <u>http://www.chemspider.com/Chemical-Structure.12259.html?rid=925ba290-a294-41e2-b8c5-346c0d3124f1</u>. The vapor pressure listed in our paper is from the same vapor pressure source as other aromatic hydrocarbons, which is thereby comparable. However, "*" should be noted as

"Experimental vapor pressure measured at 20°C, An estimated vapor pressure at 25°C is 3.56e-2 according to Chemispider" instead of "*Predicted data from Chemispider".

(11) Table S2. HC/NO ratio data would be incorrect. For example, HC concentration in experiment 104A is 2,800 ppbC (= 350 (ppb) x 8 (C atmos)) and NO concentration is 64.4 ppb; therefore HC/NO ratio should be 43.5 ppbC/ppb (=2,800/64.4).
Good catch. HC concentration listed in Table S2 is in a unit of (ug/m3). Correction is made to these values.

Technical comments:

(12) Line 7, page 31158. "Table 2" should be "Table 2S". Good point. Corrected. Table 2 to Table S2.

(13) Line 27, page 31158. The expression, "the more volatile parameters (Kom, 2)", should be substituted with "higher-volatility partitioning parameter (Kom,2)" for readers' understanding.

Agree. Changed all into "higher-volatility partitioning parameter (K_{om,2})".

(14) Line 24, page 31166. "H2O" should be "H2O+" Fixed.

(15) Line 19, page 31170. "Oligomerization products (S2)" should be "oligomerization products (S3)". Fixed.