

## Secondary Organic Aerosol Production from Local Emissions Dominates the Organic Aerosol Budget over Seoul, South Korea, during KORUS-AQ

This paper presents airborne observations of organic aerosol (OA) made over and near Seoul, Korea and investigates the local urban contribution to the formation of secondary organic aerosol (SOA). The upwind transport of OA and SOA precursors coming into the Seoul region from China are evaluated to isolate the impact of transport versus local emissions and SOA production. The formation of SOA was determined to be mostly locally produced through evaluation using FLEXPART source analysis and factor analysis of OA and their correlation with other short-lived photochemically produced species. In addition, results using an OFR indicated greater potential SOA formation in air sampled over Seoul compared with air sampled upwind. Box model calculations reproduced SOA within 15% and showed that short-lived aromatic hydrocarbons are the main SOA precursors.

This is a relevant paper for ACP and would be of interest to ACP readers. The paper is very comprehensive, well written with clear study objectives, logically presented and articulated conclusions.

I recommend acceptance to ACP after addressing some minor comments:

L184: not sure what is meant by 'also' encountered? In addition to what? Same thing with 'also in the next line.

L192: highly customized, high-resolution time-of-flight mass spectrometer?? What is customized as it seems pretty standard.

L211: Are there any particle losses through the pressure controlled inlet, and if so, how were they accounted for?

L230: ensure quality control.....this oversimplifies the need for particle filter measurements. Suggest a brief explanation.

L240: should state range of CE determined

L245: Was the contribution from organic nitrates estimated in this study (and stated anywhere)?

L249: What was scaled? The detection limits? Why were they scaled?

L252-257: Should provide brief context behind these statements ie. 24 hour power was not available and the AMS needed to be restarted each day (flight) etc. Otherwise confusing.

L257: Why reference another paper for the accuracy of your measurements? What are the estimated uncertainties related to subtracting an appropriate background (chopper closed) when sampling in/out of plume. How wide are the regional plumes? More than 1 minute? How does this affect the accuracies?

L323-325: I presume the pNO<sub>3</sub> and OA measurements are also affected for those data taken not from the OFR?

L611-612: Awkward wording

L621-622: maximum Chinese outflow stated at 40 ug/m<sup>3</sup>/ppmv, but this is only based on one flight....? I would think there could be substantial variation in this.

L611-616: The results do seem to depend on assumed CO background. This is apparent in Fig S34 where  $\Delta\text{OA}/\Delta\text{CO}$  is different with different CO backgrounds especially in more aged air masses. What I think the authors mean is that there is still significant and rapid SOA formation greater than many megacities compared in the Figure, and therefore doesn't change the interpretation of this comparison. Also in SI Fig 35, confused about what is being shown here – I presume this is for the Seoul data, but it's also not clear what CO background is being used here because the text in the paragraph indicates a CO background of 140ppbv, but the Figure 4 captions indicates for the Seoul data a background CO=200ppbv was applied (140ppb was for the WS).

L606-607: Seems to me that SOA formation is actually much higher than LA and Mexico City, rather than similar to.

L623: Do you mean finding SOA greater than POA concentrations....? And confused as to where this is shown in Figure 4 with the current data set?

Fig 7g,h: Fig is discussed, but it is interesting why in the more polluted air masses over the West Sea, the CH<sub>2</sub>O and PAN ratios to CO are lower and constant compared to the West Sea clean.

Supplemental, L57: What is meant by 'built-in' DMA?

Supplemental, L65: Do you mean mobility diameter as identified on L57?

Supplemental, L72: Was the organic NO<sub>3</sub> contribution determined? Didn't see this in the main text

Supplemental, Fig 2: Figure indicates  $\tau$  of 3-5 sec and text indicates 8s...? I'd like to see the figure caption explain the ambient closed data in that there is a line connecting the 6s of data and the ambient open-closed are corrected through an interpolated background.

Supplemental, SI Fig 37: Light pink and dark pink squares look almost identical; please change colour of one. Not sure where the light red crosses are shown for the binned values.

Typos:

L102: should be 'suggest to be major' ie. Remove 'a'

L155: should be instruments not instrument

L177: the wind 'was' instead of 'is'

L251: periodic not period

Fig 10: olefins, not olefines

L933: units needed

L207: ram should be RAM as it is an acronym

Fig 10(b): lighter color, not lighter colored