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*Supplement of*

# Formation of secondary organic aerosol in the Paris pollution plume and its impact on surrounding regions

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**Table S1 Bias (relative bias) for comparison of maximum and 30th percentile (P30) modeled and measured pollutant concentrations from VBS-LNOX (and VBS-HNOX for OA as well) and VBS-LA**

| Pollutant | Statistics | VBS-LNOX | | | VBS-LA | | |
|---|---|---|---|---|---|---|---|
| | | 16th | 21st | 29th | 16th | 21st | 29th |
| $NO_x$ (ppb) | Max. | -4.3 (-32%) | -5.2 (-65%) | -7.3 (-60%) | -7.3 (-54%) | -5.7 (-72%) | -8.7 (-71%) |
| | P30 | -0.64 (-58%) | -0.42 (-41%) | -0.59 (-52%) | -0.57 (-51%) | -0.36 (-35%) | -0.51 (-45%) |
| BC ($\mu g\ m^{-3}$) | Max. | -0.7 (-35%) | -1.5 (-74%) | -1.6 (-70%) | 0.4 (21%) | -1.2 (-62%) | -1.2 (-53%) |
| | P30 | -0.17 (-51%) | -0.31 (-62%) | -0.22 (-59%) | -0.22 (-67%) | -0.34 (-69%) | -0.27 (-71%) |
| $O_3$ (ppb) | Max. | 7.5 (12%) | 4.3 (5%) | 8.3 (13%) | 12.9 (21%) | 4.3 (5%) | 9.8 (16%) |
| | P30 | 4.3 (9%) | 11.3 (20%) | 3.0 (6%) | 4.6 (9%) | 11.7 (20%) | 3.3 (7%) |
| $O_x$ (ppb) | Max. | 8.5 (13%) | 3.6 (4%) | 8.0 (13%) | 13.1 (21%) | 3.5 (4%) | 9.2 (14%) |
| | P30 | 3.0 (6%) | 11.0 (19%) | 1.8 (4%) | 3.4 (7%) | 11.4 (19%) | 2.1 (4%) |
| OA ($\mu g\ m^{-3}$) | Max. | 1.7 (28%) | 0.4 (3%) | 1.5 (21%) | 1.0 (17%) | -9.2 (-75%) | -3.2 (-44%) |
| | P30 | -1.6 (-41%) | 2.3 (36%) | -1.0 (-25%) | -3.1 (-79%) | -4.9 (-76%) | -3.2 (-78%) |
| OA* ($\mu g\ m^{-3}$) | Max. | -0.5 (-8%) | -1.0 (-8%) | -0.5 (-7%) | | | |
| | P30 | -1.9 (-50%) | 1.9 (29%) | -1.4 (-33%) | | | |

OA*: OA from VBS-HNOX simulations

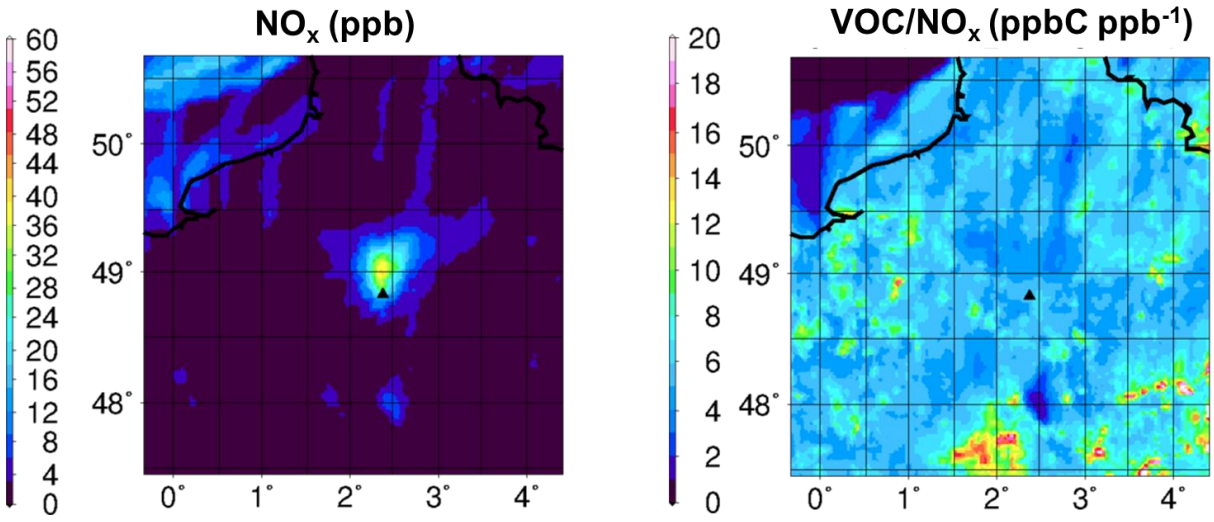


Fig. S1.Modeled $NO_x$ (left) and VOC/$NO_x$ (right) from VBS-HNOX at 10h on 16th, which shows a high-$NO_x$ condition (VOC/$NO_x$~3 ppbC $ppb^{-1}$, Lane et al., 2008) inside the Paris pollution plume (represented by $NO_x$) close to Paris represented by a triangle.

References:

Lane, T. E., Donahue, N. M., and Pandis, S. N.: Effect of $NO_x$ on secondary organic aerosol concentrations, Environ. Sci. Technol., 42, 6022–6027, 2008.

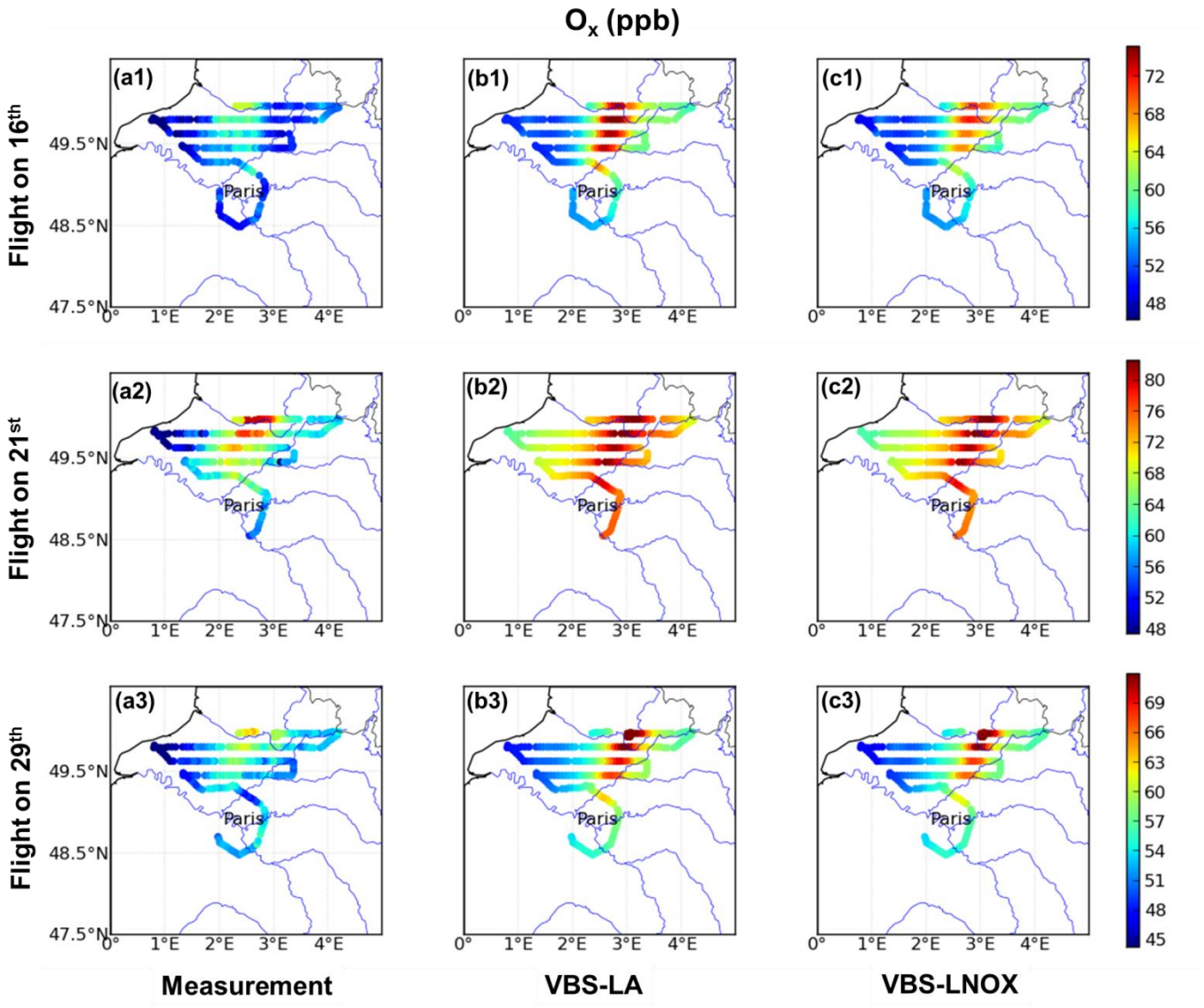


Fig. S2. Comparison of measured (a1-3) and modeled $O_x$ from VBS-LA (b1-3) and VBS-LNOX (c1-3) during the flights on 16th, 21st and 29th, respectively.

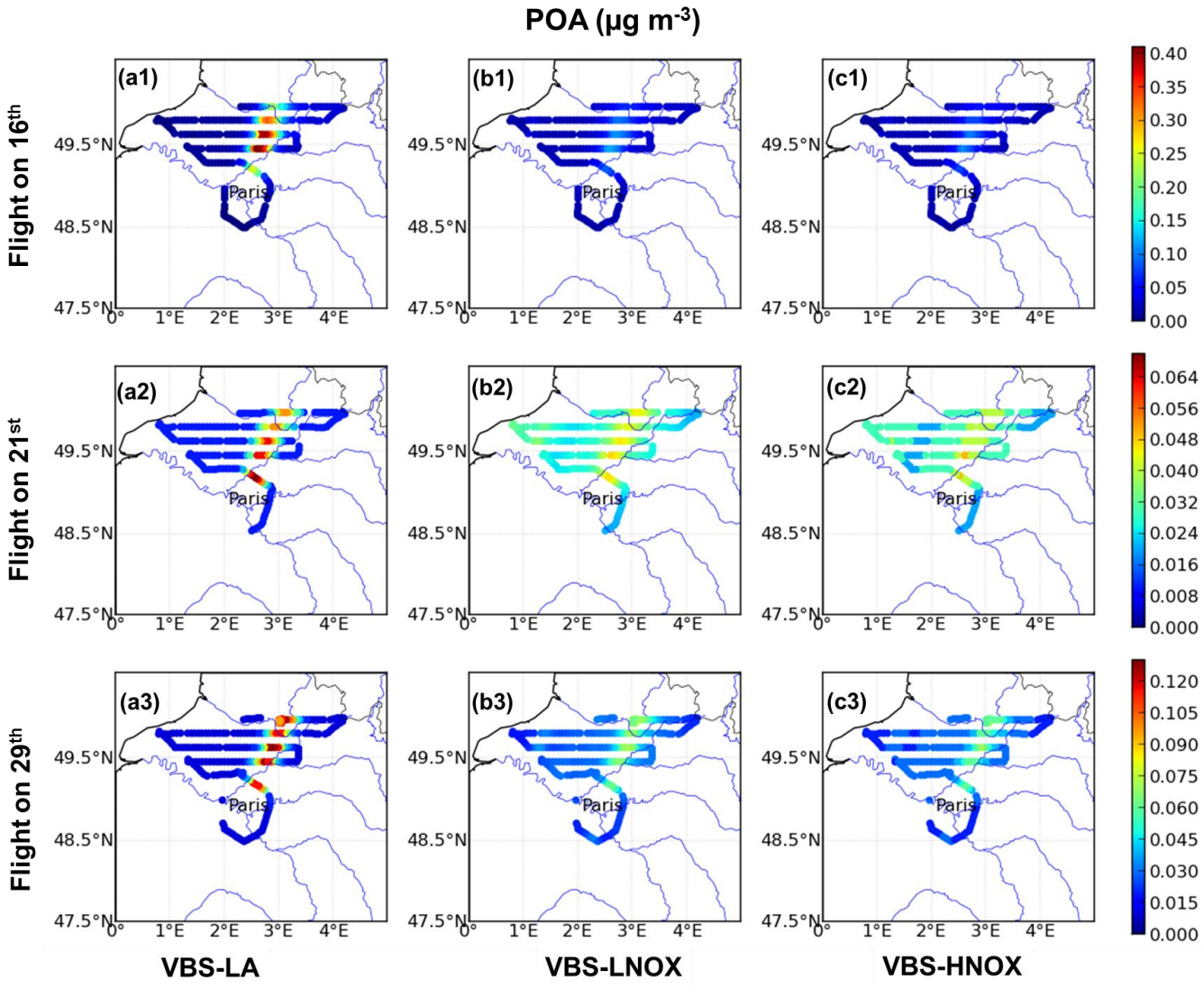


Fig. S3. Comparison of modeled POA from VBS-LA (a1-3), VBS-LNOX (b1-3) and VBS-HNOX (c1-3) during the flights on 16th, 21st and 29th, respectively.

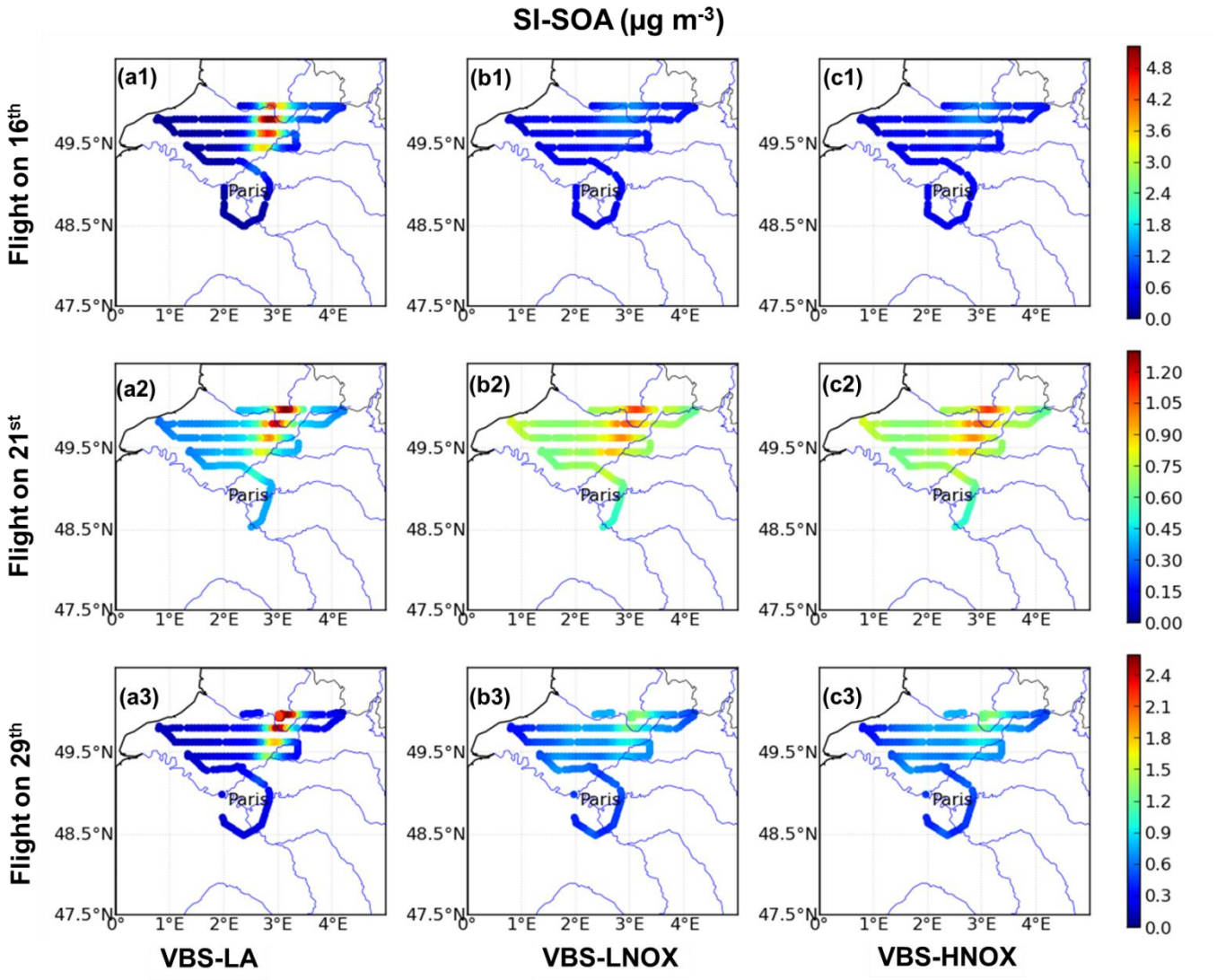


Fig. S4. Comparison of modeled SI-SOA from VBS-LA (a1-3), VBS-LNOX (b1-3) and VBS-HNOX (c1-3) during the flights on 16$^{th}$, 21$^{st}$ and 29$^{th}$, respectively.

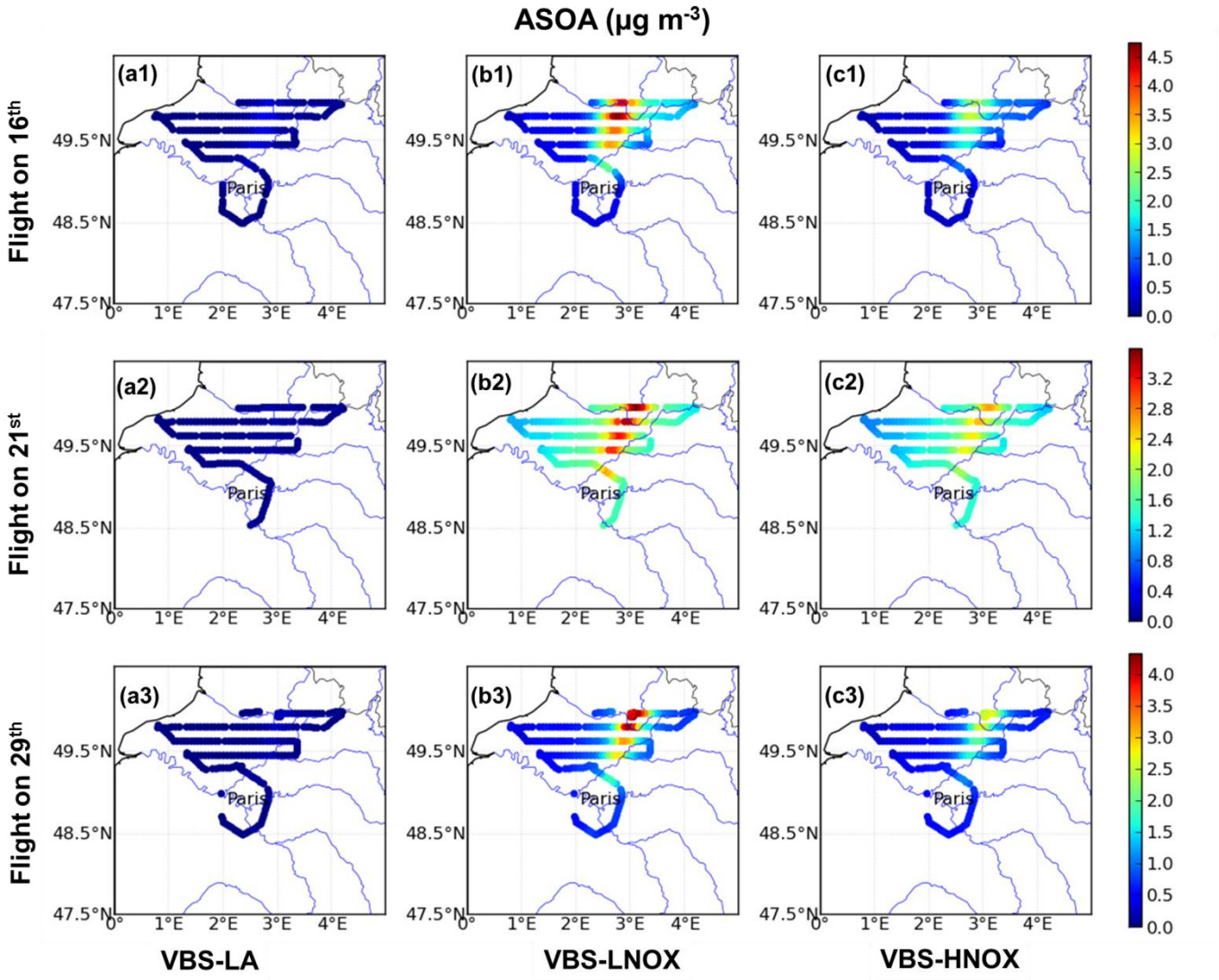


Fig. S5. Comparison of modeled ASOA from VBS-LA (a1-3), VBS-LNOX (b1-3) and VBS-HNOX (c1-3) during the flights on 16th, 21st and 29th, respectively.

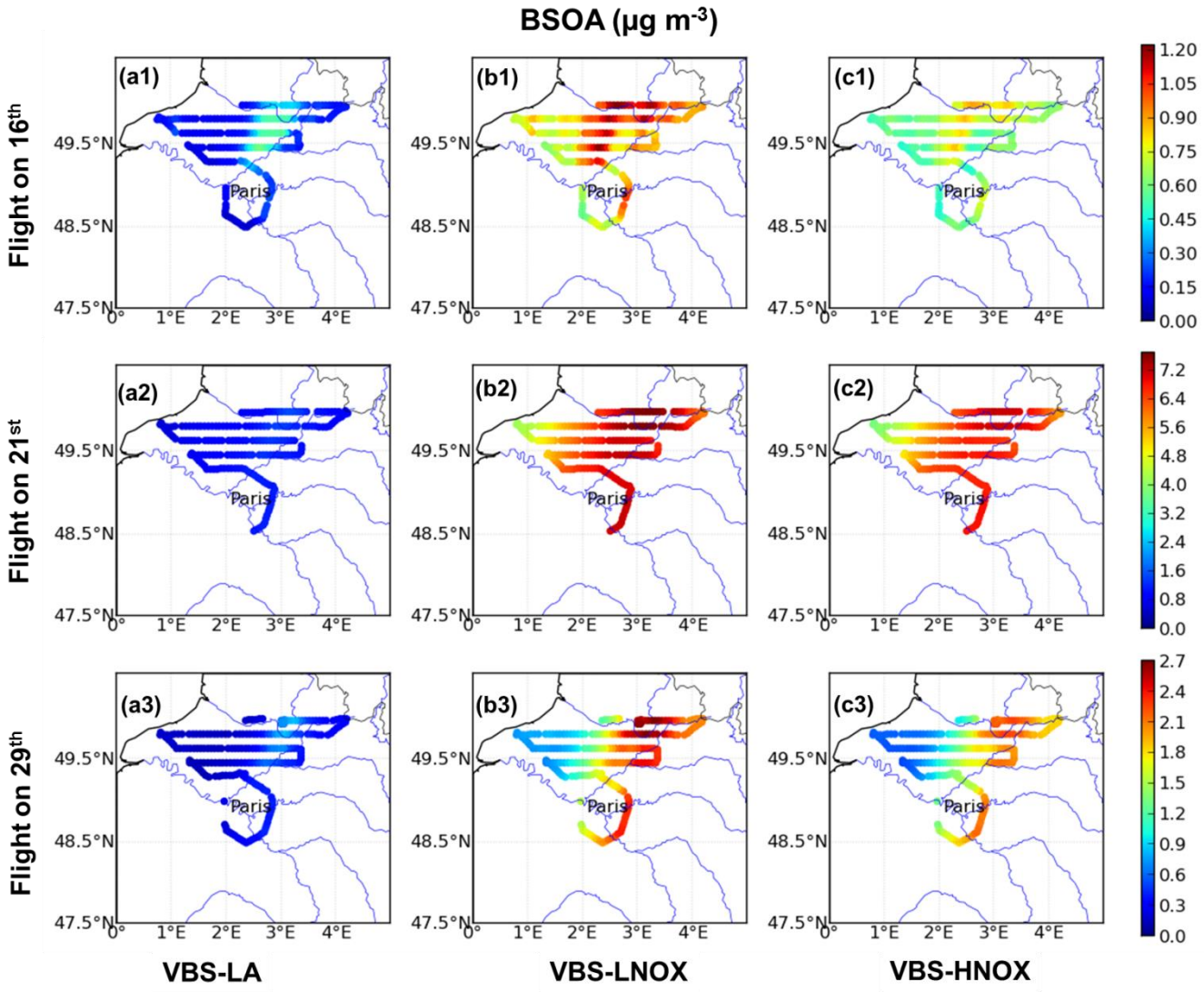


Fig. S6. Comparison of modeled BSOA from VBS-LA (a1-3), VBS-LNOX (b1-3) and VBS-HNOX (c1-3) during the flights on 16th, 21st and 29th, respectively.

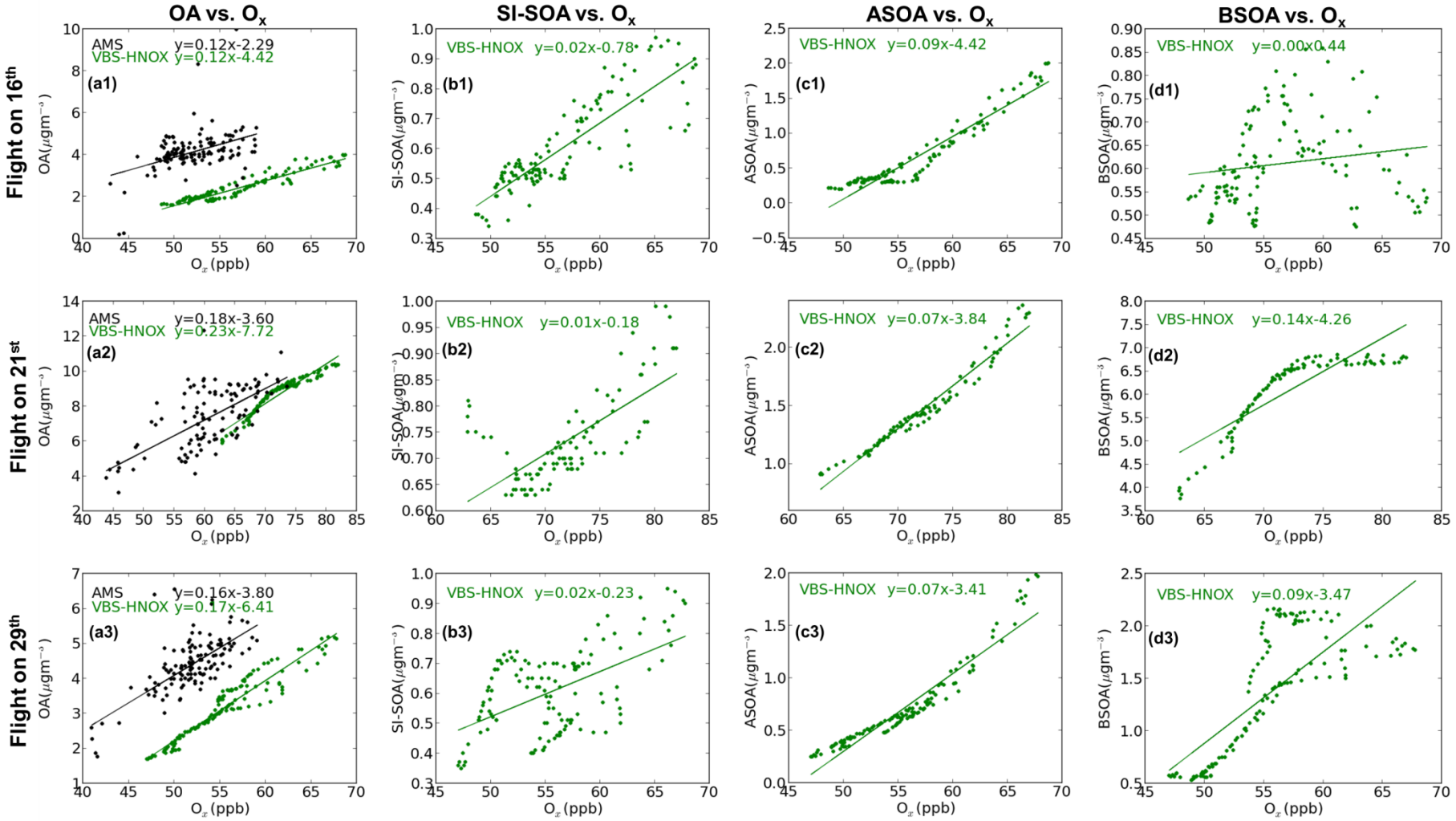


Fig. S7. OA vs. $O_x$ (a1-3), SI-SOA vs. $O_x$ (b1-3), ASOA vs. $O_x$ (c1-3) and BSOA (d1-3) vs. $O_x$ during the first two flight legs on 16$^{th}$, 21$^{st}$ and 29$^{th}$, respectively. For OA vs. $O_x$ (a, b, c), results from the measurement and VBS-HNOX are presented. For others, only results from VBS-HNOX are presented.

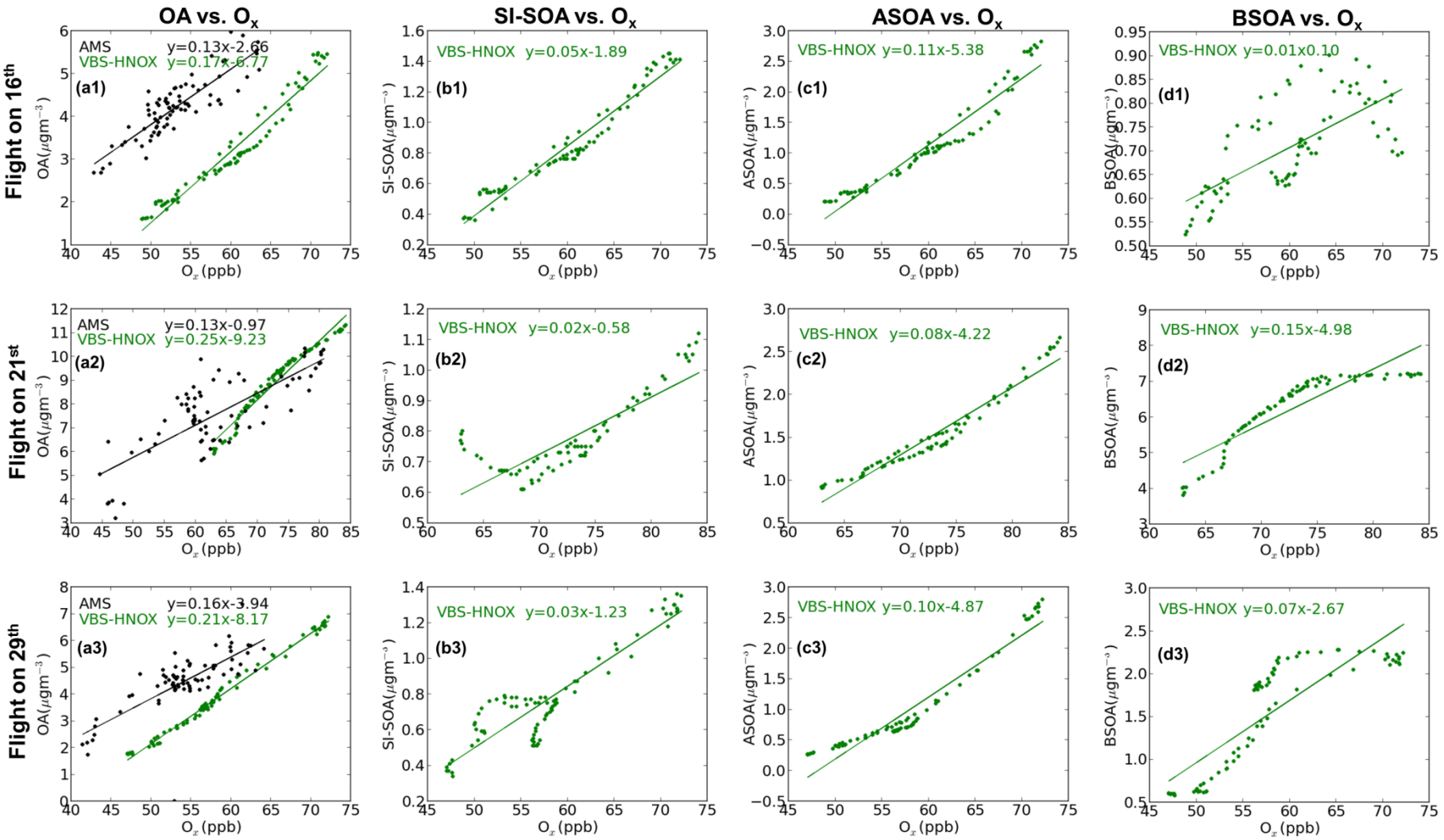


Fig. S8. OA vs. $O_x$ (a1-3), SI-SOA vs. $O_x$ (b1-3), ASOA vs. $O_x$ (c1-3) and BSOA (d1-3) vs. $O_x$ during the last two flight legs on 16$^{th}$, 21$^{st}$ and 29$^{th}$, respectively. For OA vs. $O_x$ (a, b, c), results from the measurement and VBS-HNOX are presented. For others, only results from VBS-HNOX are presented.

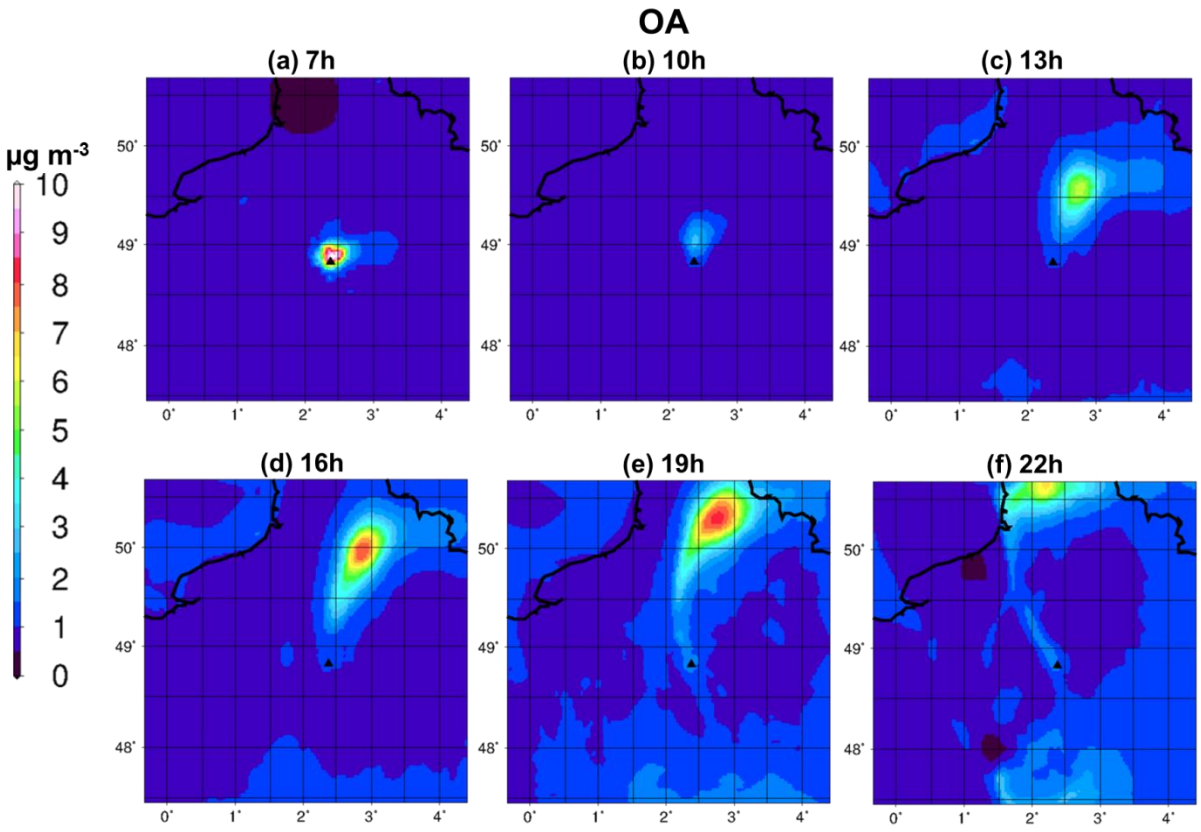


Fig. S9. Urban OA ($PM_{10}$ fraction) plume (µg $m^{-3}$) evolution on July 16$^{th}$ from VBS-LA, the triangle represents the location of Paris, illustrated by 6 panels (from a to f) corresponding to 7h (UTC +2) to 22h (UTC +2) with a time step of three hours.

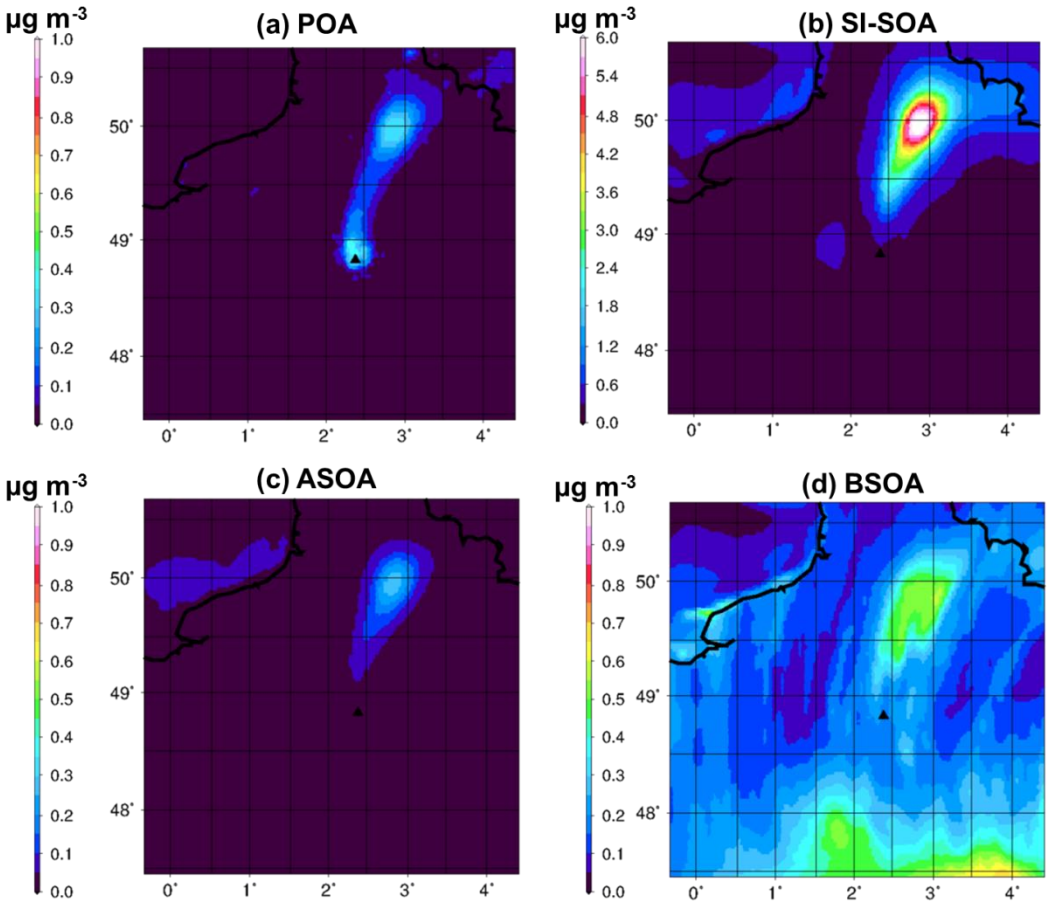


Fig. S10. Urban POA (a), SI-SOA (b), ASOA (c) and BSOA (d) (in $PM_{10}$) plume (µg $m^{-3}$) from VBS-LA at 16h (UTC +2) of July 16$^{th}$ , the triangle represents the location of Paris.

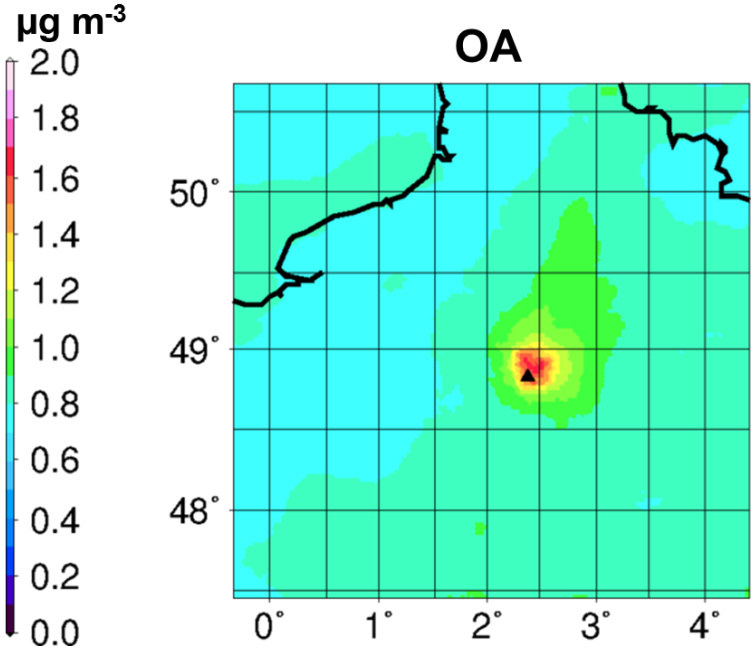


Fig. S11. Modeled monthly mean OA concentration in $PM_{10}$ (µg $m^{-3}$) from VBS-LA which represents the influence of Paris emissions on OA levels, the triangle represents the location of Paris.

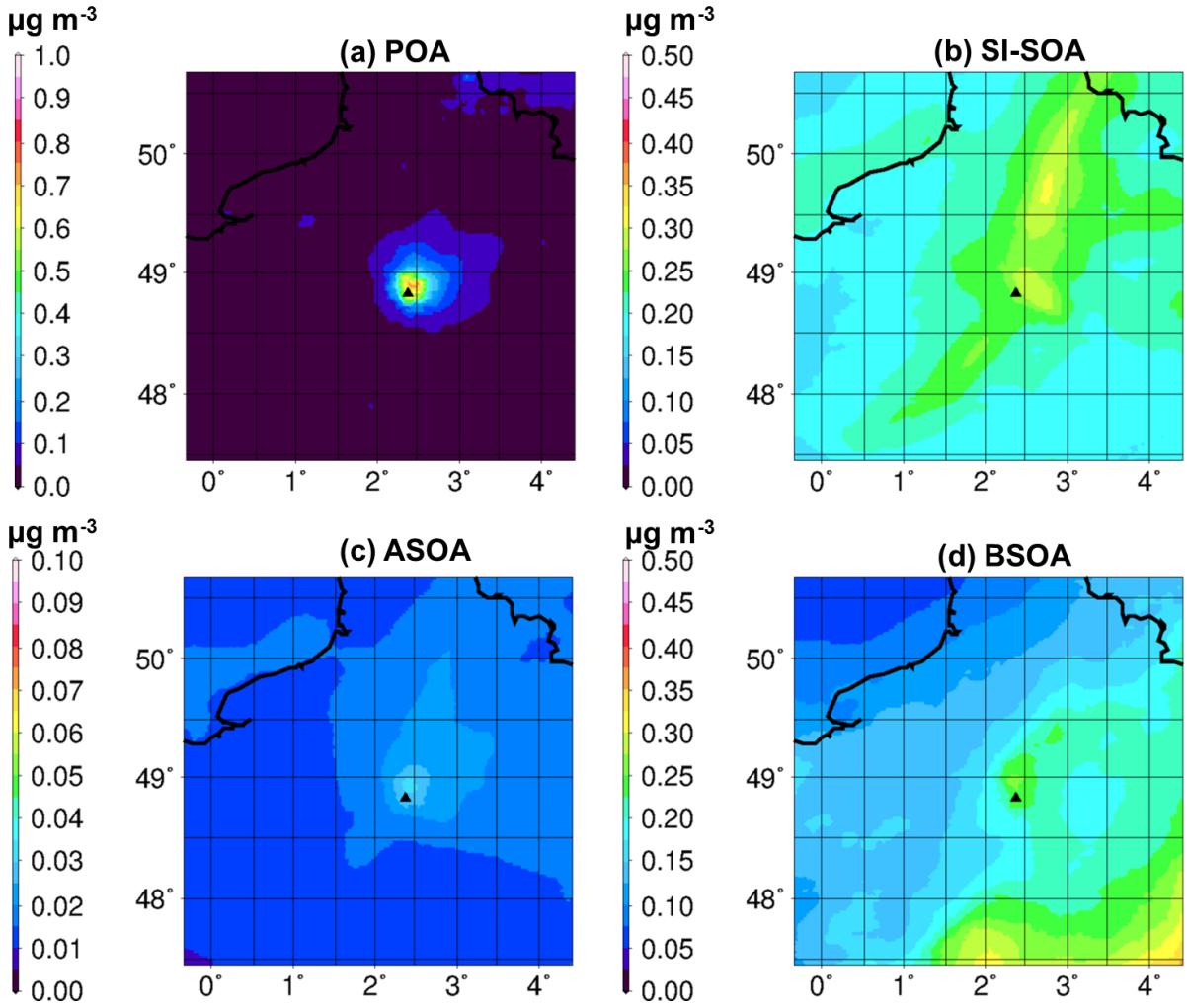


Fig. S12. Modeled monthly mean POA (a), SI-SOA (b), ASOA (c) and BSOA (d) concentration in $PM_{10}$ (μg $m^{-3}$) from VBS-LA which represents the influence of Paris emissions on OA levels, the triangle represents the location of Paris.