1 Supplementary Figure Legends:

2 **Figure S1** Location of 3 sampling villages selected in this study

3 **Figure S2** Stoves used in this study: a) Heated Kang b) Traditional coal stove c) Semi-gasifier stove

4 **Figure S3** Profiles of VOCs emitted from heating and cooking activities
Table S1 Solid fuel and stoves used in this study

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Table S3  Coefficient of divergence among VOCs profiles emitted from solid fuel burning

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<td>0.66</td>
<td>0.67</td>
<td>0.72</td>
<td>0.80</td>
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<td>0.67</td>
<td>0.72</td>
<td>0.80</td>
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<td>0.67</td>
<td>0.67</td>
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</table>

\[
\text{CD}_{jk} = \sqrt{\frac{1}{p} \sum_{i=1}^{p} \left( \frac{x_{ij} - x_{ik}}{x_{ij} + x_{ik}} \right)^2}
\]

where, \(x_{ij}\) represents the average concentration for a chemical component \(i\) at site \(j\), \(j\) and \(k\) represent two sampling sites, and \(p\) is the number of chemical components.
**Table S4** Industrial analysis results of solid fuel used in this study

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<tr>
<th>Fuel type</th>
<th>Moisture, %</th>
<th>Ash, %</th>
<th>Volatile Matters, VM%</th>
<th>Fixed Carbon, %</th>
<th>Calorific value, MJ·kg⁻¹</th>
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<tbody>
<tr>
<td>Firewood</td>
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<td>82.96</td>
<td>10.51</td>
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<td>79.66</td>
<td>13.25</td>
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<td>67.36</td>
<td>19.32</td>
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<td>7.98</td>
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*Proximate Analysis Was Conducted by the Analytical Center of Chinese Academy of Guangzhou Institute of Energy Conversion
### Table S5 Parameters in evaluation of O$_3$ contribution from solid fuel burning in Guanzhong Plain

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<th>Box model – Atmospheric capacity parameters</th>
<th>Emission rate of OFP</th>
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<tr>
<td>Dimensions</td>
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<tr>
<td>300km in length a</td>
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<tr>
<td>100 km In width a</td>
<td>Coal used</td>
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<td>516.2m in height b</td>
<td>2.50E9 kg f</td>
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<tr>
<td>Biomass fuels consumed</td>
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<tr>
<td>EFs of OFP</td>
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<td>EFs of OFP</td>
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<td>Heating periods</td>
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<tr>
<td>100 days i</td>
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<td>Atmospheric volume of Guanzhong Plain</td>
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<td>1.55E13 m$^3$ c</td>
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<td>O$_3$ concentration</td>
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<td>OFP emission rate</td>
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<td>4.46E5 kg e</td>
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<td>Total OFP emission rate</td>
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</tr>
<tr>
<td>8.72E4 kg·day$^{-1}$ k</td>
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</tr>
</tbody>
</table>

a Sun, Shen et al. (2017)
b [http://apps.ecmwf.int/datasets/data/interim-full-daily/levtype=sfc/boundary layer](http://apps.ecmwf.int/datasets/data/interim-full-daily/levtype=sfc/boundary layer)
c Expressed as volume = length * width * height
d [http://www.zhb.gov.cn/hjzl/dqhj/csqgzlzyb/], average O$_3$ concentration in winter of 2013
e Expressed as Atmospheric capacity = [O$_3$] * Atmospheric volume
f Shaanxi Province Statistical Yearbook 2013
g Average OFP value of biomass fuels heating burning in this study
h Account as bitumite only, use OFP of bitumite-SG in this study
i Sun, Shen et al. (2017)
j Expressed as OFP emission rate = Total fuels consumed * EFs of OFP / Heating period (unit: kg·day$^{-1}$)
k Expressed as Total OFP emission rate = OFP emission rate (biomass) + OFP emission rate (coal)
### Table S6 Parameters in evaluation of SOA contribution from solid fuel burning in Guanzhong Plain

<table>
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<th>Box model – Atmospheric capacity parameters</th>
<th>Emission rate of OFP</th>
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<td><strong>Dimensions</strong></td>
<td><strong>Biomass fuels consumed</strong></td>
</tr>
<tr>
<td>Atmospheric volume of Guanzhong Plain</td>
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<tr>
<td><strong>PM$_{2.5}$ concentration</strong></td>
<td>EFs of SOAP</td>
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<td><strong>SOA atmospheric capacity</strong></td>
<td>Heating periods</td>
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<td><strong>PM$_{2.5}$ concentration</strong></td>
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<tr>
<td><strong>SOA atmospheric capacity</strong></td>
<td>SOAP emission rate</td>
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<tr>
<td><strong>SOA atmospheric capacity</strong></td>
<td>Total OFP emission rate</td>
</tr>
</tbody>
</table>

| Dimensions | 300km in length | 100 km in width | 516.2m in height |
| PM$_{2.5}$ concentration | 142.6 μg·m$^{-3}$ | SOA fraction | 15.5% |
| SOA atmospheric capacity | 3.42E5 kg | Total OFP emission rate | 796.85 kg·day$^{-1}$ |

- a Sun et al., 2017
- b [http://apps.ecmwf.int/datasets/data/interim-full-daily/levtype=sfc/boundary_layer](http://apps.ecmwf.int/datasets/data/interim-full-daily/levtype=sfc/boundary_layer)
- c Expressed as volume = length * width * height
- e Huang et al. (2014)
- f Expressed as Atmospheric capacity = [PM$_{2.5}$] * Atmospheric volume
- g Shaanxi Province Statistical Yearbook 2013
- h Average SOAP value of biomass fuels heating burning in this study
- i Account as bitumite only, use SOAP of bitumite-SG in this study
- j Sun et al., 2017
- k Expressed as SOAP emission rate = Total fuels consumed * EFs of SOAP / Heating period (unit: kg·day$^{-1}$)
- m Expressed as Total SOAP emission rate = SOAP emission rate (biomass) + SOAP emission rate (coal)
Figure S2
Figure S3