

Supplement

High-resolution observation of stable carbon isotope ratios of water-soluble organic carbon in particle/gas phases at an urban site in China: Using an improved isotope ratio mass spectrometry method

Hao-Ran Yu, Yan-Lin Zhang\*, Fang Cao, Xiao-Ying Yang, Tian Xie, Yu-Xian Zhang, Yongwen

Xue

<sup>1</sup> School of Applied Meteorology, Nanjing University of Information Science & Technology, Nanjing 210044, China.

<sup>2</sup> Atmospheric Environment Center, Joint Laboratory for International Cooperation on Climate and Environmental Change, Ministry of Education (ILCEC), Nanjing University of Information Science & Technology, Nanjing 210044, China.

Table S1 Correlation analysis with other pollutants during study period

	PM <sub>2.5</sub> ( $\mu\text{g}/\text{m}^3$ )	O <sub>3</sub> ( $\mu\text{g}/\text{m}^3$ )	CO ( $\text{mg}/\text{m}^3$ )	NO <sub>2</sub> ( $\mu\text{g}/\text{m}^3$ )	NH <sub>3</sub> ( $\mu\text{g}/\text{m}^3$ )	PM <sub>10</sub> ( $\mu\text{g}/\text{m}^3$ )	WSOCp ( $\mu\text{g}/\text{m}^3$ )	WSOCg ( $\mu\text{g}/\text{m}^3$ )	fp- WSOC
$\delta^{13}\text{C}$ -WSOCp (‰)	-0.06	0.21**	-0.04	-0.24**	-0.26**	-0.05	0.13	-0.13*	0.21**
$\delta^{13}\text{C}$ -WSOCg (‰)	0.36**	-0.25**	0.32**	-0.23**	0.41**	0.37**	0.27**	0.20**	0.16*
Fractionation (‰)	-0.15*	0.16*	-0.24**	0.02	-0.45**	-0.16*	-0.13	-0.23**	-0.01
WSOCp ( $\mu\text{g}/\text{m}^3$ )	0.23**	-0.02	0.34**	-0.09	0.10	0.27**	1.00	0.44**	0.72**
WSOCg ( $\mu\text{g}/\text{m}^3$ )	0.20**	0.03	0.25**	-0.07	0.24**	0.24**	0.44**	1.00	0.29**
fp-WSOC	0.10	-0.06	0.17*	-0.05	-0.06	0.11	0.72**	-0.29**	1.00

Marked with \*\*: p<0.01; Marked with \*: p<0.05. Pollutants with no correlation were deleted.

Table S2 Correlation analysis with meteorological conditions during study period

	Temperature (°C)	Radiation (W/m <sup>2</sup> )	Relative humidity (%)	Air pressure (hPa)	Wind direction (°)	Wind speed (m/s)
$\delta^{13}\text{C}$ -WSOCp (‰)	0.15*	0.09	-0.09	0.08	-0.07	0.22**
$\delta^{13}\text{C}$ -WSOCg (‰)	-0.06	0.19**	0.32**	0.28*	-0.22**	0.23**
Fractionation (‰)	0.10	0.04	-0.17*	-0.18	-0.01	-0.02
WSOCp ( $\mu\text{g}/\text{m}^3$ )	-0.01	0.07	0.14*	0.00	-0.14	0.10
WSOCg ( $\mu\text{g}/\text{m}^3$ )	0.06	0.07	0.07	-0.23	0.12	0.02
fp-WSOC	-0.06	0.03	0.11	0.23	-0.24**	0.08

Marked with \*\*: p<0.01; Marked with \*: p<0.05. Meteorological conditions with no correlation were deleted.

17

Table S3 Correlation analysis with particulate components during study period

	Fluorine ( $\mu\text{g}/\text{m}^3$ )	Acetate ( $\mu\text{g}/\text{m}^3$ )	Chloride ( $\mu\text{g}/\text{m}^3$ )	Nitrite ( $\mu\text{g}/\text{m}^3$ )	Nitrate ( $\mu\text{g}/\text{m}^3$ )	Sulfate ( $\mu\text{g}/\text{m}^3$ )	Sodium ( $\mu\text{g}/\text{m}^3$ )	Ammonium ( $\mu\text{g}/\text{m}^3$ )	Potassium ( $\mu\text{g}/\text{m}^3$ )
$\delta^{13}\text{C}$ -WSOCp (‰)	0.11	-0.11	0.18*	-0.44**	-0.10	0.22*	0.23**	0.06	0.13
$\delta^{13}\text{C}$ -WSOCg (‰)	0.22**	-0.11	0.46**	-0.08	0.23**	0.37**	0.18*	0.33**	0.21*
WSOCp ( $\mu\text{g}/\text{m}^3$ )	0.09	0.21*	0.26**	0.25**	0.36**	0.26**	0.00	0.36**	0.22**
WSOCg ( $\mu\text{g}/\text{m}^3$ )	0.05	-0.03	0.04	0.27**	0.35**	0.23**	-0.08	0.37**	-0.00

Marked with \*\*:  $p < 0.01$ ; Marked with \*:  $p < 0.05$ . Particulate components with no correlation were deleted.

18

19

Table S4 Correlation analysis with gaseous acids during study period

	Gaseous hydrochloric acid ( $\mu\text{g}/\text{m}^3$ )	Gaseous nitrous acid ( $\mu\text{g}/\text{m}^3$ )	Gaseous oxalate ( $\mu\text{g}/\text{m}^3$ )
$\delta^{13}\text{C}$ -WSOCp (‰)	-0.14	-0.45**	-0.14
$\delta^{13}\text{C}$ -WSOCg (‰)	0.18*	0.20*	-0.17*
WSOCp ( $\mu\text{g}/\text{m}^3$ )	-0.01	0.19*	-0.06
WSOCg ( $\mu\text{g}/\text{m}^3$ )	0.19*	0.28**	-0.13

Marked with \*\*:  $p < 0.01$ ; Marked with \*:  $p < 0.05$ . Gaseous acids with no correlation were deleted.

20

21

Table S5 Correlation analysis with fp during study period

	fp-Acetate	fp-Nitrite	fp-Nitrate	fp-Sulfate	fp-Oxalate	fp-Ammonium
$\delta^{13}\text{C}$ -WSOCp (‰)	0.04	0.24**	0.09	0.00	0.03	0.20*
$\delta^{13}\text{C}$ -WSOCg (‰)	0.03	-0.44**	0.23**	0.19*	0.21*	0.03
WSOCp ( $\mu\text{g}/\text{m}^3$ )	0.22**	-0.12	0.20*	0.19*	0.16	0.28**
WSOCg ( $\mu\text{g}/\text{m}^3$ )	0.11	-0.16	0.27**	0.16	0.13	0.22**

Marked with \*\*:  $p < 0.01$ ; Marked with \*:  $p < 0.05$ . fp with no correlation was deleted.

22

23

Table S6 Correlation analysis on a daily view

	Relative humidity (%)	Air pressure (hPa)	Wind speed (m/s)	PM <sub>2.5</sub> ( $\mu\text{g}/\text{m}^3$ )	O <sub>3</sub> ( $\mu\text{g}/\text{m}^3$ )	CO ( $\text{mg}/\text{m}^3$ )	PM <sub>10</sub> ( $\mu\text{g}/\text{m}^3$ )	WSOCp ( $\mu\text{g}/\text{m}^3$ )	WSOCg ( $\mu\text{g}/\text{m}^3$ )	fp- WSOC
$\delta^{13}\text{C}$ -WSOCp (‰)	-0.49*	-0.20	0.44*	-0.571**	0.74**	-0.36	-0.50*	-0.26	-0.63**	0.08
$\delta^{13}\text{C}$ -WSOCg (‰)	0.40	-0.15	0.00	0.73**	-0.68**	0.55**	0.62**	0.16	0.43*	-0.07
Fractionation (‰)	-0.49*	-0.02	0.24	-0.72**	0.79**	-0.51*	-0.62**	-0.23	-0.59**	0.08
WSOCp ( $\mu\text{g}/\text{m}^3$ )	0.14	-0.48	-0.03	0.20	-0.25	-0.15	0.39	1.00	0.31	0.86**
WSOCg ( $\mu\text{g}/\text{m}^3$ )	0.06	0.56	-0.06	0.21	-0.33	0.23	0.25	0.31	1.00	-0.22

fp-WSOC      0.10    -0.65\*   0.00    0.09    -0.08    -0.28    0.26    0.86\*\*   -0.22    1.00  
 Marked with \*\*: p<0.01; Marked with \*: p<0.05. Species with no correlation were deleted.

24

25

Table S7 Correlation analysis during daytime

	Temperature (°C)	Relative humidity (%)	Wind speed (m/s)	Radiation (W/m <sup>2</sup> )	PM <sub>2.5</sub> (µg/m <sup>3</sup> )	O <sub>3</sub> (µg/m <sup>3</sup> )	PM <sub>10</sub> (µg/m <sup>3</sup> )	WSOCp (µg/m <sup>3</sup> )	WSOCg (µg/m <sup>3</sup> )	fp- WSOC
δ <sup>13</sup> C-WSOCp (‰)	0.68*	-0.79**	0.67*	-0.05	-0.54	0.82**	-0.39	-0.37	-0.81**	0.08
δ <sup>13</sup> C-WSOCg (‰)	-0.63*	0.77**	-0.40	0.33	0.71*	-0.88**	0.633*	0.53	0.60*	0.24
Fractionation (‰)	0.69*	-0.82**	0.56	-0.20	-0.66*	0.90**	-0.53	-0.47	-0.75**	-0.08
WSOCp (µg/m <sup>3</sup> )	0.09	0.11	0.24	0.64*	0.37	-0.31	0.49	1.00	0.52	0.83**
WSOCg (µg/m <sup>3</sup> )	-0.41	0.49	-0.55	0.03	0.23	-0.54	0.24	0.52	1.00	-0.04
fp-WSOC	0.36	-0.18	0.62*	0.74*	0.30	-0.03	0.43	0.83**	-0.04	1.00

Marked with \*\*: p<0.01; Marked with \*: p<0.05. Species with no correlation were deleted.

26

27

Table S8 Correlation analysis during nighttime

	Temperature (°C)	Relative humidity (%)	Wind speed (m/s)	PM <sub>2.5</sub> (µg/m <sup>3</sup> )	O <sub>3</sub> (µg/m <sup>3</sup> )	CO (mg/m <sup>3</sup> )	PM <sub>10</sub> (µg/m <sup>3</sup> )	WSOCp (µg/m <sup>3</sup> )	fp- WSOC
δ <sup>13</sup> C-WSOCp (‰)	0.34	-0.28	0.71**	-0.62*	0.63*	-0.26	-0.68*	-0.11	0.02
δ <sup>13</sup> C-WSOCg (‰)	-0.64*	0.57*	-0.11	0.78**	-0.59*	0.57*	0.56*	-0.24	-0.21
Fractionation (‰)	0.59*	-0.52	0.49	-0.85**	0.73**	-0.51	-0.74**	0.08	0.14
WSOCp (µg/m <sup>3</sup> )	-0.18	0.17	-0.48	0.04	-0.17	-0.54	0.31	1.00	0.90**
WSOCg (µg/m <sup>3</sup> )	-0.07	0.03	-0.33	0.12	-0.19	-0.28	0.09	0.17	-0.26
fp-WSOC	-0.14	0.16	-0.38	-0.01	-0.09	-0.43	0.28	0.90**	1.00

Marked with \*\*: p<0.01; Marked with \*: p<0.05. Species with no correlation were deleted.

28

29

30