Supplemental material includes:

Fig S1: The composition and concentration (mg/km) of emitted primary (a) and secondary (b) PM for each fuel.

Fig S2: the ratios with PAM chamber to w/o PAM chamber ratios for C_2-C_5 fragments for E10.

Fig S3-S4: Average number and volume size distributions measured for different fuels (E10, E85, E100) with and without PAM chamber

Tables S1-S3: The average OH reactivities (OHR) during different parts of the cycle for all fuels are presented in Tables include the OHR for each compound is its concentration times the reaction rate constant with OH.

Figures S5-S7: The predicted SOA formation potentials of CSUDC (0-391 s) for all fuels. The rate constants are taken from Atkinson and Arey (2003) and Li et al. (2015).

Figures S8-S19: The average mass spectra over the NEDC cycle as well as time series of all main components (organics, rBC, inorganic ions) during the NEDC cycle for all fuels (E10, E85, E100) with and without a PAM chamber

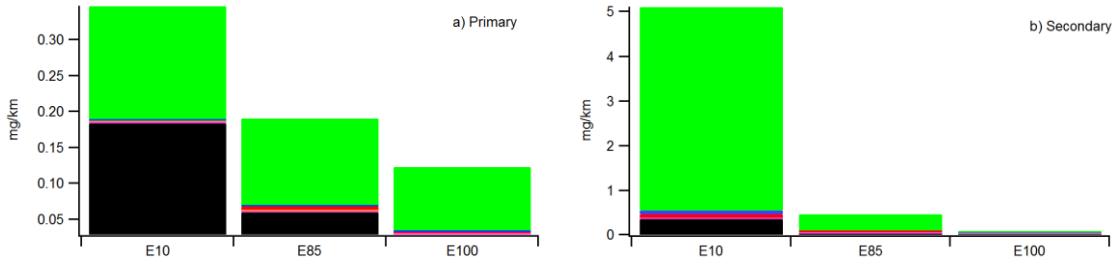

Figure S1: The composition and concentration (mg/km) of emitted primary (a) and secondary (b) PM for each fuel.

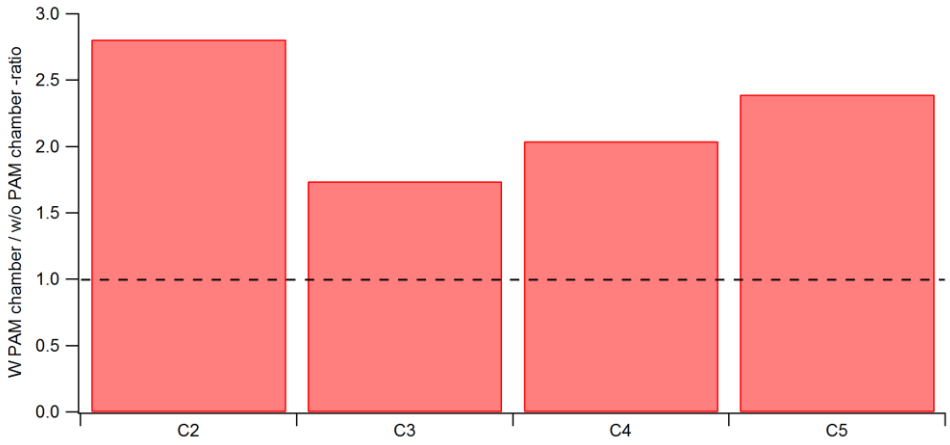

Fig S2. With PAM chamber to w/o PAM chamber ratios for C_2-C_5 fragments for E10.

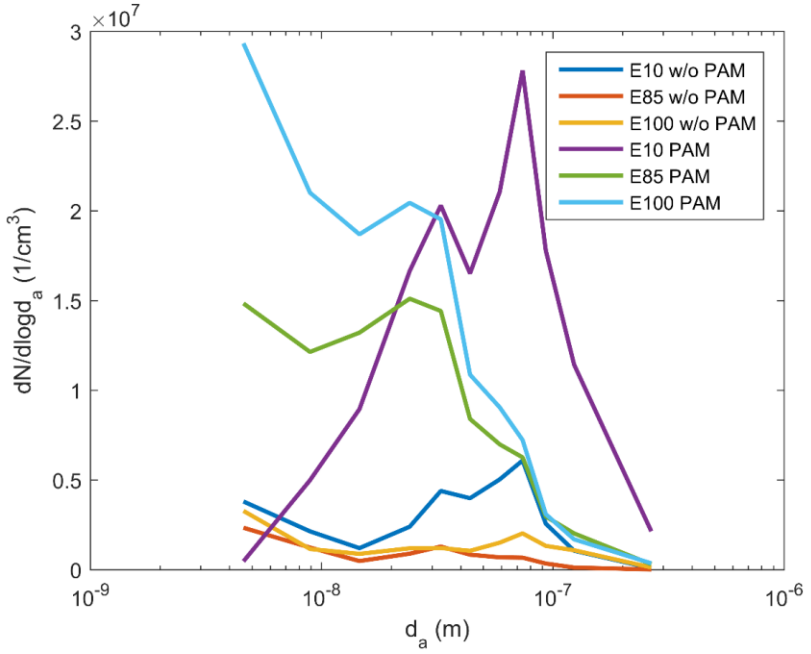

Figure S3. Average number size distributions measured for different fuels (E10, E85, E100) with and without PAM chamber.

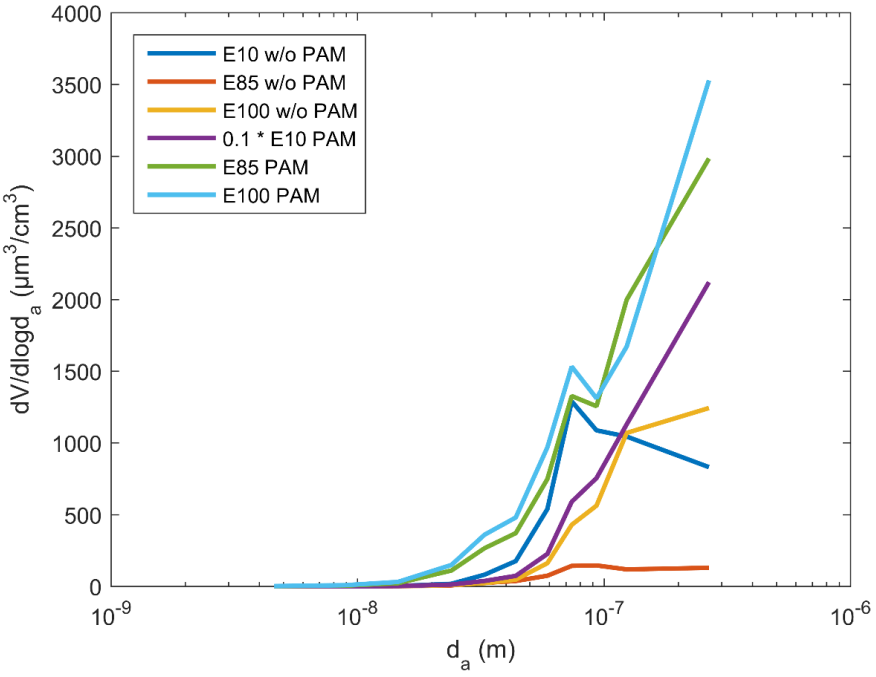

Figure S4. Average volume size distributions measured for different fuels (E10, E85, E100) with and without PAM chamber. Note the scaling by a factor 0.1 for E10 size distribution.

OH reactivity and predicted SOA formation potentials

Table S1. OHR and predicted SOA for E10 fuel.

		Concentration			OHR			Predicted SOA			
	Rate constant	CSUDC	HUDC	EUDC	CSUDC	HUDC	EUDC	Yield	CSUDC	HUDC	EUDC
	cm3 molec.-1 s-1	molec. cm-3	molec. cm-3	molec. cm-3	s-1	s-1	s-1		mg km-3	mg km-3	mg km-3
Methane	6.40E-15	4.58E+13	1.02E+13	1.42E+13	0	0	0	0	0.00	0.00	0.00
Ethane	2.48E-13	5.74E+12	0.00E+00	0.00E+00	1	0	0	0	0.00	0.00	0.00
Ethene	8.52E-12	1.91E+13	0.00E+00	0.00E+00	163	0	0	0	0.00	0.00	0.00
Propane	1.09E-12	0.00E+00	0.00E+00	0.00E+00	0	0	0	0	0.00	0.00	0.00
Propene	2.63E-11	4.63E+12	0.00E+00	0.00E+00	122	0	0	0	0.00	0.00	0.00
Acetylene	8.80E-13	7.52E+12	0.00E+00	0.00E+00	7	0	0	0.1	0.37	0.00	0.00
Iso-butene	5.14E-11	2.02E+12	0.00E+00	0.00E+00	104	0	0	0	0.00	0.00	0.00
1,3-Butadiene	6.66E-11	6.20E+11	0.00E+00	0.00E+00	41	0	0	0.18	0.11	0.00	0.00
Benzene	1.22E-12	4.50E+12	0.00E+00	3.30E+11	5	0	0	0.37	2.46	0.00	0.05
Toluene	5.63E-12	7.17E+12	1.05E+11	3.46E+11	40	1	2	0.3	3.74	0.06	0.05
Ethylbenzene	7.00E-12	1.98E+12	0.00E+00	0.00E+00	14	0	0	0.38	1.51	0.00	0.00
m/p-xylene	1.87E-11	4.42E+12	0.00E+00	0.00E+00	83	0	0	0.38	3.37	0.00	0.00
o-xylene	1.36E-11	2.02E+12	0.00E+00	0.00E+00	28	0	0	0.1	0.41	0.00	0.00
CO	1.03E-13	2.50E+15	5.69E+13	3.38E+14	258	6	35	0	0.00	0.00	0.00
Formaldehyde	9.37E-12	2.60E+12	6.12E+11	3.40E+11	24	6	3	0	0.00	0.00	0.00
Acetaldehyde	1.50E-11	1.10E+12	1.78E+11	1.16E+11	17	3	2	0	0.00	0.00	0.00
Ethanol	2.90E-12	1.37E+12	0.00E+00	0.00E+00	4	0	0	0	0.00	0.00	0.00
				SUM	910	15	42		11.97	0.06	0.11
				Total predicted SOA		2.30	mg km-3				

Table S2. OHR and predicted SOA for E85 fuel.

		Concentration			OHR			Predicted SOA			
	Rate constant	CSUDC	HUDC	EUDC	CSUDC	HUDC	EUDC	Yield	CSUDC	HUDC	EUDC
	cm3 molec.-1 s-1	molec. cm-3	molec. cm-3	molec. cm-3	s-1	s-1	s-1		mg km-3	mg km-3	mg km-3
Methane	6.40E-15	1.83E+14	1.63E+13	1.28E+13	1	0	0	0	0.00	0.00	0.00
Ethane	2.48E-13	0.00E+00	0.00E+00	0.00E+00	0	0	0	0	0.00	0.00	0.00
Ethene	8.52E-12	3.56E+13	0.00E+00	0.00E+00	304	0	0	0	0.00	0.00	0.00
Propane	1.09E-12	0.00E+00	0.00E+00	0.00E+00	0	0	0	0	0.00	0.00	0.00
Propene	2.63E-11	1.20E+12	0.00E+00	0.00E+00	31	0	0	0	0.00	0.00	0.00
Acetylene	8.80E-13	6.66E+12	0.00E+00	0.00E+00	6	0	0	0.1	0.34	0.00	0.00
Iso-butene	5.14E-11	0.00E+00	0.00E+00	0.00E+00	0	0	0	0	0.00	0.00	0.00
1,3-Butadiene	6.66E-11	0.00E+00	0.00E+00	0.00E+00	0	0	0	0.18	0.00	0.00	0.00
Benzene	1.22E-12	1.09E+12	0.00E+00	0.00E+00	1	0	0	0.37	0.62	0.00	0.00
Toluene	5.63E-12	1.54E+12	2.68E+10	6.51E+10	9	0	0	0.3	0.84	0.01	0.01
Ethylbenzene	7.00E-12	0.00E+00	0.00E+00	0.00E+00	0	0	0	0.38	0.00	0.00	0.00
m/p-xylene	1.87E-11	0.00E+00	0.00E+00	0.00E+00	0	0	0	0.38	0.00	0.00	0.00
o-xylene	1.36E-11	0.00E+00	0.00E+00	0.00E+00	0	0	0	0.1	0.00	0.00	0.00
CO	1.03E-13	9.82E+14	8.18E+12	1.16E+14	101	1	12	0	0.00	0.00	0.00
Formaldehyde	9.37E-12	5.46E+12	1.54E+12	5.50E+11	51	14	5	0	0.00	0.00	0.00
Acetaldehyde	1.50E-11	2.43E+13	2.22E+11	2.21E+11	364	3	3	0	0.00	0.00	0.00
Ethanol	2.90E-12	4.83E+13	4.71E+12	3.33E+12	140	14	10	0	0.00	0.00	0.00
				SUM	1009	33	31		1.81	0.01	0.01
				Total predicted SOA		0.35	mg km-3				

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Table S3. OHR and predicted SOA for E100 fuel.

		Concentration			OHR			Predicted SOA			
	Rate constant	CSUDC	HUDC	EUDC	CSUDC	HUDC	EUDC	Yield	CSUDC	HUDC	EUDC
	cm3 molec.-1 s-1	molec. cm-3	molec. cm-3	molec. cm-3	s-1	s-1	s-1		mg km-3	mg km-3	mg km-3
Methane	6.40E-15	2.93E+14	2.11E+13	1.82E+13	2	0	0	0	0.00	0.00	0.00
Ethane	2.48E-13	0.00E+00	0.00E+00	0.00E+00	0	0	0	0	0.00	0.00	0.00
Ethene	8.52E-12	1.03E+14	0.00E+00	0.00E+00	880	0	0	0	0.00	0.00	0.00
Propane	1.09E-12	0.00E+00	0.00E+00	0.00E+00	0	0	0	0	0.00	0.00	0.00
Propene	2.63E-11	1.46E+12	0.00E+00	0.00E+00	38	0	0	0	0.00	0.00	0.00
Acetylene	8.80E-13	2.07E+13	7.06E+11	7.06E+11	18	1	1	0.1	1.11	0.04	0.01
Iso-butene	5.14E-11	0.00E+00	0.00E+00	0.00E+00	0	0	0	0	0.00	0.00	0.00
1,3-Butadiene	6.66E-11	0.00E+00	0.00E+00	0.00E+00	0	0	0	0.18	0.00	0.00	0.00
Benzene	1.22E-12	6.05E+11	2.52E+11	2.02E+11	1	0	0	0.37	0.36	0.15	0.04
Toluene	5.63E-12	7.26E+11	4.20E+11	1.91E+11	4	2	1	0.3	0.41	0.24	0.03
Ethylbenzene	7.00E-12	0.00E+00	9.08E+11	0.00E+00	0	6	0	0.38	0.00	0.75	0.00
m/p-xylene	1.87E-11	0.00E+00	0.00E+00	0.00E+00	0	0	0	0.38	0.00	0.00	0.00
o-xylene	1.36E-11	0.00E+00	0.00E+00	0.00E+00	0	0	0	0.1	0.00	0.00	0.00
CO	1.03E-13	1.30E+15	4.85E+13	1.77E+14	134	5	18	0	0.00	0.00	0.00
Formaldehyde	9.37E-12	1.19E+13	1.15E+12	7.52E+11	111	11	7	0	0.00	0.00	0.00
Acetaldehyde	1.50E-11	8.24E+13	5.05E+11	4.23E+11	1237	8	6	0	0.00	0.00	0.00
Ethanol	2.90E-12	3.48E+15	1.01E+14	7.76E+13	10089	293	225	0	0.00	0.00	0.00
				SUM	12514	326	259		1.87	1.17	0.08
				Total predicted SOA		0.62	mg km-1				

The predicted SOA formation potentials of CSUDC for all fuels are shown in Figures S16-S18.

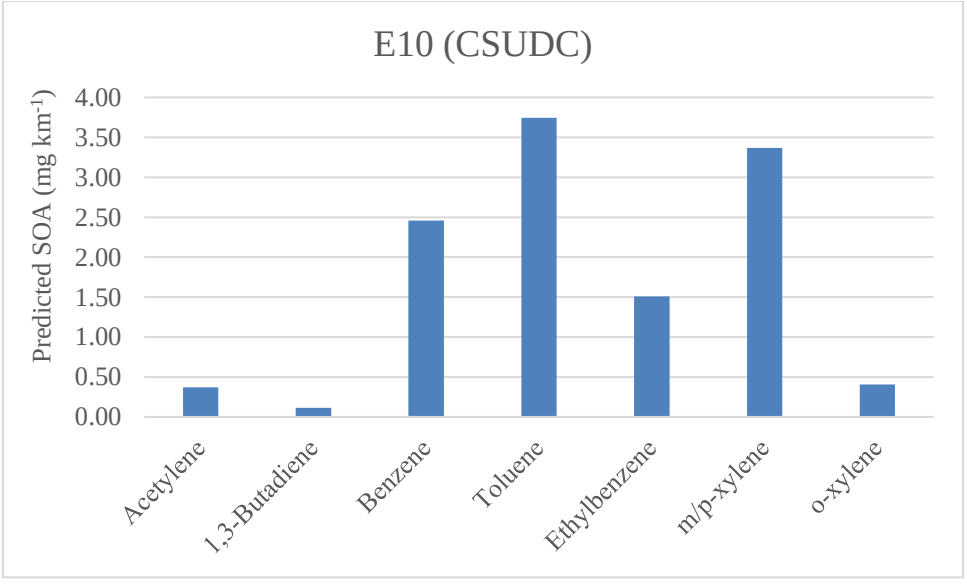

Figure S5. Predicted SOA during CSUDC for E10 fuel.

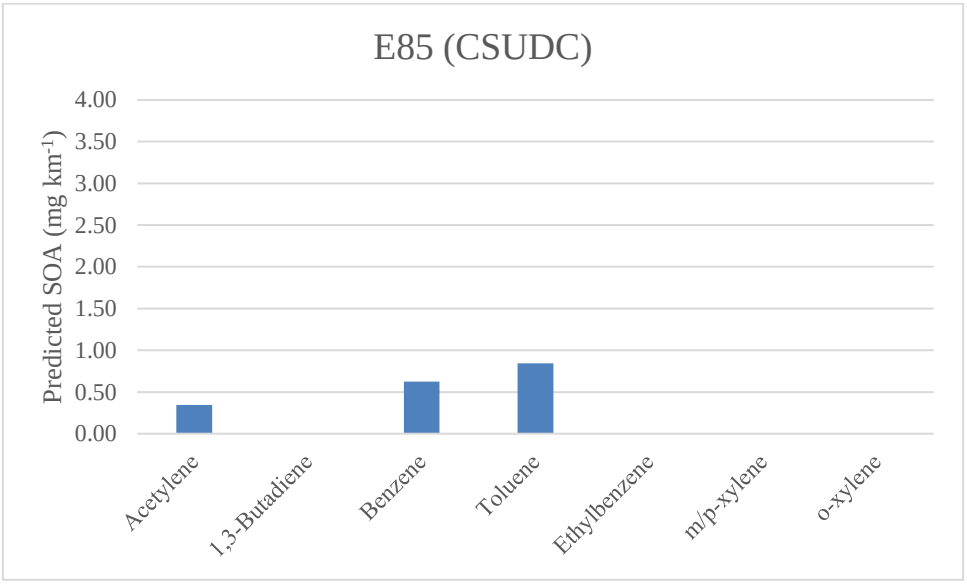

Figure S6. Predicted SOA during CSUDC for E85 fuel.

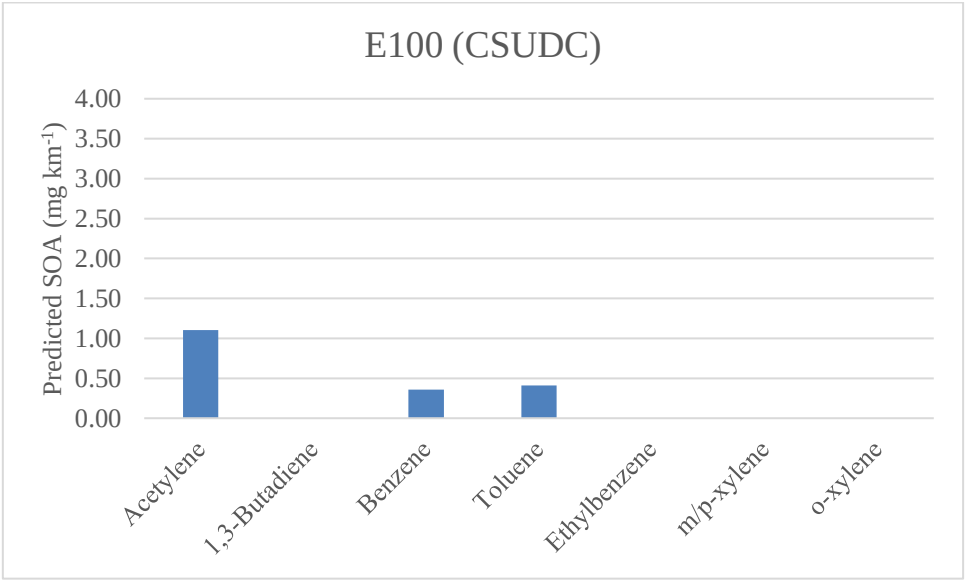

Figure S7. Predicted SOA during CSUDC for E100 fuel.

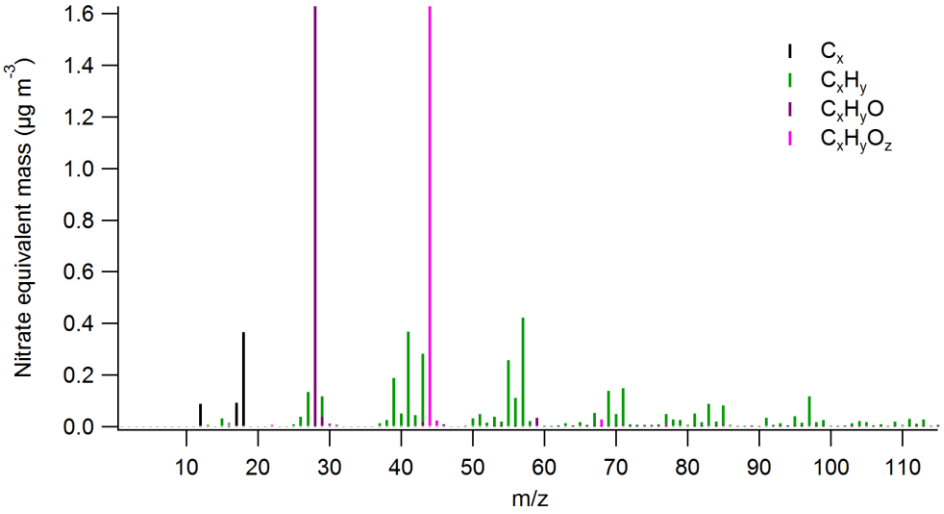

Figure S8: Average mass spectra for primary emissions of E10 during the NEDC cycle.

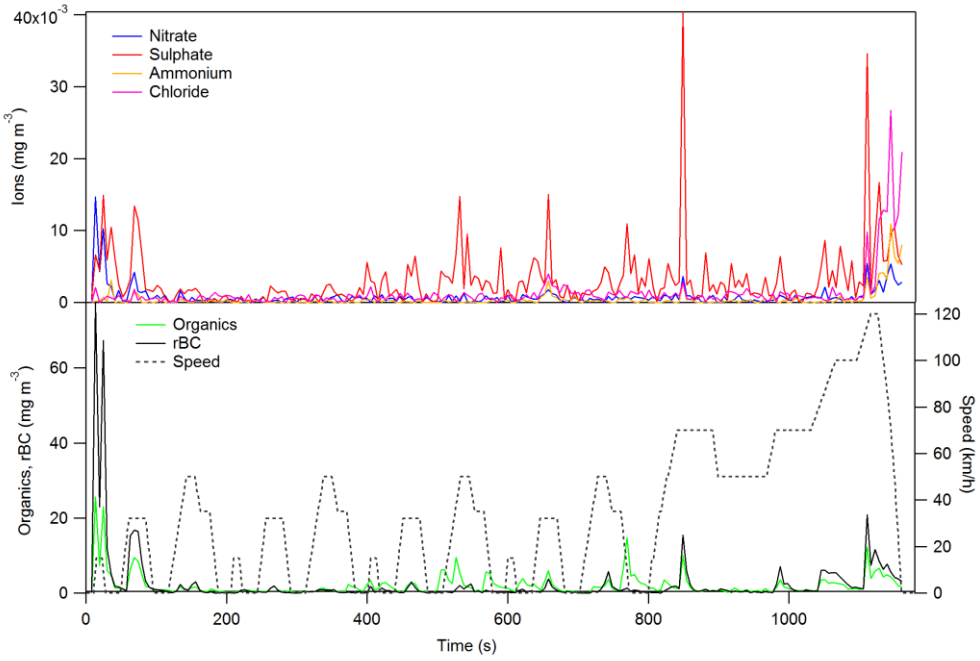

Figure S9: Timeseries of primary organic, inorganic (sulfate, ammonium, nitrate, chloride) compounds and BC during the NEDC cycle when using E10 fuel.

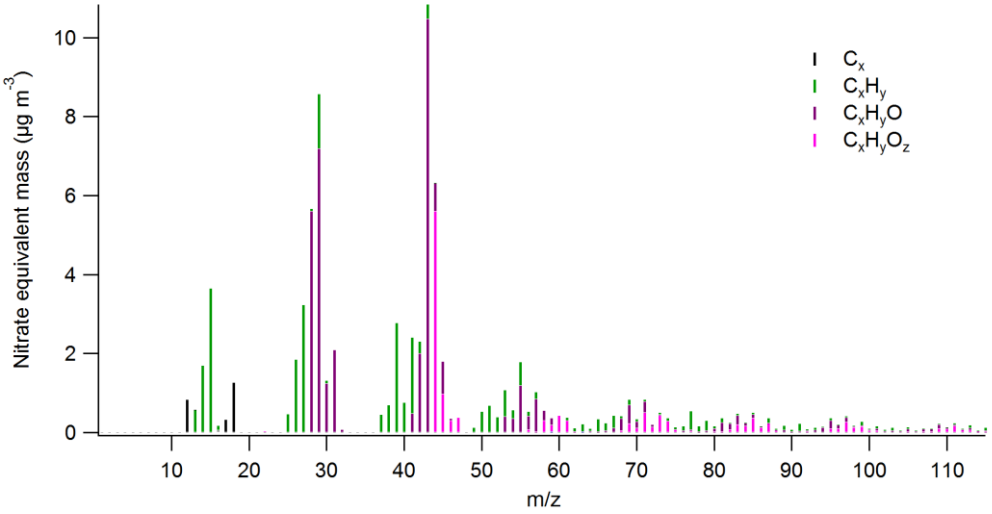

Figure S10. Average mass spectra over the NEDC cycle for E10 secondary emissions

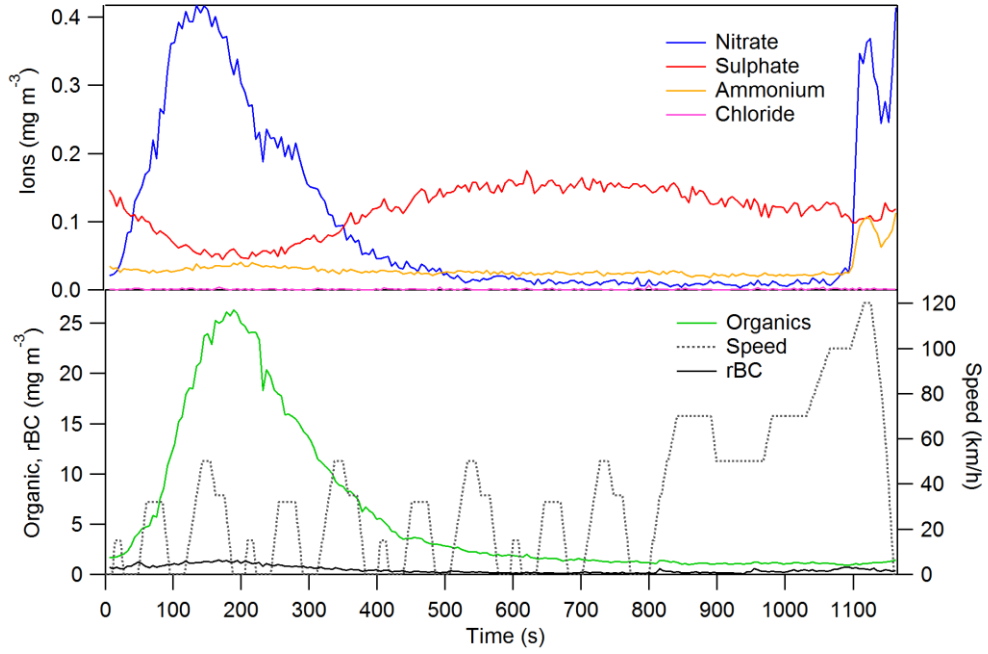

Figure S11: Timeseries of PM organic, inorganic (sulfate, ammonium, nitrate, chloride) compounds and BC observed after PAM chamber during the NEDC cycle when using E10 fuel.

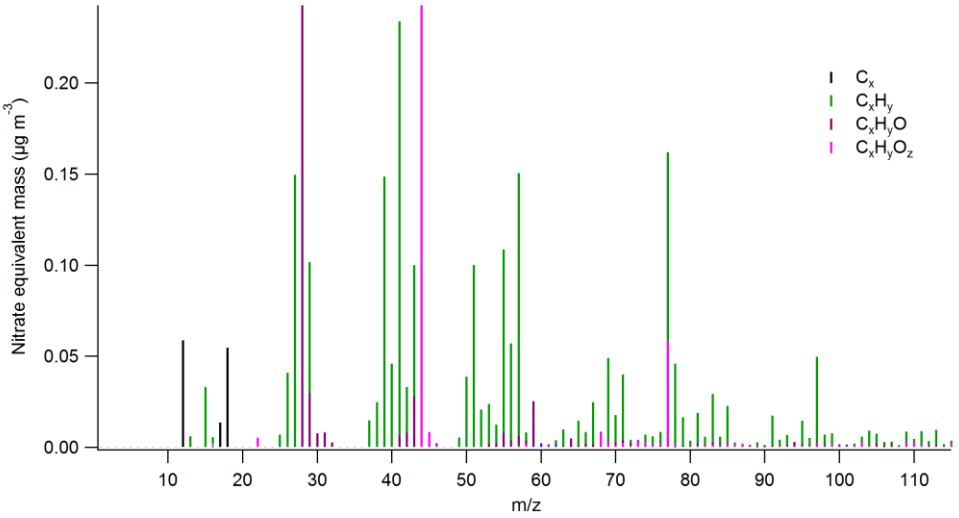

Figure S12: Average mass spectra over the NEDC cycle for E85 primary emissions

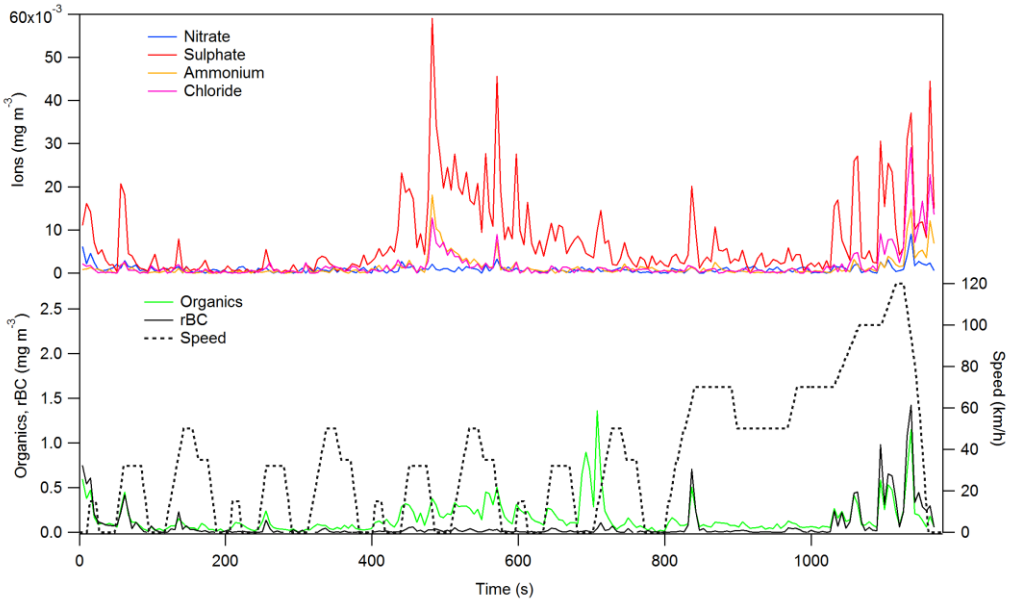

Figure S13: Timeseries of primary organic, inorganic (sulfate, ammonium, nitrate, chloride) compounds and BC during the NEDC cycle when using E85 fuel.

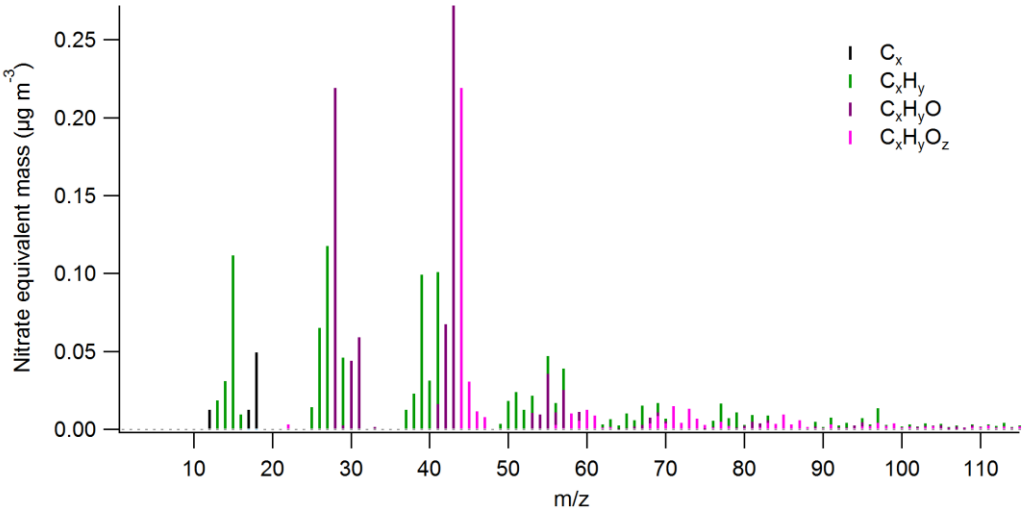

Figure S14: Average mass spectra over the NEDC cycle for E85 secondary emissions

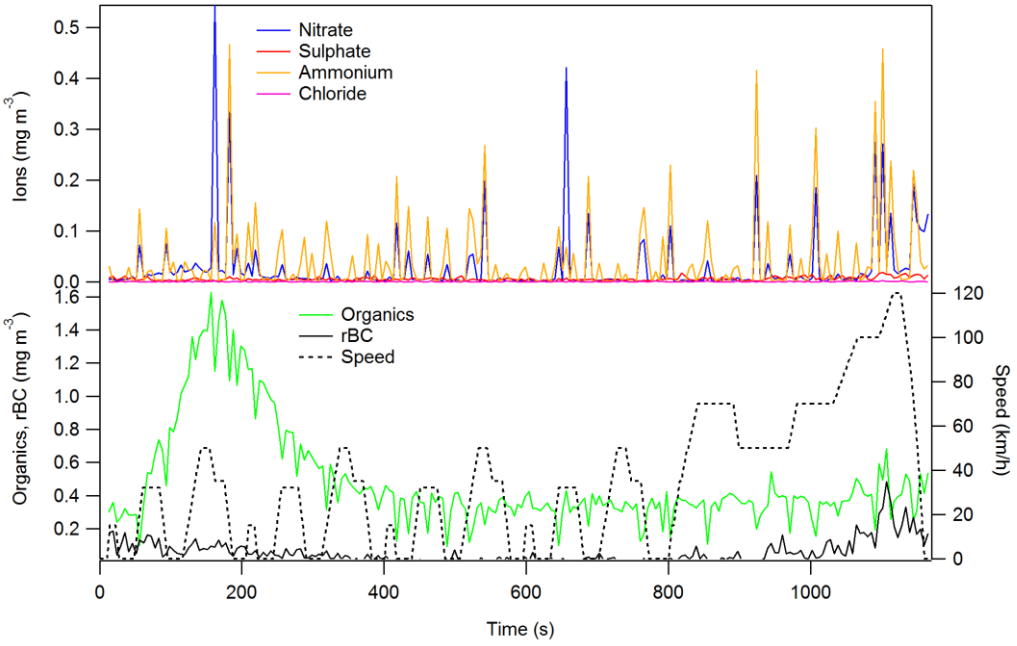

Figure S15: Timeseries of organic, inorganic (sulfate, ammonium, nitrate, chloride) compounds and BC measured after PAM chamber during the NEDC cycle when using E85 fuel.

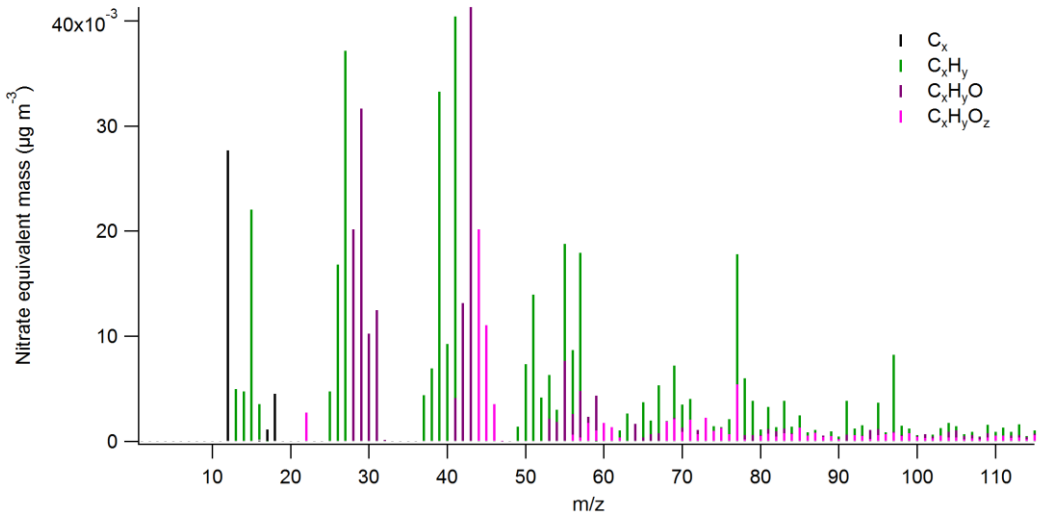

Figure S16: Average mass spectra over the NEDC cycle for E100 secondary emissions

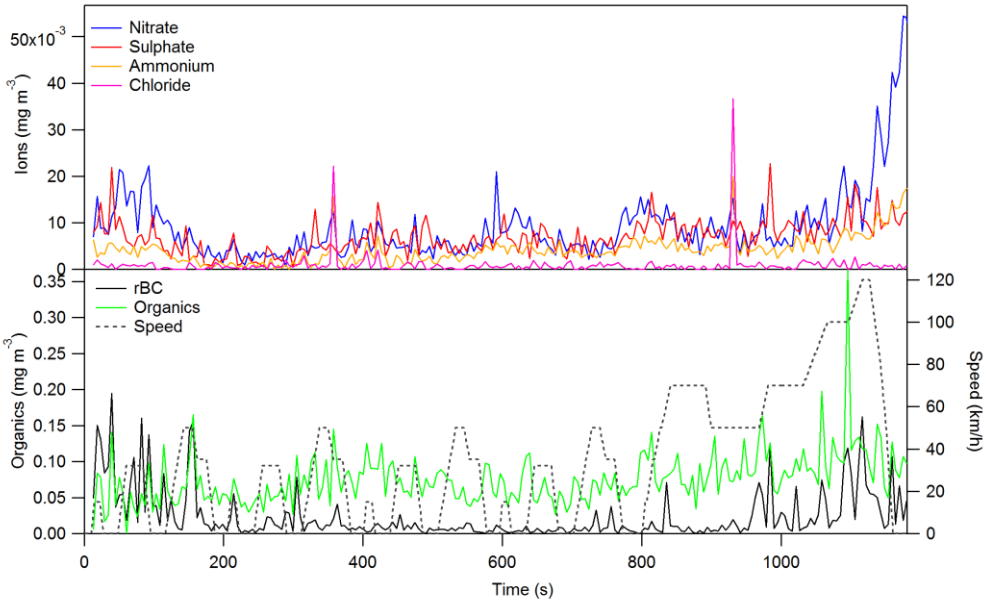

Figure S17: Timeseries of organic, inorganic (sulfate, ammonium, nitrate, chloride) compounds and BC after PAM chamber during the NEDC cycle when using E100 fuel.

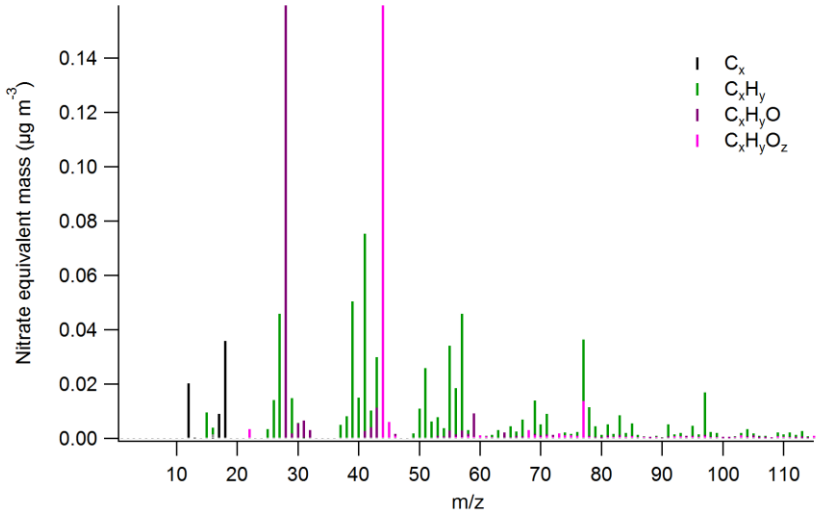

Figure S18: Average mass spectra over the NEDC cycle for E100 primary emissions

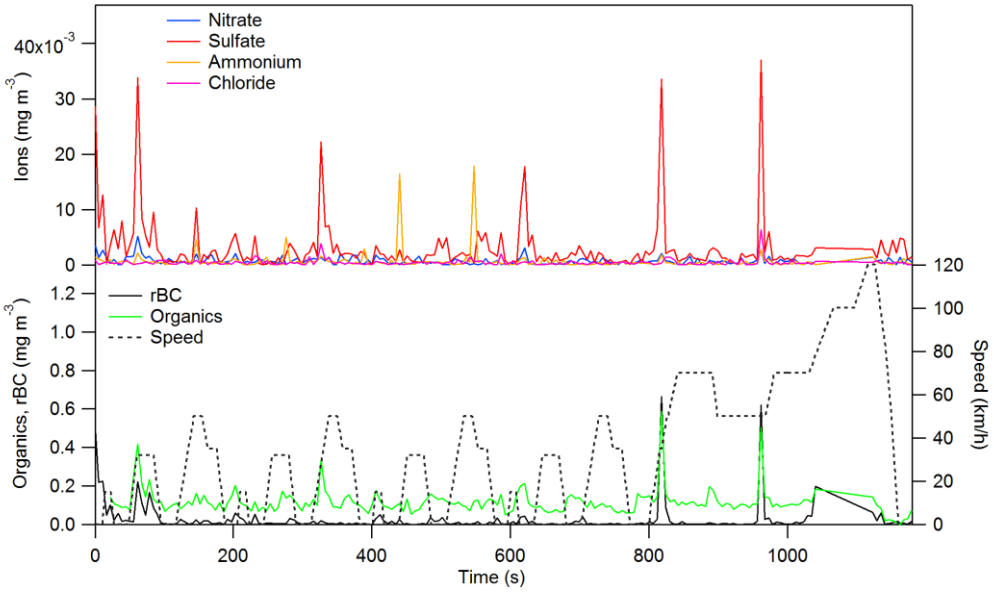

Figure S19: Timeseries of organic, inorganic (sulfate, ammonium, nitrate, chloride) compounds and BC during the NEDC cycle when using E100 fuel.

References

Atkinson, R., and Arey, J.: Atmospheric Degradation of Volatile Organic Compounds, Chemical Reviews, 103, 4605-4638, 10.1021/cr0206420, 2003.

Li, R., Palm, B.B., Ortega, A.M., Hlywiak, J., Hu, W., Peng, Z., Day, D.A., Knote, C., Brune, W.H., de Gouw, J.A., and Jimenez, J.L.: Modeling the Radical Chemistry in an Oxidation Flow Reactor: Radical Formation and Recycling, Sensitivities, and the OH Exposure Estimation Equation, The Journal of Physical Chemistry, 119, 4418-4432, 10.1021/jp509534k, 2015.