Measurement of volatile organic compounds emitted from biofuel crops and diesel vehicle exhausts

Kanako Sekimoto

Graduate School of Nanobioscience, Yokohama City University, Yokohama, Japan

Introduction

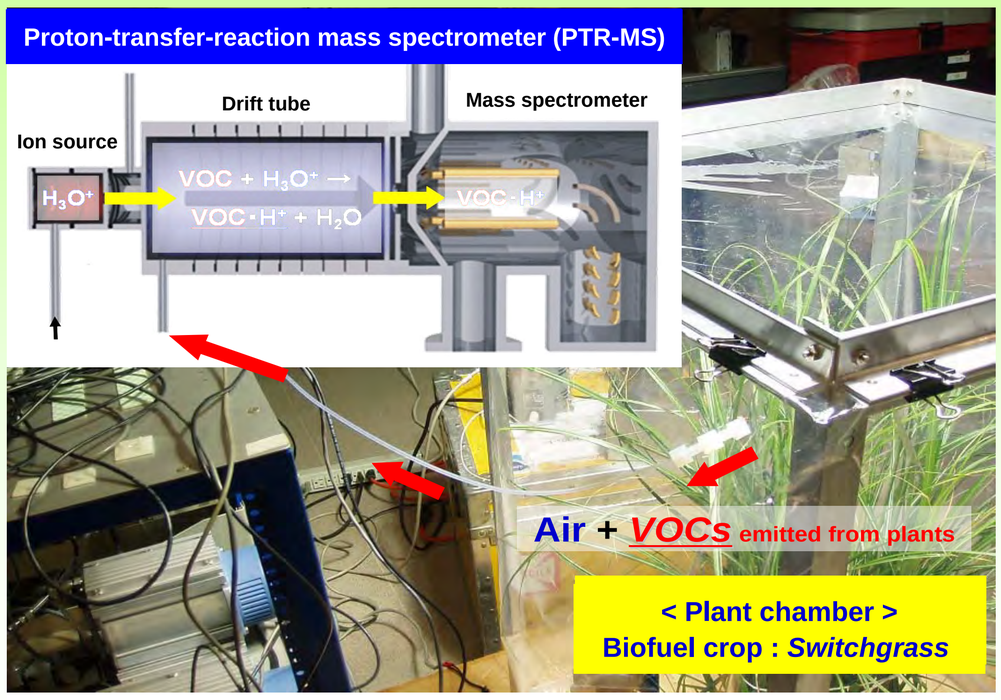
- Submicron atmospheric aerosols, most of which include organic compounds, exert a highly uncertain effect on radiative climate forcing and have serious impact on human health.
- Aerosol organic compounds are divided into two groups :
  primary organic aerosols (POA) directly emitted from various biogenic and anthropogenic sources
  secondary organic compounds (SOA) produced through oxidation of POA in the atmosphere
- The terminal SOA eventually generated via successive oxidation reactions could significantly affect the global change and air quality. Therefore, it is absolutely necessary to know the organic compounds including in aerosols.
- In this study, **we analyzed volatile organic compounds (VOCs) emitted from biofuel crops, Switchgrass, and diesel vehicle exhausts using real-time mass spectrometry**.

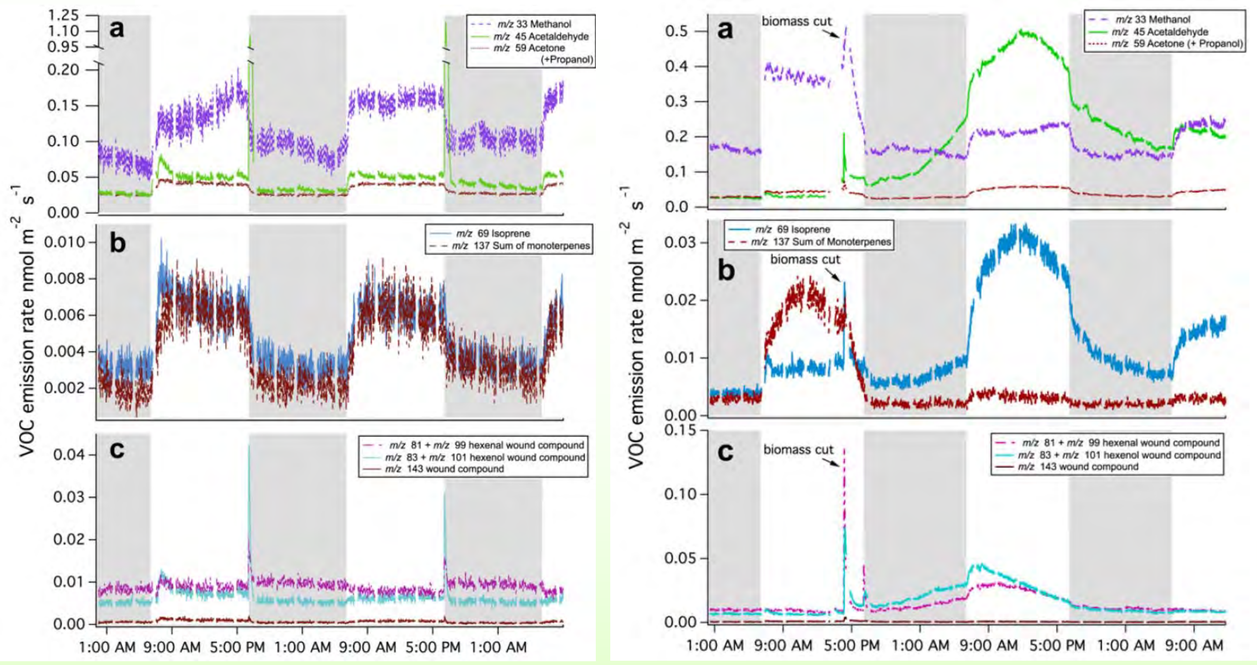
  Switchgrass (*Panicum virgatum*) : **Biogenic source for SOA**. Candidate for use in second-generation biofuel production and the acreage dedicated to its growth in the USA has already increased during the past decade.

  Diesel vehicle exhaust : **Anthropogenic source for SOA**. It has been recently suggested that the secondary of nitrated organic compounds can occur during catalytic exhaust gas treatment used reduced VOCs, nitrogen oxides (NO_x), and diesel exhaust particles (DEPs) which are the environmental pollutants.

Analysis of VOCs emitted from Switchgrass using PTR-MS and plant chamber

(NOAA Earth System Research Laboratory, Boulder, USA)



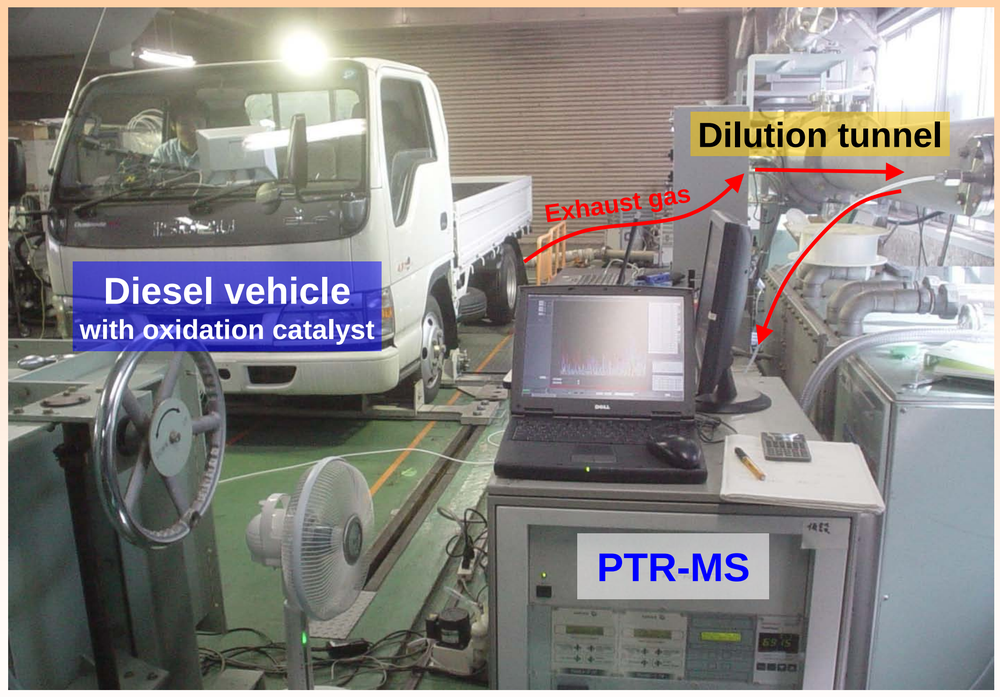


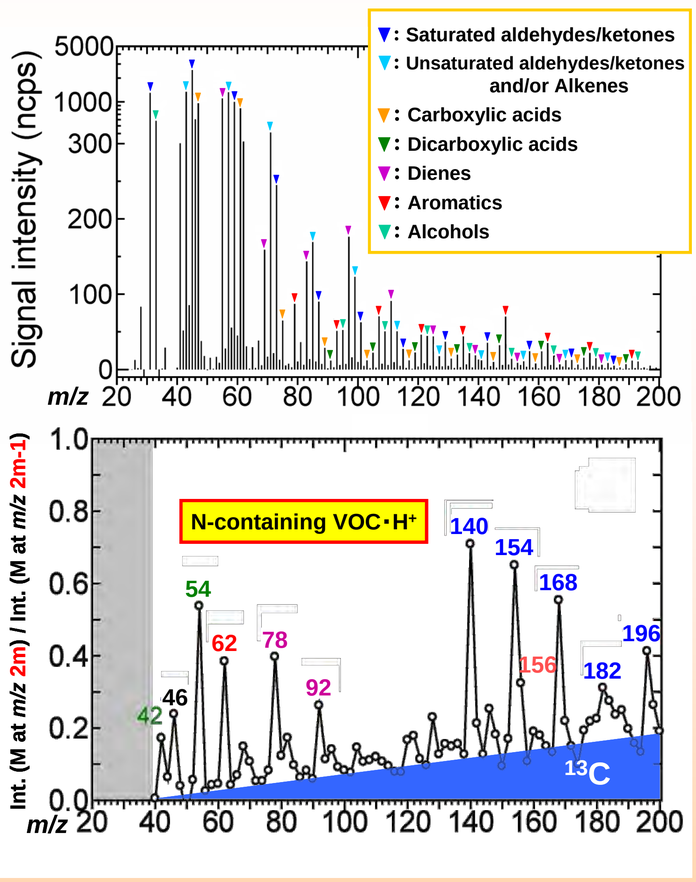
Estimated VOC emission		
Methanol	3	kgC/ha
Acetaldehyde	1	kgC/ha
Acetone	1	kgC/ha
Monoterpenes	0.8	kgC/ha
Isoprene (+ 1-penten-3-ol)	0.4	kgC/ha
Hexenals	0.1	kgC/ha
Hexenols	0.1	kgC/ha

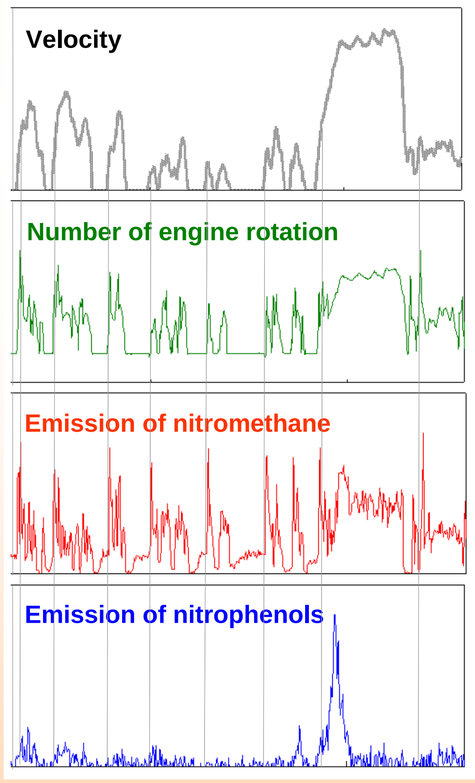
- **Those emission rates are much lower** than those expected from *Eucalyptus* or poplar plantations, which are other potential biofuel crops and have significantly higher VOC emission.
- This result suggests that the choice of species in the production of biofuels could have serious implications for regional air quality.

Analysis of VOCs in diesel vehicle exhausts using PTR-MS and chassis dynamometer

(National Traffic Safety and Environmental Laboratory, Toyko, Japan)







m/z	N-containing VOC	*m/z*	N-containing VOC
42	Acetonitrile	92	Ethyl nitrate
46	Nitrogen dioxide	140	Nitrophenol
54	Acrylonitrile	156+14n	C_7-, C_8-, C_9-,
62	Nitromethane		C_{10}-Nitrophenol
78	Metyl nitrate	156	Nitrodihydroxybenzene

- Emission pattern of nitromethane is synchronized with the rotation of vehicle conditions such as number of engine rotation. This result suggests **that nitromethane can be formed in fuel combustion**.
- Emission of nitrophenols is not correlated with any vehicle conditions, which indicates that **formation of nitrophenols is attributed to catalyst conditions**.