Particulate organic nitrogen at an agricultural region in South Africa

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Abstract

An assessment of the characteristics and sources of organic N compounds in atmospheric aerosols collected at a savanna-grassland agricultural background region was conducted utilising comprehensive two-dimensional gas chromatography coupled with a time-of-flight mass spectrometer. 135 organic N compounds were characterised and semi-quantified. Amines contributed to 51% of the semi-quantified concentrations, while nitriles, pyridine derivatives, and amides comprised 20%, 11%, and 8%, respectively, of the semi-quantified concentrations. Anthropogenic sources impacting air masses measured at Welgegund, as well as regional agricultural activities, were considered as the major sources of organic N species.

Keywords: organic aerosols; amines; Welgegund

1. Introduction

Although atmospheric organic N compounds are considered to be important, especially in new particle formation (Almeida et al., 2013) and their contribution to brown carbon (Galloway et al., 2008), these species are not that well understood due to their chemical complexity. Therefore, the aim of this study was to assess the characteristics of organic N compounds utilising comprehensive two-dimensional gas chromatography coupled with a time-of-flight mass spectrometer (GCxGC-TOFMS) in aerosol samples that were collected at a savanna-grassland agricultural background region and to determine the possible sources.

2. Experimental

Aerosol samples were collcted at the Welgegund monitoring station located within the South African Highveld approximately 100 km west of Johannesburg on a commercial farm.

3. Results and Conclusion

3.1 Characterisation

135 atmospheric organic N compounds were tentatively characterised and semi-quantified, which included amines, nitriles, amides, urea, pyridine derivatives, amino acids, nitro-and nitroso compounds, imines, cyanates and isocyanates, and azo compounds. Amines contributed to 51% of the semi-quantified concentrations, while nitriles, pyridine derivatives, and amides comprised 20%, 11%, and 8%, respectively, of the semi-quantified concentrations. Amines, nitriles, amides, and pyridine derivatives concentrations were higher during the dry season, which were attributed to

meteorological patterns, as well as the infleunce of seasonal local and regional open biomass burning in southern Africa.

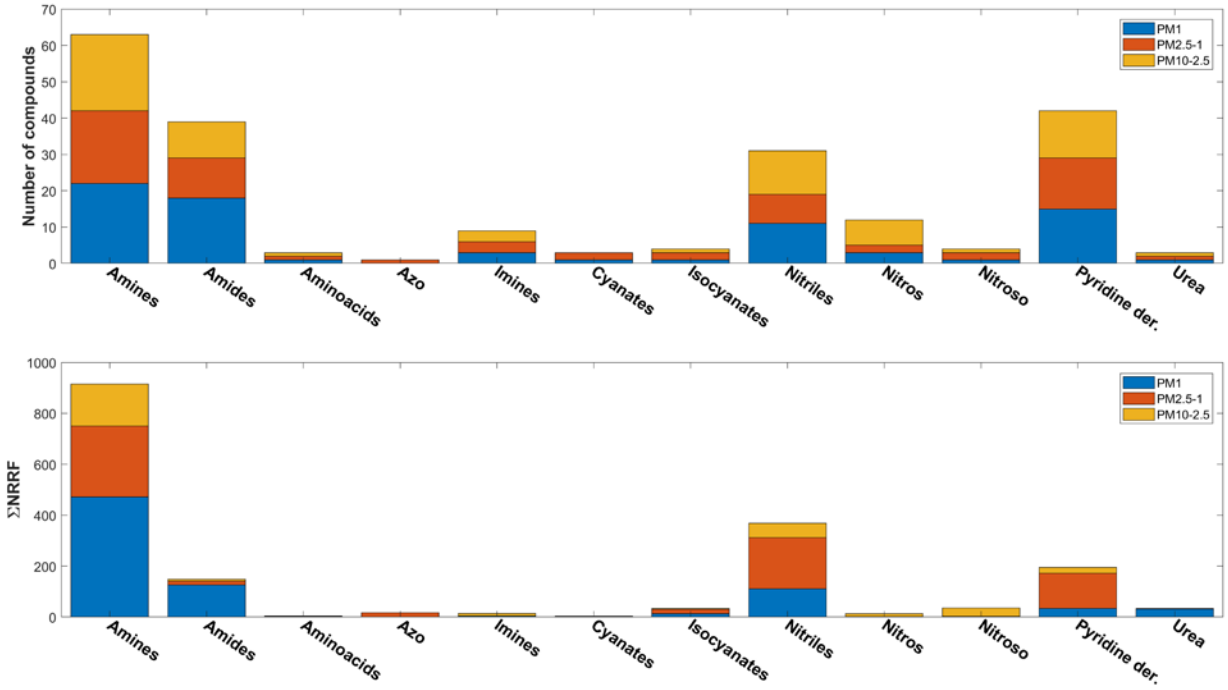

Fig. 1: Total number of nitrogen-containing species identified with their normalised relative response factors (ΣNRRFs) (Booyens et al., 2019)

3.2 Sources

Anthropogenic sources impacting air masses measured at Welgegund, as well as regional agricultural activities, were considered as the major sources of amines, while the regional influence of household combustion was most likely the main source of nitriles, amides, and pyridine derivatives. All other organic N species were most likely related to the influence of local and regional agricultural activities.

References

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