Research brief

Size-resolved characteristics of inorganic ionic species in atmospheric aerosols at a regional background site on the South African Highveld North-West University's research published in Journal of Atmospheric Chemistry

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Atmospheric aerosols or particulate matter (PM) are important components of the atmosphere with high temporal and spatial variability, which can have significant impacts on air quality and climate change. Detailed physical and chemical characterisation are crucial in establishing the impacts of atmospheric aerosol. Aerosols consist of organic and inorganic species, and the composition and concentration of these species depends on their sources, chemical transformation and sinks. In this study an assessment of major inorganic ions determined in three aerosol particle size ranges, i.e. PM_1, $PM_{1-2.5}$ and $PM_{2.5-10}$ collected for one year at Welgegund was conducted.

Sulphate (SO_4^{2-}) and ammonium (NH_4^+) dominated the PM_1 size fraction, while SO_4^{2-} and nitrate (NO_3^-) dominated the $PM_{1-2.5}$ and $PM_{2.5-10}$ size fractions. SO_4^{2-} had the highest contribution in the two smaller size fractions, while NO_3^- had the highest contribution in the $PM_{2.5-10}$ size fraction. SO_4^{2-} and NO_3^- levels were attributed to the impacts of aged air masses passing over major anthropogenic source regions. Comparison of inorganic ion concentrations to levels thereof within the western Bushveld Igneous Complexes – a source region influencing Welgegund – indicated higher levels of most inorganic species within the source region. However, the comparative ratio of SO_4^{2-} was significantly lower due to SO_4^{2-} being formed distant from SO_2 emissions and submicron SO_4^{2-} having longer atmospheric residencies. Aerosols at Welgegund were determined to be generally acidic, which was mainly attributed to high concentrations of SO_4^{2-}.

PM_1 and $PM_{1-2.5}$ fractions revealed a seasonal pattern, with higher inorganic ion concentrations measured from May to September. Higher PM concentrations were attributed to decreased wet removal, more pronounced inversion layers trapping pollutants, and increases in household combustion and wild fires during winter. Back trajectory analysis also revealed higher concentrations of inorganic ionic species corresponding to air mass movements over significant anthropogenic activities.