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Characterisation of plumes from the Johannesburg-Pretoria megacity within the regional South African context

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Introduction

The Johannesburg-Pretoria conurbation in South Africa is inhabited by more than 10 million people, making it one of the 40 largest metropolitan areas in the world. Conurbations of this magnitude have been defined as megacities (Molina and Molina, 2004). However, similar to many developing world megacities, relatively little has been published on the Johannesburg-Pretoria conurbation. Megacities are not only important from a local air quality (health) perspective, but also since they have a global atmospheric impact (Butler and Lawrence, 2009).

Approach

In this paper, the Johannesburg-Pretoria megacity source region, as well as other source regions in the interior of South Africa was defined, as observed from a relatively new super site for atmospheric measurements (www.welgegund.org) that is located at Welgegund (26˚34'10"S, 26˚56'21"E, 1480 m.asl). This site is approximately 70km west of the Johannesburg-Pretoria megacity source region. Plumes from the megacity source region arriving at Welgegund were identified via obtaining and overlaying back trajectories for a two year period. The back trajectory arrival times were correlated to in situ measurement to chemically and physically characterize the plumes. The characteristics of the megacity plumes were also compared to plumes from other defined source regions, as well as the regional background.

Results

Results indicated that the plumes arriving at Welgegund after passing over the Johannesburg-Pretoria megacity source region had much higher concentrations of gaseous pollutant species which include NO, NO_2, O_3, SO_2, CO and anthropogenic VOC's, as well as aerosol total organic content, SO_4^{2-}, NO_3^- and NH_4^+, if compared to the regional background. PM_1 aerosol absorption (black carbon), scattering and number concentrations indicated similar trends.

Comparison of the Johannesburg-Pretoria megacity source region with other defined source regions indicated that plumes from the megacity was as polluted as plumes from the more well-known source regions i.e. the Mpumalanga Highveld and the Vaal Triangle, which have been proclaimed as a national air pollution hotspots in terms of the South African National Environmental Management: Air Quality Act (Government Gazette Republic of South Africa, 2005; Government Gazette Republic of South Africa, 2007).

The above-mentioned results obtained for the Johannesburg-Pretoria conurbation indicate serious air quality and climate change related impacts for the human population and regional ecosystems.

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