NACA

2019 Conference of the National Association for Clean Air

3 - 4 OCTOBER I WESTERN CAPE

Annual Conference Proceedings

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3 – 4 October 2019

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WELCOME MESSAGE

Dear Conference Delegates

It gives me pleasure to welcome you to the Annual Conference of the National Association for Clean Air (NACA) at Stellenbosch, 3-4 October 2019. South Africa's first legislation to manage air quality was promulgated in 1965 – the Air Pollution Prevention Act (APPA) of 1965. NACA was founded shortly thereafter, as a civil society organisation of interested parties, including industry, government and individuals. In the early years, circa 1970, NACA's annual conferences were co-hosted by the Department of Health, which at that time carried the responsibility for air pollution control. Issues of the day were smoke control, regulation and enforcement of industrial emissions and wind-blown dust from mine tailings, as reflected in the first issue of the NACA's Clean Air Journal. Regulations, informed by British legislation, were focused on industrial source control. Technologies for ambient monitoring were rudimentary by today's standards, making use of bubblers for determining SO_2, and for filter opacity measurements for measuring smoke (particulate) matter.

In the interim, NACA has played a leading role in the evolution of the science, technology, regulations and standards for managing air quality in South Africa. NACA has organised numerous training workshops, presented by experts from home and abroad, sponsored bursaries, participated in standards setting processes, and engaged constructively with industry and government.

The Clean Air Journal, which recently published its 80th volume, provides an authoritative platform for print (and electronic) dissemination of advances in air quality science and management. NACA played an important role in the drafting of the Air Quality Management Act (2004) as well as contributing to subsequent legislation that has been promulgated over the past decade. The annual conference has and continues to be the principal forum for discussing and debating the most topical issues associated with air quality.

Air pollution has been a very topical issue during 2019, with many press reports, a special Parliamentary session, as well as a court case opened by civil society environmental organisations against the Government.

Over the past year NACA has continued to enact its founding mission – To promote the cause of clean air. The Clean Air Journal has been recognised by SCOPUS as an accredited international refereed journal, qualifying academic papers to be subsidised by the Department of Higher Education. Advances in monitoring technology and air dispersion modelling are disseminating through training to the South Africa air quality community. Six Introduction to Air Quality courses were presented in three provinces. All four branches of NACA have organized seminars throughout the year with topics including National GHG Reporting Regulations and the Carbon Tax Bill; Odour Emissions: Case Studies, Challenges and Successes; the National GHG Reporting Regulations; The Carbon Tax Bill – What you need to know; and The certification of emission personnel and capacity building in the current Air Quality Framework.

In addition, a joint seminar was hosted by NACA and DEA entitled: Emission reduction options relevant to South Africa. All these events were well attended.

NACA is committed to continue to provide a platform through which the different components of air quality, including, emissions, monitoring, ambient air pollution, indoor air pollution, mitigation, management, policy and law can be discussed to ensure well-informed stakeholders. The Annual Conference of NACA is the premier event on our calendar, at which delegates from all sectors have the opportunity to engage in formal and informal interactions. Thank you for participating in the 2019 NACA Conferencing. On behalf of the NACA Council, I welcome you to Stellenbosch and wish you fruitful and enjoyable conferencing.

I would like to thank the many sponsors of NACA and its activities throughout the year. The conference this year has been sponsored by Eskom, SASOL, GCRF- Mine Dust and Health Network, NMISA, Levego Environmental Services, Enviroserv Waste Management, Lakes Environmental Software, Shepstone Wylie Attorneys and SACNASP.

Stuart Piketh
NACA President

The organising committee would like to thank all those who gave their time and effort in the various aspects of the conference organisation.

2019 Local Organising Committee

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Scientific Review Process & Committee

The 2019 National Association of Clean air conference proceedings include peer reviewed publications that were subjected to the following process. After screening by the editors, Prof Stuart Piketh and Dr Roelof Burger, each manuscript was subjected to a blind review by two independent specialists. A total of 31 manuscripts out of 41 submissions were submitted for review, 3 were rejected outright, 11 had major proposed corrections, 13 had minor corrections and 4 were retracted. Authors had to resubmit their revised manuscripts and reviewers commented on the degree to which corrections were incorporated. Finally, the editors evaluated the comments from reviewers and communicated with authors where concerns were raised by the reviewers after the second round of reviews. One manuscript was accepted after additional corrections and two were rejected for failing to implement comments to the satisfaction of the reviewers. A total of 21 manuscripts were accepted for publication in the 2019 NACA conference proceedings. The review processes were managed by an online management system under the care of Mrs Renée le Roux and a full archive of the review history was made. The review panel was made up by the following 28 individuals:

Co-chairpersons of the NACA 2019 Scientific Review Committee

Prof Stuart John Piketh,
North-West University
Dr Roelof Burger,
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THURSDAY, 3 OCTOBER 2019

09:00 -17:00	NACA Conference Registration
10:00 - 13:00	Department of Environment, Forestry and Fisheries and the National Association for Clean Air (NACA) Multi-Stakeholder Workshop on Air Quality Management.
13:00 - 14:00	Lunch
	Plenary Session Chair: Prof. Stuart Piketh (National Association for Clean Air)
14:15 – 14:30	**Opening by the President of the National Association for Clean Air President** Prof. Stuart Piketh
14:30 – 14:35	**NACA Conference Platium Sponsor** GCRF Mine Dust and Health Network
14:35 – 15:00	**Feedback from DEFF Lekgotla** Dr Thuli Khumalo, National Air Quality Officer, Department of Environment, Forestry and Fisheries
15:00 - 15:20	**"GCRF Mine dust and Health Network: a collaborative, inter-disciplinary think-tank"** Associate Professor Jennifer Broadhurst, Department of Chemical Engineering, University of Cape Town
15:20 – 15:30	**Questions & Answers**
15:30 – 15:40	**Launch of the new Clean Air Journal platform** Dr Gregor Feig, Prof Rebecca Garland and Dr Kristy Langerman, Co-editors, Clean Air Journal
15:40 – 16:00	Mid-afternoon Refreshments - Exhibition and Poster Viewing
	Session 1: Policy Session Chair: Dr Patience Gwaze (Department of Environment, Forestry and Fisheries)
16:00 – 16:20	**Are air quality offsets just?** Kristy Langerman
16:20 – 16:40	**Air quality offsets in South Africa's dense low-income settlements:** **evaluating options in law** Crucial Bondamakara
16:40 – 17:00	**Truth and Perceptions in Public Understanding of** **Atmospheric Science and Technology** Harold Annegarn
17:15 – 17:45	**NACA Annual General Meeting** Plenary Venue
18:00 - 18:45	**Invited speaker:** **The Legal basis for the Centre for Environmental Rights Lawsuit Against Department of** **Environment, Forestry and Fisheries** Ms Olivia Rumble, Senior Lecturer, Institute of Marine and Environmental Law, University of Cape Town
19:00 - Late	**Informal Braai** Protea Hotel by Marriot Stellenbosch, Clubhouse

CONFERENCE PROGRAMME continued

FRIDAY, 4 OCTOBER 2019	
07:00 - 08:00	Tea & Coffee Refreshments
	Session 2: Air Quality and Human Health Impacts Session Chair: Mr Grant Ravenscroft (Argos Scientific Africa (Pty) Ltd.)
08:00 - 08:20	**Morphology and elemental composition of coal particles emitted from domestic coal burning brazier** Daniel Masekameni
08:20 – 08:40	**Mortality Reductions Associated with Meeting NAAQS and WHO Guidelines in the Highveld and Vaal Triangle Air Quality Priority Areas** Katye Altieri
08:40 - 09:00	**The assessment of the external costs of dust fallout in Blyvooruitzicht Gold Mining Village** Mbalenhle Mpanza
09:00 - 09:20	**An investigation of temporal and spatial correlations between citizen science odour reports and gas measurements from open-path UV-DOAS** Mark Wicking-Baird
09:20 - 09:40	**A modelling approach to calculate the dust risk change for a platinum Tailing Storage Facility (TSF) when consolidated with another** Laurike de Beer
09:40 - 10:00	**Simulating the Urban Heat Island over the City of Tshwane** Rebecca Garland
10:00 - 10:20	Mid-morning Refreshments - Exhibition and Poster Viewing
	Session 3: Emissions Session Chair: Mr Benton Pillay (uMoya-NILU)
10:20 - 10:40	**Development of a non-industrial emissions inventory for a coastal region** Seneca Naidoo
10:40 - 11:00	**Characterisation of Atmospheric Particulate Matter from Opencast Coal Mining Activities and Adjacent Communities** Lerato Khumalo
11:00 - 11:20	**Use of Unmanned Aerial Vehicles for Fugitive Emission Characterisation** Quentin Hurt
11:20 – 11:40	**Characterisation of semi-volatile hydrocarbon emissions from diesel engines** Amanda Mahlangu
11:40 – 12:00	**A comparison of the influence of different conditioning agents on South African fly ash resistivity** Dawie Branken
12:00 – 12:20	**Estimated emissions of domestic waste burning in South Africa** Ngwako Kwatala

12:20 - 13:30	Lunch - Poster Viewing

	Session 4: Air Quality Session Chair: Ms Colleen McCreadie (The Environmental Practice)
13:30 - 13:50	**Invited speaker** **Eskom's Minimum Emission Standards Application Motivation and Objections** Deidre Herbst, Environmental Manager, Eskom
13:50 - 14:10	**Long-term WRFChem Modelling and Verification of Wet and** **Dry Deposition over the Highveld of South Africa** Theo Fischer
14:10 - 14:30	**Characterizing source contribution of ambient particulate matter in Wedela, Gauteng** Kealeboga Ntshabele
14:30 - 14:50	**Harbour and Intra-City Drivers of Air Pollution:** **Findings from a Land Use Regression Model, Durban, South Africa** Hasheel Tularam
14:50 - 15:10	**Assessing the exposure to ambient air pollution at the intraurban scale:** **A case of Wedela and Zamdela** Prince Chidhindi

15:10 – 15:20	Mid-afternoon Refreshments - Exhibition and Poster Viewing

	Session 5: Innovative Solutions to Air Quality Session Chair: Ms Gabi Mkhatshwa (Eskom)
15:20 - 15:40	**An Online Tracking and Evaluation System for South Africa's National** **Climate Change Mitigation and Adaptation Actions** Elanie van Staden
15:40 – 16:00	**Application of Passive Diffusive Particulate Monitors for Indoor Measurements** Christiaan Pauw
16:00 – 16:20	**Dust Deposition Validation Study Using the ASTM D1739 – 98 (Reapproved 2017)** **Method with Three Different Container Dimensions and Windshield** Kerusha Naidoo
16:20 – 16:40	**Evaluation of the Thermal Performance and Emissions in a** **Semi-Continuous Coal Stove** Louise-M. Dreyer
16:40 – 17:00	**Awards for Best Papers** Announcement of NACA 2020 & CLOSING

INVITED SPEAKERS

"ESKOM'S MINUM EMISSION STANDARDS APPLICATION MOTIVATION AND OBJECTIONS"

Deidre Herbst *, Bryan McCourt
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Abstract
Eskom as South Africa's public electricity utility, generates, transmits and distributes electricity throughout South Africa and into neighbouring countries. Eskom's principal generation technology is pulverised coal with approximately 90% of its current generating capacity lying in coal-fired power stations all in declared air quality priority areas. In terms of the National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004) (NEMAQA), all of Eskom's coal and liquid fuel-fired power stations are required to meet the Minimum Emission Standards (MES). Where it is not possible to meet these requirements it is possible to apply for a postponement or suspension from the MES.

Eskom has for many years had an emission reduction plan but is still unable to fully comply with the MES and as such has submitted MES postponement applications in 2014 and in 2019. The 2019 application has included an assessment of ambient monitoring results, a cumulative air quality dispersion model, a health impact focussed cost-benefit analysis and a public participation process. Eskom's rational for the postponement applications include general compliance to the ambient air quality standards, limited water availability, a low reserve margin which means that retrofits have to be carefully phased to maintain the reserve margin, public pressure to keep the electricity tariff low and other negative environmental consequences including greenhouse gas emissions, transport related impacts and waste. Eskom contends that granting the postponement is in the national interest, weighing up the costs and benefits of compliance and considering the broad Constitutional and other legal requirements.

Eskom's postponement application has been objected to strongly by various parties who consider the air quality issues in the Highveld as a public health crisis and argue that no further postponement from the MES compliance time frames should be permitted.

This paper provides a summary of the Eskom MES postponement application the arguments presented against it and lessons learnt in the process.

Keywords: *Eskom, Minimum Emission Standards, ambient air quality, cost-benefit, industry perspective, GO perspective, cost of compliance.*

GCRF MINE DUST AND HEALTH NETWORK: A COLLABORATIVE, INTER-DISCIPLINARY THINK-TANK

Jennifer L Broadhurst[*1], Shahieda Adams[2] and Johanna RC von Holdt[3]

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Abstract

Fugitive dust from mining activities can significantly influence air quality, the environment, and the health and quality of life of workers and surrounding communities. Poor engagement and communication between experts and lay persons, disciplinary silos and polarised viewpoints have made it difficult to develop a holistic understanding of the complex health issues associated with environmental emissions of mine dusts, and consequently to design meaningful and integrated approaches to address such issues. The Global Challenges Research Fund (GCRF) Mine Dust and Health Network, hosted by Minerals to Metals at the University of Cape Town, serves as a collaborative think-tank to inform research directions within and across disciplines; government policy and regulations; health monitoring programmes at public clinics; industry best practice; and community healthcare and impact prevention programmes. It focuses initially on the southern African region, but with the intention to expand to mining-intensive developing countries within the rest of Africa, South America and Asia. The Network's specific objectives are to: (1) facilitate a shared and common understanding of the inter-related health risks and mitigation opportunities relating to mine dust by creating safe spaces for open discussion by all stakeholders; (2) develop interdisciplinary research capacity, particularly among early career researchers in developing countries, to provide meaningful inputs to collaborative problem solving and to propose integrated solutions relevant to specific country/population contexts; (3) increase community and regulatory awareness of mine dust related health risks and mitigation measures to devise low-cost solutions and make previously voiceless communities part of the problem-solving team, and (4) expand its sphere of influence and attract further funding by increasing the network membership and connecting with other relevant networks and GCRF Challenge Leaders. Our first network event held in Cape Town in September identified areas on which we will focus our research efforts, people that will be involved, and deliverables we will target.

Keywords: *Mine dust, health, GCRF network.*

SCIENTIFIC PAPERS

MORTALITY REDUCTIONS ASSOCIATED WITH MEETING NAAQS AND WHO GUIDELINES IN THE HIGHVELD AND VAAL TRIANGLE AIR QUALITY PRIORITY AREAS

Katye E. Altieri*[1] and Samantha L. Keen[2]

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Abstract

The Vaal Triangle Airshed and the Highveld are two of South Africa's national air pollution priority areas. There are ~ 7.5 million people exposed to high air pollution levels in these regions, with potential impacts on human health and economic growth. The environmental Benefits Mapping and Analysis Program (BenMAP) model was run using local data on population, mortality rates, and concentrations of fine particulate matter ($PM_{2.5}$), as well as mortality risk coefficients from the epidemiological literature. BenMAP calculates the number of premature mortalities that would likely be avoided if air quality levels within the air pollution priority areas met the existing National Ambient Air Quality Standard (NAAQS) of 20 µg m^{-3}, and the more stringent World Health Organization (WHO) guideline for annual average $PM_{2.5}$ of 10 µg m^{-3}. There are six air quality monitoring stations within the Vaal Triangle Airshed Priority Area (VTAPA) and five in the Highveld Priority Area (HPA). None of the monitoring stations meet the WHO guideline during the analysis time period of 2008-2016, and only a few stations meet the annual average $PM_{2.5}$ NAAQS in more recent years. Avoided premature mortalities are significantly higher in the VTAPA than the HPA as a result of higher annual average $PM_{2.5}$ and a larger population. In both priority areas, potentially avoided premature mortalities increase from 2008 to 2011, and then decrease to a minimum in 2013 with a more modest increase from 2013 to 2016.

Keywords: *Priority areas, $PM_{2.5}$, health impacts, BenMAP.*

TRUTH AND PERCEPTIONS IN PUBLIC UNDERSTANDING OF ATMOSPHERIC SCIENCE AND TECHNOLOGY

Harold J Annegarn*, Stuart J Piketh and Roelof Burger

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Abstract

For ~20 years, the literature on the health effects of air pollution was dominated by the work of Pope and Dockery (1999). With the publication of the Global Burden of Disease Study [Lim et al. Lancet, 380(9859) (2012) 2224], which placed particulate air pollution (PM) as the fourth most prevalent risk factor for premature death, a new reference point was established. Stimulated by this report, the World Health Organisation revised its guidelines for PM downwards. With the claim that it made the message more comprehensible to the lay public, the WHO subtly shifted the concept of "risk factor for premature deaths" to "caused 2.4 million deaths per year". Subsequently, the WHO report has been widely quoted to justify stricter air quality standards, from national agencies to EIAs for small industrial or mining operations, to environmental advocacy groups. While such advocacy groups play an essential role in developing a public understanding of science and technology (PUST), there have been recent publications containing serious scientific errors; and single-issue advocacy in neglect of national environmental policies and strategies. This paper selects a recent press release issued by Greenpeace ('New satellite data reveals the world's largest air pollution hotspot is Mpumalanga – South Africa.' 29 October 2018) that attracted widespread attention and subjects it to critical analysis. We find the purpose of the title of the article is factually inaccurate and mismatched to the real purpose of the article. Moreover, there are logical errors that lead to scientifically invalid conclusions. The article appeals to the adverse health effects of air pollution in a manner that appears to raise the emotional temperature, rather than to enhance the public understanding of atmospheric science and technology. We conclude that scientists have a responsibility to speak out also in the policy arena to ensure that truth and perceptions coincide in PUST.

Keywords: PUST, Public Understanding of Science and Technology, particulate matter, NOx, coal-fired power plants, Eskom, Sasol, offsets, $PM_{2.5}$, public perceptions, Greenpeace, science communication, health impacts

SCIENTIFIC PAPERS

AIR QUALITY OFFSETS IN SOUTH AFRICA'S DENSE LOW-INCOME SETTLEMENTS: EVALUATING OPTIONS IN LAW

Crucial Bondamakara[1]*, Roelof Burger[2] and Anél Du Plessis[3]

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Abstract

In South Africa, domestic sources of air pollution have significant impacts on health matters. Solid fuel is a prominent energy carrier, largely due to poverty. As a result, dense low-income settlements typically experience the worst ambient levels of pollution. These areas are typically located in close proximity to industrial hotspots, that further exacerbates air quality. Previous studies have shown that intra-urban air pollution sources account for the majority of South Africa's burden of disease. To intervene, Air Quality Offset Guidelines were published in 2015 as a vehicle to combat air pollution. Subsequently, on 17 May 2019, the national government published a Strategy to Address Air Pollution in Dense Low Income Settlements which reiterates, the pivotal role that the private sector can play in mitigating air pollution in these areas. The proposed paper sets out to probe the strengths and weaknesses of the options presented in South Africa's environmental and urban law framework for the use and implementation of air quality offsets. Offsets are a concept designed to urge industries or commercial firms (the private sector) and other actors to generate environmental improvements. Subsequently, these environmental improvements/dividends are then used to offset pollution mitigation requirements for regulated entities. Whereas offsets are attractive in concept, their implementation in practice is confronted with a number of obstacles. Local context should be considered carefully to ensure the effectiveness of this legal vehicle.

Keywords: *Air quality offsets, dense low-income settlements, household air pollution, poverty*

A COMPARISON OF THE INFLUENCE OF DIFFERENT CONDITIONING AGENTS ON SOUTH AFRICAN FLY ASH RESISTIVITY

Gregory N. Okolo, Jandri A. Ribberink, Jané Schroeder, Dawie J. Branken*
and Hein W.J.P. Neomagus

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Abstract

Increasingly stringent minimum emissions standards as dictated by the National Environmental Management: Ambient Air Quality Act (Act no. 39 of 2004), necessitates performance improvements of current particulate matter (PM) emissions abatement technologies at South African coal-fired power stations. Electrostatic precipitators (ESPs) are still being used at many of the South African coal-fired power stations, and one important characteristic which determines the efficiency of ESPs is the resistivity of the fly ash. One factor which influences the resistivity of the fly ash is its chemical composition, which can be controlled by the introduction of conditioning agents such as brine injection into the flue gas upstream of the ESP. Other conditioning methods include moisture or sulphur trioxide (SO_3).

In this study, the effect of these different conditioning methods on the resistivity of fly ash sampled at South African power stations were studied. Some ashes were treated with a synthetic brine solution of which the composition was similar of that found at a coal fired power station. Additionally, the ambient moisture concentration was varied to characterise the combined effect of moisture and brine conditioning on the fly ash resistivity as a function of temperature. This was done to compare the individual and synergistic effect of these two conditioning agents on the fly ash resistivity, since moisture is also introduced into the flue gas during brine injection.

Although SO_3 conditioning is already practiced at some South African power stations, the effect of this conditioning agent under varying levels of moisture and for varying ash composition are not well documented in the literature. Therefore, quantifying the effect of this and other conditioning agents on fly ash resistivity can aid in identifying power stations where flue gas conditioning would be most beneficial, and which conditioning method would be the most cost-efficient.

Keywords: *Particulate matter, coal ash, flue gas conditioning, ambient moisture, SO_3, brine, resistivity*

SCIENTIFIC PAPERS

ASSESSING THE EXPOSURE TO AMBIENT AIR POLLUTION AT THE INTRAURBAN SCALE: A CASE OF WEDELA AND ZAMDELA

Prince Chidhindi*, Roelof Burger, Stuart Piketh

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Abstract

Air pollution is an environmental problem which needs urgent action and has been receiving a lot of attention from different stakeholders around the world including South Africa. This is understandable considering that a significant number of the world population live in areas characterised by poor air quality. In response, decision-makers have developed several strategies such as national ambient air quality standards (NAAQS), guidelines and regulations. Existing strategies are however mainly focused on regulating industrial emissions and little is done to address the impact of low-level sources within townships. Emission inventories can help determine significant sources of air pollutants and hence the advancement of regulatory actions. To date, little has been done to assess intraurban exposure, hence due to a variety of reasons ranging from the diversity of potential sources within townships, misaligned regulations to the vulnerability of the people residing in the settlements, there is motivation to do such a study. The aims of the study are to develop a particulate matter (PM) emissions inventory for local sources dominant within densely populated low-income townships in South Africa and to evaluate the use of dispersion models as regulatory tools in modelling emissions within intra-urban environments. The study aims were achieved by identifying and characterising the sources of emissions within Wedela and Zamdela, and using dispersion modelling to estimate the impact of the identified sources on ambient air of the townships. Both primary and secondary data sources were used in the study namely past studies that focused on sources apportionment, satellite imagery, land use maps and observations. California Puff model (CALPUFF) a lagrangian model and the American Meteorological Society (AMS) and U.S. Environmental Protection Agency (EPA) Regulatory Model (AERMOD) will be used to simulate the emissions. The simulated results will be compared to the measured data to access if they agree and an evaluation of the two models against each other will be drawn.

Keywords: *Air pollution, particulate matter, emissions inventory, intraurban*

A MODELLING APPROACH TO CALCULATE THE DUST RISK CHANGE FOR A PLATINUM TAILING STORAGE FACILITY (TSF) WHEN CONSOLIDATED WITH ANOTHER

Laurike de Beer

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Abstract

Mine waste materials, stored in tailings facilities, can result in fugitive dust when exposed to aerodynamic forces. Due to this significant risk, and associated health and environmental hazards, mines have to comply with specific legislation. Different approaches for the prediction, monitoring and mitigation of dust in the atmosphere can be implemented to assist mines in preventing dustfall exceedances. This study evaluated the change in the dust risk profile for a platinum tailing storage facility (TSF) with the construction of another TSF alongside it to form a complex. The combination of model outputs was used to derive target areas for dust suppression and delineating dust risk zones to stratify the most appropriate management actions. Different scenarios were tested and evaluated. Each scenario represented a sequential tailings deposition phase with the new TSF at different heights. The model outputs from each scenario were compared to assess the changes in dustfall that will occur through deposition. For each scenario, three models were combined. The Single-event Wind Erosion Estimation Program (SWEEP) was used to derive emission factors, Airflow modelling was used to determine the areas with high shear stress and AERMOD was used to predict the dispersion of fugitive tailings particles (PM_{10}) into the air. The results show a significant difference in the daily average dust fallout for each scenario. The combination of the outputs for these scenarios gives one the ability to assist mines with targeted, effective and affordable solutions that fit the dust risk profile.

Keywords: *Mine Waste, Tailings Storage Facilities (TSF), fugitive dust, modelling, PM_{10}*

SCIENTIFIC PAPERS

EVALUATION OF THE THERMAL PERFORMANCE AND EMISSIONS IN A SEMI-CONTINUOUS COAL STOVE

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Abstract

Coal still remains a primary energy source for residents of informal settlements in South Africa, which can mainly be attributed to the affordability and accessibility of coal as well as its dual utility in coal stoves. Traditional coal stoves, such as imbaulas and Unions stoves, are used as both cooking devices and sources of heat during the colder winter months. The use of traditional coal stoves is the single greatest contributor to poor indoor air quality and is associated with a variety of health risks, including respiratory infections, cardiovascular diseases, carbon monoxide poisoning and death. The ignition phase of traditional coal stoves is of special concern since the majority of harmful pollutants are emitted during this time.

In this study, a semi-continuous coal stove that was specifically designed for the South African market is tested using coals of different grade. The design of the stove allows for semi-continuous operation over long periods of time, which reduces the amount of ignition phases, and the associated high intensity release of emissions.

The overall thermal efficiency of the stove is determined from continuous monitoring of the internal and external temperatures of the stove, while the specific cooking efficiency is evaluated from water boiling tests. The coal burning rate is indicative of the power output of the stove, and is determined by continuous measuring of the mass loss of coal during operation.

The emissions are continuously monitored, using an array of analysis techniques, in order to quantify the amount of CO, CO_2, O_2, NO_x, SO_2, and particulate matter in the chimney effluent, while the total volatile organic compounds are determined for the complete run. The reduction in emissions was quantified in relation to traditional coal stoves. In this study, it is further aimed to formulate an experimental protocol by which heating and cooking devices can be tested. The experimental data collected from this study can be used as input to computational fluid dynamics (CFD) models, as to further optimize the design of the stove.

Keywords: *Indoor air quality, coal stove, emissions, particulate matter, thermal performance, energy efficiency*

LONG-TERM WRFCHEM MODELLING AND VERIFICATION OF WET AND DRY DEPOSITION OVER THE HIGHVELD OF SOUTH AFRICA

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Abstract

Acid deposition has been studied extensively over the Highveld region of South Africa, due to its high density of emissions arising mostly from power generation, petrochemical plants and household fuel combustion. The Weather Research and Forecasting model coupled to Chemistry (WRF-Chem) was used to model emissions of acidic precursors, namely SO_x and NO_x, their chemical conversions, as well as their wet and dry deposition for the Highveld region. Modelled acidic deposition results were verified against wet and dry deposition data calculated by a previous study using measured concentrations and rainfall data. The modelled deposition was not compared to comprehensive field deposition measurements. Modelled annual Sulphur (S) wet deposition for 2006 and 2007 correlated reasonably well with the 30 measurement sites. Annual total S wet deposition was modelled to exceed 3 kg/ha/year and 2.5 kg/ha/year for 2006 and 2007 respectively. The lower wet deposition observed in 2007 can be attributed to a lower total annual rainfall for this year. Dry deposition model results did not perform as well when compared with measured data, the dry deposition modelled results where 384 – 391% higher than the inferred dry deposition. However, the inferred dry deposition values are inferred from ambient air measurements where ambient concentrations were multiplied with a deposition velocity which was determined based on modelling of meteorological conditions and thus could introduce inaccuracies to measured results.

Keywords: *WRFChem; Acid Deposition; Modelling; Highveld; Power Generation; Vaal Dam*

SCIENTIFIC PAPERS

SIMULATING THE URBAN HEAT ISLAND OVER THE CITY OF TSHWANE

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Abstract
Urban areas within South Africa are rapidly growing, and are projected to continue to grow. During this time, these growing cities will also be impacted by global change. It is projected that surface temperatures across southern Africa will increase at a rate faster than the global average, which can have large impacts on human health. Additionally, this increased urbanization can increase the urban heat island (UHI), where urban areas experience higher temperatures than surrounding rural areas. This urbanization can also lead to deterioration of air quality. Exposure to both air pollution and high temperatures at the same time can exacerbate the potential risk to human health; thus, it is important to assess these environmental exposures together. High-resolution urban climate modelling that considers the urban form is necessary in order to resolve the UHI. In addition, in order to simulate climate-air quality linkages and impacts under climate change, high-resolution climate model output that accounts for the urban form is a necessary input into air quality models. This study presents the simulation of the urban climate, specifically the UHI, in the City of Tshwane. In this analysis, the screen temperature (temperature 2-meters above surface) was used due to its relevance to health impacts. All of the common characteristics of UHI were seen in the simulated temperatures. The urban areas were simulated to be warmer than the rural areas, with the peak difference at night-time. The UHI was most visible in minimum screen temperatures. The increases in screen temperature were seen over areas with higher urban fraction. On a seasonal scale on average for the domain, the UHI was larger in May-August, when Tshwane experiences calm and clear conditions. The simulated vertical temperature also showed an increase in temperature, i.e. a bubble of warm air, over the urban areas.

Keywords: *Climate change and air quality linkages, urban climate, urbanization, urban air pollution*

USE OF UNMANNED AERIAL VEHICLES FOR FUGITIVE EMISSION CHARACTERISATION

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Abstract

Management of fugitive emissions starts with a reliable assessment of the priorities for treatment, which in turn depends on an understanding of the relative magnitude of the emissions of multiple sources on a site. Measuring fugitive emissions is complicated and potentially expensive, especially if the source is relatively diffuse and measurement conditions are difficult. The rise in popularity of Unattended Aerial Vehicles (UAV) or drone technologies potentially presents some interesting opportunities. This paper reports on fugitive measurement of dust and combustion gases from various sources on a metallurgical site using an Argras M1S UAV with relatively conventional monitoring devices.

A literature review indicated that UAVs were being used for similar projects but that the instrumentation was generally subject to weight limitation and generally used a proxy measurement, sometimes corrected with measurement from a local ground station for calibration. Often the focus was on direct measurement of concentration close to a source, particularly where the source was relatively inaccessible.

The practicalities of operating UAVs are demanding and many facilities and regions ban or restrict their use. We were able to secure permits and clearances to operate. The sampling then required coordination between the technician, pilot and operations personnel.

The measurement equipment was calibrated before and after each campaign. The UAV carried the equipment 10 m below it. A regular pattern was flown so as to intersect the plume repeatedly, insodoing measuring a cross-section of the plume concentrations. An integrated concentration profile was thus measured. Wind speed data transformed concentration to a flux, allowing the technician to calculate a total emission from the notional fugitive release.

The method was successfully applied, and a variety of sources were mapped and characterised using this technique. There are several ways in which the technique could be automated and improved but it represents a promising approach to assist managers deal with diffuse sources. The data was collected as part of a commercial campaign and is not presented in this paper.

Keywords: *Fugitive emission, source ranking, UAV, sensors, dust, sulphur dioxide, drone*

SCIENTIFIC PAPERS

CHARACTERISATION OF ATMOSPHERIC PARTICULATE MATTER FROM OPENCAST COAL MINING ACTIVITIES AND ADJACENT COMMUNITIES

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Abstract

Microscopic and spectroscopic techniques were applied for the characterisation of atmospheric particulate matter (PM) samples collected from opencast coal mines and surrounding communities in the Mpumalanga and Limpopo Provinces in South Africa. The applied techniques include Scanning Electron Microscopy (SEM) with Energy Dispersive X-ray Spectroscopy (EDS), reflectance microscopy (reflectance), optical microscopy, X-Ray Photoelectron Spectroscopy (XPS), Raman Spectroscopy (Raman) and Thermogravimetric Analysis (TGA). Atmospheric PM samples of ≥10 microns (μm) or smaller were sampled through active ambient PM10 monitors (Minivols) and passive diffusive samplers. The passive diffusive samplers were placed within three opencast coal mines, i.e two opencast coal mines in the Mpumalanga Province and one in the Limpopo Province. The samplers were also placed in three community areas i.e Delpark (Delmas) and Clewer (Emalahleni) in Mpumalanga Province and Marapong (Lephalale) in the Limpopo Province. The morphological characteristics, particulate dimensions and chemical compositions of atmospheric PM samples from opencast coal mining activities and adjacent communities could be characterised using the combination of SEM-EDS. Furthermore, SEM-EDS analysis enabled the differentiation of elemental carbon (EC) and brown/ organic carbon (OC). Reflectance analysis of the atmospheric PM samples did not yield comprehensive results due to the resolution limits of the light microscope. For XPS analysis, information on the surface chemical compositions of the atmospheric PM samples was obtained and comparisons were made with chemical composition information obtained from SEM-EDS. However, instrument limitations did not permit further XPS analysis to differentiate between EC and OC for the purposes of emission source identification. Raman spectra were observed for the opencast mines and communities' atmospheric PM samples. The use of optical microscopy enabled the quantification of atmospheric PM concentrations, the determination of atmospheric particulate dimensions and morphological characteristics, although with lesser detail when compared to SEM-EDS results.

Keywords: *SEM-EDS, characterisation, atmospheric PM, elemental carbon, organic carbon, reflectance, morphology, opencast, dimensions, concentrations.*

ESTIMATED EMISSIONS OF DOMESTIC WASTE BURNING IN SOUTH AFRICA

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Abstract

There are harmful air pollutants that are emitted from domestic waste burning. However, the emissions from this activity are not well quantified in South Africa. This paper presents the spatially-resolved estimated quantity of municipal solid waste burned in South Africa at a small area level, as well as the recent trends in emissions. Determining the amount and the spatial resolution of waste burning has been a challenge due to the lack of data availability. Estimated emissions of harmful air pollutants were calculated using Stats SA's General Household Survey and the waste generated per person. Estimated emissions calculated include CO_2, CO, CH_4, HCl, Benzene, PAH, PM_{10}, $PM_{2.5}$, NO_x, SO_2 and NMOC. North West and Eastern Cape regions are the highest emitters of the emissions under study. All regions showed an increase in all the emissions estimated over the period of study. The results obtained demonstrate that emitted emissions of greenhouse gases, particulate matter, hazardous air pollutants and trace gases are substantial.

Keywords: *Domestic waste burning, Municipal solid waste generation, Emission inventory.*

SCIENTIFIC PAPERS

ARE AIR QUALITY OFFSETS JUST?

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Abstract

Air quality offsets are intended to counterbalance the harm caused by atmospheric emissions and deliver a net ambient air quality benefit in the affected airshed. In practice, they are implemented as a condition of leniency from compliance with the Minimum Emission Standards, and they focus on converting solid fuel burning households in low-income communities to cleaner forms of energy. Air quality offsets are not supported by all stakeholders, with non-governmental organisations in particular voicing vociferous objections. To date, there have only been very limited analyses of the ethical dimensions of air quality offsets. In this paper, air quality offsets and the Minimum Emission Standards are examined and compared from the perspective of three notions of environmental justice: distributive justice, which focuses on the distribution of environmental burdens and benefits; procedural justice, which considers inclusion and exclusion in decision- and policy-making processes; and justice as recognition, which focuses on the cultural and institutional processes that determine recognition, misrecognition and non-recognition of various groups. It was found that air quality offsets should promote distributive justice because they are focussed on reducing exposure to air pollution in vulnerable, low-income communities that are exposed to the highest levels of ambient pollution. It is proposed that a basis for equivalence, ideally based on the health risk of air pollution, is needed to ensure that the benefits achieved through offsets are equivalent to those that would have been achieved through compliance with the Minimum Emission Standards. From a procedural justice perspective, South Africa's legislative processes provide for involving most stakeholders in decision-making processes. Studies informing the setting of the Minimum Emission Standards, and initial research by project teams into the effectiveness of implemented offset interventions, need to be published to facilitate access for affected communities to key information.

Keywords: *Air quality offsets, minimum emission standards, environmental justice*

CHARACTERISATION OF SEMI-VOLATILE HYDROCARBON EMISSIONS FROM DIESEL ENGINES

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Abstract

Exhaust emissions from diesel vehicles have recently been receiving global attention, due to potential human health effects associated with exposure to emitted pollutants. In addition, a link has recently been established between unburnt hydrocarbon (HC) emissions from diesel engines and photochemical smog. Despite being present at very low concentrations in the exhaust, these HCs may act as precursors in the formation of photochemical smog pollution. While short-chain HCs are easier to characterise and have been successfully reduced in many developed cities, longer chain HCs, most likely arising from diesel exhaust emissions, have been poorly quantified and to date a limited range of HCs from this source has been studied. In this study, transient cycle tests were conducted to collect exhaust emissions from a Euro 3 compliant, 1.6 L test engine fuelled with three diesel fuels (SAM10, PAR10 and EUR10), using portable denuder samplers which were analysed by thermal desorption-comprehensive 2D gas chromatography-time of flight mass spectrometry (TD-GC x GC-TofMS). The SAM10 diesel had the greatest n-alkane emissions with greater emissions observed in the earlier phases (low and medium phase) of the WLTC cycle. PAR10 diesel had the second highest n-alkane emissions and EUR10 had the lowest n-alkane emissions amongst the three fuels. Substituted alkyl benzenes were also detected in the gas phase emissions from each fuel. The results showed that long chain HCs were present at easily detectable concentrations in diesel engine exhaust emissions, which is critical in understanding their contribution to photochemical ozone and informing appropriate mitigation and management strategies.

Keywords: Photochemical smog, hydrocarbons, ozone, diesel exhaust emissions,
ozone formation potential, emission factor

SCIENTIFIC PAPERS

MORPHOLOGY AND ELEMENTAL COMPOSITION OF COAL PARTICLES EMITTED FROM DOMESTIC COAL BURNING BRAZIER

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Abstract

This study was conducted in a laboratory-controlled environment aiming at studying the physical properties and elemental composition of coal combustion smoke particles emitted from a brazier. Particles were sampled ~1 m above the stove using a partector, where particles were collected on gold TEM grids and polycarbonate filters for transmission electron microscopy (TEM) and inductively coupled mass spectrometry (ICP-MS) analysis, respectively. Particles for elemental analysis were sampled ~ 1 m above the stove using a Gillian pump where particles were collected using a 37 μm polycarbonate filters. During sampling, a 2.5 μm cyclone was attached to the sampling cassette to isolate larger particles. The results have shown that combustion particles emitted during the early stage of combustion where single spherical particles with a diameter of around 450 nm. As the combustion progresses, the particle diameter gradually decreases and the morphology changes to accretion chain and fluffy bead structure for the flaming and char burning phase, respectively. The study results imply that smouldering coal combustion condition may be a major source of atmospheric spherical organic particles (SOP), which need to be included during source inventory development. Over 50% of trace elements dominated by silicon were released during the char burning phase. Since silicon was used as a marker for coal combustion emission. We therefore, confirmed that the spherical particles with characteristics of tar balls were generated from the small-scale coal combustion.

Keywords: *Physical properties, TEM, ICP-MS, elemental composition*

THE ASSESSMENT OF THE EXTERNAL COSTS OF DUST FALLOUT IN BLYVOORUITZICHT GOLD MINING VILLAGE

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Abstract

Mining is important for the South African economy, as it is for many developing African nations. In 2017, mining was reported to contribute 6.8 % to the South African GDP and provided more than 460,000 jobs. Though mining adds an enormous amount of value to the country, it has significant impacts on the environment and the socio-economic factors of a society. The well-documented environmental impact of mining operations on surface and groundwater systems, known as Acid Mine Drainage (AMD), is just one of these environmental impacts. There are also other impacts such as the pollution of agricultural soils, the creation of sinkholes and air pollution. For example, airborne dust remains a persistent problem in South African urban areas due to the climatic conditions, extensive surface mining, unrehabilitated tailings dumps and mineral processing. However, very little is reported on the socio-economic costs that are due to poor environmental management. Some scholars assert that despite the Mine Health and Safety Act, deposition monitoring guidelines and national dust regulations, South Africa still experiences persistent dust problems, especially in coal and gold mining districts. This paper investigates the effect of gold mining dust pollution in and around Blyvooruitzicht Gold Mining Village, in South Africa. A quantitative and qualitative approach was used, where the community of Blyvooruitzicht was interviewed to examine their perceptions on dust pollution and their socio-economic environment. This paper examines how poor and premature mine closure by liquidation results in unrehabilitated mine tailings and how this has significant impacts on the socio-economic status of individuals and surrounding businesses. The community of Blyvooruitzicht being investigated in the paper, perceives the dust fallout impact to be a socio-economic threat. The paper finds that the community believes it incurs financial expenditures due to treating respiratory related diseases triggered by dust fallout.

Keywords: *Mine liquidation, mine closure, Blyvooruitzicht, dust, socio-economic costs, perceptions*

SCIENTIFIC PAPERS

DUST DEPOSITION VALIDATION STUDY USING THE ASTM D1739 – 98 (REAPPROVED 2017) METHOD THREE DIFFERENT CONTAINER DIMENSIONS AND WINDSHIELD

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Abstract

The Department of Environmental Affairs (DEA) has reviewed methods for measuring dustfall in terms of the National Dust Control Regulations (NDCR). DEA recommended that the American Standard Test Method D1739 Method for Measurement of Dustfall (Settleable Particulate Matter) be retained but updated to the current version ASTM D1739–98 (Reapproved 2017). Changes include a windshield fitted to the sampling stand, a move to dry sampling and reporting metrics differing from the units in the NDCR. The South African Bureau of Standards has adopted ASTM D1739–98 (R2017) with modifications. Promulgation is anticipated in November 2019, after which dustfall monitoring networks will need to upgrade to include a windshield and containers that meet the standard dimensions: "An open-topped cylinder not less than 150 mm in diameter with height, not less than twice its diameter." Strict adherence to the dimensional specification for containers will require either manual manufacture or a purpose-designed injection mould. Either option would add considerably to monitoring costs. Plastic buckets shallower than the specification are commercially available at a lower cost. A trial was conducted to compare sampling efficiencies of three containers of different dimensions to justify a possible deviation from the ASTM D1739–98 (R2017). Dimensions of the containers were: (a) a hand-manufactured container meeting the exact ASTM D1739 dimensions – Diameter = 150 mm, Height = 300 mm, D:H = 2.00; (b) a 6 L bucket, D = 170 mm, H = 270 mm, D:H = 1.59; and (c) a 5 L, D = 170 mm, H = 230 mm, D:H = 1.35. Samplers with each of these containers were co-located at seven sites near mine tailings facilities in Johannesburg, and operated for 12 months, September 2018 to August 2019. Results are presented with conclusions as to whether the dimensions of the commercial buckets may be regarded as equivalent and able to justify a modification of the South African implementation of the ASTM1937 dustfall method. Other compliance issues related to the length of the sampling period and the units of reporting are discussed.

Keywords: Dustfall, windshield, ASTM D1739, dust deposition, windblown dust, National Dust Control Regulations

DEVELOPMENT OF A NON-INDUSTRIAL EMISSIONS INVENTORY FOR A COASTAL REGION

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Abstract

Emission inventories are the most important input for air quality modeling. They represent the mass of pollutant (or any necessary chemical species) entering the model domain for a specified period of time. A variety of emission sources can contribute to pollutants within a given domain; and the region itself may play a role regarding which sources are relevant. For example wind-blown dust would be important for arid regions while biogenic emissions would be important for heavily vegetated regions.

The CSIR Climate and Air Quality Modeling group are conducting research around the impact of a Urban Heat Island on air quality within current and future climate time scales. The region of interest is around the eThekwini Municipality; however the model domain is comprised of a majority of KwaZulu-Natal. This necessitates inclusion of coastal specific emission sources such as shipping and ports as well as marine aerosol and VOC. Other sources such as biomass burning, domestic fuel combustion and waste burning may also exhibit regional specific characteristics. For example biomass burning will include sugar cane burning while waste composition and burning practices are likely to be different to those on the Highveld.

This paper aims to describe the approaches used to develop the emissions inventory for the model domain encompassing eThekwini. These emission estimates are also compared to readily available global high-resolution inventories. The results and lessons learnt show the importance of including domain specific information.

Keywords: *Emissions, modeling, Durban, marine emissions*

SCIENTIFIC PAPERS

CHARACTERISING SOURCE CONTRIBUTION OF PARTICULATE MATTER IN WEDELA, GAUTENG

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Abstract

The impacts of mining residue areas on residential areas were explored in this research. The aim of this study was to characterize the source contribution to ambient particulate matter in Wedela using a receptor model. The study was broken down to three stages which are 1) quantifying the absolute ambient loading of $PM_{2.5}$ and PM_{10}, 2) determining the chemical composition of the aerosol loading in the course and fine fraction and 3) determining the source contribution using a receptor model. The data for the study was collected via two methods, namely: continuous monitoring and sampling campaigns. Two Met One EBAM plus instruments were located at the site and every season; two weeks were set apart for sampling. Teflon and quartz filters were used for sampling - these filters underwent treatment prior to exposure. Treatment of quartz filters included them being baked at 500°C, cooled in a laminar flow hood and then weighed before they were deployed into the field. After exposure the filters were dried in a laminar flow hood and then weighed again before analysis. The collected samples were analyzed for various constituents, including elements and soluble inorganic ions. The filters used in the sampling campaigns were analyzed to determine the chemical composition of the sample through X-Ray Fluorescence and Ion-chromatography. The results indicate the Wedela does not exceed the National Ambient Air Quality Standards for both PM_{10} and $PM_{2.5}$. The potential sources that can be identified for Wedela are fugitive dust (paved and unpaved road dust, wind-blown dust, dust from industrial activities), domestic fuel burning, vehicle emissions and waste incineration.

Keywords: *Particulate matter, tailings storage facilities, dust.*

APPLICATION OF PASSIVE DIFFUSIVE PARTICULATE MONITORS FOR INDOOR MEASUREMENTS

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Abstract

A previous paper reported on the local development and calibration of a passive monitor for ambient particulate matter. We now report on the use of the monitor for the monitoring of indoor particulate concentrations during interventions in household energy supply and house insulation in Lebohang on the Mpumalanga Highveld. Monitors were exposed for three days and seven days during summer (15 houses sampled) and winter (20 houses sampled). In addition to the normal glass collection substrate, samples were taken using a polycarbonate substrate to allow EDX analysis with scanning electroscope microscopy. The inferred daily particulate concentration ($PM_{10-2.5}$) exceeds the ambient PM_{10} daily limit value by a considerable margin both in winter and in summer. The origin of the particles in this size range cannot be linked directly to the energy supply activities in the households. Chemical analysis using SEM indicate that most of the coarse particles are of mineral origin. The inference to be drawn is that management measures to reduce community dust exposure in residential areas should not be limited to combustion processes but should also address other fugitive dust sources such as unpaved road dust.

Keywords: *Passive particulate monitor, indoor particulate, household air pollution.*

SCIENTIFIC PAPERS

HARBOUR AND INTRA-CITY DRIVERS OF AIR POLLUTION: FINDINGS FROM A LAND USE REGRESSION MODEL, DURBAN, SOUTH AFRICA

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Abstract

A land use regression model (LUR) was developed to characterise long term effects of air pollution exposure, in Durban, South Africa. By applying the European Study of Cohorts for Air Pollution Effects (ESCAPE) methodology, particulate matter (PM_{10} and $PM_{2.5}$), sulphur dioxide (SO_2), and nitrogen dioxide (NO_2) was measured over a period of one year and regressed against potential predictor variables. Sampling was undertaken in two regions of Durban, one with high levels of heavy industry, and the other small scale business activity. Air pollution concentrations showed a clear seasonal trend with higher concentrations being measured during winter (26 µg/m³, 4 µg/m³, 50 µg/m³, and 21 µg/m³ for NO_2, SO_2, PM_{10} and $PM_{2.5}$ respectively) as compared to summer (11 µg/m³, 3 µg/m³, 20 µg/m³, and 8 µg/m³ for NO_2, SO_2, PM_{10} and $PM_{2.5}$ respectively). Furthermore, higher levels of NO_2 and SO_2 were measured in south Durban as compared to north Durban as these are industrial related pollutants, while higher levels of PM were measured in north Durban as compared to south Durban and can be attributed to either traffic or domestic fuel burning. The LUR NO_2 models for annual, summer and winter explained 73%, 60% and 59% of the variance with elevation, traffic, population, open space, harbour and a regional variable being identified as important predictors. The SO_2 models were less robust with lower R^2 annual (37%), summer (49%) and winter (33%) with industrial and traffic variables being important predictors. The R^2 for PM_{10} models ranged from 59-66% while for $PM_{2.5}$ models this range was 62%-73% with only total length of major roads emerging as a predictor. Variables such as urban area and length of minor roads remained statistically insignificant in each model. While these results demonstrate the influence of industrial and traffic emissions from major roads on air pollution concentrations, this study highlights the importance of regional and harbour variables serving as a proxy markers for industry as done in other parts of the world (example the Netherlands). Industry stack emissions can be better represented using an air pollution dispersion model.

Keywords: *Air Pollution Monitoring, Land Use Regression Modelling, Exposure Assessment*

AN ONLINE TRACKING AND EVALUATION SYSTEM FOR SOUTH AFRICA'S NATIONAL CLIMATE CHANGE MITIGATION AND ADAPTATION ACTIONS

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Abstract

The National Climate Change Response Policy (NCCRP) (DEA 2011) and the National Development Plan (NDP) (NPC 2013) highlight the importance of understanding South Africa's progress in moving towards the climate resilient and lower carbon economy and society. To this end, both policies call for setting up a national monitoring, evaluation and reporting system for climate change information. As part of the Paris Agreement, countries agreed to an enhanced transparency framework for action and support. Transparency and reporting of progress in responding to climate change are at the heart of the Paris Agreement and as such South Africa, along with other countries will need to enhance reporting on climate actions and their effects, among other things. South Africa needs to strengthen national institutional and technical capacities to meet the enhanced transparency requirements of the Paris Agreement. South Africa submitted its Nationally Determined Contribution to the United Nations Framework Convention on Climate Change (UNFCCC) in September 2015.

This project created a tracking and evaluation (T&E) system for South Africa that records national actions for mitigation and adaptation alongside associated data, including challenges, targets, investment, indicators and wider impacts. The T&E System provides an excellent data gathering system for information related to mitigation and adaptation climate actions and their support. It provides a central archive and database for producing an array of reports and data visualisations to inspire and drive action at a national level. The information added during this project provides an excellent starting point for future data gathering, refinement and output generation on national progress and ambition and on how sub-national activities are contributing. The system is designed to be a living resource of high-quality information tracking climate action, the challenges, progress and ambition. It needs to be continually kept up to date as policies develop, new analysis is done, and actions are implemented. With a suitable governance and data flow in place, the T&E system will provide timely, transparent and reusable outputs for a range of different audiences and drive and inspire action.

Keywords: *Climate Change, Adaptation, Mitigation, Tracking, Evaluation, National System, Climate Change Action*

SCIENTIFIC PAPERS

AN INVESTIGATION OF TEMPORAL AND SPATIAL CORRELATIONS BETWEEN CITIZEN SCIENCE ODOUR REPORTS AND GAS MEASUREMENTS FROM OPEN-PATH UV-DOAS

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Abstract

Over the last few years, the Create Lab at Carnegie Mellon University has developed and deployed a citizen science tool called "Smell Pittsburgh" (SmellPGH). Citizen science addresses issues through collaboration between experts and citizens. The SmellPGH mobile phone application allows anyone to document air quality issues where they are. The application crowdsources odour complaints from smartphones resulting in a qualitative olfactory dataset that is tagged in time and space. The complaints are also submitted to the Allegheny County Health Department (ACHD) in the required format. Olfactory data is not quantitative so it is difficult to put into the context of typical air quality data. In conjunction with the Create Lab and the Heinz Foundation, Argos Scientific has deployed an open-path Ultraviolet Differential Optical Absorption Spectroscopy (UV DOAS) air monitoring system near potential sources and receptors in the Pittsburgh airshed. The instrument is capable of obtaining 5-minute quantitative readings for aromatic gases including benzene, as well as sulphur gases including sulphur dioxide (SO_2) and several other gases. The system is co-located with particulate matter sensors from ACHD. With the spatial coverage of the thousands of SmellPGH users and the rapid sampling of gases with the UV DOAS system, both qualitative and quantitative information is generated with the odour reports. This study summarises some of the work to date performed to integrate information sources. This includes showing the relationship between odour complaints and data collected by the UV DOAS system, as well as the integration of meteorological data to identify specific odour sources. In addition the data shows how analysis of the UV spectra collected from the instrument allowed the researchers to identify an industry that was not operating its plant to specification and was causing an increased impact on the surrounding communities.

Keywords: *Odour, UV DOAS, Air quality, Sulphur dioxide, Benzene*

CHEMICAL TRANSPORT MODEL VALIDATION OVER SOUTH AFRICA
Kabelo Mathibela
South African Weather Service, Pretoria, South Africa

ANALYSIS OF DIURNAL AND SEASONAL RELATION OF SURFACE OZONE, ITS PRECURSORS, METEOROLOGICAL PARAMETERS, AND TRANSPORT ANALYSIS OF OZONE EXCEEDANCES AT XANADU IN THE NORTH WEST PROVINCE.
Cheledi Tshehla
South African Weather Service, Pretoria, South Africa

THE TRANSPORT OF PM10 OVER CAPE TOWN DURING HIGH POLLUTION EPISODES
Koketso Molepo [1],*, Babatunde Abiodun [1], Rembu Magoba [2]
[1]University of Cape Town, Cape Town, South Africa
[2]Scientific Services, Water and Sanitation Department, City of Cape Town, Cape Town, South Africa

INCORPORATING POTENTIAL HARM INTO RISK CHARACTERISATION OF INHALABLE COAL DUST
Conchita Kamanzi*, A/Prof Jennifer Broadhurst, A/Prof Megan Becker, Dr Johanna von Holdt
Minerals to Metals initiative, University of Cape Town, Cape Town, South Africa

CERTIFICATION OF ISOTOPIC MOLE FRACTIONS OF CARBON DIOXIDE IN THE ATMOSPHERE
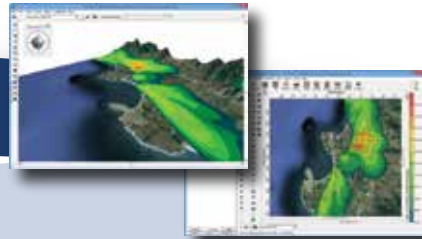James Tshilongo
National Metrology Institute of South Africa, Pretoria, South Africa

Notes

CALPUFF View

Long Range Puff Air Dispersion Model
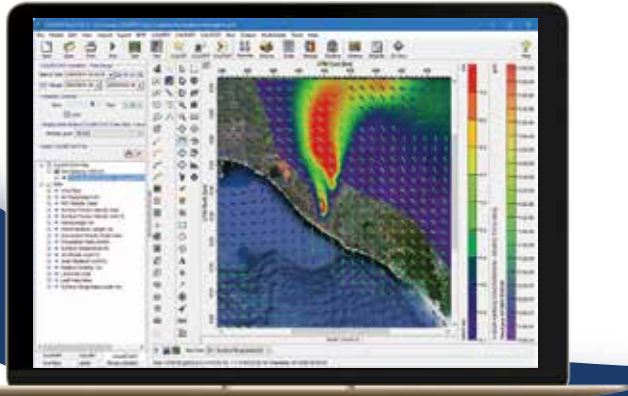
- Support for Latest US EPA Models
- CALMET Parallel
- Plume Animation
- Percentile & Rolling Averages
- Auto-Download of Maps
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Notes

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Clean Air Campaign

Making our air cleaner and better to breathe is the best thing to do for the health of our families, ourselves and our communities.

Let's do it together!

Generation Division