## Opportunities for using integrated methods for air quality assessment in Africa

UNIVERSITEIT VAN PRETORIA UNIVERSITY OF PRETORIA

**Rebecca Garland** Department of Geography, Geoinformatics and Meteorology, University of Pretoria, Pretoria, South Africa

Juanette John, Mogesh Naidoo Smart Places Cluster, CSIR, Pretoria, South Africa

29 March 2023

Make today matter

A. Annual average exposure to outdoor PM25 concentrations in Africa's major subregions



### Focus of today

- On-going work to provide some examples and thoughts of integrated work
- Much is focused on,
  - What can we do with the globally available information?
  - How can we improve it?
- Work is highly collaborative as we are a small group and we aren't experts in everything!
- Collaboration can help to address capacity constraints, and our most successful projects are when the leads are local.





#### Gauteng Province: Case study for urban air quality

- Gauteng Province, South Africa
  - Smallest in size, highest population (~15 million)
  - Economic center ~35% of country's GDP
- PM and ozone ambient levels exceed national standards → some decreases in levels seen
- **High spatially heterogenous** emission levels and sources, ambient concentration, vulnerability, impacts
  - Air Inequality: Highest PM in low-income areas
- **Mix** of strong anthropogenic and natural sources
- Impacted by local to regional sources (e.g., southern Africa biomass burning/fires)







https://2summers.net/2011/10/03/alex-joburgs-other-township/





## Emission inventories: largest uncertainty in air quality modelling and management

- Local data and understanding are key → Integration of many datasets
- Spatial and temporal heterogenicity of sources, concentrations and impacts
  - Large contributions from combustion of fossil fuel
  - Complex community-based sources
- eThekwini: Global coarser resolution (~10km) compared to finer local emissions inventory (1 km resolution)
  - What source can other regions improve (even if a little) with local data?
- Input data have many large assumptions → improvements possible with local information
  - GEIA African Working group
- Improved air quality modelling and management





# Using Reduced Complexity Models to improve air quality management

- "We want low-cost models as well as low-cost sensors!" Peter Adams (CMU)
- RCMs: Changes in emissions → Changes in ambient concentrations of PM<sub>2.5</sub> → Changes in impacts
- RCMs allow for scenario and impact assessment without the use of Chemical Transport Models (i.e. complex air quality models)
- Many forms of RCMs (including GAINS, InMAP, EASIUR, REACH)
  - Policy
  - Impact studies
  - Training
- There are uncertainties and data may be scarce, but what can they tell us?





### GAINS: Modelling to improve air quality management

- GAINS (Greenhouse Gas-Air Pollution Interactions and Synergies) model developed by IIASA → GAINS-JET
  - Emissions: CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O, SO<sub>2</sub>, NOx, NMVOC, CO, NH<sub>3</sub>, PM<sub>2.5</sub>, primary carbonaceous compounds of PM (BC, OC)
  - Ambient and health impacts: PM<sub>2.5</sub>
- GAINS had default values for South Africa, this project improved these.
- Modelling platform developed: local local local local where we knew we had better information
- Improve characterization of sources, ambient and impacts
- Multiple **policy scenarios** were analysed to support management
- Preliminary findings: Final stakeholder engagement outstanding













## **Concluding thoughts for discussion**

- Even with data scarcity, **there is some information** to improve our knowledge and test what is robust.
  - Updating global products with some local data we know are key
  - High-resolution and local information, needs, expertise
  - This can then highlight the key needs and gaps where uncertainty is too high
- In air quality management, the **open/accessible data needs are large and wide-ranging** 
  - Information on current implementation rates of industrial mitigation controls
  - Health data
  - Trace gas measurements are scarce across the continent
  - More detailed measurement data
- <u>Scenario</u>s. Translating development scenarios to air quality futures → CCAC/UNEP Integrated African Assessment will be invaluable; LEAP model will be publicly available. News item in current Clean Air Journal on Assessment and data access.
- Integrating information: Highly collaborative project with science and policy leads are local
  - Local lead key to downscaling global/regional information
  - Collaborative nature assists with local capacity constraints
- Local policy priorities will also drive questions, e.g. Just energy transition and improved energy access

#### <u>African group on atmospheric sciences (ANGA)</u> Summary of ANGA working group purpose



ANGA is a regional working group under the International Global Atmospheric Chemistry Program (IGAC)

- Enhance collaboration between African atmospheric scientists
- Enhance collaboration between African atmospheric scientists and international atmospheric scientists,
- Foster and enable the next generation of African atmospheric scientists,
- Provide a platform to highlight, share and discuss African atmospheric research in order to improve visibility and impact, and to work towards answering atmospheric research questions
- Define, develop and promote Africa-led research projects and programmes

Website: <u>http://igacproject.org/activities/african-group-atmospheric-sciences-anga</u> (join mailing

list at our website)

E-mail: ANGA.Mailing@gmail.com

Twitter: @ANGA\_AtmosSci





- Clean Air Journal has been publishing article on atmospheric science since 1971. The focus of the journal includes, but is not limited to:
  - Impacts of human activities and natural processes on ambient air quality
  - Air quality and climate change linkages
  - Air pollution mitigation technologies and applications
  - Matters of public policy regarding air quality management
  - Measurement and analysis of ambient and indoor air pollution
  - Atmospheric modelling application and development
  - Atmospheric emissions
  - Other topics on atmospheric physics or chemistry with particular relevance to Africa
- The scope of the journal is broad, but the core theme of the journal is air quality and atmospheric science in and of relevance for Africa.
- Indexed in many international indices including SCOPUS, SciELO-SA
- Free to publish and free to read

Website https://cleanairjournal.org.za/



Twitter @CleanAirJ

## **Concluding thoughts for discussion**

- Even with data scarcity, **there is some information** to improve our knowledge and test what is robust.
  - Updating global products with some local data we know are key
  - High-resolution and local information, needs, expertise
  - This can then highlight the key needs and gaps where uncertainty is too high
- In air quality management, the **open/accessible data needs are large and wide-ranging** 
  - Information on current implementation rates of industrial mitigation controls
  - Health data
  - Trace gas measurements are scarce across the continent
  - More detailed measurement data
- <u>Scenario</u>s. Translating development scenarios to air quality futures → CCAC/UNEP Integrated African Assessment will be invaluable; LEAP model will be publicly available. News item in current Clean Air Journal on Assessment and data access.
- Integrating information: Highly collaborative project with science and policy leads are local
  - Local lead key to downscaling global/regional information
  - Collaborative nature assists with local capacity constraints
- Local policy priorities will also drive questions, e.g. Just energy transition and improved energy access

