Offsets, one tool in the toolbox

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Toolbox

- Toolbox contains things that the country needs to improve ambient air quality
  - **Comprehensive, transparent, agreed upon modelling platform**
  - **Active regulator who decides on the interventions and policies in their airshed and has capacity required to decide on the needed suite of interventions, regulations and policies to improve air quality**
  - **Variety of regulatory levers**
  - Monitoring of ambient air pollutants
  - Enforcement
  - ….

Importance of modelling

- The goal of air quality regulations, policies, interventions is to bring **ambient air pollution into compliance with standards nationwide** in order to protect public health
- In order to design a set of intervention(s) or policy(ies) for an airshed, **modelling will be used to understand the potential impacts**
- Thus, your intervention – in this case offset – is only as "good" as your air quality (AQ) modelling is → True where magnitude matters
- Examples
  - Define success as improvement in indoor air – intervention can still be "good" even if AQ modelling is poor
    - Monitoring and attributing impact easier - but can still get complicated
  - Define success as improvement in ambient AQ
    - Much more complicated → **appropriate modelling is needed to correctly identify species, magnitude, and attributing marginal impact** of specific emitters or policies

Modelling magnitude correctly is key!

- Impact Pathway:

  emissions → transformation → ambient → exposure → uptake → impact

- As you continue down this, your uncertainty will increase → if you can't model ambient correctly, you can't model impact (e.g. health outcome) correctly
- There is a lot of **non-linearity** in these arrows
  - E.g. **secondary pollutants**
- Efforts to model ambient AQ are hindered by lack of comprehensive and open emissions inventory for air quality modelling use

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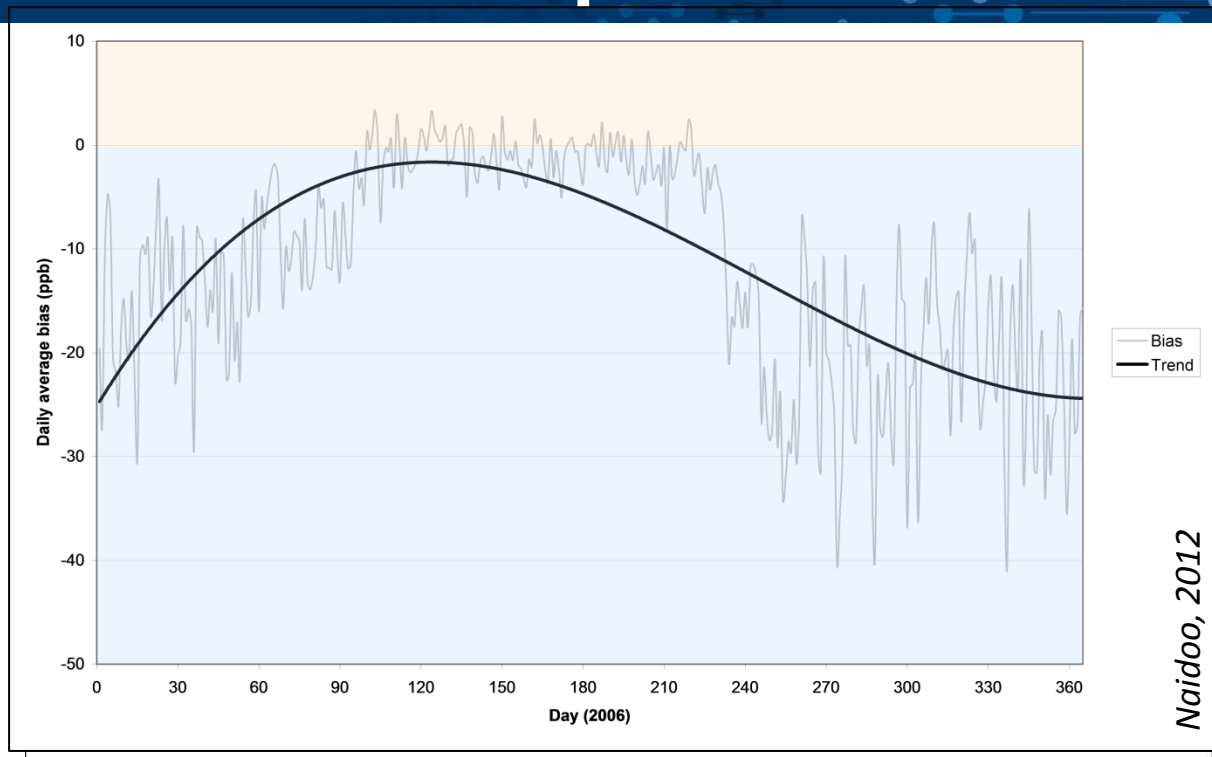
Examples of state of modelling

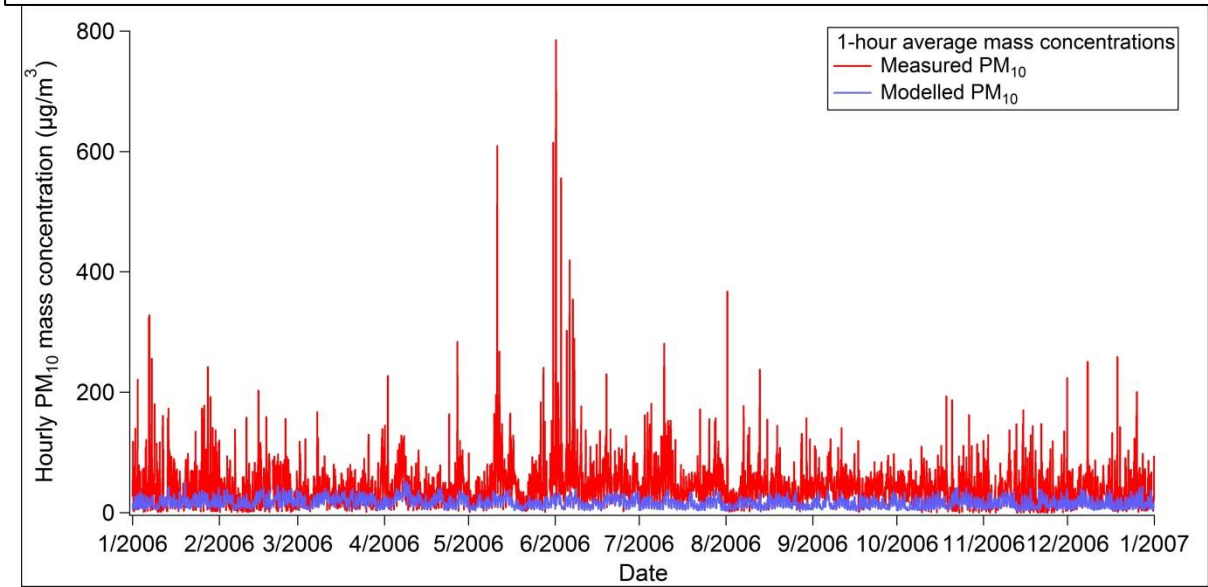
- Currently models are **far from getting magnitude of ambient concentrations correct**
- Example: Ozone and PM_{10} in Johannesburg were modelled with a chemical air quality model
- Emissions inventory contained a good representation of industry – traffic, biogenic, domestic fuel burning were captured – no biomass burning
- Emissions inventory was thus incomplete, represented a single year (2006) and was at a low spatial resolution of 12km (thereby not able to capture spatial distribution of smaller more disperse emitters). However the inventory did present a **valuable starting point** onto which further development is being carried out.
- Every project you have to create your own emissions inventory, build on the one you have – **not open, not agreed upon, not audited**

Modelled vs Monitored examples: Newtown

- This is what is available right now to make a decision on → **not good enough**
- No, our model is not particularly “bad”
- We are constantly working to improve emissions inventory as we can → but this is largest stumbling block to provide policy support
- **How can a regulator be certain of the impact of an offset without being able to accurately model it?**



Naidoo, 2012



What modelling capabilities are needed in toolbox?

- Modelling that the regulator has to work with must be more comprehensive
  - Need to understand the impact of specific policies and of suite of policies – no guessing
  - A regulatory environment that includes more complex levers (such as offsets) modelling is critical as outcome may not be straight-forward
- National effort is needed to develop agreed upon method and data flows to develop on a regular basis an open, accessible, agreed upon and comprehensive emissions inventory for use in air quality modelling and management
  - For modelling and management all emitters are important, including things like biogenic, biomass burning, marine aerosols, etc.
- The emissions inventory and process must be agreed upon –
  - Scientists
  - AQ modellers
  - Industry
  - Government across levels
- Model capabilities
  - Include transformation of pollutants (e.g. secondary pollutants, ageing)
  - Can capture acute and chronic impacts
  - Attribution of pollution to sources – on-line or through scenarios
  - Varying spatial resolution – including airshed and regional

Active regulator is key

- Improving air quality is difficult
- Innovative policy options can have the potential to aid in management
- But the design, implementation, and calculation of the impact of these policies can get complicated quickly if you want to be certain that you are actually having the desired effect
- **Active regulator is key**
- Active regulator who decides on the interventions and policies in their airshed and has capacity required to decide on the needed suite of interventions, regulations, policies to improve AQ

Example of active and sophisticated regulator

- National regulator gives policy options – e.g. offsets
- For an airshed the regulator needs to figure out what to implement – e.g. offsets
- There must be an agreed upon approach for the design of the offsets, its implementation and how to estimate its impact (modelling specifics) → well-thought out by regulator
- For offsets, it could be that controlled emitters follow this agreed upon approach to make proposals of their offset program
- The regulator can use the emitters modelling, can also model different scenarios with numerous proposal themselves – decide what is needed to improve air quality
- Once that regulator approves the plan →
  - Risk of ambient air not getting better on regulator
  - Controlled emitter is responsible that the offset project is implemented and MRVed as indicated in the accepted proposal
  - Needs to be consideration of who is responsible for things like shifting baseline

Example of an inter-pollutant offset program

- Modelling capabilities and an active regulator must be in place to support a complex policy like offsetting
- How should offsetting itself be structured?
- A few interesting points about inter-pollutant from an offsetting program that has been implemented → I am still talking with EPA to understand applicable lessons learned
- US EPA has many levers for pollution control, those that can include offsetting outlined in Economic Incentive Programs (EIPs) – US EPA 2001, *Improving Air Quality with Economic Incentive Programs*
- US EPA has a regulatory offsetting program that allows for inter-pollutant offsetting – there are many differences to South Africa, but still are some interesting points

Inter-pollutant offsets – $PM_{2.5}$

- NOx and VOC offsets are allowed as well for considering ozone, highlight today $PM_{2.5}$
- "Under the Clean Air Act, anyone seeking **to construct or undertake a major modification at a major stationary source** in an NAAQS nonattainment area must obtain emissions reductions, or ***offsets*, for the pollutant causing the area to be in nonattainment**. The offsets can be obtained from either the same source or other sources in the affected area.
- The 2008 policy explained that states could allow (aim decrease $PM_{2.5}$):
  - Reductions in direct $PM_{2.5}$ emissions to offset increases in emissions of sulfur dioxide (SO_2) or nitrous oxides (NOx), which are precursors in the formation of $PM_{2.5}$;
  - Reductions in emissions of one precursor to offset emissions increases of another precursor; *or*
  - Reductions in precursor emissions to offset direct $PM_{2.5}$ emissions increases." *http://enviro.blr.com/whitepapers/air/CAA-air-regulations/PM-2.5-Offsets/*
- In this, EPA came up with default offset ratios (Boylan, 2012)
  - SO_2 to Primary PM2.5
    - 40:1 (SO_2 tons for $PM_{2.5}$ tons) nationwide.
  - NOx to Primary PM2.5
    - 200:1 (NOx tons for $PM_{2.5}$ tons) in the eastern United States.
    - 100:1 (NOx tons for $PM_{2.5}$ tons) in the western United States

EPA 2011, revised policy for inter-pollutant trading provisions

- Obama EPA had litigation and administrative petitions filed against them about this Bush EPA rule → Obama EPA revised the policy
- "However, we will no longer consider the preferred ratios set forth in the preamble to the 2008 final rule for $PM_{2.5}$ NSR implementation to be presumptively approvable. Instead, any ratio involving $PM_{2.5}$ precursors adopted by the state for use in the inter-pollutant offset program for $PM_{2.5}$ non-attainment areas must be **accompanied by a technical demonstration that shows the net air quality benefits of such ratio** for the $PM_{2.5}$ nonattainment area in which it will be applied."

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EPA 2011, revised policy for interpollutant trading provisions

- "We expect existing models and techniques to be adequate for states to conduct local demonstrations leading to the development of area-specific ratios for PM2.5 nonattainment areas. The general framework for such developmental efforts would include the following steps:
  - 1) Define the **geographic area(s)** in which offsets between emission sources are allowed, i.e., nonattainment area(s).
  - 2) Conduct a series of **sensitivity runs** with appropriate air quality models to develop a database of modeled PM2.5 concentration changes associated with reductions of direct PM2.5 emissions and PM2.5 precursor emissions (e.g., S02 and NOx) from anthropogenic point sources within the area of interest. For precursor emissions, **a photochemical model** (e.g., CMAQ, CAMx) at grid resolution of 12 kilometers (km) or less is recommended to predict changes in PM2.5 concentrations. For direct PM2.5 emissions, **a dispersion model** (e.g., AERMOD) or photochemical model at grid resolution of 4 km or less is recommended to predict changes in PM2.5 concentrations.
  - 3) **Calculate the interpollutant** offset ratios for PM2.5 between direct PM2.5 emissions and precursor emissions in a manner similar to the EPA's 2007 technical assessment, i.e., the ratio of impact metrics from step 3, above. (tons of modelling guidance)
  - 4) **Conduct quality assurance** of resulting rations and evaluate their interpretation and appropriateness given the nature of PM2.5 sources and formation in the area of interest. This evaluation will likely require emissions inventory data and observed ambient data for PM2.5 and its component species."

Example of ratios calculated for specific plant (Boylan, 2012)

- Plant Washington
  - 850 MW Coal Fired Power Plant located in Washington County, GA
  - Boylan (2012) used "CAMx modeling to account for secondary PM2.5 impacts and ozone impacts from the proposed facility."
- SO_2 to Primary PM2.5
  - 40:1 for annual NAAQS (near source)
  - 10:1 for annual NAAQS (far from source)
  - 25:1 for daily NAAQS (Q3 - near source)
  - 5:1 for daily NAAQS (Q3 - far from source)
- NOx to Primary PM2.5
  - 85:1 for annual NAAQS (near source)
  - 40:1 for annual NAAQS (far from source)
  - 60:1 for daily NAAQS (Q3 - near source)
  - 20:1 for daily NAAQS (Q3 - far from source)

Reminder of "default"

SO_2 to Primary PM2.5

40:1 (SO_2 tons for $PM_{2.5}$ tons)

NOx to Primary PM2.5

200:1 (NOx tons for $PM_{2.5}$ tons) in the E US

100:1 (NOx tons for $PM_{2.5}$ tons) in the W US

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Sensitivities

Boylan (2012) reported the following

- “PM2.5 offset ratios vary with distance.
  - Maximum ratio is always near the source.
- PM2.5 offset ratios vary with season.
  - Can use seasonal ratio for daily PM2.5 ratio.
- PM2.5 offset ratios vary with grid resolution.
  - Need 4-km grid resolution (or less) to evaluate near source impacts, 12-km sufficient for more distant impacts.
- PM2.5 offset ratios vary with stack height.
  - Impacts of meteorology and chemistry are important near the source.
- PM2.5 offset ratios vary with emission rate.
  - Direct PM2.5 is linear, but SO2 and NOx are nonlinear near the source.”

Potential for South Africa to develop local ratios!(?)

Questions

- *What is a legitimate air quality offset?*
  - Depends on your definition of success – improve ambient air quality. Inter-pollutant: precursors and secondary pollutant
- *What is the ethical framework for considering air quality offsets?*
  - A key aspect will be minimizing uncertainty – are you really having a net improvement in AQ?
- *What is technically accounted for in air quality offsets? What is the currency of air quality offsets?*
  - Emissions. Emissions most conservative from uncertainty standpoint.
- *What are the uncertainties and risks associated with air quality offsets and how should we account for them?*
  - Your offset is only as good as your modelling capability and regulator

Thank you

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