Validation of newest developments within the Operational Street Pollution Model (OSPM)

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Outline

› The OSPM model
› Changes / Updates in OSPM
› Validation
› Application of OSPM for “Air Quality at your Street” for all addresses in Denmark
› Conclusion
Comments on OSPM (1/2)

› OSPM slightly older than Harmo conference (25+ years!) Developed at NERI by Berkowicz and Hertel since 1988

› Applied and validated many places worldwide

› Part of several AQM systems

K. E. Kakosimos et al.
Comments on OSPM (2/2)

- **Parameterised model**

- **Based on physics**
  - Direct plume
  - \[ \sigma_z(x) = \sigma_w \frac{x}{u_b} + h_0 \]
  - \[ \sigma_w = \left( \left( \alpha u_b \right)^2 + \sigma_{w_0}^2 \right)^{1/2} \]
  - \[ \sigma_{w_0}^2 = b^2 V^2 D \]

- Traffic produced turbulence

- Recirculation

- **How to re-estimate the parameters?**
  - "Ruwims" constant(s) 0.1 0.3 ...
  - (-> talk on Thursday)
OSPM - Present changes / updates

Short-term issues (urgent and “need to have”)

› General building height definition,
  › defined by OSPM for streets with many exceptions
  › DONE (-> Air Quality 2014)

› Asymmetric streets - DONE -> Air Quality 2014, Paper on way

› NO$_2$ fits well while NO$_x$ is underestimated
  › Chemistry?! Or Parameter estimation -> talk on Thursday

› Uroof / Umast - ratio ; parameter ‘fRoof’
  › changed from 0.82 to 0.4 when switching to COPERT emis.
  › Develop a ‘sub’ model to put this on more solid ground

› Are our travel speeds / emission factors right?
  › Change from now 40..50 km/h to 20…30 km/h
  › Double penalty: a) +++ emissions b) --- TPT
Change of traffic speed

New data based on GIS-based "SpeedMap"
Validation

- Using 5 street stations in DK
- Correlation usually high 0.7—0.8
- Focus on reducing the bias
  - Typical bias at street level ±20% for NO₂

Future

- More streets (SE, UK)
- Re-estimate several parameters in OSPM
Air Quality at your street

- **Background**
  - Citizens have great interest in information about air quality where they live, work, and their kids to kindergarten or school
  - Authorities also want to get information about AQ in relation to urban planning or complains
  - Used in epidemiological studies

- **Screening tool**
  - Working with national datasets
  - Might give ‘outliers’ at specific locations
AQ models

- **Regional background concentrations**
  - DEHM (Danish Eulerian Hemispheric Model)
  - Adjusted for PM mass closure
  - Geographic resolution 5.6 km x 5.6 km in DK

- **Urban background concentrations**
  - Urban Background Model (UBM)
  - Coupled to DEHM in one hour time step
  - Geographic resolution 1km x 1km
  - New: all SNAP emission sectors

- **Street concentrations**
  - OSPM (Operational Street Pollution Model)
  - AirGIS (automatic generation of input data to OSPM about traffic and buildings)
  - Geographic resolution: address level
Preprocessing of data

› National traffic model
› Building footprints + heights
› National address data
› AirGIS script to generate
Example of large discrepancy in Aalborg

- Street geometry at measuring station at Aalborg
- AirGIS model estimates street width to 21 m due to two small buildings
- Width of 41 m is more representative
- Modelled concentrations become too high
User interface in GeoExt
Urban background concentrations of NO$_2$
Street concentrations of NO$_2$
Urban background variations

- Traffic sources and ships emissions clearly visible
- Domained by long-rang and local sources hardly visible. Gradient from south.
- Domained by long-rang and local sources hardly visible. Sea salt visible.
Discussion of uncertainties and limitations

- generalised road network – if not edited – make unrepresentative street geometry
- AQ at ‘background addresses’ in cities outside LTM road network can be underestimated
- input data about traffic and interpretation of street geometry may not be representative
- direct contribution from motorways is underestimated
- AQ close to or exceeding limit values should be interpreted with caution due to uncertainty and requires more scrutiny of input data
Conclusion

- OSPM has been further developed and coupled with a revised version of the urban background model.
- Satisfying performance when evaluated with measurements.
- Air Quality at Your Street gives in general a fairly accurate picture of air quality and its geographic variation and relative difference between areas.
- But may be very wrong at single addresses.
Future work on OSPM

Long-term (“Nice to have” – wish list)

› More validation for Non-standard streets
  › Qatar .... HCAB .... Hong Kong ... LA
› buildings in different distances
› variable receptor position
  › Horizontal positioning of the receptor point
  › Height dependence

› street crossings
› calculate the influence of the nearby road network
Thank you for your attention

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