What is the present air quality in my street?
What is the present air quality in my street?

In 2017: nobody knows for sure...

Why? Air quality is very hard to measure!
Air Quality Monitoring: Current Situation

**Satellite (OMI)**
Once a day
13 x 24 km² at best

**Official urban network**
very sparse: 0-5 stations/city
but very accurate
Air Quality Monitoring: Trends

**Satellite (TROPOMI)**
- Once a day
- 7 x 3 km² at best

**Alternative city network**
- ~50 stations
- Less accurate

**Official urban network**
- Very sparse: 0-5 stations/city
- But very accurate

**Citizen network**
- 100-1000 stations, depending on price
- Inaccurate
How to make sense of heterogeneous data sources?

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Example: New NO$_2$ sensors

- AlphaSense NO2 series
- City Technologies NO2 series
- SGX SensorTech MICS-2714
- SPEC sensor 3SP-NO2-20
- KNMI NO$_2$ sensor

- Electrochemical
- Semiconductor
- Chemiluminescence
Electrochemical sensors useful or useless?

- Start-up time
- Sensor drift, aging
- Cross-sensitivity to e.g. ozone
- Temperature dependence
- Huge sensor-to-sensor variations in sensitivity
Urban AirQ
Waag Society, Longfonds, Universiteit Wageningen, ECN, KNMI
Urban AirQ campaign  (June-August 2016)
Urban AirQ campaign (June-August 2016)

Waag Society • GGD Amsterdam • ECN • Longfonds • Alterra • KNMI

• 16 low-cost sensors built with AlphaSense NO2-B
• Distributed among residents in Amsterdam living close to busy streets
• Calibration by comparing onsite to an official monitor
  — Improvements by including temperature and humidity
  — Different before and after the campaign and for each sensor
  — $R^2$ ranging
    • from 0.3 to 0.7 raw
    • from 0.6 to 0.9, including T, RH and drift corrections

Calibrated at GGD Vondelpark station, but validated against GGD Oude Schans

More info: Bas Mijling, mijling@knmi.nl
Urban Air Quality Data Analysis

• Hourly now-cast of air pollution at street level.

• Use heterogeneous monitoring sources (official/low-cost/satellite).

• Based on **open data**!

• Versatile: (relatively) easy to install the system for a new city.

RETINA is part of the KNMI DataLab
AiREAS Network Eindhoven

AirBox (by ECN)
30 stations measuring NO₂, PM, ozone

www.aireas.com
Goal: connect the dots!
Spatial interpolation of observations

Most important unknowns at the urban resolution are the air pollutant emissions.

Approximate these by proxies, such as traffic and population density.
## Data Sources

<table>
<thead>
<tr>
<th>obs</th>
<th>Hourly measurements by AiREAS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hourly measurements from LML</td>
</tr>
<tr>
<td>model</td>
<td>Road maps by OpenStreetMap</td>
</tr>
<tr>
<td></td>
<td>Traffic information by NDW</td>
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<tr>
<td></td>
<td>Meteorological information by KNMI</td>
</tr>
<tr>
<td></td>
<td>Background concentrations from CAMS</td>
</tr>
</tbody>
</table>

NB: All used data is open!
Simulated concentrations by proxy

17:00 (A) Highways

17:00 (B) Principal roads

17:00 (C) Population

17:00 (A) + (B) + (C) + Bg
Model performance at monitoring locations

After the proxy fields have been scaled to give the best correspondence with hourly measurements in March 2016.
Optimal statistical interpolation

NO$_2$ in Eindhoven at 3 March 2016, 17h UTC
Outlook

- Build operational now-cast system
- Apply to Amsterdam (Air Portal – ESA)
- Apply to Delhi
- Build forecast system (2-day, hourly)
- TROPOMI validation
- TROPOMI inclusion
- Include other pollutants (PM, ozone)
Questions?

Assimilated NO2, 3 March 2016

more info: Bas Mijling  📧 mijling@knmi.nl