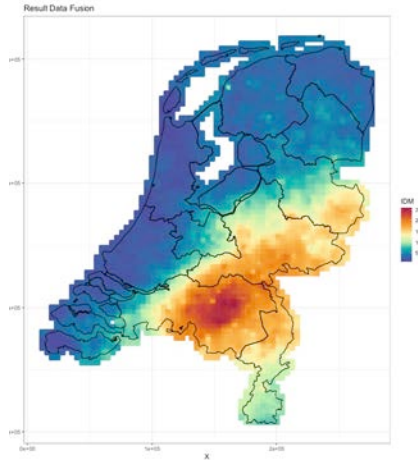


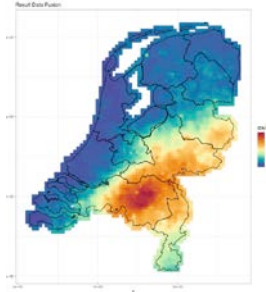
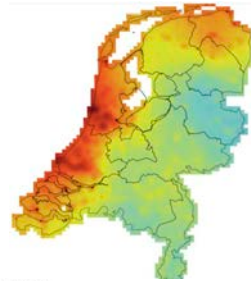
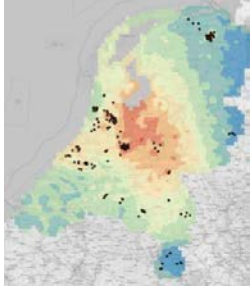
Benchmark of Data Fusion using sensor data

Joost Wesseling
Sjoerd van Ratingen



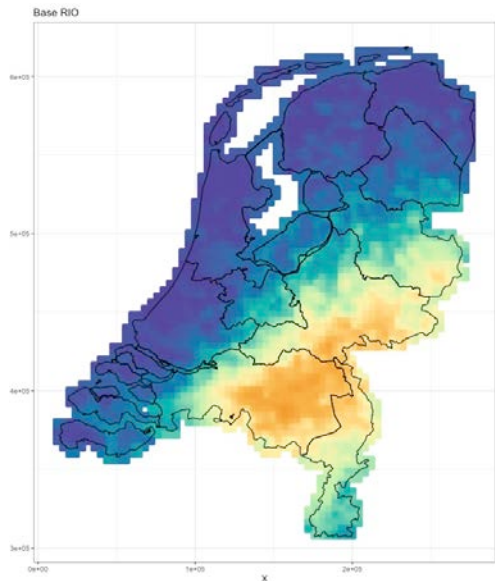
- Introduction
- A benchmark of data fusion methods
- Benchmark practicalities
- Interest?

- During 2021-2023, benchmark sensor calibration in FAIRMODE.
- Benchmarking is an important and useful process.
- The algorithms applied in the benchmark for network-calibration can substantially correct for the influence of environmental conditions on the performance of the SDS011 PM2.5 sensors.
- Next step in use of (low-cost) sensor data?

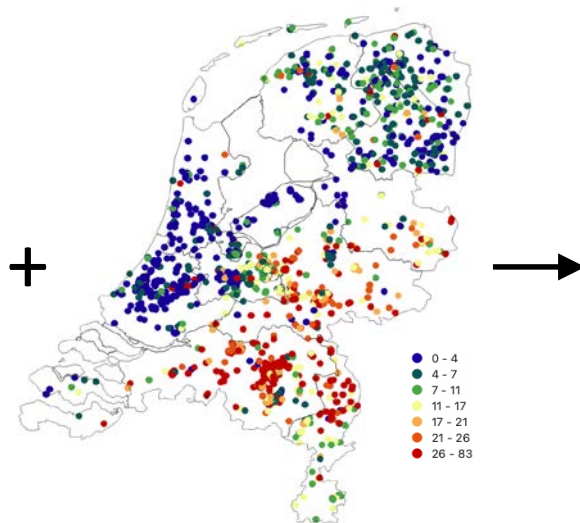


- A common situation is that we want to get a better estimate of the air quality in a specific area using the available (official) measurements, (low-cost) sensor measurements and often a (rough) estimate of the concentration field in the area.
- Data Fusion: Combine the available measurements, the calibrated sensors and the existing estimate(s) for the concentration field to obtain a better (more detailed) estimate for the concentration field.
- Other techniques to obtain a better estimate for the concentration field are also possible.

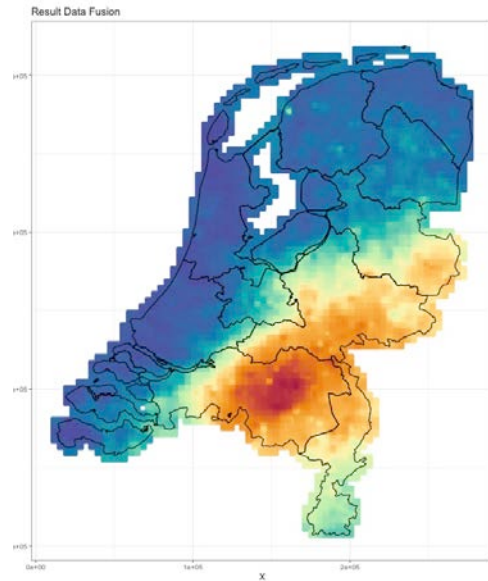
Starting from a concentration field based on official measurements and many sensors, what is the best combination?



PM2.5 concentrations calculated with the RIO model based on ~40 official measurements.



Some 2000 low-cost PM2.5 sensors (SDS011), calibrated using official measurements.



Including the sensors in the analysis leads to higher concentrations in parts of the Netherlands. Method used: inverse-variance weighting. 5

- Given enough interested parties, **FAIRMODE/WG6** will organize a benchmark on data fusion methods using real low-cost PM2.5 measurements/sensor data.
- Select (at least) one **area** for the benchmark.
- The present setup in **the Netherlands**, can be used. Other locations welcome.
- Discuss and define **sensible metrics**, not looking for the “best” but for a useful comparison of practical methods.

- Can we show **improvement** due to sensor/model fusion over only the model?
- Is this improvement something for which we can perform a meaningful **comparison** (qualitatively, quantitatively).

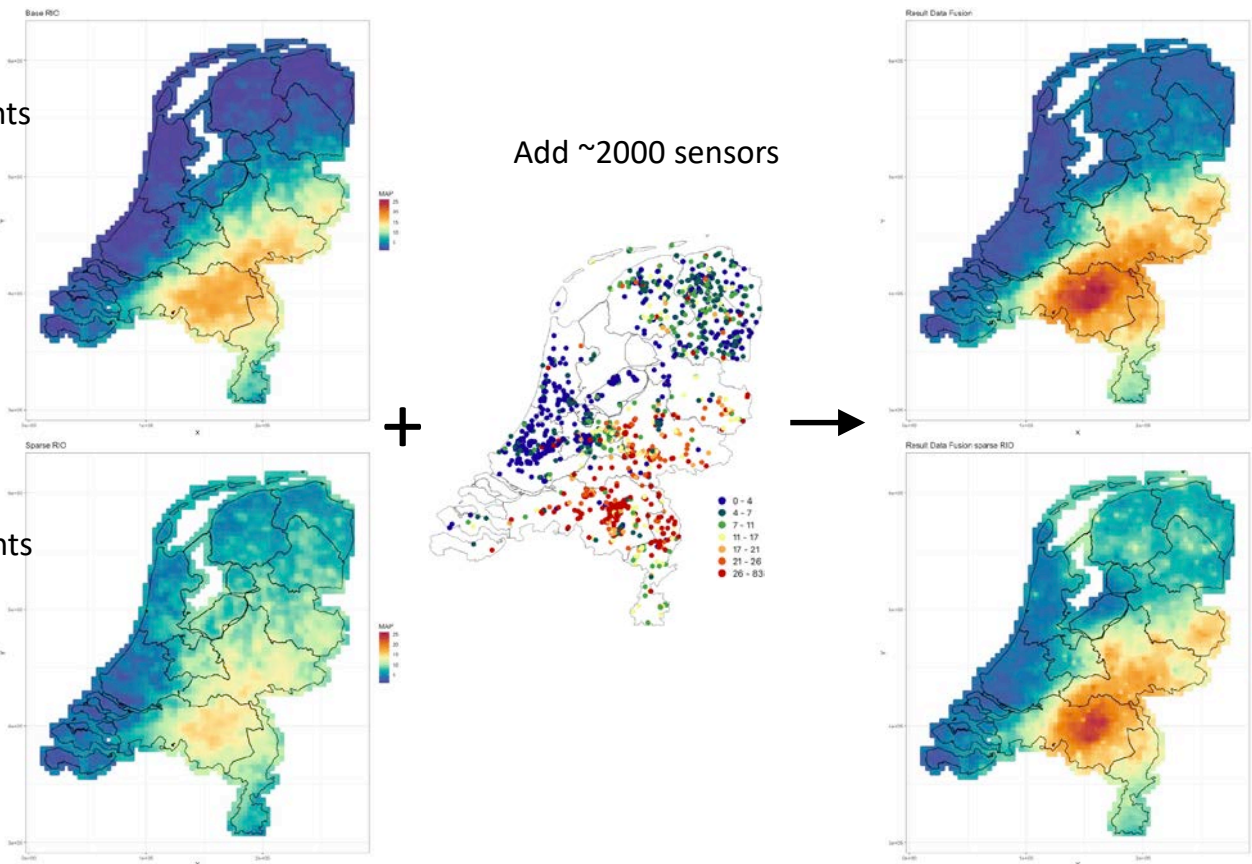
Different tests using real air quality data for PM2.5

- All available model, official and sensor data (in the Netherlands) used to perform data fusion with different methods/models → Comparison of models results.
- Data fusion using part of the available data → Effect of using more/less data.
 - Use a subset of official measurements in the Netherlands to create the global concentration field.
 - Leave out data in a part of the country.
 - How many sensors are needed for a substantial effect?
 - Use more/less accurate low-cost sensor data.
 - Effect of uncertainties?
 - Hourly versus annual results?

- A comparison of the results of several different methods/ways to perform data fusion (or similar) using large numbers of low-cost PM2.5 measurements.
- How are the results of data fusion influenced by the available amount and quality of the input data (official measurements, low-cost measurements, model quality and input).
- Can data fusion compensate for less official measurements or an incomplete model?
- What are the (data) requirements for successful use of data fusion?

Use **all 40** official PM2.5 measurements for concentration map (RIO).

Use **8 out of 40** official measurements for concentration map (RIO).



The available sensors can, to a large extent, compensate for the missing information in RIO.

- Are you interested in participating in a **data fusion benchmark** using your own (or other) DF model with **real low-cost PM2.5 sensors** in the Netherlands?
 - Suggestions, requests, advice?
- If you are not interested in data fusion using data from the Netherlands, would you participate with real data provided in (selected) other areas in Europe?
- Questions / discussion?





Thank You !