Spatial representativeness and station classification

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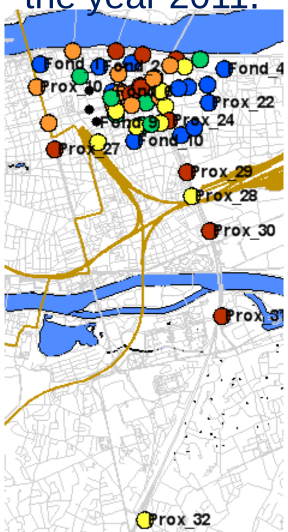
- Local assessment of station representativeness based on sampling surveys and (where possible) geostatistical data analysis

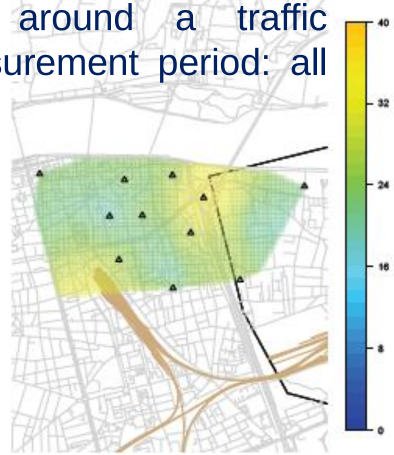
- European/national scale: on-going studies on station classification and data quality for model evaluation and air quality mapping
  - ✓ Classification according to Joly and Peuch methodology (2012), comparison with AirBase classification
  - ✓ Detection of outliers

❑ Local assessment of spatial representativeness

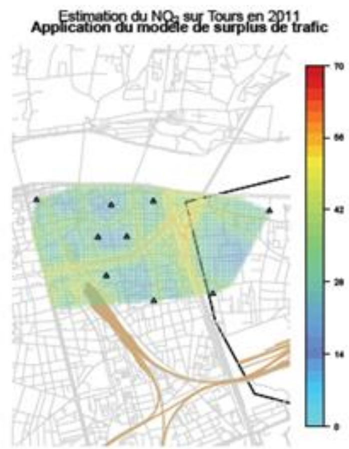
- ➢ Implemention of a geostatistical approach based on passive sampling surveys (Bobbia et al., 2008; LCSQA, 2007, 2010-2012)

City of Tours. NO_2. Passive sampling survey conducted by Lig'Air around a traffic monitoring station. Measurement period: all the year 2011.



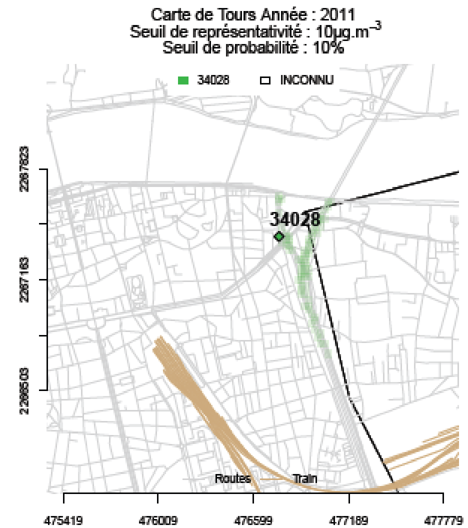


Background pollution: kriging with NO_x emissions and population density as external drift.



Background + traffic-related pollution (statistical adjustment along the roads using sampling data at traffic points)

Estimation of NO_2 annual mean concentration



Estimation of the corresponding representativeness area

- Main criterion: concentration difference with respect to the station measurement
- For a station S_0 located in x_0, a given pollutant (ex: NO_2), a given concentration variable *Z* (ex: annual mean) and a given period (ex: one year),
  - *x* is considered as part of the representativeness area of S_0 if:

$$|Z(x) - Z(x_0)| < \delta$$

δ : threshold in µg/m^3

- Method:
  - Z(x) is estimated from sampling data and auxiliary variables: external drift kriging + statistical correction along roads.
  - The estimation uncertainty is taken into account by considering the probability η of wrongly including a point *x* in the representativeness area of S_0:

Modified condition for representativeness:

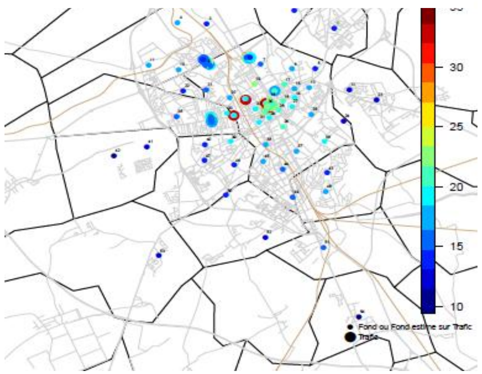
$$|Z^*(x) - Z(x_0)| < \delta - \sigma_k(x) * q_{1-\frac{\eta}{2}}$$

Kriging standard deviation

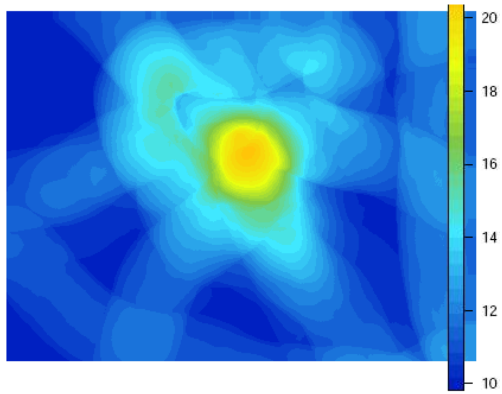
Quantile of the normal distribution

- Methodology applicable on the urban scale

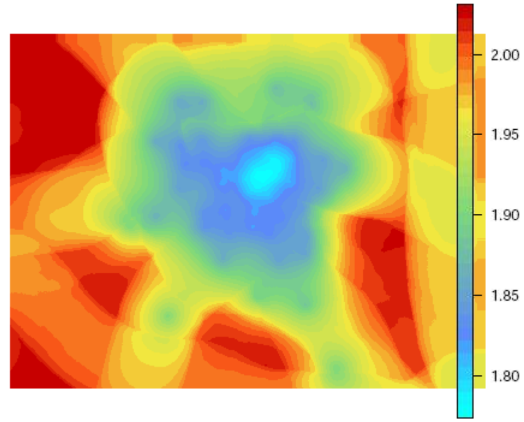
Sampling points: several periods during the year 2009



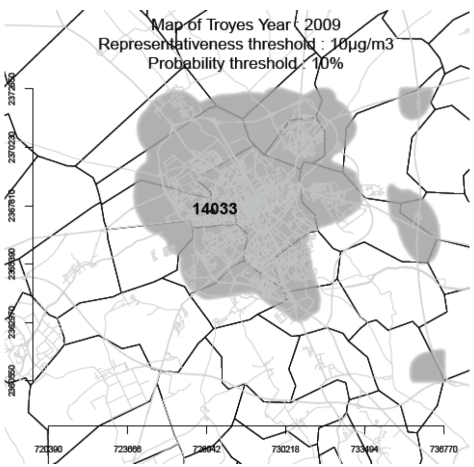
Estimation map of NO2 annual mean concentrations: kriging with NOx emissions as external drift



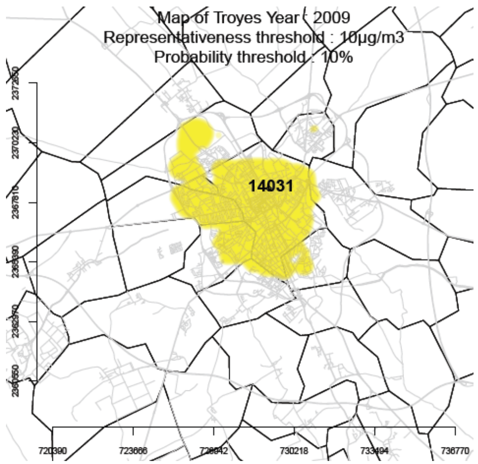
Kriging standard deviation



City of Troyes (campaign conducted by ATMO Champagne-Ardenne) Annual mean concentrations of background NO_2. 2009.

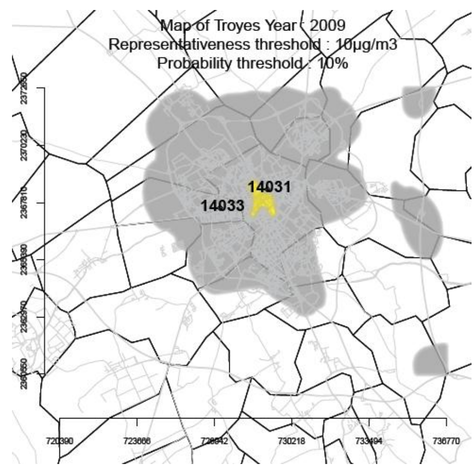


Representativeness area for site 14033



Representativeness area for site 14031

Suppression of the overlap. Different criteria tested. Retained criterion: minimum concentration difference

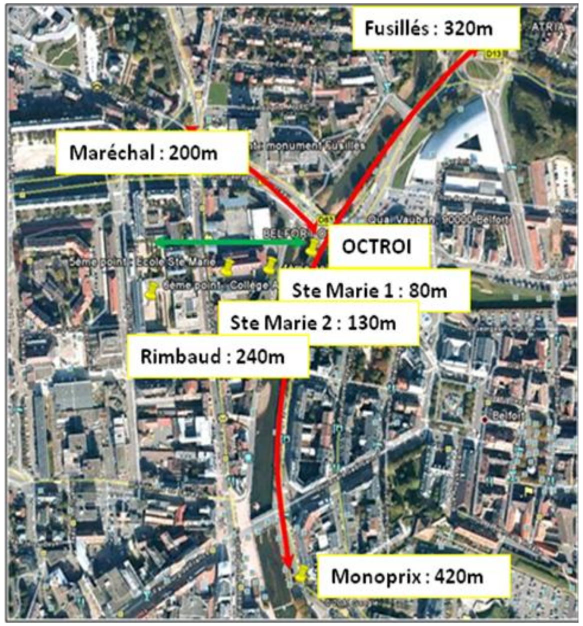


⇒ Partly redundant information. 14033: the most suitable for comparison with large scale modelling results.

- Remarks

  - Application limited by the possibility of conducting dense sampling campaigns.
  - Methodology mostly adapted to NO_2 or benzene annual, seasonal or monthly average concentrations.
  - Requires information on the uncertainty of the concentration map.
  - To investigate: how could the methodology be extended to other types of spatial estimates and wider spatial scales?

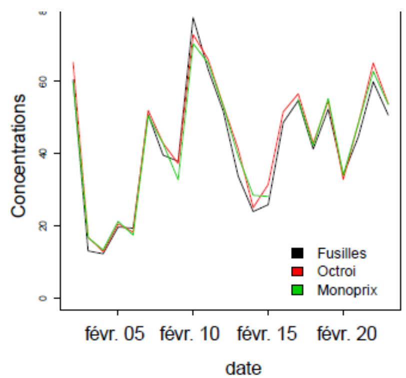
- Representativeness of PM_{10} monitoring sites: feasibility study of an experimental approach



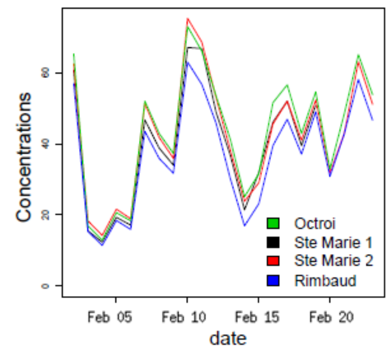
Ex: City of Belfort, PM_{10} measurement campaign around a traffic site (Octroi). Campaign conducted in collaboration with ATMO Franche-Comté, February 2011

Gravimetric measurements with DA-80 samplers along the main roads and at increasing distances from the station

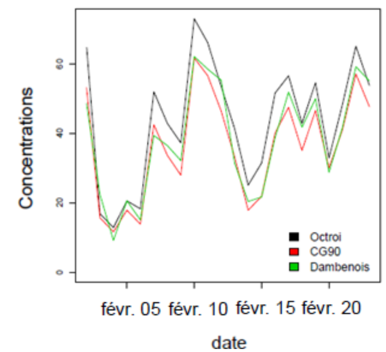
Along the road



Across the road



Comparison with the urban and suburban background measurements



Comparison of time series → qualitative assessment of spatial representativeness (in terms of concentration and daily exceedances)

Station classification

To qualify monitoring sites on a wider scale

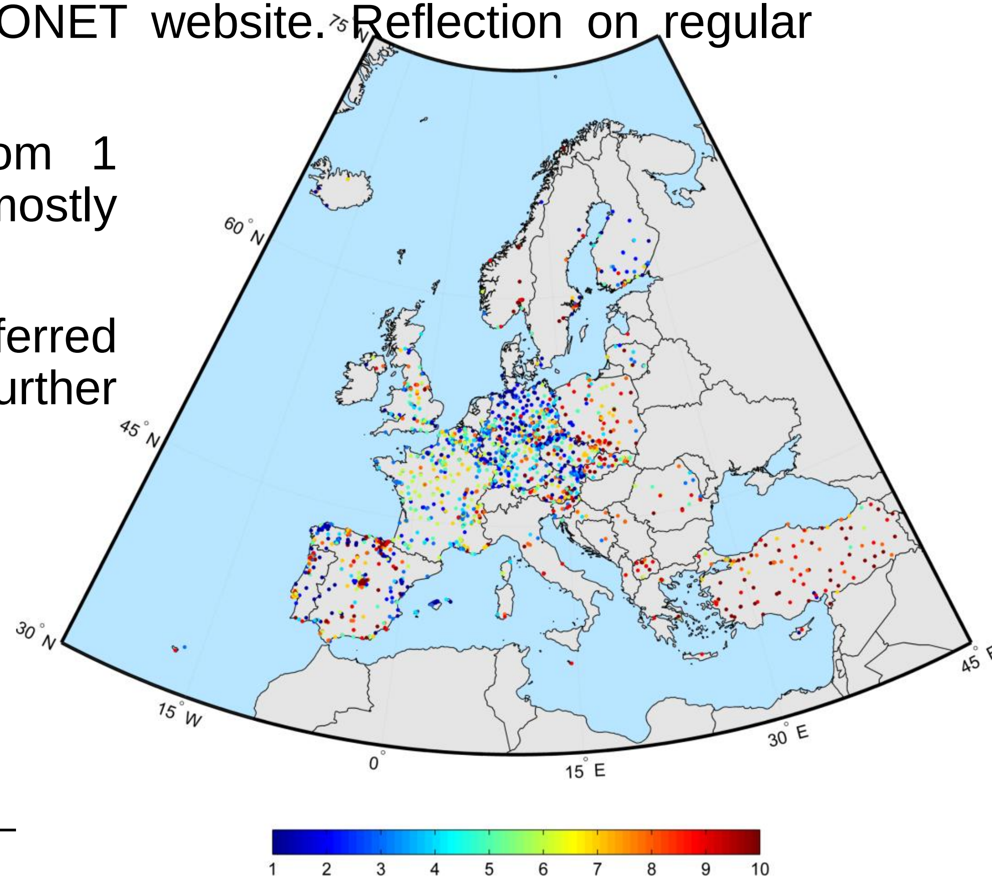
Possible application for model evaluation and air quality mapping

Study on national scale (LCSQA, 2012)

- ✓ Classification through principal component analysis based on environmental parameters (terrain height, population density, land cover, NO_x emissions from traffic) and average concentration data (ratio NO/NO_2, PM_{10}/NO_2)
- ✓ The stations split into five groups which can be interpreted in relation to the environment (urban, agricultural, forest…) and emission sources.

Station classification

- Study on European scale (ETC/ACM, 2012 & 2013)
  - ✓ Classification based on the temporal variability of concentrations: diurnal cycle, weekend effect, high frequency variability. AirBase type of area and type of station are used as a priori information in the classification process. Methodology developed by Joly and Peuch (2012).
  - ✓ Underlying idea: spatial representativeness and temporal variability are linked.
  - ✓ Application of the methodology to AirBase v6 and update with AirBase v7. Report and results available on EIONET website. Reflection on regular update within MACC project
  - ✓ Pollutant specific classification, from 1 (rural behaviour) to 10 (behaviour mostly influenced by urban traffic)
  - ✓ Identification of specific situations referred to as « outliers » that require further investigation



Classification of PM_{10} monitoring stations according to Joly & Peuch (2012) methodology

European Topic Centre on Air Pollution and Climate Change Mitigation

- Use of station classification in model evaluation and air quality mapping
  - ✓ Currently : selection of stations based on AirBase classification (type of area and type of station) and local expertise
  - ✓ On-going investigations on the use of Joly & Peuch methodology for air quality mapping :

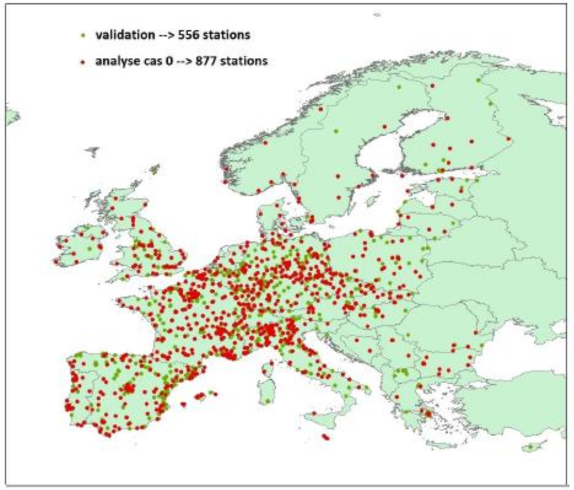
    Comparison of different selections of stations for air quality mapping (observations + CHIMERE combined in an external drift kriging)

    Study carried out on the European scale, O_3 and PM_{10}

    Stations split into two sets:

1/3 of stations randomly taken out from the different Joly & Peuch classes: used as independent validation stations in all the tests

Different selections of stations taken from the remaining 2/3: used as input in the kriging
-background stations
-stations classified as1to 3
-stations classified as1to 4
- (...)
- stations classified as1to 10



Computation of performance indicators by validation station and on average by class

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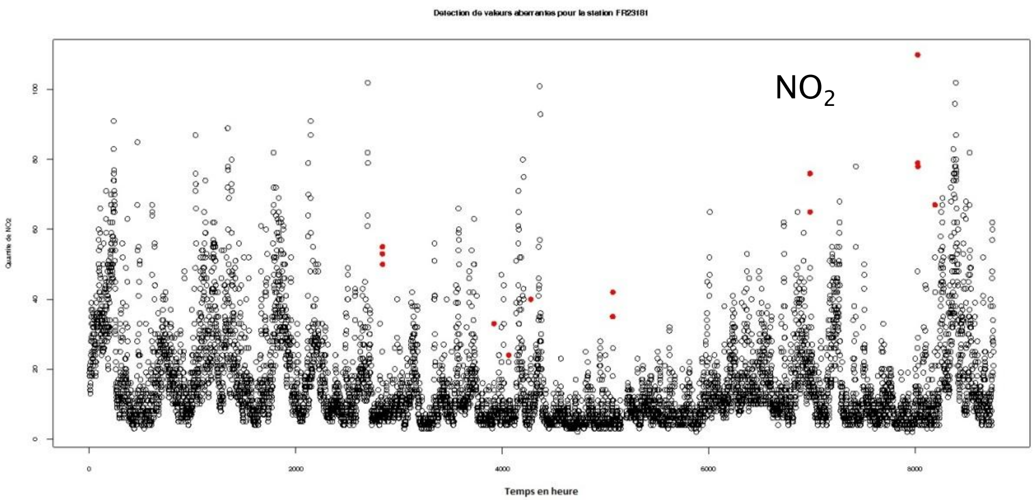
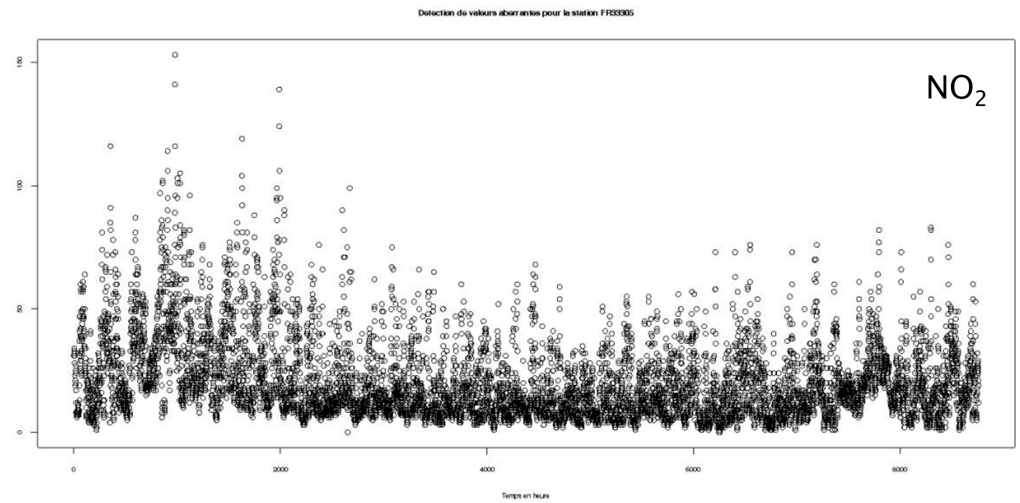
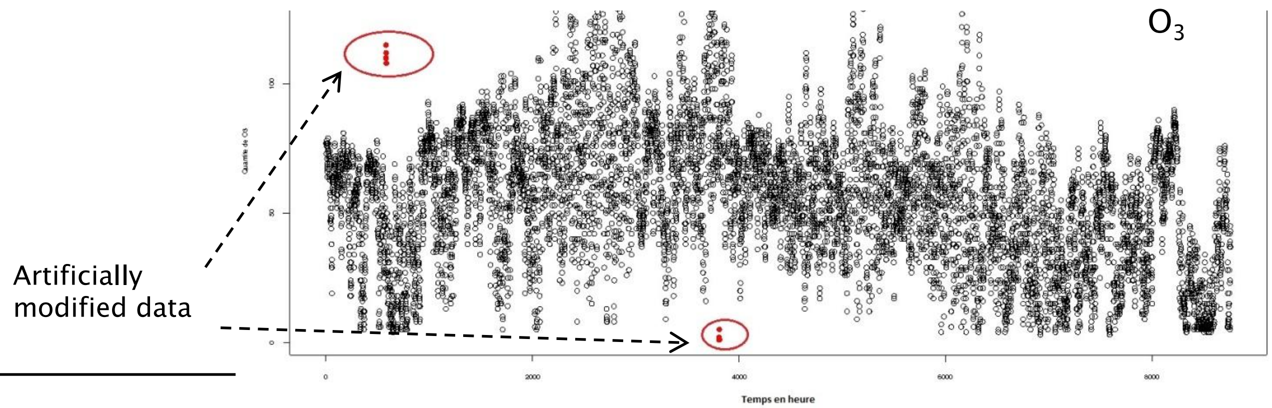
Detection of outliers

Preliminary study

- ✓ Tests performed on AirBase timeseries
- ✓ Adjustment of a method studied by Gherarz et al. (ETC/ACM 2011)
- ✓ Application of a moving window filter (parameters adjusted for each pollutant):







Outlook

- Support to French local AQ monitoring networks interested in better characterizing station representativeness
- Classification according to Joly and Peuch methodology (2012) :
  - ✓ Get feedback from data providers, e.g. on the stations identified as « outliers » in ETC/ACM 2013 study.
  - ✓ Update of the classification to include more stations.
- Evaluation of CTMs:
  - ✓ Definition of a validation strategy taking the spatial distribution and the classification of stations (AirBase, Joly & Peuch) into account.
  - ✓ Analysis of the model skill scores as a function of the classification. Focus on the model performance for the stations identified as “outliers”.
- Mapping:
  - ✓ Detection of outliers : operational implementation for near-real-time data.
  - ✓ Impact of the selection of stations used in the mapping on the quality of the final maps.

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