Mapping exceedances: Italian experiences

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FAIRMODE Technical Meeting, WG1 session
Zagreb, 28 June 2016

Outline

- Task attribution for air quality evaluation in Italy
- A simple idea for estimating exceedance areas
- Italian experience

Task attribution for air quality evaluation in Italy

Law 155/2010:

Regions and autonomous provinces (REGs) have the mandate of evaluating air quality.

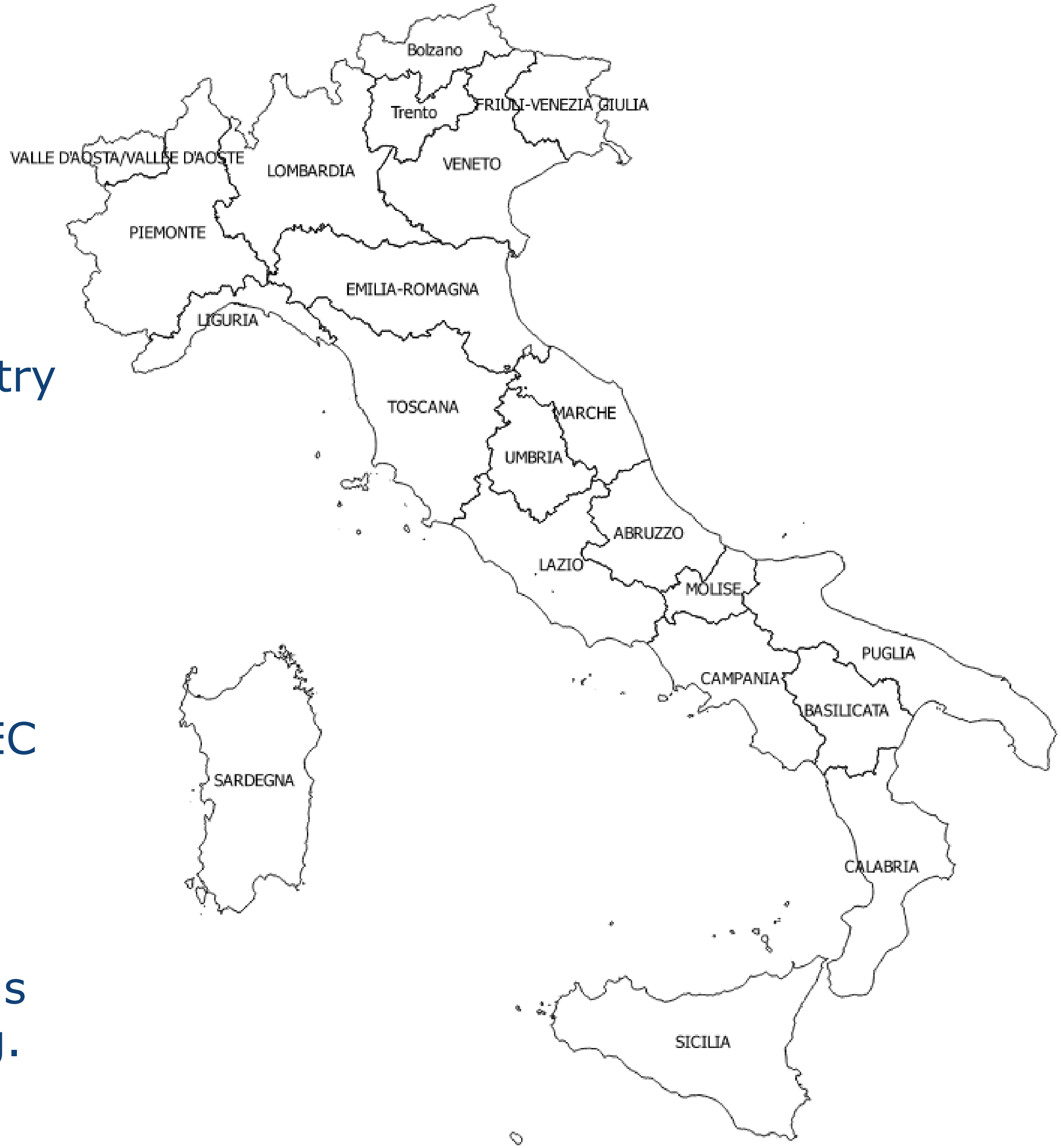
REGs report air quality to the Ministry of Environment (MoE) and the National Environmental Institute (ISPRA)

(ISPRA is neither JRC-ISPRA, nor ENEA!).

The MoE reports air quality to the EC and the EEA.

→ REGs, with their environmental agencies, decide and take actions on measurements and modelling.

The MoE acts as coordinator, especially for EU obligations.



Task attribution for air quality evaluation in Italy

The MoE has given mandates to ISPRA and ENEA for technical coordination (ISPRA mainly on measurements and eReporting, ENEA mainly on modelling)

but the coordination processes are not easy, for lack of resources, local AQ peculiarities, local political-administrative issues and tendencies to autonomy.

→ there is (still?) no unique national position on several parameters of the new AQ reporting, including exceedance areas and road length, population and vegetation exposed to exceedances.

P.s.: ENEA is the NCP for Italy in FAIRMODE.

IPR, reporting exceedance situations

- estimate of the surface area where the level was above the environmental objective
- estimate of the length of road where the level was above the environmental objective
- estimate of the total resident population in the exceedance area
- estimate of the ecosystem/vegetation area exposed above the environmental objective

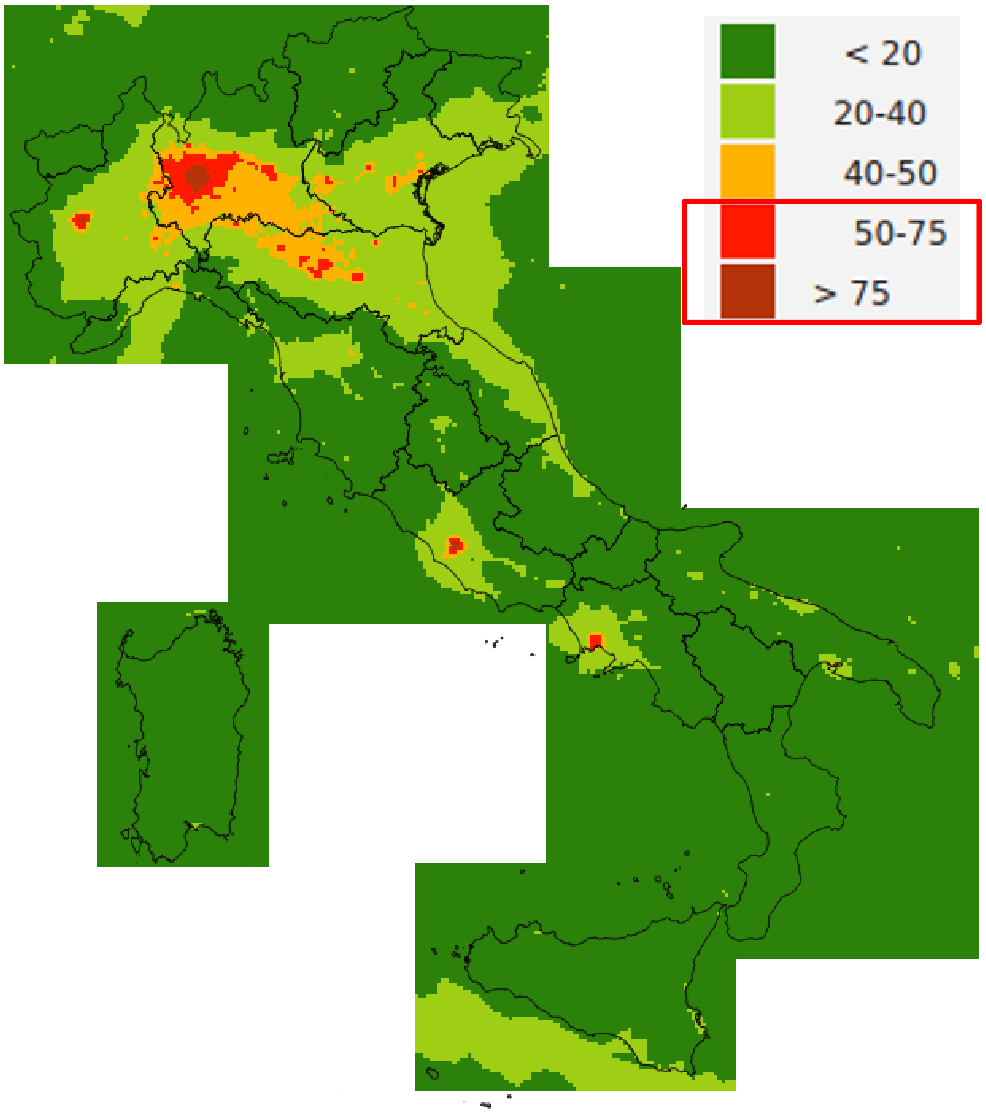
exceedance areas

On an adequate CTM map of the regulated parameter, delimitating the exceedance area is conceptually trivial,

but a bunch of practical issues rise:

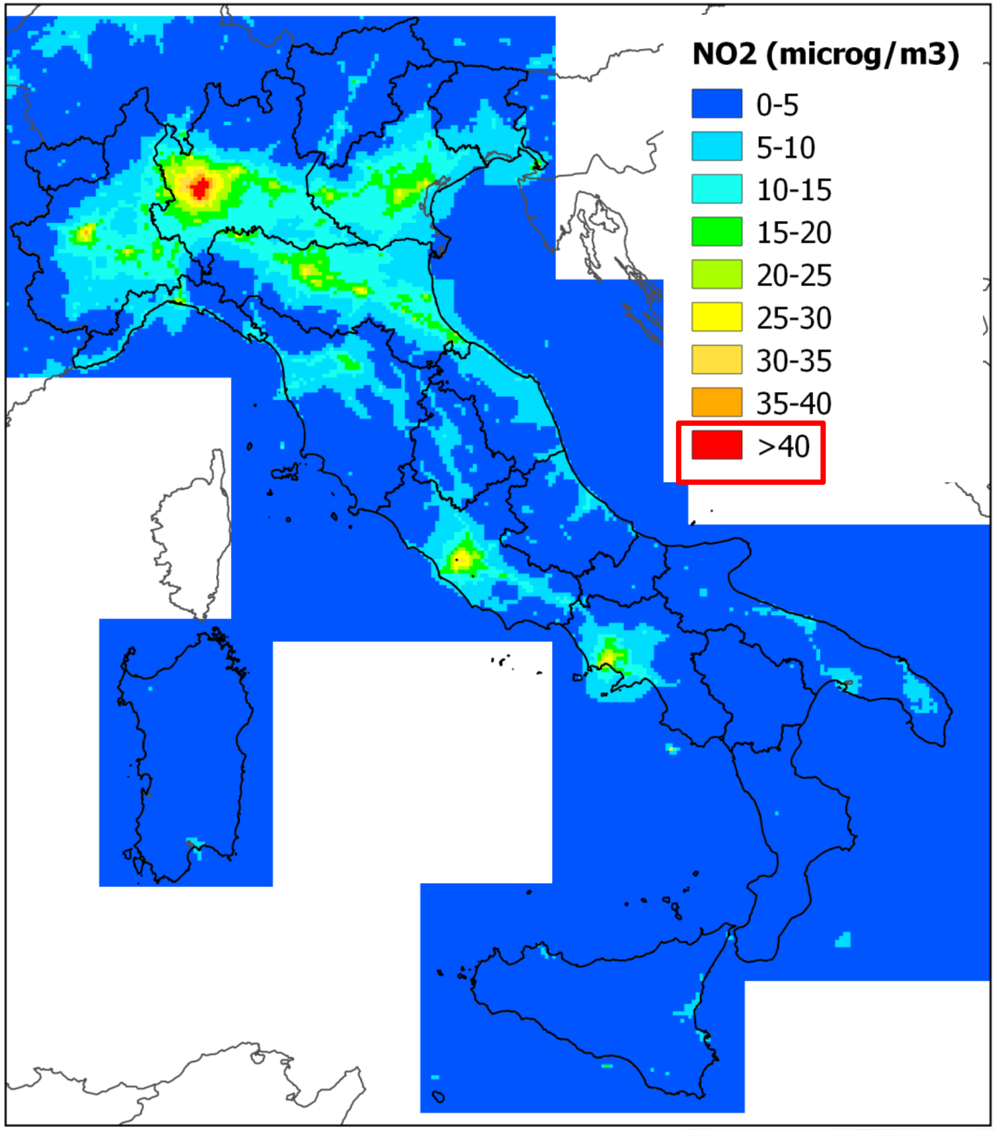
- does the model value at the station represent the measured value? How large is the "error"? What if my CTM does not see a measured exceedance?
  - → assimilation/fusion can help, but the weighting parameters drive the concentrations in the surrounding cells and change the "pure" model distribution…
- what if no measured values are available for assimilation/fusion, e.g. in scenario runs?
- for hourly-daily exceedances, is hourly assimilation robust enough?
- …

exceedance areas



PM10, 35th percentile of daily averages

2010



NO_2, annual average

2020

A simple idea for estimating exceedance areas

using the station representativeness area of the monitoring station (“general” feature, with many application fields) as the area of exceedance (“specific” feature with respect to the limit value, one the application fields of SR)

spatial representativeness: Italian experience

in a Collaboration Agreement MoE-ENEA (2012-2015) for setting up the National Network of Special Purpose Monitoring Stations (PM10/PM2.5 and chemical components, ozone and precursors, PAHs, heavy metals)

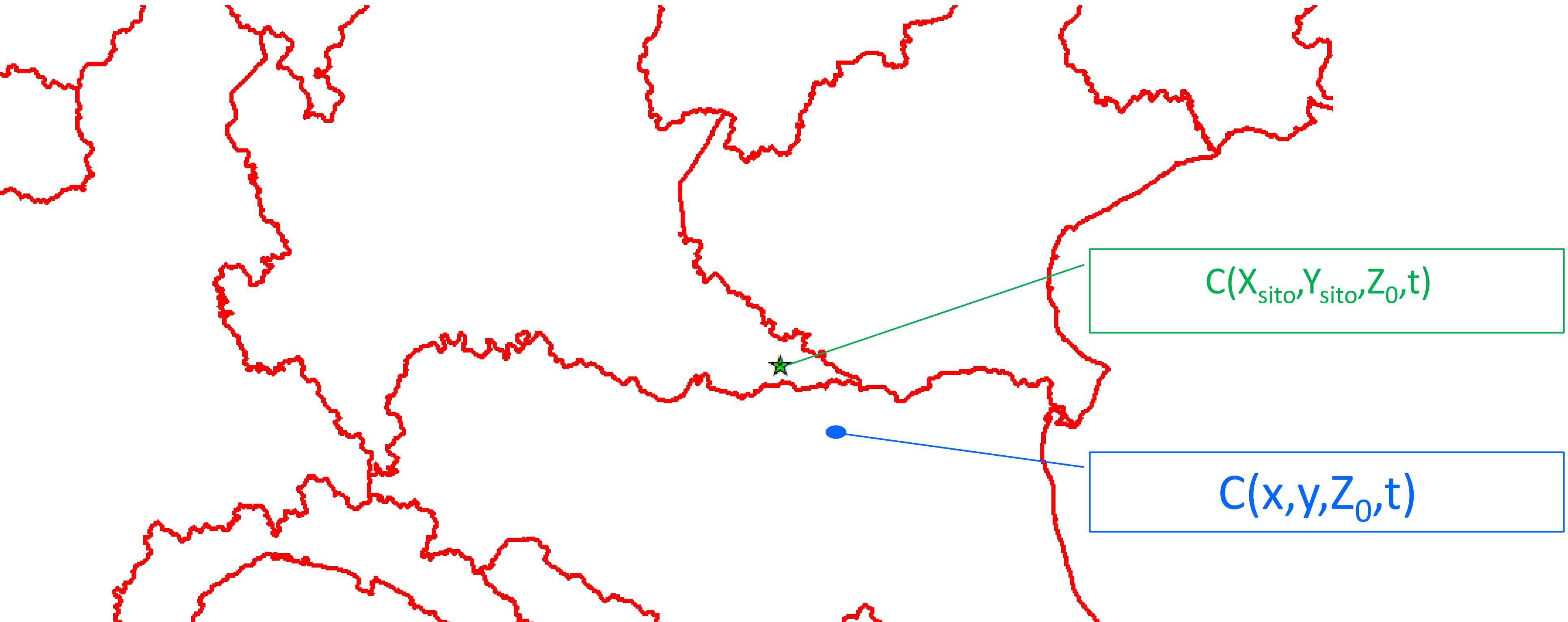
ENEA developed 4 methods for spatial representativeness of AQ stations (Righini et al., 2013, 2014),

including the Concentration Similarity Frequency (CSF) function (Piersanti et al., 2015):

- able to provide quantitative estimates of SR areas
- based on gridded model hourly time series
- tested on rural and urban background stations + 1 industrial station (Vitali et al., 2016), and above listed pollutants

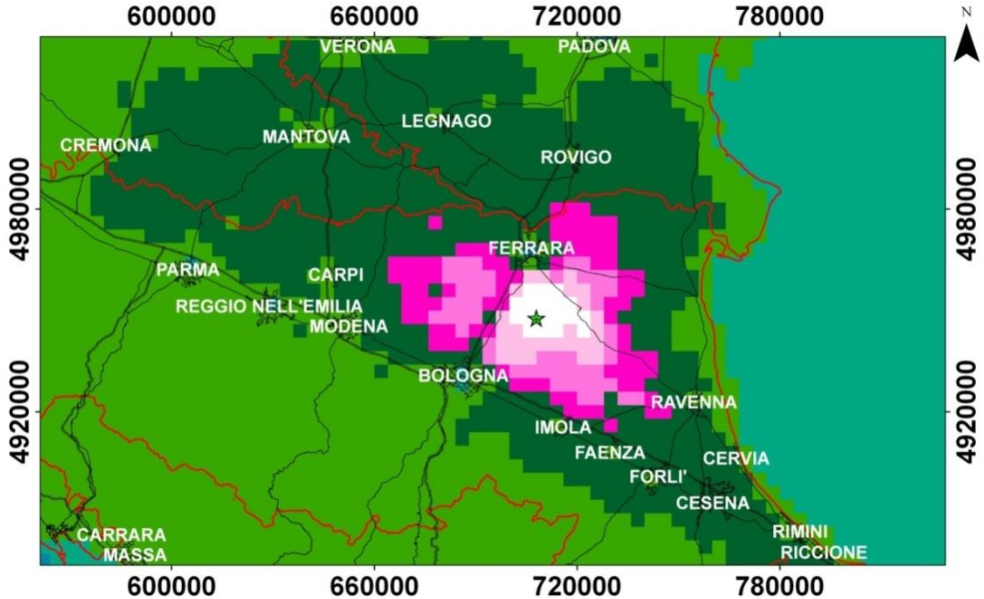
CSF (Piersanti et al., 2015)

A measurement point is representative of a wider area when the difference between the value at the site and the value in the area is smaller than a threshold (20%) for more than a certain number of time instants (90%)



$$f_{sito}(x,y) = \frac{\sum_{i=1}^{N_t} flag}{N_t}, \quad con\ flag = \begin{cases} 1, & \frac{|C(X_{sito},Y_{sito},Z_0,t_i) - C(x,y,Z_0,t_i)|}{C(X_{sito},Y_{sito},Z_0,t_i)} < 0.2 \\ 0, & \frac{|C(X_{sito},Y_{sito},Z_0,t_i) - C(x,y,Z_0,t_i)|}{C(X_{sito},Y_{sito},Z_0,t_i)} > 0.2 \end{cases}$$

CSF



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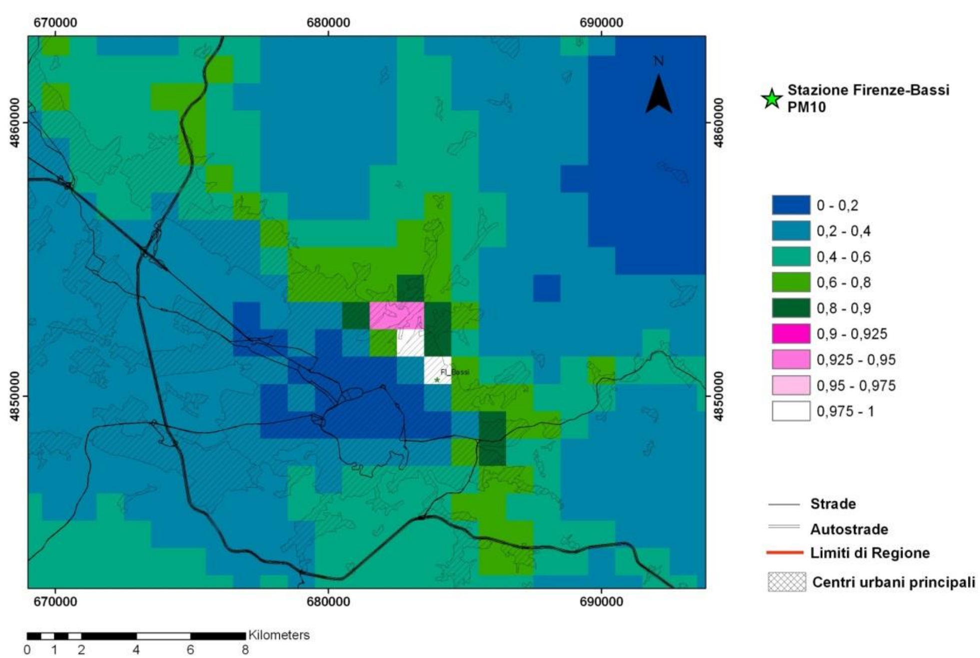
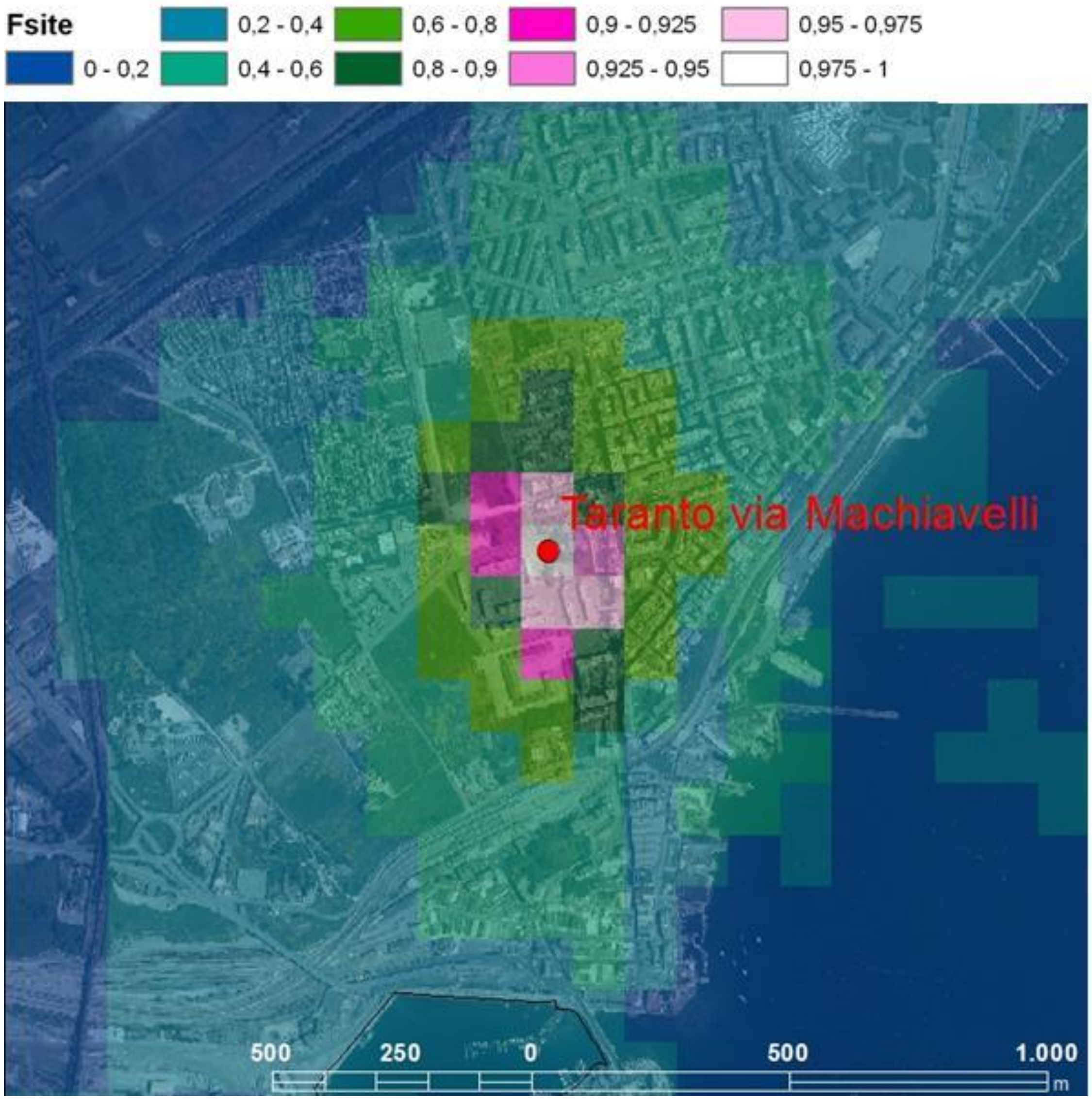


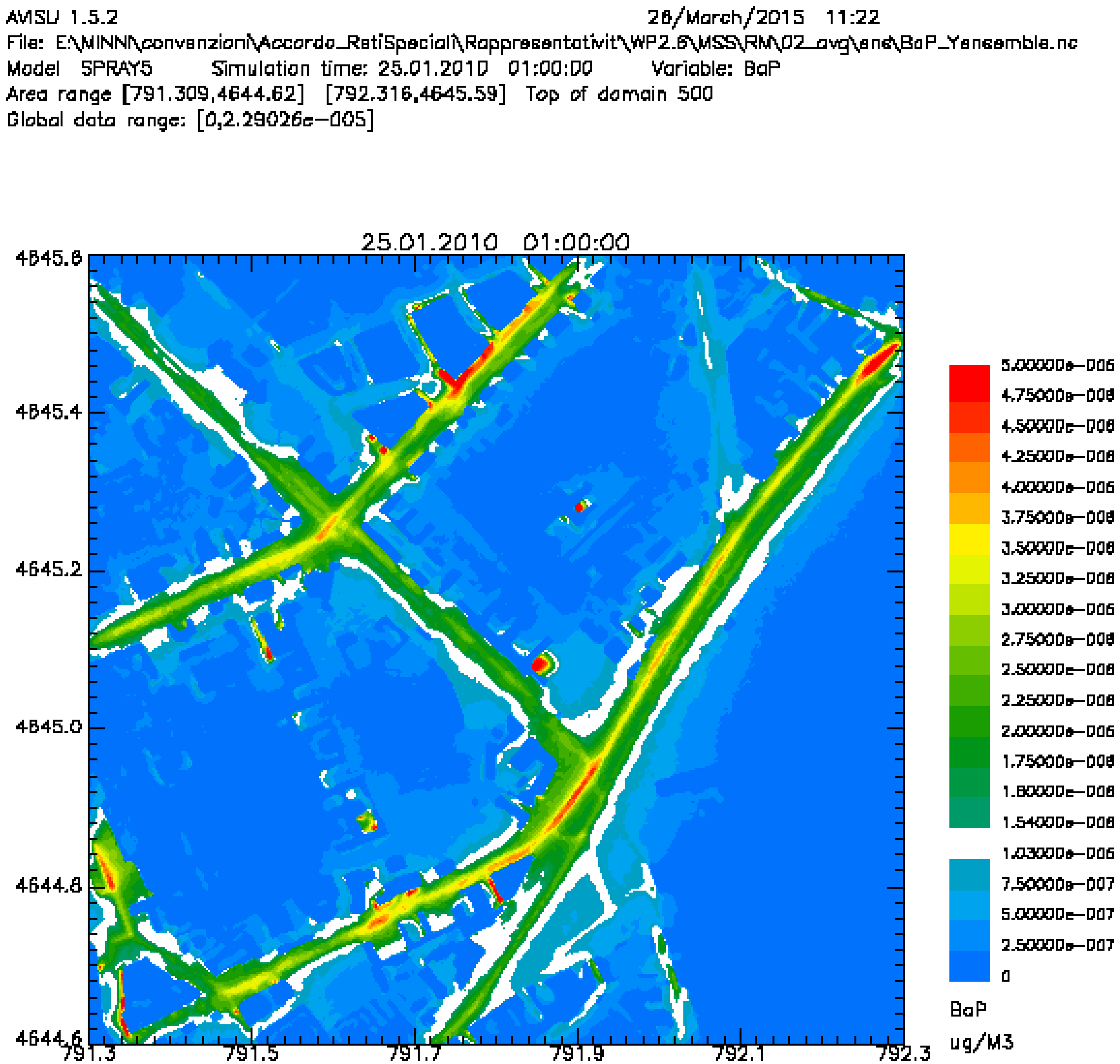
- at 4km x 4km, nice results on RB stations, not on UB stations
- some tests on 1km x 1km: UB are better described, but not everywhere → higher resolution needed in some cases
- not validated against measurements
- of course, the exceedance area would be the +20% area, not the ±20% area

SR of industrial stations



- need a detailed and complete EI need a local scale model (Lagrangian, CFD, Gaussian) at high resolution

SR of traffic stations



Traffic stations

- need a detailed and complete EI need a local scale model (Lagrangian, CFD, Gaussian) at high resolution
- do not allow yearly runs at hourly resolution

We did ~10 daily runs of typical circulation conditions across the year, with only traffic emissions and MicroSpray Lagrangian model (Tinarelli et al., 2012)

→ CSF on hourly values was not applicable

→ we traced the ±20% area around the station

what we learned

- the CSF method for SR is promising for urban background stations with exceedances of annual limits
- a CTM with a good EI and at least 1 km resolution is needed → in Italy, regional agencies are the most appropriate subject to use the CSF method (Tuscany and Apulia have started, but only for SR)
- model resolution is crucial, as it becomes the resolution of the exceedance area (subgrid issues)
- the CSF is not useful for traffic stations, where long series of hourly model values are not feasible
- one advisable development: assimilation of measured time series (risk of alterating the spatial coherence of the model?)
- we plan to use the CSF in the Intercomparison Exercise on SR

references

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Thank you for your attention

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