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31st May 2022
Emilia-Romagna Region Delegation to the EU

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Air quality assessment in Po Valley and Slovenia for year 2021

Roberta Amorati (*ARPAE Emilia Romagna*) Stefano Bande (*ARPA Piemonte*)

on behalf of D5 Action

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Action D5 second air quality assessment

The reports with a detailed description of methods and results are available at https://www.lifeprepair.eu/

Authors:
Stefano Bande (*ARPA Piemonte*), Michele Stortini, Roberta Amorati, Giulia Giovannini (*ARPAE Emilia Romagna*)
Giovanni Bonafè (*ARPA Friuli Venezia Giulia*) Luka Matavz (*ARSO, Slovenia*)
Elisabetta Angelino, Loris Colombo,

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Assessment methodology

The methodology considers an integrated approach that exploits two different types of information:

- ✓ **air quality monitoring data**
- ✓ high spatial resolution concentration fields produced by means of a **chemical transport model (CTM)**

Concentration fields and air quality monitoring data have been integrated using different **data fusion techniques**

The most critical air quality indicators have been considered in the assessment:

- ✓ PM10 annual mean concentration values
- ✓ PM2.5 annual mean concentration values
- ✓ NO2 annual mean concentration values
- ✓ percentile 90.4 of PM10 daily mean concentration values corresponding to the 36th highest daily mean of the year
- ✓ percentile 93.1 of O3 maximum daily 8-hour average concentration values corresponding to the 26th highest daily maximum of the running 8-h mean of the year

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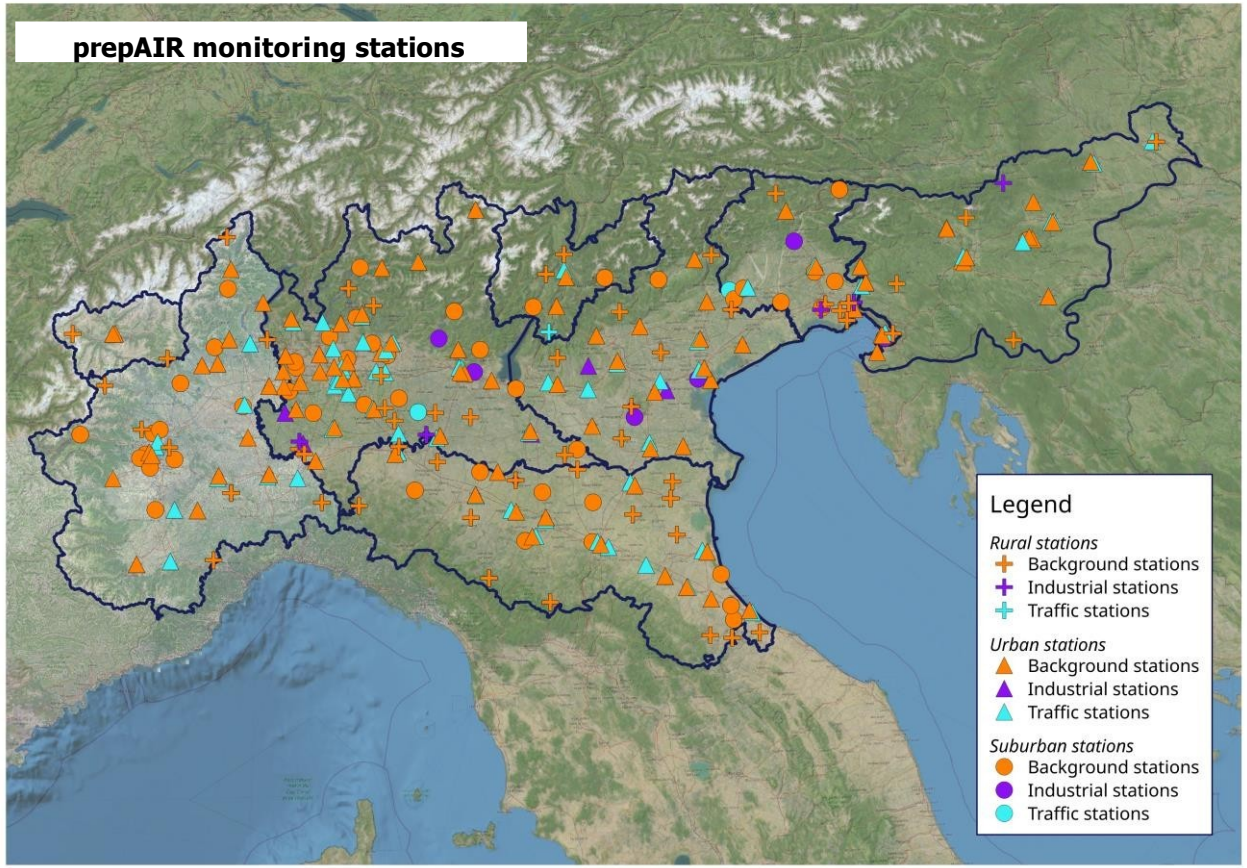
Air quality monitoring data



Criteria used to select stations for data fusion procedures:

- ✓ only background stations
- ✓ data capture percentage not less than 75%

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CTM & data fusion modelling systems

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	ARPAE Emilia-Romagna	ARPA Piemonte	ARPA Lombaria	ARSO Slovenia
Model suite	NINFA-ER	FARM-PI	FARM-LO	CAMx-SLO
CTM	CHIMERE	FARM	FARM	CAMx
Meteorological Driver	COSMO-I5	COSMO-I5	WRF	ALADIN
Boundary Condition	SNPA CAMS service	Prev'Air service	QualeAria service	IFS-TM5
Emission Data	Prepair, ISPRA, TNO-MACCIII	Prepair, ISPRA, EMEP, PACA, AURA	Prepair, INEMAR, ISPRA, EMEP	Prepair, National Inventory, TNO-MACCIII
Horizontal Resolution	~5km	8km	4km	4km
Data fusion Technique	Kriging with External Drift (KED)	Kriging with External Drift (KED)	Successive Correction Method (SCM)	Kriging with External Drift (KED) (from 4 to 1 km)

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Data fusion validation

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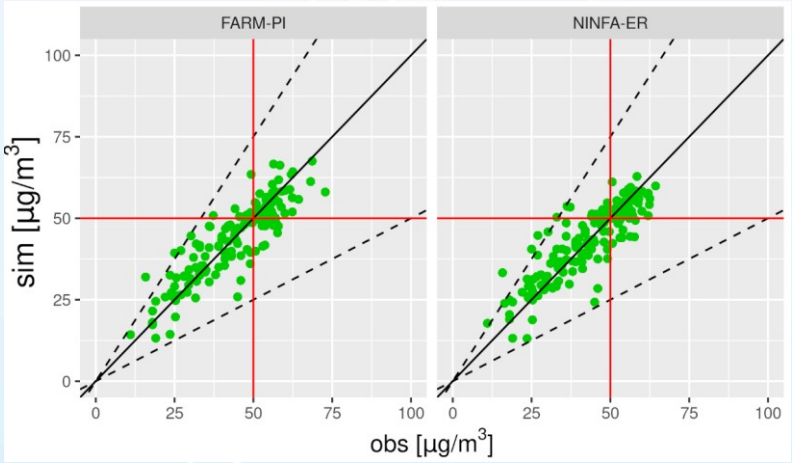
Data fusion simulations are validated by means of a cross-validation study.



Good agreement between observed and simulated data for all the data fusion systems for almost all air quality indicators.

model	index	pollutant	ME	URMSE	PEARSON
NINFA-ER	annualMean	PM10	0.07	3.01	0.87
FARM-PI	annualMean	PM10	-0.10	2.89	0.89
FARM-LO	annualMean	PM10	-1.86	3.48	0.87
CAMx-SLO	annualMean	PM10	0.03	3.22	0.86
NINFA-ER	annualMean	NO_2	0.15	4.15	0.79
FARM-PI	annualMean	NO_2	-0.16	3.94	0.82
FARM-LO	annualMean	NO_2	-1.18	3.81	0.86
CAMx-SLO	annualMean	NO_2	0.00	5.95	0.74
NINFA-ER	annualMean	PM2.5	0.01	2.04	0.87
FARM-PI	annualMean	PM2.5	-0.03	2.08	0.87
FARM-LO	annualMean	PM2.5	-1.01	2.57	0.82
CAMx-SLO	annualMean	PM2.5	0.08	2.68	0.77
NINFA-ER	perc-90.4	PM10	0.18	6.31	0.86
FARM-PI	perc-90.4	PM10	-0.16	6.1	0.88
FARM-LO	perc-90.4	PM10	-3.13	6.65	0.88
CAMx-SLO	perc-90.4	PM10	0.08	6.19	0.87
NINFA	perc-93.1	O_3	0.13	8.13	0.68
FARM-PI	perc-93.1	O_3	-0.59	7.58	0.73
FARM-LO	perc-93.1	O_3	-2.00	5.52	0.88
CAMx-SLO	perc-93.1	O_3	0.19	8.27	0.69

Satisfying performances for data fusion methodologies for almost all air quality indicators.

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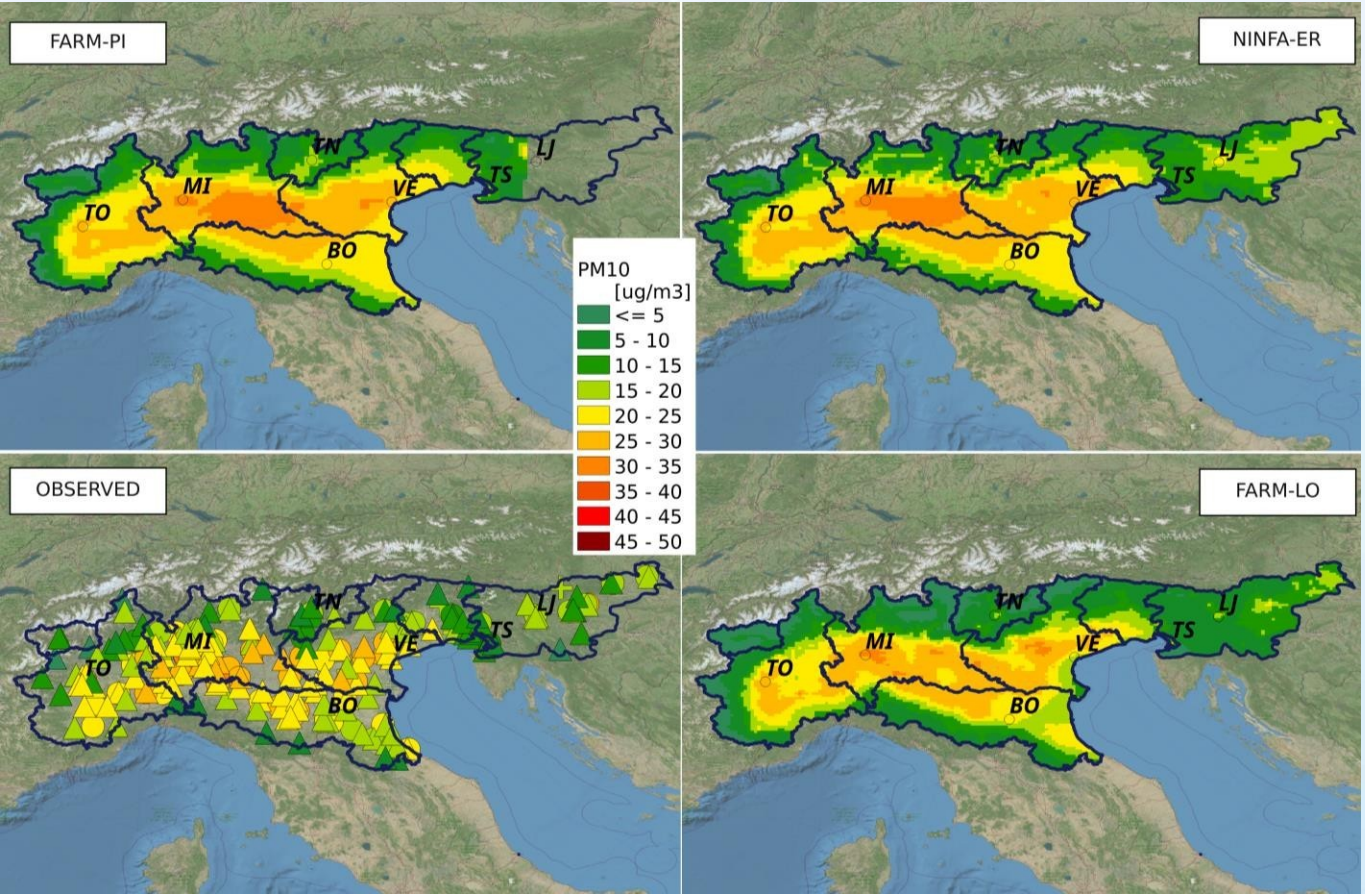
PM10 annual mean



No model estimates annual average concentration above current EU limit of 40 µg/m^3, as also confirmed by the monitoring data

The areas with the highest concentrations are located between the Lombardia and Veneto plains and around the metropolitan areas.

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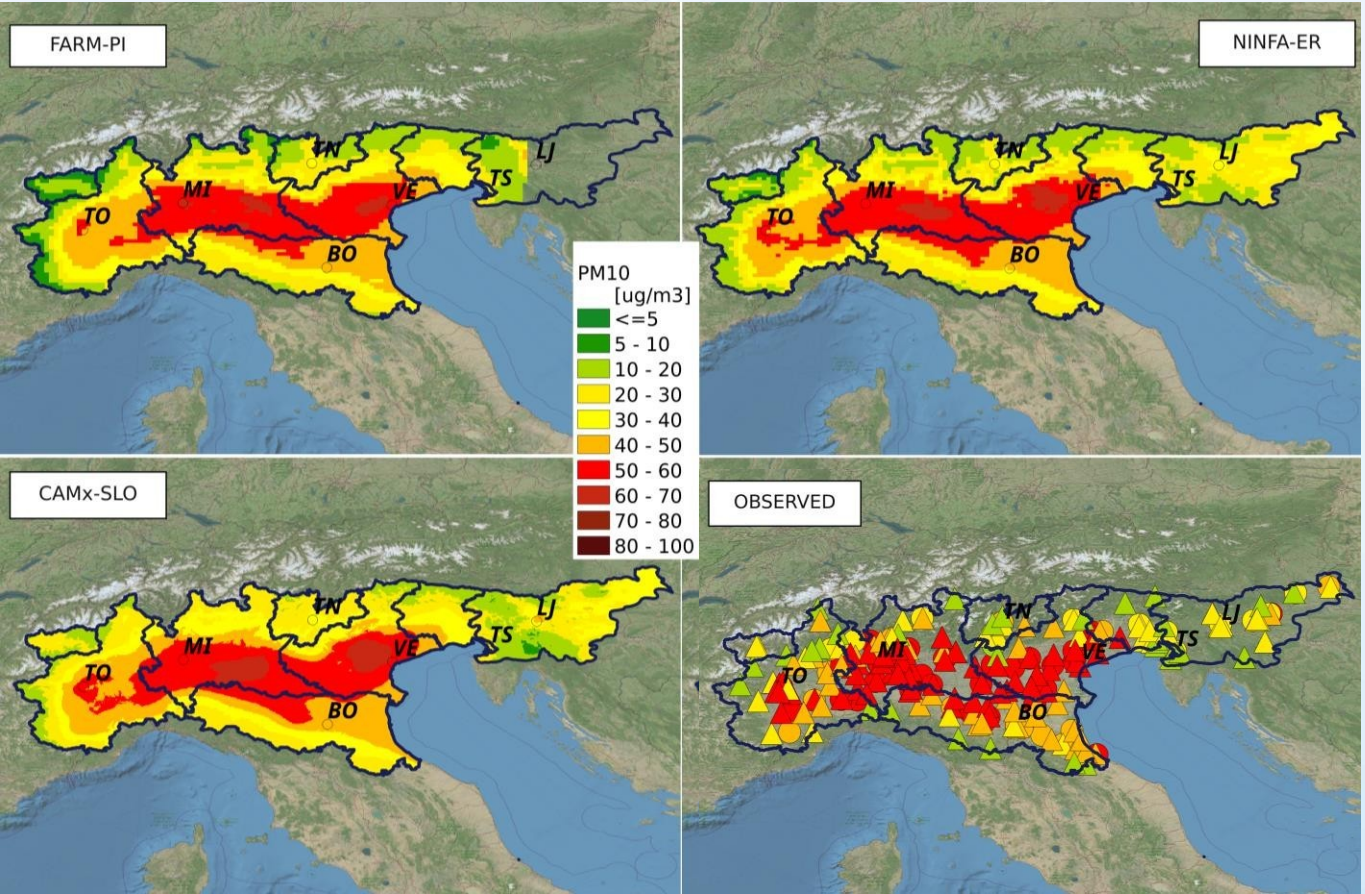
percentile 90.4 of PM10



All the models and monitoring data show PM10 concentrations above the EU daily limit - 50 µg/m^3 - across the whole flat area of the Po Valley and around main metropolitan areas.

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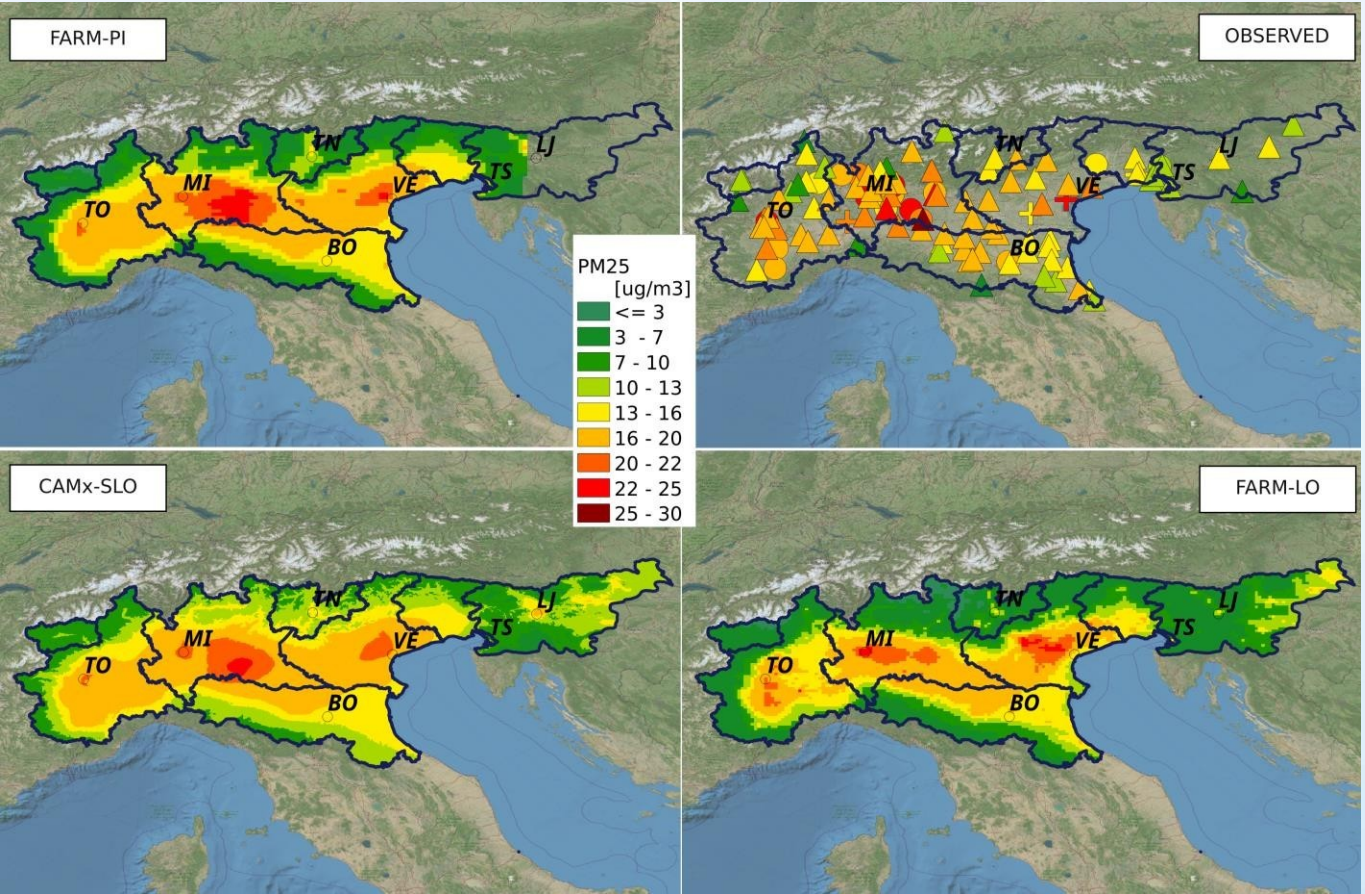
PM2.5 annual mean



All the models show average annual concentration below the EU limit of 25 µg/m^3 (stage I).

Considering the EU limit of 20 µg/m^3 (stage II) the nonattainment area extends across the significant part of Lombardia and minority part of Veneto and Piemonte.

The same scenario is described by monitoring data

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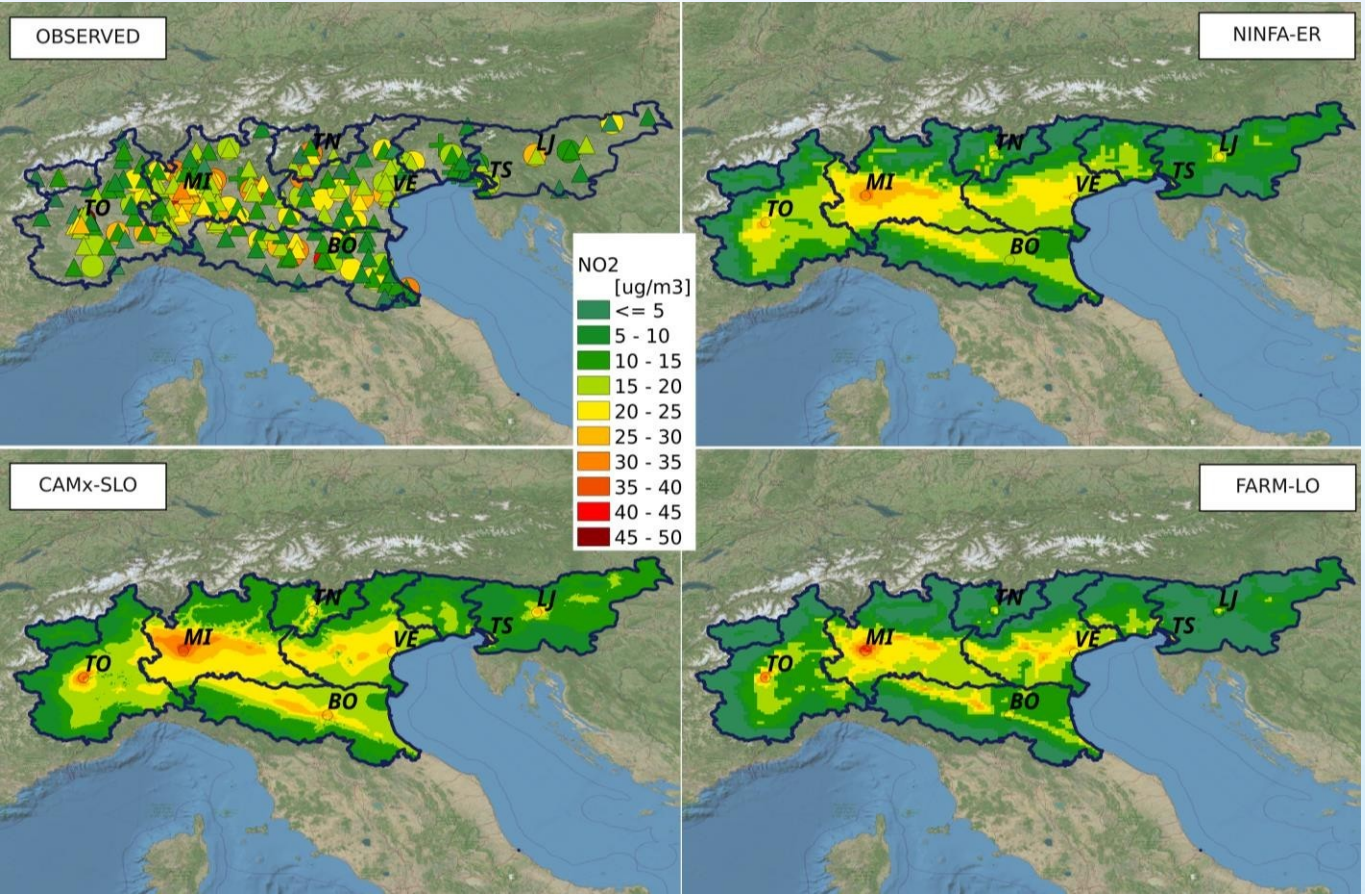
NO2 annual mean



There are no nonattainment areas for the annual mean of NO2; the monitoring data record exceedances only in a few traffic stations located in the Lombardia, Piemonte and Emilia-Romagna regions.

All the models identify the main urban agglomerations as areas with the highest values

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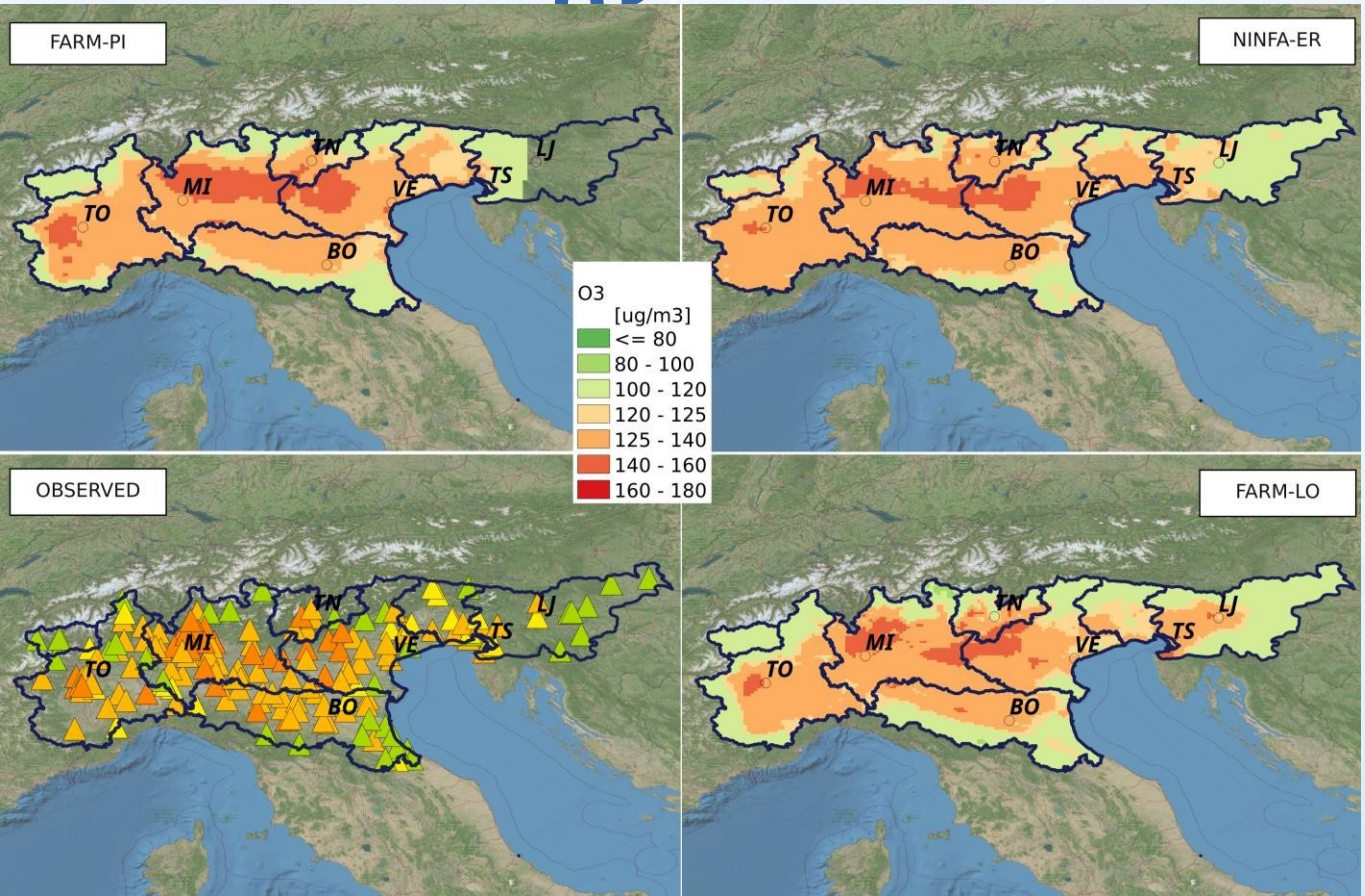
percentile 93.1 of O3



All the models estimate concentration above the 120 µg/m^3 threshold, implying an exceedance of the target value in almost the entire Po Valley, as also confirmed by the monitoring data.

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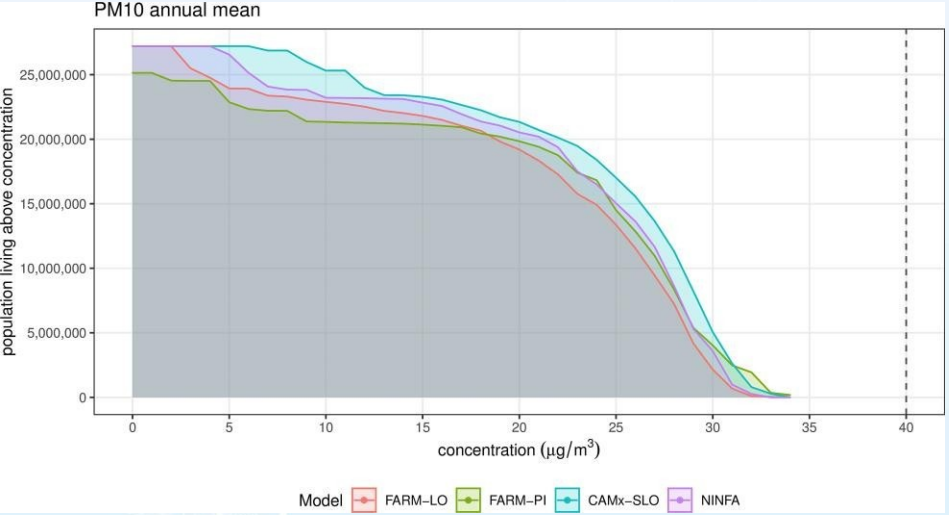
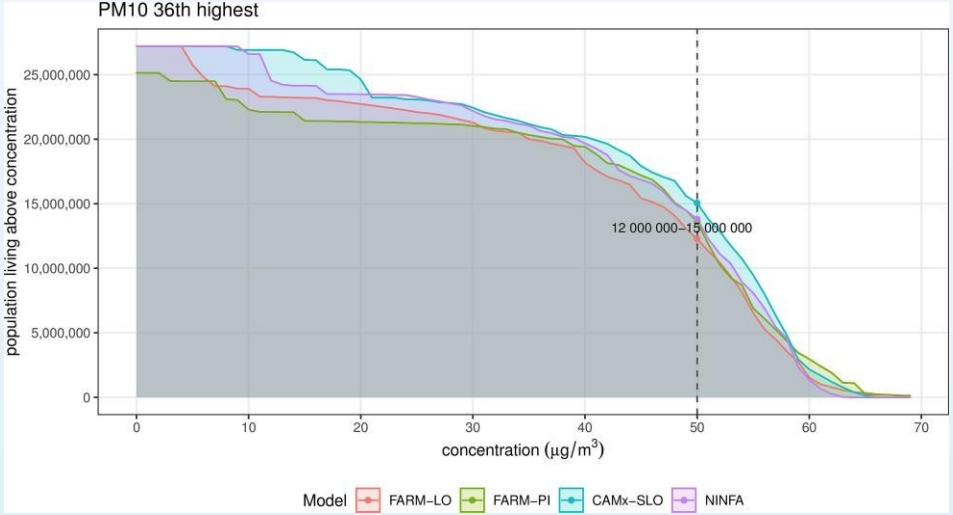
Population exposure (1/3)

The population exposed to different air quality indicator values was estimated assuming that each inhabitant is exposed to the concentration that was estimated in the model cell in which it resides.



According to all models, in year 2021 no citizens were exposed to values above the threshold for the PM10 annual average



Up to fifteen millions of citizens were exposed to more than 35 daily PM10 exceedances in 2021

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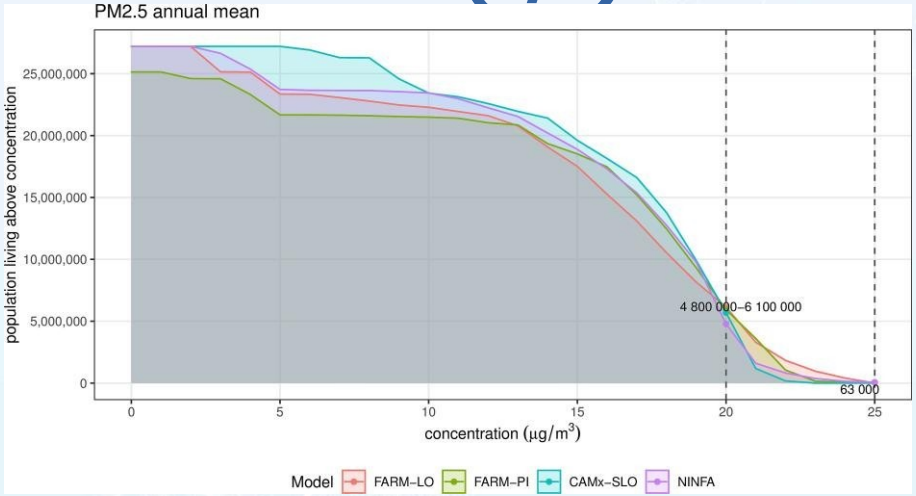
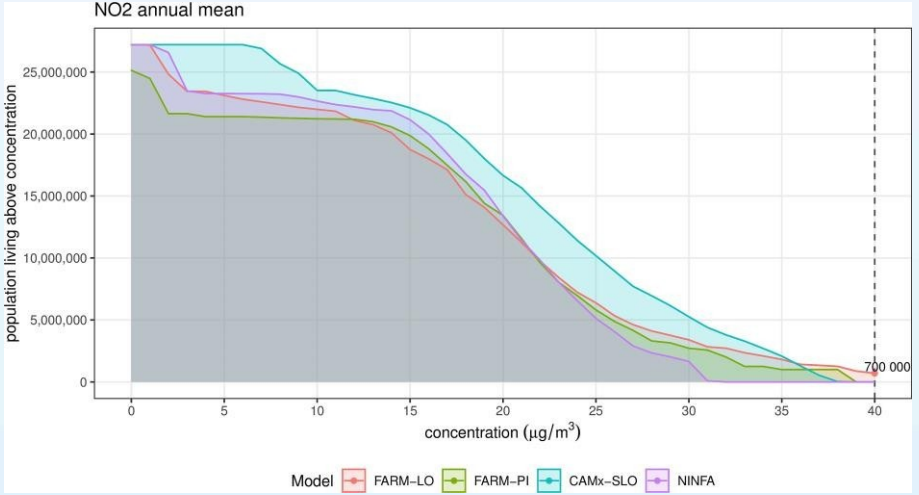
Population exposure (2/3)



The models agree in estimating that about five/six millions of citizens were exposed to average PM2.5 annual values above 20 µg/m3 (EU Limit stage Ⅱ).



Only one model estimates that there were citizens (about 700000) exposed to values above the threshold for the NO2 annual. The other three models remain under the limits across their domain

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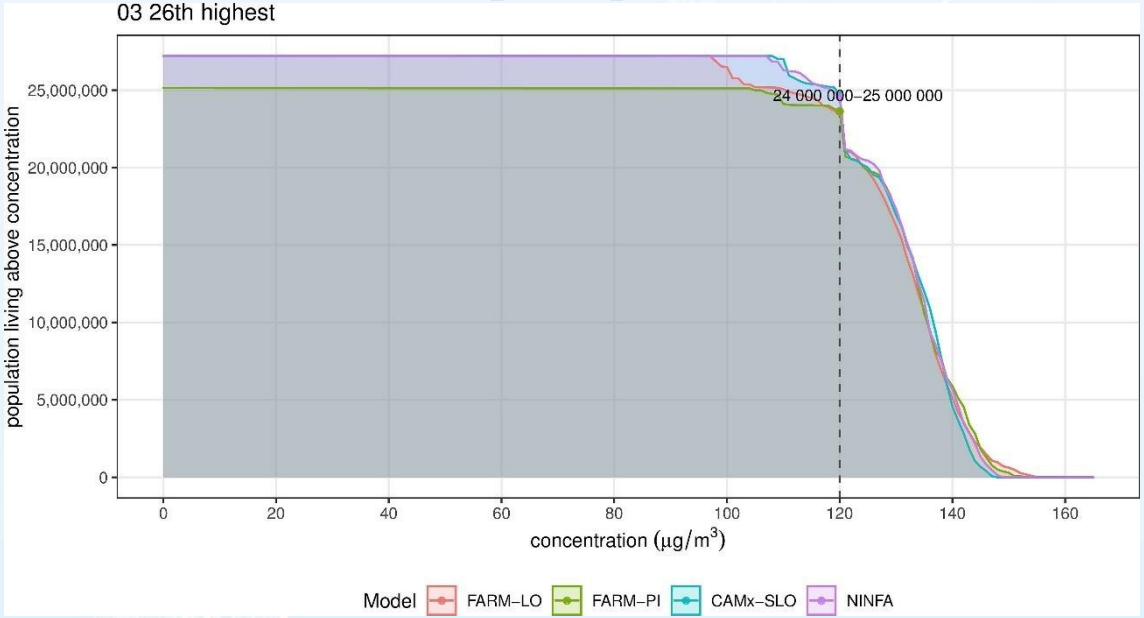
Population exposure (3/3)



Almost 25 million of citizens were exposed in 2021 to ozone concentration levels higher than target values for health protection set by EU legislation

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Conclusions

This second Air Quality Assessment report provides a synthetic view on the status of air quality in Po Valley and Slovenia for year 2021. The assessment was carried out with a state-of-art approach that uses data fusion techniques to integrate information coming from air quality monitoring networks and CTM modelling systems

Even if the four CTM systems used have different setup (CTM, model resolution, boundary condition, meteorological driver and data fusion technique), the outputs are similar to each other showing the reliability of the assessment.

Almost everywhere the PM10,NO2 and PM2.5 annual EU limits are respected.
However a large percentage of the population living in the flat area of the Po Valley is exposed to values above the EU daily limit value for daily PM10 concentrations and most of the population lives in areas where the ozone concentrations are above the target value.

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Thank you for your attention

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