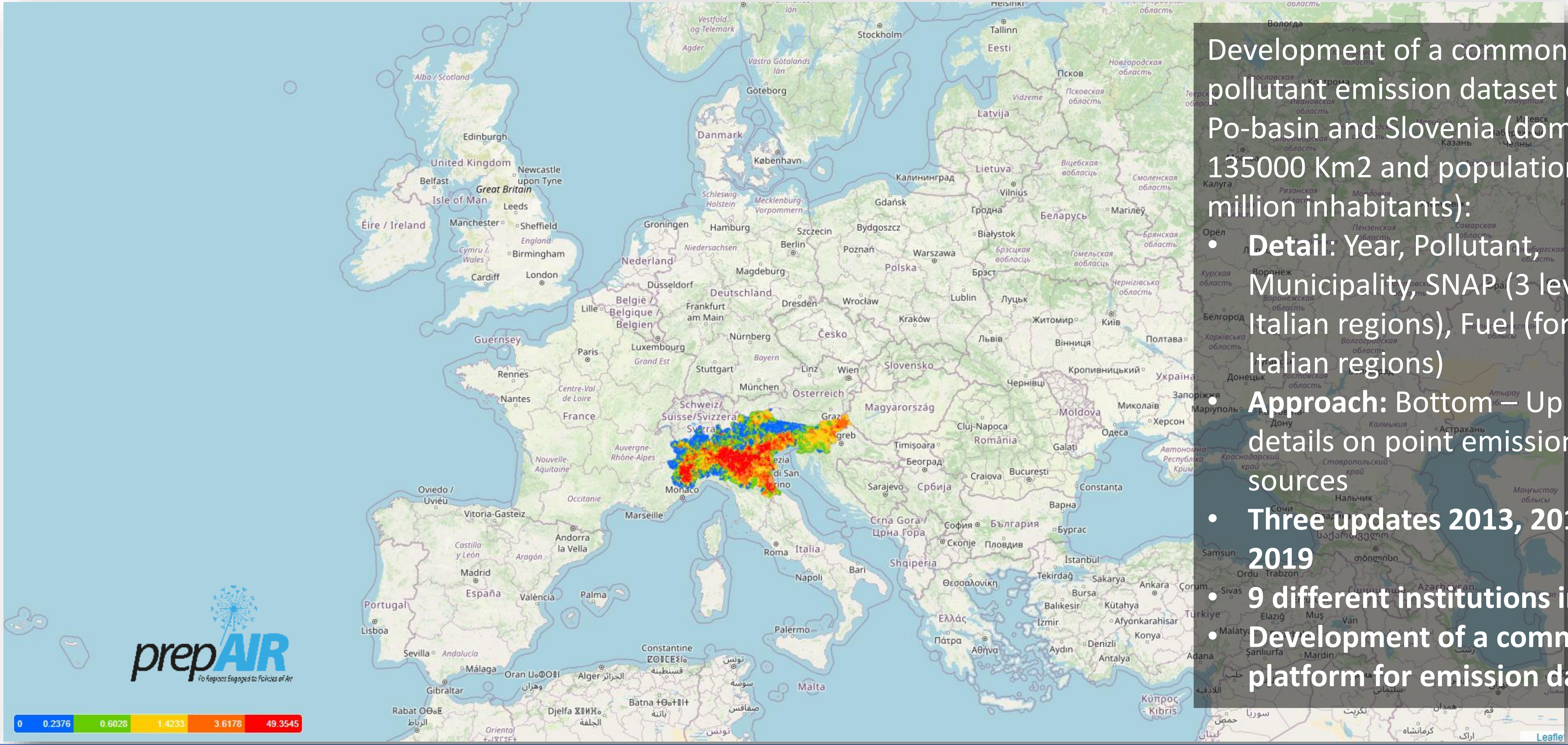
AGATE
Introduction and User Requirements of ARPA

Alessandro Marongiu
ARPA Lombardia
a.marongiu@arpalombardia.it

Framework on emission estimates

- **Italian Regions and autonomous provinces** have different functions in the monitoring and management of air quality and must compile and update an **emission inventory** every two or three years on their own territory.
- The **EEA-EMEP Guidebook is the main technical reference** for updating the emission inventories both at national and local levels and plays a fundamental role in the comparability of the estimates.
- The Italian local emission inventories are generally compiled at a **municipal detail** and implement the SNAP source classification.
- **LIFE PREPAIR** collected emission inventories in the Po-basin offering an important **benchmark** for comparing Italian and European emission estimates

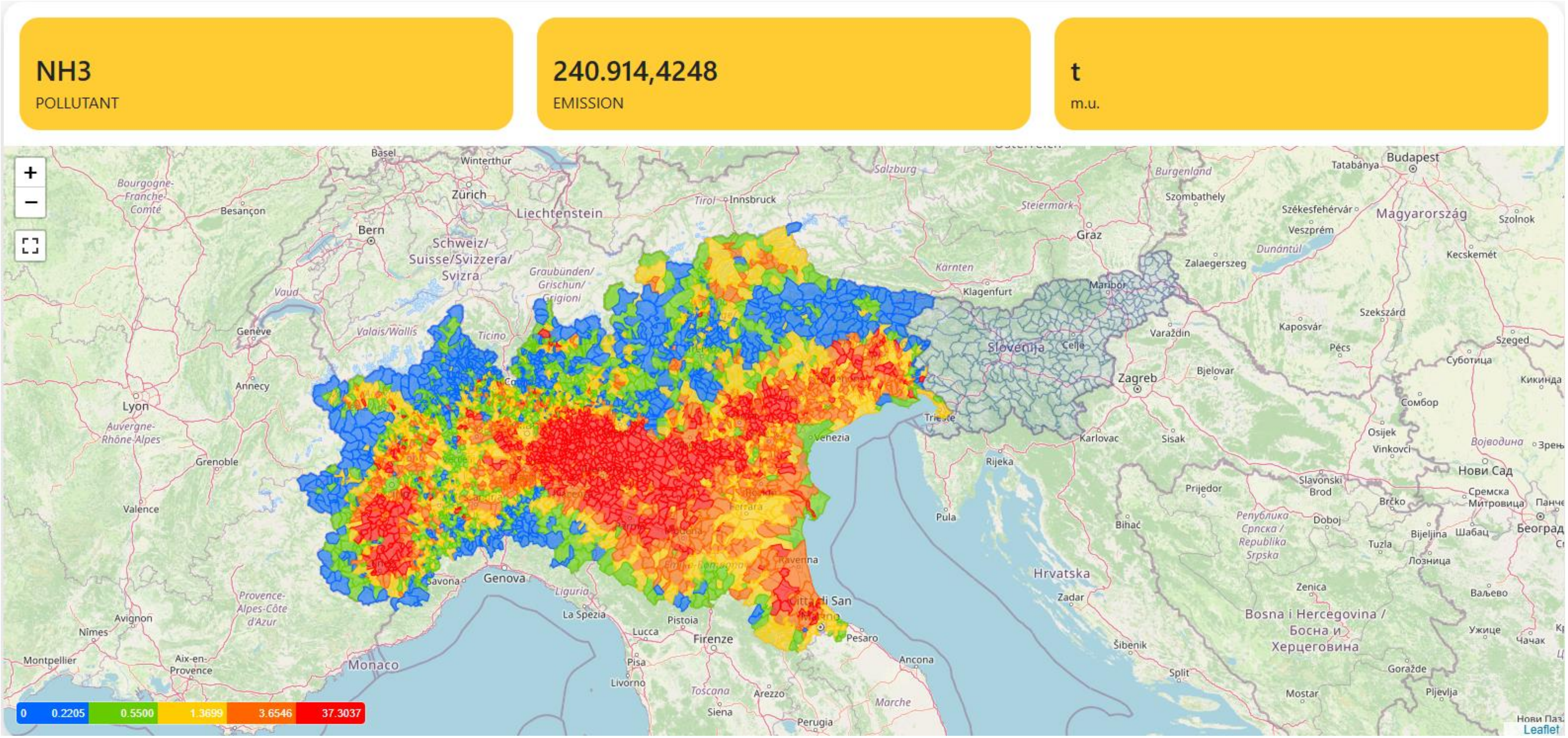
Emission dataset in LIFE PREPAIR



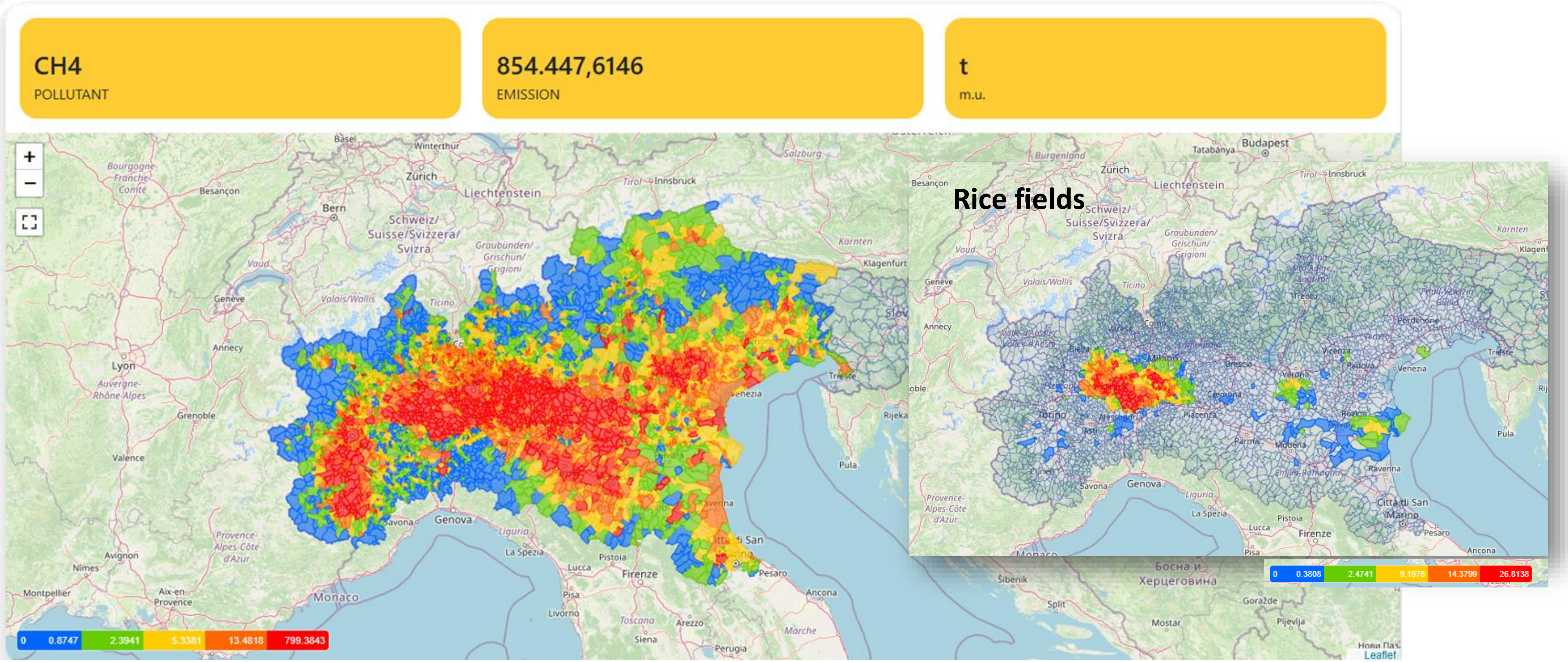
Development of a common pollutant emission dataset on the Po-basin and Slovenia (domain of 135000 Km2 and population of 28 million inhabitants):

- **Detail**: Year, Pollutant, Municipality, SNAP (3 levels for Italian regions), Fuel (for the Italian regions)
- **Approach:** Bottom – Up with details on point emissions sources
- **Three updates 2013, 2017 and 2019**
- **9 different institutions involved**
- **Development of a common platform for emission datasets**

Available emission dataset on Ammonia



Available emission dataset on Methane



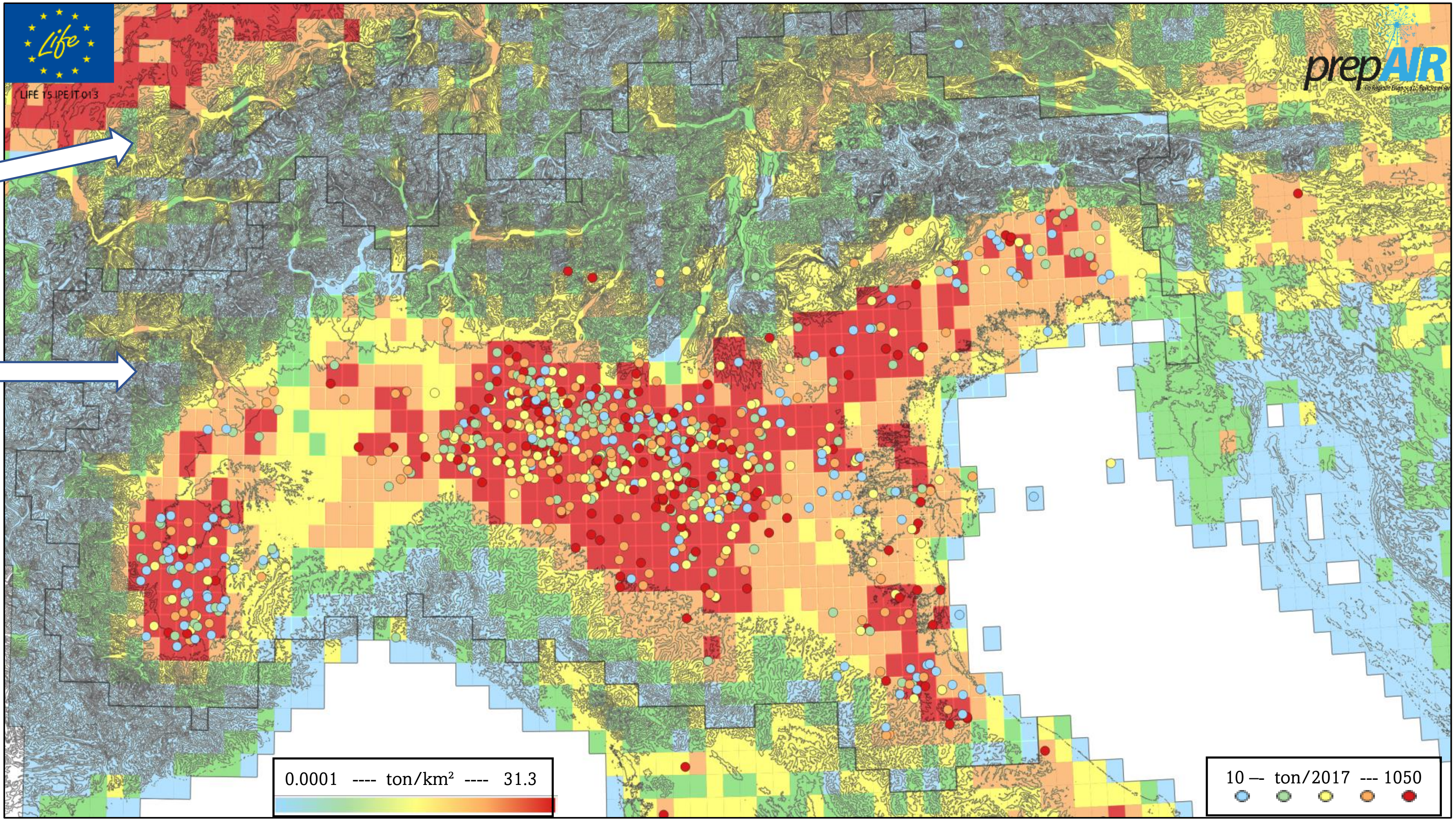
Emission mapping of NH3 in Northern Italy

Composite map from emission data (2017) from different sources:

- data in the outline represent those coming from ceip.at/the-emep-grid;
- representation of the data from "LIFE PREPAIR"* project within black outlines;

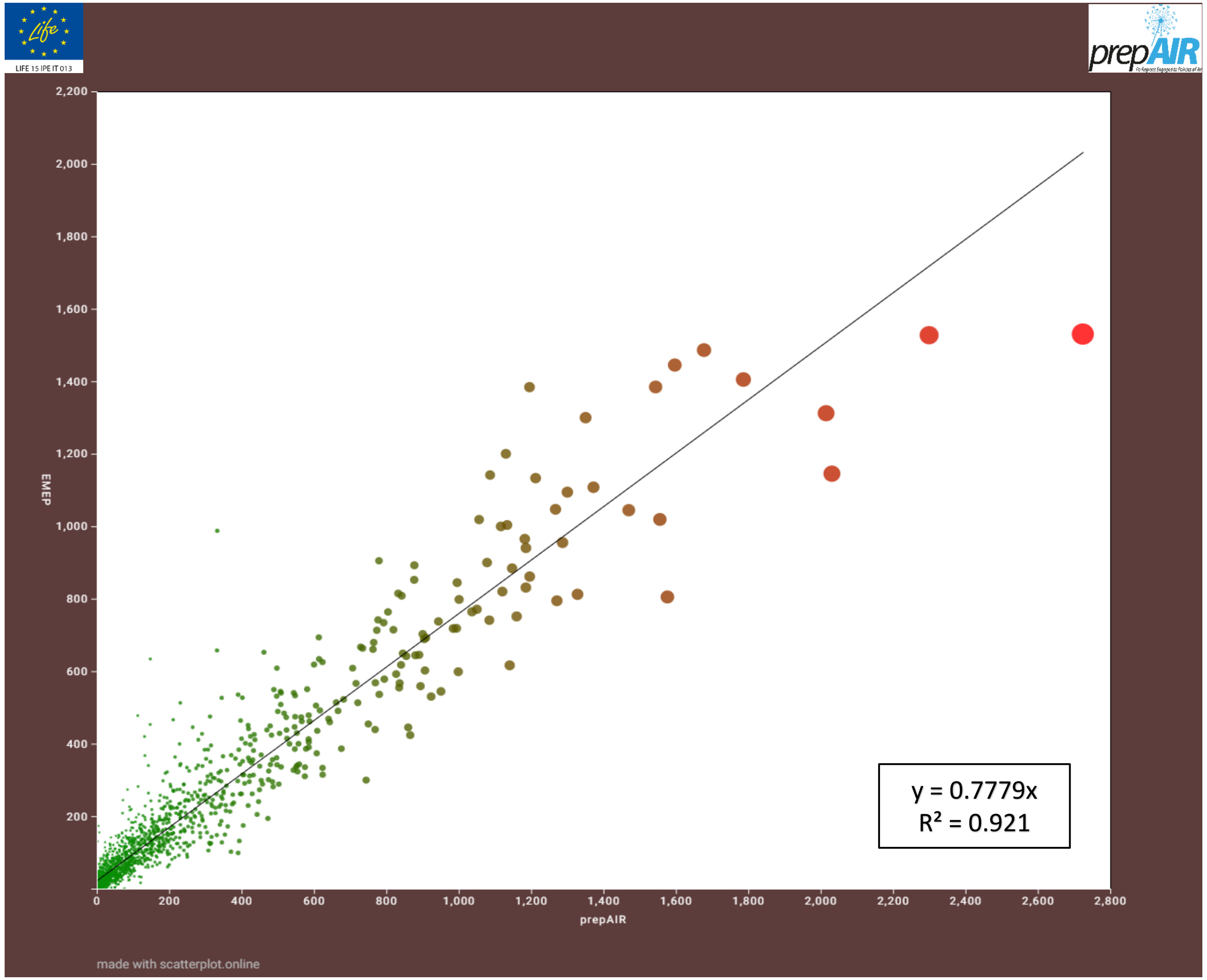
both are expressed as the emission density (ton of ammonia per km²).

- 945-point emission sources in Italy from 10 tonnes of NH_3 from intensive rearing of poultry or swine reported in E-PRTR database v.18 (industry.eea.europa.eu).



*https://www.scirp.org/journal/paperinformation.aspx?paperid=119885

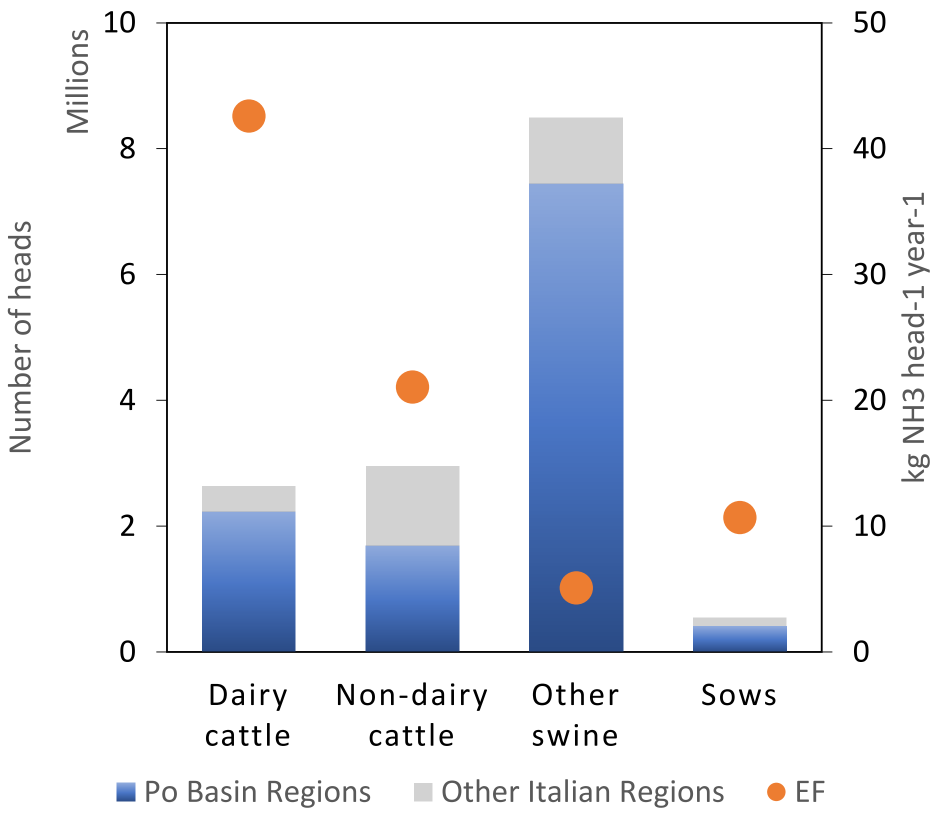
Map comparison LIFE PREPAIR vs EMEP grid

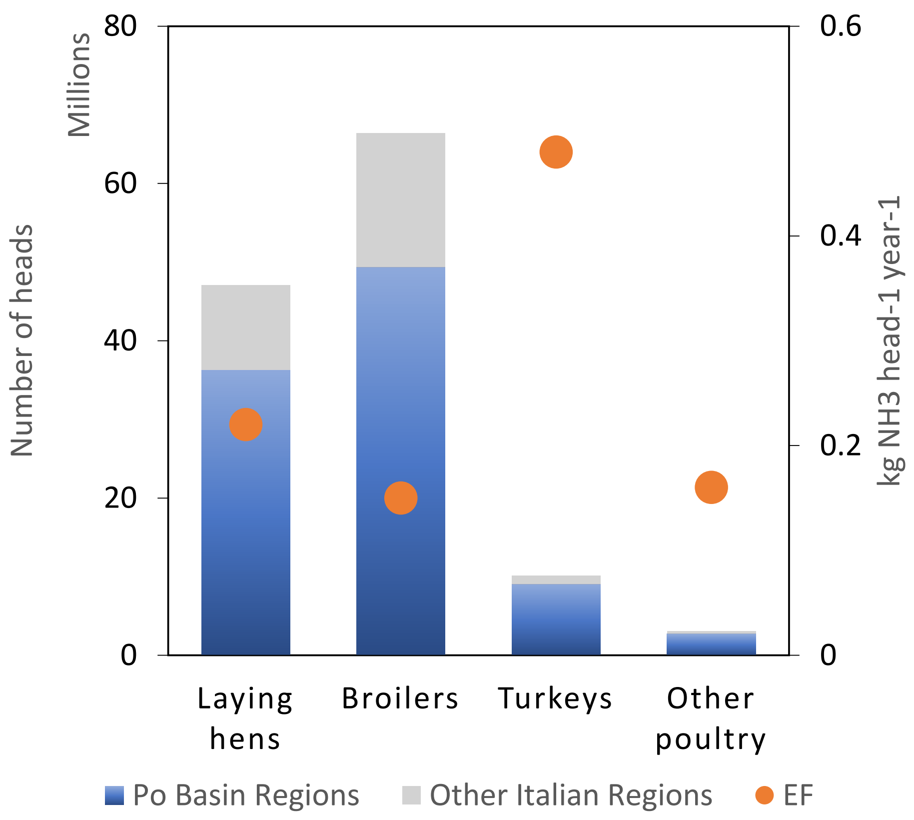


The comparison between the value reported in EMEP and that obtained from the prepAIR emission estimation methodology has the purpose of verifying and comparing emission inventories at European, national and regional level.

Each point of the scatter plot represents the ammonia emitted in tons in 2017 for each cell according to PREPAIR and EMEP estimates. 1735 cells representing the Po basin were compared.

Livestocks in Italy and Po-basin

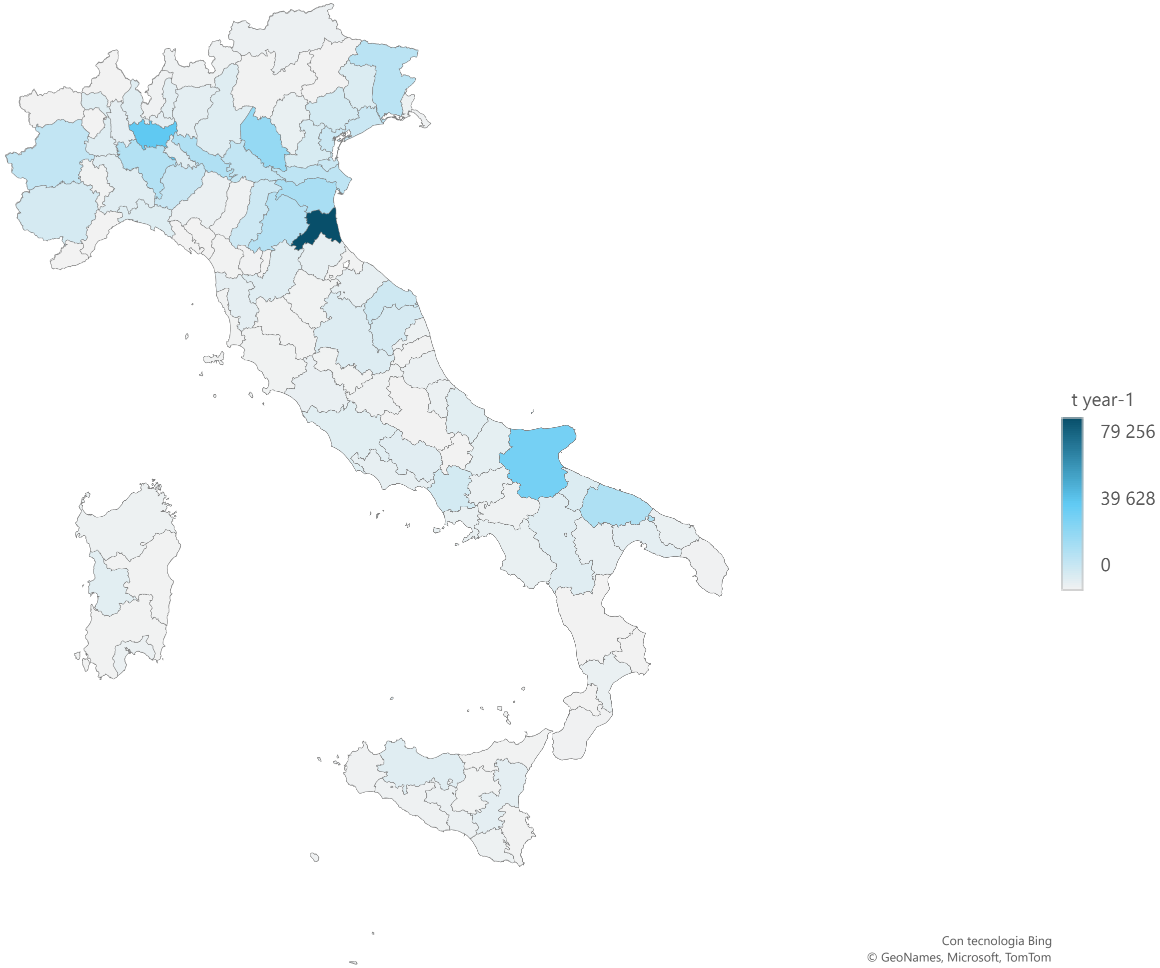




Data reported by Veterinary Authority show that the most (about of 80%) of cattle, swine and poultry are bred in the regions of Po valley. This analysis explains the relative higher emission density of the Po valley area compared to Italy and EU.

Elaboration on: https://www.vetinfo.it/j6_statistiche/#/report-pbi/41 and Italian IIR 2023

N Emissions from fertilizers



INPUT eg.:
Sales of Urea in 2023, according to ISTAT **(Italian National Statistics Institute)**

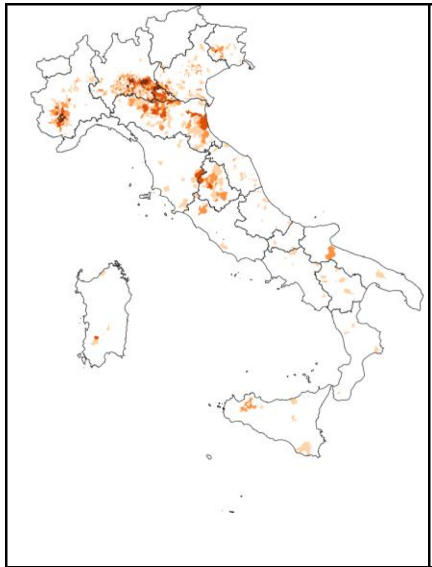
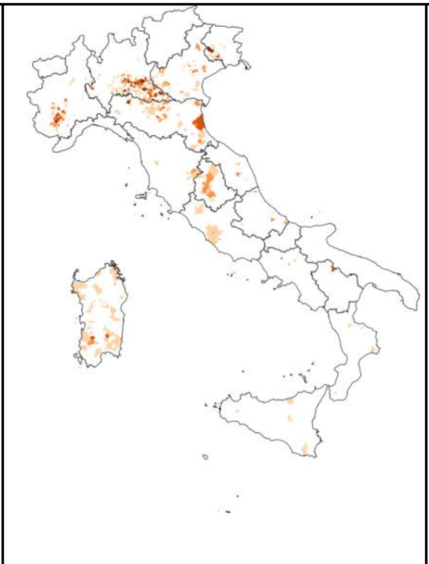
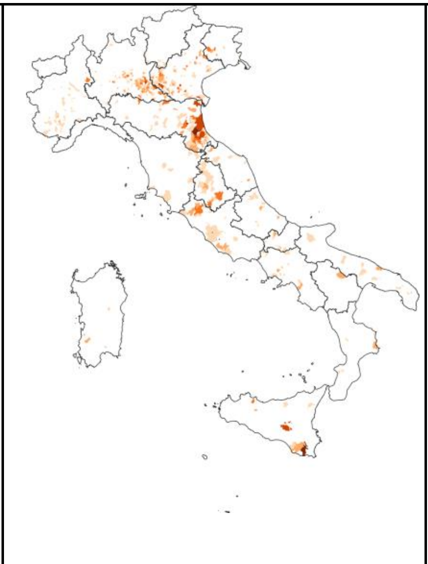
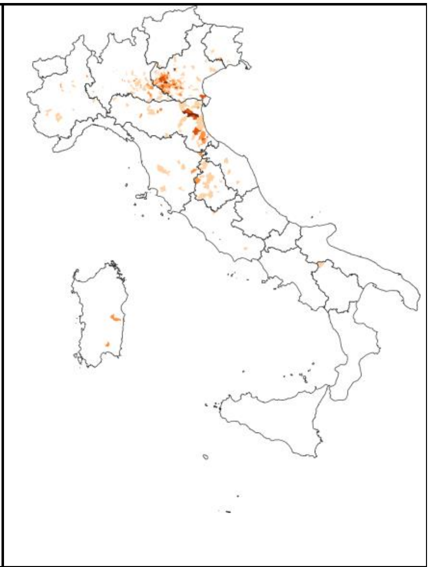
↓

N to field vs cultivatated areas in different municipalities

↓

Emissions

Main indicators/proxies for NH3 emissions

				
Other pigs (number of heads: 0-78522)	Sows (number of heads: 0-7650)	Broilers (number of heads: 0-1393790)	Laying Hens (number of heads: 0-1601478)	Other poultries (number of heads: 0-516092)

Marongiu, A.; Distefano, G.G.; Moretti, M.; Petrosino, F.; Fossati, G.; Collalto, A.G.; Angelino, E. Machine Learning Approach for Local Atmospheric Emission Predictions. *Air* **2024**, *2*, 380-401. https://doi.org/10.3390/air2040022

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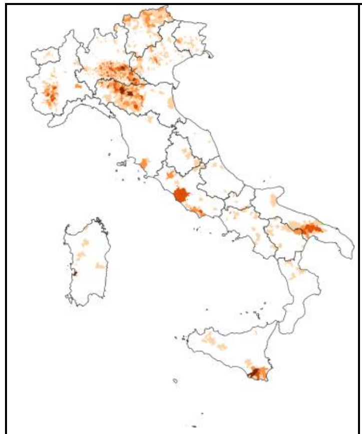	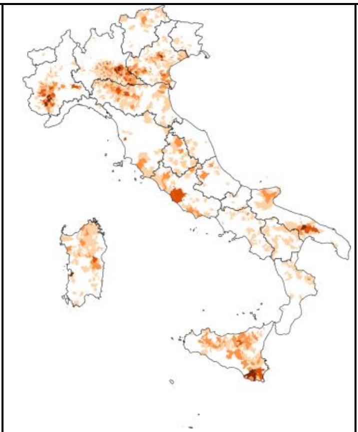	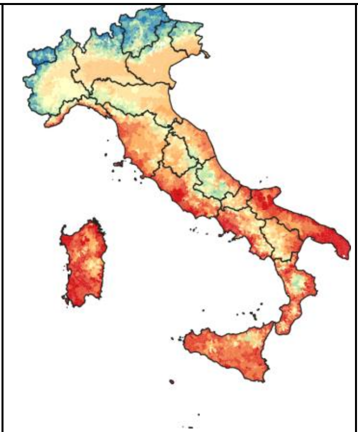	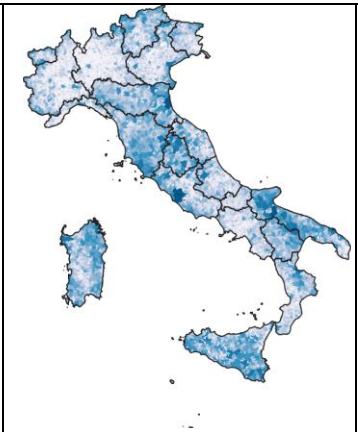	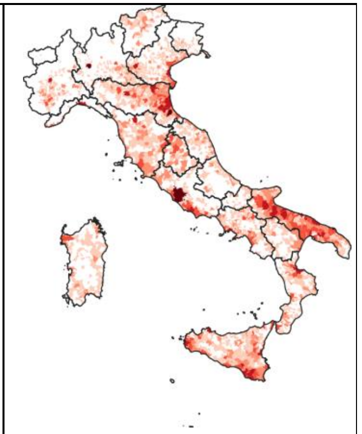	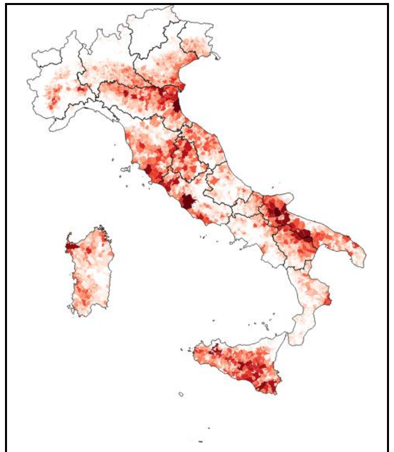
Dairy cows (number of heads: 0-15206)	Non dairy cows (number of heads: 0-28691)	Heating Degree Days HDD (1203- 4663)	Area Km2 (0.12-1287.39)	Employment by section A,B – Total Agriculture (0-14782)	Non-irrigated arable land (2-557)

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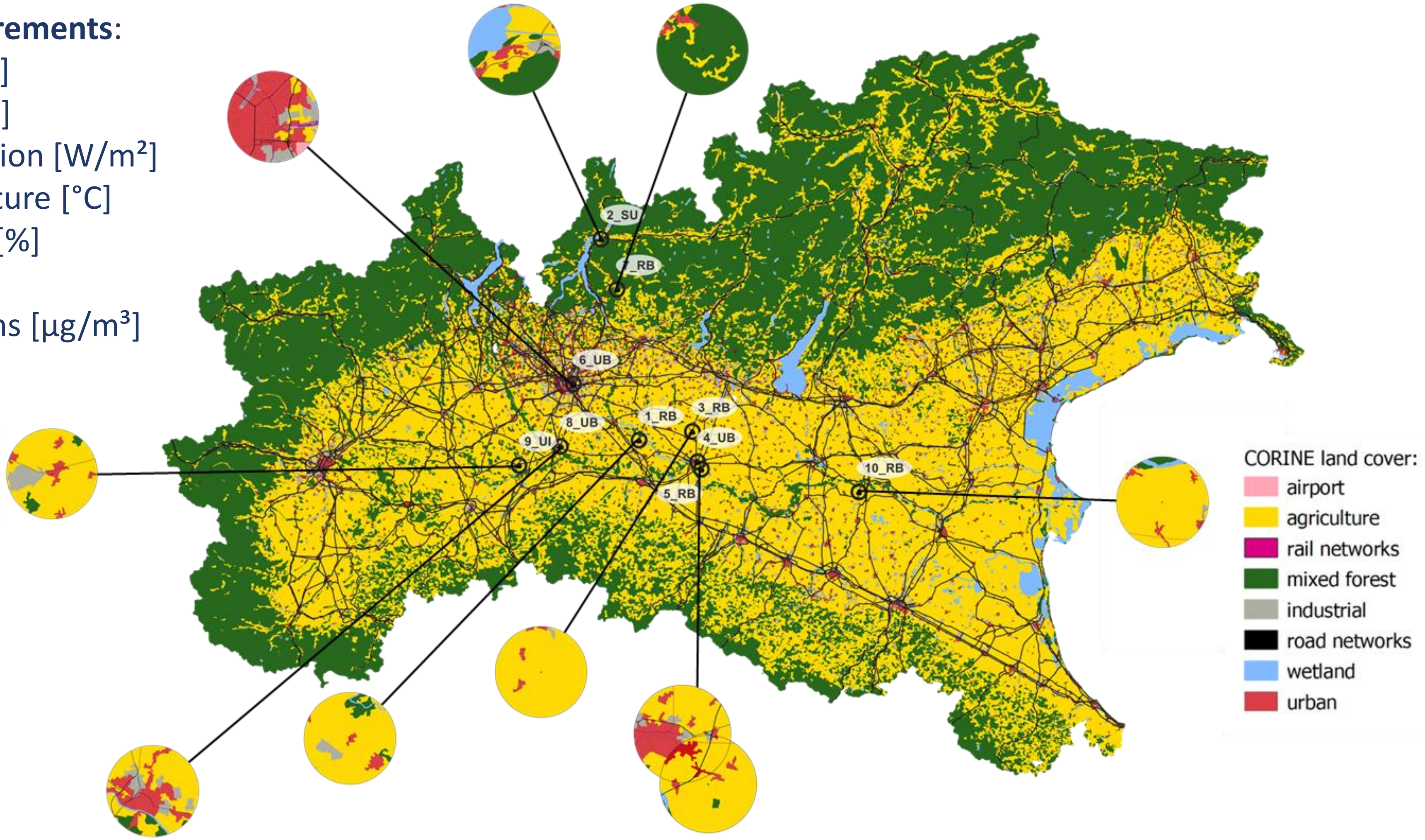
NH_3 concentrations and meteorological parameters

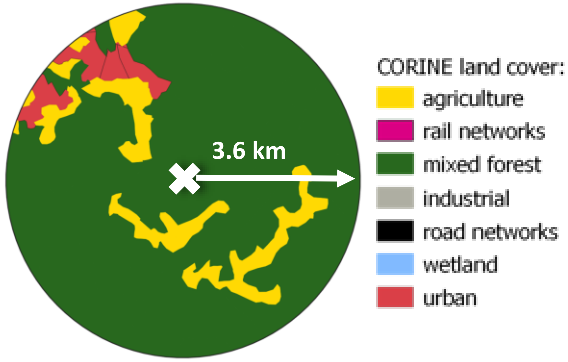
Hourly based measurements:

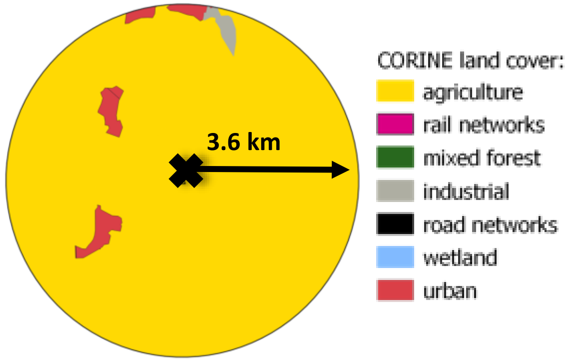
- wind direction [°C]
- precipitation [mm]
- global solar radiation [W/m²]
- ambient temperature [°C]
- relative humidity [%]
- wind speed [m/s]
- NH_3 concentrations [µg/m³]

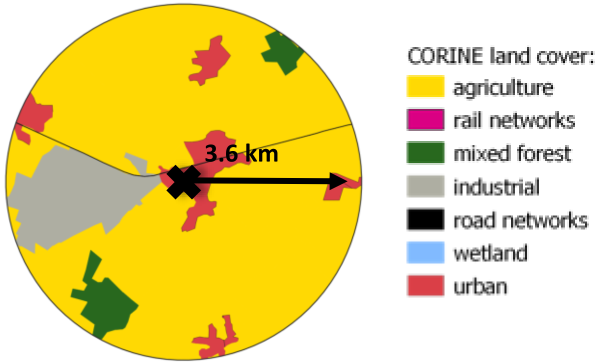


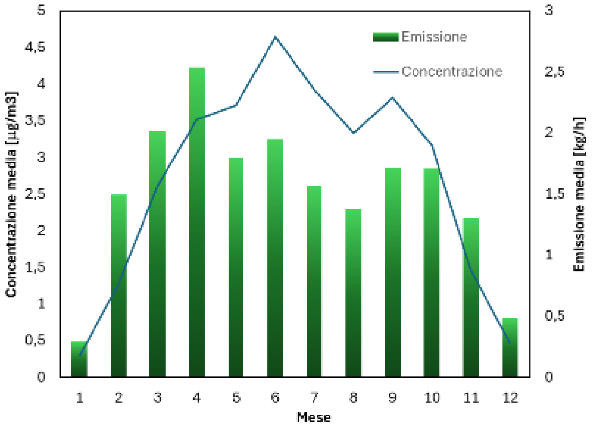
Monitoring sites: RB: rural background; UB: urban background; SU: suburban background; UI: urban industrial

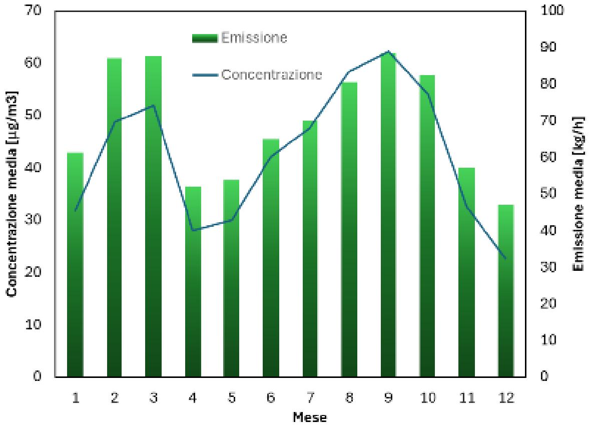
Emissions and concentratios time variation

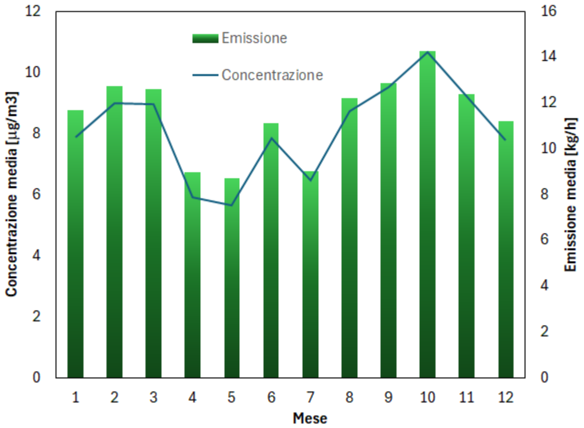






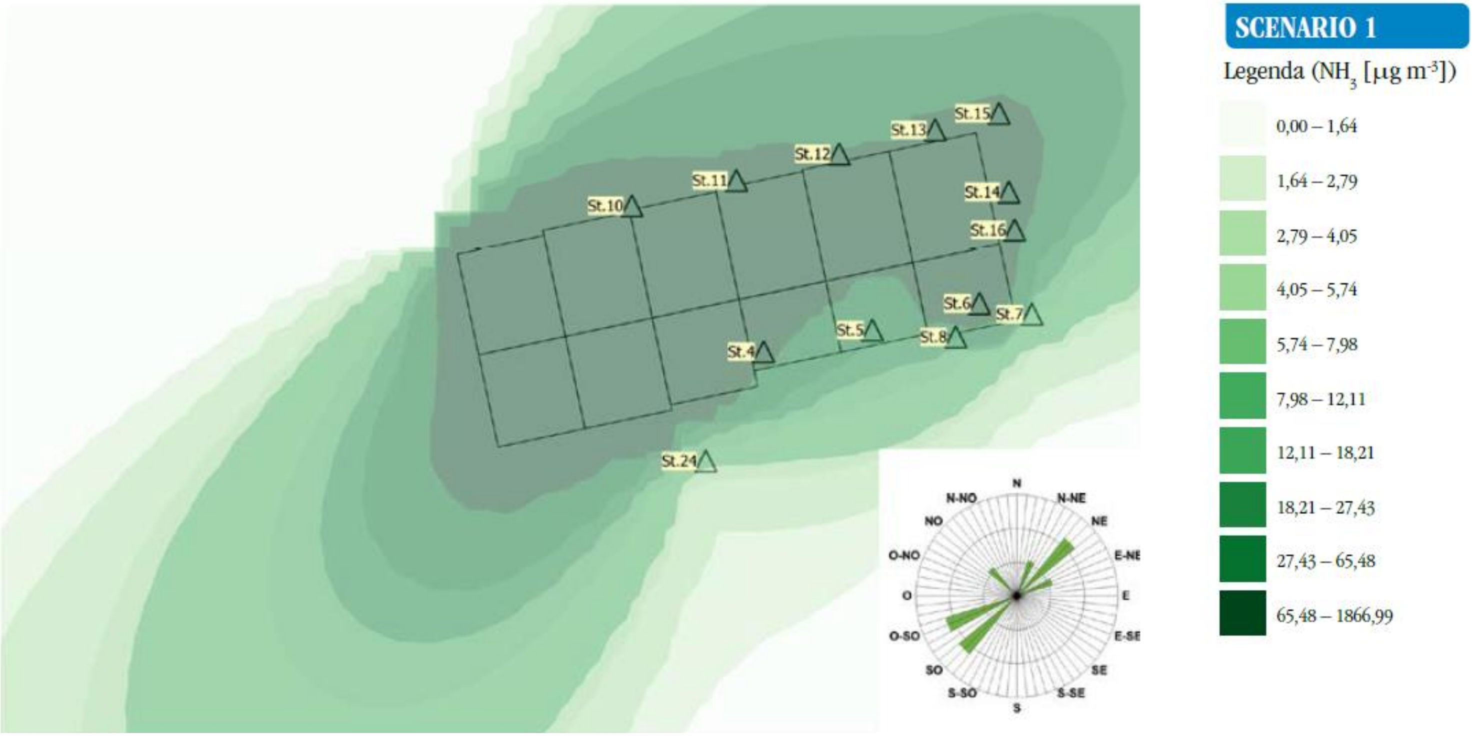






Marongiu, A.; Collalto, A.G.; Distefano, G.G.; Angelino, E. Application of Machine Learning to Estimate Ammonia Atmospheric Emissions and Concentrations. *Air* **2024**, *2*, 38-60. https://doi.org/10.3390/air2010003

Field measurements and reverse modelling



https://doi.org/10.32024/ida.v9i1.391

Scenario	Azienda	Sorgente emissiva	Flusso di emissione [$\mu g\ m^{-2}\ s^{-1}$]	Temperatura [°]	Velocità del vento [$m\ s^{-1}$]
Scenario 1	Azienda bovini	Spandimento interrato – maggio 2018	40,20	20,5	1,20
Scenario 2	Azienda bovini	Spandimento superficiale – maggio 2018	232,00	19,4	0,84
Scenario 3	Azienda bovini	Spandimento interrato – settembre 2018	62,90	19,0	2,20
Scenario 4	Azienda bovini	Spandimento superficiale – settembre 2018	110,00	18,5	1,50
Scenario 5	Azienda suini	Area di campo spandimento interrato	3,57	12,8	1,20

Conclusions

Ammonia emission rates

- For direct comparison with emission inventories, they can be useful as annual emissions with spatial details on the domain. The spatial resolution would be compared with municipal administrative boundaries on the domain.
- Possible increase of temporal resolution will be also interesting in CTM applications considering for a reference year the emission profiles on monthly and/or number of week basis. Always referring to the CTM applications also a mean day-hour profile could be useful.
- As possible we would ask for a data format in plain text (eg.: CSV).
- In the results a possible suggestion is to classify the information considering the importance of the remote sensing measurements and their level of completeness.