MODELLING HEAVY METALS CONCENTRATIONS OVER ITALY: COMPARISON WITH OBSERVATIONS AND SOME SENSITIVITY TESTS

Mario Adani[1], Mihaela Mircea[1], Camillo Silibello[2] Massimo D'Isidoro[1], Luisella Ciancarella[1], Lina Vitali[1], Antonio Piersanti[1], Gino Briganti[1], Andrea Capelletti[1],Gaia Righini[1], Giuseppe Cremona[1], Gabriele Zanini[1]

[1]ENEA, National Agency for New Technologies, Energy and Sustainable Economic Development, via Martiri di Monte Sole 4, 40129, Bologna, Italy
[2]ARIANET Srl, Via Gilino, 9, 20128, Milan, Italy

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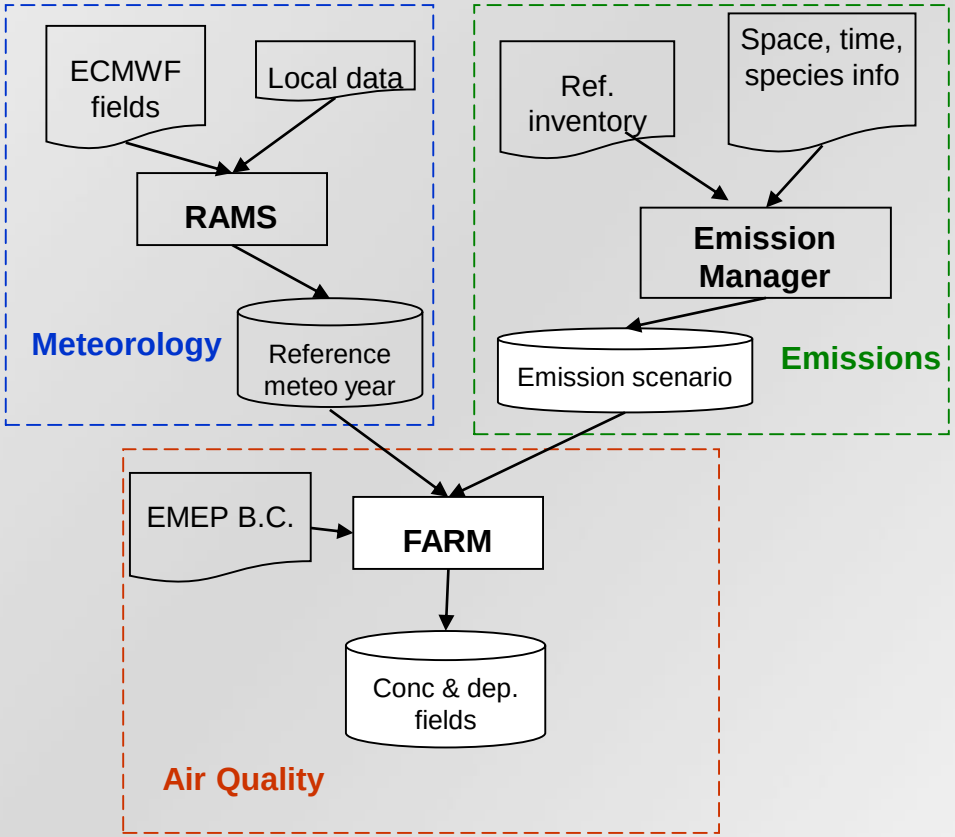
AMS-MINNI Atmospheric Modelling System



FARM Main features:

- ✓ **Emission** of pollutants from area and point sources, with plume rise calculation and mass assignment to vertical grid cells
- ✓ **3D dispersion** by advection and turbulent diffusion
- ✓ Flexible **gas-phase mechanism** (SAPRC-99, **POPs-Hg**) through **KPP** (Kinetic Pre-Processor: Damian *et al.*, 2002).
- ✓ Treatment of **PM_{10}** and **$PM_{2.5}$** (*aero3* modal aerosol module)
- ✓ **Dry removal** of pollutants dependent on local meteorology and land-use
- ✓ Removal through **precipitation scavenging** processes

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Model configuration and set up

- aero3 modified in order to take into account Pb, As, Ni, Cd.
- spatial resolution: 20 Km for ITx and 4 Km for NI; simulated year 2005
- initial/boundary condition: EMEP MSC-W and MSC-E at 3 and 6 hour time resolution, respectively .
- emission: national inventory over Italy (ISPRA 2009) and EMEP inventory for foreign countries
- meteorological fields computed with RAMS model over Italy at 20 km resolution using ic/bc from ECMWF analysis and downscaled from 20 km run to 4 km resolution using LAPS (Local Analysis and Prediction System) over Northern Italy.

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List of simulations

NAME	Boundary Condition	Emissions	Model domain/ Resolution
IT0	EMEP MSC-W (other pollutans) EMEP MSC-E (HMs)	Inside Italy (National Inventory) Outside Italy (EMEP MSC-W,E)	Italy 20x20 km^2
IT1	EMEP MSC-W (other pollutans)	Inside Italy (National Inventory) Outside Italy (EMEP MSC-W,E)	Italy 20x20 km^2
IT2	EMEP MSC-W (other pollutans) EMEP MSC-E (HMs)	Inside Italy (National Inventory)	Italy 20x20 km^2
NI	From IT0 simulation	Inside Italy (National Inventory) Outside Italy (EMEP MSC-W,E) (EMEP)	Northern Italy 4x4 km^2

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Results outline

- EMEP MSC-E vs MINNI (IT0)
- concentration (IT0) vs emissions
- sensitivity tests to transport through the boundaries (IT1) and to foreign emissions (IT2)
- fine grid (NI) vs coarse grid (IT0) simulations
- model estimates vs observations

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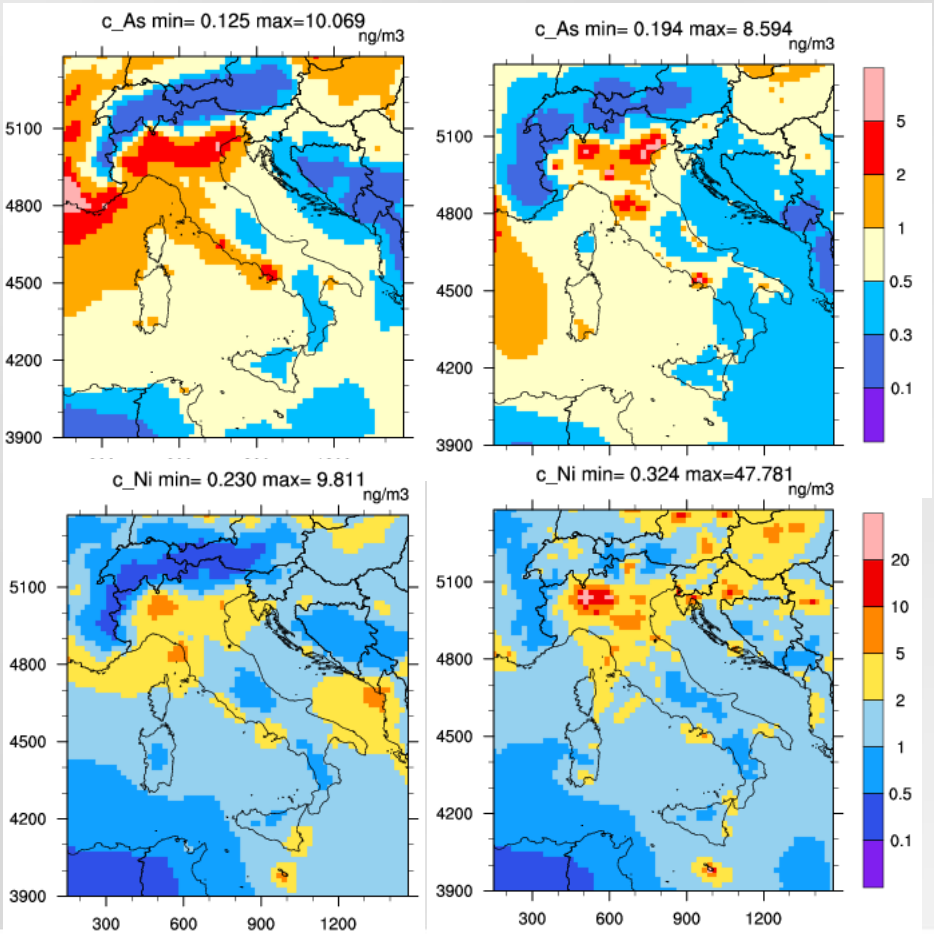
EMEP vs MINNI (1)

EMEP 50x50km

MINNI 20x20km



As: Target Value: 6ng/m^3

Ni: Target Value: 20ng/m^3

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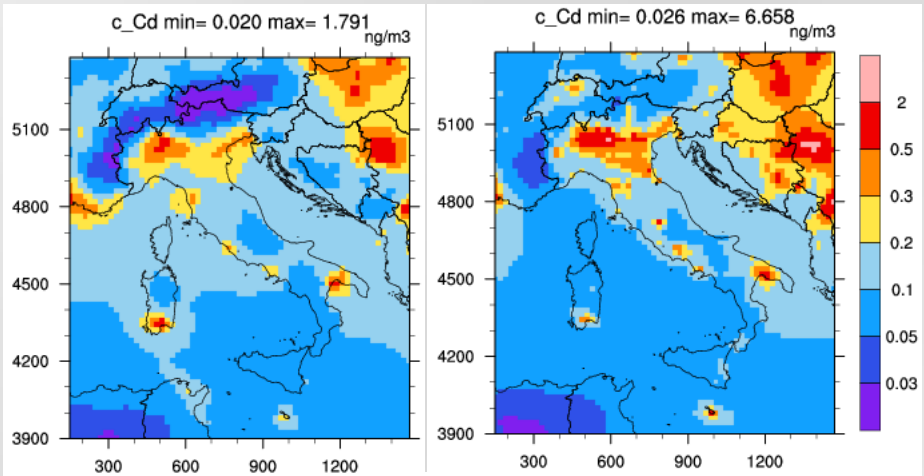
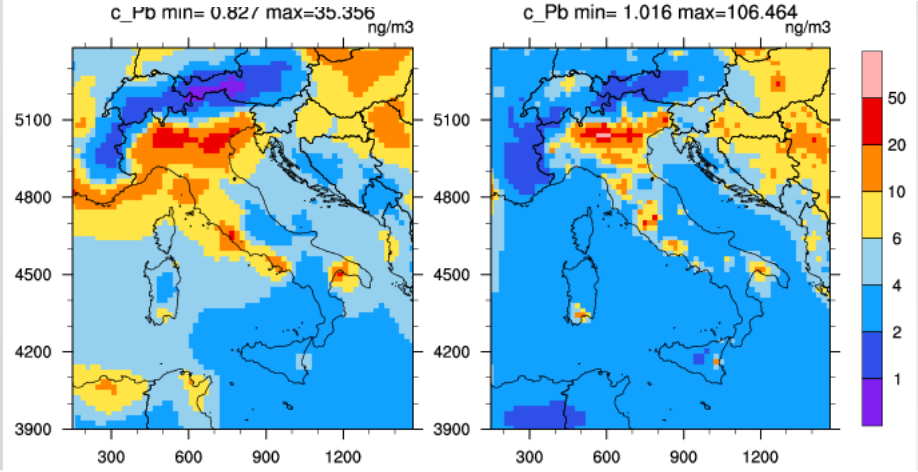
EMEP vs MINNI (2)

EMEP 50x50km

MINNI 20x20km





Cd: Target Value: 5ng/m^3

Pb: Limit Value: 500ng/m^3

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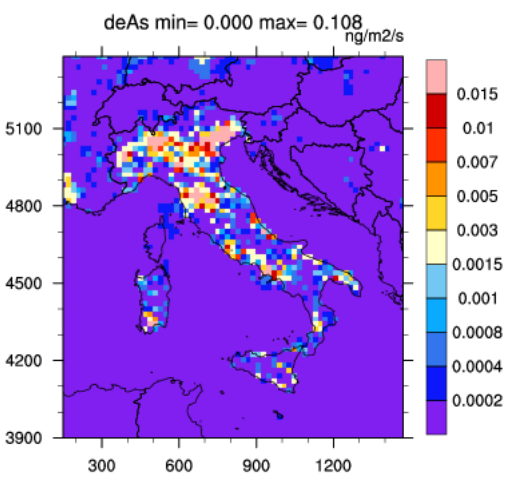
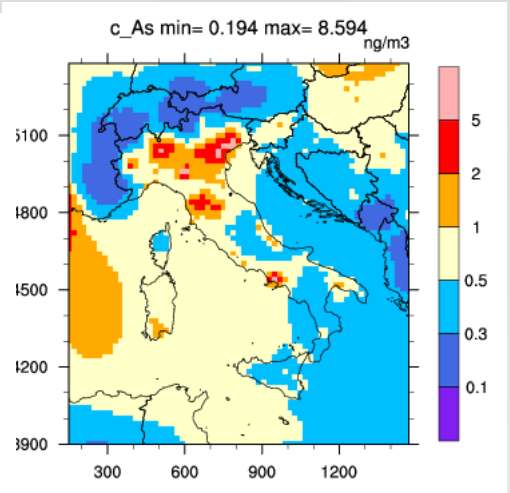
Emissions vs Concentrations (1)

EMI

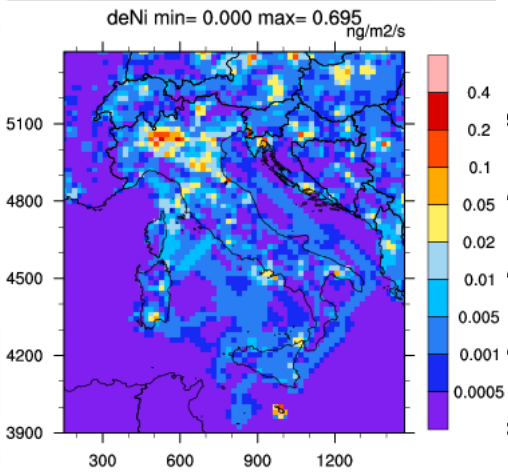
CONC

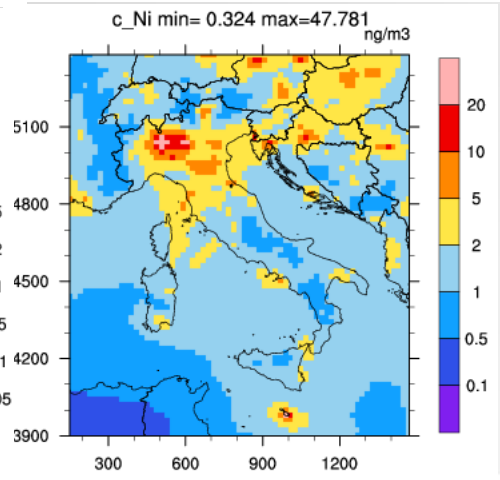




anthropogenic + natural
No point emission

As





Ni

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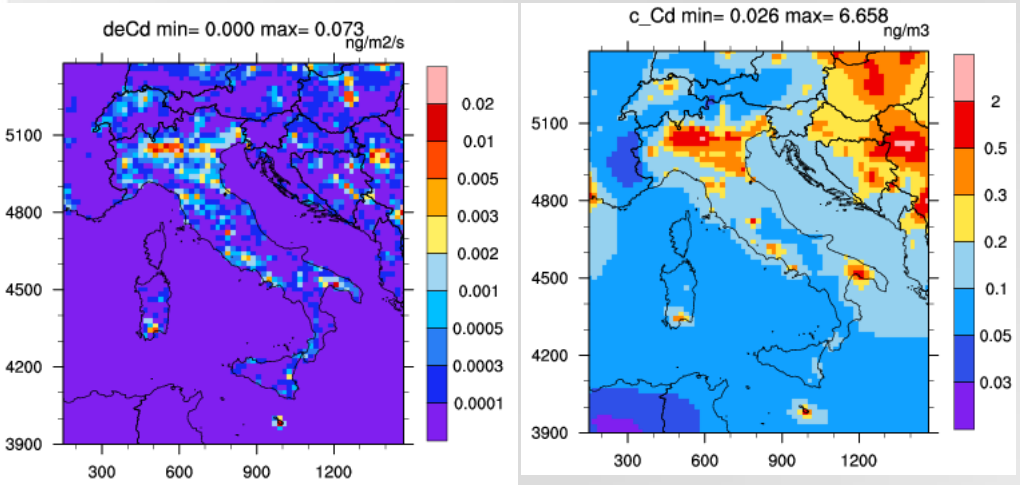
Emission vs Concentration(2)

EMI

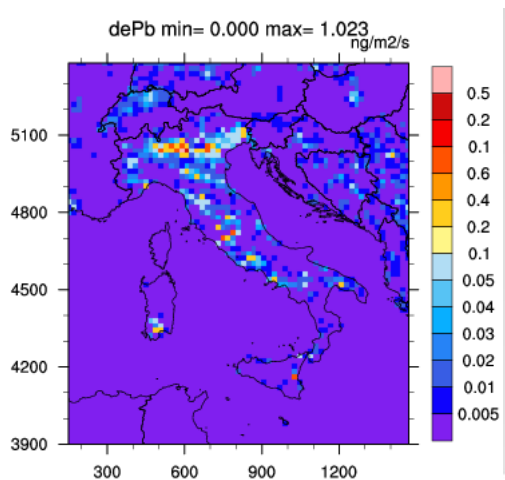
CONC

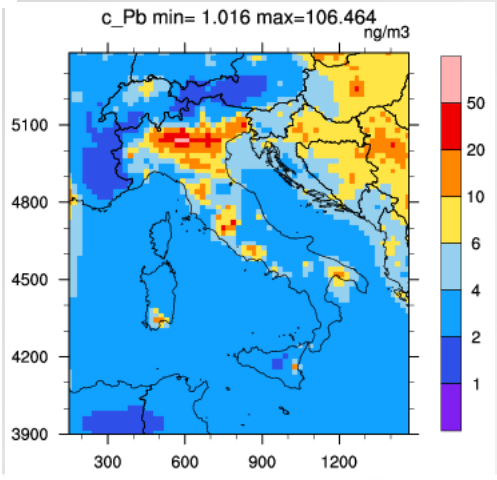
anthropogenic + natural
No point emission

Cd



Pb





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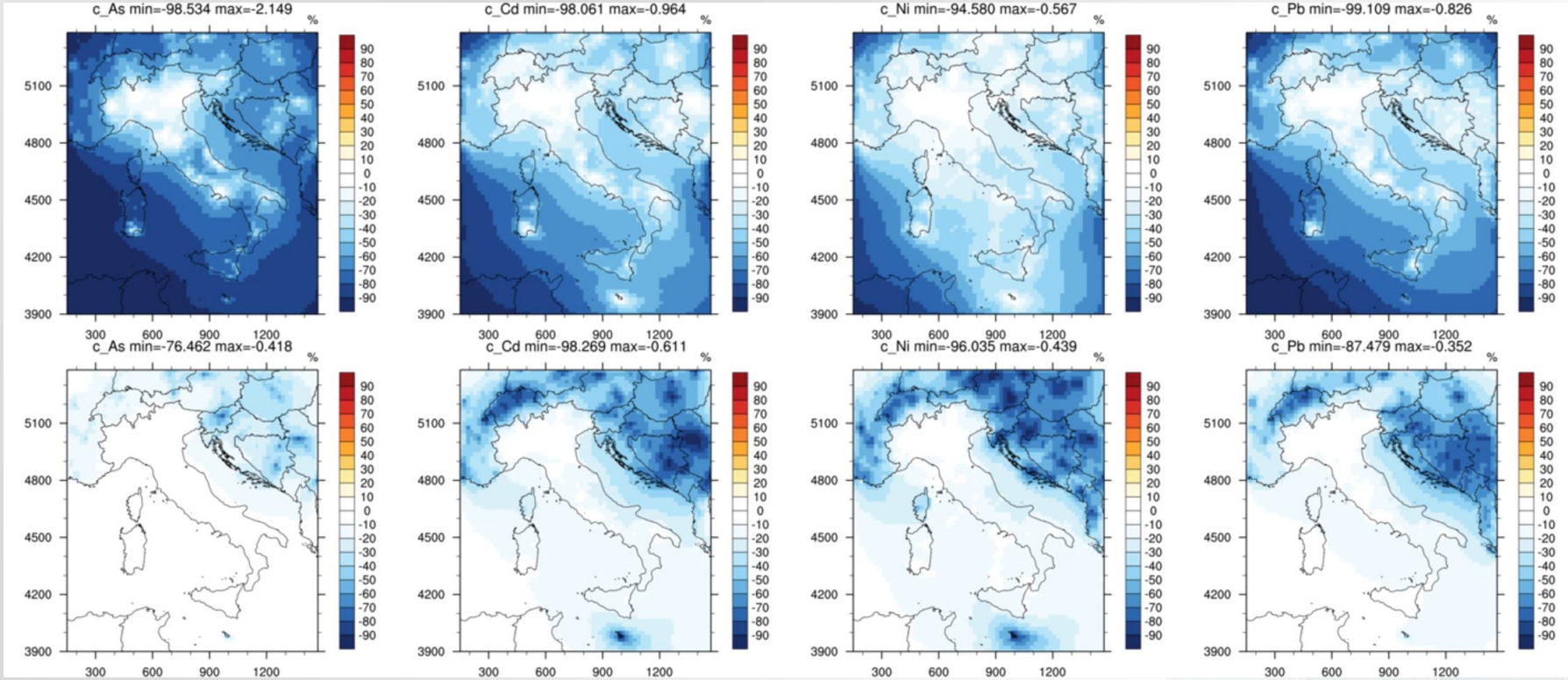
Sensitivity tests:
-top panel no boundary conditions
-bottom panel no foreign emissions



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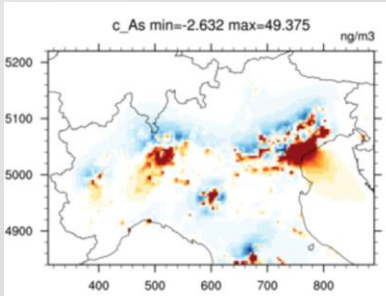
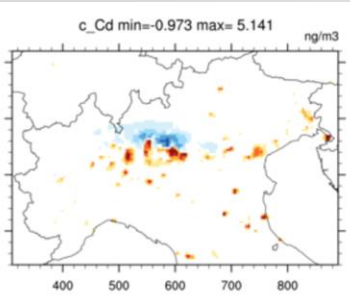
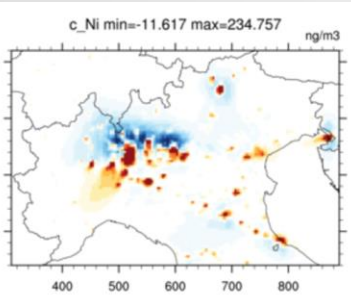
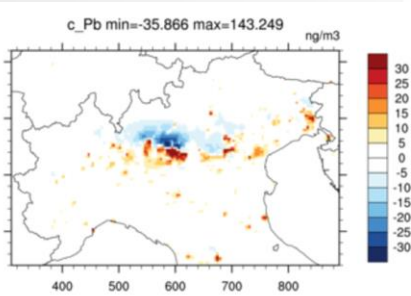
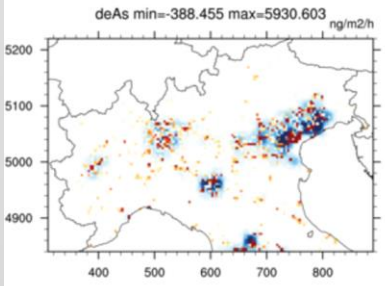
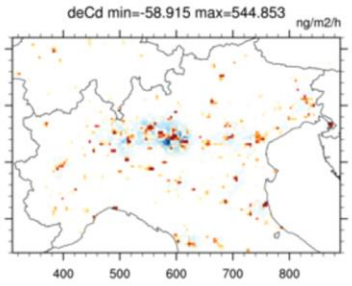
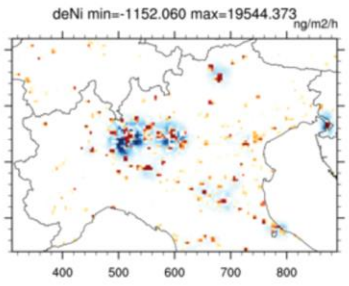
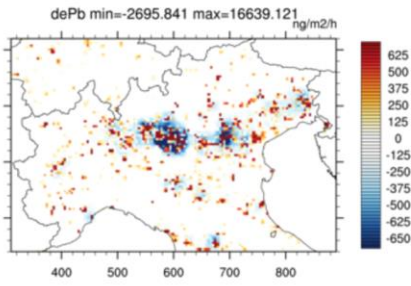
High resolution experiment:
-top panel NI-IT0 concentration difference
-bottom panel NI-IT0 emission difference

	As	Cd	Ni	Pb
conc				
emi				

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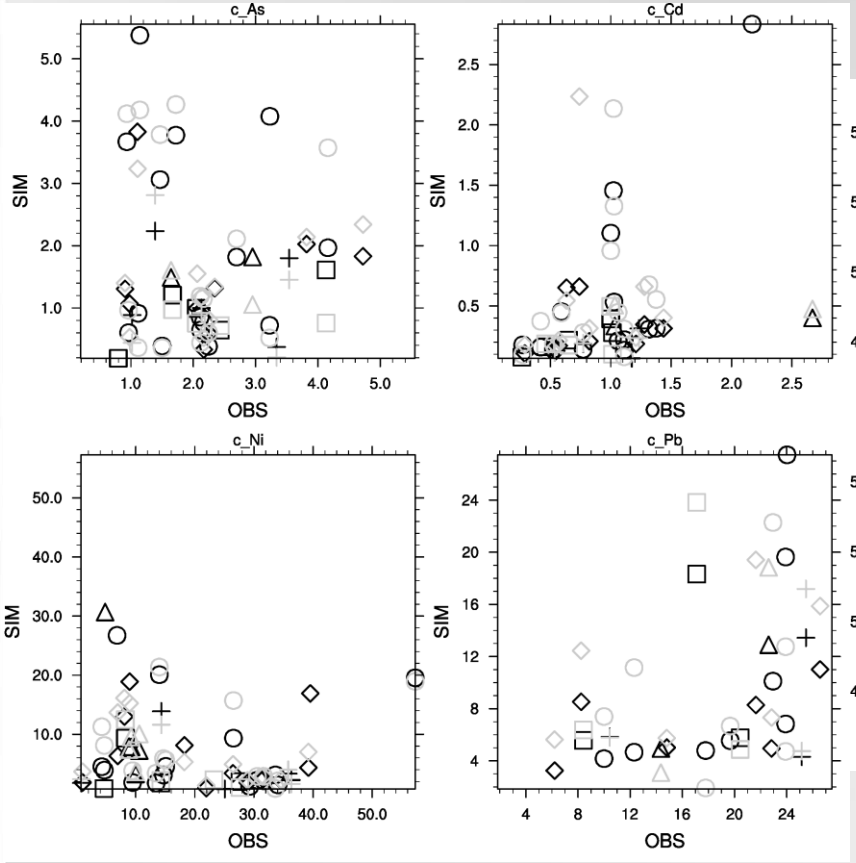
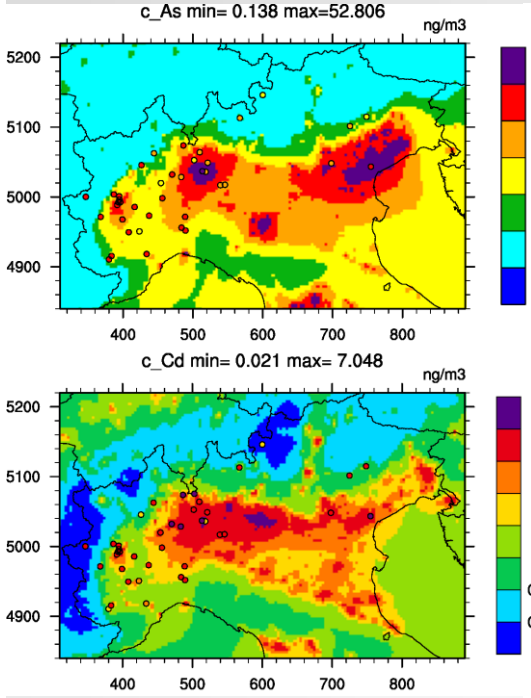
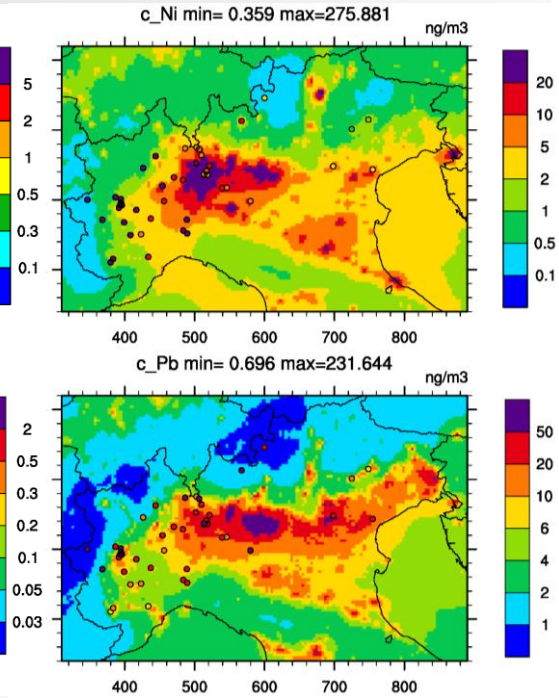
Model vs Observations







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Conclusions

- The results show good agreement with observations.
- The AMS-MINNI and EMEP simulations shows similar spatial distributions, but AMS-MINNI predicts higher concentrations since it is carried out with a finer grid (20 km with respect of 50 km of EMEP).
- The increase of concentrations in high-resolution experiment improves the agreement with observations but more detailed emissions inventory and a higher horizontal spatial resolutions may further improve the simulations.
- The boundary conditions have significant contributions in areas with low emissions.
- The foreign emissions contribution is generally below 20%.

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More information about AMS-MINNI and the present study are available from:
Web site: http://www.minni.org/
Conctact: mario.adani@enea.it