

Problematiche ed incertezze nell'uso di modelli a supporto delle decisioni: esperienze con il sistema modellistico MINNI

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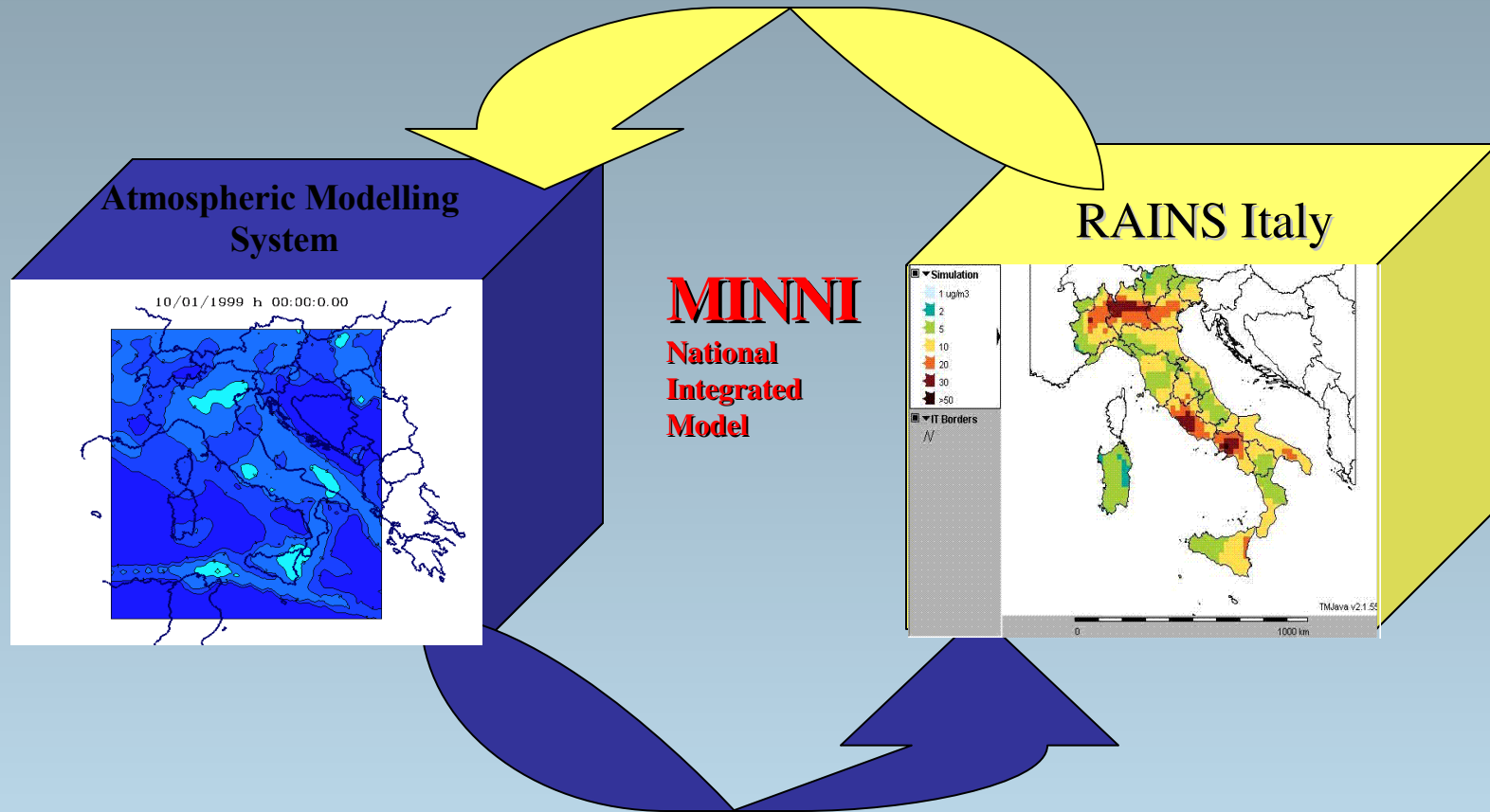


MINNI non è ...



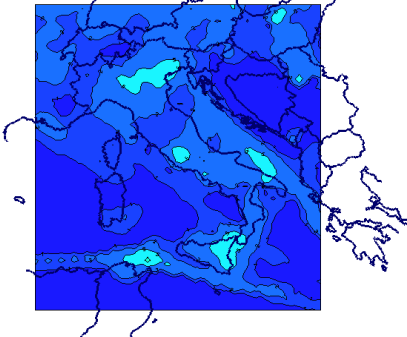
**... ma il “Modello Integrato Nazionale a
supporto della Negoziazione
internazionale sui temi
dell’Inquinamento atmosferico”**

Emission Projections



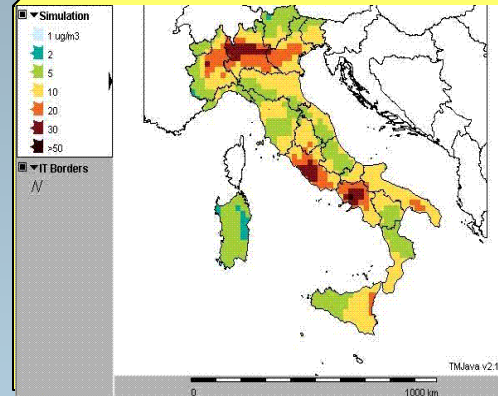
Atmospheric Modelling System

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MINNI
National
Integrated
Model

RAINS Italy



Atmospheric Transfer Matrix

The MINNI Project

Summary Info

- ❑ A 3 year project for the development of a National Integrated Modelling System (started in mid 2002);
 - ❑ Financed by ENEA and the Italian Ministry for the Environment (total investment 1,268 million euros);
 - ❑ Carried out under the leadership of ENEA in cooperation with ARIANET and IIASA.
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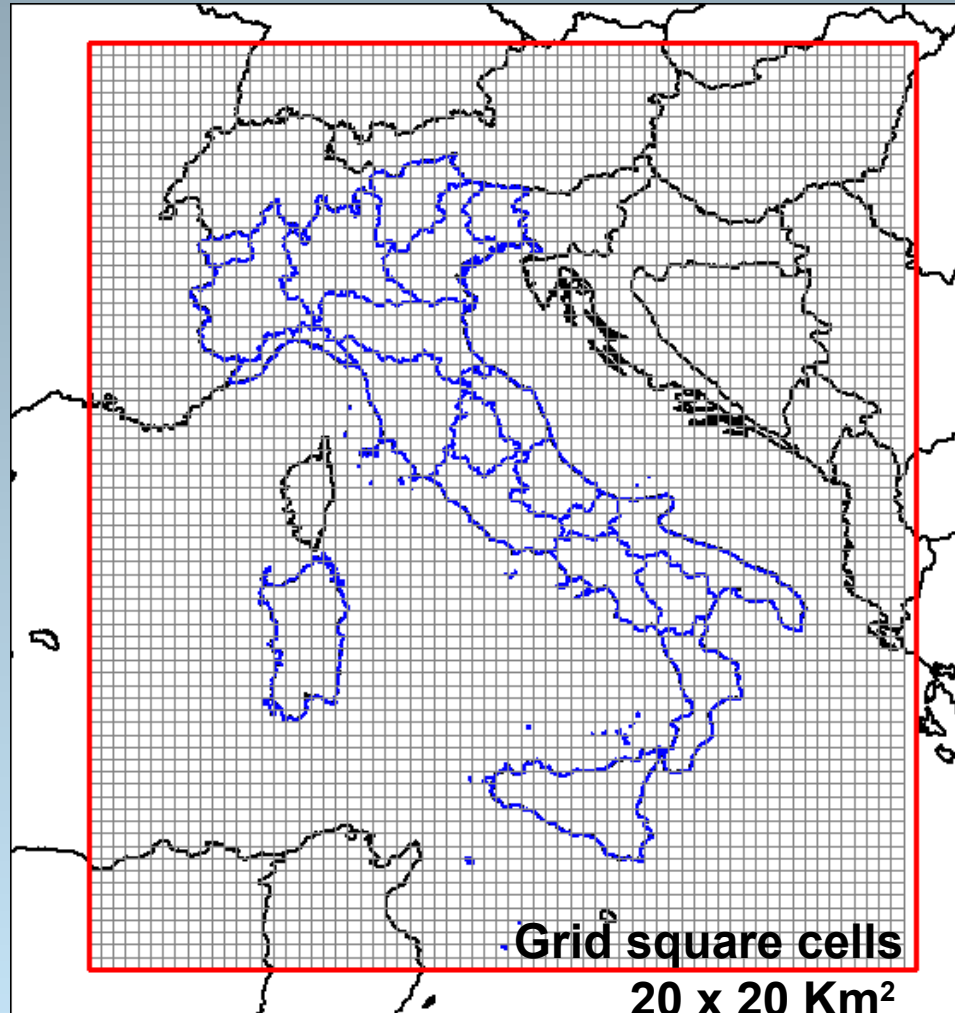
The MINNI Project

Ultimate Objectives

- ❑ RAINS-Italy;
 - ❑ Scenario Analysis for the Göteborg Protocol pollutants, O₃ and PM;
 - ❑ Environment and health impact (acidification, eutrofication, impact on vegetation, effect of PM and ozone on human health);
 - ❑ Policy assessment and cost effectiveness of abatement measures;
 - ❑ Support to stakeholders and policy makers.
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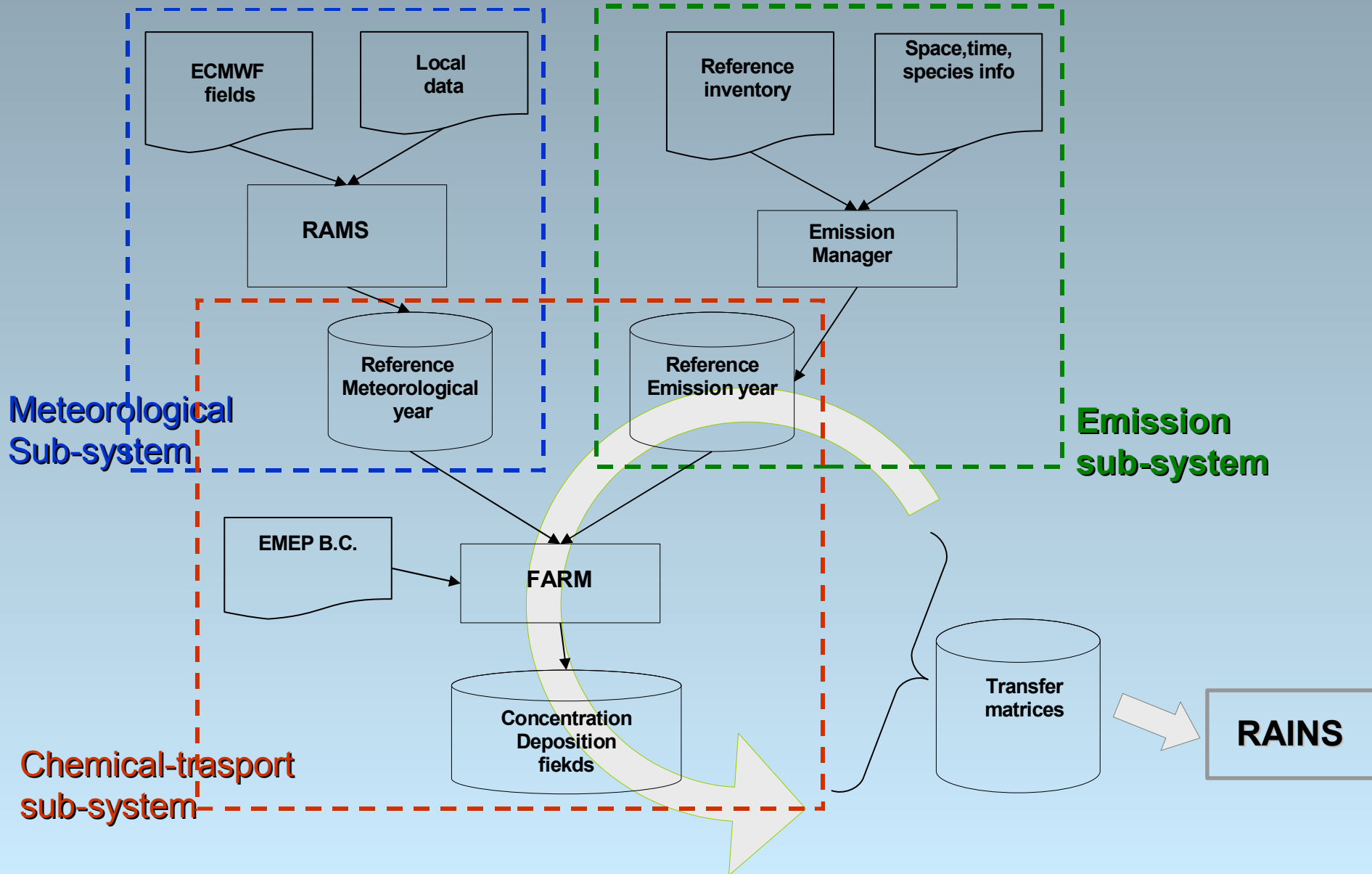
The MINNI Project

Computational domain



The MINNI Project

Atmospheric modelling system



Flexible Air quality Regional Model (FARM)

(included in the EEA Model Documentation System)



GAS PHASE

Assigned through **FCM** pre-processor (Kumar *et al.*, 1995); currently adopted:

- **SAPRC-90** (Carter, 1990);
- SAPRC-99 (Carter, 2000);
- adapted EMEP-acid (Hov *et al.*, 1988).

AEROSOL MODULES

Aero0 (transfer matrices)

- ‘bulk approach’ :
 - Fine (0-2.5 μm)
 - Coarse (PM10 - PM2.5)
- Aerosol processes:
 - sulfates, nitrates, ammonium, primary particles;
 - excluding SOA, natural sources

Aero3 – CMAQ (experimental)

- Lognormal size distribution (s_g and D_g):
 - Aitken mode (0-0.1 μm)
 - Accumulation mode (0.1-2.5 μm)
 - Coarse (PM10 - PM2.5)
- Aerosol processes:
 - Nucleation;
 - Coagulation;
 - *ISORROPIA equilibrium model*;
 - *SOA treatment*

Meteorological sub-system

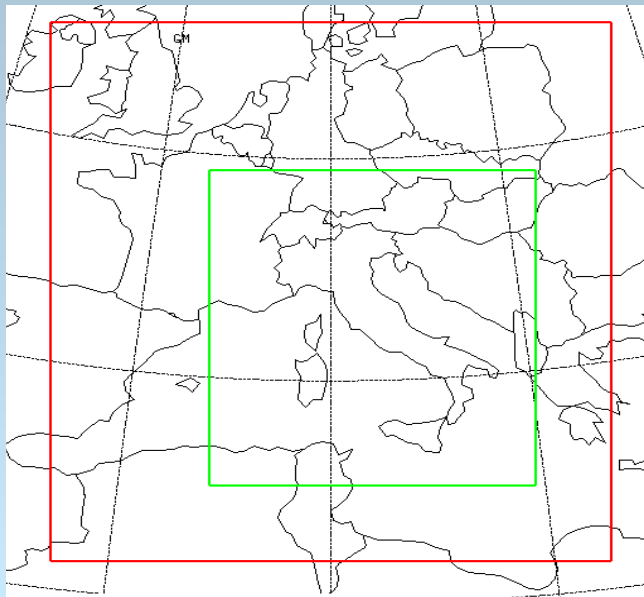
FARM Input File Requirements

Meteorological input files:

- Wind;
- Temperature;
- Water-vapor concentration;
- Pressure;
- cloud cover, base, top, water content;
- precipitation rate;
- Horizontal and vertical diffusivity (effective mixing height);
- Deposition velocities (gas);
- Aerodynamic resistance, u^* , w^* (aero3)

RAMS

RAMS Computational Domains		
	Coarse Grid	Target Grid
Nx	41	71
Ny	46	80
Nz	35	35
Δxy (km)	60	20
Δt (sec)	90	45



RAMS Simulations Details

Initialisation: ECMWF Analyses, Synop observations, ECMWF soil temperature and humidity;

Soil/Surface: Soil-Vegetation-Atmosphere transfer model;

Turbulence: Mellor & Yamada level 2.5;

Microphysics: Prognostic Hydrometeor equations;

Convection: Modified Kuo scheme activated;

4DDA: Nudging on pre-analysed fields;

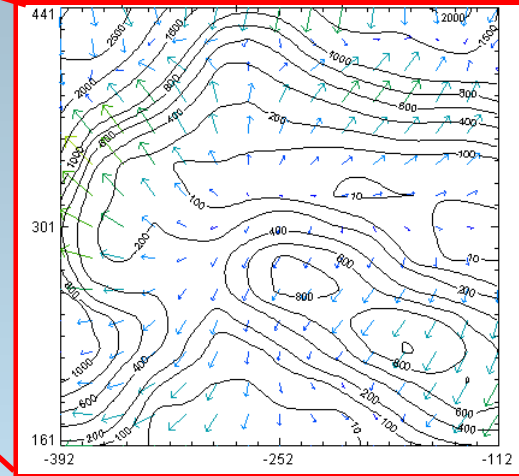
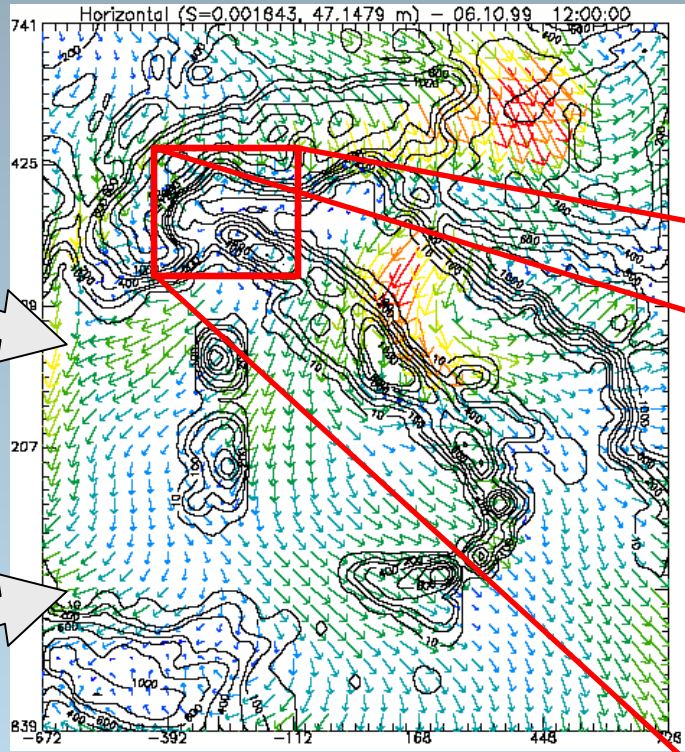
Archiving: Fields archived on hourly basis.

ECMWF fields

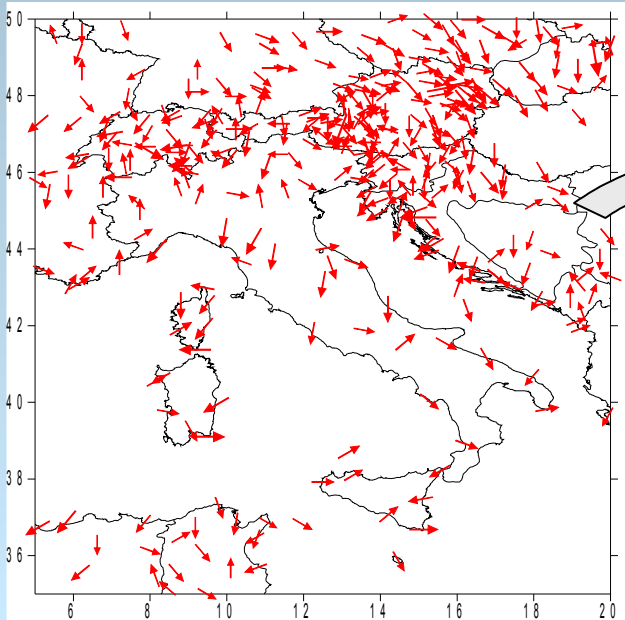
RAMS

RAMS Re-analysis

Po Valley detail



SYNOPSIS



Example for 06/10/1999 at 12:00 UTC

ECMWF plotted fields refer to 850 Hpa
RAMS reanalysis reports surface wind

Emission sub-system



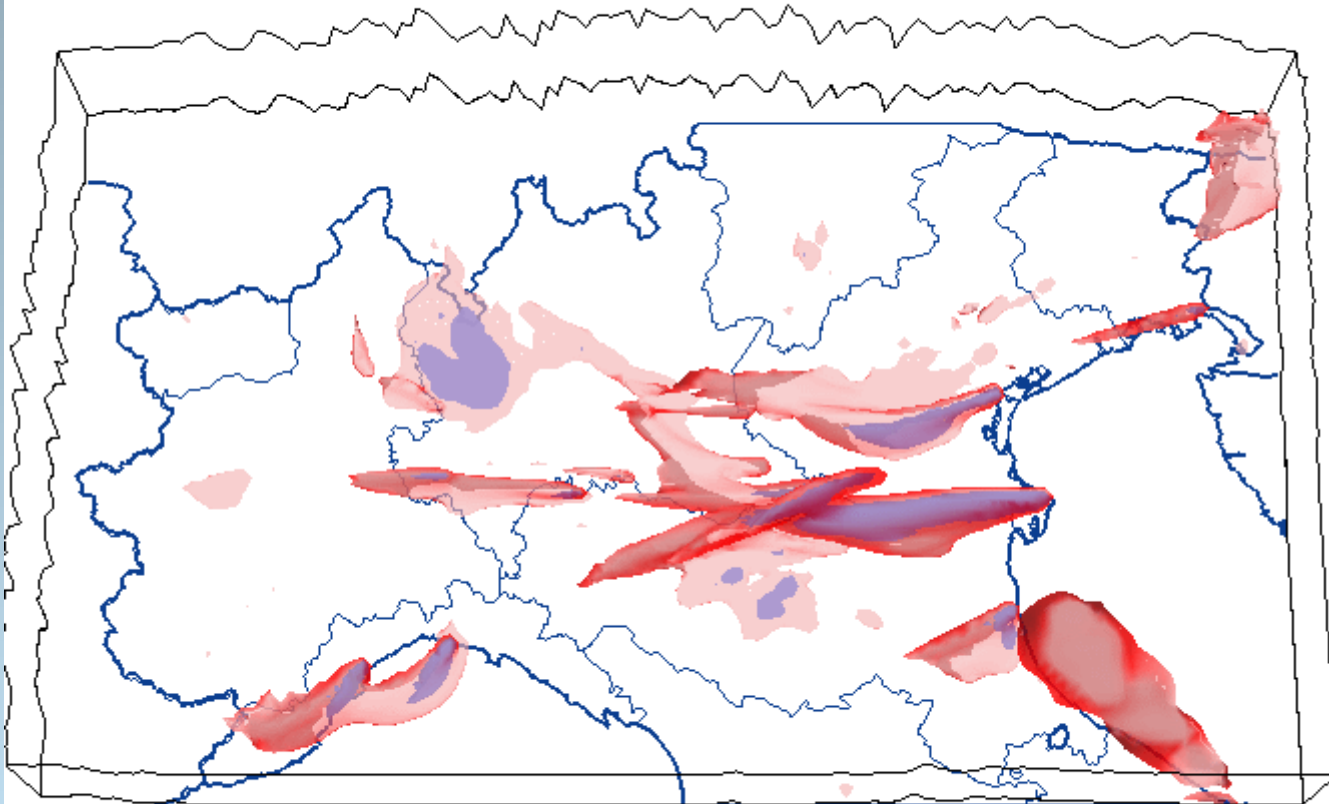
FARM Input File Requirements

Emissions input files:

- Diffuse emissions;
- Elevated point source emissions

Periodo invernale: esempio pennacchi SO₂

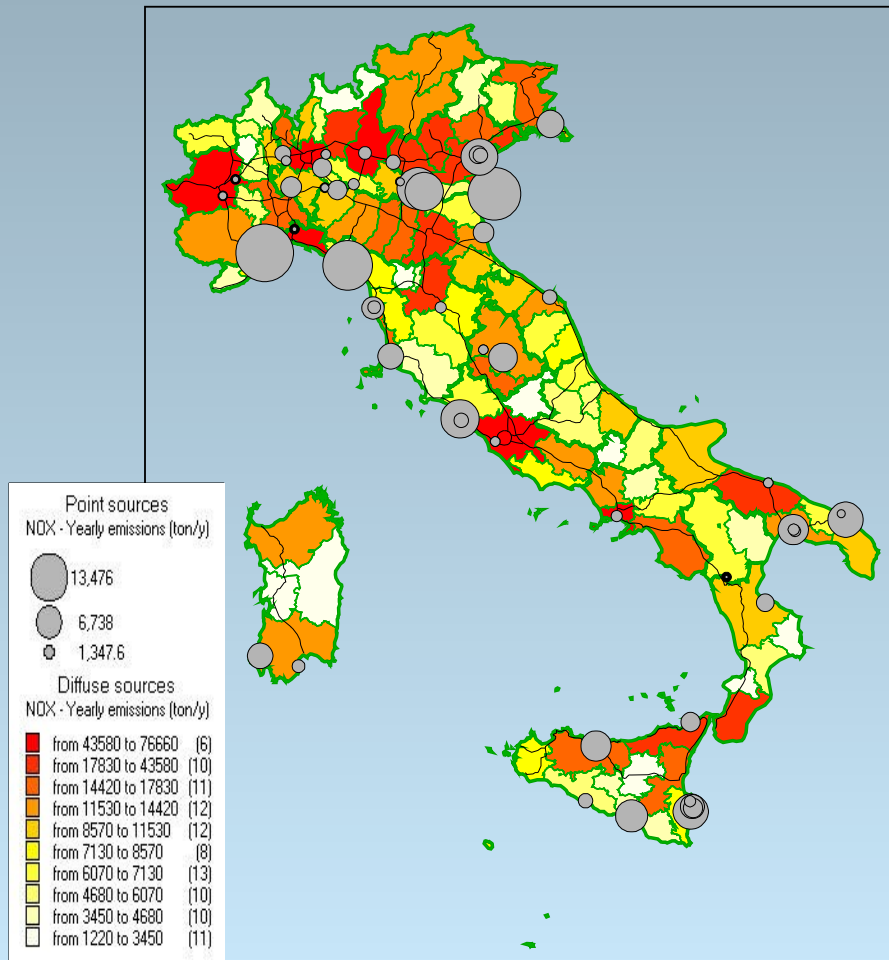
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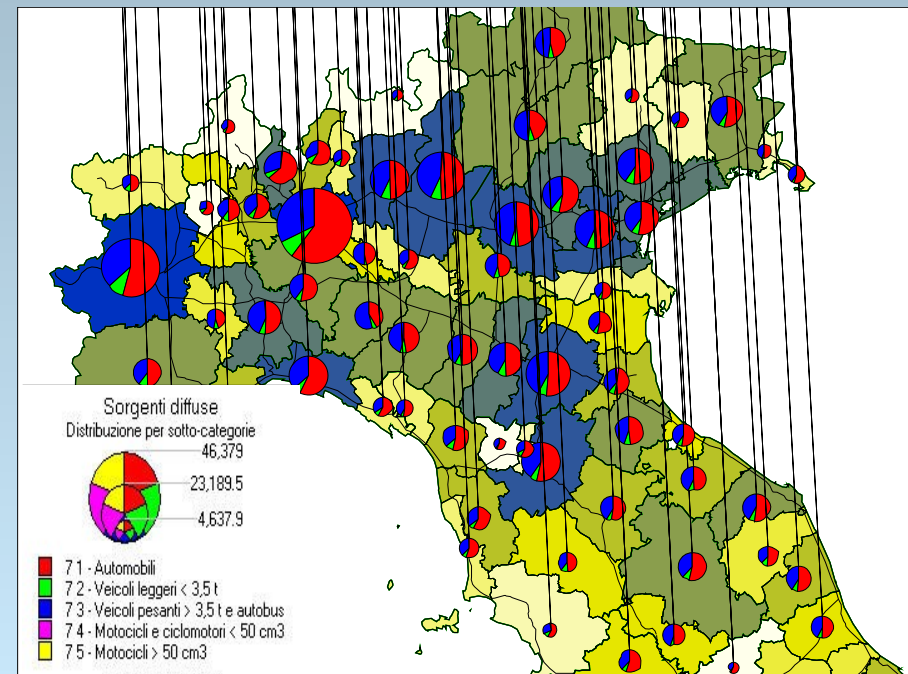
Isosuperfici a 10 e 20 ppb

National emission inventory of NOX by province and sector (NUTS3 and SNAP2/3) + LPS

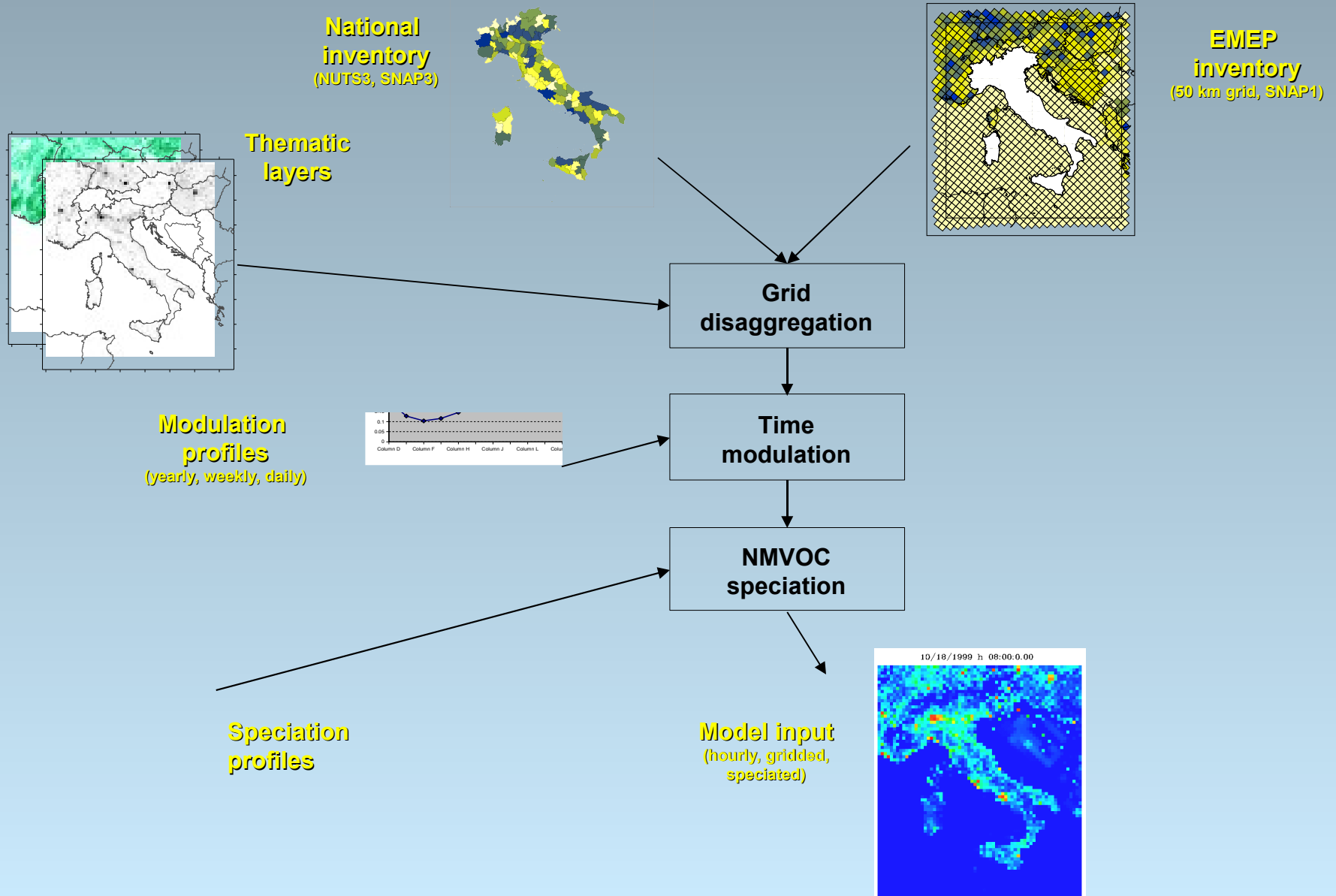
All sectors



Sector 7 (road traffic)



Emission module



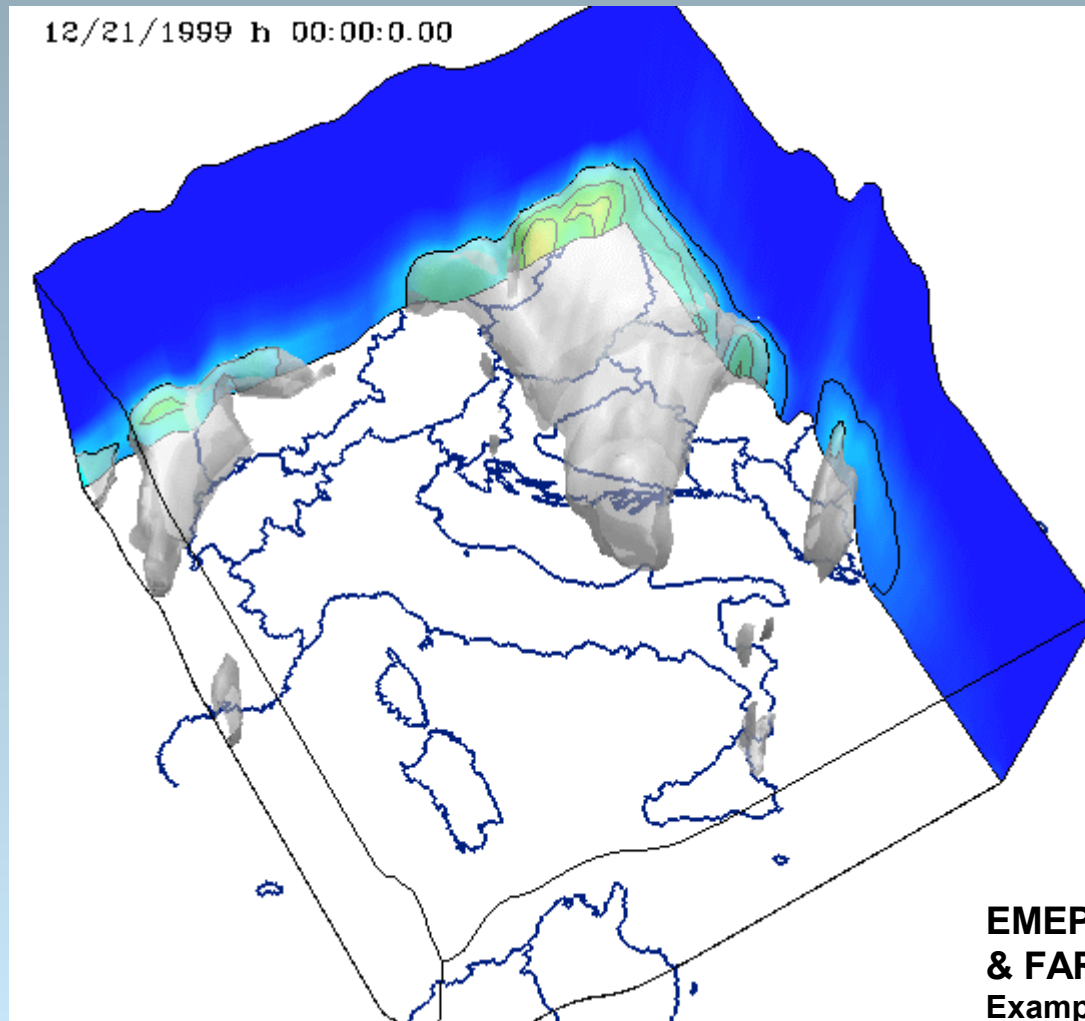
Chemical-transport sub-system

FARM Input File Requirements

Air quality related input files:

- Initial concentrations;
- Boundary concentrations

Nesting into EMEP European model



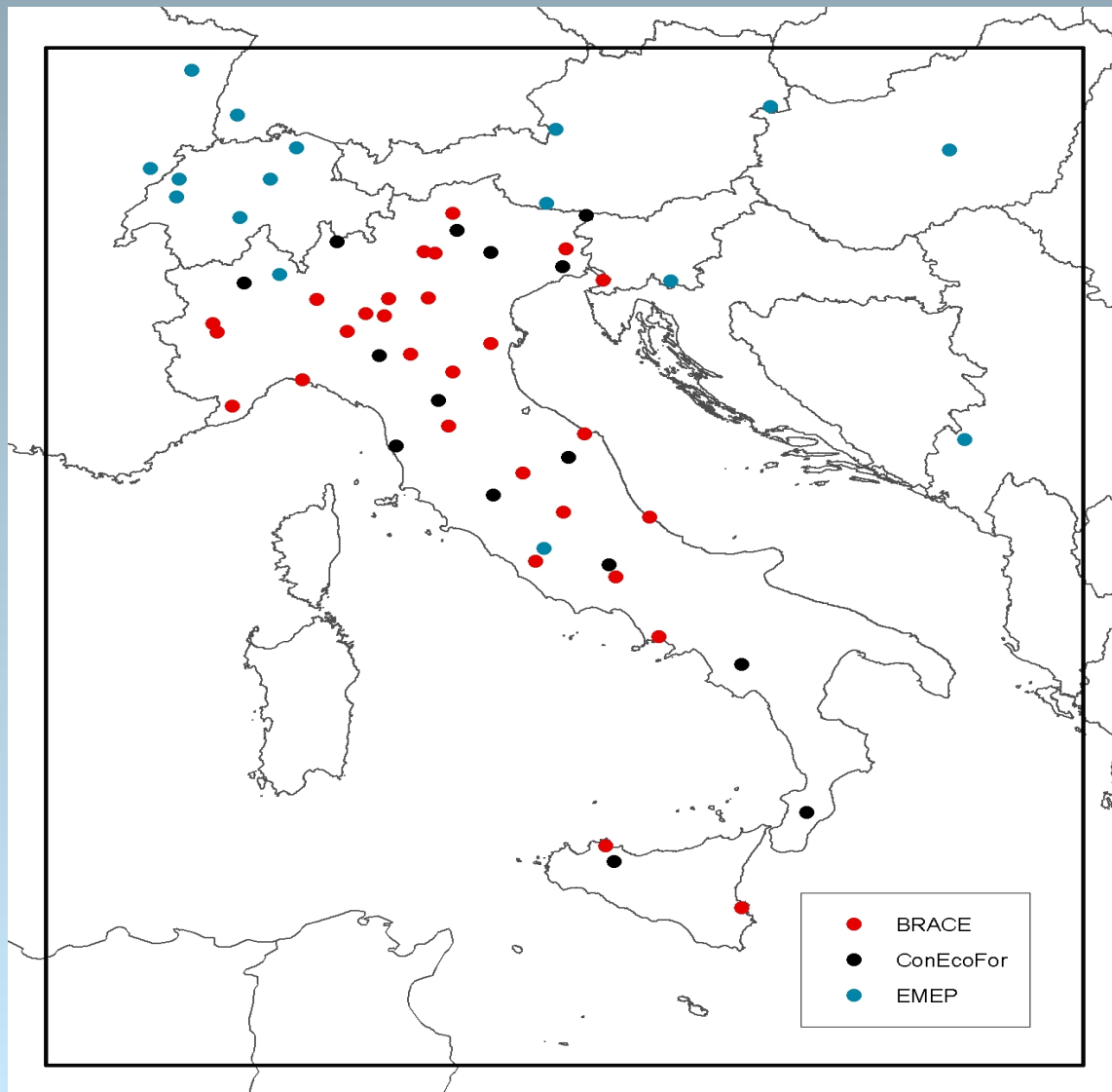
Data source for BC:

emep



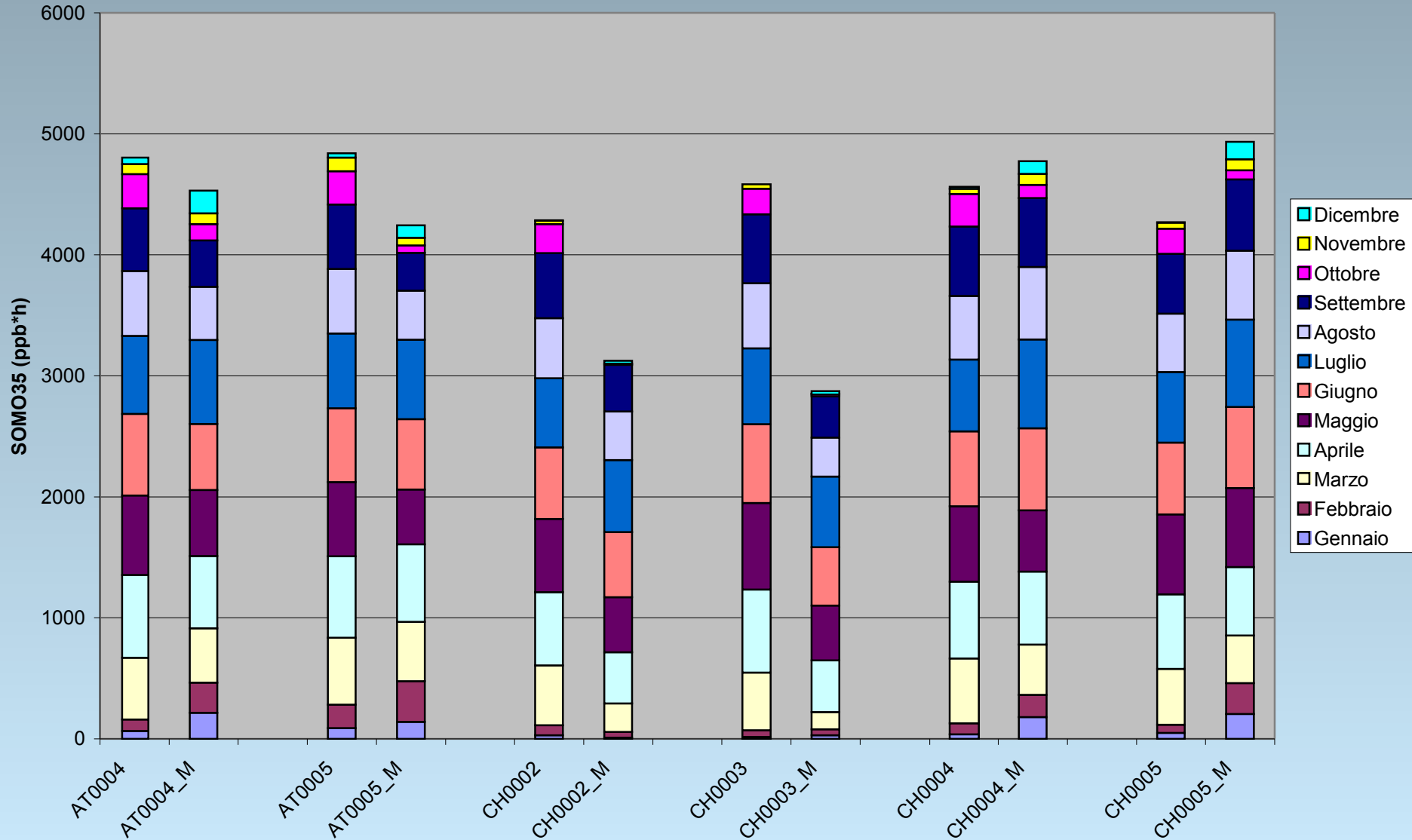
DNMI

Comparison with O₃ monitoring data

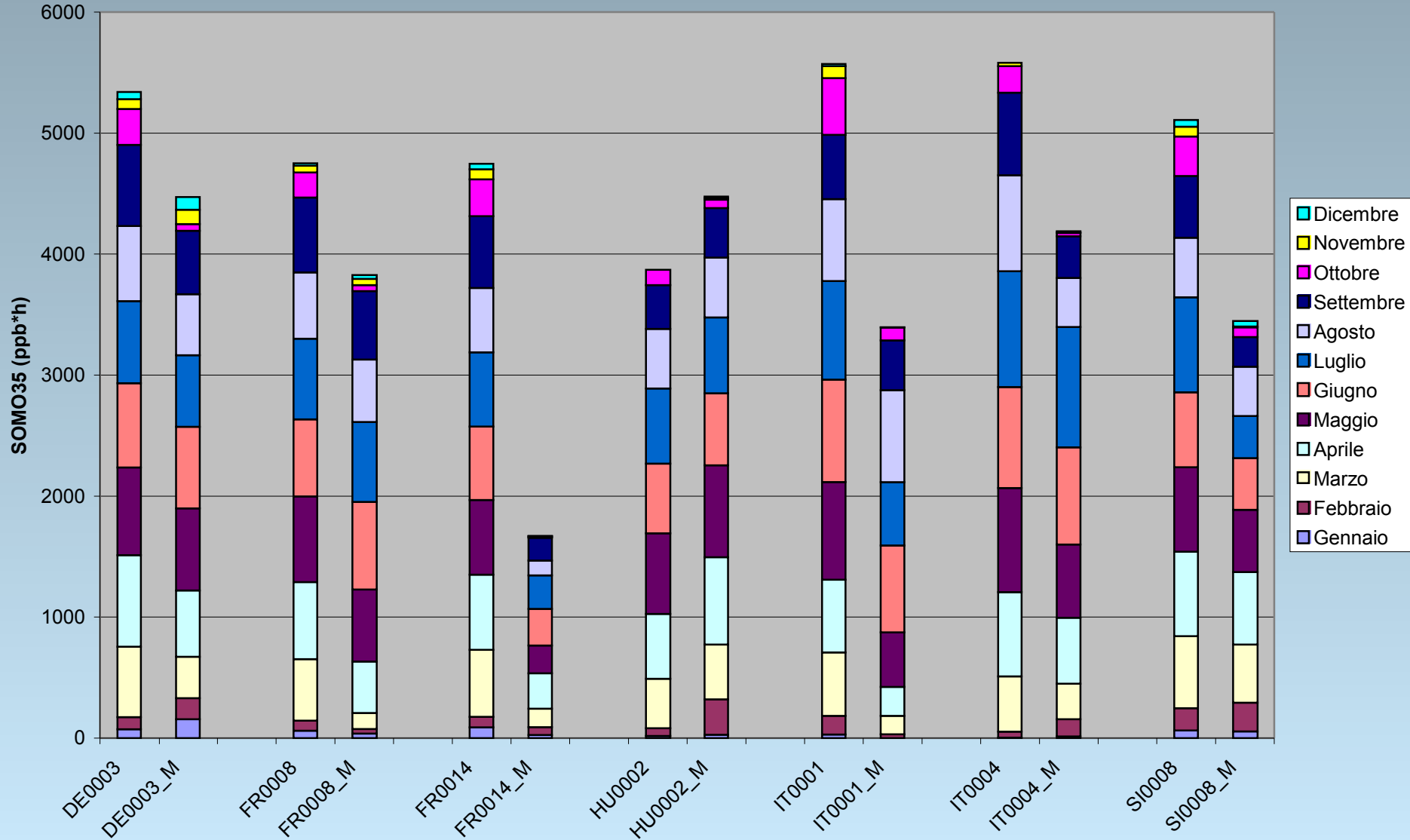


SOMO35 - Comparison with EMEP network data (1)

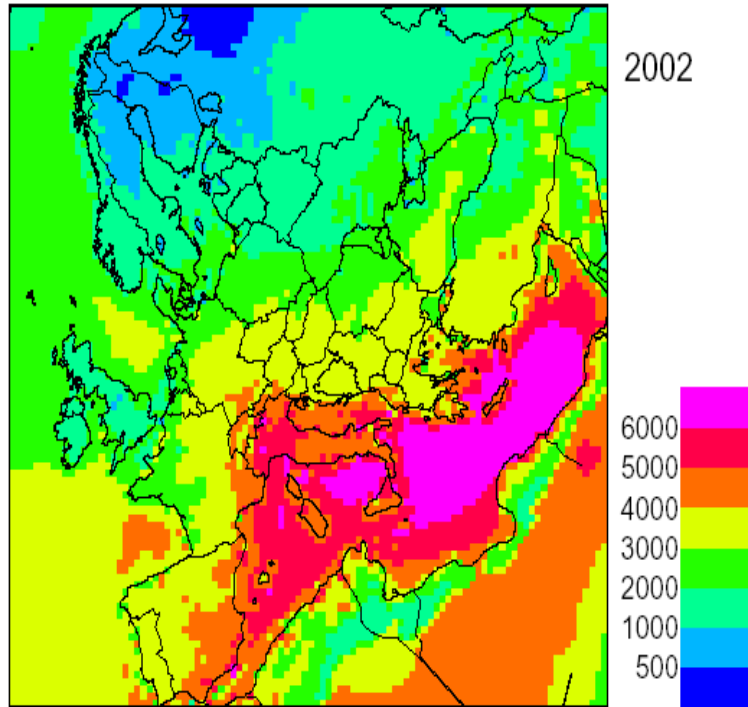
(sum of excess of daily maximum 8-means over a cut-off of 35 ppb calculated for all days in a year)



SOMO35 - Comparison with EMEP network data (1)



SOMO35 - Comparison between models

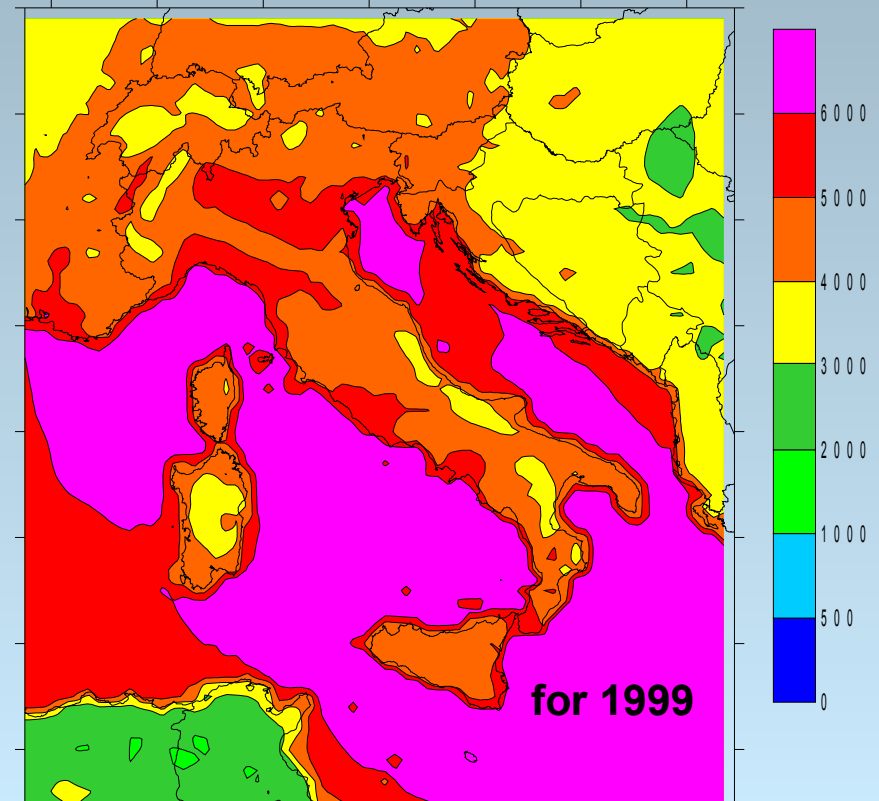


SOMO35

Figure 6.17: SOMO35, sum of means over 35ppb for 2002

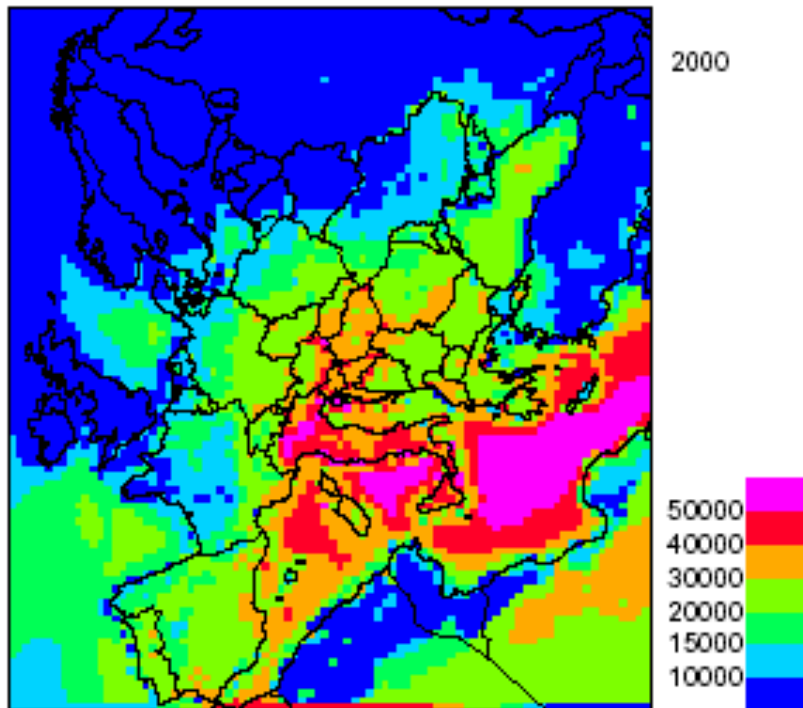
EMEP

AMS

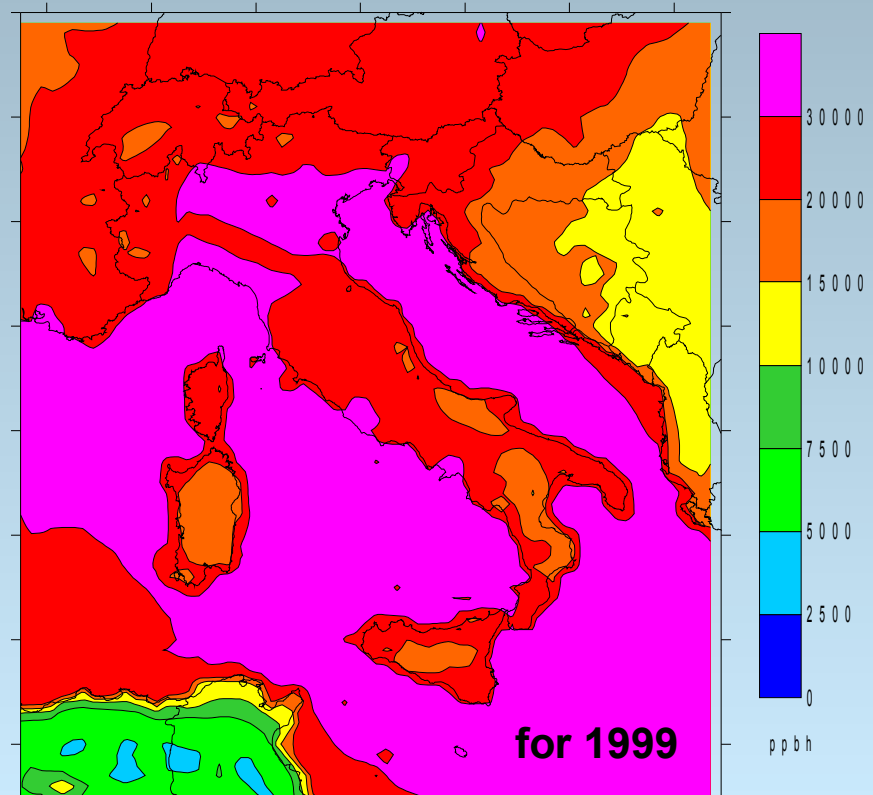


AOT40 - Comparison between models

EMEP



AMS



Aero0 (transfer matrices)

$$PM_{2.5} = PM_{\text{fine}} + ASO_4 + ANO_3 + ANH_4$$

$$PM_{10} = PM_{2.5} + PM_{\text{coarse}}$$

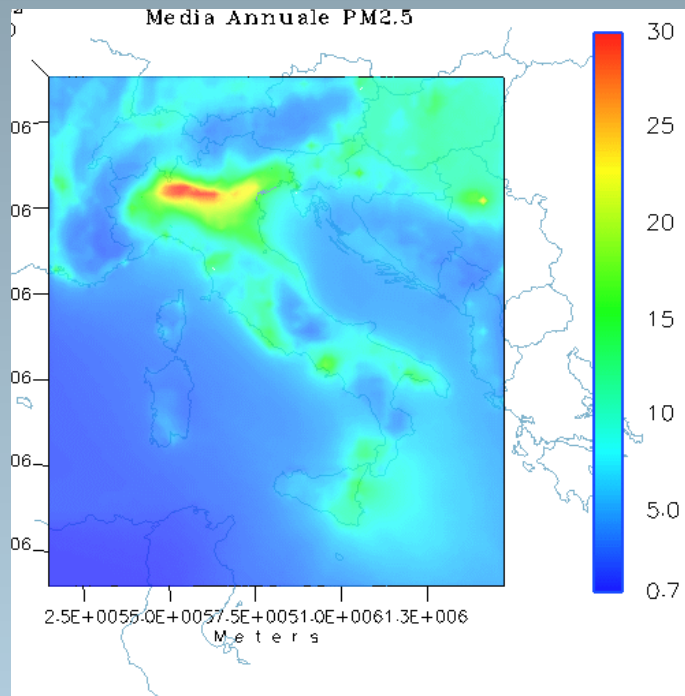
where:

Primary *fine* → PM_{fine}

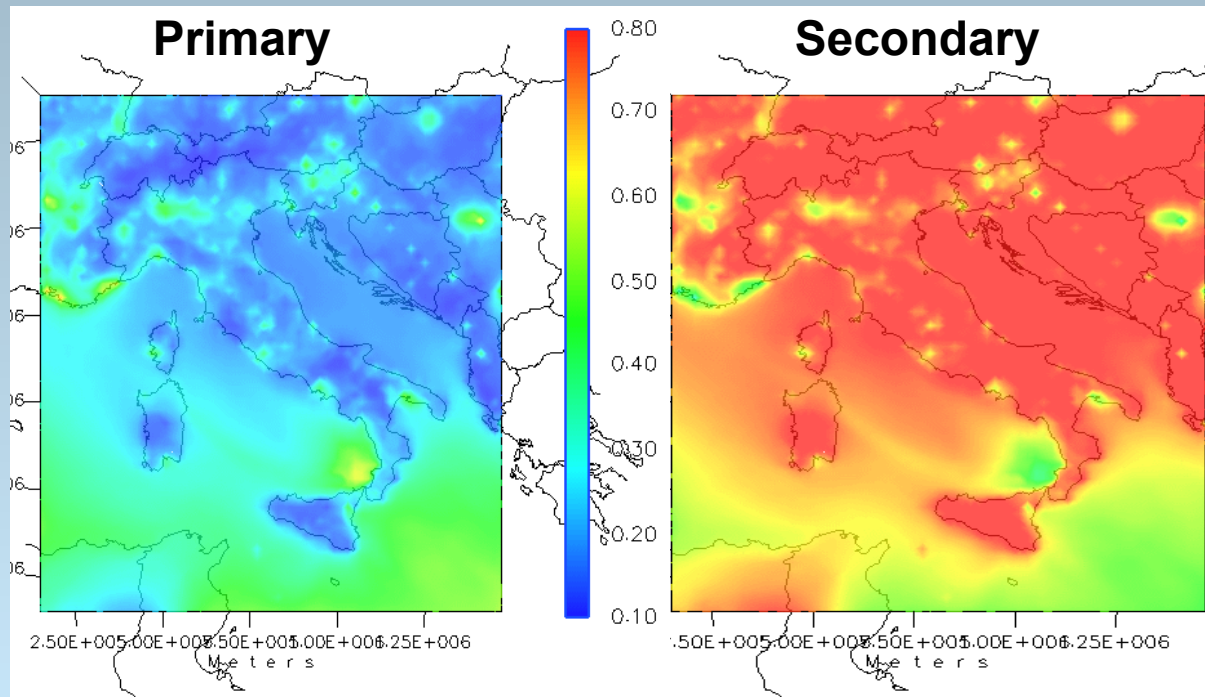
Primary *coarse* → PM_{coarse}

Modules to compute ASO_4 , ANO_3 and ANH_4

Average PM10 concentrations -1999



Yearly avg. conc.



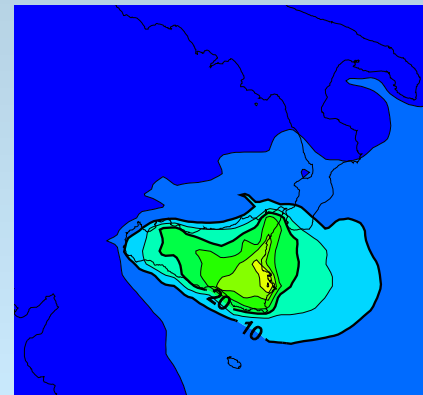
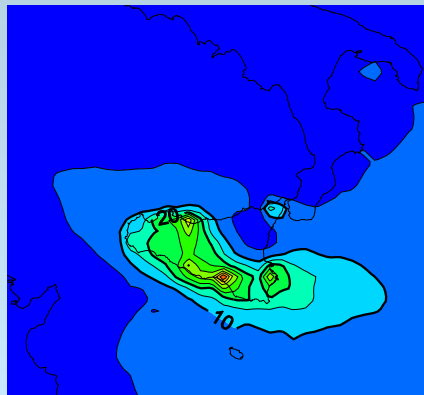
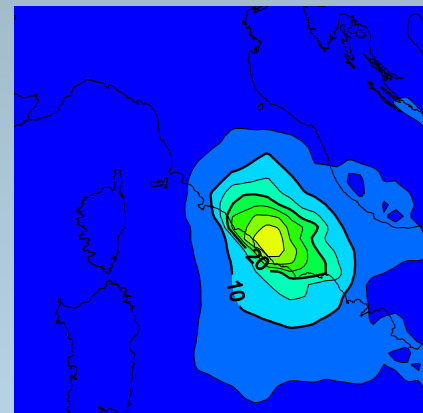
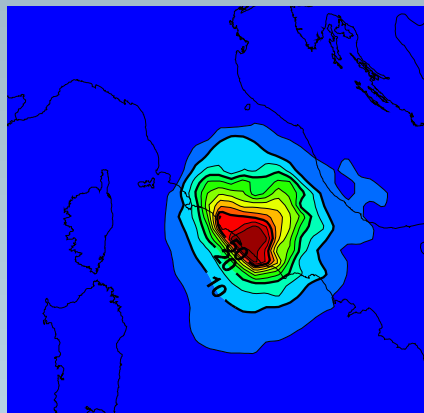
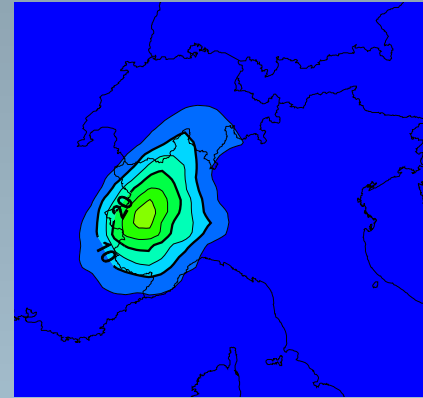
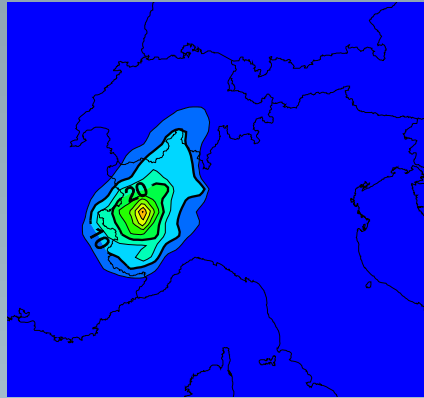
Secondary PM dominant !

Calculation of S-R relationships for RAINS/Italy

Emi SO_x ⇒ Dep S

Emi NO_x ⇒ Dep oxN

Contributions (%)
to yearly total
depositions



Piemonte

Lazio

Sicilia