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APPLICATION OF A PHOTOCHEMICAL MODEL TO THE ASSESSMENT OF REGIONAL AIR QUALITY LEVELS IN SOUTHERN ITALY: PROCEDURES AND RESULTS

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INTRODUCTION

The application of numerical models for air quality assessment is allowed by the legislation of European Community (EU) that establishes the possibility of using modelling techniques in combination with air quality observations. This work showed the air quality modelling assessment results over the Apulia region with 4 km grid spacing for the year 2013 (fig.1(a)); for this purpose, the three-dimensional Eulerian model **FARM** (Mircea et al., 2015) was applied (fig.2) and evaluated.

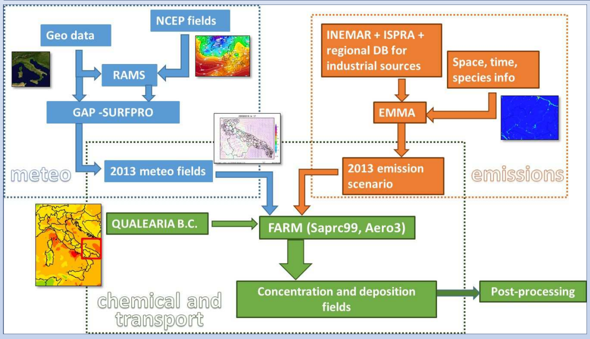
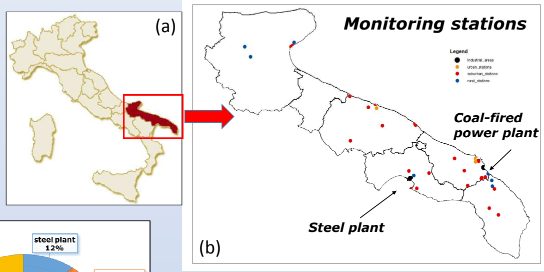


***Figure 2**: Modelling scheme.*

***Figure 1**: Investigated area (a), simulation domain and number of stations per type and pollutant for 2013 (b).*



Number of Stations	NO_2 hourly	O_3 hourly	PM_{10} daily	$PM_{2.5}$ daily	BaP monthly
Urban-background	3	1	2	-	6
Suburban	25	11	19	3	4
Rural	7	4	7	3	2
N° of stations with more than 75% of available data	32	16	28	6	12

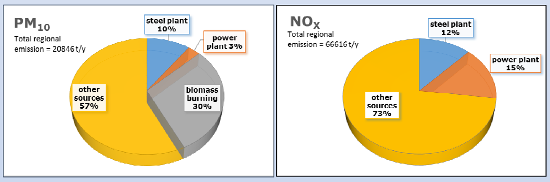


***Figure 3**: Total yearly emissions of PM_{10} and NO_x and percentage contribution for PM_{10} and NO_x.*

EMISSIONS

Emission data were derived from the regional INEMAR inventory (http://www.inemar.arpa.puglia.it), updated to the 2013, while the emissions from the neighboring regions were taken from the Italian national emission inventory. According to the INEMAR inventory, the most relevant pollutant sources in the region are a steel plant, the largest in Europe (placed in Taranto area, fig. 1(b)), a coal-fired power plant, the second most powerful in Italy (in Brindisi area, fig. 1(b)) and biomass burning for residential heating. To reconstruct accurately the emissions from the biomass residential heating, it was carried out a specific survey on the biomass consumption for the residential heating in Apulia (fig. 3).

RESULTS

For NO_2 (fig. 4(a)), relevantly lower than the prescribed thresholds, higher levels were estimated in correspondence of larger urban areas and major traffic roads. As for $PM_{2.5}$, PM_{10} and BaP (fig. 4(b-d)), the highest predicted concentrations were estimated in the Taranto industrial area and in the central southern part of the peninsula, where the biomass burning emissions due to agricultural activities and (especially) to residential heating by fireplaces are relevant. Results showed some exceeding of the limit values as regard the PM_{10} and BaP species.

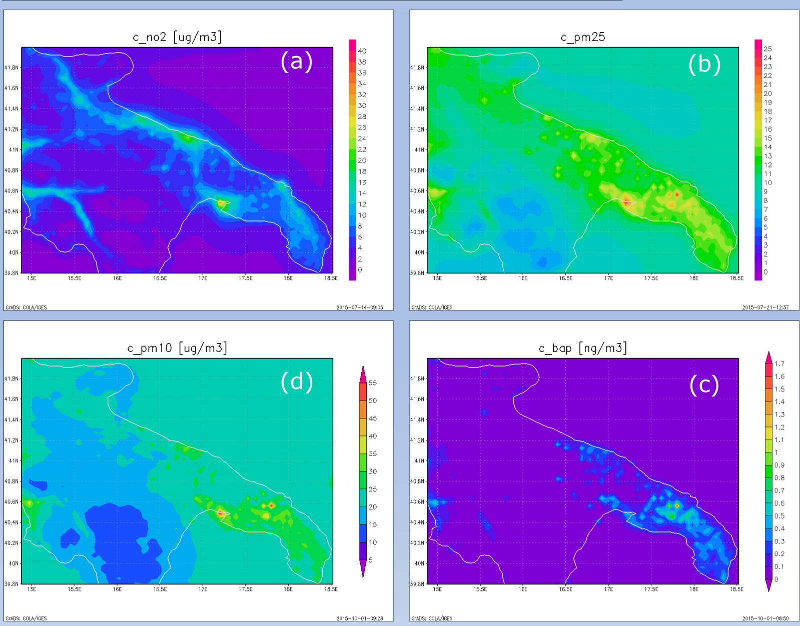
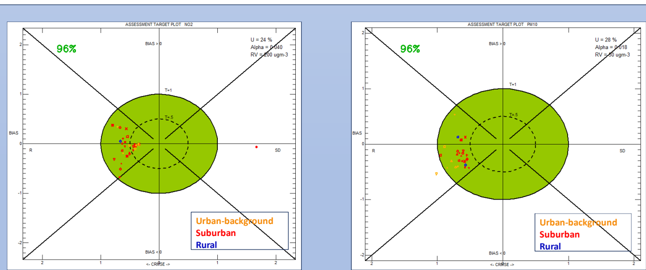


***Figure 4**: Annual mean concentrations for (a) NO_2, (b) $PM_{2.5}$ ($\mu g\ m^{-3}$), (c) BaP ($ng\ m^{-3}$) and (d) 90.4°percentile for PM_{10} ($\mu g\ m^{-3}$).*

***Figure 5:** Target plot for NO_2 hourly values and daily mean PM_{10} concentrations.*



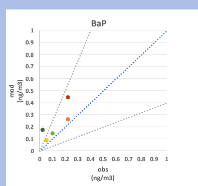


***Figure 6**: Scatter plot for BaP observed vs modelled yearly concentrations.*

***Table 1:** Statistical indicators.*

Station type	Mean obs. (μg m⁻³)	Mean mod. (μg m⁻³)	BIAS (μg m⁻³)	RMSE (μg m⁻³)	R	FA2 (%)	IOA
NO_2 hourly (year)							
rural	9.5	9.4	-0.12	10.0	0.33	56	0.55
suburban	13.9	12.0	-1.9	14.7	0.47	57	0.63
urban	19.2	20.3	1.14	15.0	0.58	72	0.75
PM_{10} daily (year)							
rural	19.3	15.8	-3.5	11.8	0.32	80	0.51
suburban	19.7	17.2	-2.6	8.5	0.43	88	0.68
urban	19.4	17.3	-2.1	8.4	0.46	89	0.65
$PM_{2.5}$ daily (year)							
rural	11.4	13.5	2.1	7.3	0.55	80	0.64
suburban	14.9	14.0	-0.9	6.6	0.69	89	0.81
urban	-	-	-	-	-	-	-

The model performance was estimated by using the DELTA software package (fig. 5), showing a good behaviour of the model, with a tendency to underestimate the PM_{10} levels (Tab. 1).

These promising results suggest the use of this modelling system for source apportionment studies to better analyse the influence of different sources on air quality. Future improvements will consider the application of data assimilation/fusion techniques.