IMPACT ASSESSMENT ON AIR QUALITY OF A WASTE-TO-ENERGY PLANT IN TURIN

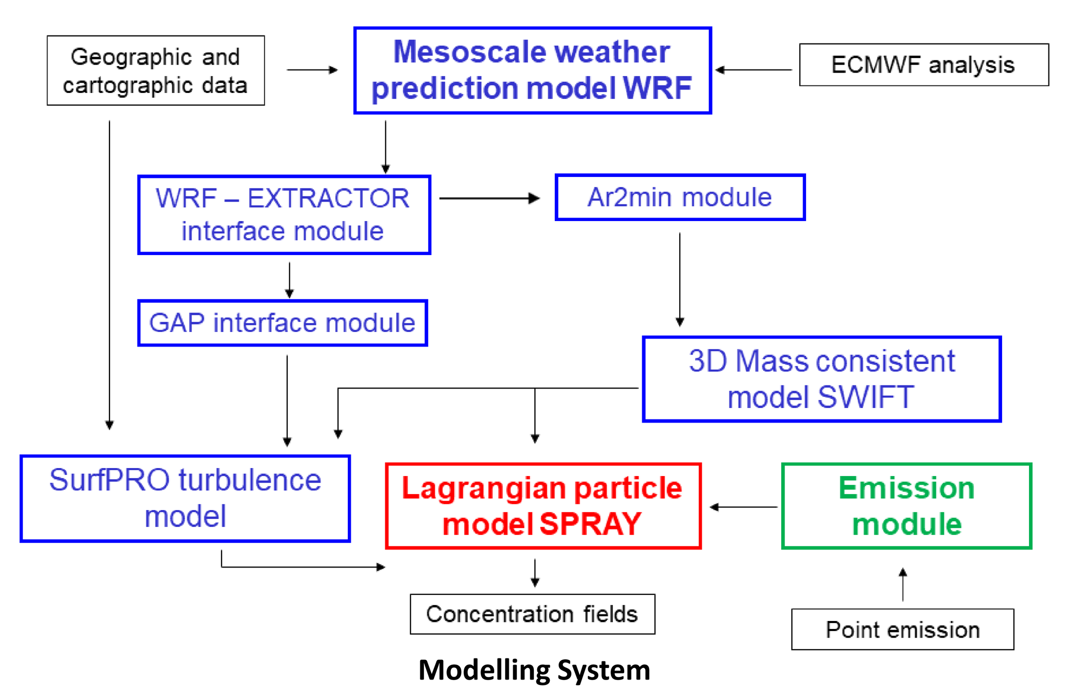
Sorveglianza sulla salute della Popolazione nei pressi del Termovalorizzatore di Torino

Sistema Nazionale per la Protezione dell'Ambiente

Stefano Bande, Francesca Bissardella, Cinzia Cascone, Roberta De Maria, Stefania Ghigo, Marilena Maringo

Arpa Piemonte (Regional Environmental Protection Agency), Via Pio VII 9, Torino, ITALY

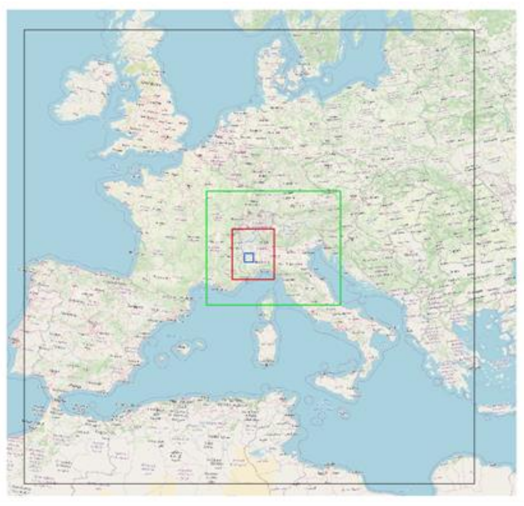
1. INTRODUCTION



Modelling System

Waste treatment plants usually rise great concern in the population living in the neighbourhood about their impact on environment and health. For this reason, a sanitary survillance plan was foreseen to keep a close watch on the possible state of health changes of population living near the Turin waste-to-energy plant: ***SPOTT*** (Surveillance on Population health around the Turin waste-to-energy plant) programme, started in 2013 involving a group of public institutions working on sanitary and environmental topics. In the second phase of the SPOTT programme (to be realized between 2020 and 2023), a certain number of dispersion modelling simulations (with the ***lagrangian dispersion model SPRAY*** for primary pollutants and with the ***CTM FARM*** to assess the plant contribution to secondary pollutants) were foreseen to estimate the plant contribution to air quality levels and soil deposition over an area including Turin (860,000 inhabitants) and the neighbouring municipalities.

2. METEOROLOGICAL SIMULATIONS


Meteorological domains

Runs with the WRF limited area model (4 nested domains, starting from ECMWF analysis) were used to produce meteorological fields at 1 km horizontal resolution, then downscaled with the mass consistent model SWIFT to obtain wind and temperature fields at 500 m resolution. Turbulence scaling parameters, horizontal and vertical eddy diffusivities, deposition velocities were estimated with SURFPro3 pre-processor.

3. EMISSION DATA

Pollutant emissions were described with hourly pollutants mass flow registered during year 2019 by the waste-to-energy plant continuous emissions monitoring system (CEMS) and, for metals and micropollutants, with data from discontinuous monitoring emissions measured between years 2013 and 2020, both by control authority and plant operator.

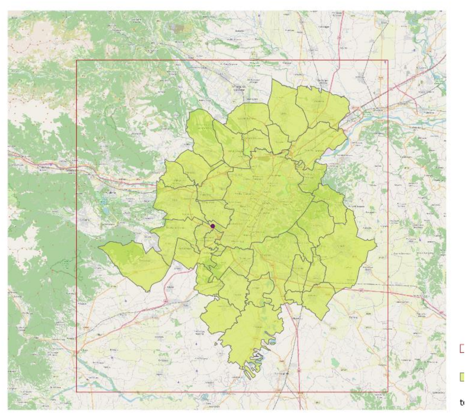
Mass flow (kg/h)									
NO_x	CO	NMVOC	NH_3	SO_2	PM2.5	PM10	Hg	HCl	HF
17.33	2.70	0.29	0.44	0.36	0.08	0.10	0.004	0.86	0.02

Average mass flow from CEMS

	Median					
	Cd+Tl	Zn	Metals	PAH	PCDD/DF	PCB-DL
	mg/Nm³	mg/Nm³	mg/Nm³	mg/Nm³	ng/Nm³	ng/Nm³
2013-2020	0.0010	0.041	0.050	0.000010	0.00214	0.000225
Limit value	0.03	0.5	0.3	0.005	0.05	0.05

Discontinuously measured data

4. AIR QUALITY SIMULATIONS


Air quality domain

Air quality simulations were conducted over an area of 45 km x 48 km centered on the city of Turin.

SPRAY simulations (500 m horizontal resolution) were used to assess plant contribution to primary pollutans and total soil depositions (dry and wet). To evaluate metals and micropollutants depositions, these substances were considered as having the same behaviour as PM10.

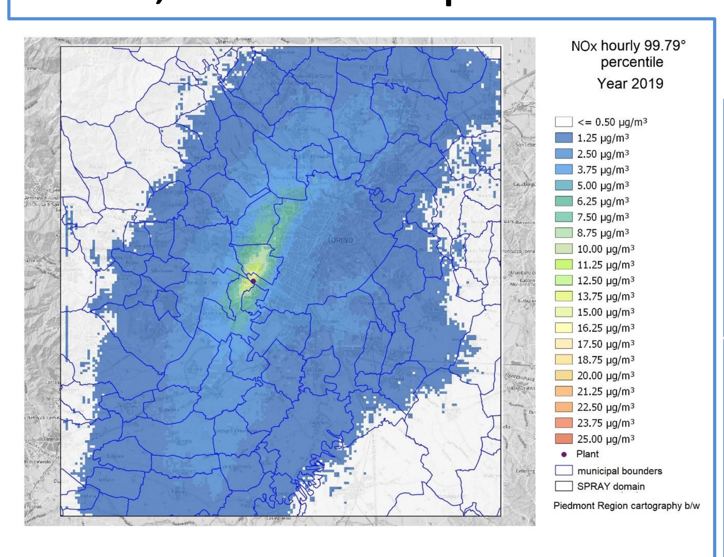
With **FARM model**, two simulations were carried out on the same domain (at 1000 m horizontal resolution): the first taking into account all the emission sources (from the Regional Emission Inventory INEMAR), the second considering all the sources except the waste-to-energy plant. The difference between the results in the two simulations will be able to describe the plant contribution to secondary pollutants air concentrations ; results are being processed.

5. SPRAY SIMULATIONS RESULTS

Primary pollutant concentration levels were compared with measured values at air quality monitoring stations. For all the pollutants (NO_x, SO_2, CO, PM, NH_3, TOC, PAH, PCB, PCDD, metals), the contribution to both air concentration and deposition levels due to the waste-to-energy plant showed to be rather limited, with values frequently one or two order of magnitude lower than the measured ones. Only in case of mercury depostitions, simulated values are comparable to the one measured, confirming the waste-to-energy plants as non-negligible sources for this pollutant. Further investigations will be conducted with the next simulations, regarding year 2016, when the plant was characterized by higher mercury emissions. Besides, new information will be made available at a new monitoring station in Turin, foreseen within the SPOTT programme, measuring Hg depositions.

NITROGEN OXYDES	Annual mean (µg/m³)		Maximum hourly value (µg/m³)		hourly 99.79°percentile (µg/m³)	
Measuring station	measured	simulated	measured	simulated	measured	simulated
Baldissero	15.2	0.01	100	1.8	70	0.6
Beinasco	30.8	0.09	205	12.4	122	4.0
Borgaro	24.9	0.05	129	4.0	100	2.3
Carmagnola	34.1	0.01	134	0.8	107	0.4
Chieri	21	0.01	108	1.2	92	0.6
Collegno	45.8	0.11	189	9.4	159	4.6
Druento	11.3	0.02	90	2.0	65	0.7
Leinì	22.8	0.04	118	3.3	90	2.2
Orbassano	31.1	0.18	140	10.8	114	4.0
Settimo Torinese	36.3	0.02	163	1.8	143	0.9
Torino - Consolata	53.3	0.03	195	3.0	147	1.4
Torino - Lingotto	37.3	0.05	136	3.6	110	1.7
Torino - Rebaudengo	59.9 (*)	0.03	269 (*)	4.6	195 (*)	1.3
Torino - Rubino	33	0.05	135	4.3	118	2.2
Vinovo	27.5	0.03	140	2.4	109	1.1

(*) Less than 90% valid data



PCDD/DF	Annual mean (fg/m³)		PCDD/DF Depositions	Annual mean (pg/m²d)	
Monitoring station	measured	simulated	Monitoring station	measured	simulated
Beinasco	12.1	0.0034	Beinasco	4.13	0.0045

Mercury	Annual mean (ng/m³)		Maximum daily average (ng/m³)		Hourly maximum (ng/m³)		Mercury deposition	Annual mean (ng/m²d)	
Monitoring station	measured	simulated	measured	simulated	measured	simulated	Monitoring station	measured	simulated
Beinasco	3	0.015	9	0.300	42	1.38	Beinasco	30	18.5

6. CONCLUSIONS

Air quality dispersion simulations realized with the Spray model, describe the primary pollutants distribution around the Turin waste-to-energy plant during year 2019, pointing out the need of further investigation about Hg depositions. Farm simulations results, being available in short time, will supply information about the secondary pollutants such as PM10 and PM2.5. The whole work will give the stakeholdes a complete description of the plant impact on air quality and support the epidemiological studies in the SPOTT programme.

HARMO21

21th International Conference on Harmonisation within Atmospheric Dispersion Modelling for Regulatory Purposes

27 – 30 September 2022, Aveiro, Portugal