Influence of meteorological parameters on air pollution in the city of A Coruña (Spain)

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Introduction

Nowadays, air pollution is a global problem due to greatly industrial development and economic activities (Calvo, 2009). As a consequence, some air quality policies have been developed with the aim of reducing the emissions to the atmosphere. Despite reductions in the emissions of some air pollutants produced by the actions contemplated in the new legislation on air quality, high concentrations continue to be registered in some urban areas (EEA, 2017). The road traffic is the main cause of these high concentrations, exceeding in some cases the limits established by current regulations (RD 2008/50 / CE).

The aim of this study is to determine the significant correlations between some pollutants concentration and several meteorological parameters in A Coruña (Spain) during 2016.

Study Area

Fig. 1. Stations of the air quality network of A Coruña.

Conclusions

- The higher concentration of pollutants was recorded during winter months.

- The current legislation (RD 102/2011) has been complied, although in A Coruña, the limit value was exceeded on 12/08/2016 in Santa Margarita (61 $\mu g/m^3$), on 13/08/2016 in Castrillón (53 $\mu g/m^3$) and in San Diego (57 $\mu g/m^3$) and on 10/30/2016 in San Diego (52 $\mu g/m^3$).

- Anticyclonic, Northeast, North and Cyclonic weather types represent close to 50% of the days of 2016. Anticyclonic types predominate with 18% of the days.

- The higher pollutant concentrations were recorded in the Cyclonic weather type.

- The majority of pollutants measured in the four measurement stations presented a statistical negative correlation with wind speed at surface, at 850 hPa, at 500 hPa and at 200 hPa, LFC, SWEAT, SrH, BRN Shear, and wind direction. They also have a positive correlation with Cap Strength, Boyden Index, Convective temperature, CCL, LCL and the thickness of the different atmospheric layers.

- The ozone presented a different behavior from the rest of the pollutants, presenting opposite correlations than the rest.

REFERENCES

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Material and Methods

- The data of pollutant concentration were obtained from four stations (Fig. 1) of the air quality network of A Coruña (http://coruna.es/infoambiental/es/calidad-del-aire/red-de-vigilancia.html): i) Sta. Margarita (urban); ii) Castrillón (urban); iii) San Diego (urban) and iv) San Pedro (urban background).
- The weather types have been calculated according to the Lamb (1972) classification (Table 1).
- The data of the meteorological parameters were obtained from the daily radiosounding provided by the Meteorological Information Service of OGIMET (www.ogimet.com). The data of 54 parameters and the meteorological indexes, after their treatment through the RAOB computer program (RAwinsonde OBservation), have been analyzed (Fig. 2) (Table 2).

Table 1. Weather types according to Lamb classification (Lamb, 1972).

Anticyclonic types		Pure directional		Cyclonic types	
A	Anticyclonic			C	Cyclonic
ANE	Anticyclonic- northeast	NE	Northeast	CNE	Cyclonic- northeast
AE	Anticyclonic- east	E	East	CE	Cyclonic- east
ASE	Anticyclonic - southeast	SE	Southeast	CSE	Cyclonic - southeast
AS	Anticyclonic - south	S	South	CS	Cyclonic - south
ASW	Anticyclonic - southwest	SW	Southwest	CSW	Cyclonic - southwest
AW	Anticyclonic - west	W	West	CW	Cyclonic - west
ANW	Anticyclonic - northwest	NW	Northwest	CNW	Cyclonic - northwest
AN	Anticyclonic - north	N	North	CN	Cyclonic - north

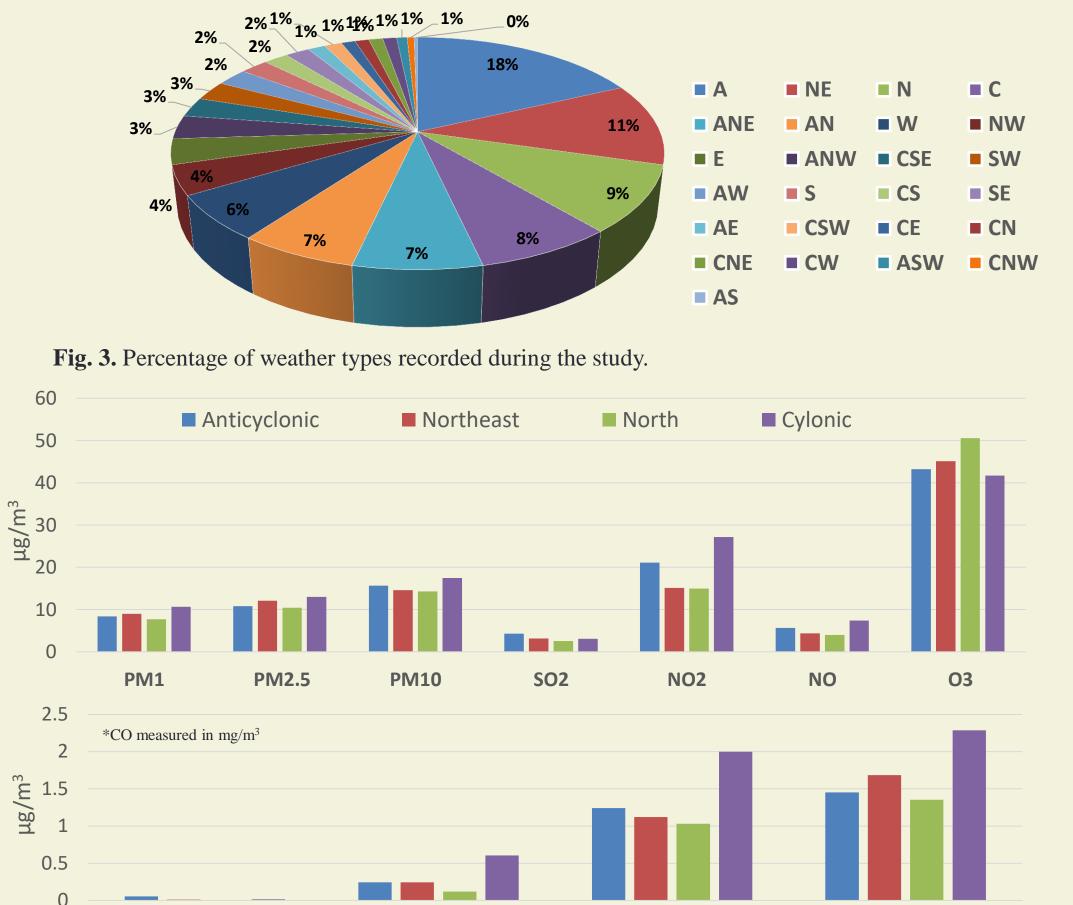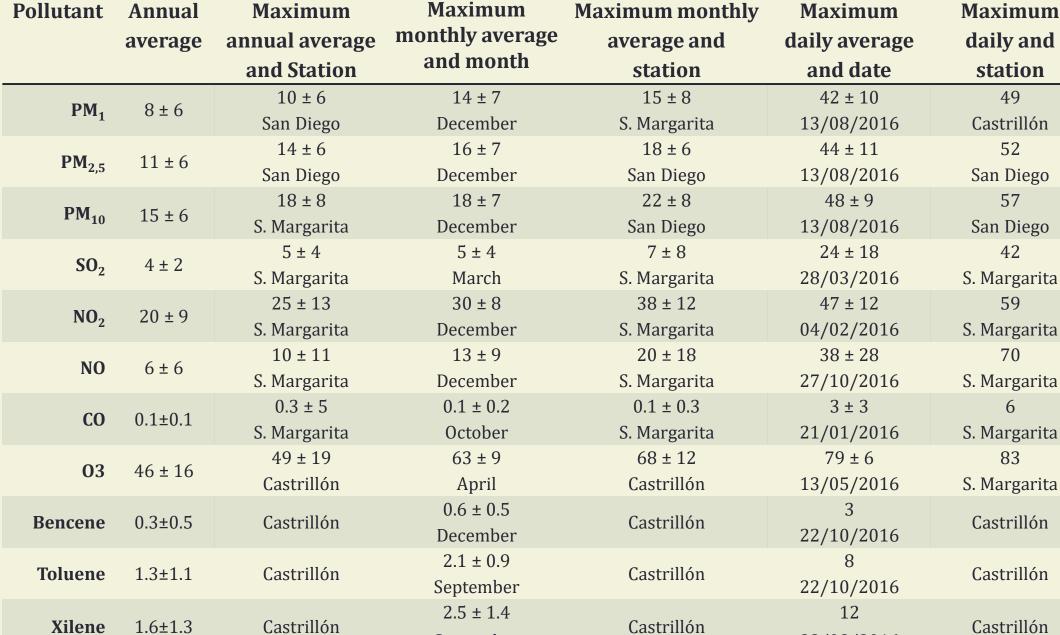**Fig. 2.** Example of radiosounding (07/03/2016, A Coruña).

Results

Fig. 3. Percentage of weather types recorded during the study.

Fig. 4. Pollutant concentrations for the four predominant weather types.

Table 2. Annual, monthly and daily average and maximum concentrations of each station in A Coruña during study.

Pollutant	Annual average	Maximum annual average and Station	Maximum monthly average and month	Maximum monthly average and station	Maximum daily average and date	Maximum daily and station
PM_1	8 ± 6	10 ± 6 San Diego	14 ± 7 December	15 ± 8 S. Margarita	42 ± 10 13/08/2016	49 Castrillón
$PM_{2.5}$	11 ± 6	14 ± 6 San Diego	16 ± 7 December	18 ± 6 San Diego	44 ± 11 13/08/2016	52 San Diego
PM_{10}	15 ± 6	18 ± 8 S. Margarita	18 ± 7 December	22 ± 8 San Diego	48 ± 9 13/08/2016	57 San Diego
SO_2	4 ± 2	5 ± 4 S. Margarita	5 ± 4 March	7 ± 8 S. Margarita	24 ± 18 28/03/2016	42 S. Margarita
NO_2	20 ± 9	25 ± 13 S. Margarita	30 ± 8 December	38 ± 12 S. Margarita	47 ± 12 04/02/2016	59 S. Margarita
NO	6 ± 6	10 ± 11 S. Margarita	13 ± 9 December	20 ± 18 S. Margarita	38 ± 28 27/10/2016	70 S. Margarita
CO	0.1±0.1	0.3 ± 5 Castrillón	0.1 ± 0.2 October	0.1 ± 0.3 S. Margarita	3 ± 3 21/01/2016	6 S. Margarita
O3	46 ± 16	49 ± 19 Castrillón	63 ± 9 April	68 ± 12 Castrillón	79 ± 6 13/05/2016	83 S. Margarita
Bencene	0.3±0.5	Castrillón	0.6 ± 0.5 December		3 22/10/2016	Castrillón
Toluene	1.3±1.1	Castrillón	2.1 ± 0.9 September		8 22/10/2016	Castrillón
Xilene	1.6±1.3	Castrillón	2.5 ± 1.4 September		12 22/08/2016	Castrillón

Table 3. Significant correlations ($\alpha = 0.01$) between meteorological parameters and atmospheric pollutants. ■ Positive correlation ■ Negative correlation