

Comparison of methodologies for estimating spatial representativeness of rural background stations in Spain

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CIEMAT

2021

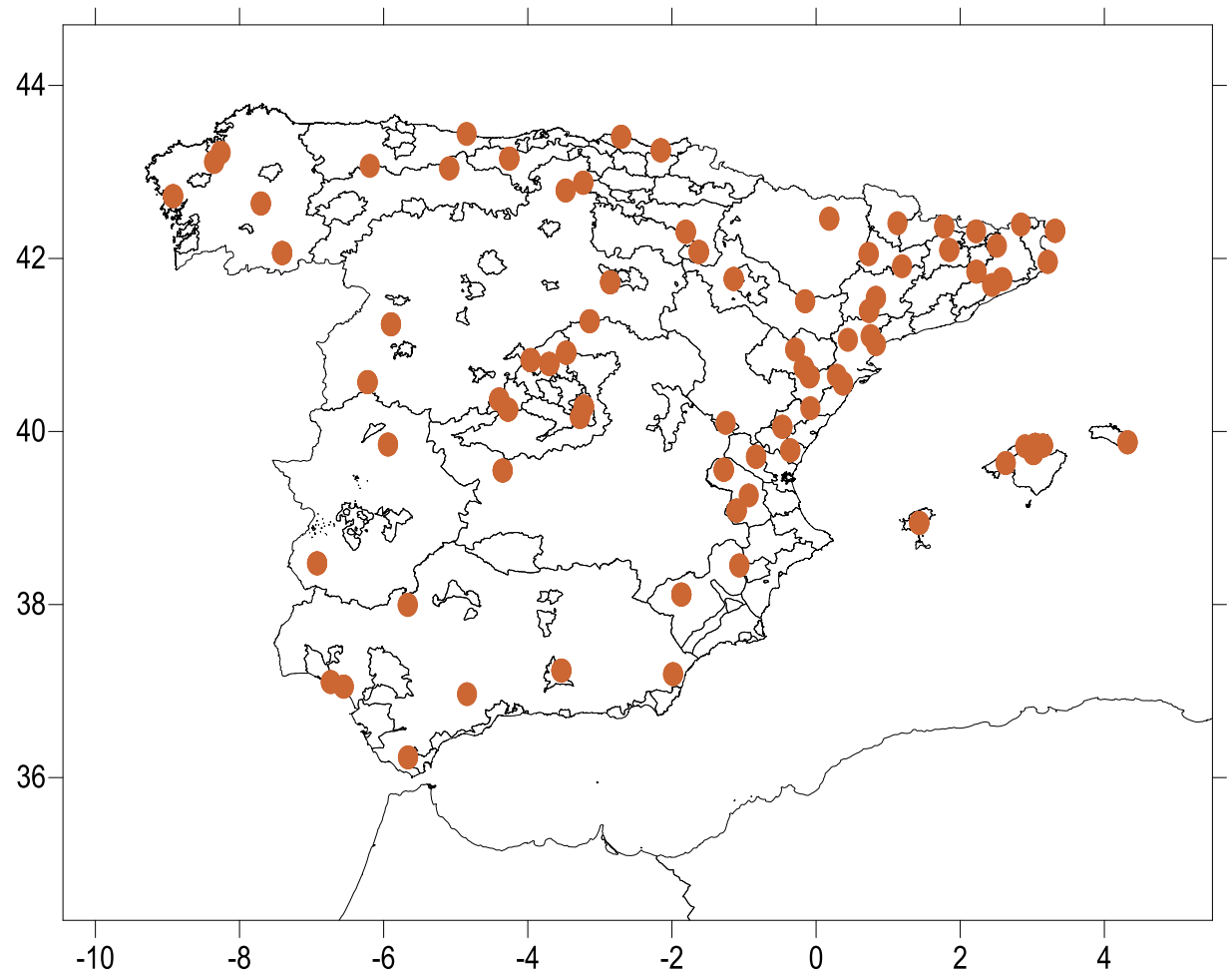
FAIRMODE TECHNICAL MEETING 2021
CT8 Session October 6th, 2021

Outline

- Objective
- Used methodologies
- Comparison of the SR area results
- Conclusions

Objective

- To compare a simple methodology for estimating SR area of AQ stations with a more elaborated methodology used by CIEMAT for rural background stations in Spain.
- NO_2 , O_3 and PM_{10}
- 2019



Rural Background Stations in Spain

Methodologies for SR area estimates

- Simple methodology no size limit. **A.**
 - Pollutant Concentración Similarity (area with concentration differs less than 20% of the concentration at AQ station location).
- Simple methodology with a size limit. **A+.**
 - Pollutant Concentración Similarity (area with concentration differs less than 20% of the concentration at AQ station location).
 - SR area limited to 200 km from AQ station
- **CIEMAT** methodology (*Martin et al, 2014, Atmospheric Pollution Research 5 (2014) 779-788*). **SR area for air quality assessment**


Atmospheric Pollution Research 5 (2014) 779-788

Atmospheric Pollution Research
www.atmospolres.com

Analysis of the spatial representativeness of rural background monitoring stations in Spain

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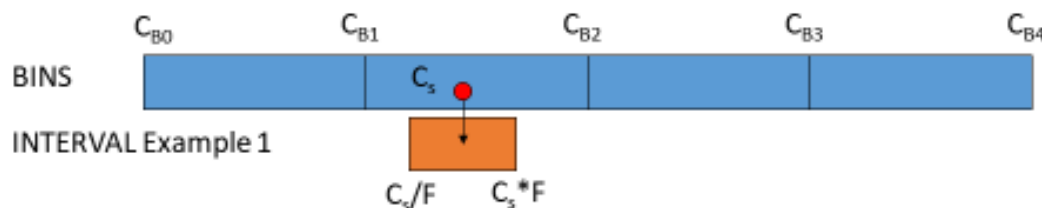


- Multiannual analysis (2008-2010) for several pollutants
- Based on CHIMERE model combined with measurements
- Interannual variation using a persistence index,
- Network analysis using a redundancy index (overlapping and coverage)

CIEMAT methodology - SR delimiting criteria

- Criteria for delimiting representativeness area are based on:
 - Concentration does not vary more than a certain factor (F) of the concentration at the station **[C/F, C*F]**
 - Concentration in the SR falls in the same air quality assessment classification (assessment thresholds, limits values).
 - Maximum SR area is a circle of 200 km of radius around the station (area of 125664 km²). Directive EC 2008/50 states one rural background station per 100000 km².

Setting concentrations intervals



$F=1.2 \rightarrow [C/1.2, C*1.2] = [C*0.83, C*1.2]$

$F=2.0 \rightarrow [C/2.0, C*2.0] = [C*0.5, C*2.0]$

C_{Bi} = bin limits (related to LV, TV, UAT, LAT)
 C_s = concentration at station
 F = factor for setting intervals (1.2 or 2.0 for very low concentrations)

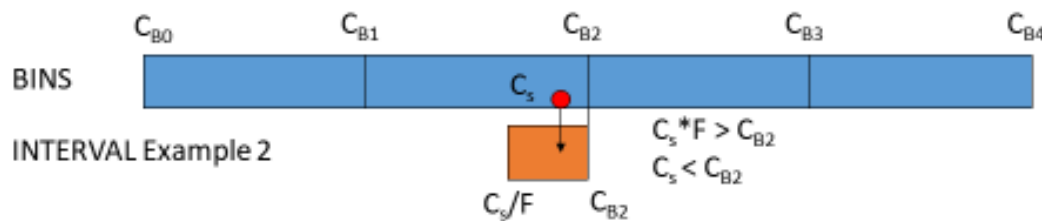
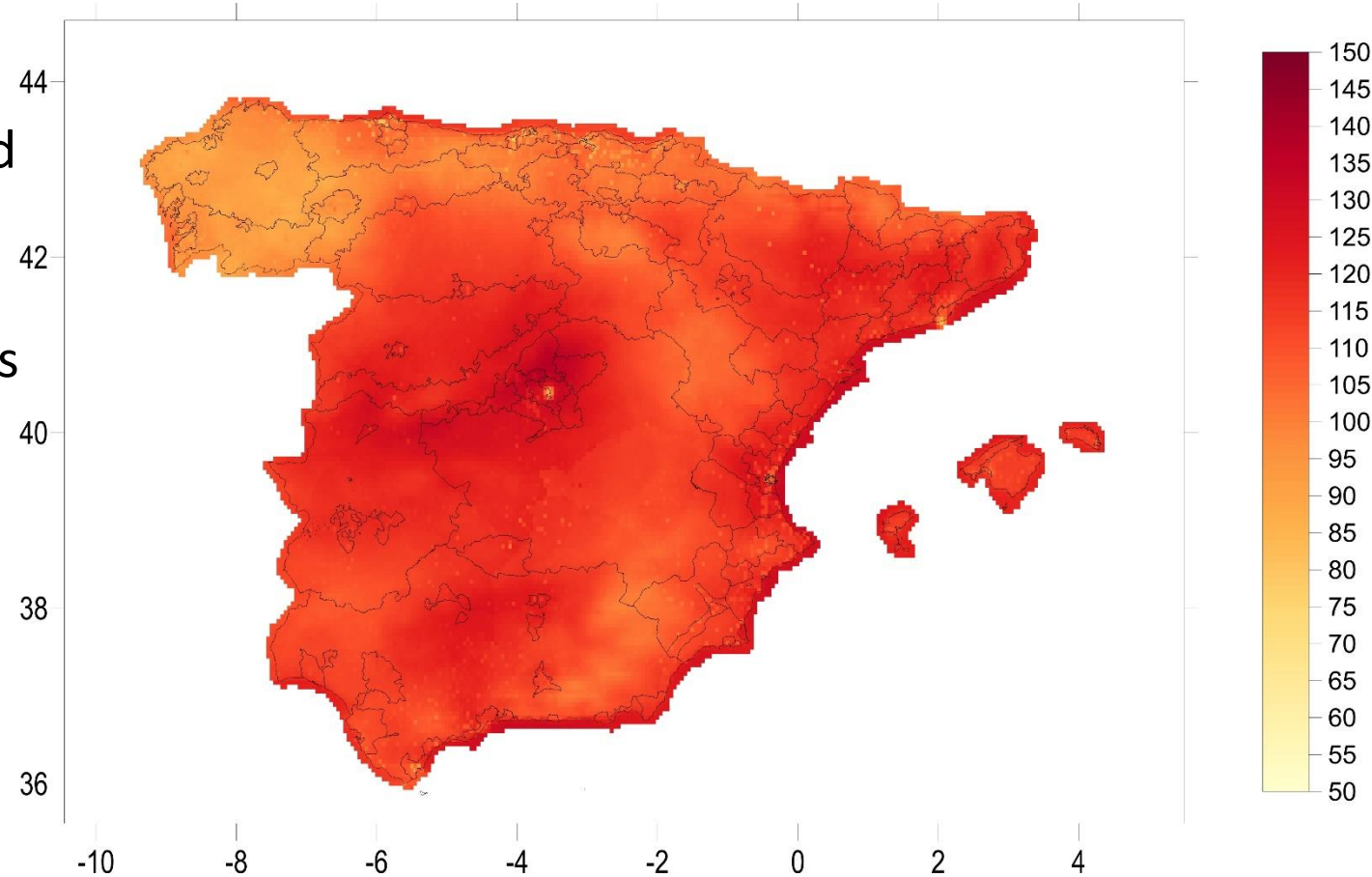


Table 2. Criteria for delimiting the SR of the RB stations for every pollutant and air quality standard. I=bins of concentrations ($\mu\text{g}/\text{m}^3$), F=factor applied to set the concentration interval respect to the reference concentration at the station in each of the concentration bins. The limits of the concentration interval can never exceed the limits of the concentration bins.

Averaging Time	SO ₂		O ₃		NO ₂		PM ₁₀	
	I	F	I	F	I	F	I	F
Annual mean	<4	2.0			<13	2.0		
	≥4, <8	1.2			≥13, <26	1.2	<20	1.2
	≥8, <12	1.2			≥26, <32	1.2	≥20, <28	1.2
	≥12, <20	1.2			≥32, <40	1.2	≥28, <40	1.2
	≥20	1.2			≥40	1.2	≥40	1.2
Daily average	<25	2.0						
	≥25, <50	1.2					<25	1.2
	≥50, <75	1.2					≥25, <35	1.2
	≥75, <125	1.2					≥35, <50	1.2
Hourly average	≥125	1.2					≥50	1.2
	<70	2.0	<90	1.2	<50	2.0		
	≥70, <140	1.2	≥90, <135	1.2	≥50, <100	1.2		
	≥140, <210	1.2	≥135, <180	1.2	≥100, <140	1.2		
	≥210, <350	1.2	≥180, <210	1.2	≥140, <200	1.2		
8-hour average	≥350,	1.2	≥210, <240	1.2	≥200, <400	1.2		
			≥240	1.2	≥400	1.2		
			<84	1.2				
			≥84, <108	1.2				
			≥108, <120	1.2				
		≥120, <180	1.2					
		≥180	1.2					

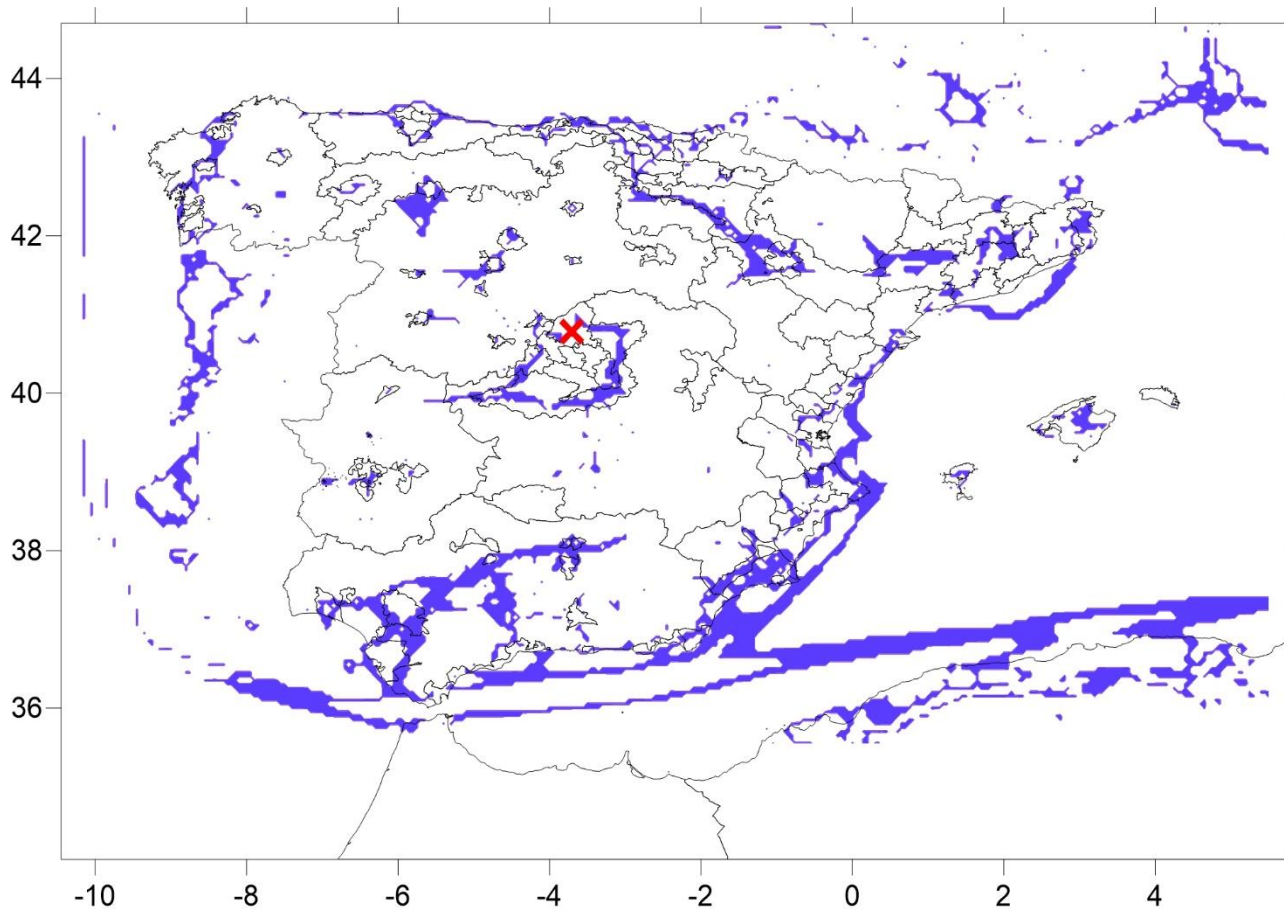
Concentrations fields

- Analysis of the annual maps of pollutant concentrations of O_3 , NO_2 and PM_{10} for 2019 computed routinely for annual air quality assessment in Spain.
- Maps obtained from annual simulations with the IFS and CHIMERE models system combined with measurements at air quality stations.
- 5x5 km resolution
- Iberian Peninsula (excluding Portugal) and Balearic Islands

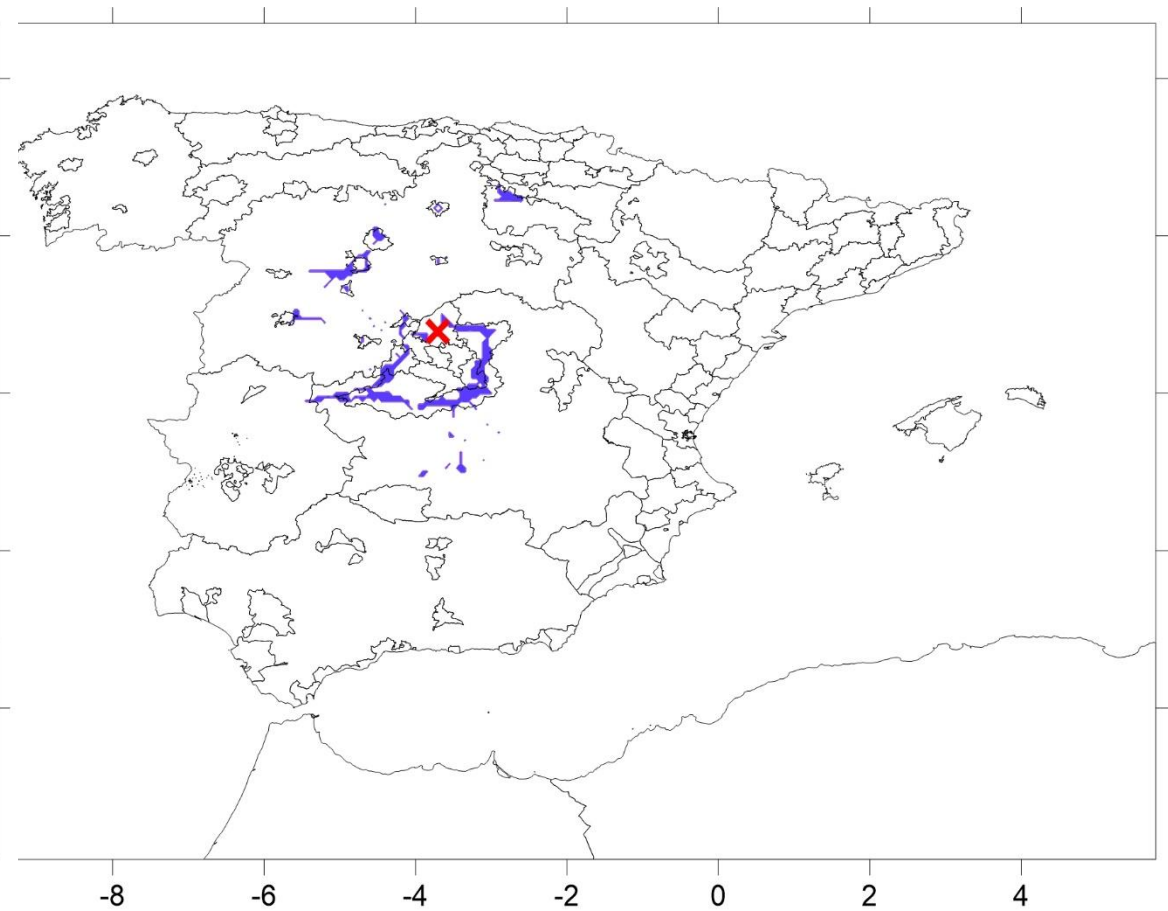


26th highest value of O_3 8-hourly concentrations

A vs A+. NO₂ annual

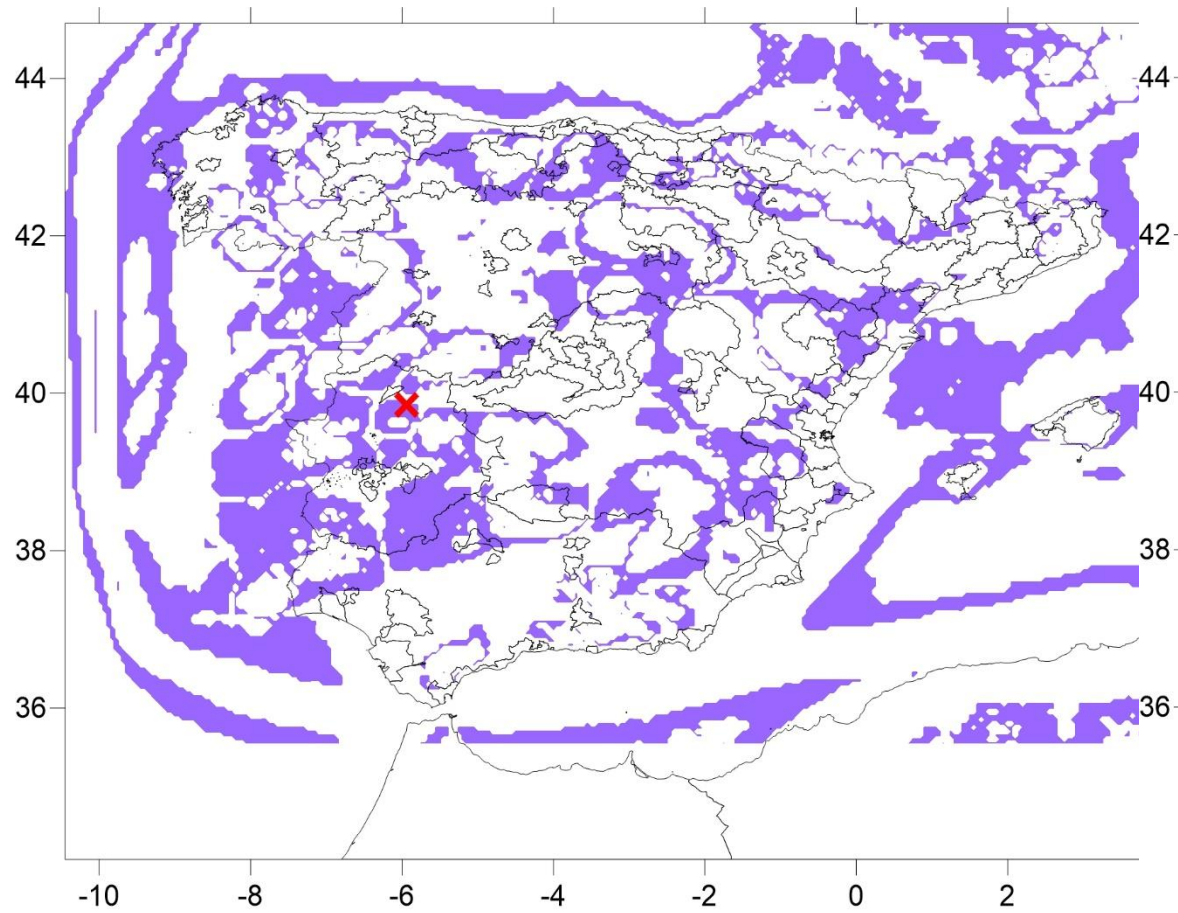


REPRESENTATIVIDAD NO2 ANUAL. AÑO 2019 GUADALIX

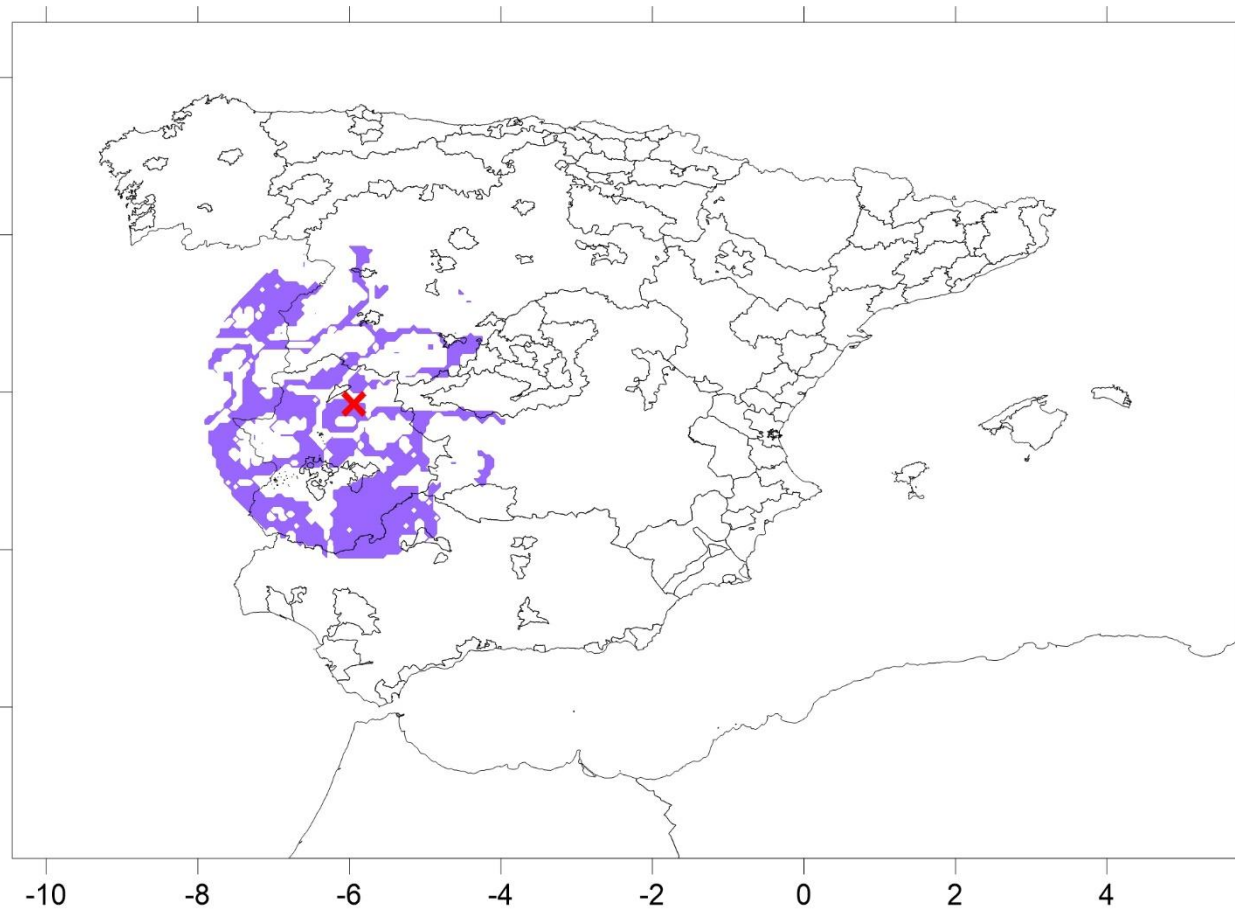


REPRESENTATIVIDAD NO2 ANUAL. AÑO 2019 GUADALIX

A vs A+. NO₂ annual

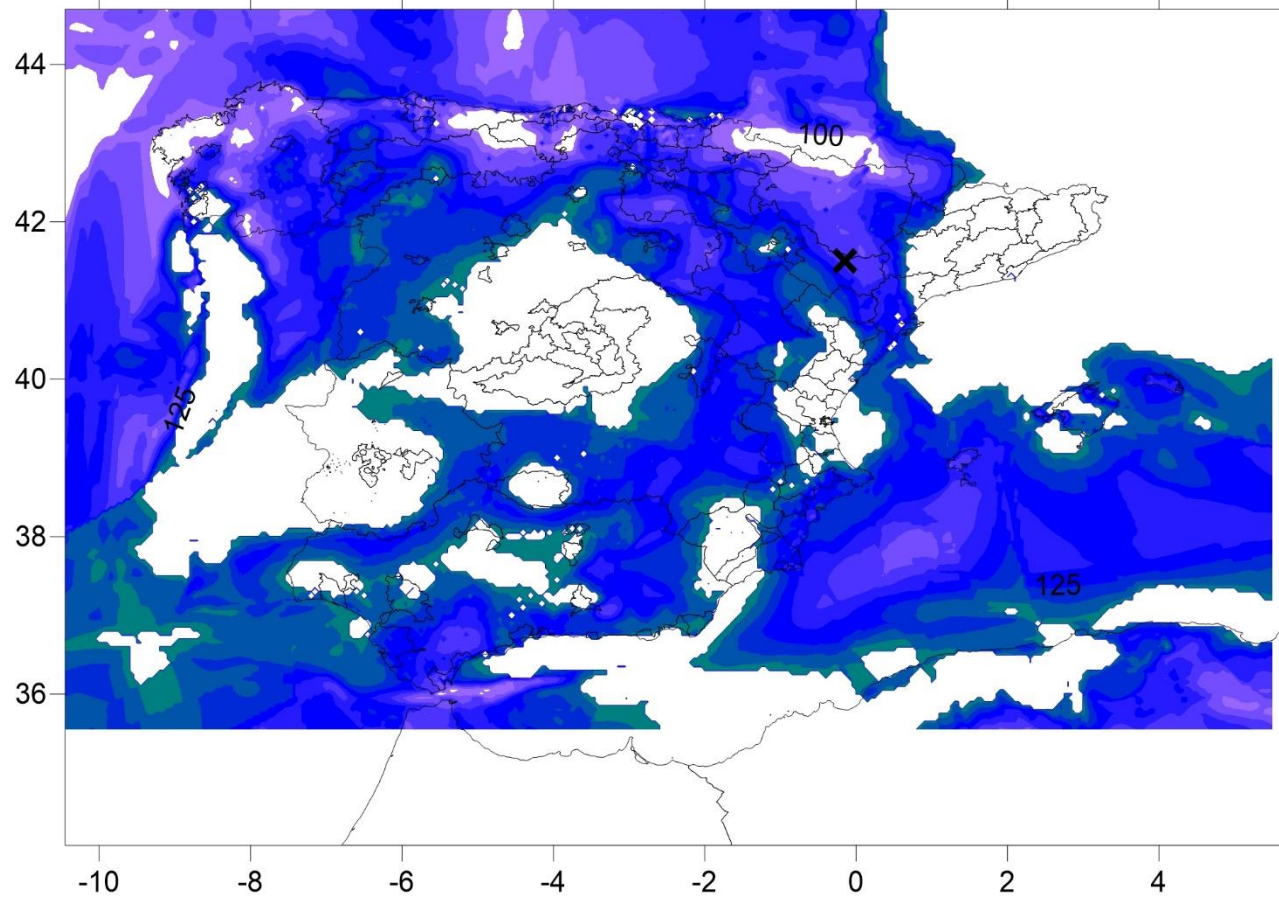


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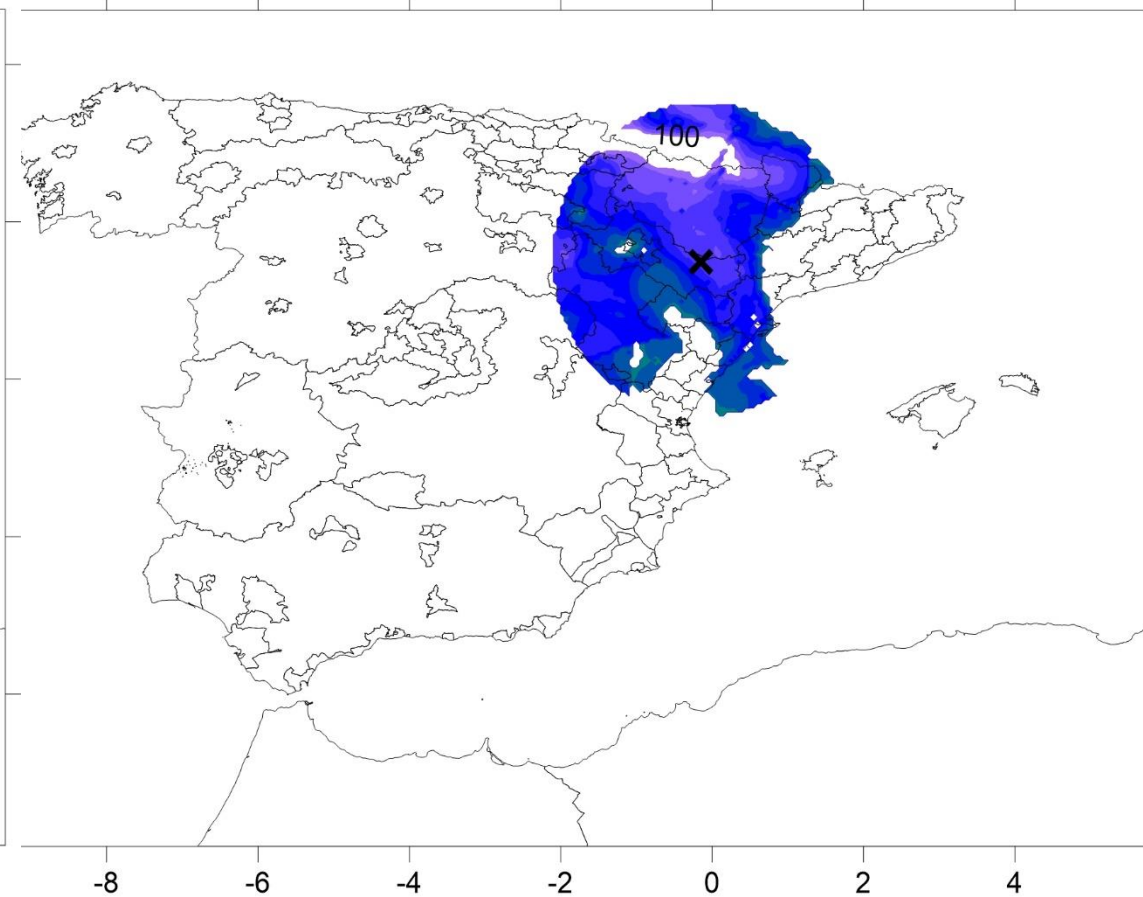


REPRESENTATIVIDAD NO2 ANUAL. AÑO 2019 MONFRAG-

A vs A+. O₃ hourly

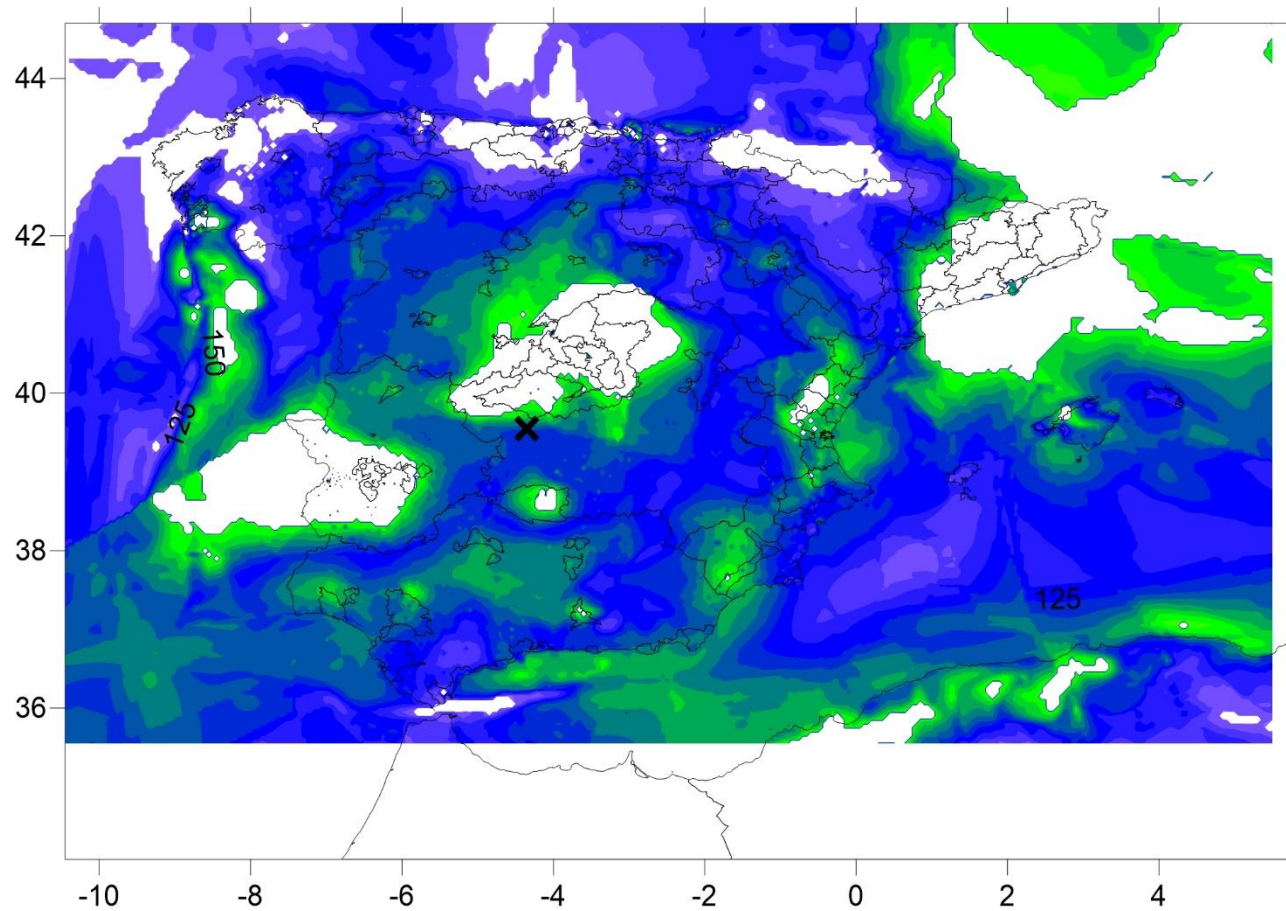


REPRESENTATIVIDAD O3.horario AÑO 2019 BUJARALO

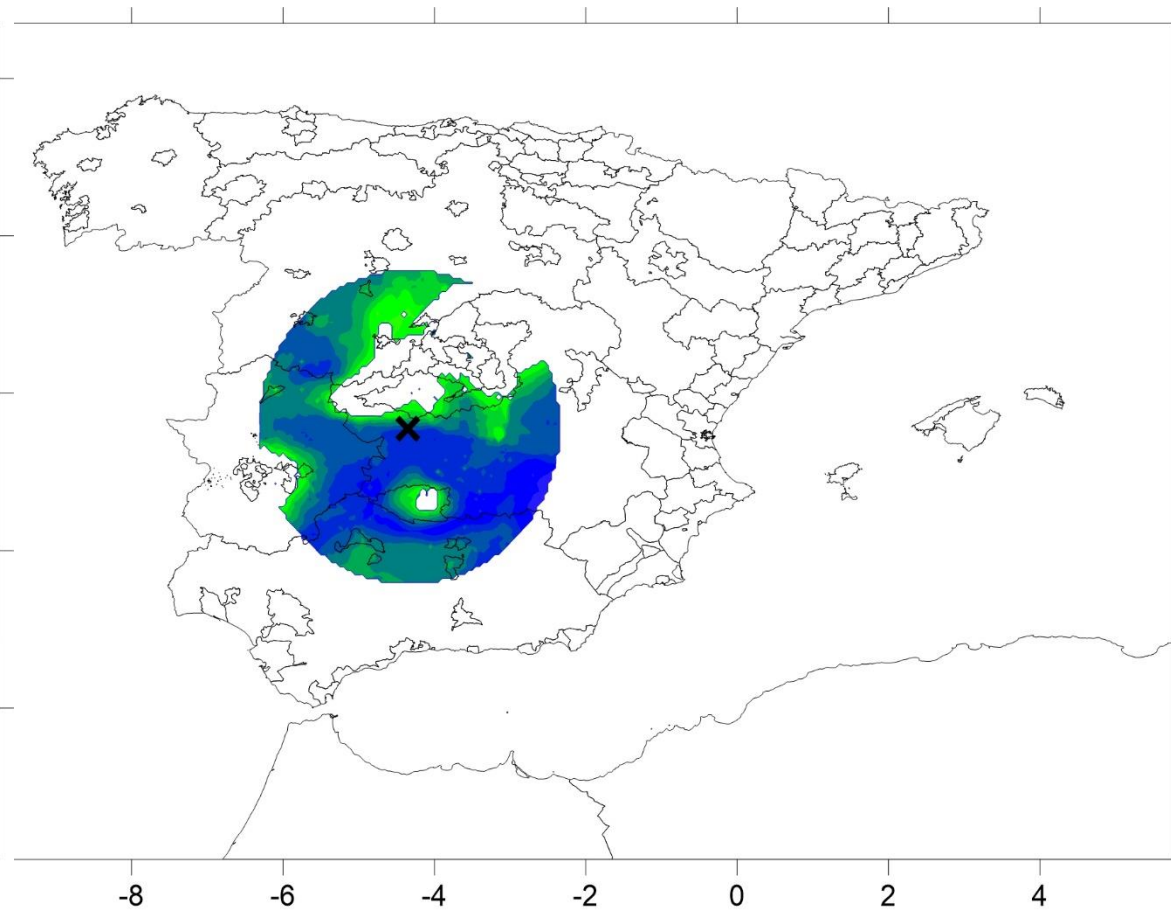


REPRESENTATIVIDAD O3.horario AÑO 2019 BUJARALO

A vs A+. O₃ hourly

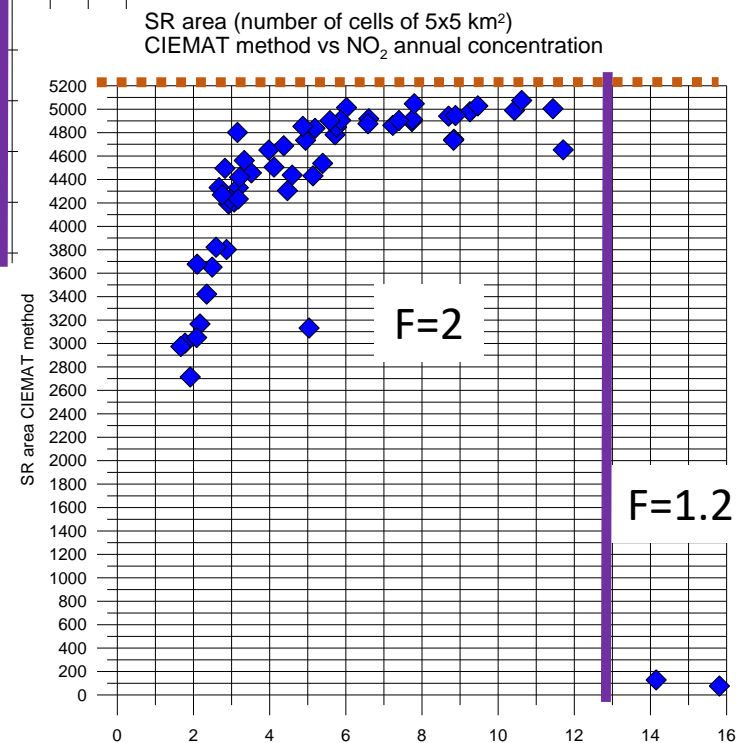
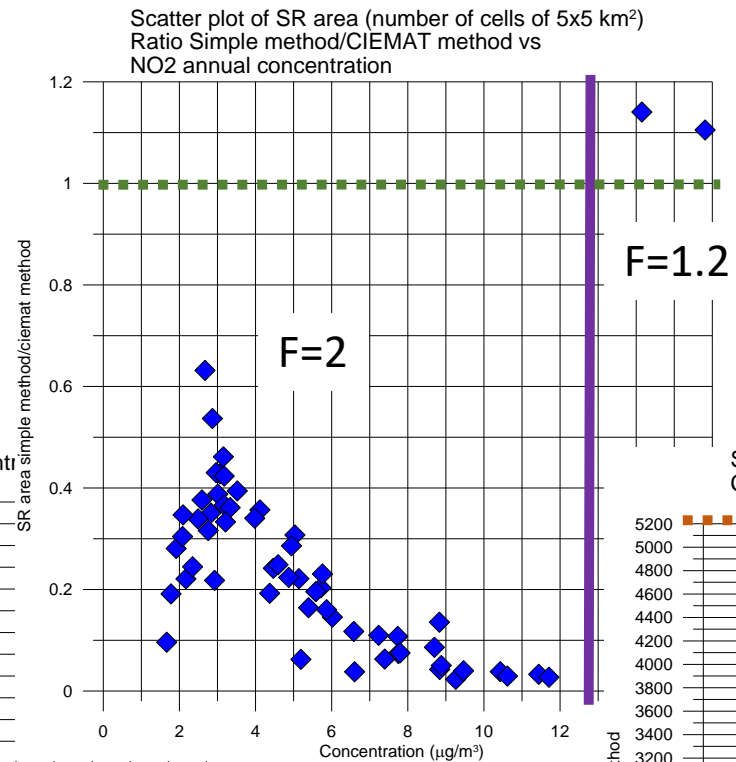
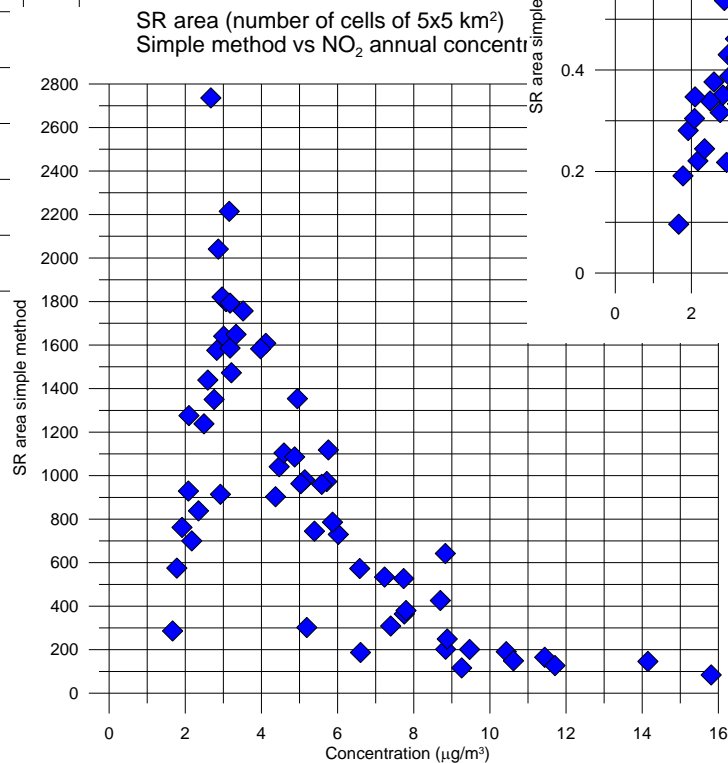
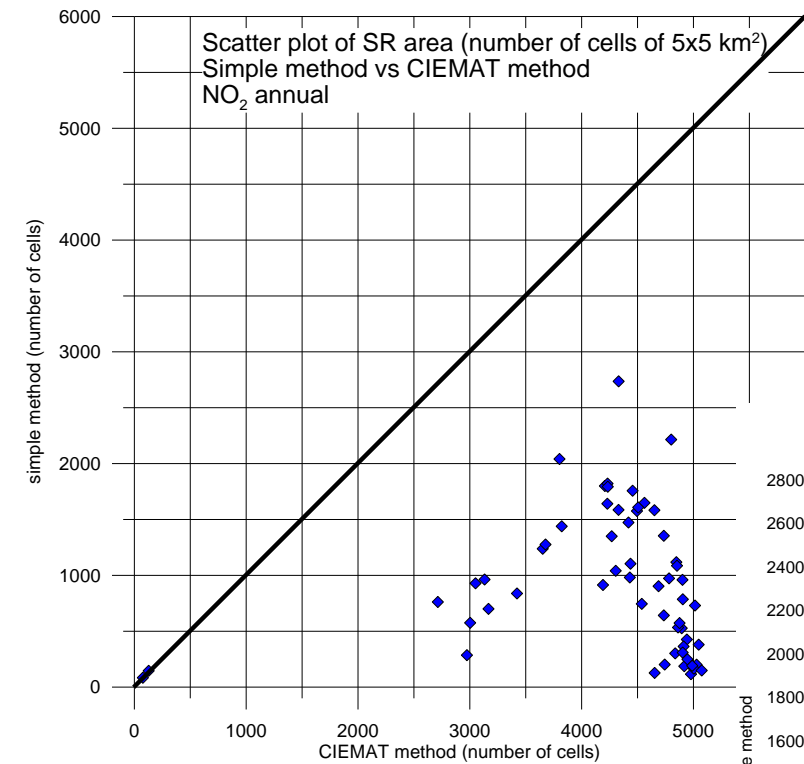


REPRESENTATIVIDAD O3.horario AÑO 2019 SAN_PABL

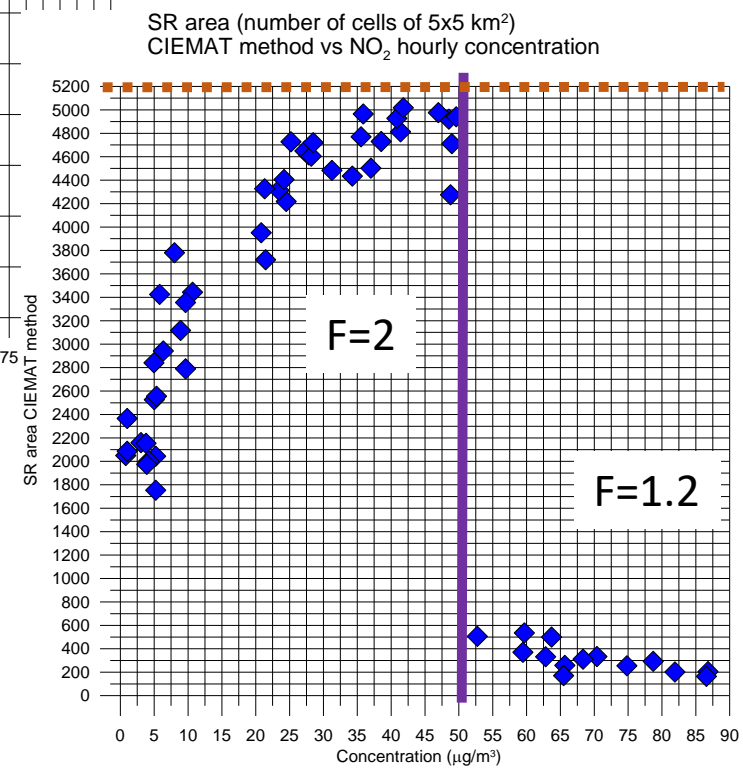
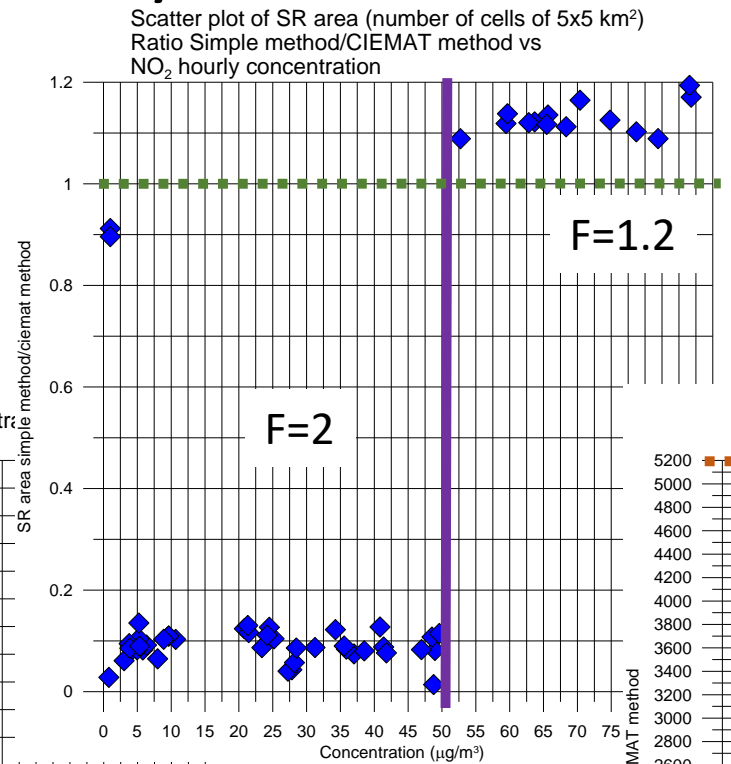
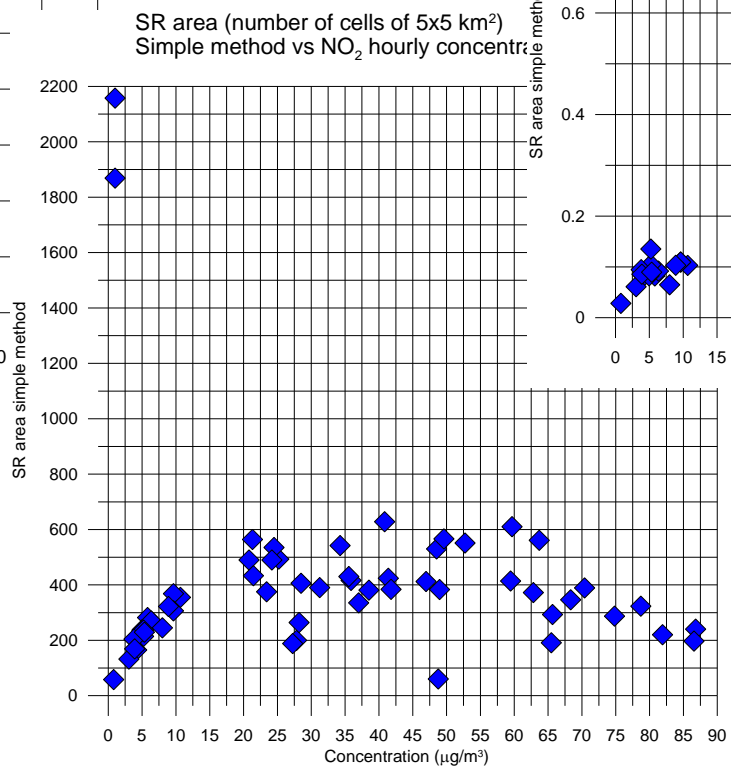
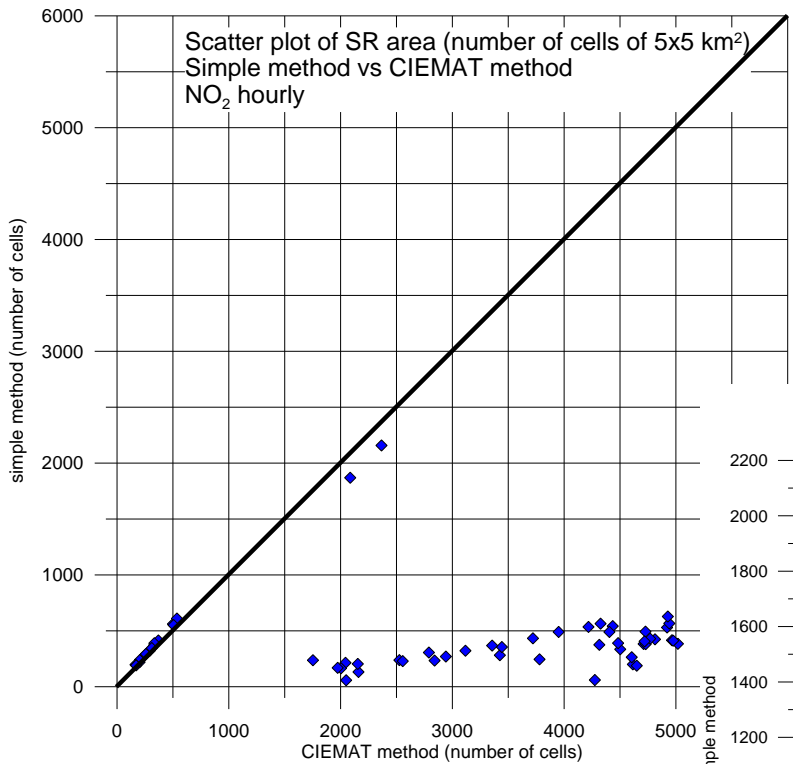


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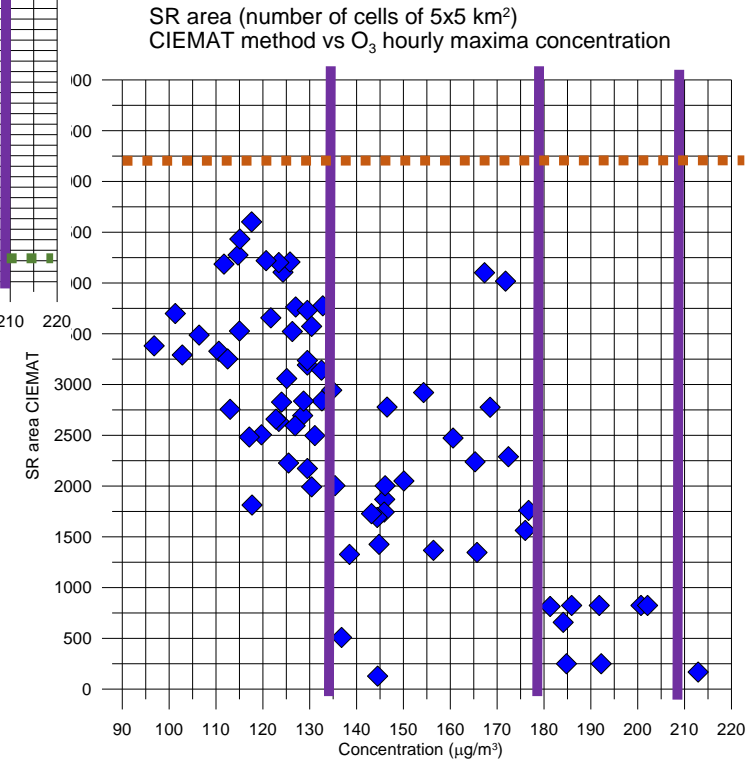
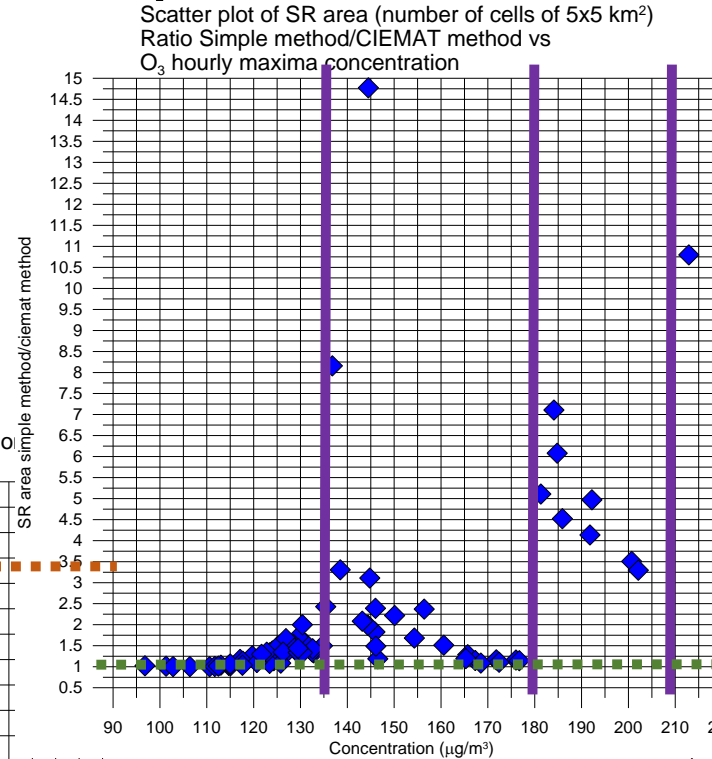
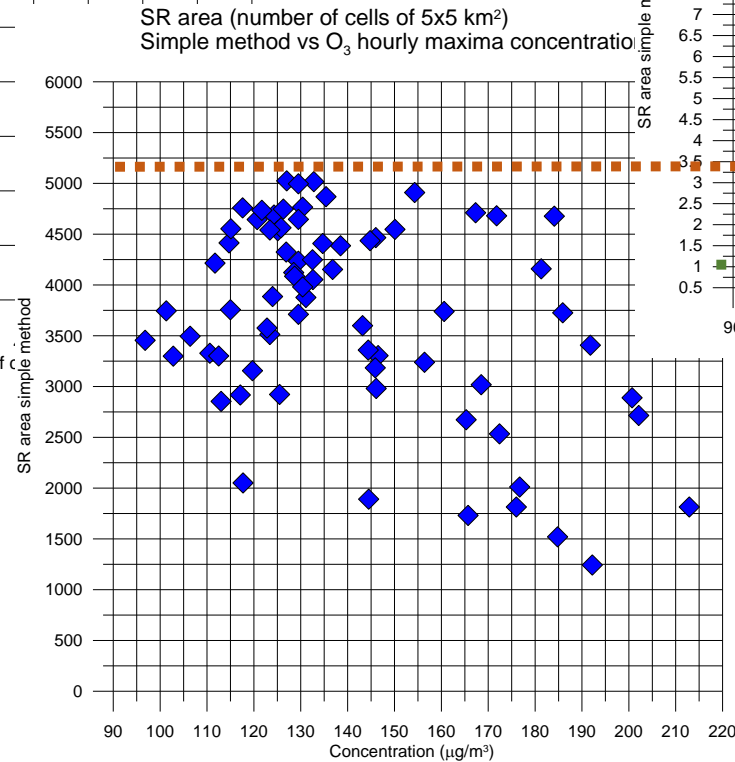
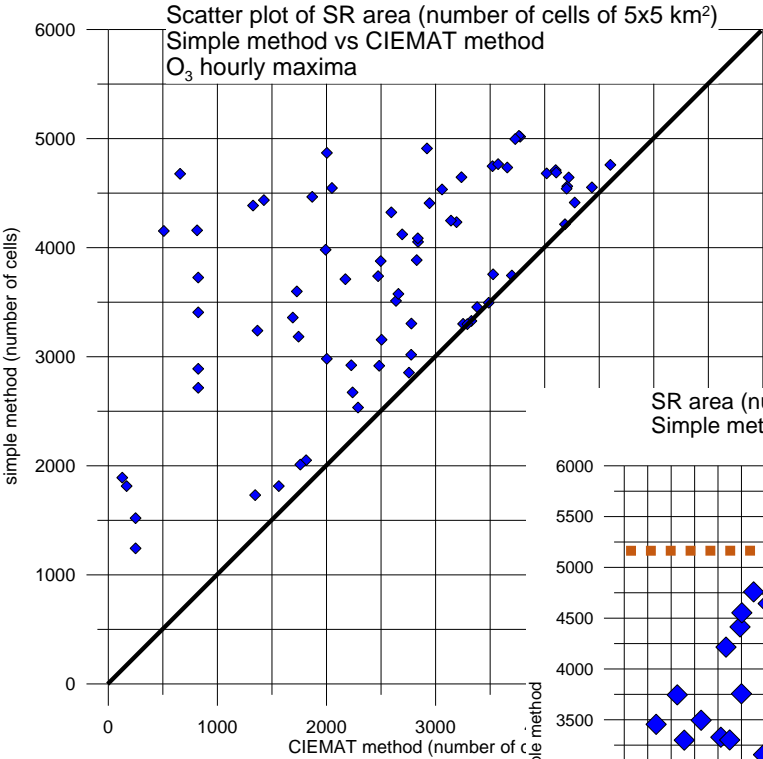
A+ vs CIEMAT. NO₂ annual



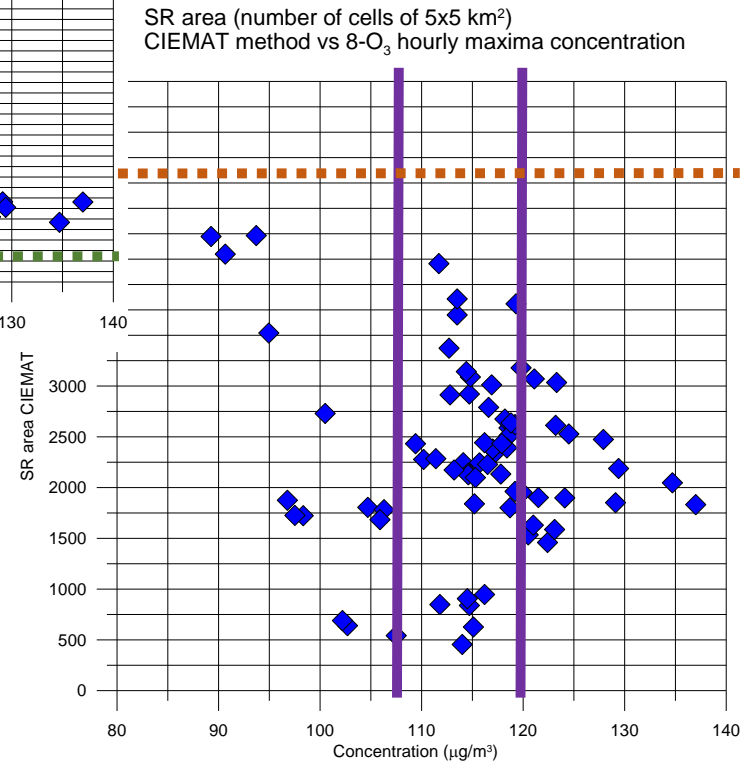
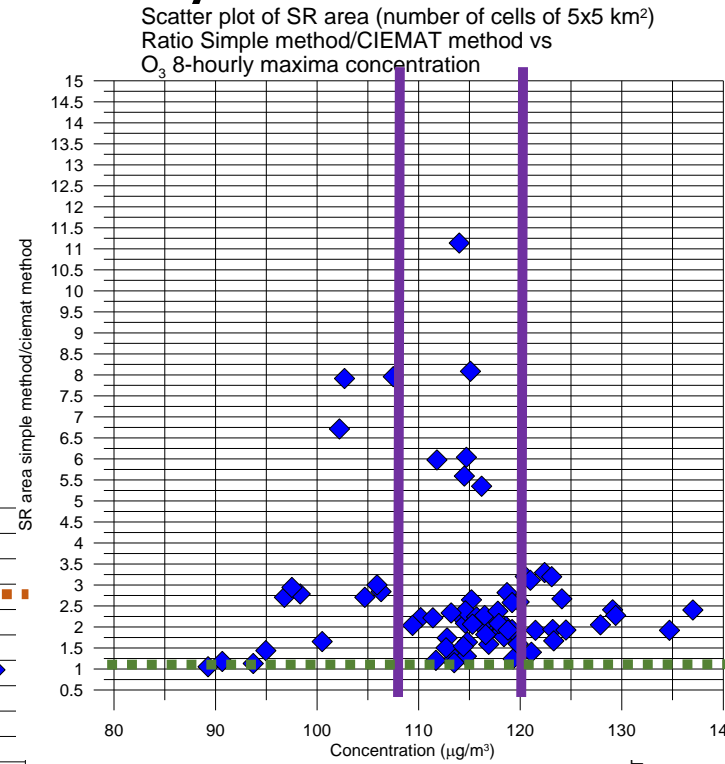
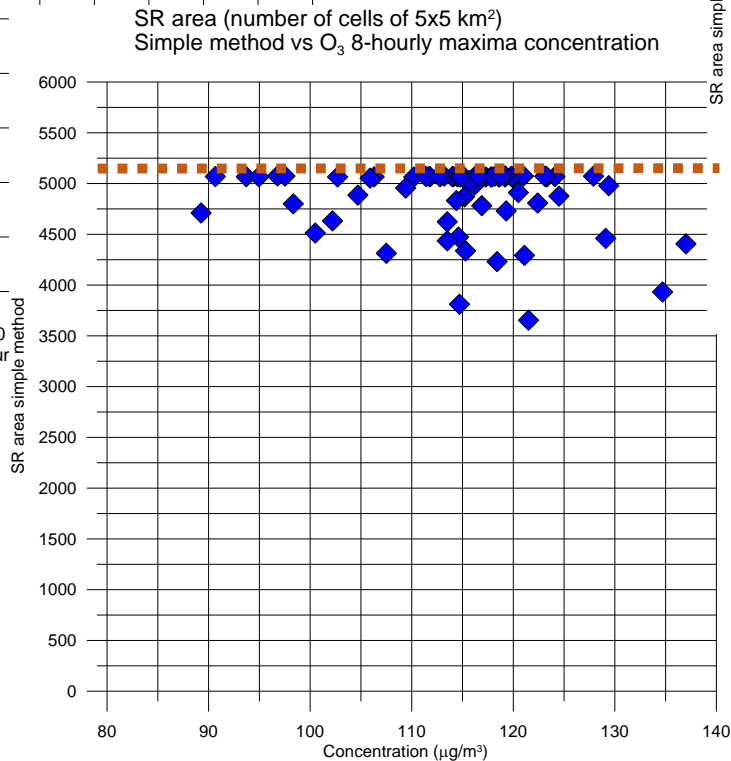
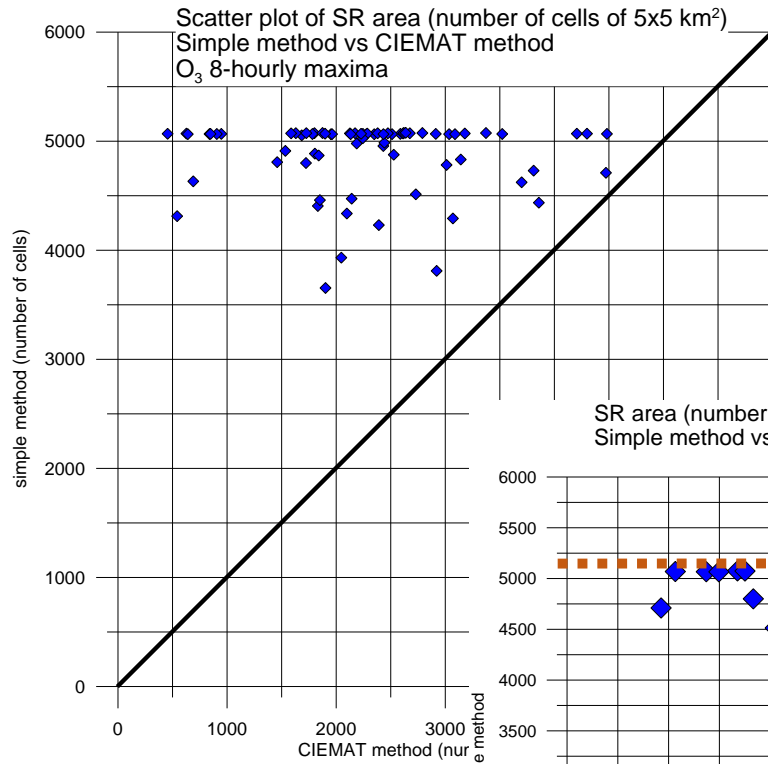
A+ vs CIEMAT. NO₂ hourly



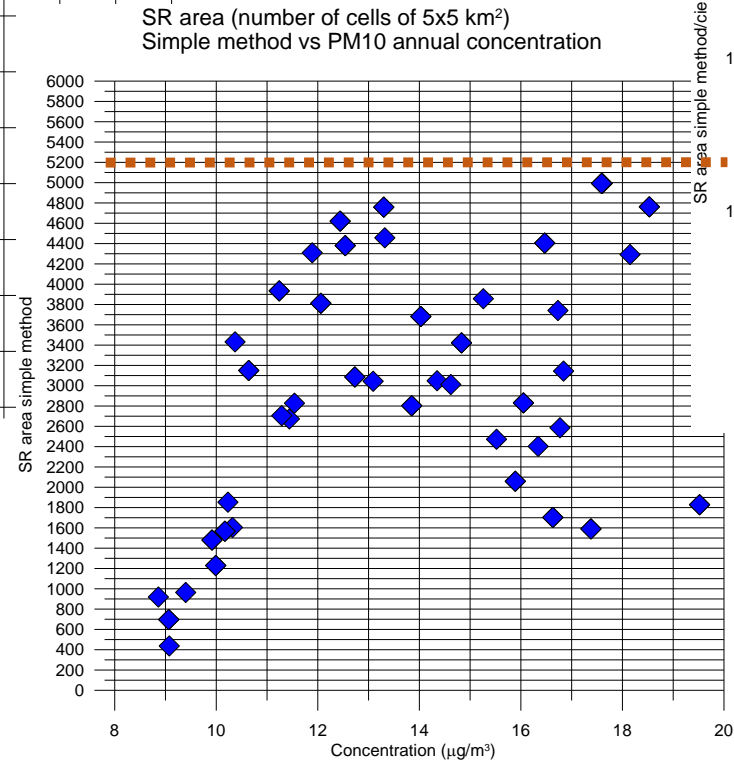
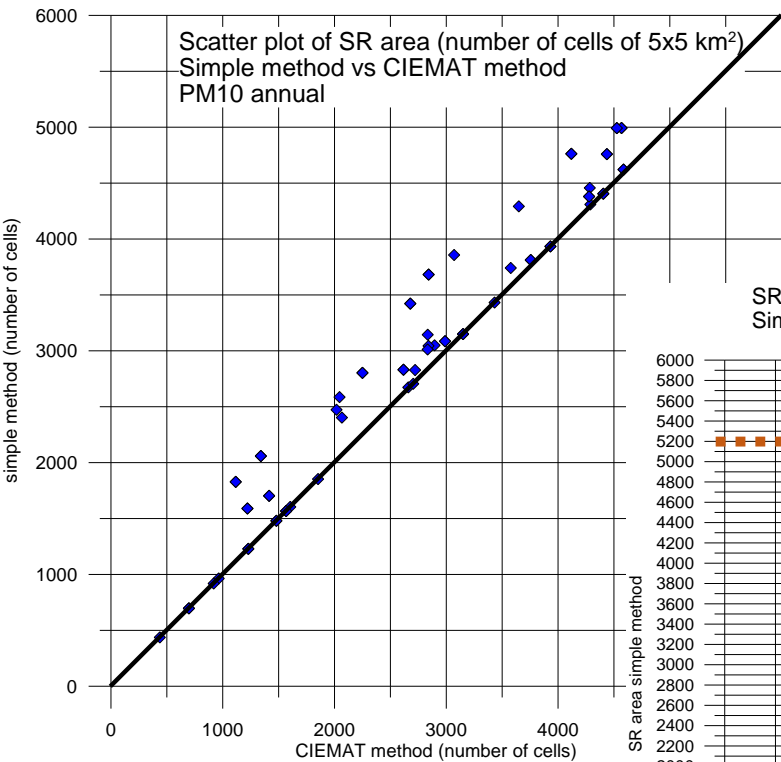
A+ vs CIEMAT. O₃ hourly



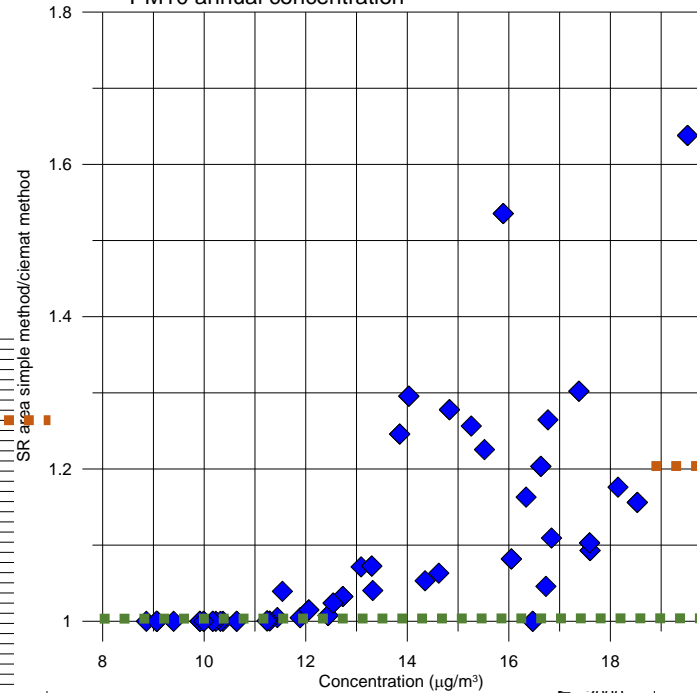
A+ vs CIEMAT. O₃ 8-hourly



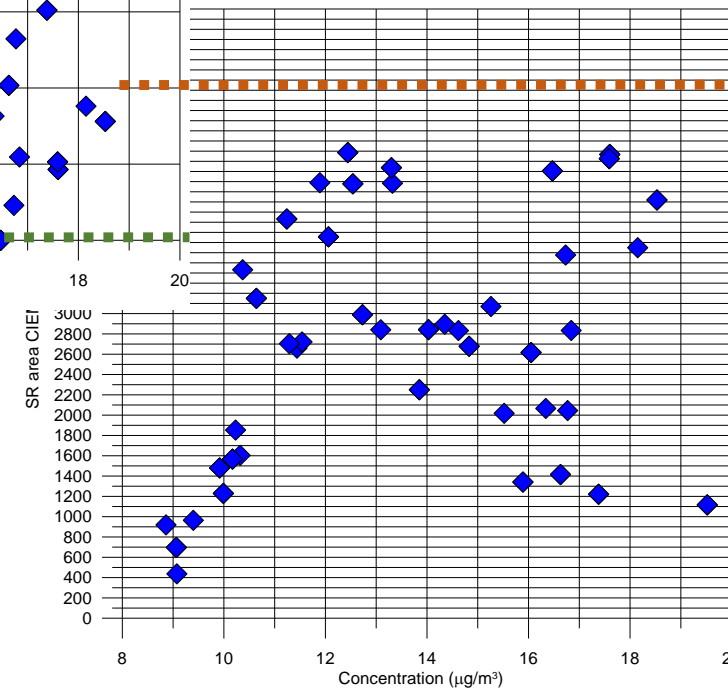
A+ vs CIEMAT. PM10 annual



Scatter plot of SR area (number of cells of 5x5 km²)
Ratio Simple method/CIEMAT method vs
PM10 annual concentration



area (number of cells of 5x5 km²)
MAT method vs PM10 annual concentration





Conclusions

- Need of a size limit for the SR área.
 - Not clear that using the boundaries of the AQ zone should be good.
 - SR area estimates can help to improve the delimitation of the AQ zones.
- SR area differences are very dependent on the pollutant and on the concentration limits used in the CIEMAT methodology.