

Influence of the modelling methodology on the assessment of impacts and air quality compliance. Spanish National Air Pollution Control Programme – 2023 (NAPCP-2023) case study.



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Updated National Air Pollution Control Programme – 2023 (NAPCP-2023)

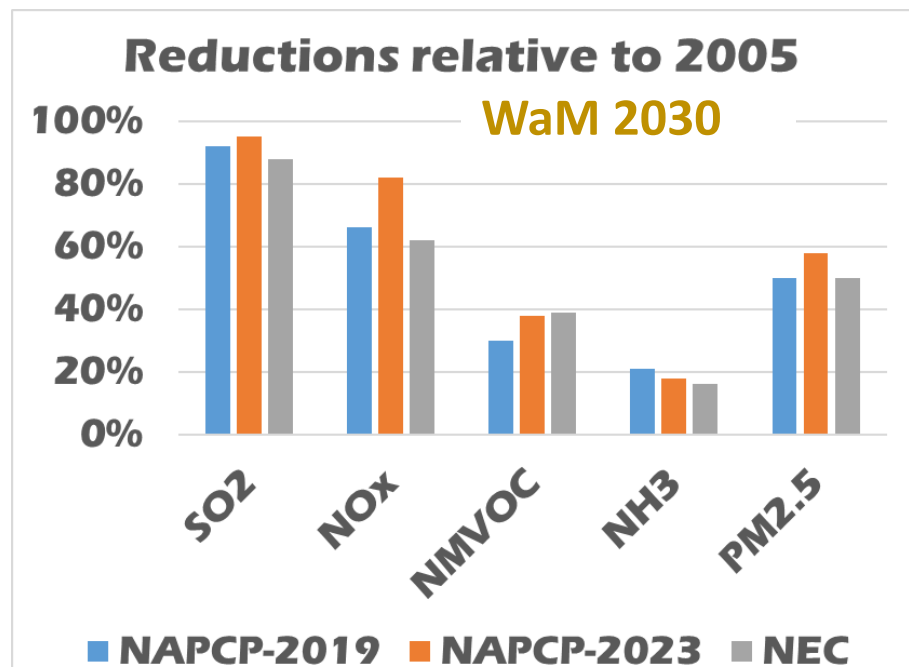
Developed by the **Ministry for the Ecological Transition and Demographic Challenge (MITECO)**



NAPCP-2023 contains emission reduction measures to meet the objectives for 2030 in the **National Emission Ceilings Directive** for Spain

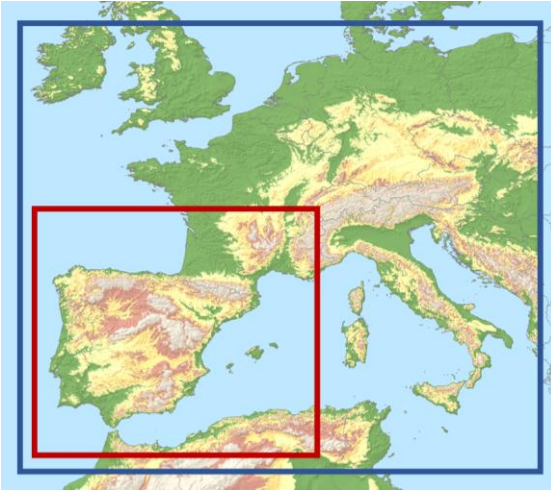
NEC Objectives for Spain:	
SO _x	88%
NO _x	62%
NMVOC	39%
NH ₃	16%
PM2.5	50%

Relative to 2005

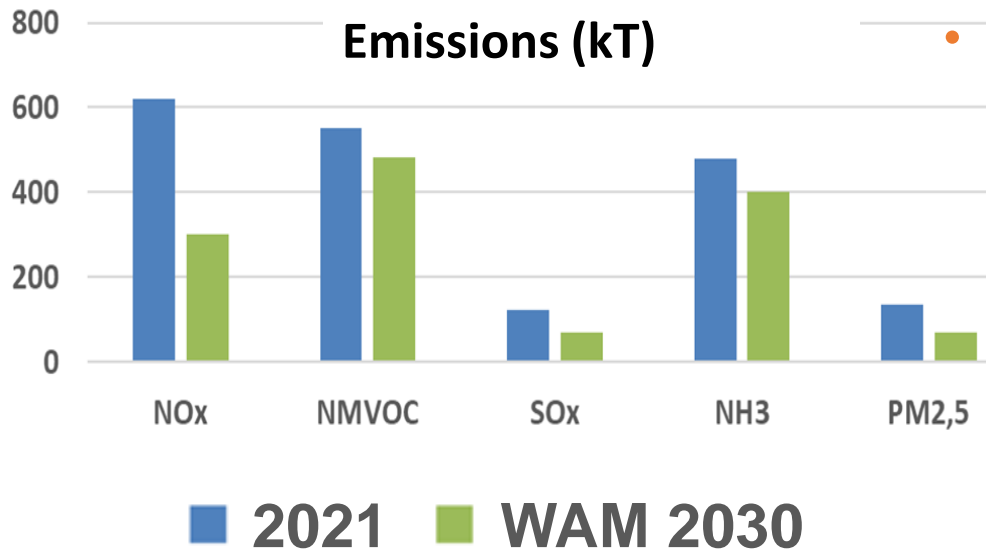


https://www.miteco.gob.es/content/dam/miteco/es/calidad-y-evaluacion-ambiental/sgalsi/atm%C3%B3sfera-y-calidad-del-aire/emisiones/pol-med/actualizacion_pncca2023_240115.pdf

Methodology



- Chemistry and Transport Model: **CHIMERE**
- $0.08^\circ \times 0.08^\circ$ (within a european simulation at $0.15^\circ \times 0.15^\circ$)
- 2021 emissions: Spain: **MITECO**. Rest of Europe: **EMEP**
- Emission reductions in **WAM 2030**: **MITECO**. Relative to 2021
- **Meteorology**: **ECMWF-IFS 2021** (Thanks to AEMET for access to the MARS archive of ECMWF)
- **Correction based on 2021 observations**



WAM: With Additional Measures

$$CM(2021) = M(2021) + R(2021)$$

$$CM(2030) = M(2030) + R(2021) \cdot M(2030)/M(2021)$$

CM: CORRECTED MODEL
M: MODEL
R: RESIDUAL (O-M)

NO2 ANNUAL MEAN

PM10 ANNUAL MEAN

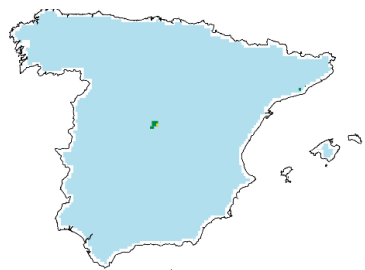
2021

CD

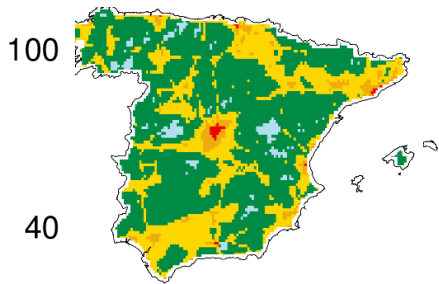
ND

CD

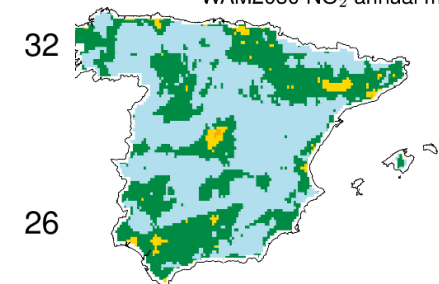
ND



FS2021M annual mean

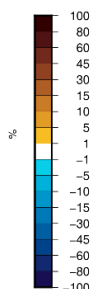
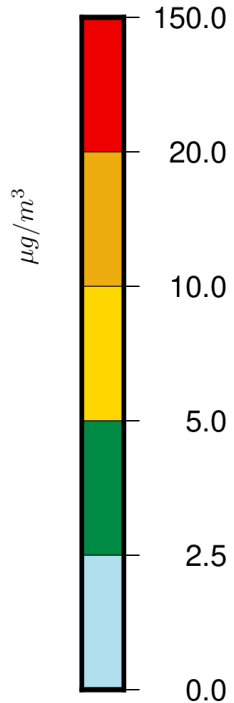
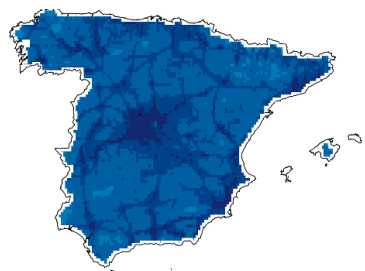


SP08BIGcm CHIM13IFS2021MC/WAM2030 NO₂ annual mean



SP08BIGcm CHIM13IFS2021MC/WAM2030 NO₂ annual mean

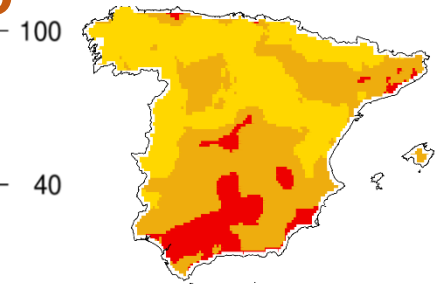
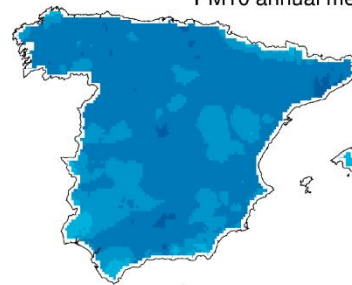
IMPACTS



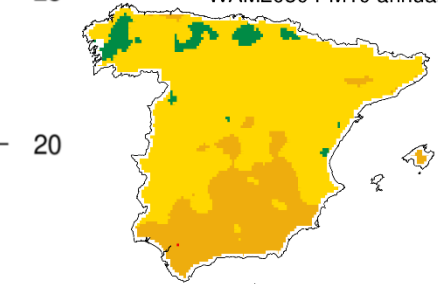
SP08BIGcm CHIM13IFS2021MC/WAM2030 PM10 annual mean



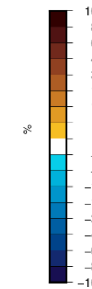
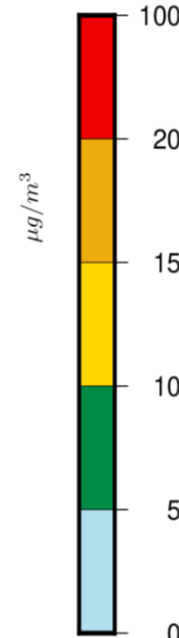
SP08BIGcm CHIM13IFS2021MC/WAM2030 PM10 annual mean



SP08BIGcm CHIM13IFS2021MC/WAM2030 PM10 annual mean

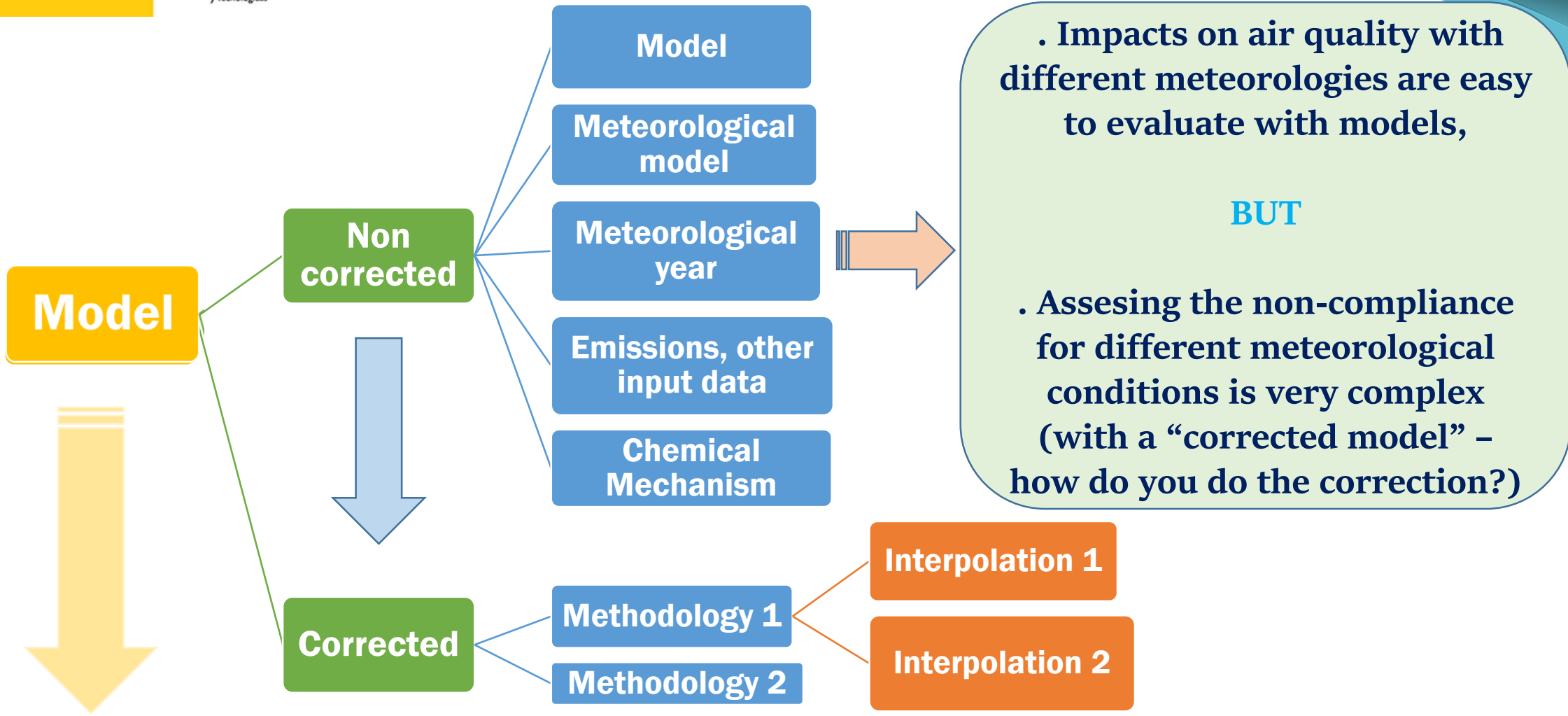


SP08BIGcm CHIM13IFS2021MC/WAM2030 PM10 annual mean



CD: Current Directive; ND: New Directive

FAIRMODE WG5 (Future Scenario Bias Corrections), 27 May 2024

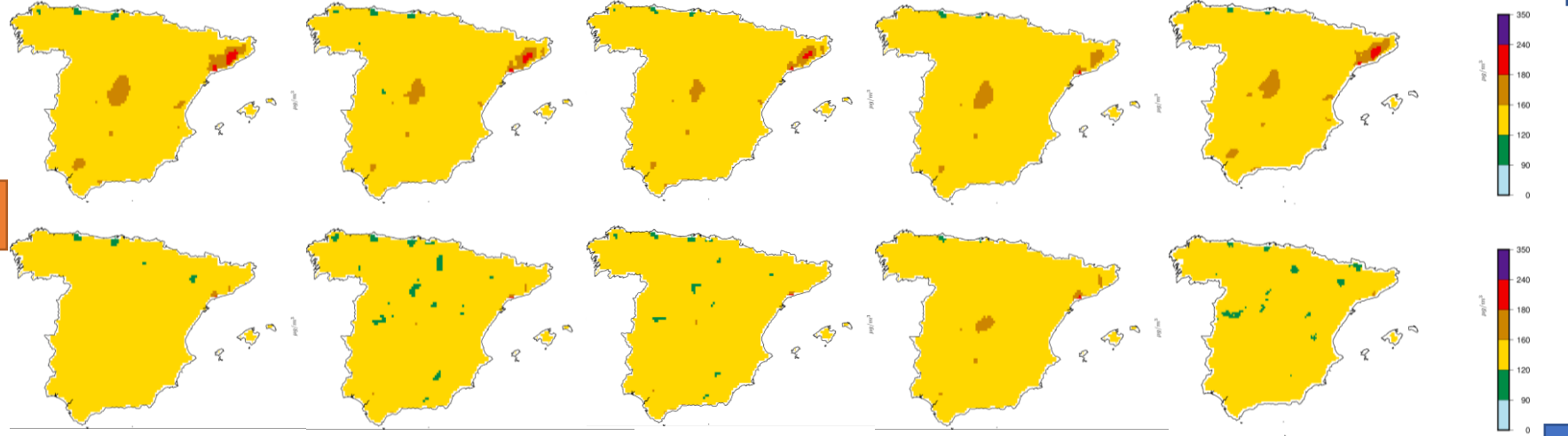


CONCENTRATION

	CHIM13	CHIM17			
	Met Model: IFS Res: 0.1°	CHEM. MECH.: MELCHIOR2	CHEM. MECH.: SAPRC07	Met Model: WRF	Res. 0.08°
2021	7	5	4	1	6

NON-COMPL. AQZ

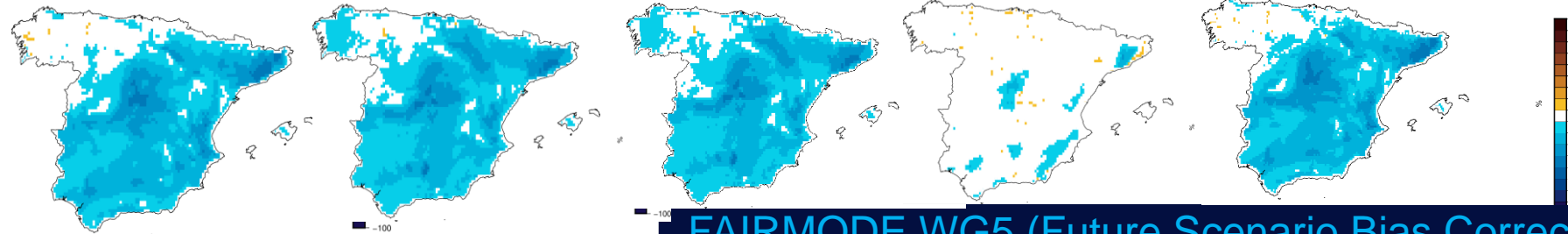
WAM2030



1	1	1	1	1	0
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NON-COMPL. AQZ

IMPACTS



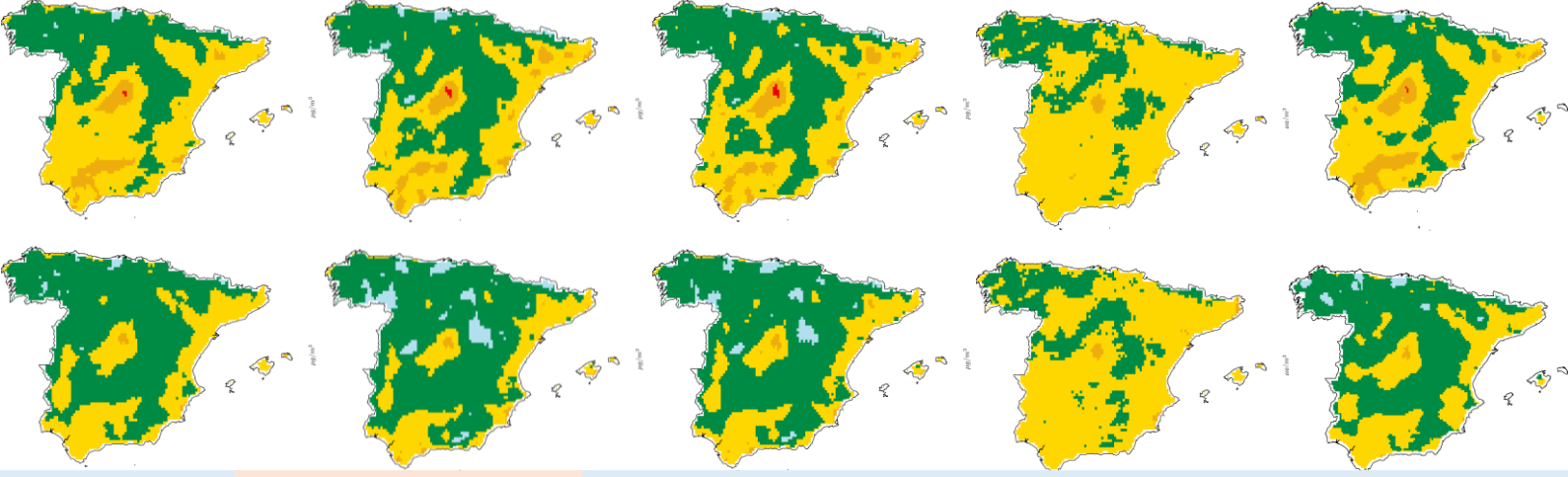
03

MÁX. 8-HOR (MAX 26°)

	CHIM13	CHIM17			
	Met Model: IFS	CHEM. MECH.: MELCHIOR2	CHEM. MECH.: SAPRC07	Met Model: WRF	
	Res: 0.1°				Res. 0.08°
2021	1	6	5	0	2

NON-COMPL. AQZ

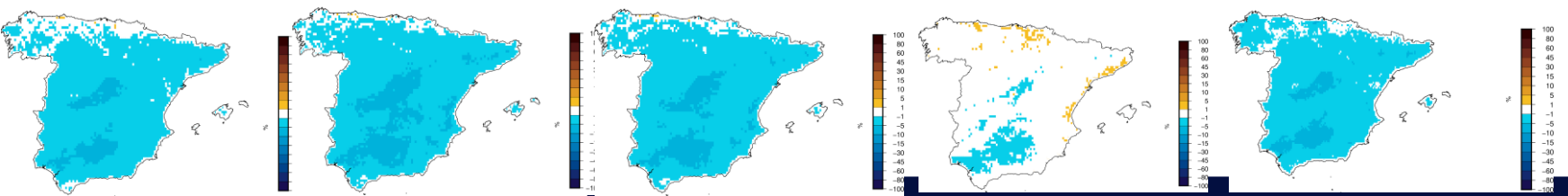
WAM2030



0	1	0	0	0
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NON-COMPL. AQZ

IMPACTS

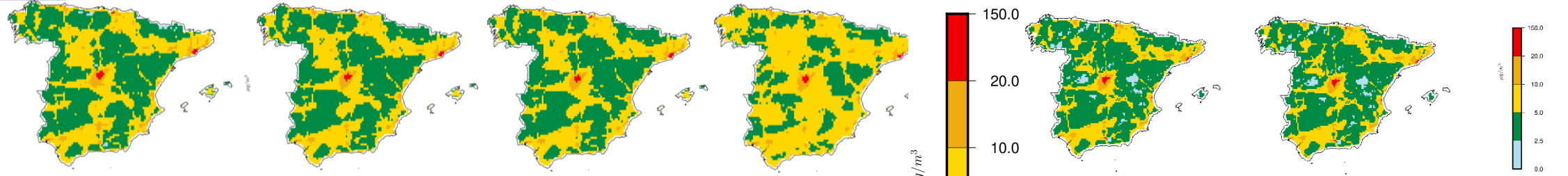


CHIM13	CHIM17					
Met Model: IFS	CHEM. MECH.: MELCHIOR2		CHEM. MECH.: SAPRC07	Met Model: WRF		Other mod.correc.
Res: 0.1°					Res. 0.08°	Res. 0.08°

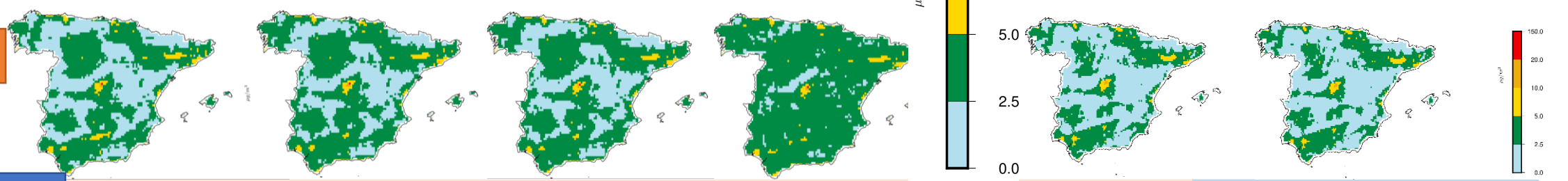
NON-COMPL. AQZ

8 8 8 7 8 13

2021



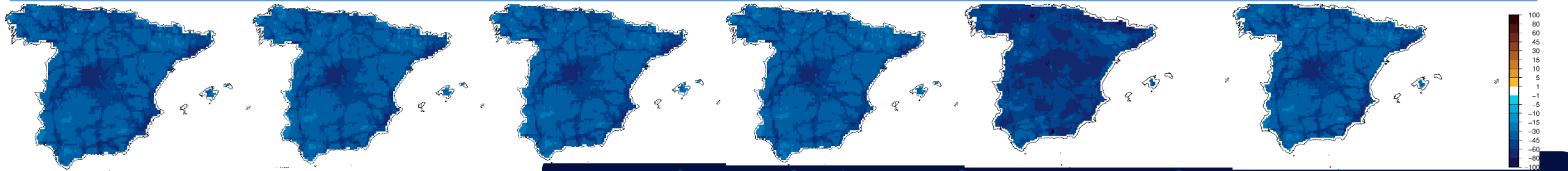
WAM2030



NON-COMPL. AQZ

1 1 1 1 1 0

IMPACTS

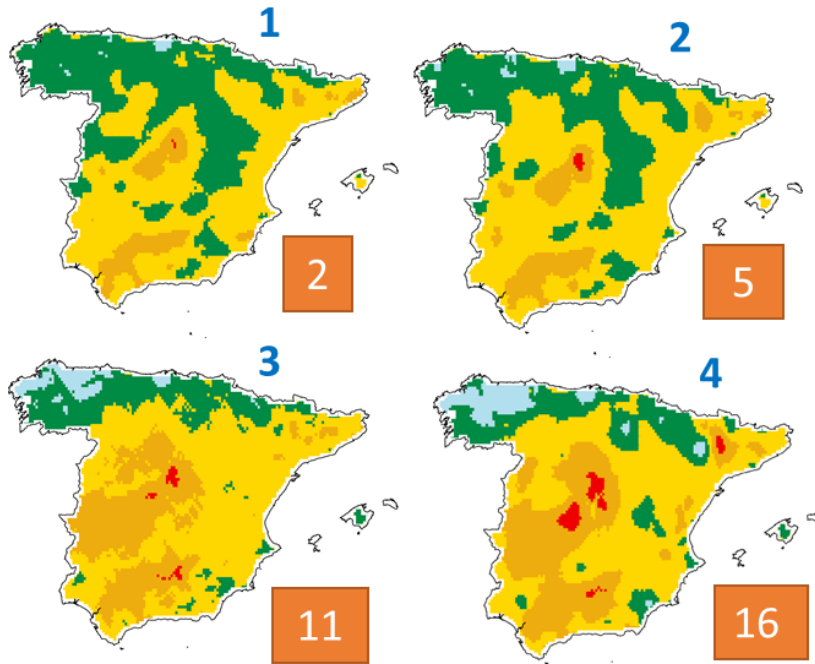


Model correction

- Model + Bias
- Bias grid obtained from ordinary kriging of bias at sites (Obs. - Model)
- Differences in the method of fitting the theoretical variogram to the empirical one
- 3 of them use a spherical model as a theoretical variogram; they differ on some parameters used in the fitting

O3 26th max8hd

Different ways of doing the kriging of residuals



X Number of NC-AQZ

1: Python (**MC75**): Ordinary Kriging; spherical model to fit the experimental semivariogram (automatic fitting, varying bin distance)

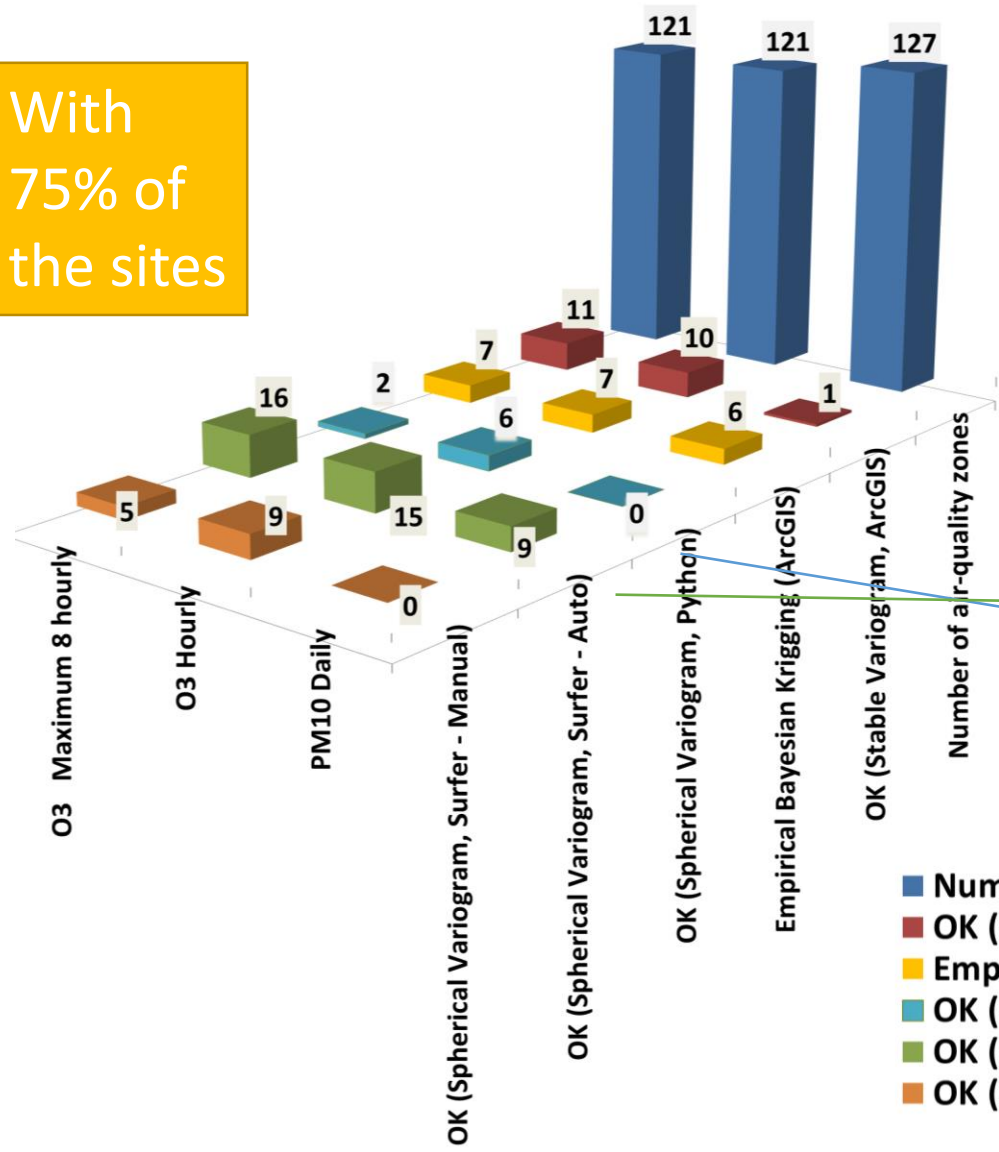
2: Surfer Manual (**MCSMA75**): Ordinary Kriging; spherical model to fit the experimental semivariogram (manual fitting, varying: range, nugget, sill...)

3: ArcGIS (**MCAOK75**): Ordinary Kriging; stable model to fit the experimental semivariogram (automatic fitting)

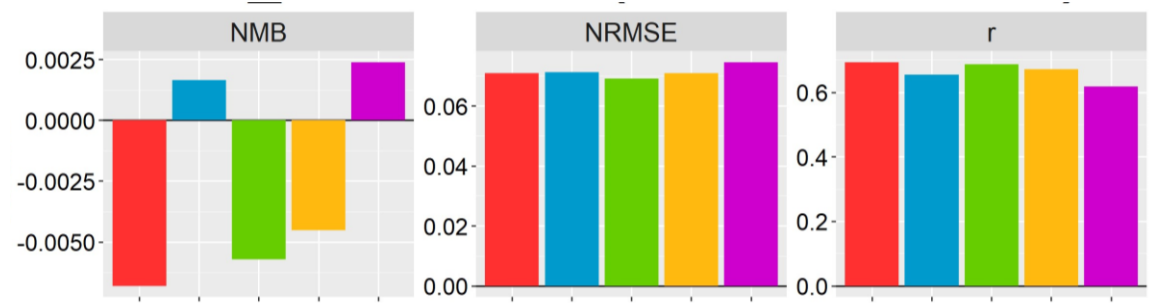
4: Surfer Auto (**MCSAU75**): Ordinary Kriging; spherical model to fit the experimental semivariogram (automatic fitting)

Validation of model correction

With 75% of the sites



For the 25% not used



- Modelo
- AUTO_SURFER
 - MANUAL_SURFER
 - EBK_M26_ARCGIS
 - ORDINARY_ARCGIS
 - CON_GEO_140KM_PYTHON

- Number of air-quality zones
- OK (Stable Variogram, ArcGIS)
- Empirical Bayesian Krigging (ArcGIS)
- OK (Spherical Variogram, Python)
- OK (Spherical Variogram, Surfer - Auto)
- OK (Spherical Variogram, Surfer - Manual)

Bias correction for other meteorological years

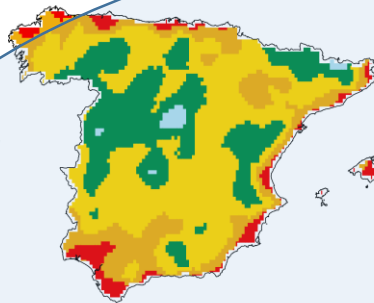
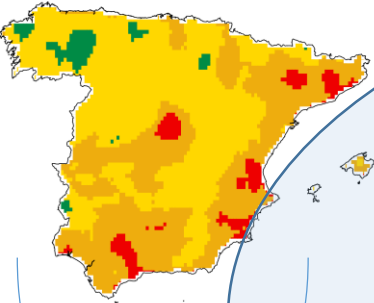
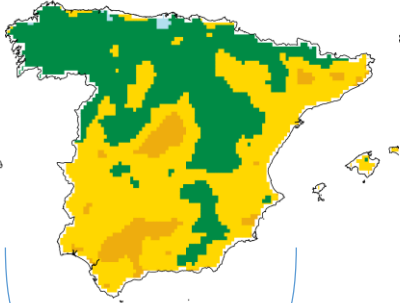
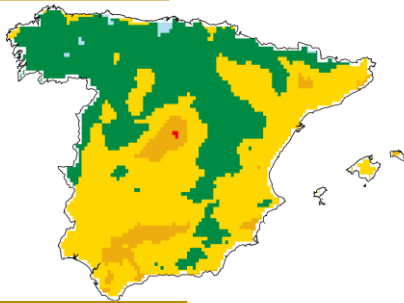
Meteo 2021

Meteo 2016

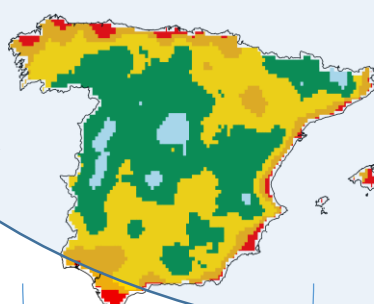
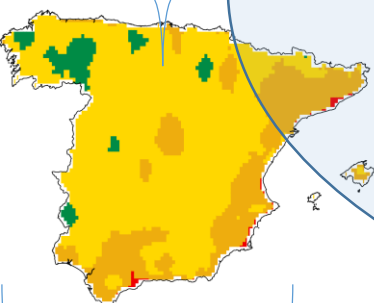
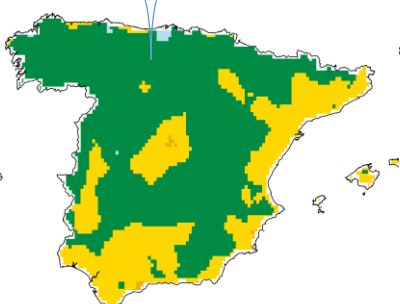
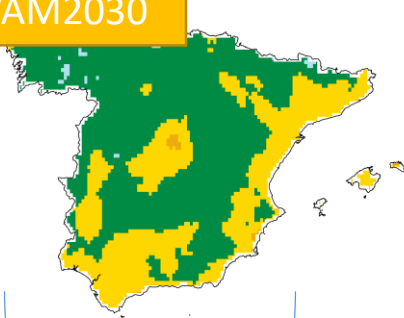
Meteo 2016

Meteo 2016

REF. CASE



WAM2030



Estimation of fictitious 2021 obs with 2016 meteo-conditions at sites (GAM), followed by kriging of bias.

Bias relative to 2021 reference simulation bias.

Bias relative to 2021 reference simulation bias.

Bias relative to 2016 reference simulation bias.

Year -1
Year -2
Year -3
Year -4

GAM Forecast with Yearmet

GAM training

Year concentration with yearmet

NO SENSE

IMPACTS MET 2016

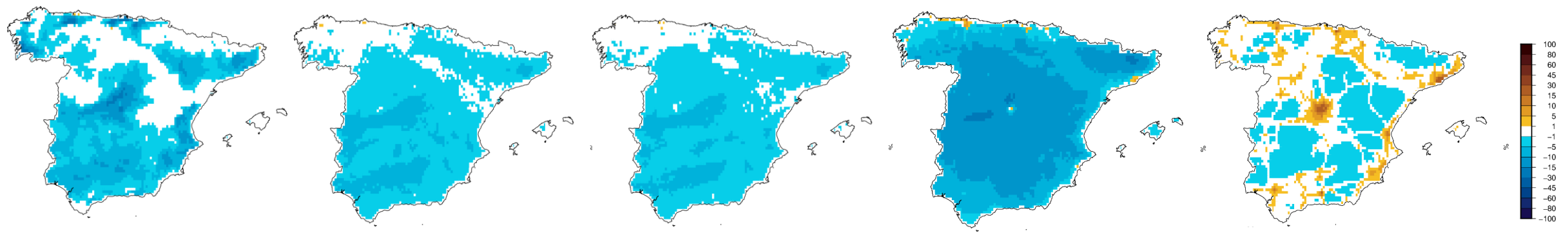
O3 -1st

O3 -19th

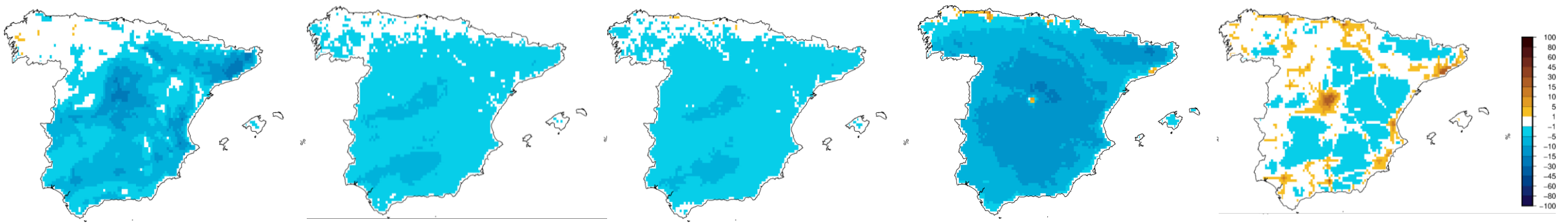
O3 -26th

SOMO35

ANNUAL MEAN



IMPACTS MET 2021



Thanks!

- Thanks to the European Center for Medium-Range Weather Forecasts (ECMWF) for the provision of meteorological modelling data; with thanks also to AEMET for managing access to this information.
- Project TED2021-132431B-I00 (TRANSAIRE: Transition to cleaner air in Spain) funded by MCIN/AEI/10.13039/501100011033 and by the European Union NextGenerationEU/PRTR



- We thank the Ministry for the Ecological Transition and Demographic Challenge (MITERD) for the provision of the emission inventory and reductions for the measures in the NAPCP. We also acknowledge MITERD for providing data from air quality stations.



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