FAIRMODE – CT9
Simulations of the Madrid Ozone Episode
(CIEMAT)

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FAIRMODE Technical Meeting
06/10 - 08/10 (online)

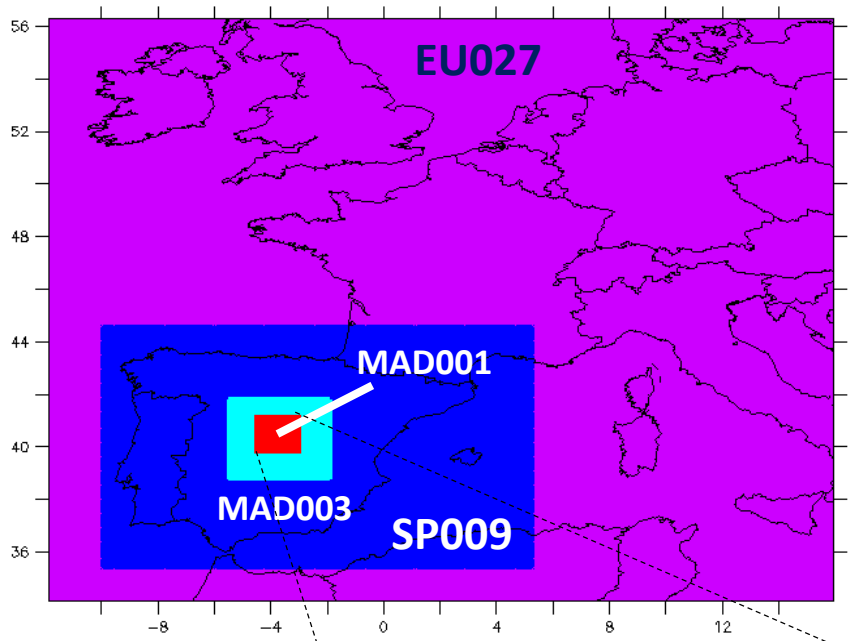
MODELING SET-UP

- Case: **Madrid Ozone Episode**
- Time period: **01/07/2015 – 05/07/2015**
- Simulation start: **5 days before**
- **Base case + 6 emissions reduction scenarios**
  - NOx reduced by 25%
  - NOx reduced by 50%
  - VOCs reduced by 25%
  - VOCs reduced by 50%
  - NOx and VOCs reduced by 25%
  - NOx and VOCs reduced by 50%

Model: **CHIMERE v2017**

Meteo: **IFS**

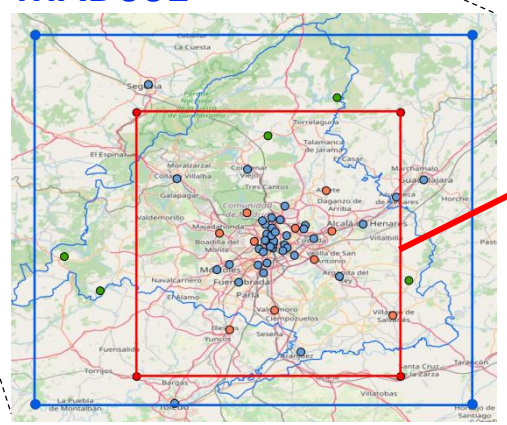
Emissions: **EMEP + NEI, 2015**



Domains simulated

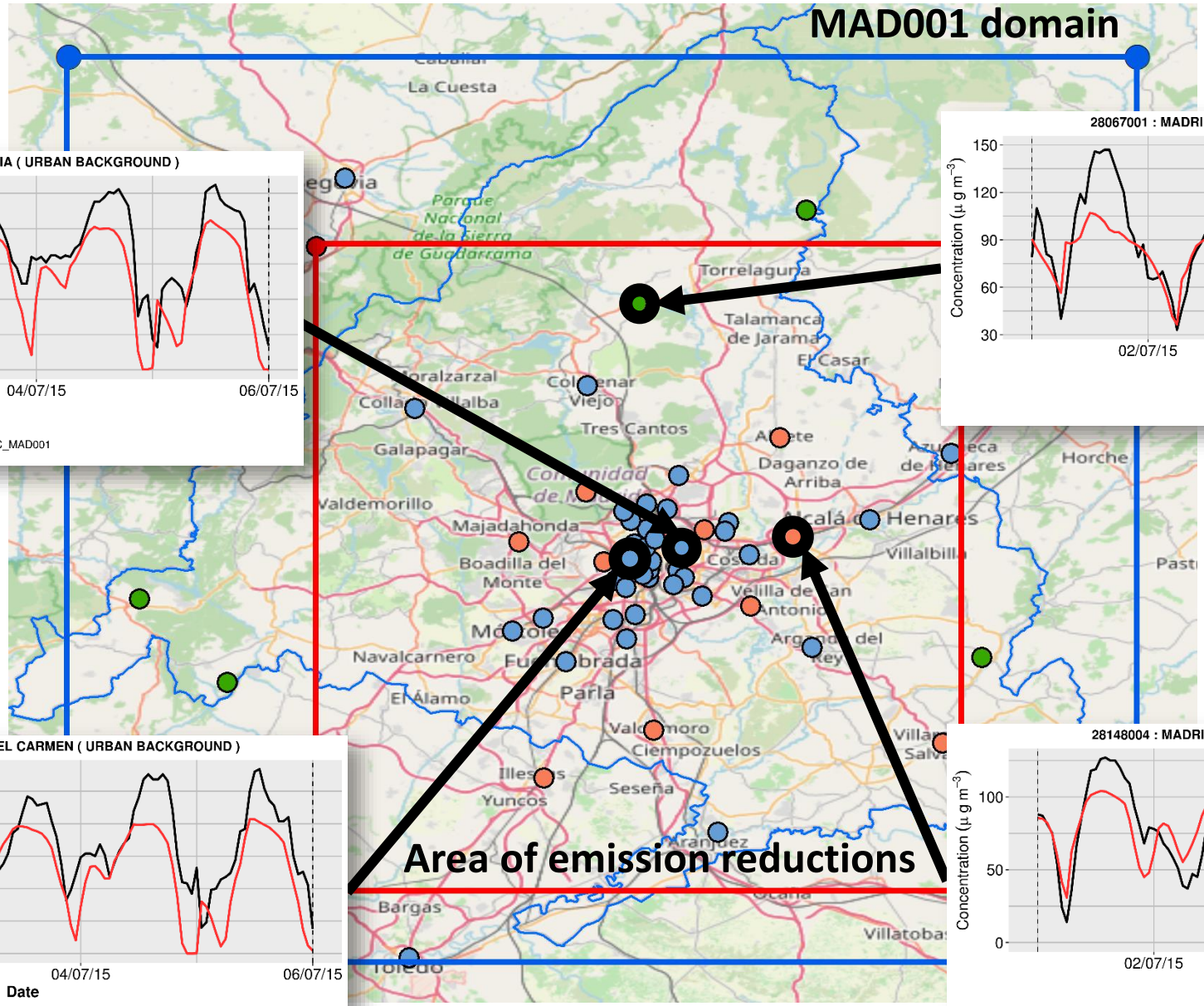
EU027: 0.27° x 0.27°
SP09: 0.09° x 0.09°
MAD003: 0.03° x 0.03°
MAD001: 0.01° x 0.01°

MAD001

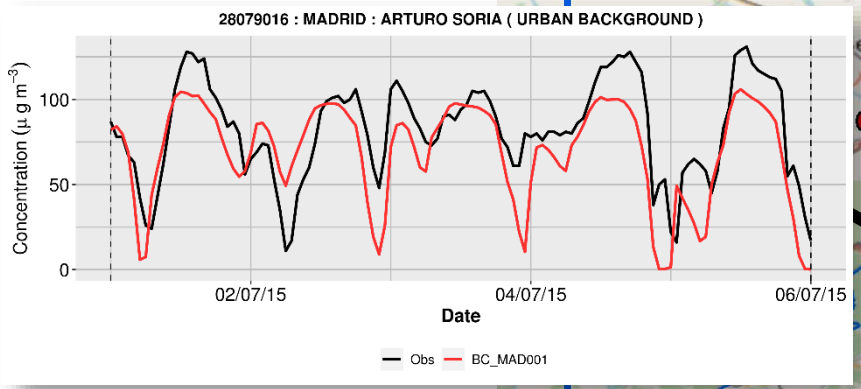


Area of emission reductions

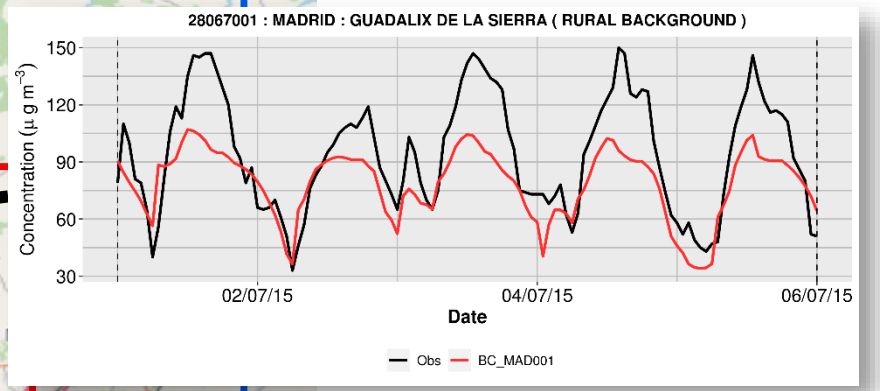
Visual evaluation of the BASE CASE



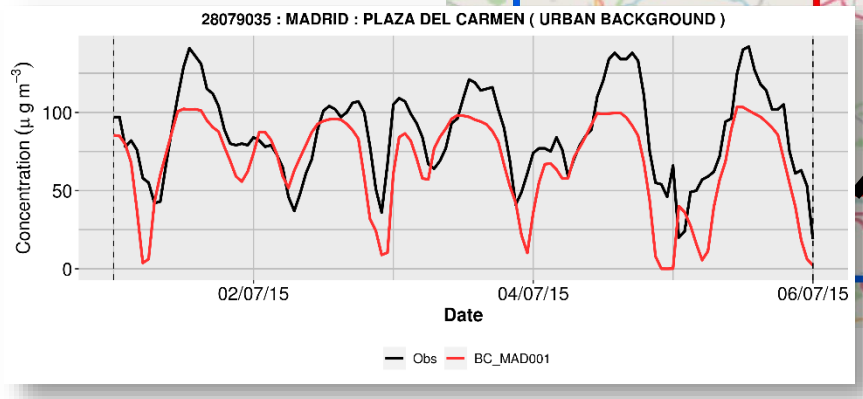
Urban background



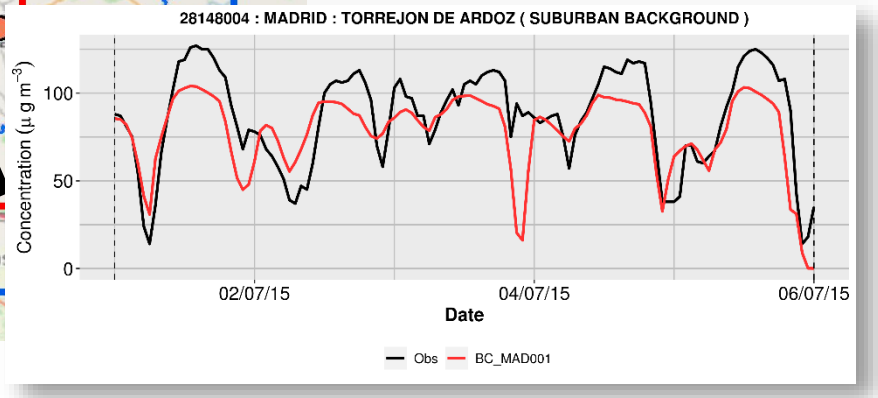
Rural background



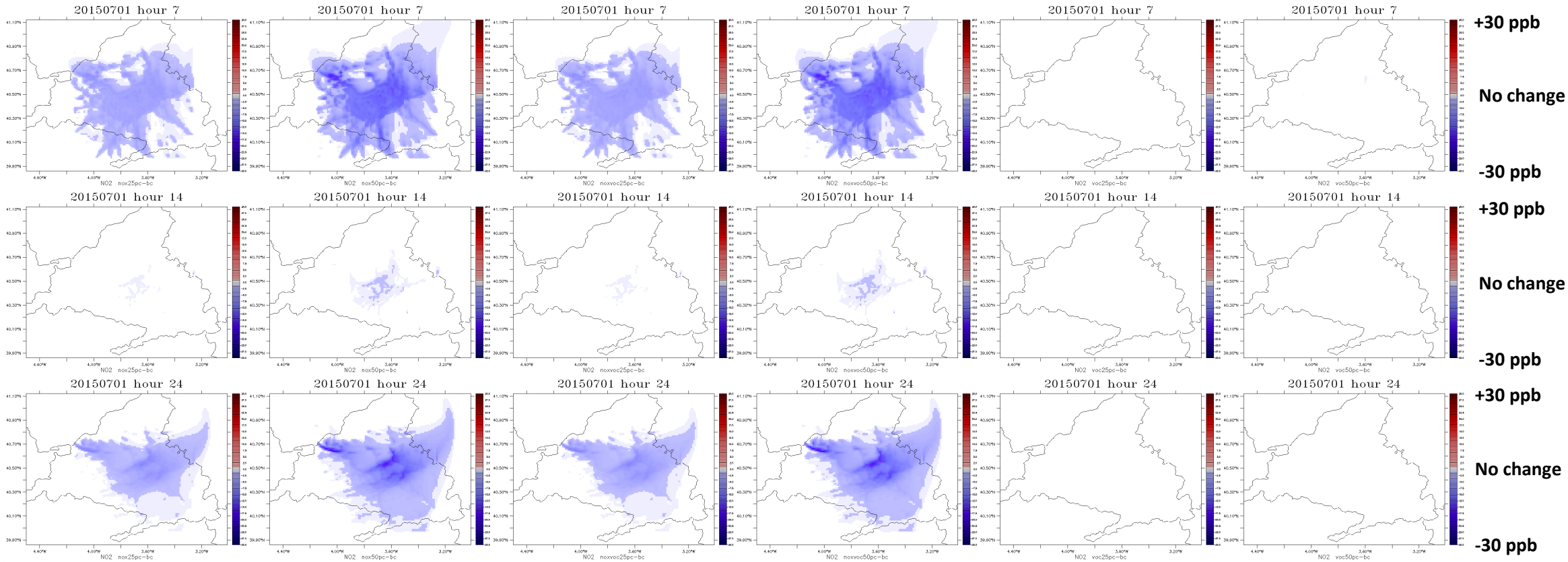
Urban background



Suburban background



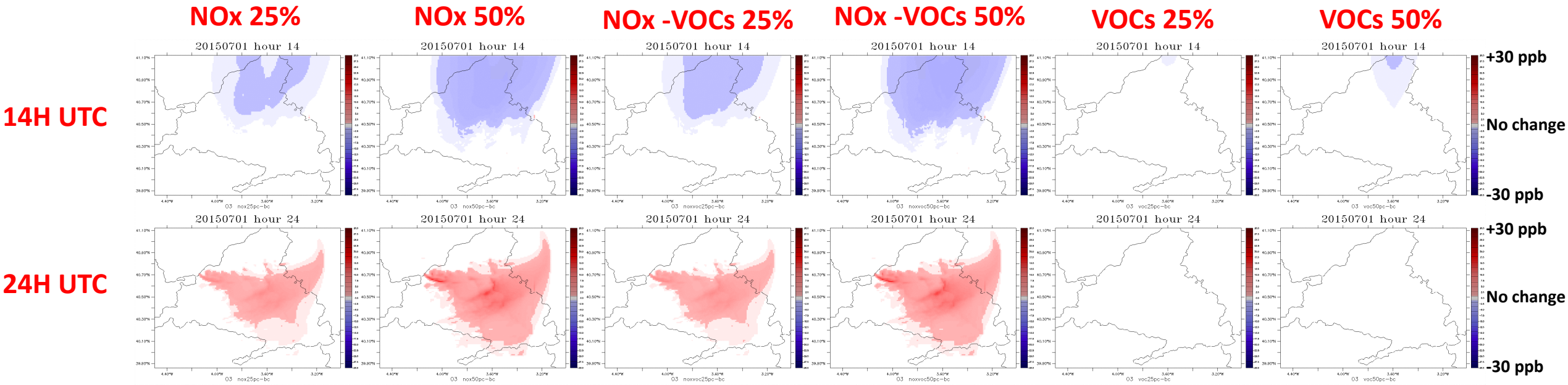
Results: NO_2 with respect to base case (1st July 2015)



- Maximum decrease in concentration at 7h and 24h
- Slight decrease in urban areas at 14h
- No effect of VOC reduction

Decrease in NO_2

Results: O_3 with respect to base case (1st July 2015)



- Decreased concentration at 14h
- Increased concentration at 24h
- Almost no effect of VOC reduction

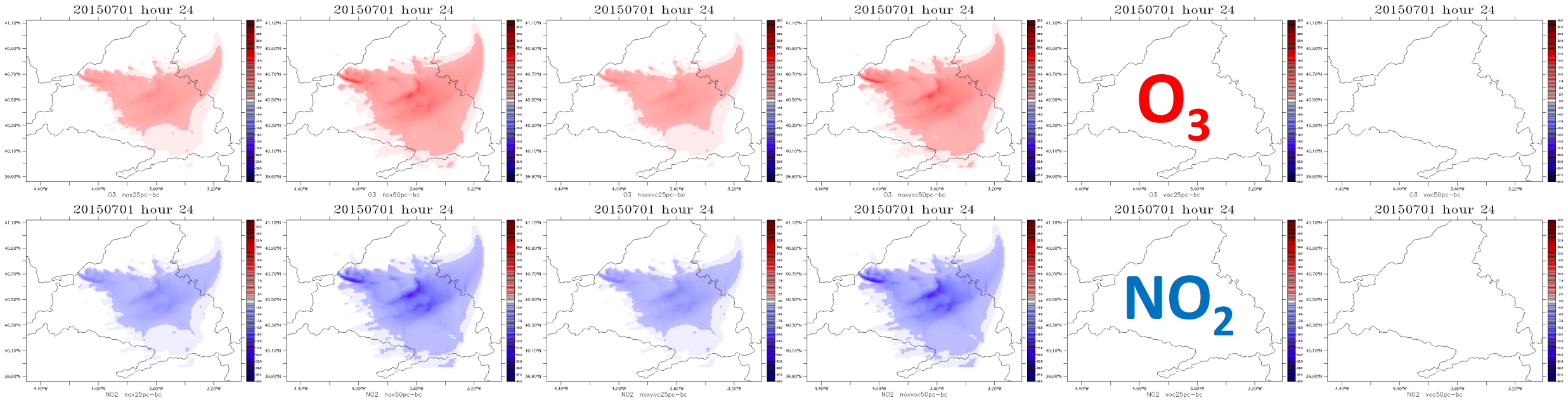
Increase in O_3

Decrease in O_3

Results: Effect of emission reductions on nighttime O_3 and NO_2

- 2nd July 0:00

NOx 25% | **NOx 50%** | **NOx -VOCs 25%** | **NOx -VOCs 50%** | **VOCs 25%** | **VOCs 50%**



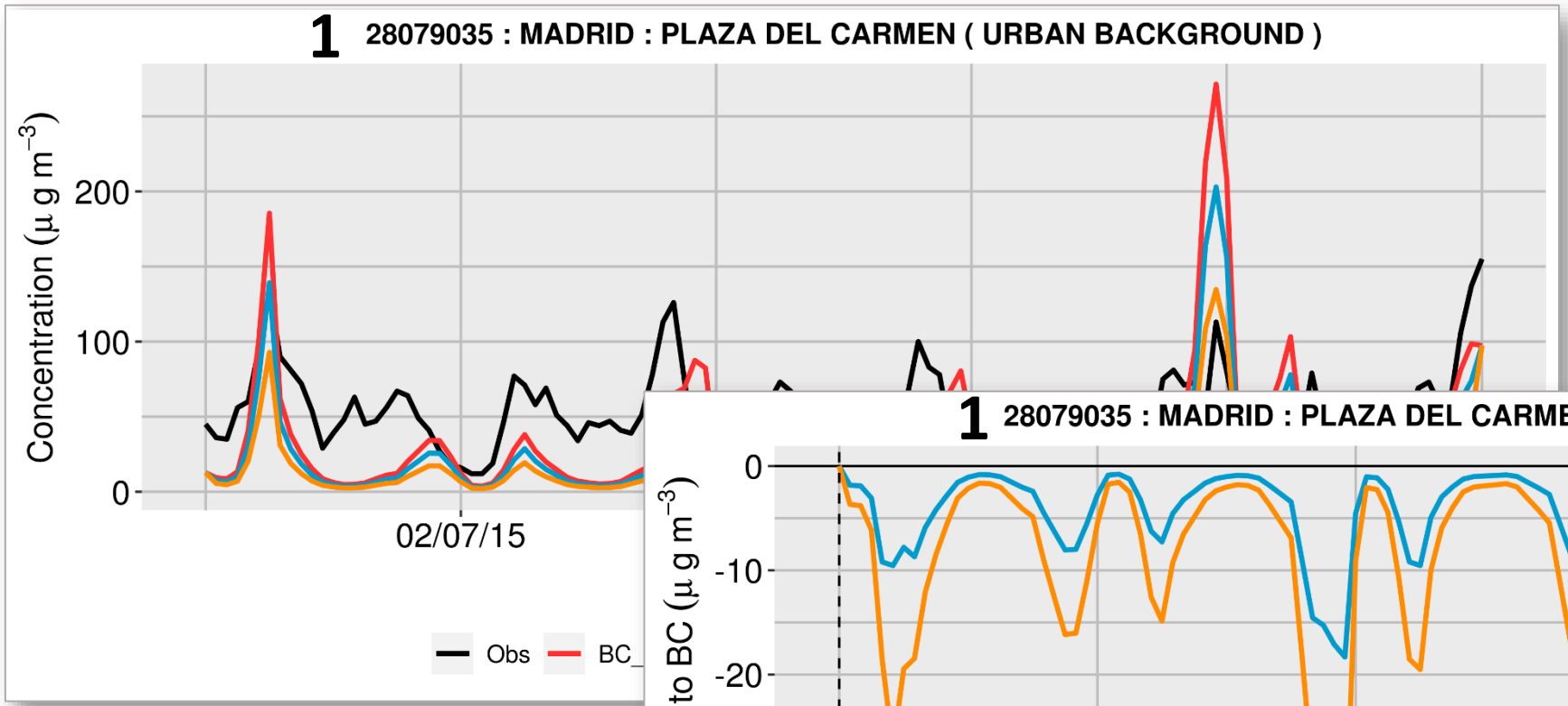
Increase in O_3

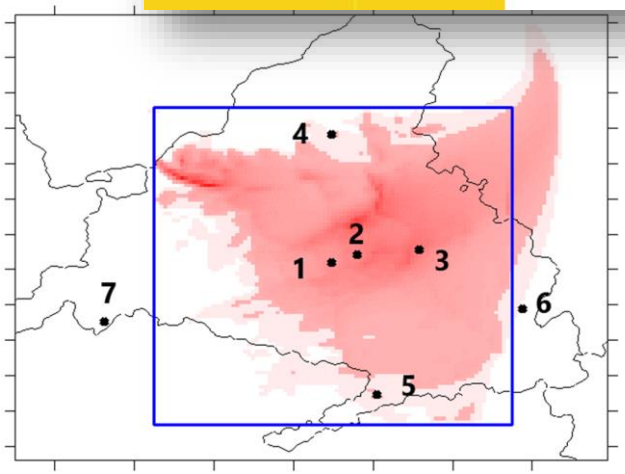
Decrease in NO_2

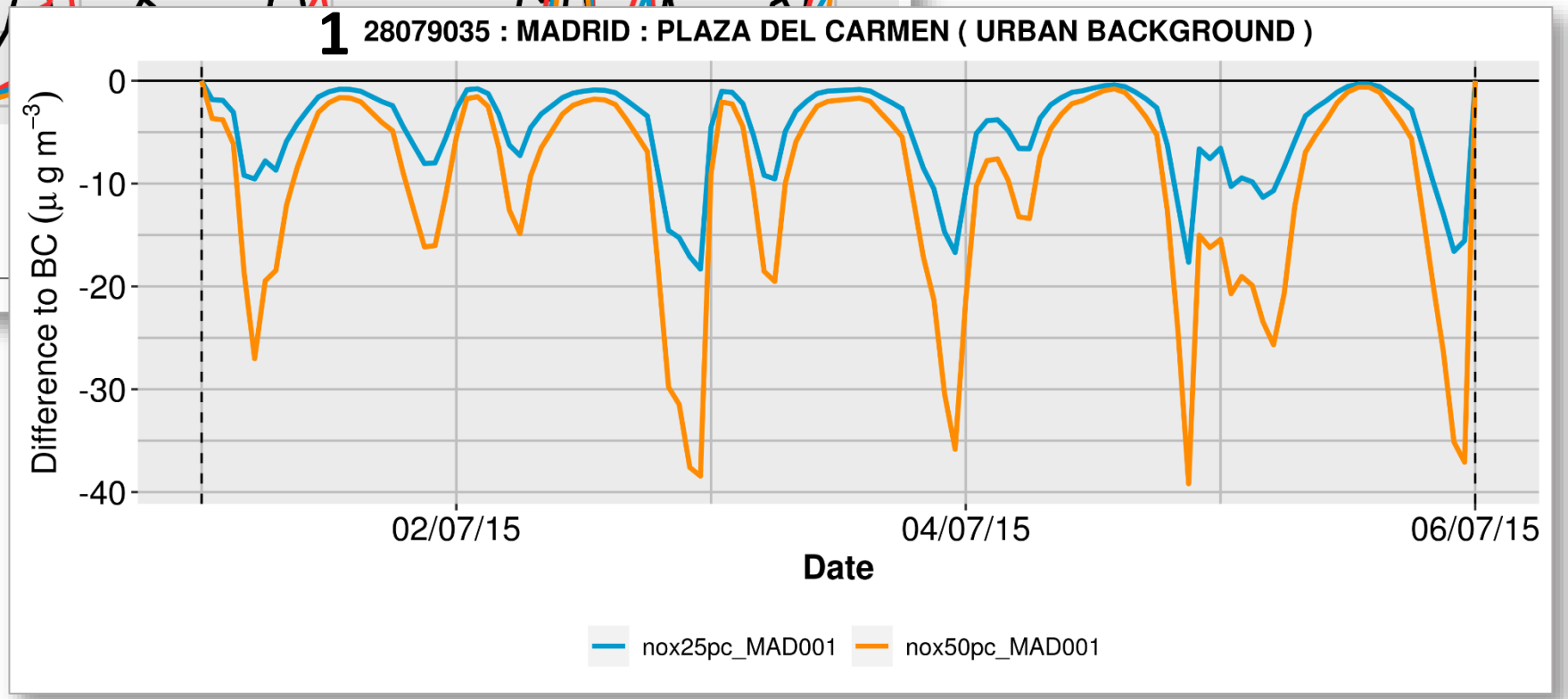
$$O_3 + NO \rightarrow NO_2 + O_2$$

Results: NO_2

Urban background

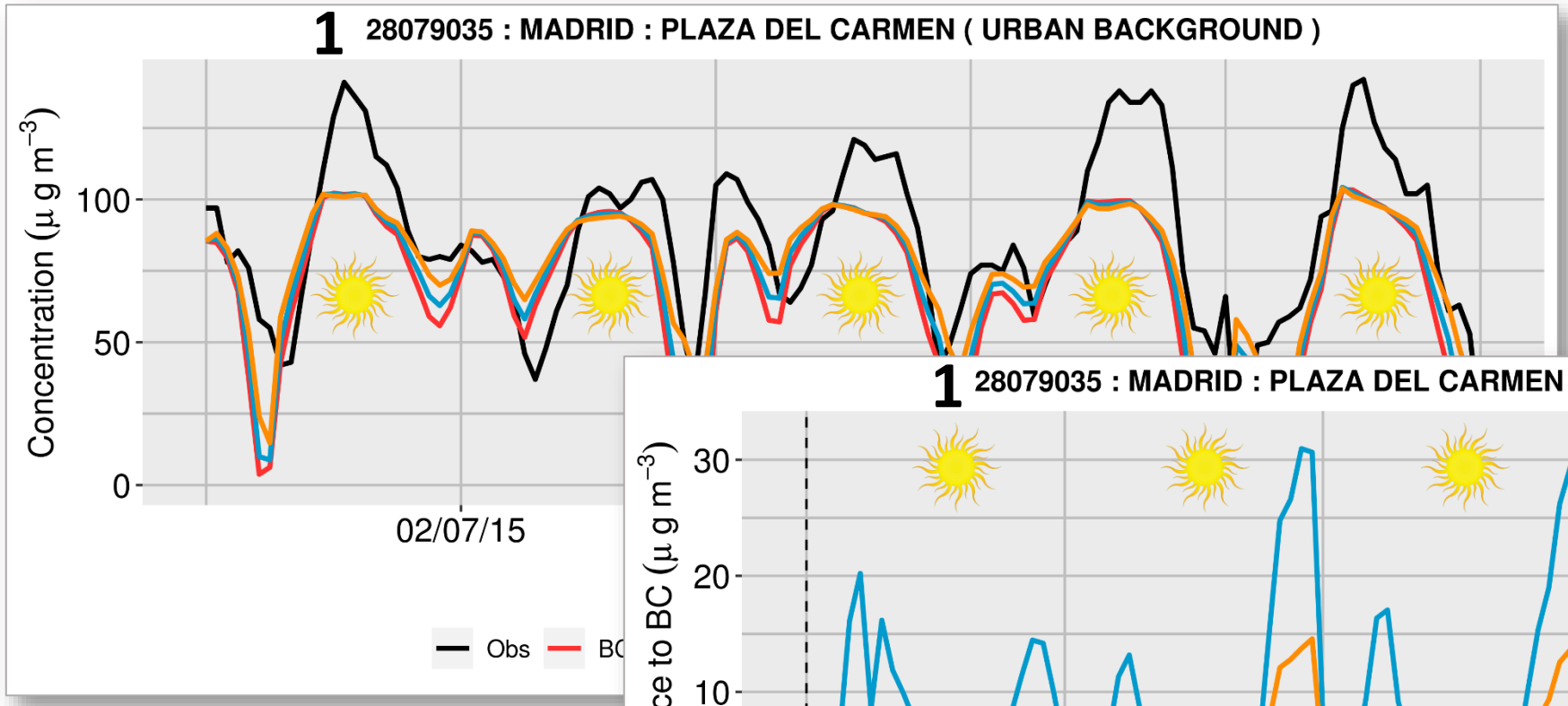


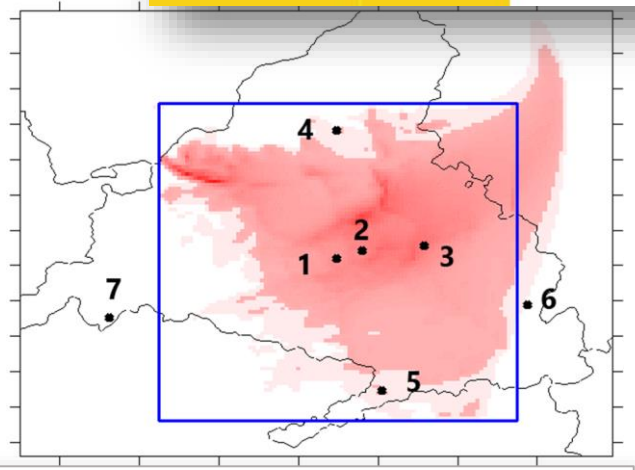


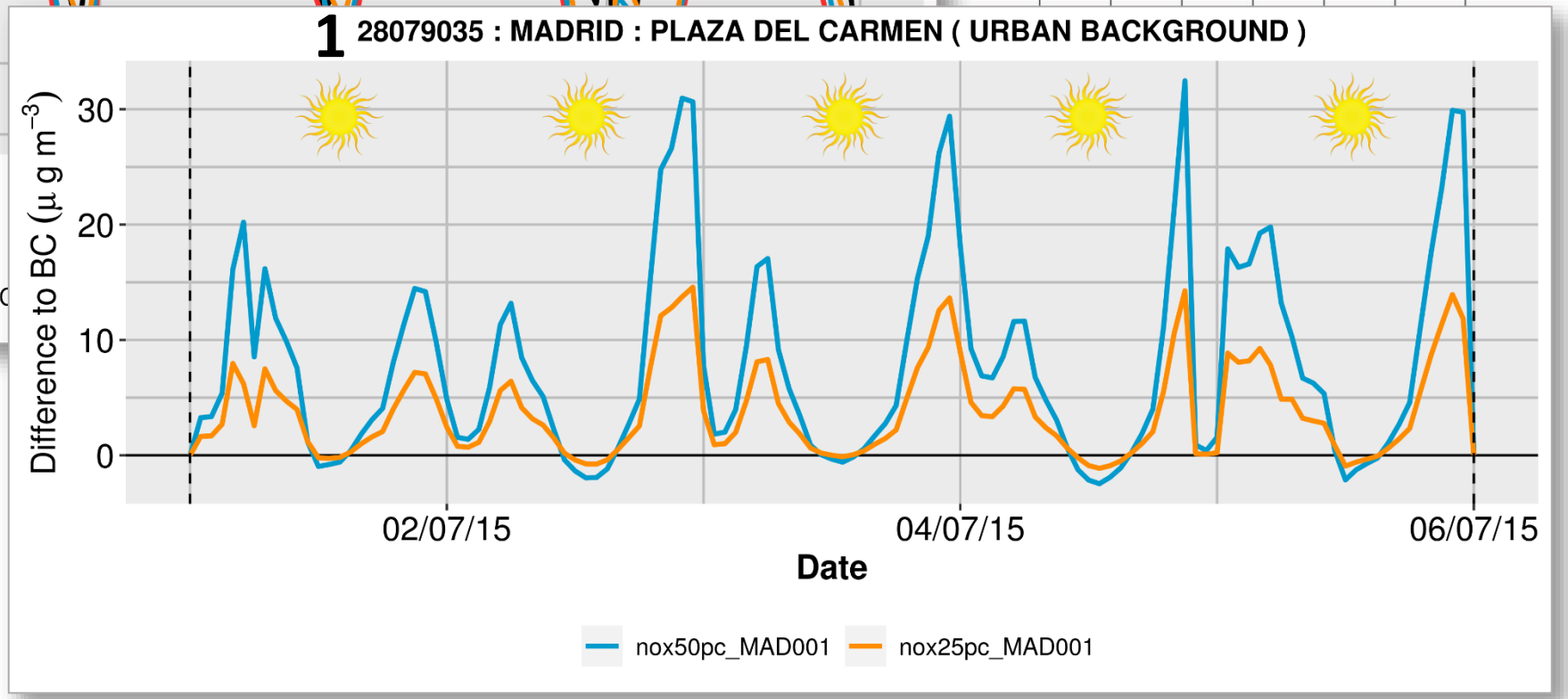


Results: O_3

Urban background



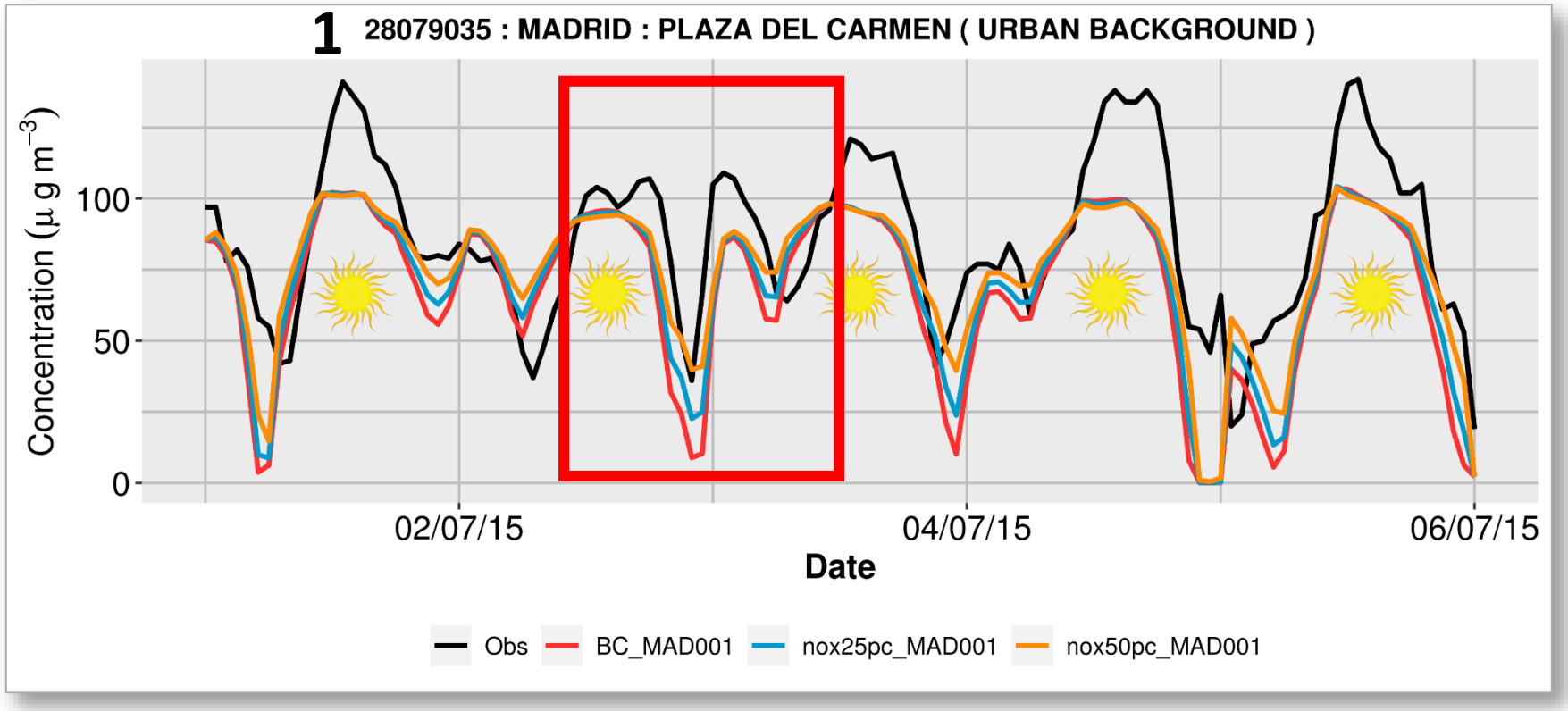


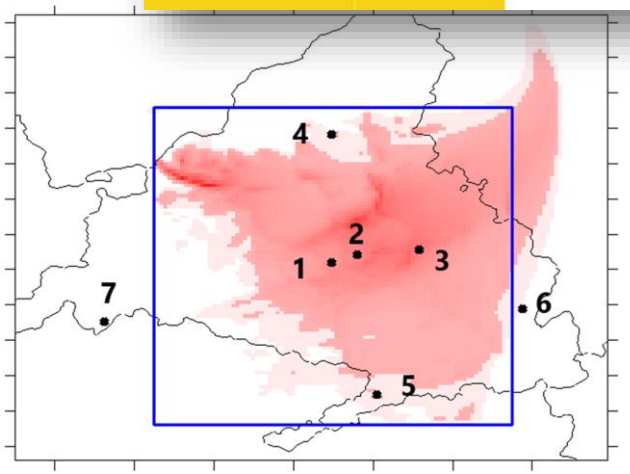


The greatest differences in concentration happen at night

Results: O_3

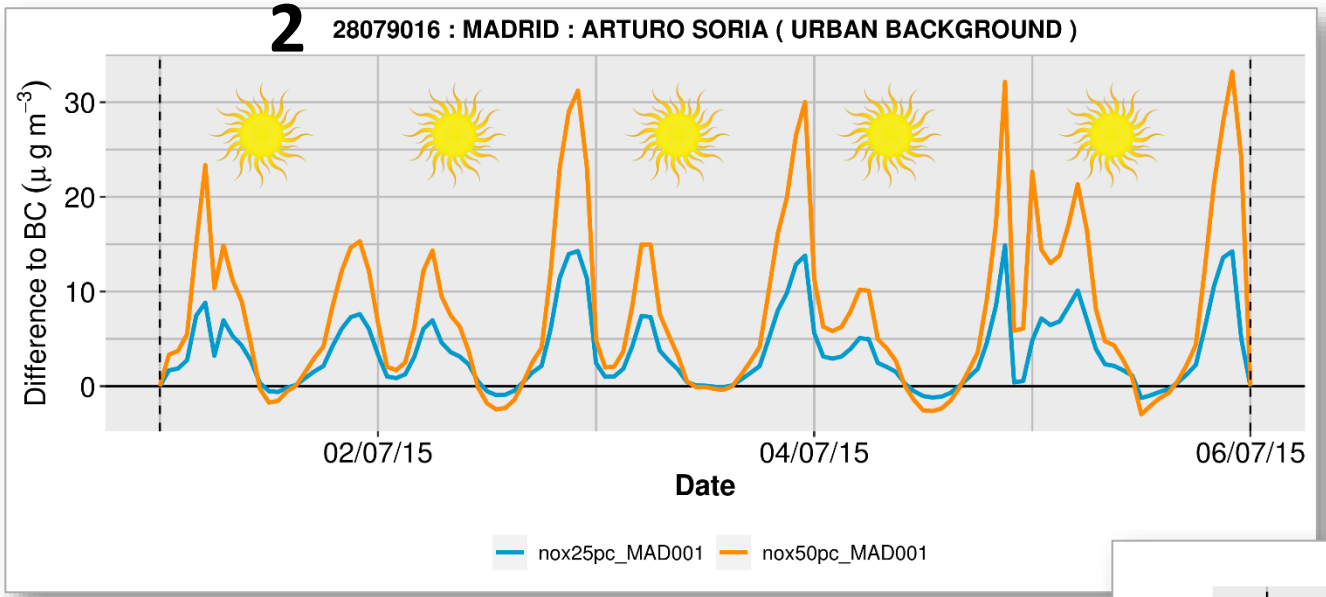
Urban background

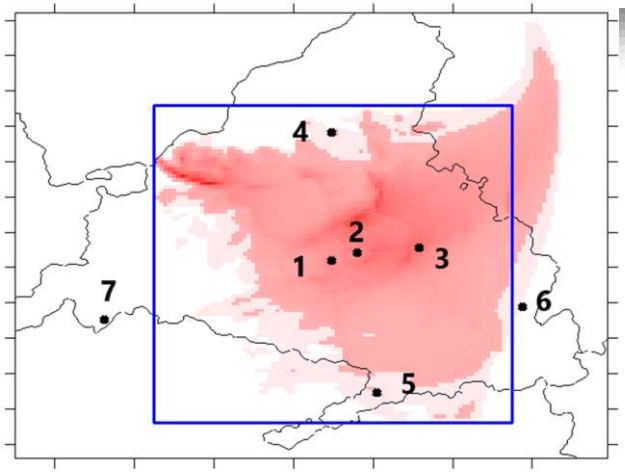




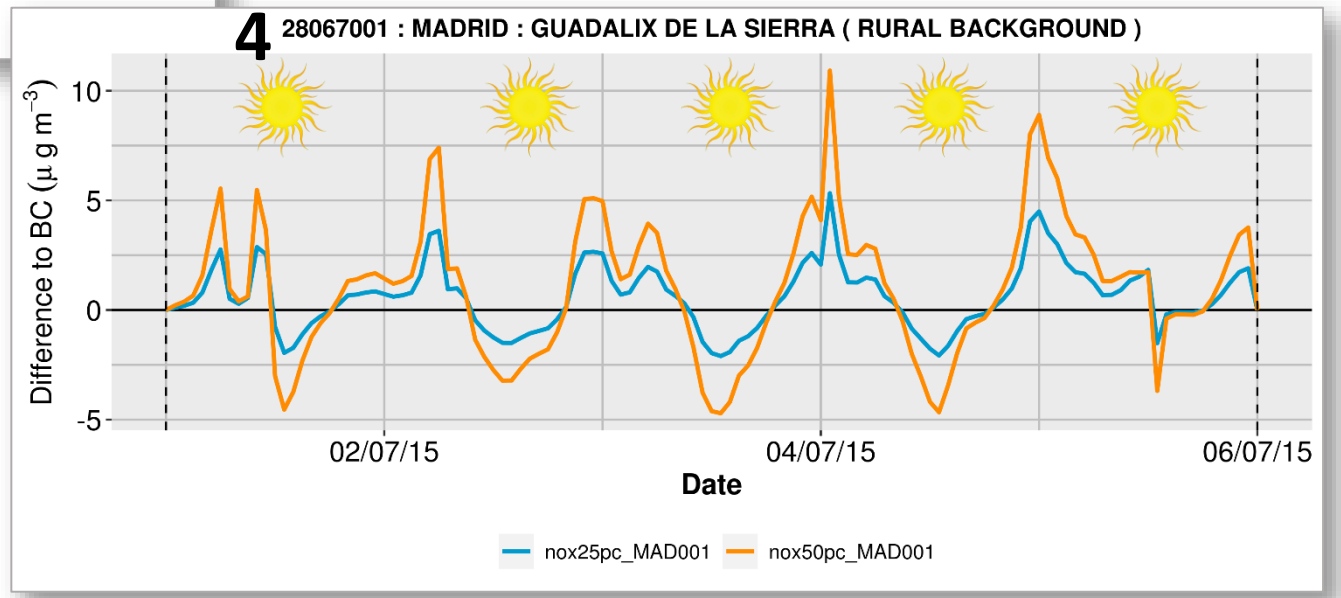
Results: O_3

Urban background





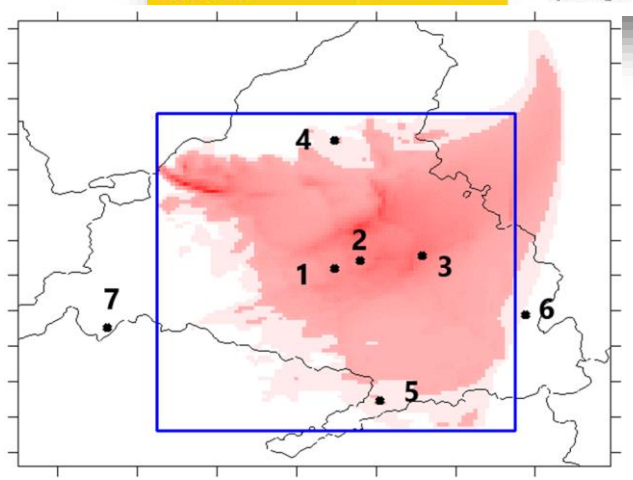
Rural background



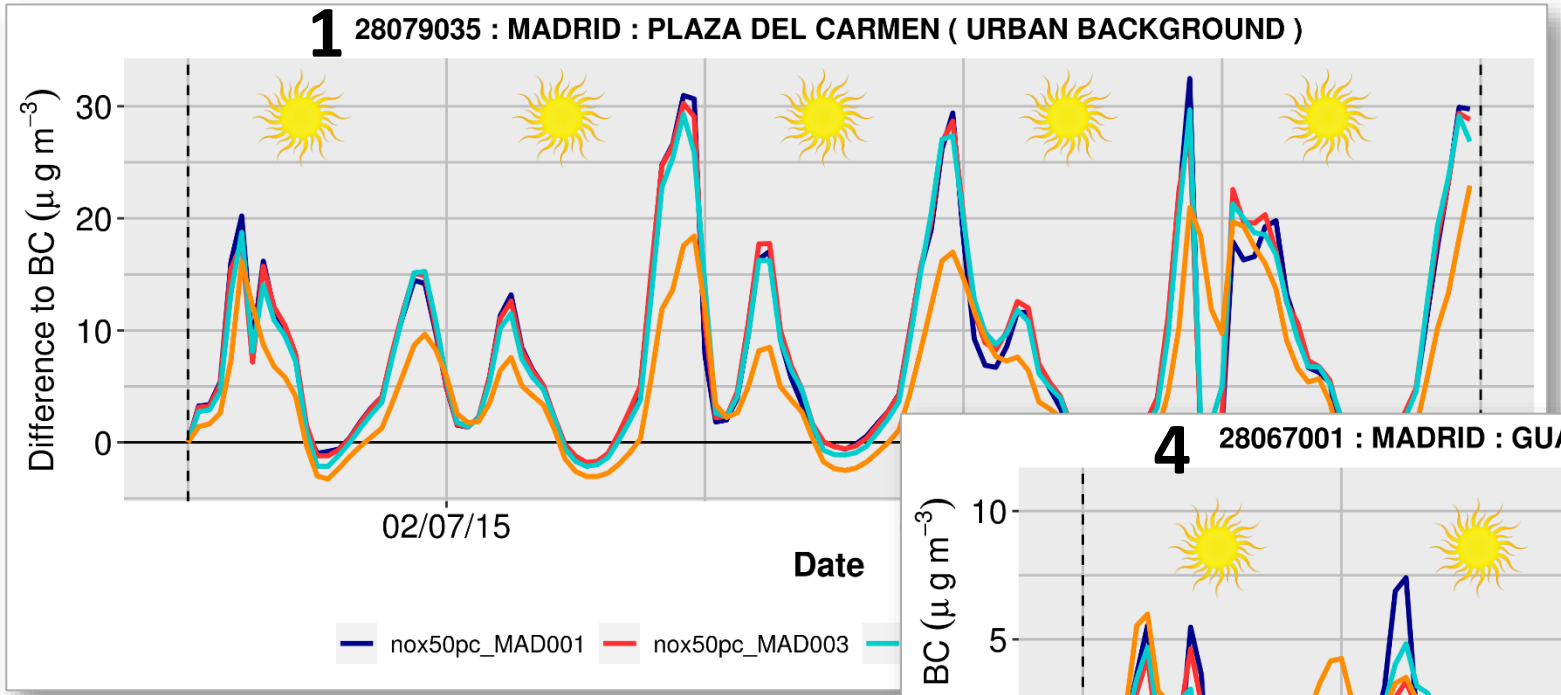
- The increase in concentration is greatest in urban areas.
- In rural areas the nocturnal increase is lower and the diurnal decrease is bigger.

Effect of spatial resolution on changes in O_3

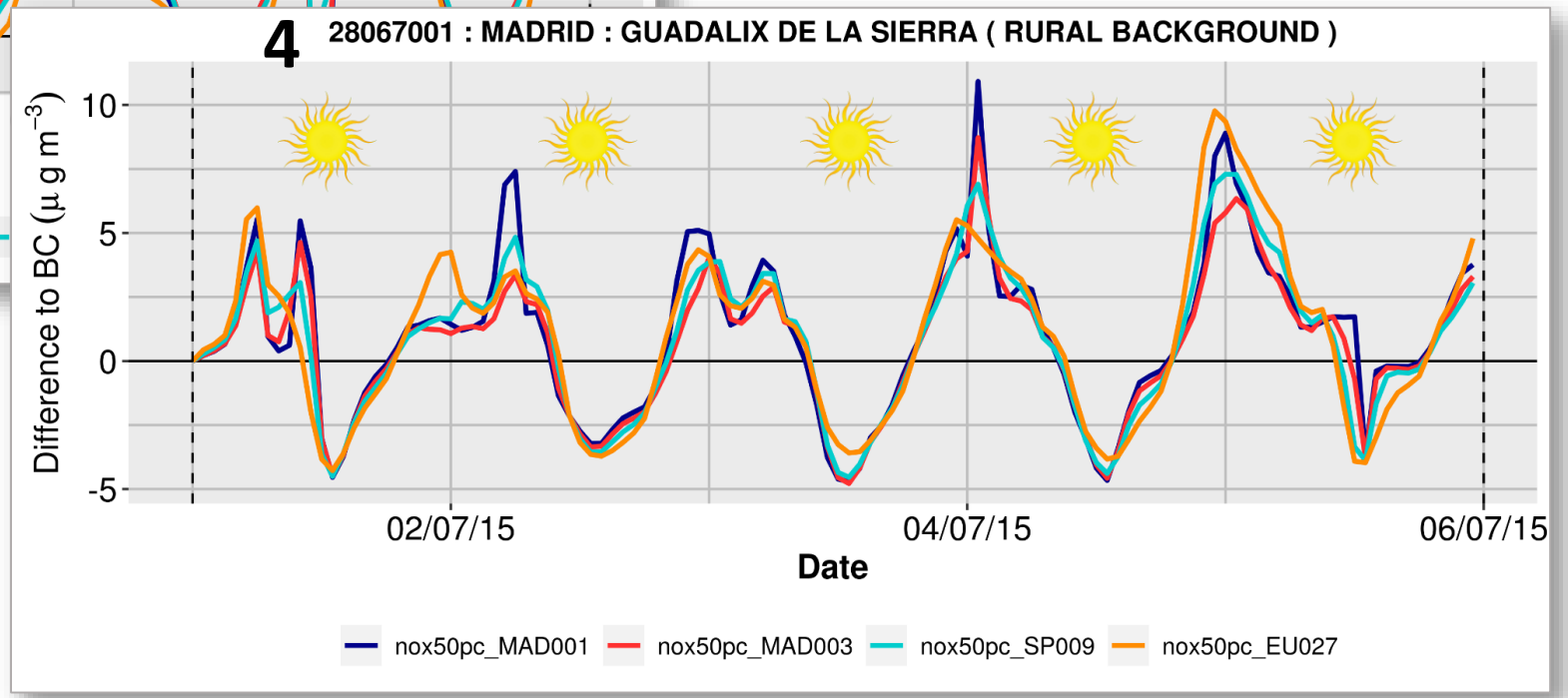
50% reduction of NOx



Urban background



Rural background



Conclusions and future work

- Reducing NOx emissions tends to increase nighttime O_3 concentrations substantially, especially in urban areas (NO titration)
- By contrast, reducing the emissions does not improve peak daytime values much in source areas (but it does outside the city)
- The effect of the emission reductions is consistent between the different spatial resolutions (except for the coarse-scale European domain.

Potential plans

- **Simulate the Madrid $PM_{2.5}$ episode (although we tend to underestimate)?**
- **Rerun the simulations with CHIMERE v2020?**
- **Simulate the full year 2015?**
- **Joint analysis with other studies (Madrid O_3 episode 2016, National Air Pollution Control Programme..)**

Thank you for your attention

Acknowledgments

Study funded by the Retos-AIRE project: *Ai**R** pollution mitigation actions for **E**nvironmen**T**al p**O**licy **S**upport. **AIR** quality multiscale modelling and evaluation of h**E**alth and vegetation impacts.*

We thank the Ministry for the Ecological Transition and Demographic Challenge (METDC) for the provision of the national emission and air quality monitoring data. We also acknowledge EMEP for providing European emission data. We are also grateful for the services offered by the European Center for Medium-Range Weather Forecasts (ECMWF), including the provision of meteorological modelling data with thanks also to AEMET for managing access to this information. Finally, we thank the Ministry of Science and Innovation for financing the Retos-AIRE project (Plan Nacional I+D+i RTI2018-099138-B-100).