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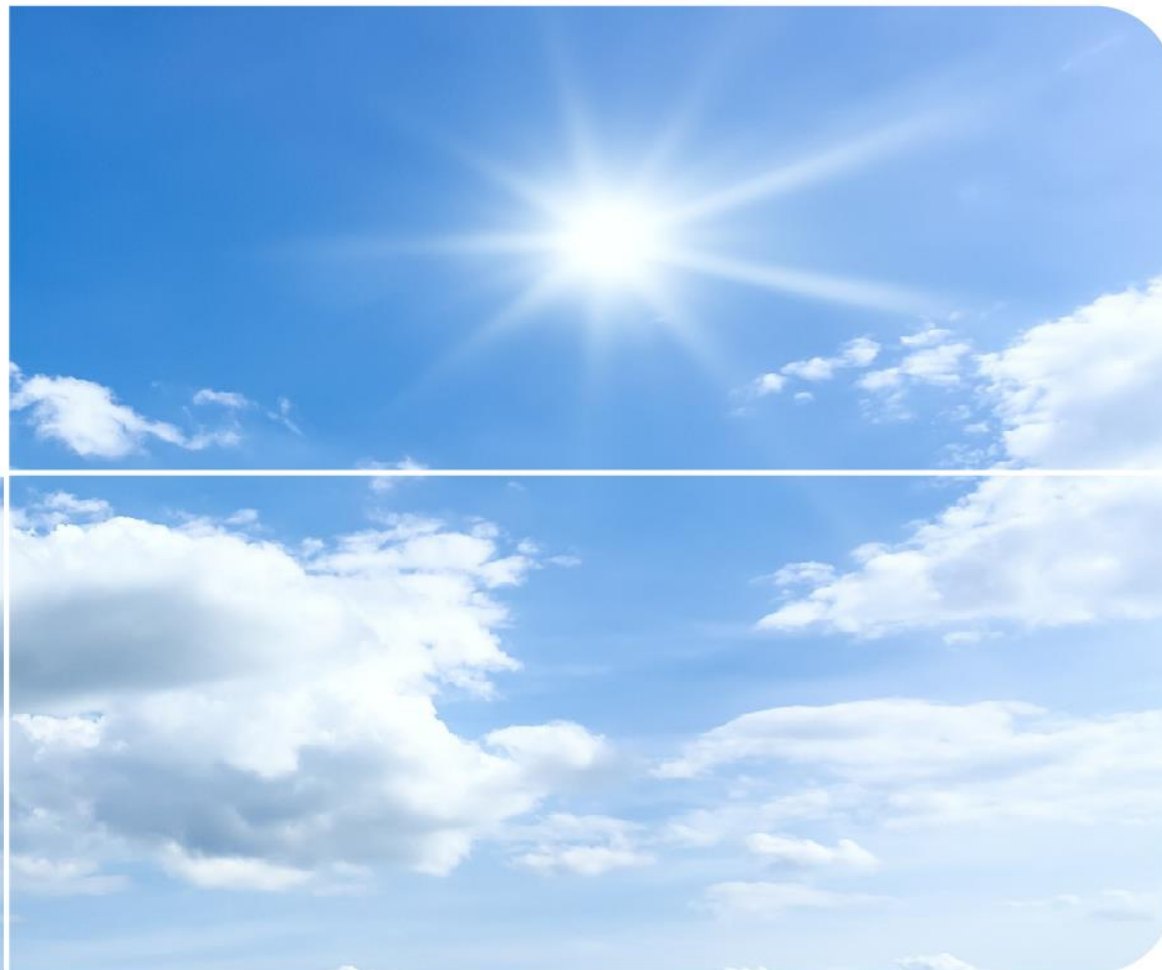
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EU FOR BETTER ENVIRONMENT



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Air pollutant dispersion modelling results for Serbia

Elsa Real, INERIS

Presentation Outline

01

Methodology

02

**Modeling air
pollutant in Serbia
for the reference
year (2015)**

03

**Air pollution in
Serbia in 2030:
prospective
scenarios**

04

**Conclusions .. And
next steps**



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01

Methodology



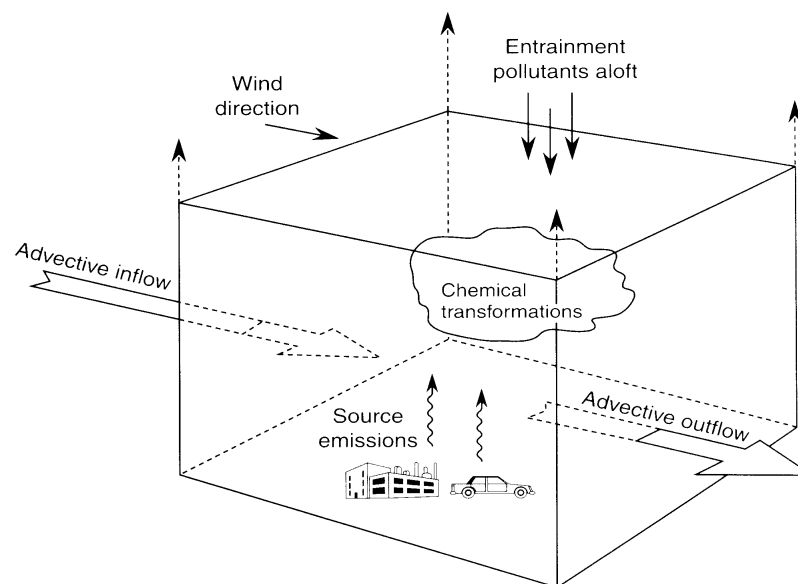
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CHIMERE : Regional Chemistry Transport Model *developed by the CNRS and INERIS (Mailler et al., 2017)*

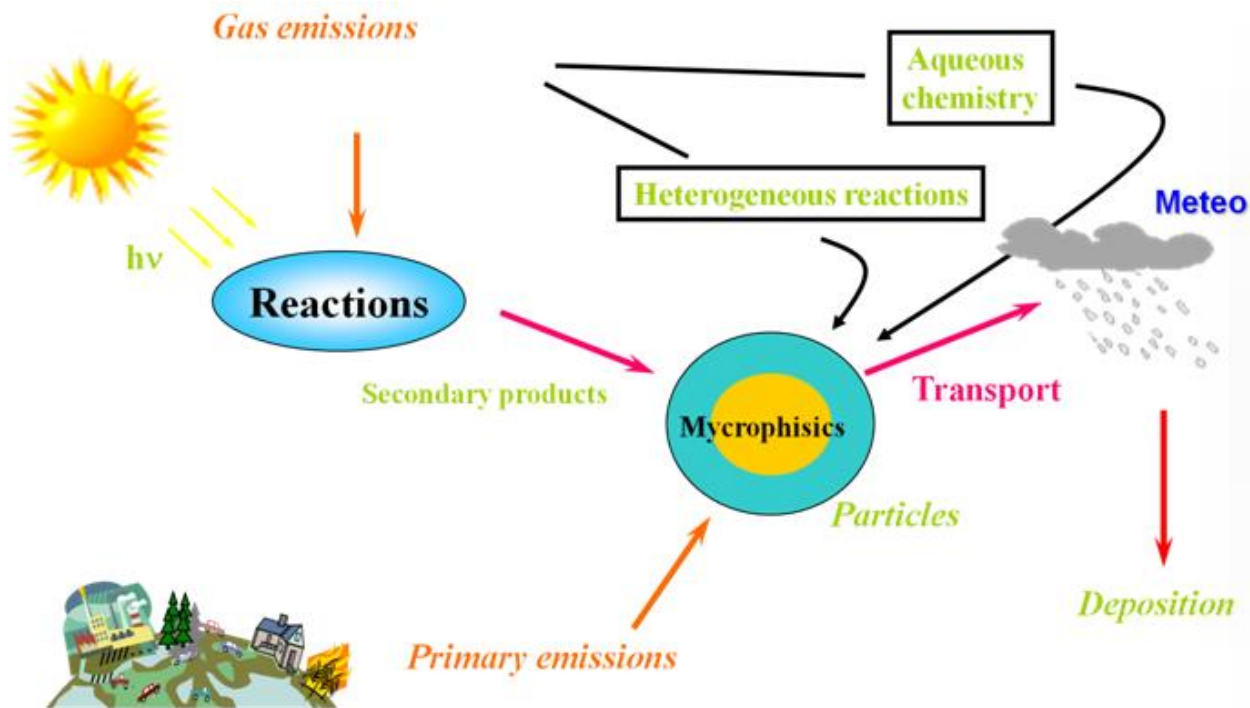


CHIMERE reproduce the photochemical activity in the low troposphere:

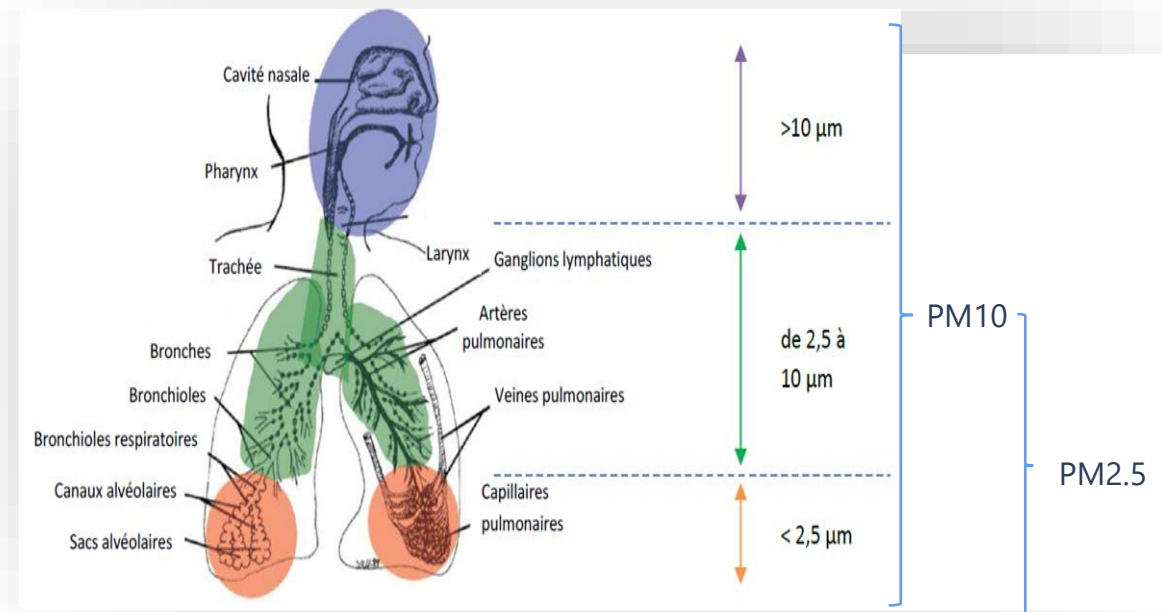
- More than 80 gaseous species and 300 chemical reactions
- Aerosol module: nucleation, coagulation, condensation/evaporation

Focus on aerosol

Aerosols can be directly emitted (primary particles) or form in the atmosphere from gaseous precursors (mainly NO_2 , SO_2 , NH_3 and NMVOC).

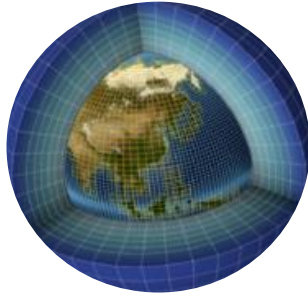


Strong heterogeneity of particles size in the atmosphere. The smaller the particles, the greater their impact on health.



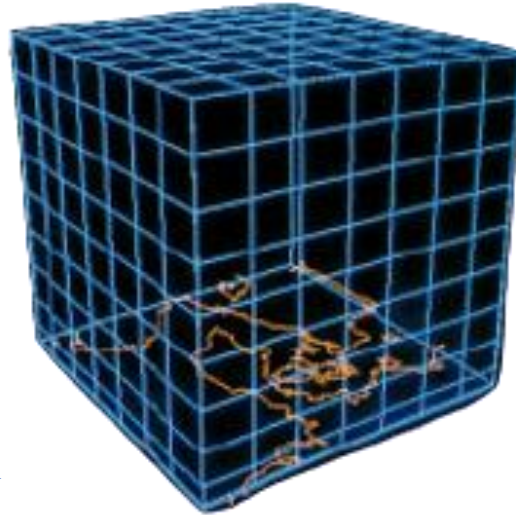
Input data for CHIMERE

Global Chemistry:
Boundary conditions
from global MACC
concentrations



Regional Meteorology:
3D meteorological driver:
IFS data provided by ECMWF,
the European Meteorological
Center

CHIMERE : Regional Chemistry
Transport Model



**Surface emissions of pollutant :
Anthropogenic**



Specific inventory over Serbia
developed for this project (annual
emissions + temporalization)

+

EMEP inventory (officially reported
inventory) outside Serbia

Biogenic

Model internal emission inventory



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Two nested domains

- EUROPE-domain: ($\approx 25\text{km} \times 50\text{km}$)
- SERBIA-domain ($\approx 5\text{km} \times 5\text{km}$)



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02

**Modeling air
pollutant in Serbia
for the reference
year (2015)**



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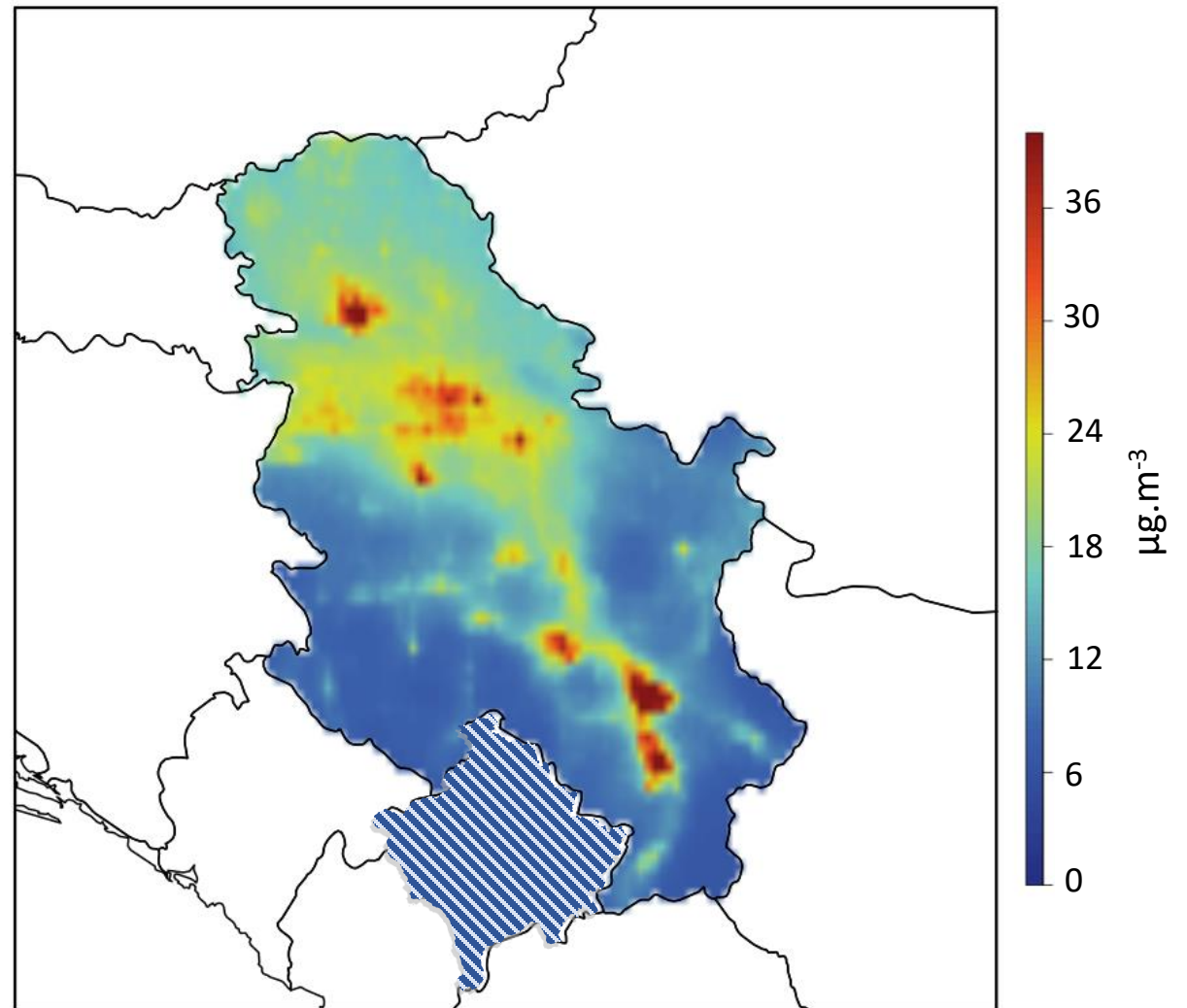


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PM10

Modelled concentrations

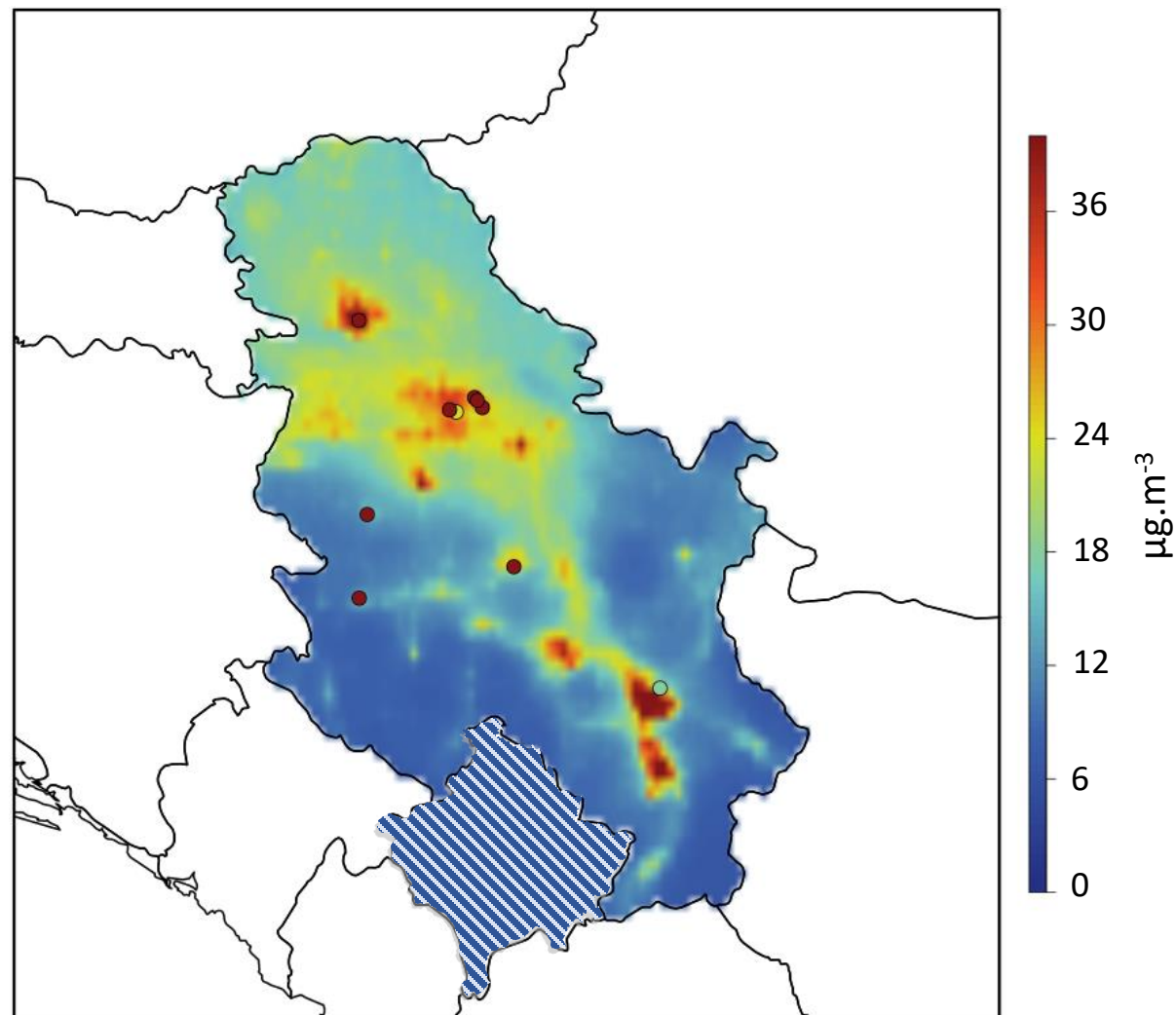


PM10

Modelled concentrations

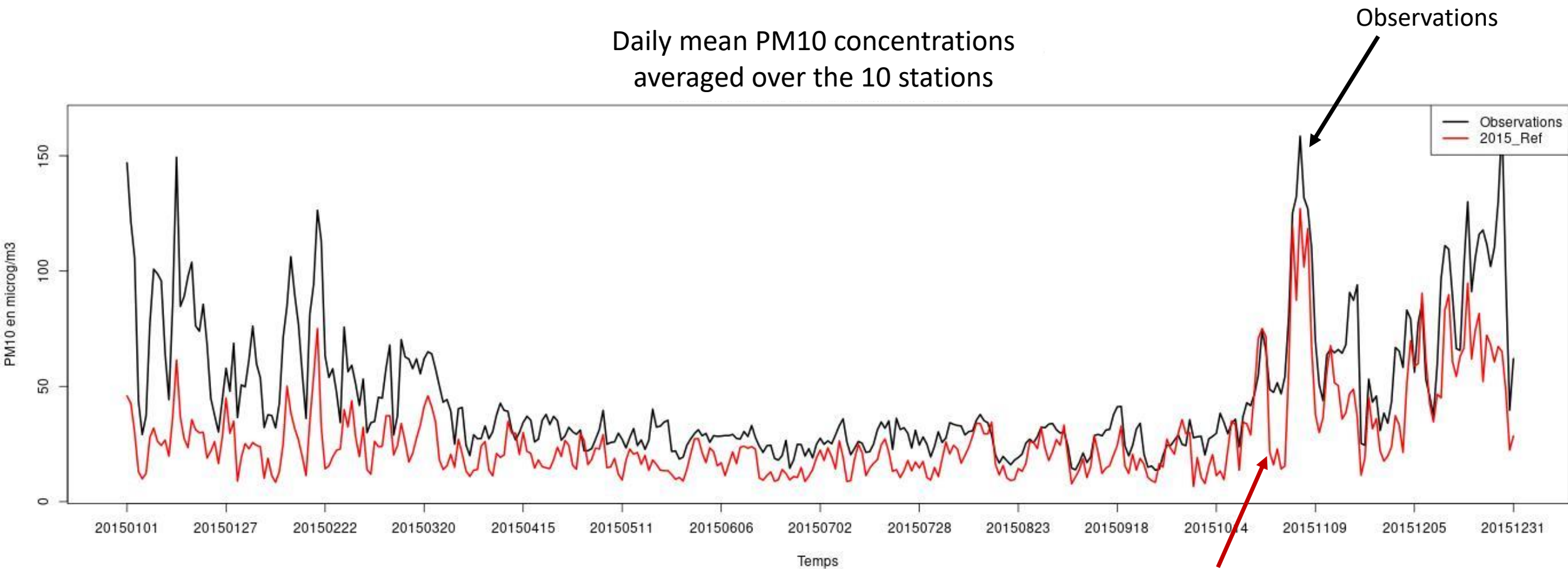
+

Observations at the
measurement stations (10
stations)



PM10: Observations vs Modeling

Daily mean PM10 concentrations
averaged over the 10 stations



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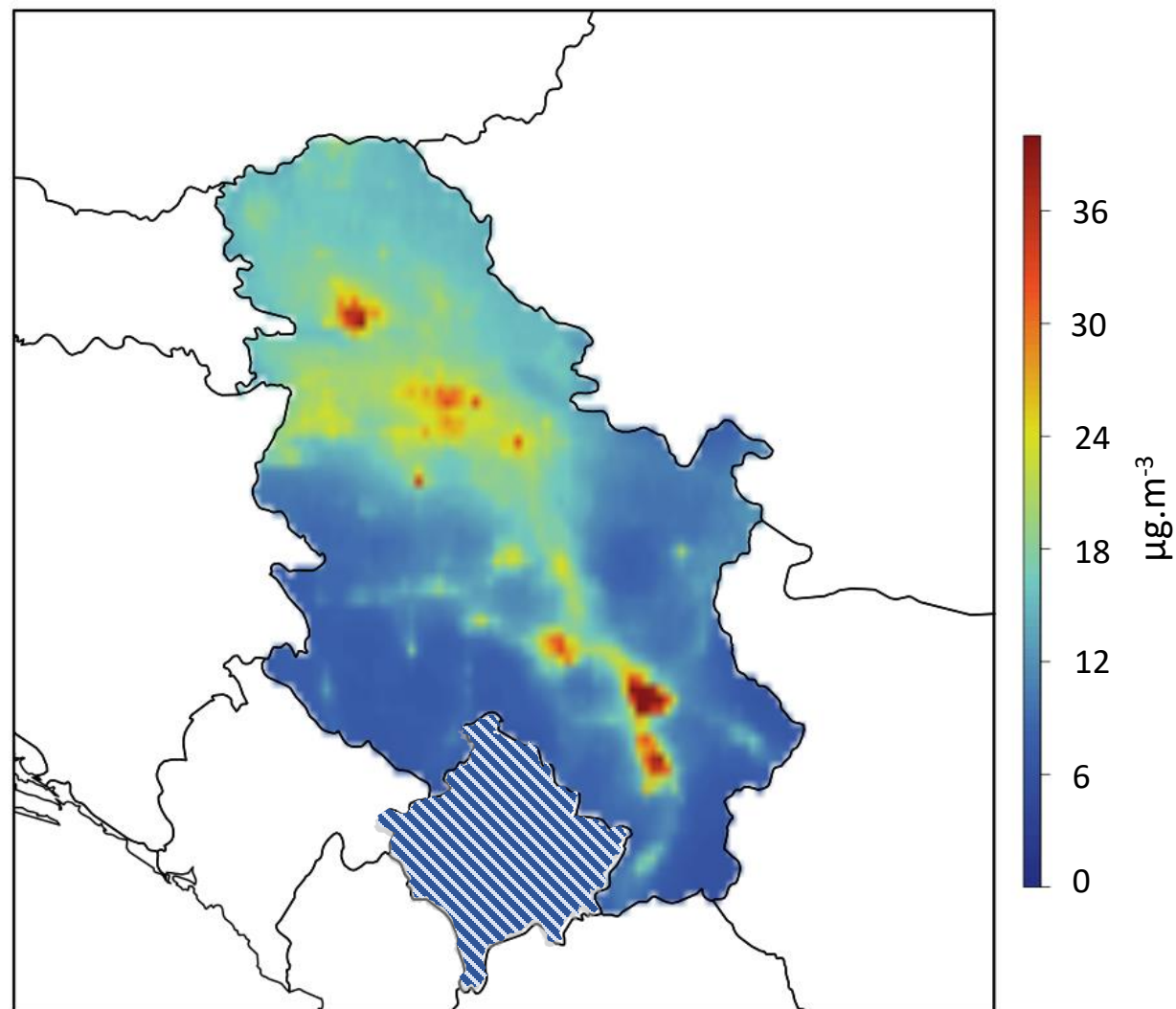


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PM2.5

Modelled concentrations



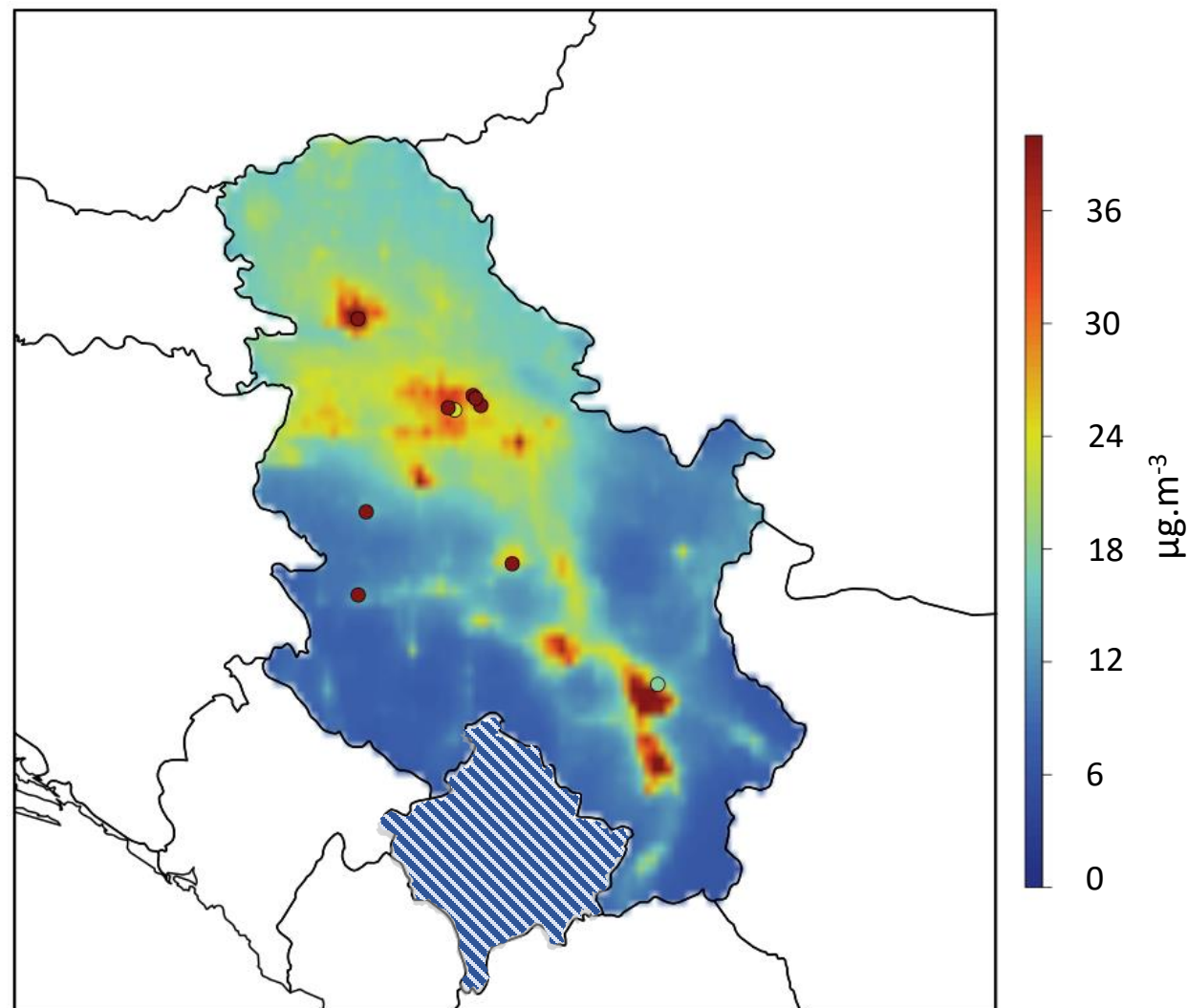
PM2.5

Modelled concentrations

+

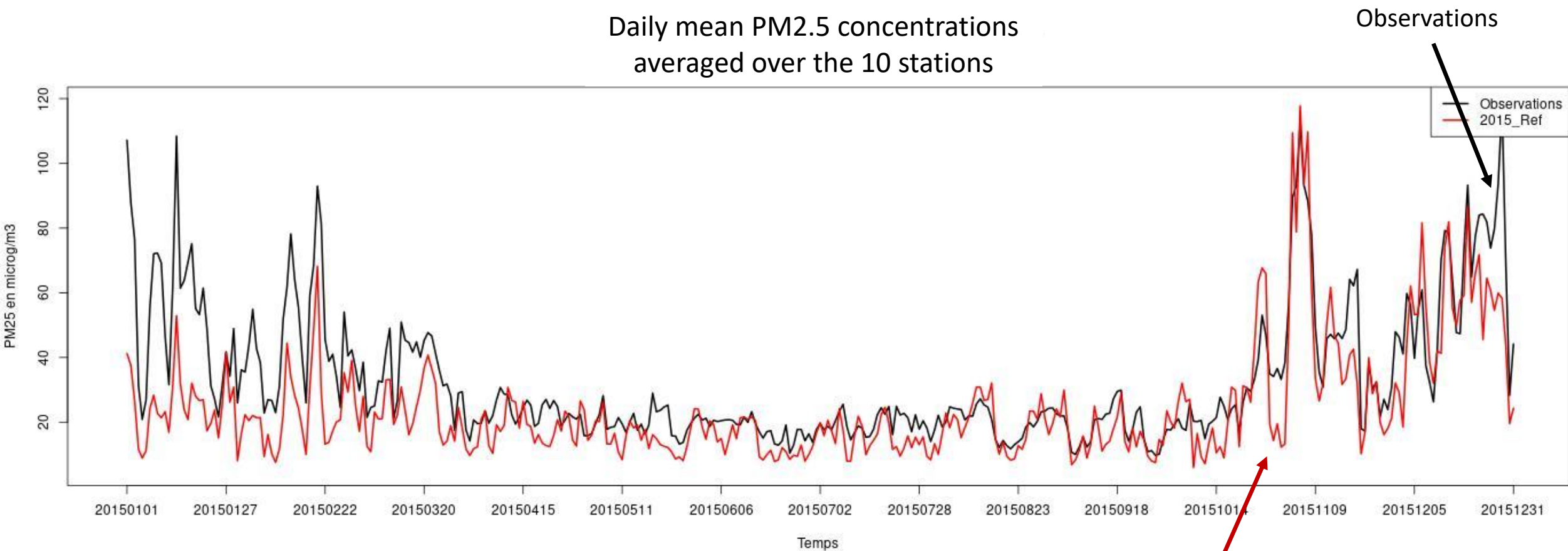
Observations at the
measurement stations (10
stations)

There were no measurement of PM2.5 over Serbia in 2015. PM2.5 “virtual” observations has been created based on PM10 measurements and PM2.5:PM10 measured ratio at those stations on a more recent period (2016-2020)



PM2.5: Observations vs Modeling

Daily mean PM2.5 concentrations
averaged over the 10 stations



Modelled
concentrations



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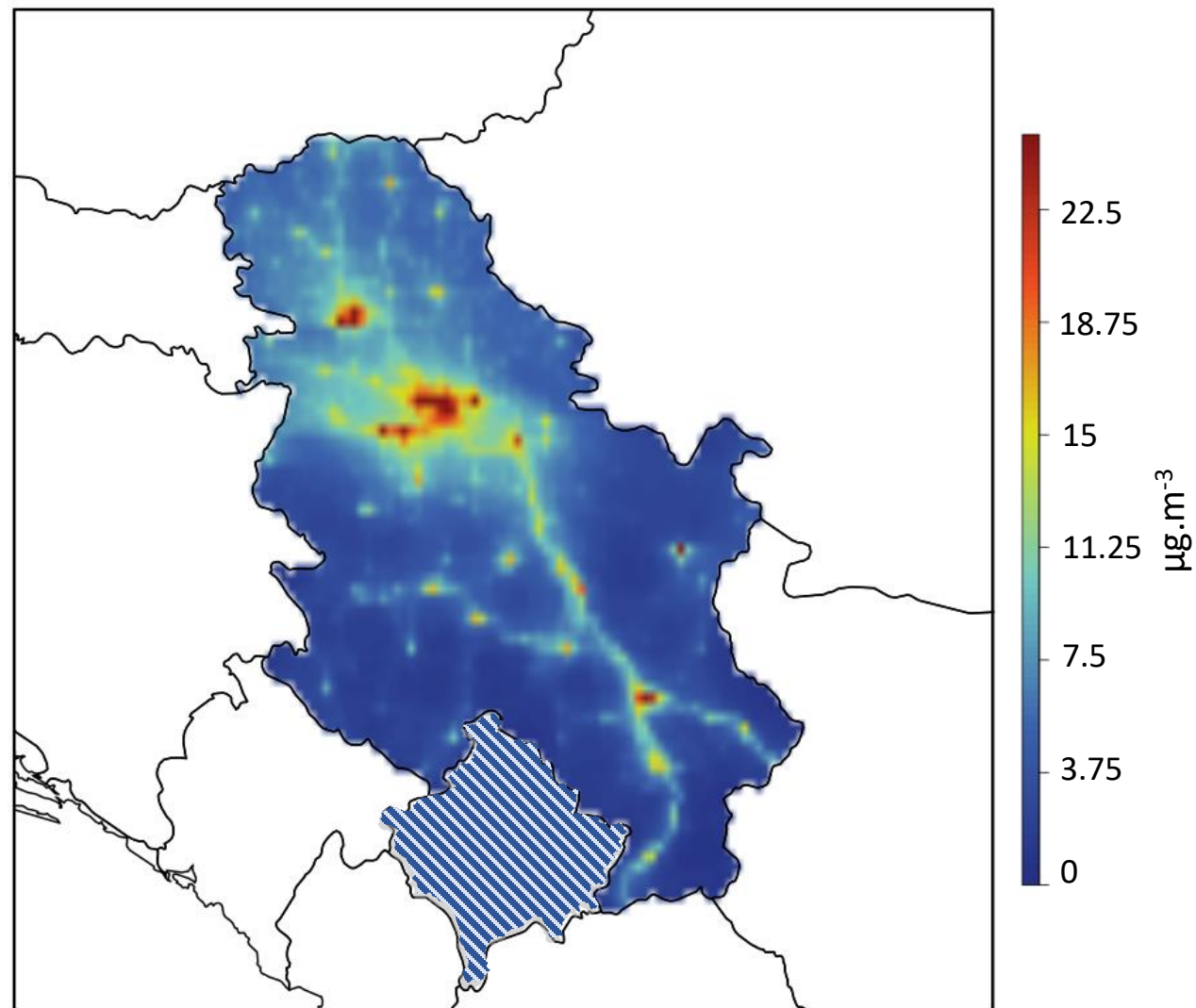


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NO₂

Modelled concentrations



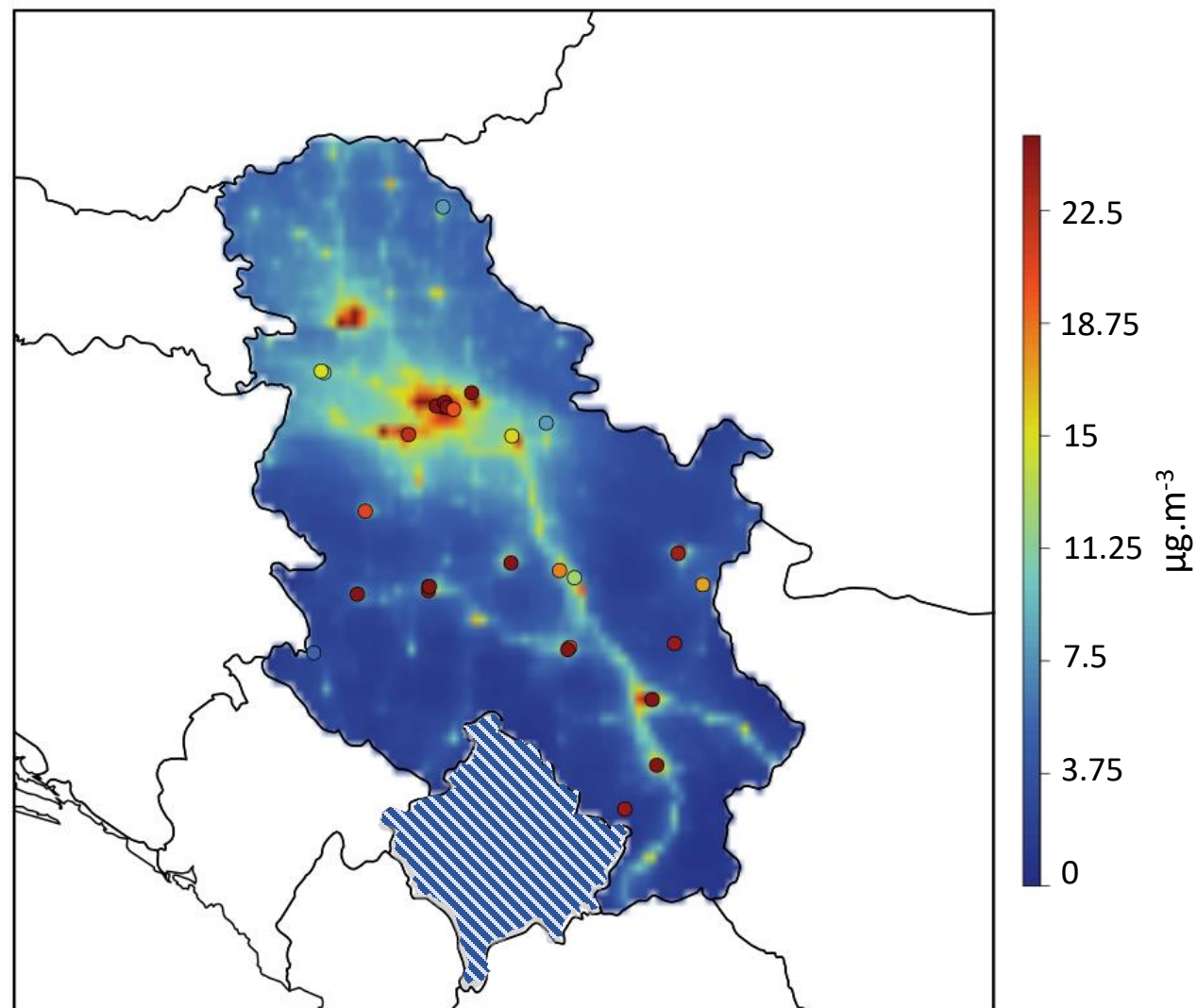
NO₂: Modeling of the reference year 2015

NO₂

Modelled concentrations

+

Observations at the
measurement stations (28
stations)



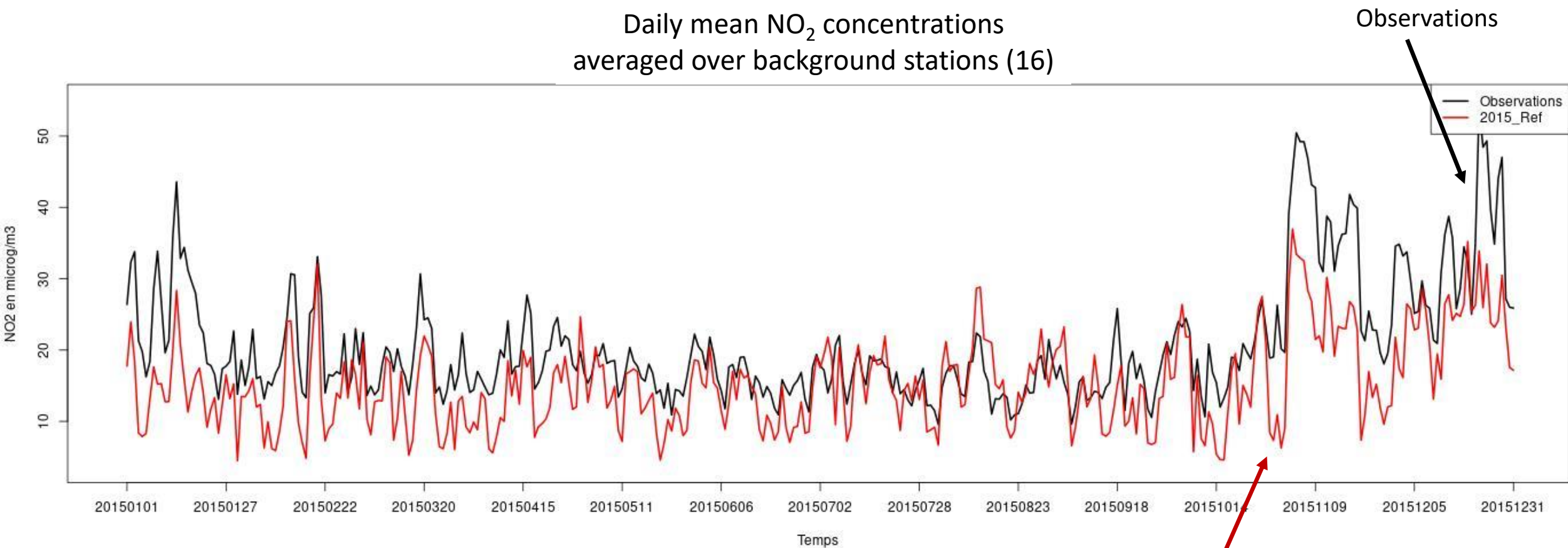
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NO₂: Observations vs Modeling

Daily mean NO₂ concentrations
averaged over background stations (16)



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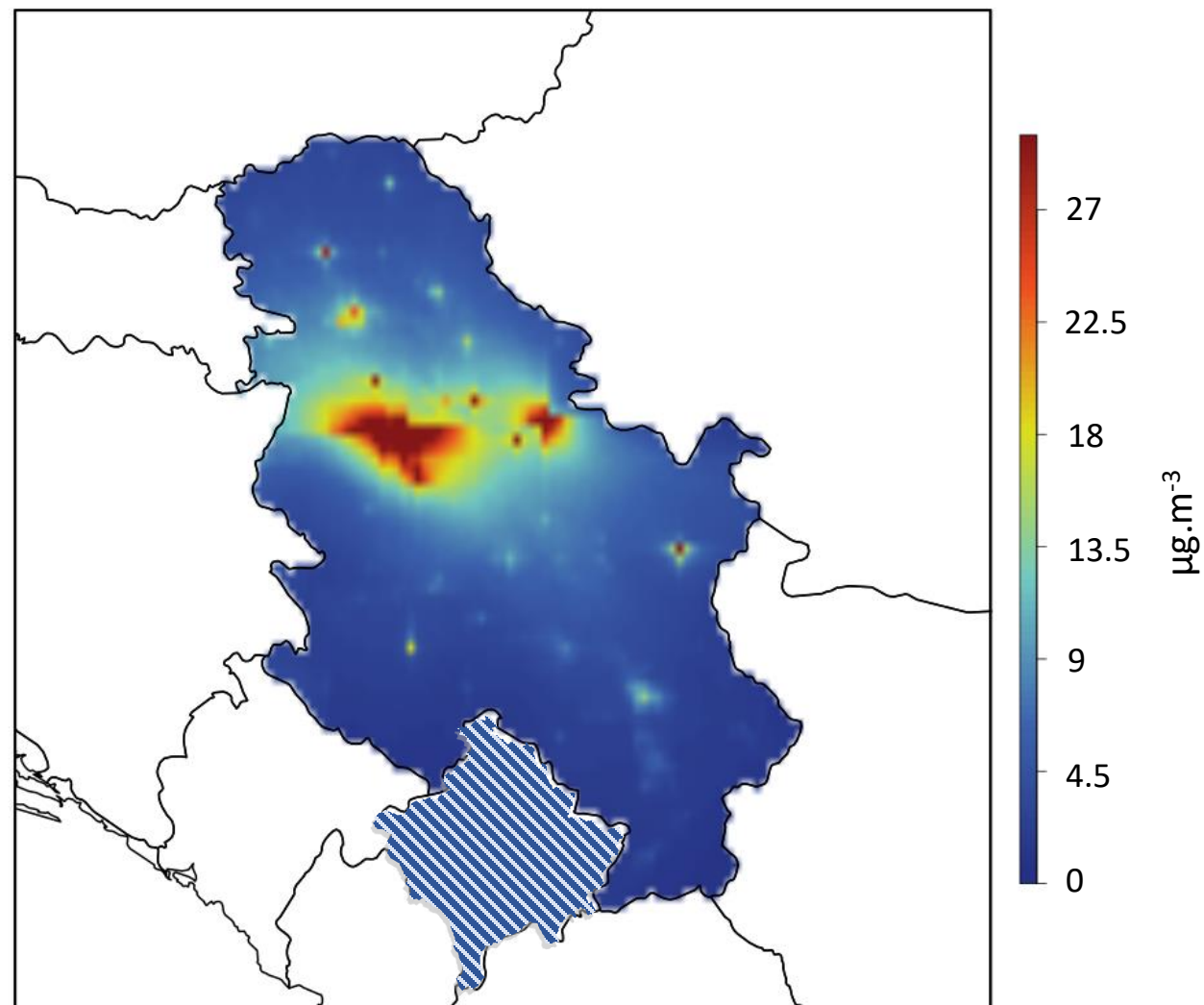
Modelled
concentrations

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SO₂: Modeling of the reference year 2015

SO₂

Modelled concentrations



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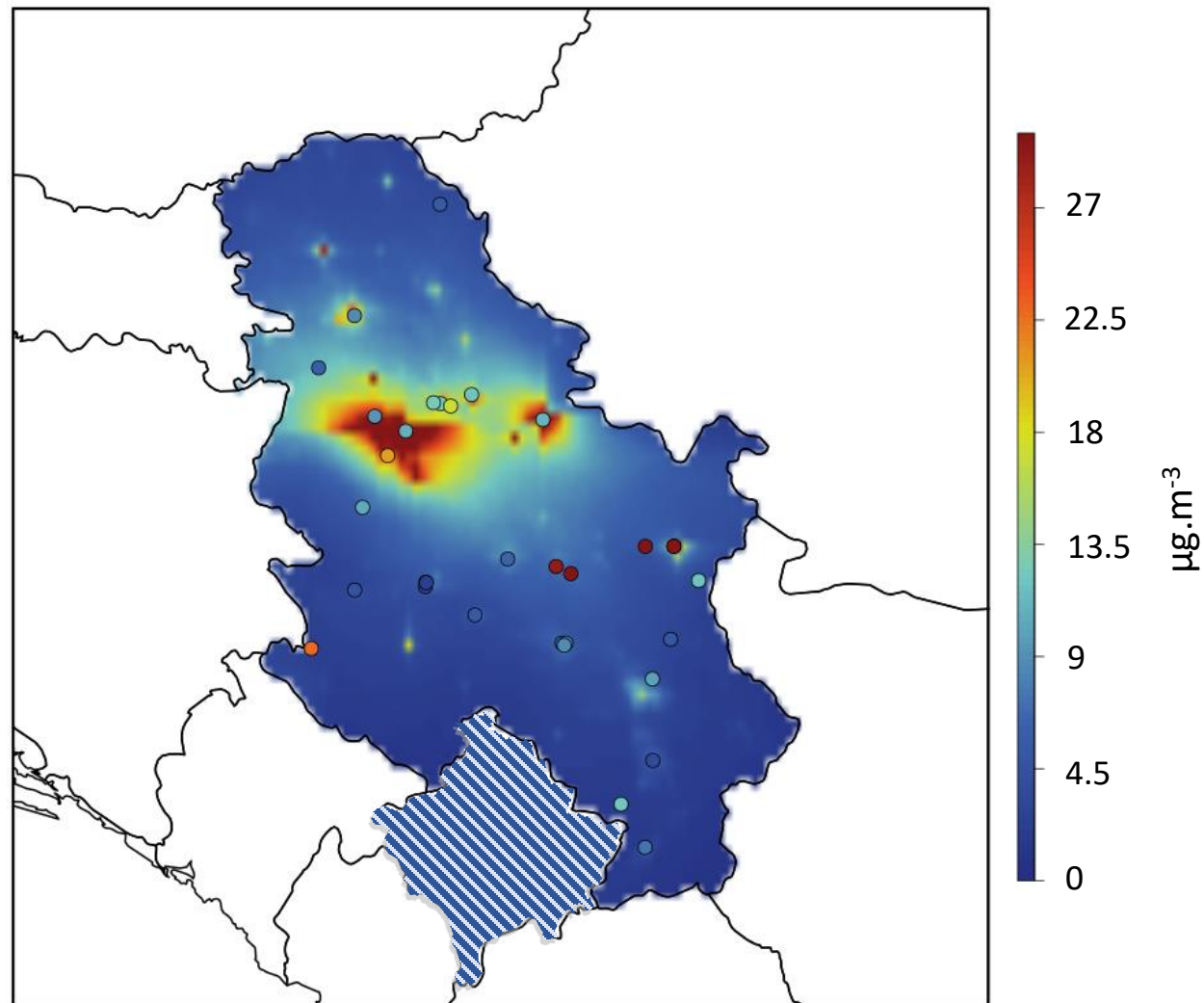
SO₂: Modeling of the reference year 2015

SO₂

Modelled concentrations

+

Observations at the
measurement stations (34
stations)



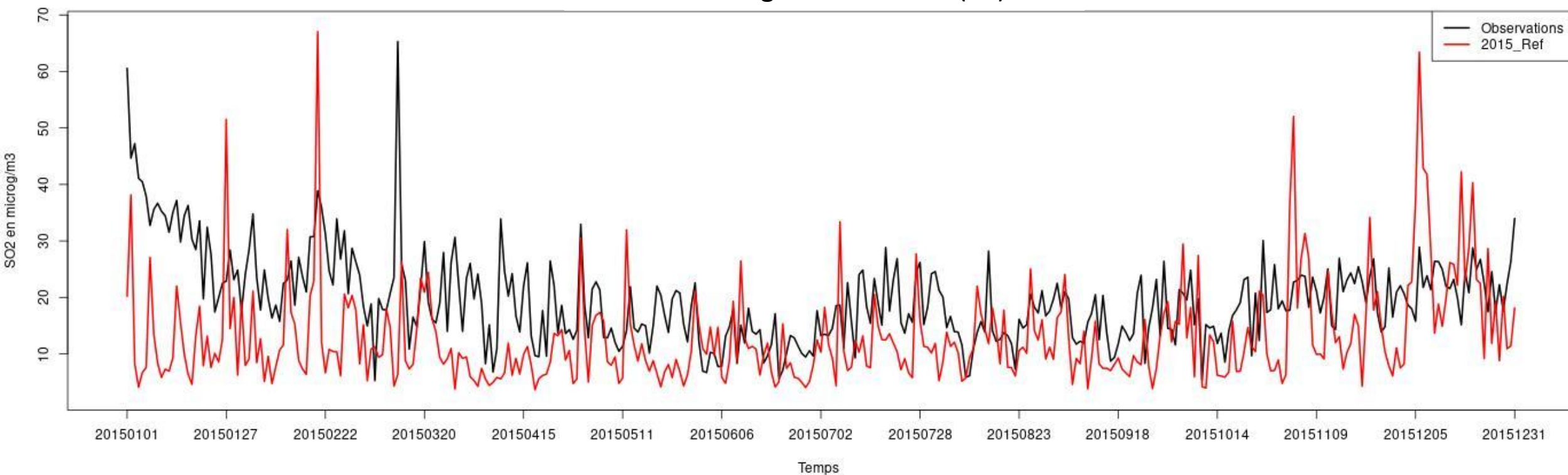
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SO₂: Observations vs Modeling

Daily mean SO₂ concentrations averaged
over background stations (17)



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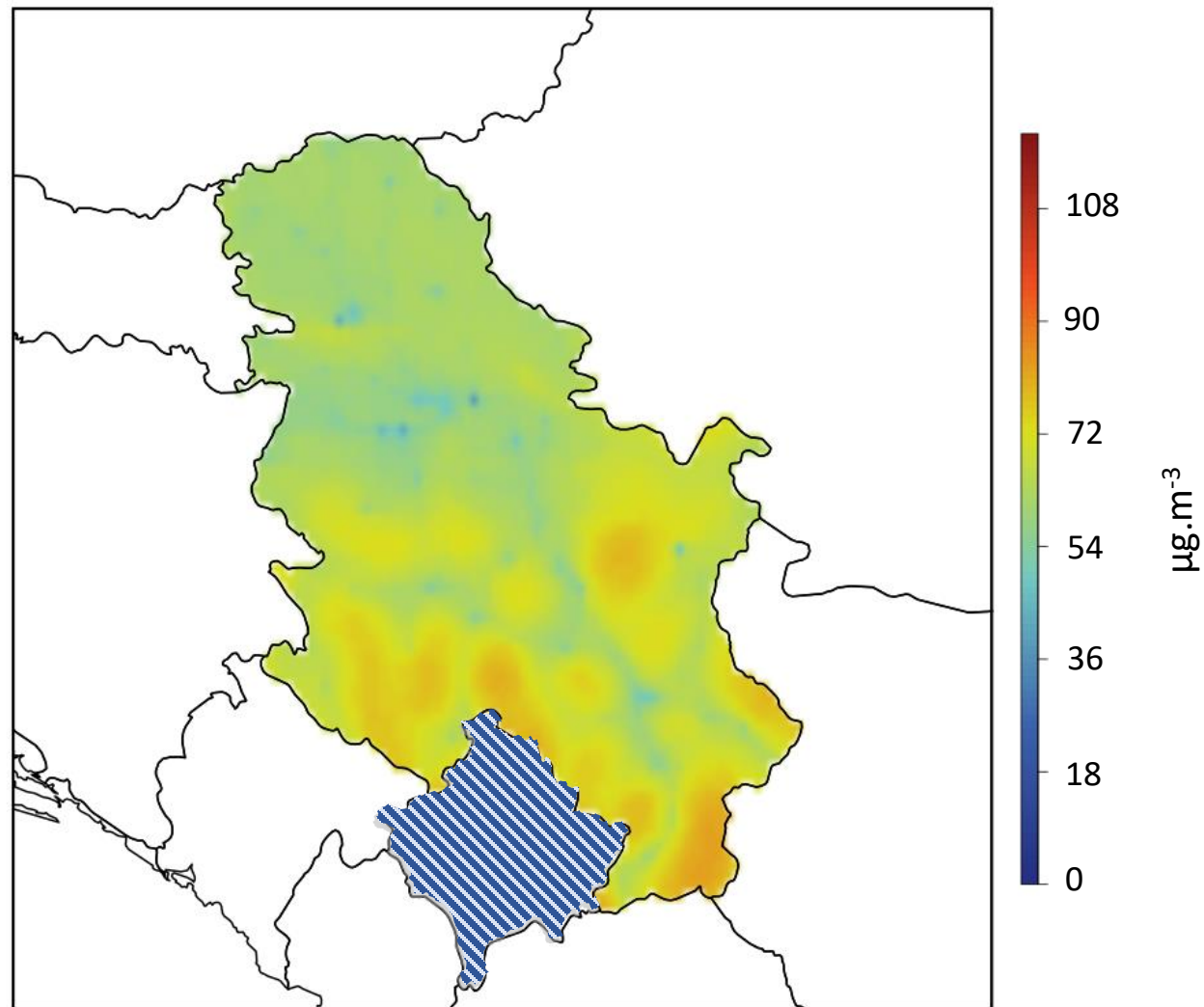
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O₃: Modeling of the reference year 2015

O₃

Modelled concentrations



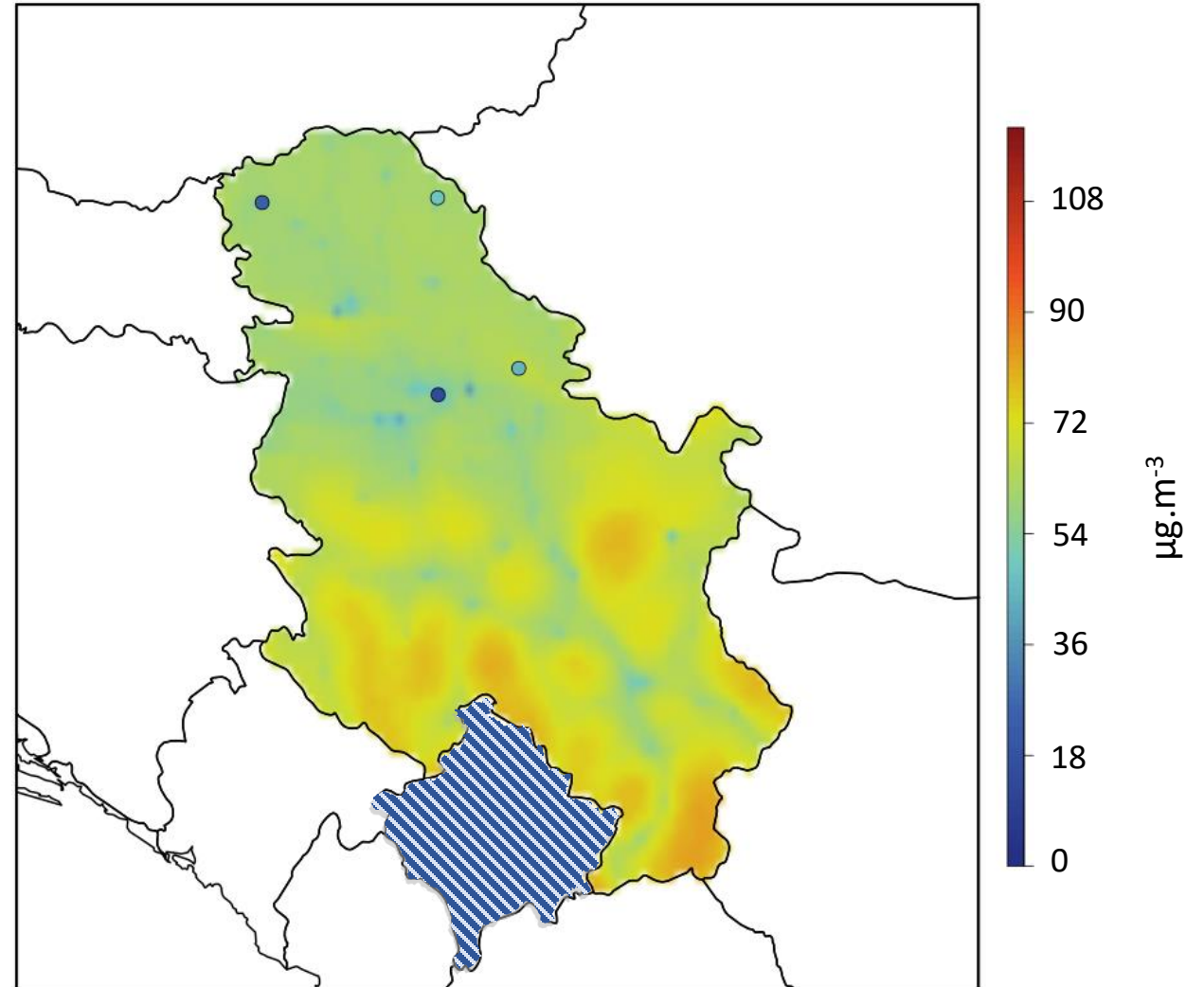
O₃: Modeling of the reference year 2015

O₃

Modelled concentrations

+

Observations at the measurement stations (4 stations, 2 of which are traffic stations, and one is industrial)



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Differences between model and observations are inevitable.

There are due to :

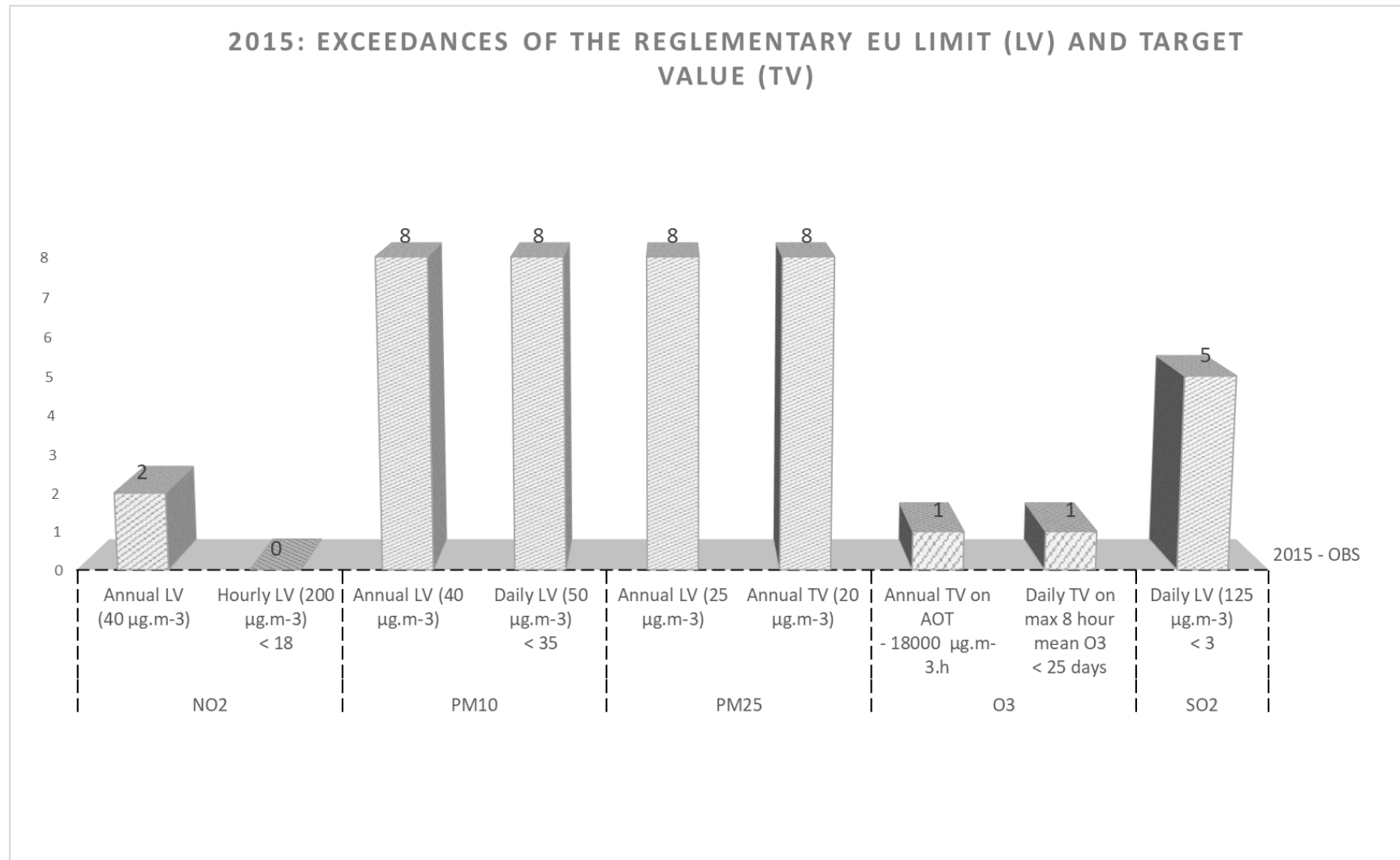
- **the model itself**, especially related to the spatial resolution of 5x5 km that smooth out the high concentration peaks from individual source or from short life-time species that rapidly decrease far from their sources. For this reason, model should be compared with stations that are representative of background concentrations.

It may also be difficulty to correctly reproduce concentration accumulation in narrow valley (Uzice ?)

- **input data** (boundary conditions, emissions, meteorological conditions)

However, despite some underestimation, the overall correlation between model and observations is very good. Therefore, we considered that by reasoning in relative differences (%) between 2015 and 2030 scenarios, the modeling results for 2030 scenario **are robust**.

2015: Observed exceedances of EU reglementary AQ Standards



03

**Air pollution in
Serbia in 2030:
prospective
scenarios**



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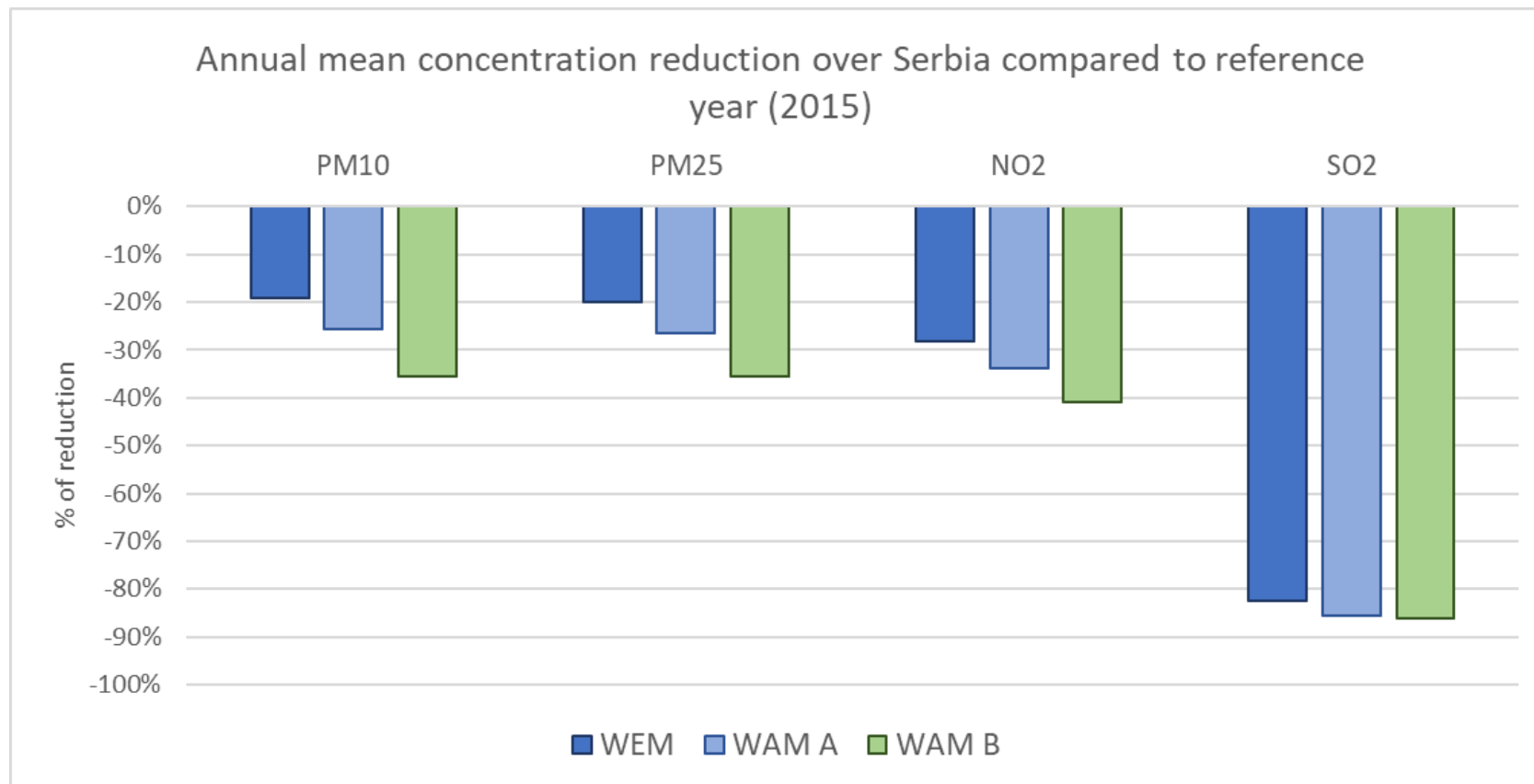


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Trends in concentrations over Serbia according to scenarios

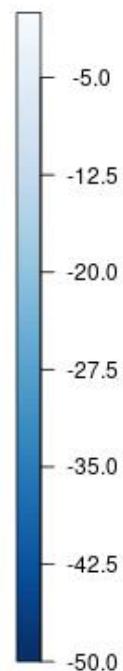
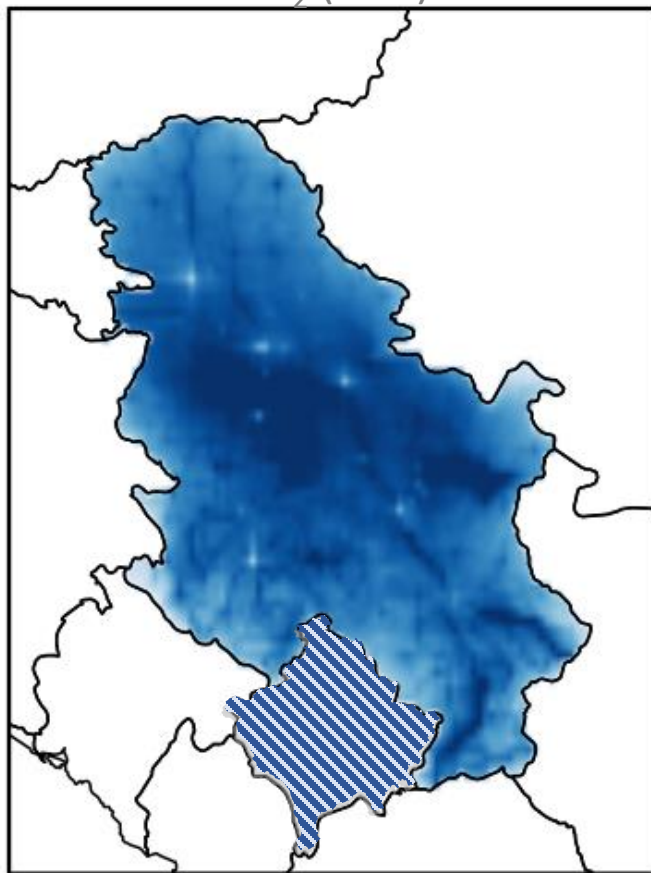
- For the WEM scenario PM10 and PM2.5 reductions are larger than emissions reductions of primary particles. This is due to concomitant reductions of other pollutants such as NO₂ and SO₂ that form secondary particles
- For WAMA and WAMB, smaller reductions in SO₂ and NO₂ lead to lower impact on secondary particles.
- About half of the added concentrations reductions of scenario WAMB is due to restriction of agricultural residue burning



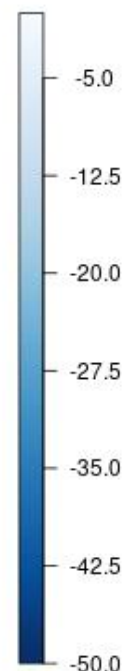
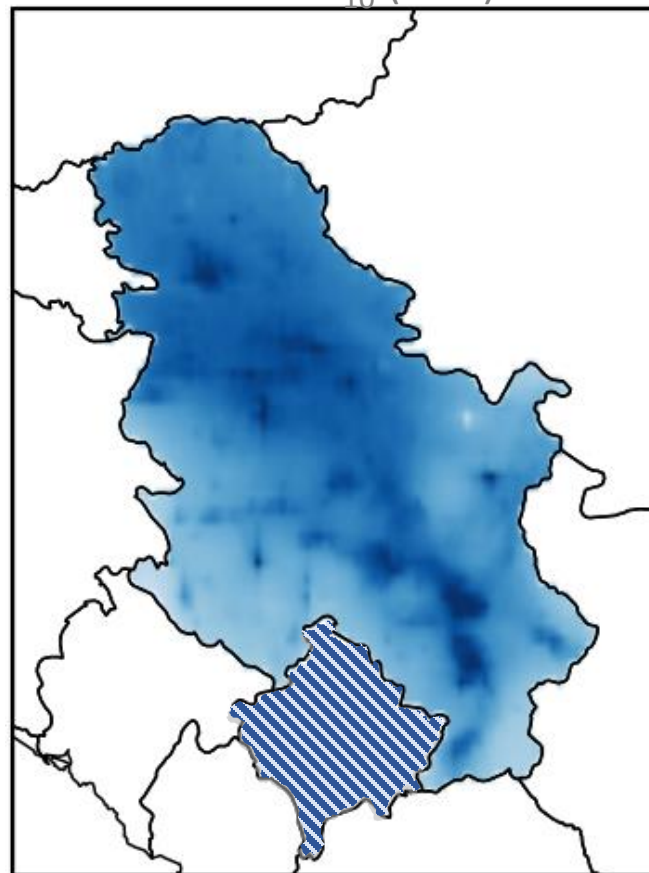
Concentration reduction mapping: example of 2030 WAM B scenario implementation

2015 Ref – 2030 WAM B (in %)

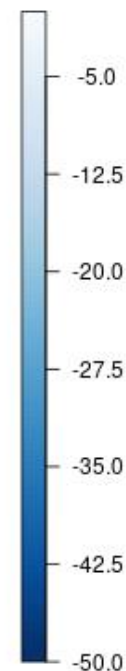
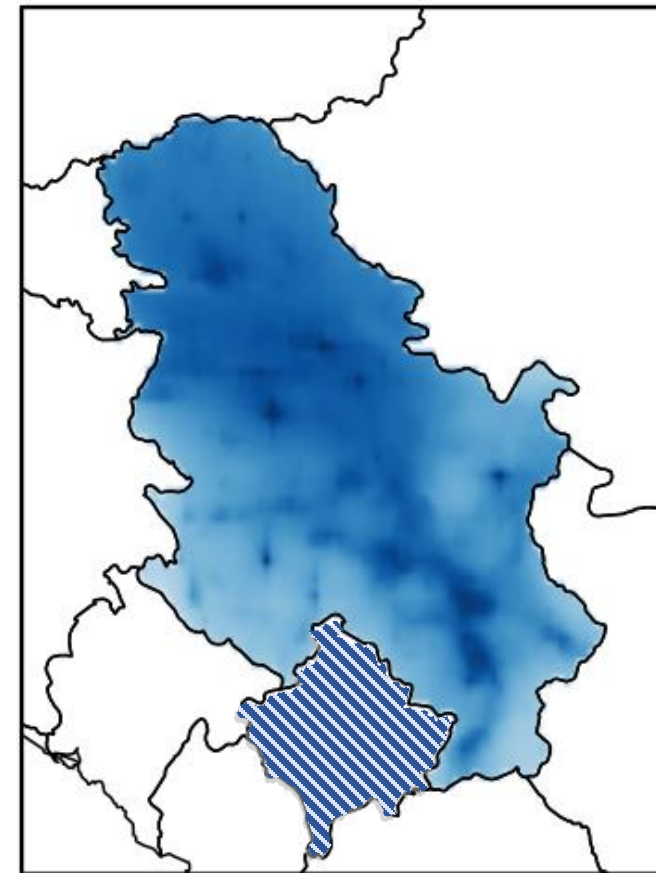
NO₂ (in %)



PM₁₀ (in %)



PM_{2.5} (in %)



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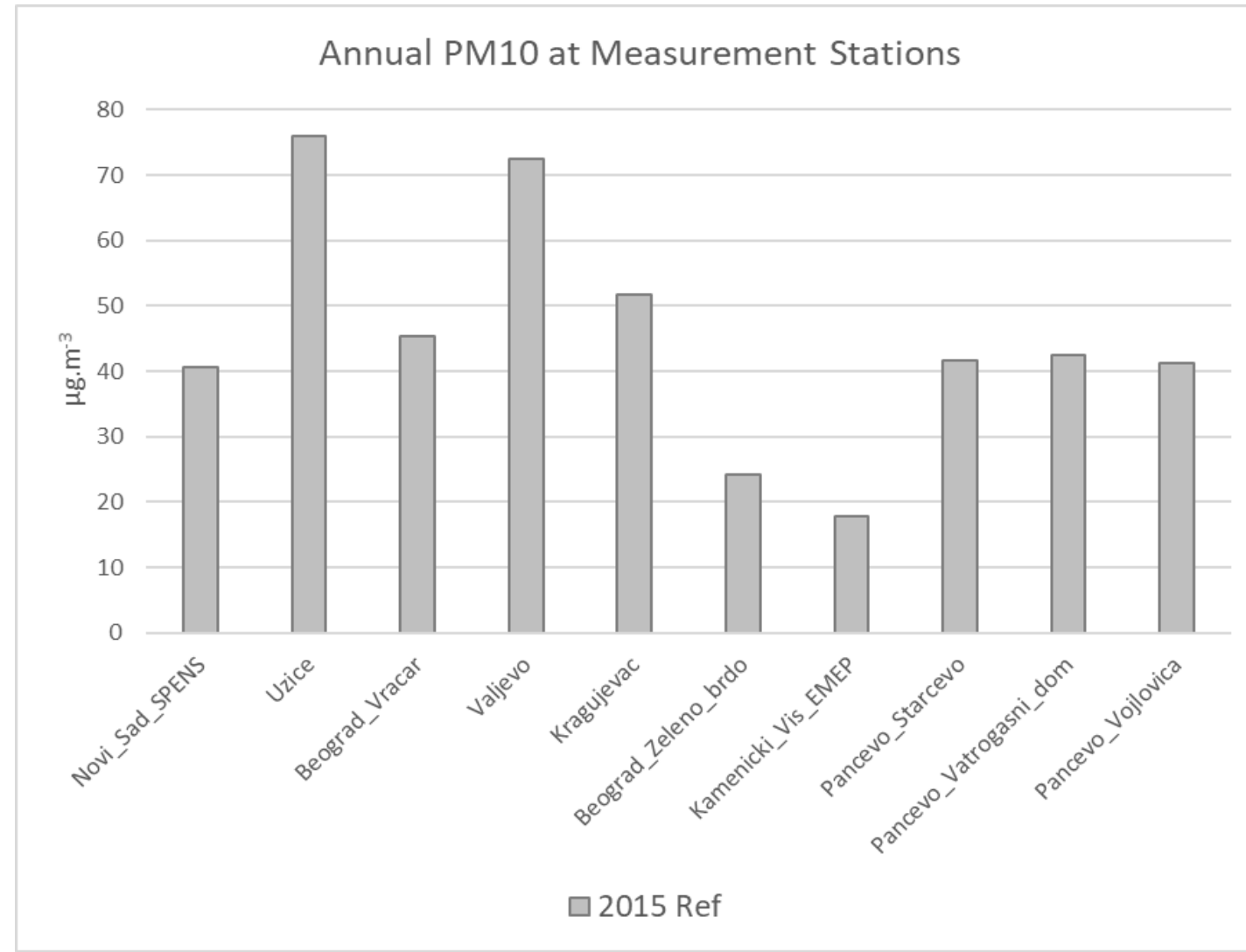
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Focus on regulatory aspects: EU AQ standards in 2030

Methodology (example of PM10)

- 1) Calculation of the real concentrations and exceedances observed at the monitoring stations in 2015



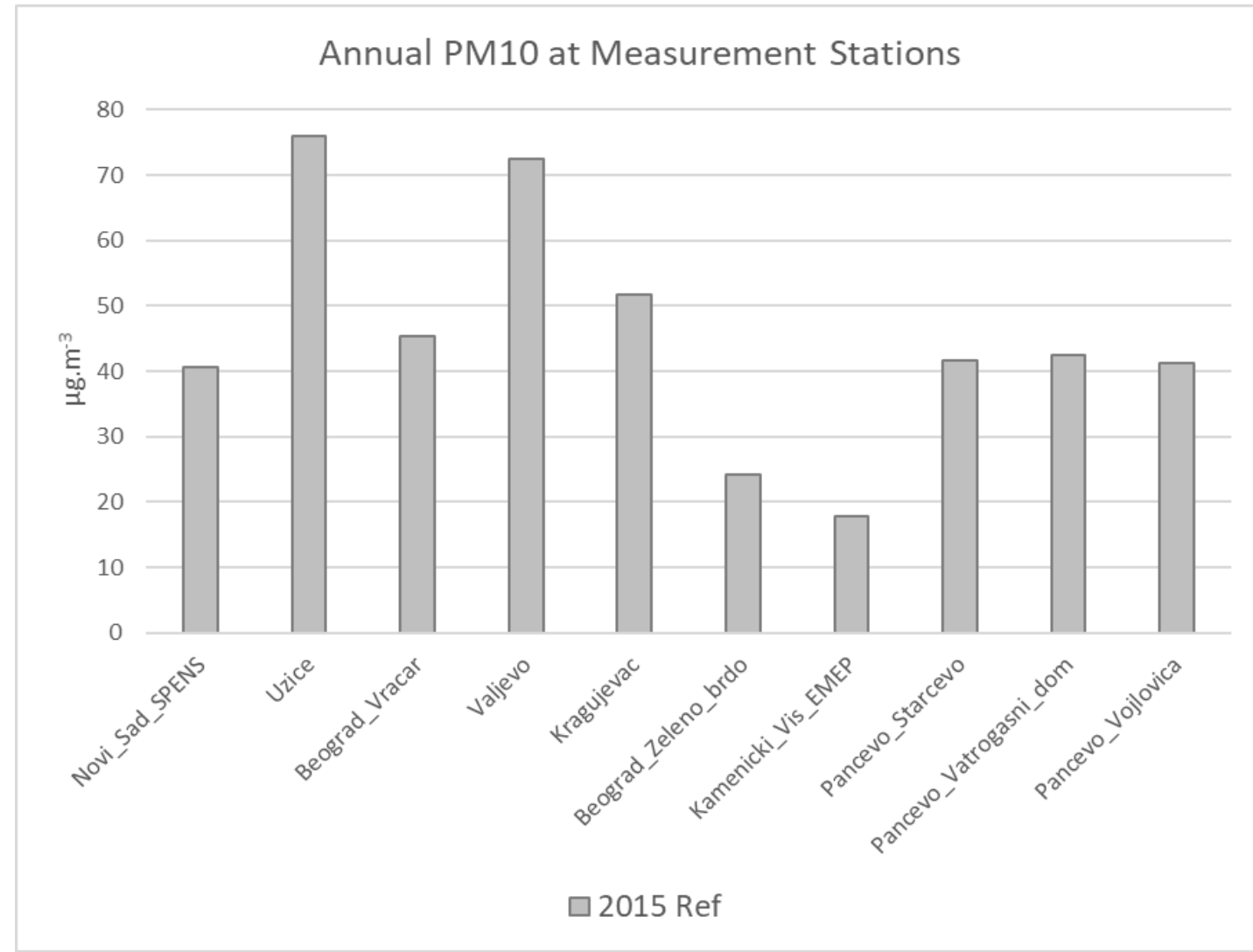
Focus on regulatory aspects: EU AQ standards in 2030 Methodology (example of PM10)

1) Calculation of the real concentrations and exceedances observed at the monitoring stations in 2015

2) Calculation of the concentration reduction in % estimated by the model between 2015 and 2030 scenario at these stations

Example of Uzice:

34%



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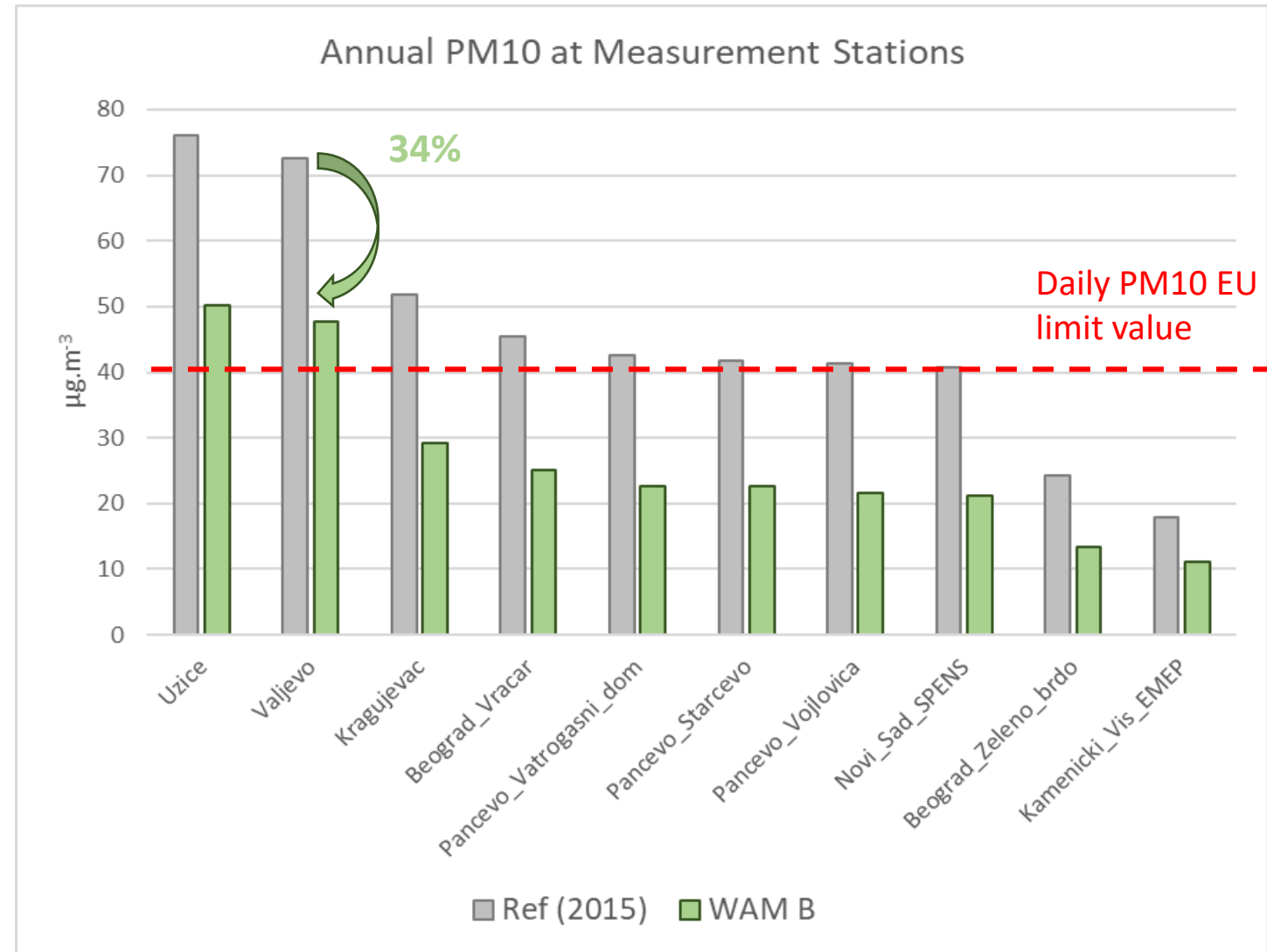
Focus on regulatory aspects: EU AQ standards in 2030

Methodology (example of PM10)

- 1) Calculation of the real concentrations and exceedances observed at the monitoring stations in 2015
- 2) Calculation of the concentration reduction in % estimated by the model between 2015 and 2030 scenario at these stations
- 3) Application of these modeling reductions to the 2015 concentrations to simulate the expected concentrations and exceedances at the measurement stations in 2030

Example of Uzice:

34%



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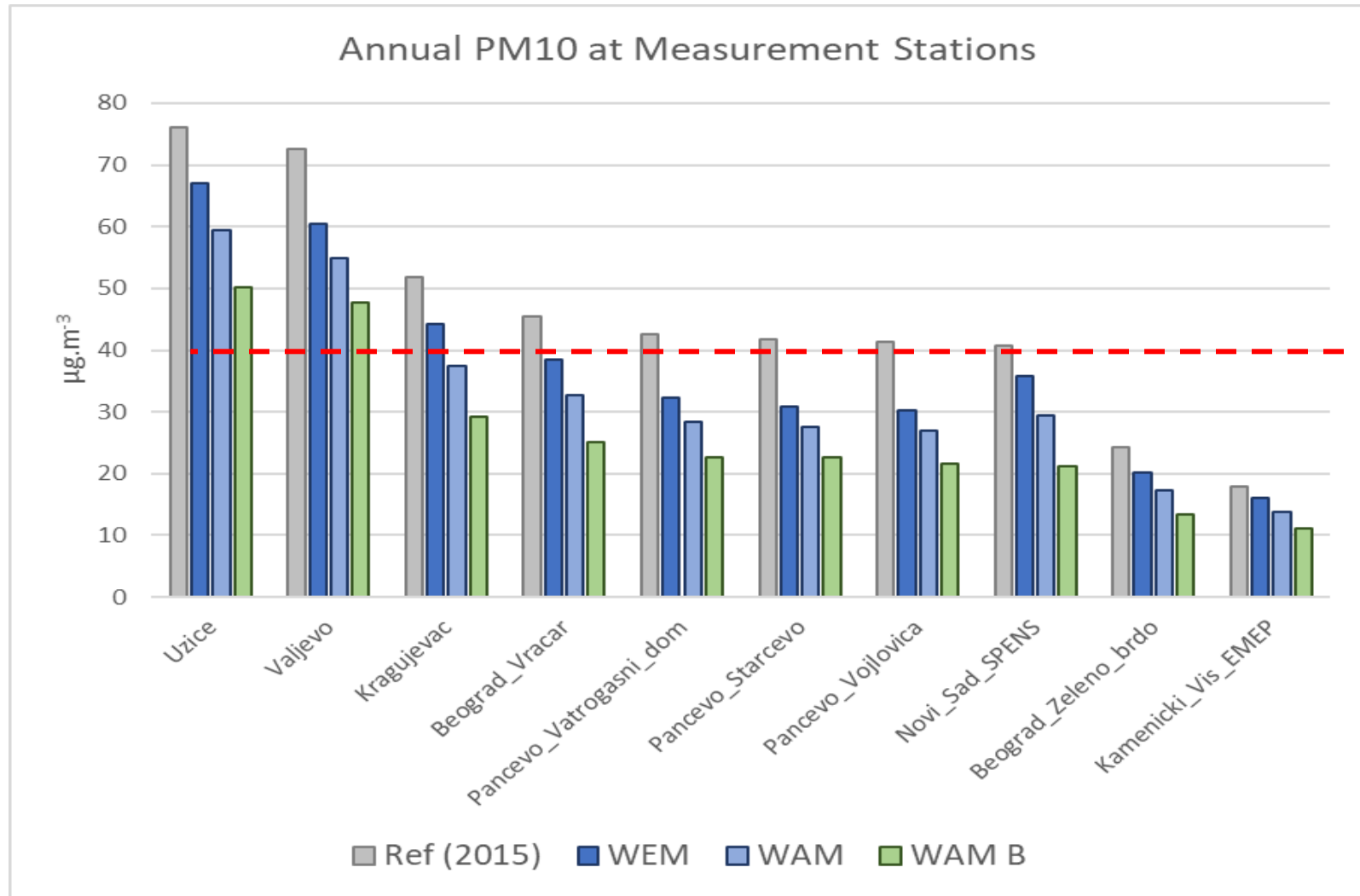


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Focus on regulatory aspects: EU AQ standards in 2030

PM10

LV 1: annual concentration of $40 \mu\text{g.m}^{-3}$



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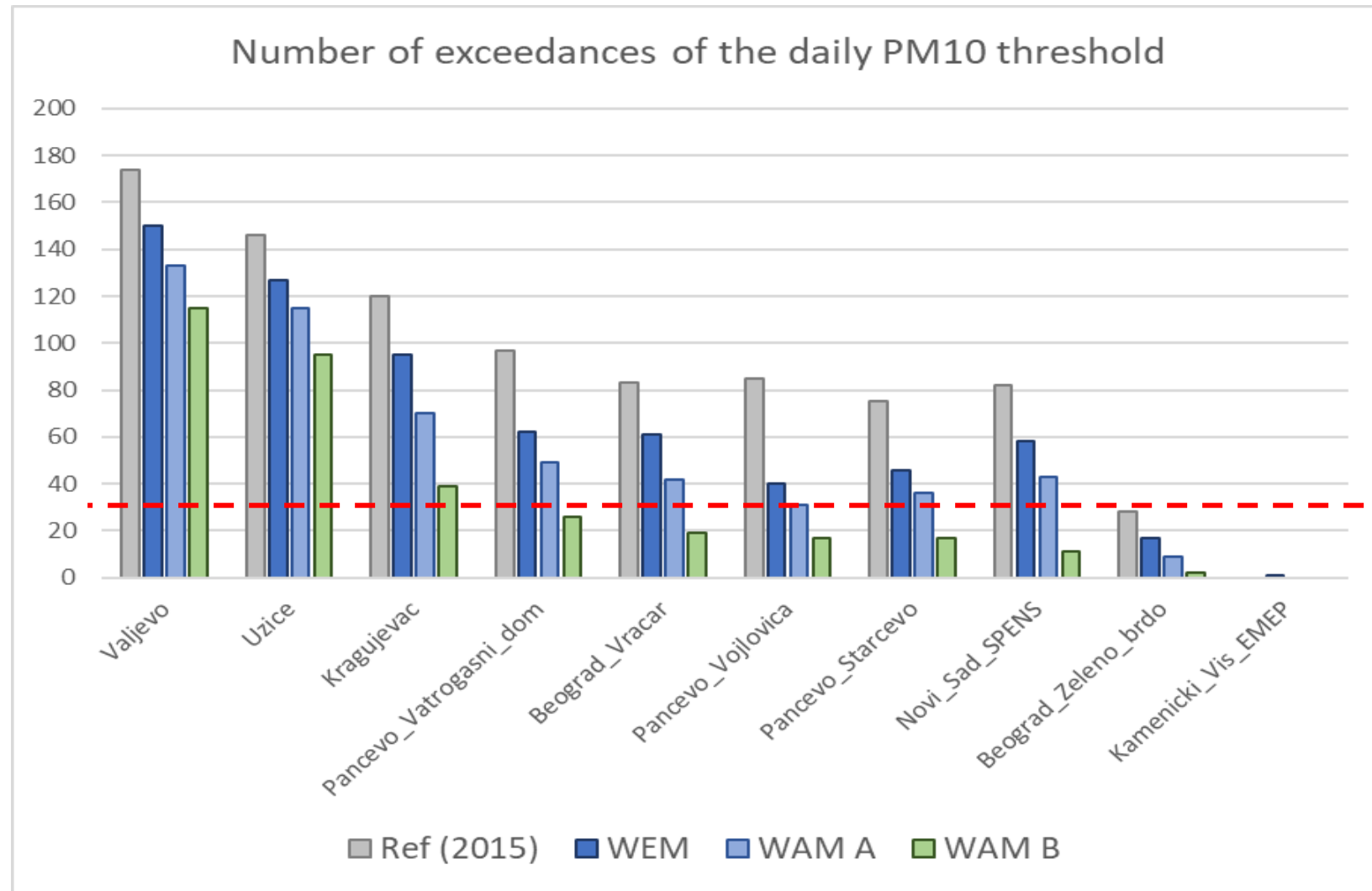
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Focus on regulatory aspects: EU AQ standards in 2030

PM10

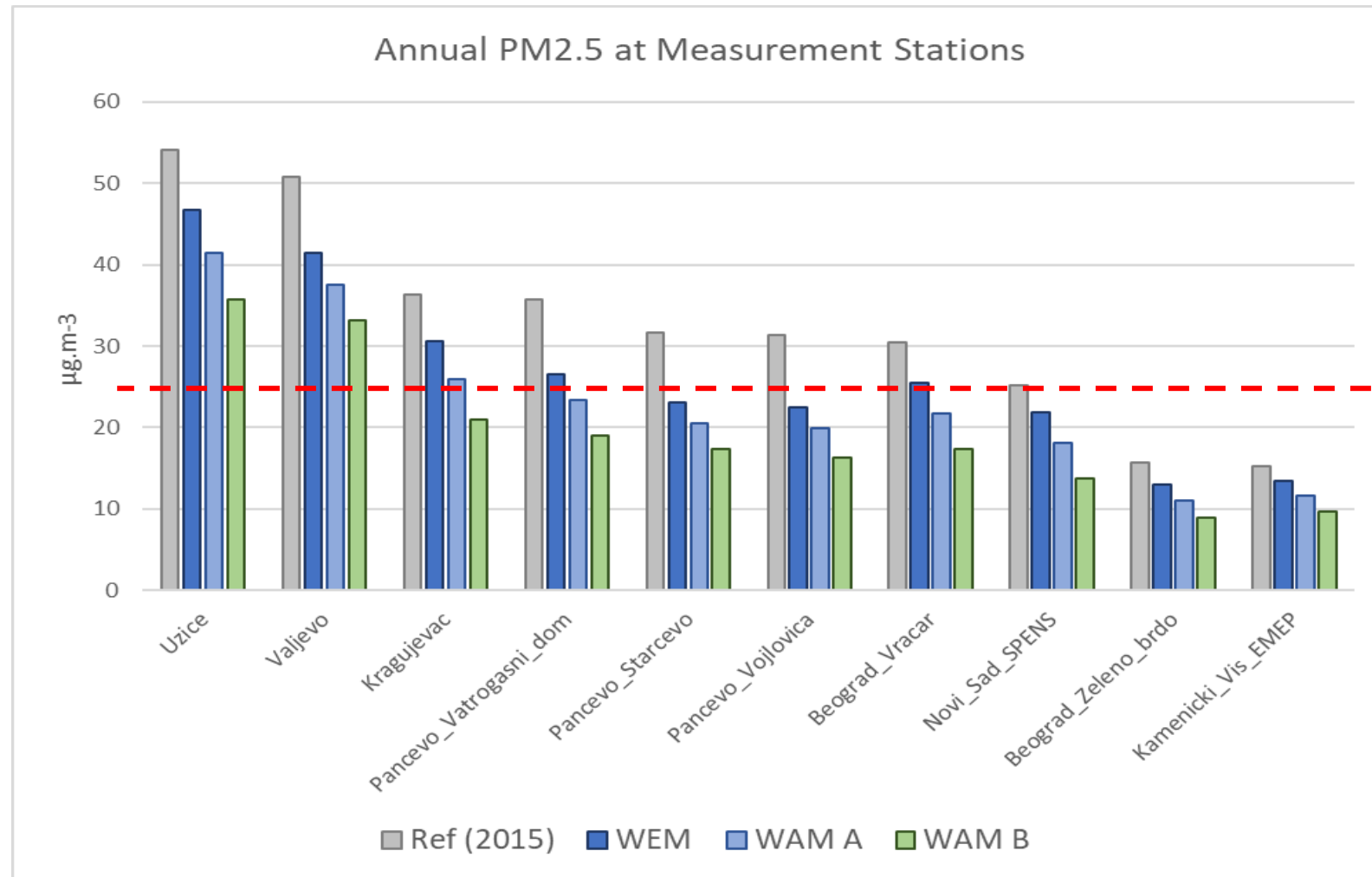
LV 2: Daily concentrations of $50 \mu\text{g.m}^{-3}$ not exceeded more than 35 times



Focus on regulatory aspects: EU AQ standards in 2030

PM_{2.5}

LV: annual
concentration
of 25 $\mu\text{g}\cdot\text{m}^{-3}$



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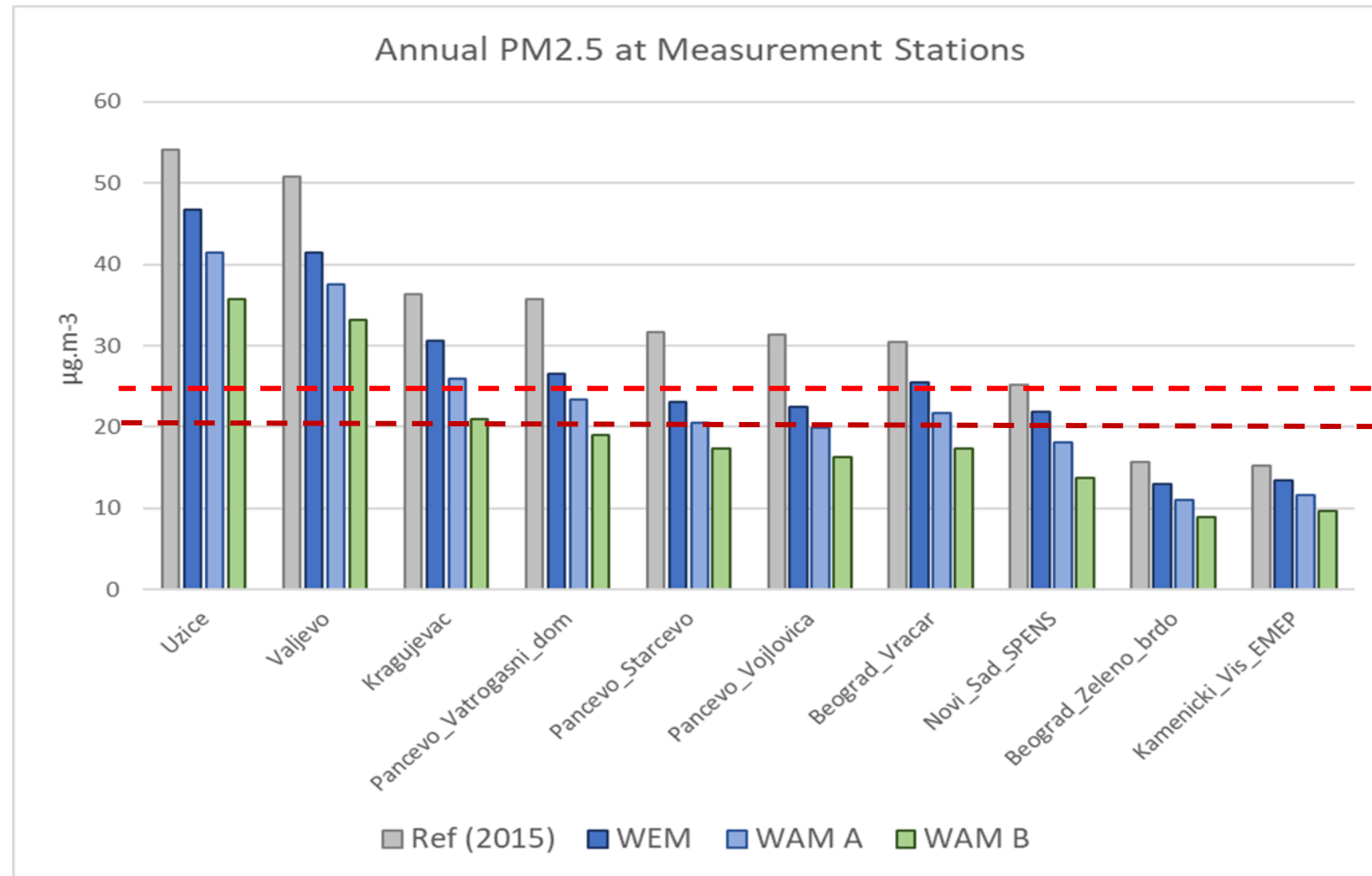
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PM_{2.5}

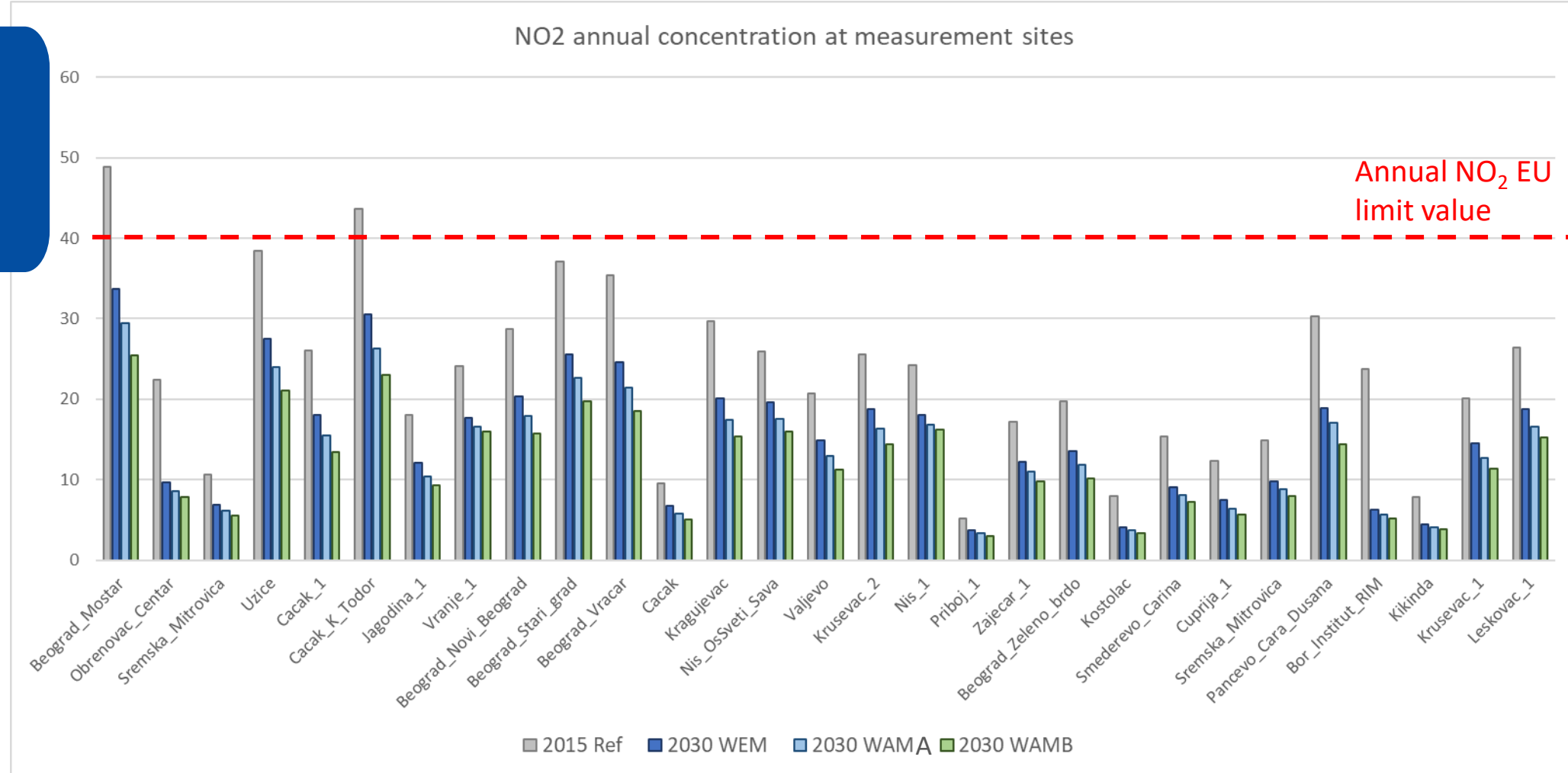
LV: annual concentration of 25 $\mu\text{g}\cdot\text{m}^{-3}$

Annual target (step2): 20 $\mu\text{g}\cdot\text{m}^{-3}$



Focus on regulatory aspects: EU AQ standards in 2030

NO₂
LV: annual
concentration
of 40 µg.m⁻³



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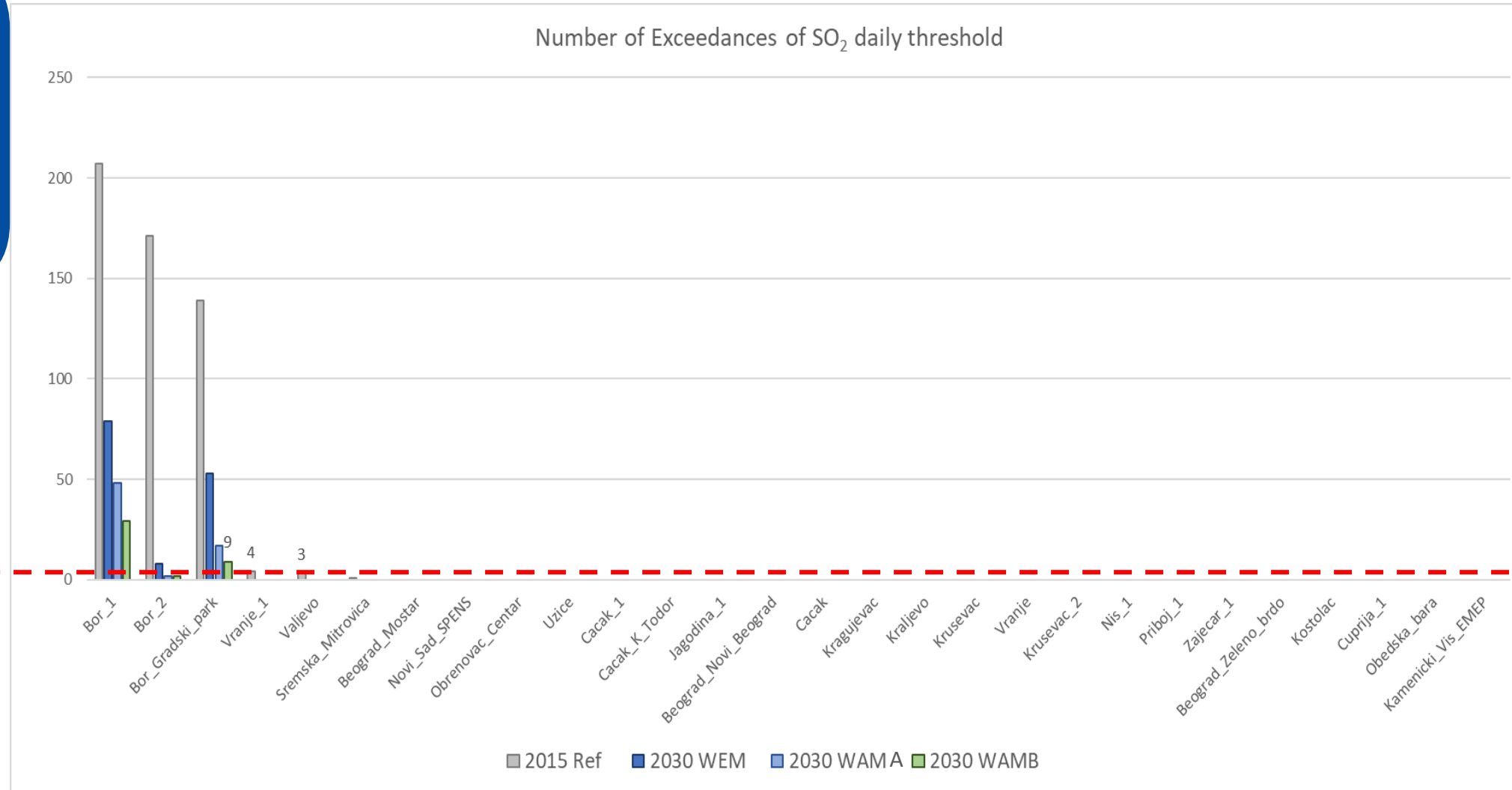
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SO₂
LV1: Daily concentrations of 125 µg.m⁻³ not exceeded more than 3 times

SO₂ EU limit value



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04

Conclusions .. And next steps



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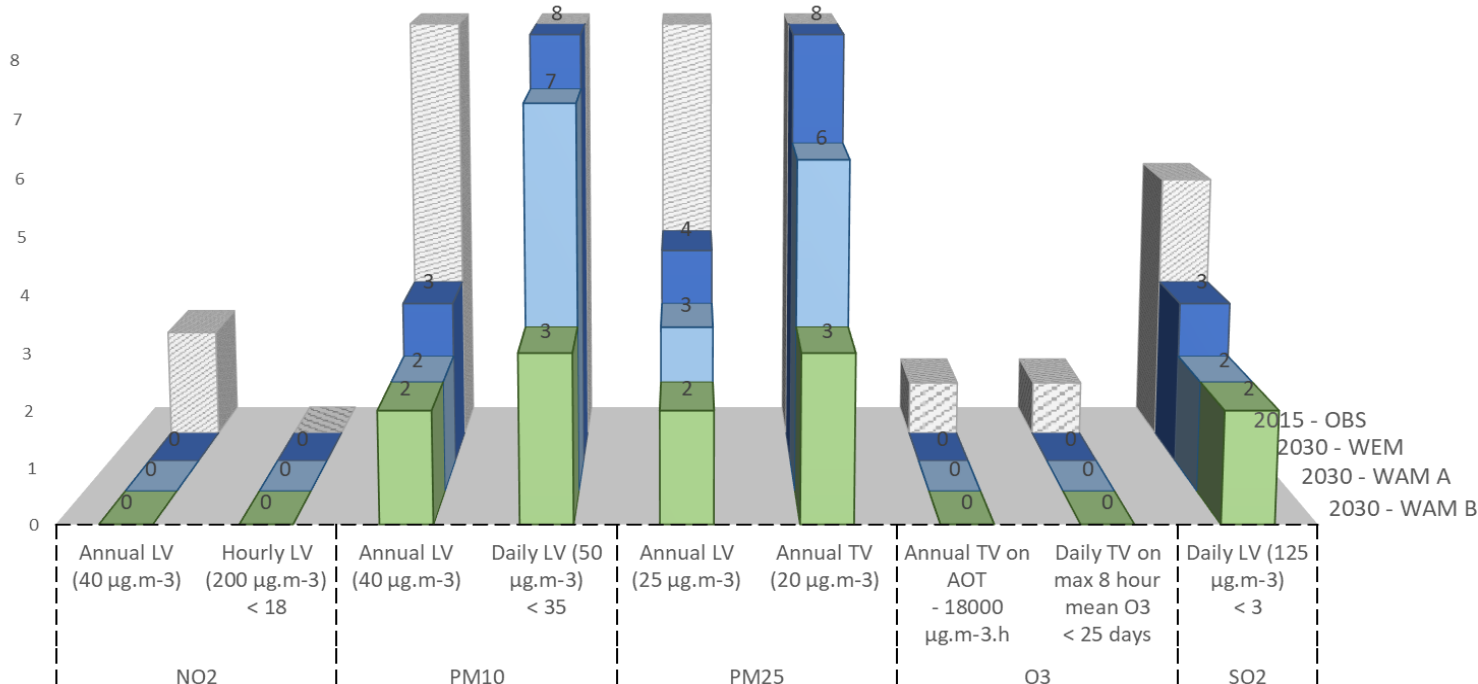


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Focus on regulatory aspects: EU AQ standards in 2030

EXCEEDANCES OF THE REGLEMENTARY EU LIMIT (LV) AND TARGET VALUE (TV)



- In 2030, full implementation of measures adopted by 2019 (WEM scenario) allows to remove exceedances on NO₂ and O₃ and the SO₂ exceedances excepted in Bor. But LV for particles are still exceeded in most stations
- WAM A and in a larger extend WAMB measures are necessary to further reduce LV exceedances for particles; by more than 50% with the WAMB scenario
- Hot spots for particles still remains in 2030 with the WAMB scenario: Valjevo, Uzice, Kragujevac. Pancevo and Belograd are also very close to the LV. The model also simulated large PM spot over Nis. For SO₂ the hot spot is Bor.

Next steps

- New AQ simulation with the WAM C scenario with additional measures

Next steps

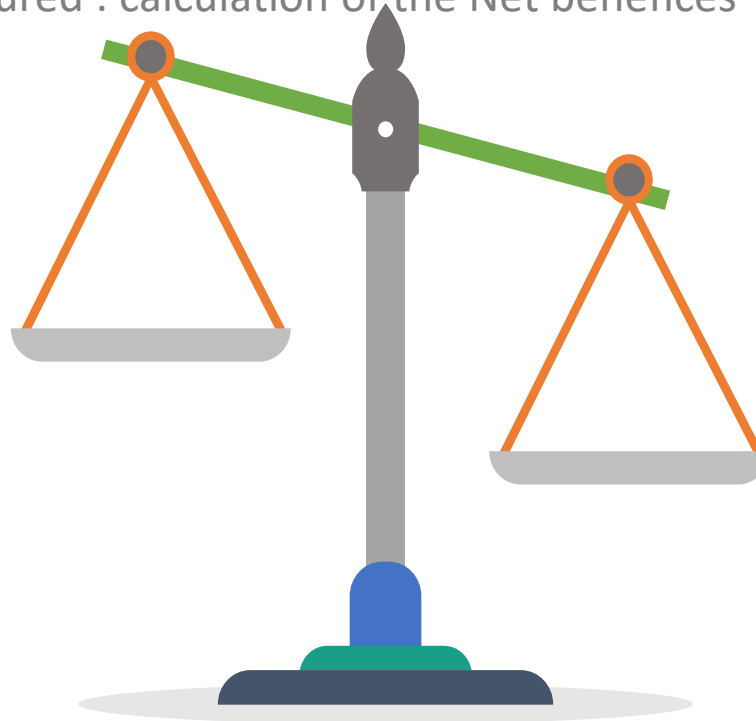
- New AQ simulation with the WAM C scenario with additional measures
- Calculation of avoided health impact from the different scenarios (mortality and morbidity) using the Alpha-RiskPoll model

Next steps

- New AQ simulation with the WAM C scenario with additional measures
- Calculation of avoided health impact from the different scenarios (mortality and morbidity) using the Alpha-RiskPoll model
- Comparison with the costs of the measures : calculation of the Net benefits

Health benefits

health impacts and costs avoided by the implementation of an emission reduction measure or strategy (scenario)



Costs of measures

evaluation of the costs of the implementation of the measures for the civil society

$$\text{Net benefices} = \text{Health benefits} - \text{Cost of measures}$$



Questions and assistance

Real Elsa

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Thank you for your attention!