MODELLING COVID19 LOCKDOWN IMPACT ON THE ITALIAN LOMBARDY REGION AIR QUALITY: ASSESSING OF TWO METHODS

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Overview

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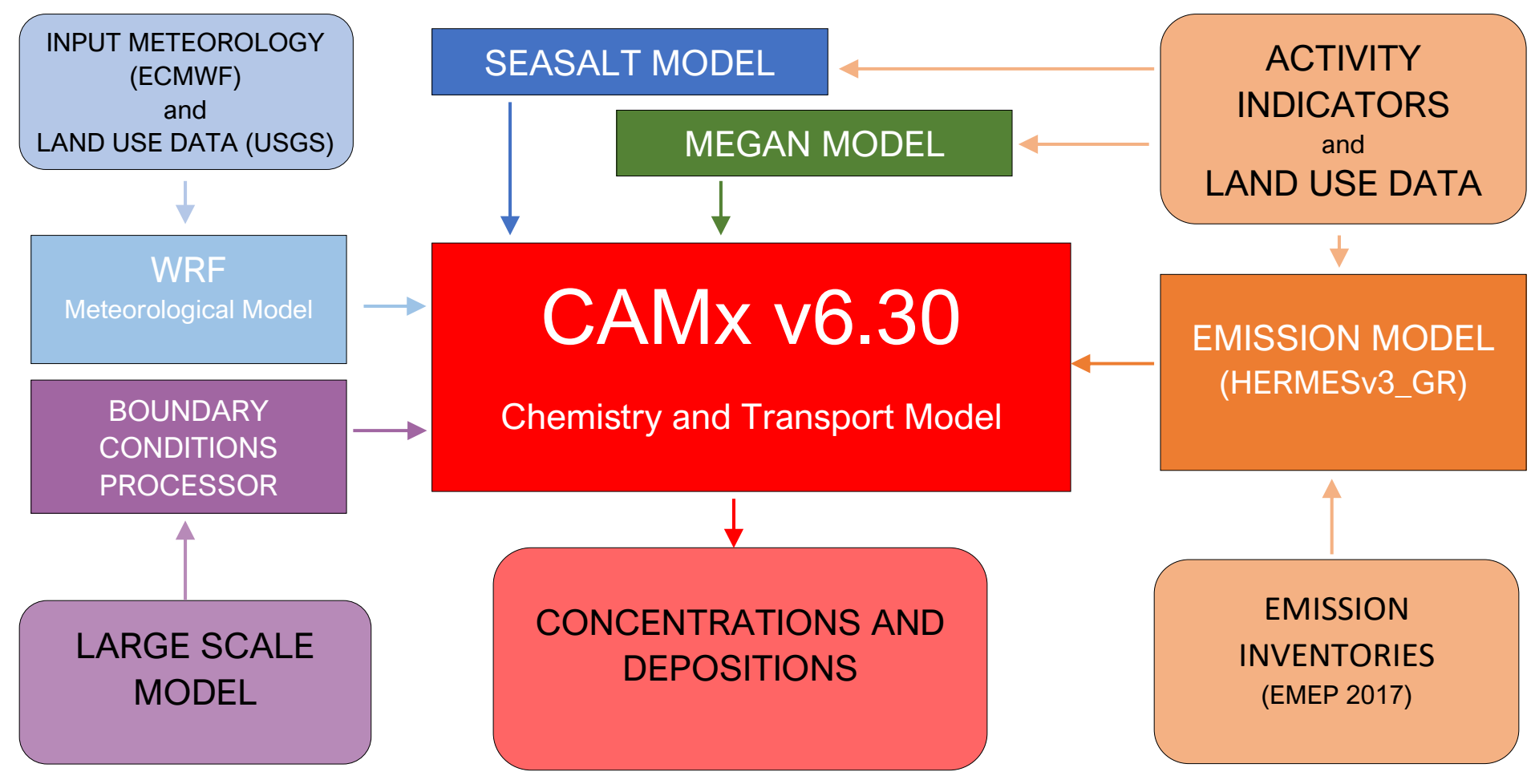
Introduction

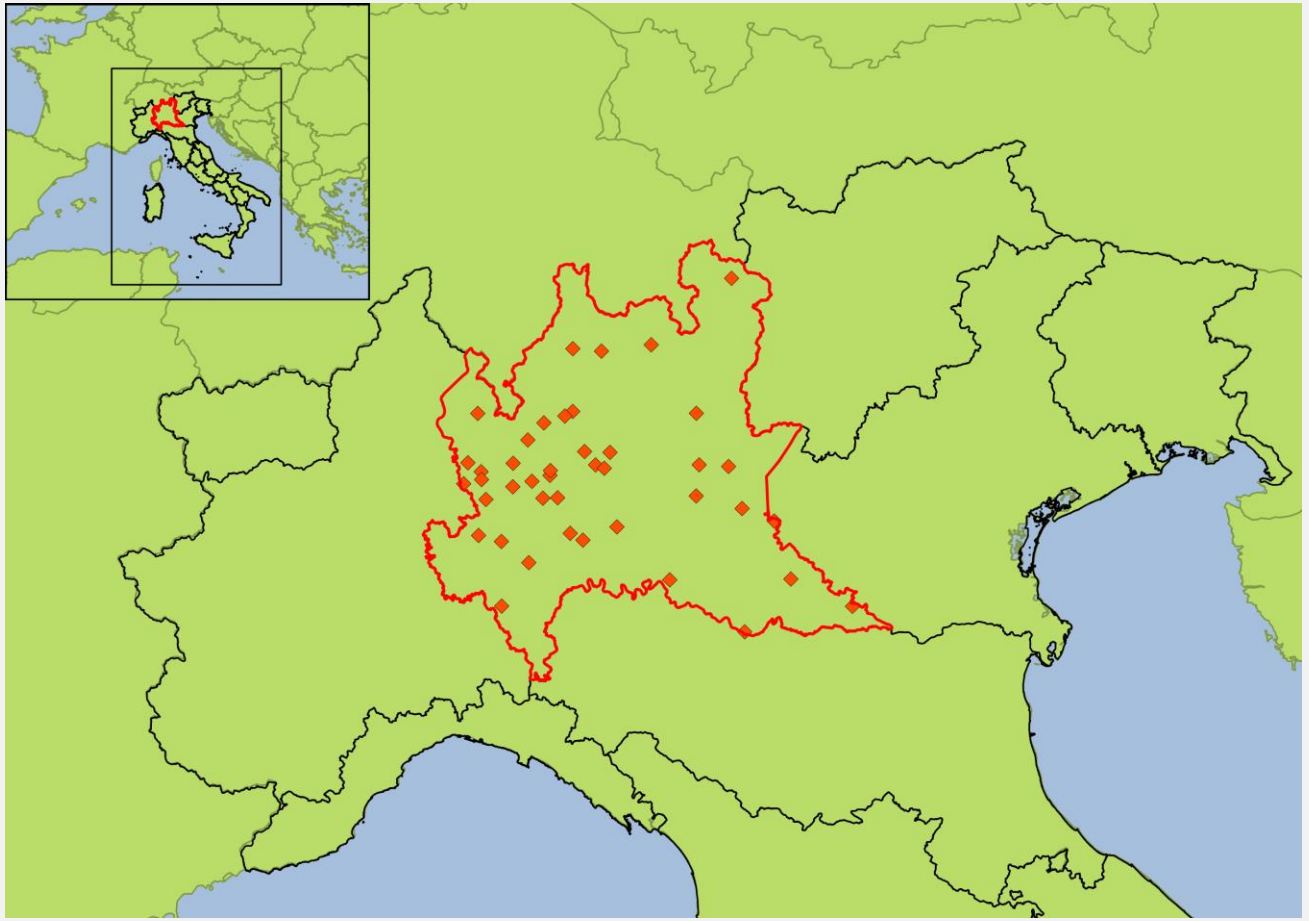
- The Lombardy region was one of the European areas earliest affected by the Coronavirus in 2020
- The first lockdown measures were imposed on 24th February 2020 and a national lockdown was declared from March 9th
- Several studies report observed reductions in ambient concentration for Northern Italy
- This study aims at evaluating the ability of two different methods of computing road traffic emission reduction to simulate the lockdown air quality effects for NO2, PM10 and PM2.5
- Study period: 10 February 2020 – 30 April 2020

Modelling Setup



Study Area

- Italian domain simulated at 4x4 Km^2 resolution
- Results are focused on Lombardy region (red borders)
- Modelled concentration are validated against the regional air quality monitoring stations (red markers)
- Only Background Urban and Suburban stations



Emission Scenarios

- LOCK_1:
  - Based on emission coefficients calculated by the regional air quality agency [ARPA Lombardia]
  - Specifically computed for the assessment of the effect of 2020 spring lockdown on Lombardy
- LOCK_2:
  - Based on mobile phone data as a proxy for mobility reduction
  - Computed starting from the “COVID-19 mobility trends” published by Apple (https://covid19.apple.com/mobility)
  - Weekly coefficients obtained using the driving category and using the January 13th week (13/01/2020-19/01/2020) as a reference
- Both scenarios are compared with a Business as Usual (BAU) simulation and with concentrations measured at air quality monitoring stations

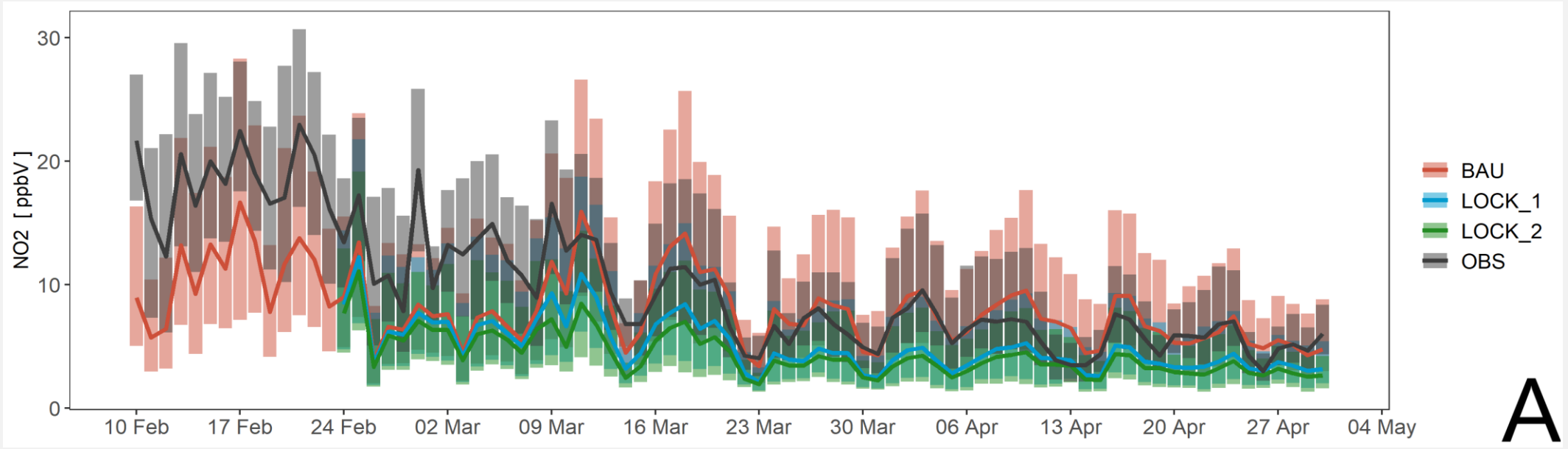
Concentration reduction and Model Validation (1/3)

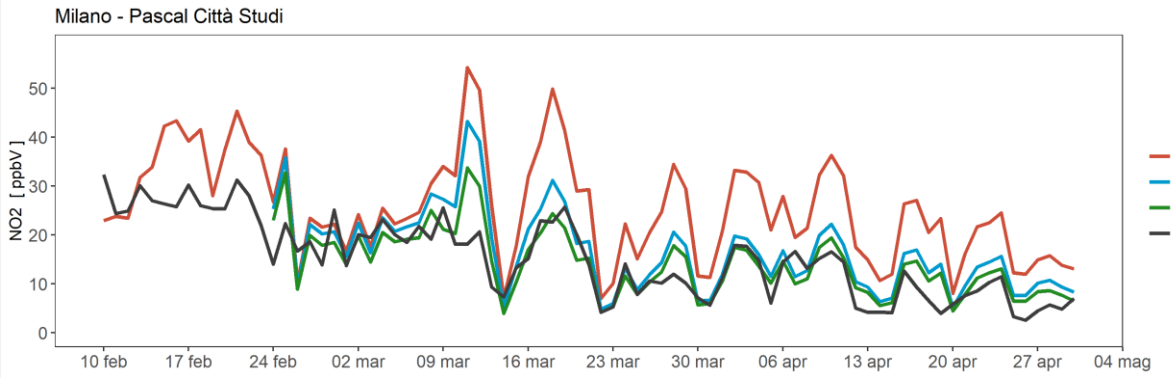
Average concentration reduction for Lombardy in the Nation lockdown period (March 9th – April 30th)

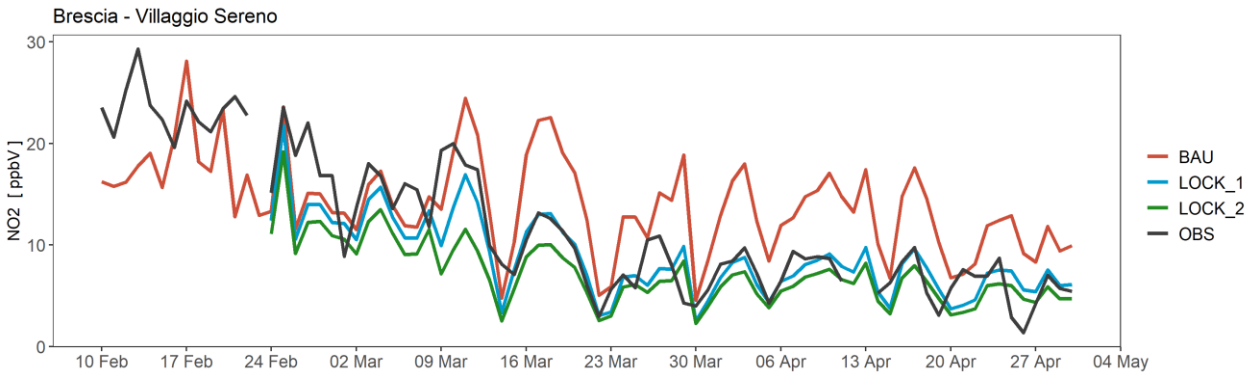
	BAU – LOCK_1	BAU – LOCK_2
NO_2	-37.2 %	-45.5 %
PM_{10}	-15.3 %	-17.6 %
$PM_{2.5}$	-17.0 %	-19.7 %

	NO_2			PM_{10}			$PM_{2.5}$		
	NMB	RMSE	R	NMB	RMSE	R	NMB	RMSE	R
BAU	0.071	6.462	0.578	0.065	12.196	0.693	0.301	12.615	0.620
LOCK_1	-0.281	5.296	0.675	-0.082	11.139	0.715	0.111	9.522	0.640
LOCK_2	-0.390	5.713	0.676	-0.110	11.054	0.725	0.075	9.010	0.646

Concentration reduction and Model Validation (2/3)







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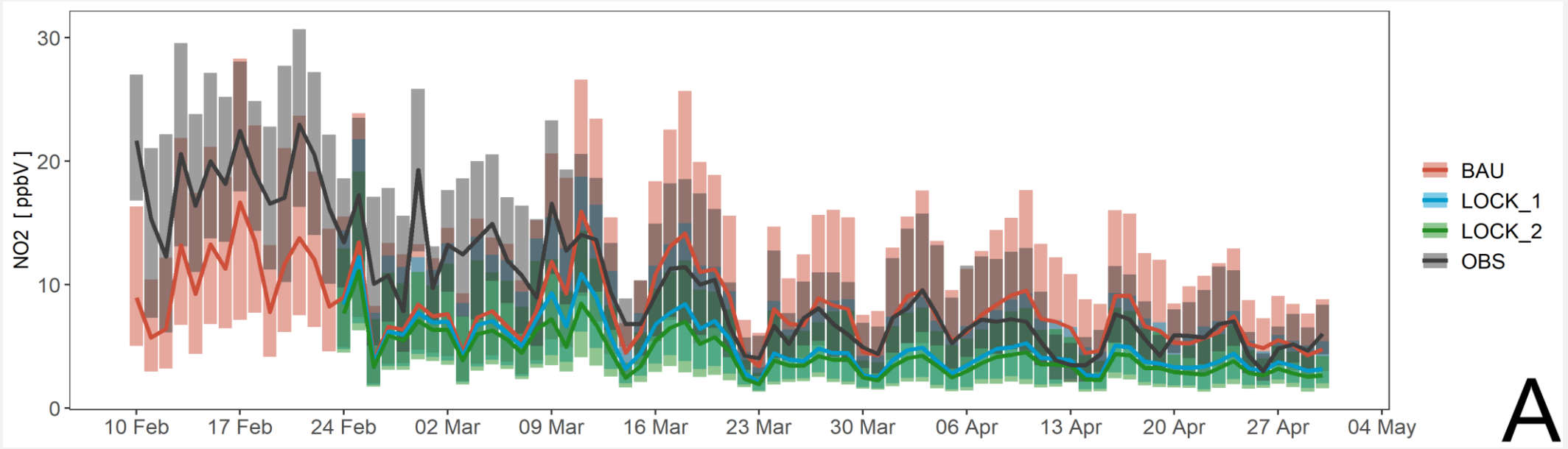
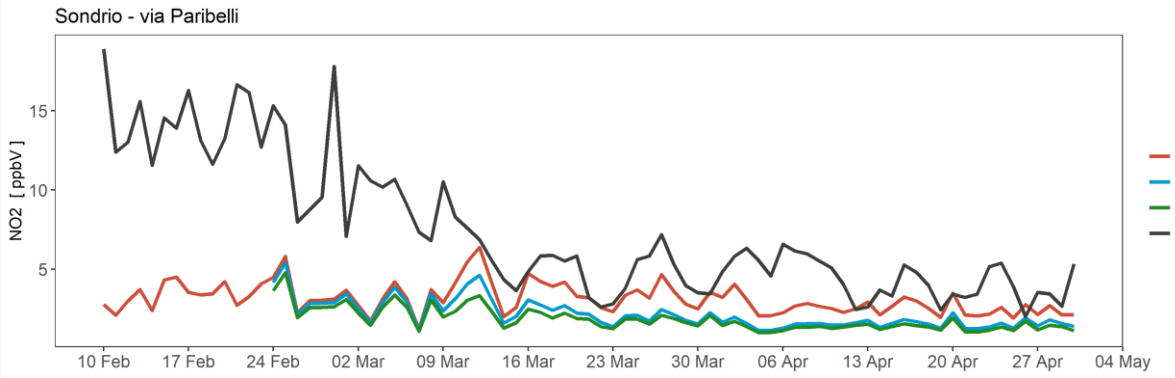
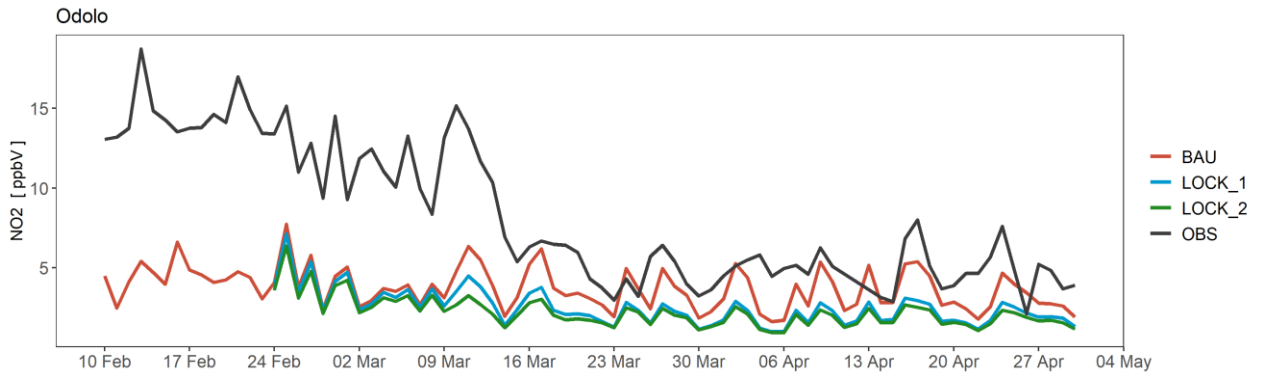
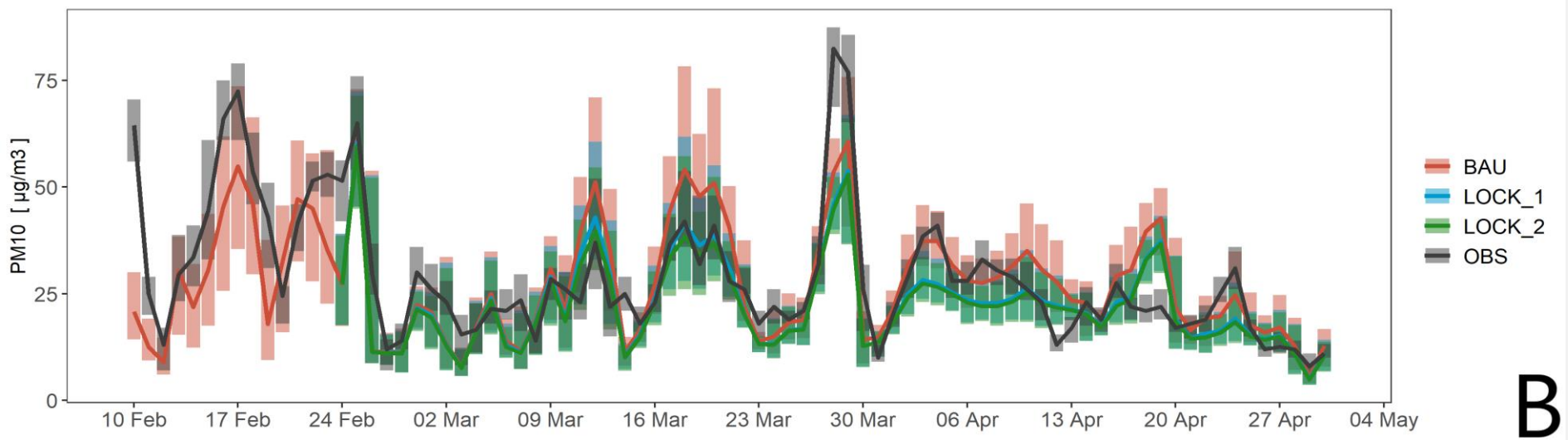
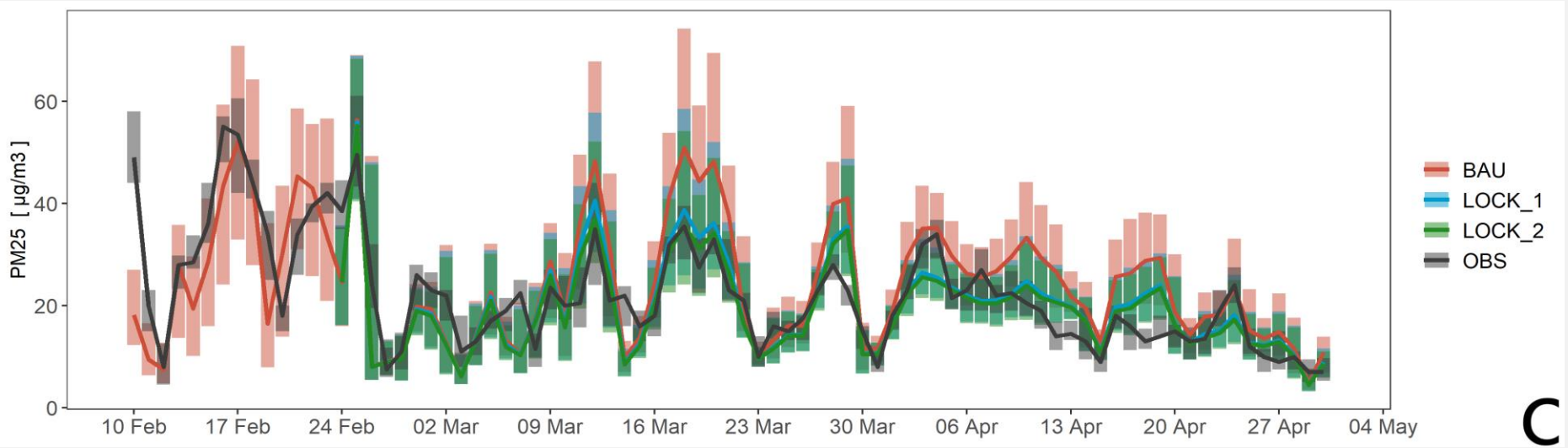






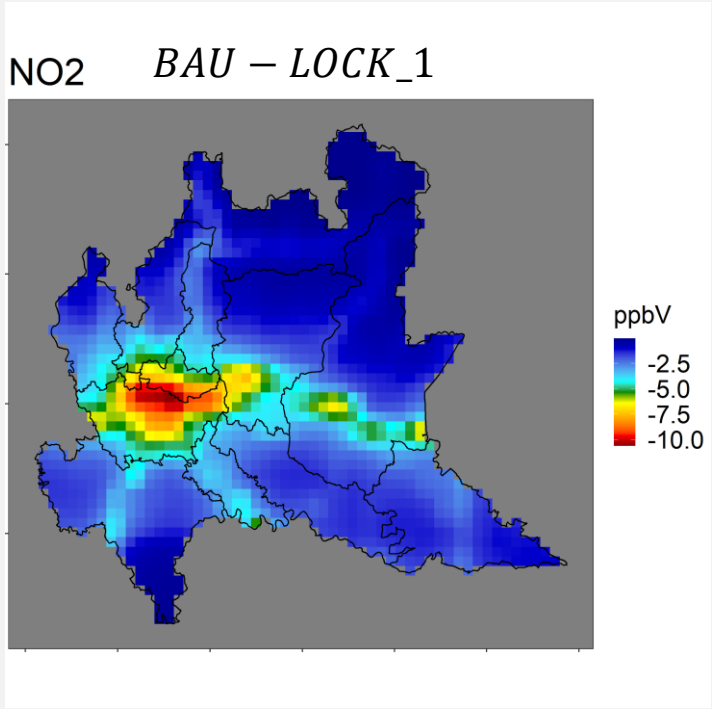
Concentration reduction and Model Validation (3/3)

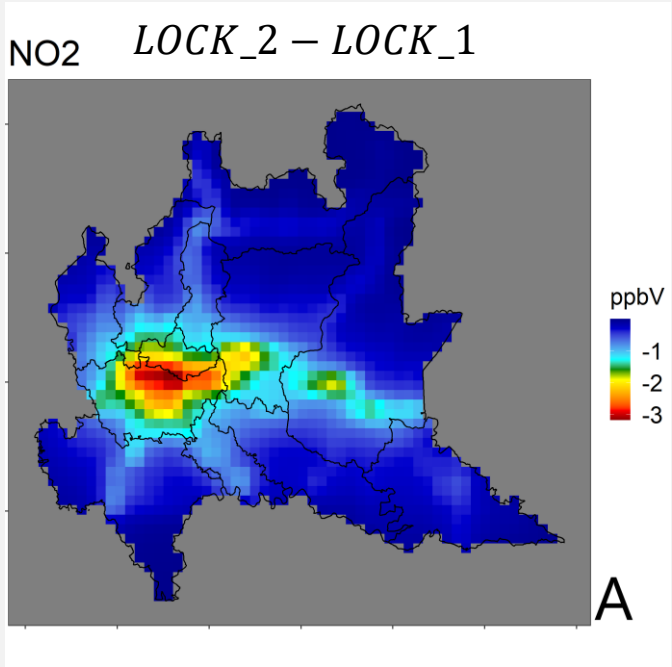


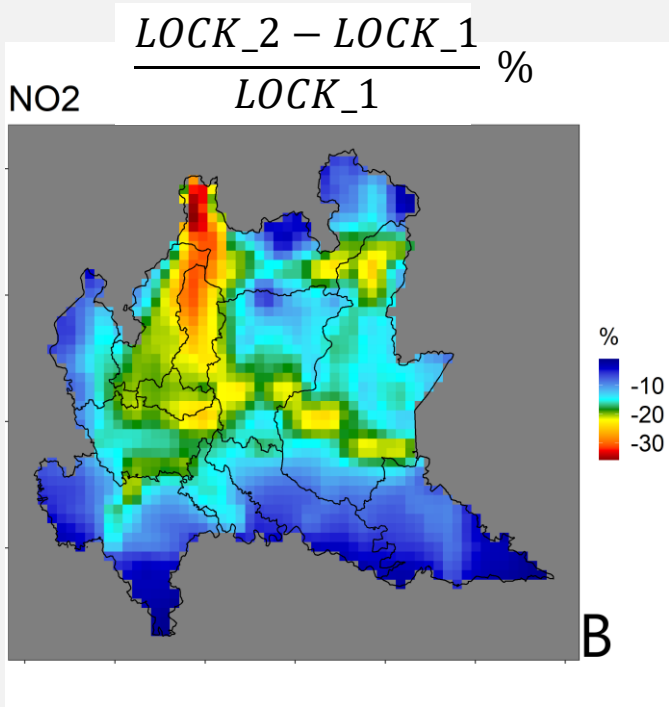


Lockdown scenario comparison: NO_2

- The estimated concentration reductions for NO_2 are higher in the LOCK_2 scenario
- The difference in the emission coefficients had a greater effect on NO_2 concentration due to the high contribution of the road transport sector to the NOx total emission.

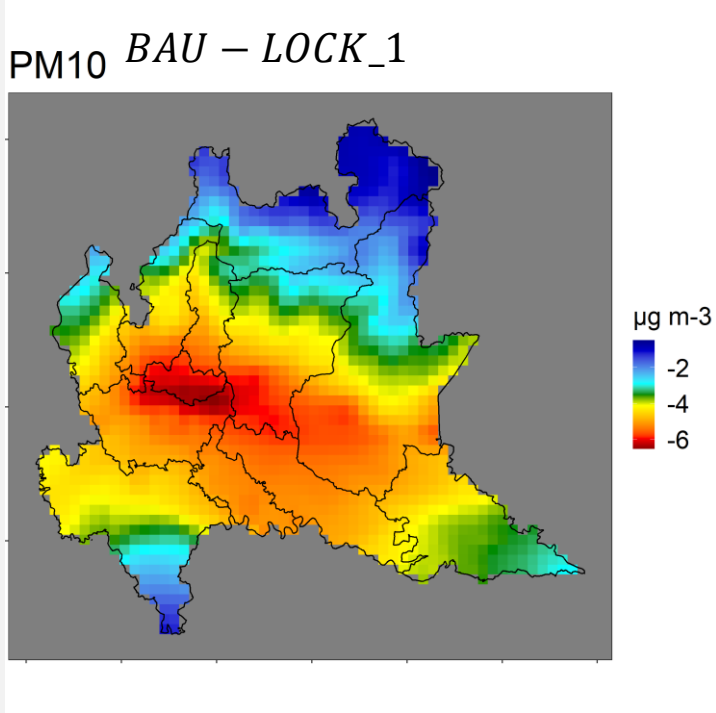


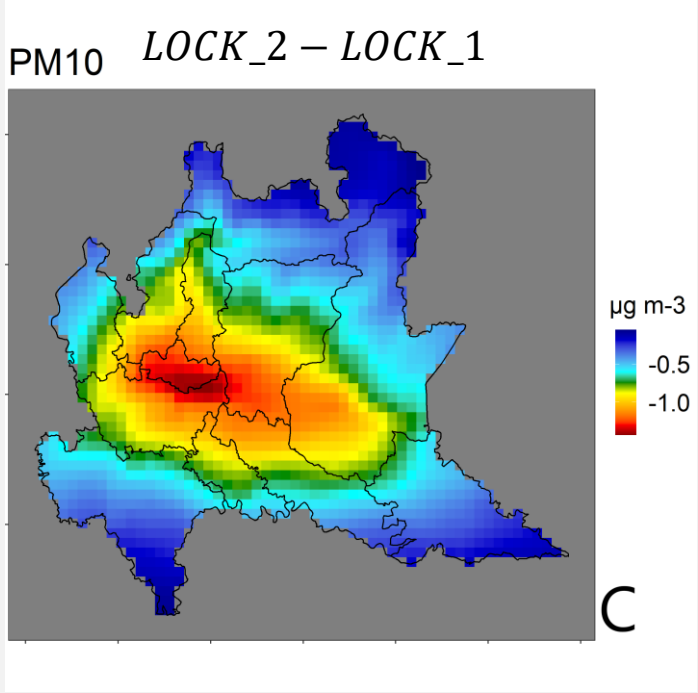


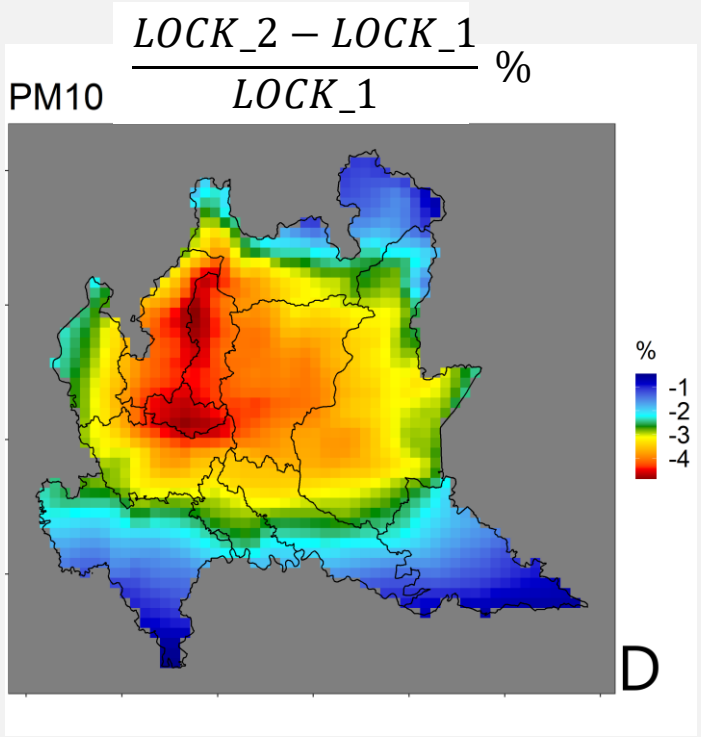


Lockdown scenario comparison: PM_{10}

- The maximum relative difference for $PM_{2.5}$ is 5.4%
- For PM_{10} and $PM_{2.5}$ the differences between scenarios are low in both absolute (a few µg m^{-3}) and relative terms (maximum 5%).







Lockdown scenario comparison

- Both scenarios are able to simulate the concentration reduction signal in sites where BAU performance in pre-COVID period is good
- The coherence between LOCK_1 and LOCK_2 scenarios showed that mobile phone data can be used without intensive processing in assessing mobility scenario if specific datasets are not available
- The main drawback of these kind of data is the lack of detail on vehicle type
  - a single coefficient for the entire road transport sector can lead to a misrepresentation of the active vehicle fleet and therefore of the actual emissions

CONCLUSIONS

- The validation of modelled data for urban environment of LOCK scenarios shows good performance for particulate matter
- NO2 modelled concentration in LOCK scenarios tends to underestimate the observations
- The mobility scenario based on mobile phone data required minimal preprocessing
- The performances of LOCK scenarios are comparable
- Mobile phone data are an effective proxy for mobility studies effects on air quality if specific datasets are missing

Thank You!