



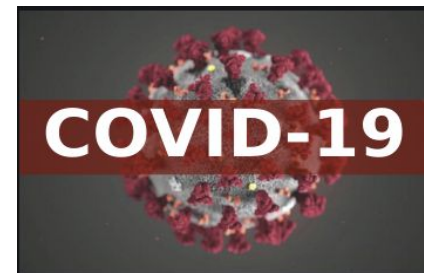
# Impacts of COVID-19 lockdown on European air quality

Augustin Mortier, Michael Schulz, Svetlana Tsyro, Anna Benedictow, Hilde Fagerli

## Restrictions in place



19th AeroCom workshop, October 12-16, 2020  
(web-conference)

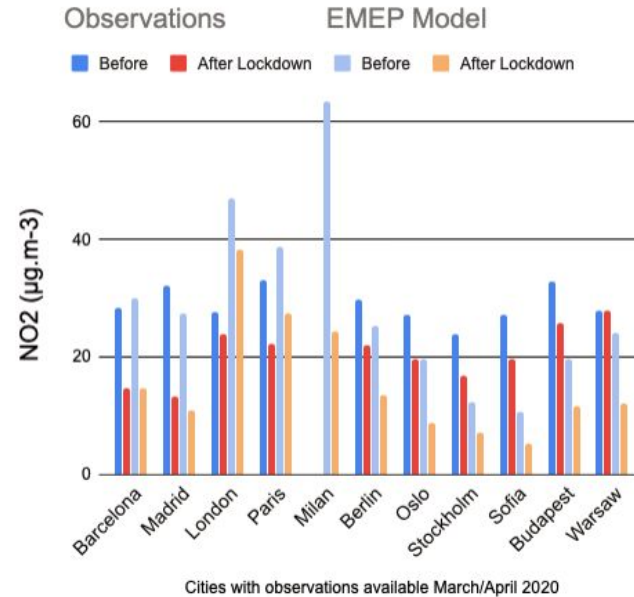
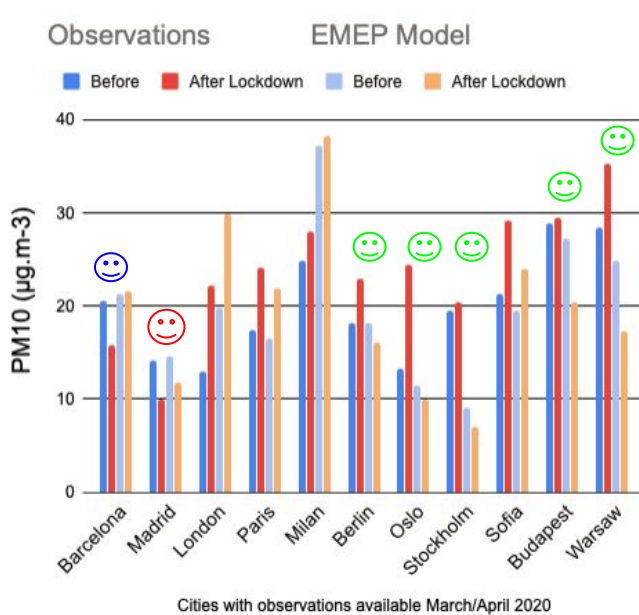


**EMEP model** (~14 km, ECMWF meteorology):

- ❑ CAMS operational setup (with DA) - two runs:
  - Reference
  - Emission reductions for EU+EEA countries (Barcelona Computing Center): Road transportation (54%), Industry (16%), Aviation (94%)
- ❑ Source-receptor runs
- ❑ **NO<sub>2</sub>** and **PM<sub>10</sub>**                      Period: 1 March - 30 April 2020

**Observations:** air quality observations reported to the EEA AQ e-reporting database (excluding traffic sites)

# Observed and EMEP modelled mean concentrations of PM<sub>10</sub> and NO<sub>2</sub> before and after the lockdown in the period March-April 2020 in selected European cities



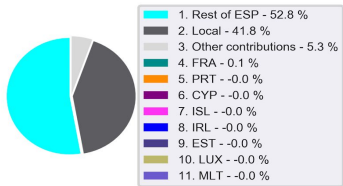
**Model:** EMEP simulation results (averaged over the “larger city area” of ca. 60\*60km)

**Observations:** EEA near real time (site averages in the same larger city area).

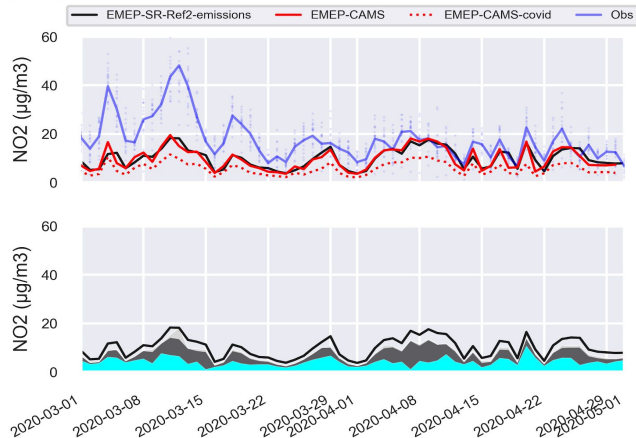
**Source for lockdown dates:** POLITICO research, Frontex, Oxford COVID-19 Government Response Tracker

Urban bias correction is applied to the modeled concentrations, using 11 city-mean model biases before lockdown: -28% for PM<sub>10</sub> and -63% for NO<sub>2</sub>.

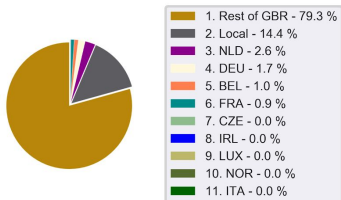
# Barcelona



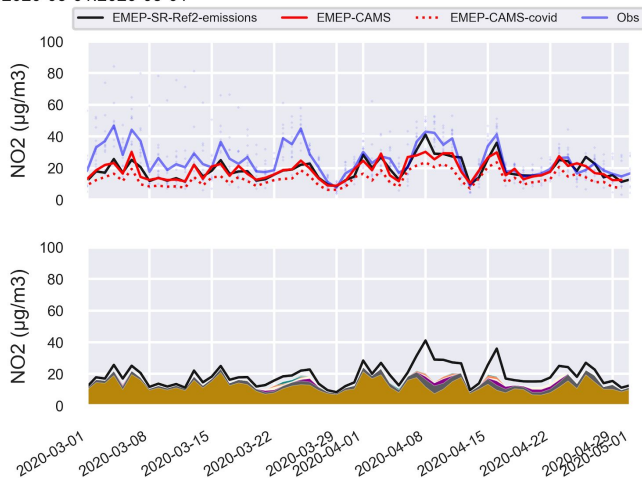
Barcelona 2020-03-01:2020-05-01



# London

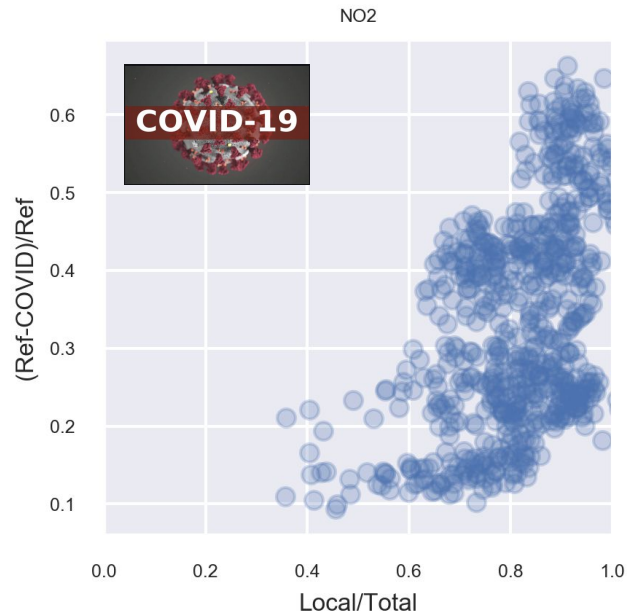


London 2020-03-01:2020-05-01

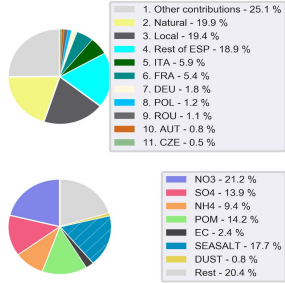


# NO2

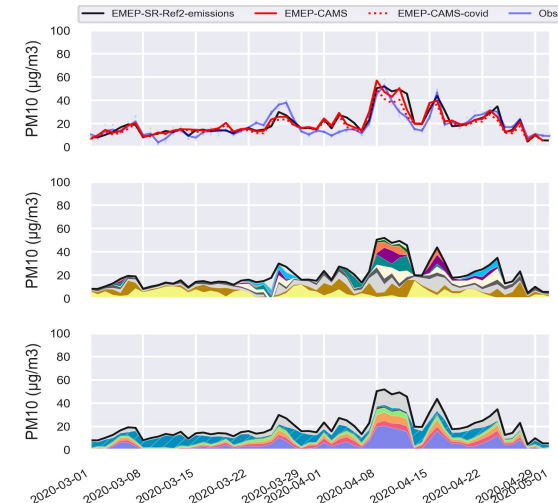
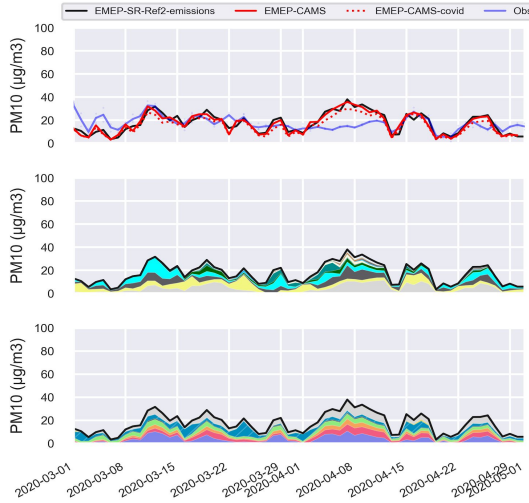
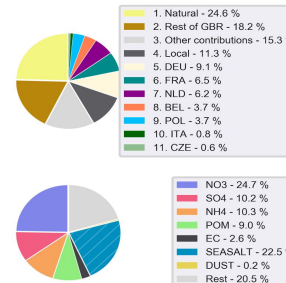
Lockdown effects: 10 - 65%



# Barcelona



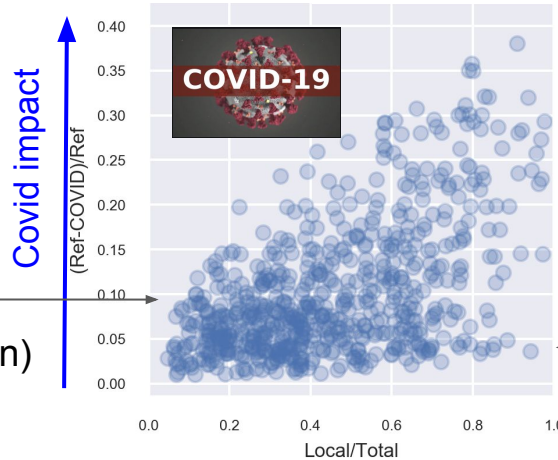
# PM10 London



Lockdown effects: 0 - 35%

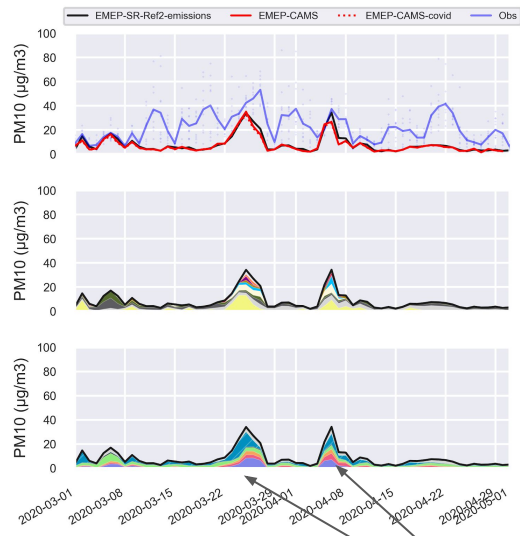
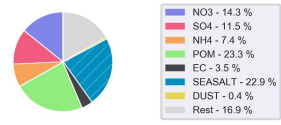
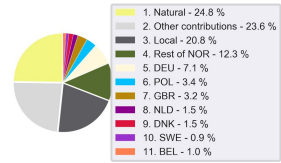
Long-range transport

Transboundary anthropogenic (London)  
Natural (e.g. dust in Sofia, Budapest  
sea salt in Oslo et al.)



# PM10

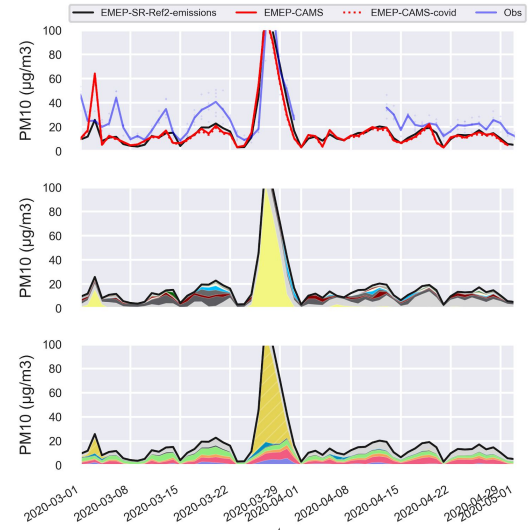
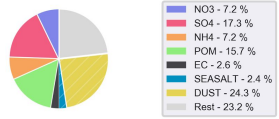
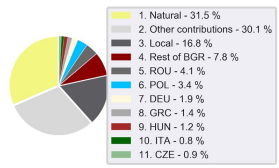
## Oslo



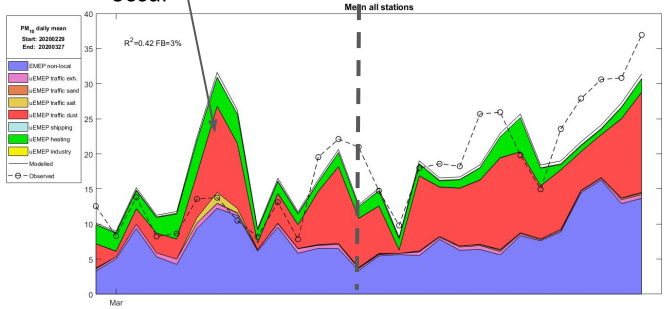
3 day modelled road dust event that did not occur

LR transport from DE, PL Sea salt

## Sofia



Aralkum desert dust episode



By courtesy of Bruce Denby

# City-group specific impacts

City areas with visible PM<sub>10</sub> pollution decrease due to lockdown emission reductions

City areas with PM<sub>10</sub> increase (or slight decrease) after lockdown due to dominating effect of emission advections from anthropogenic sources (e.g. agricultural, industrial) over COVID related reductions

City areas with only small decrease of PM<sub>10</sub> levels due to considerable effect of road dust due to studded tyres, road dusting and salting

City areas with mixed decrease/increase of the average PM<sub>10</sub> concentrations as the effect of lockdown emission reductions was disturbed by a large natural dust episode on 26-29 March

City	Lockdown Date*)	NO <sub>2</sub>				PM <sub>10</sub>			
		Concentration change (%) wrt to before lockdown start			Local contribution (%)	Concentration change (%) wrt to before lockdown start			Local contribution (%), major country contributions
		Observed	Model	Model Reference		Observed	Model	Model Reference	
Barcelona	16.03	-49	-51	-16	42	-23	1	16	19% EPS, IAT, FAR, DUE
Madrid	16.03	-59	-61	-1	24	-30	-19	-4	27% Natural dust
London	24.03	-14	4	13	14	72	51	69	13% DEU, FRA, NLD, BEL, POL
Paris	17.03	-33	-29	22	24	38	32	61	19 rest FRA, DEU, BEL, GBR
Milan	10.03	-	-62	21	39	-13	3	38	22 rest ITA
Berlin	22.03	-27	-47	-28	19	26	-12	-5	11 rest DEU, POL; sea salt
Oslo	12.03	-27	-55	-47	46	84	-12	-9	21 road dust (in observations)
Stockholm	15.03	-29	-43	33	56	4	-23	-18	24 road dust (in observations)
Sofia	15.03	-27	-51	15	80	37	23	29	17 Aralkum desert dust episode**)
Budapest	28.03	-22	-42	21	39	2	-25	-20	16 Aralkum desert dust episode**)
Warsaw	25.03	0	-50	31	71	24	-31	-27	30 Model does not reproduce observed episodes

# Summary



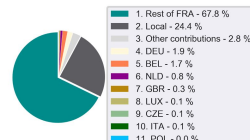
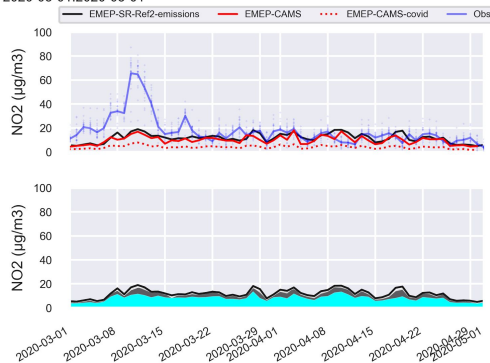
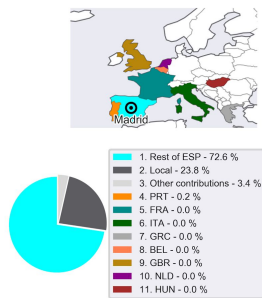
- A preliminary analysis of the impact of emission drop caused by reduced activity due to COVID-19 lockdown on air pollution in European cities was performed within CAMS71 framework: EMEP model simulations with/without emission reductions & EEA AQ observations
- Compared to Reference run, in the run with Covid emission reductions the model simulates (larger) decrease/smaller increase of  $\text{NO}_2$  and  $\text{PM}_{10}$  during lockdown period
- $\text{NO}_2$  concentrations decreased during the lockdown period compared to pre-COVID situation by 29% according to observations and by 46% according to model (measurement sites average at 10 cities)
- The overall effect of the lockdown on  $\text{PM}_{10}$  is less obvious: both concentration decreases and increases were observed and modelled
- SR analysis, used for interpretation of these results, identified significant differences in air pollution patterns and dominating PM sources among the cities. The role of episodes due to local sources and long range transport in masking those reductions is illustrated



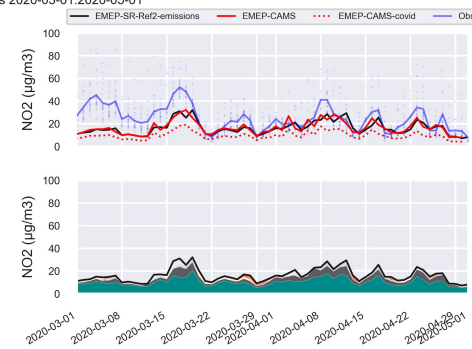


# Annex (for breakout discussions)

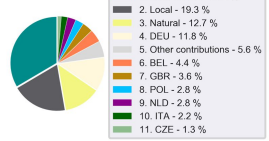
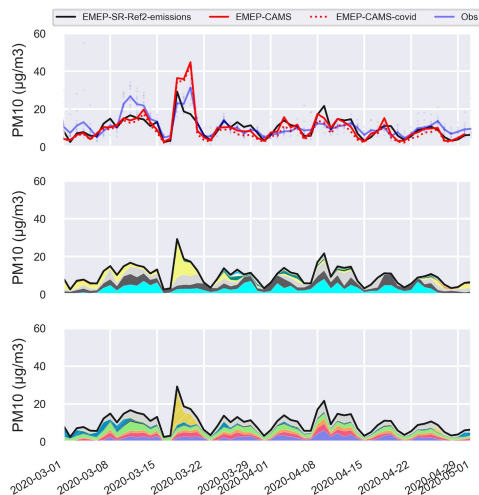
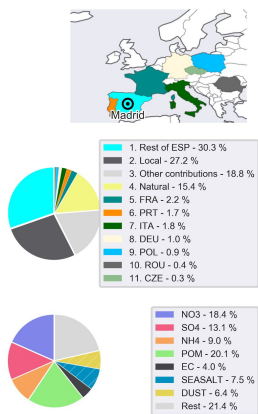
Madrid 2020-03-01:2020-05-01



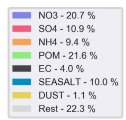
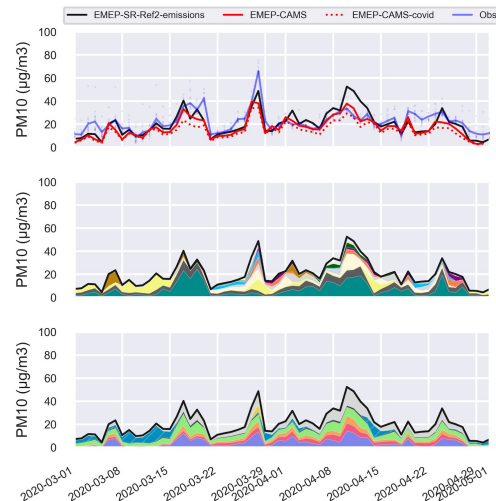
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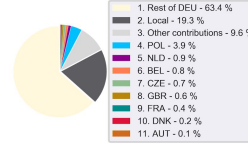
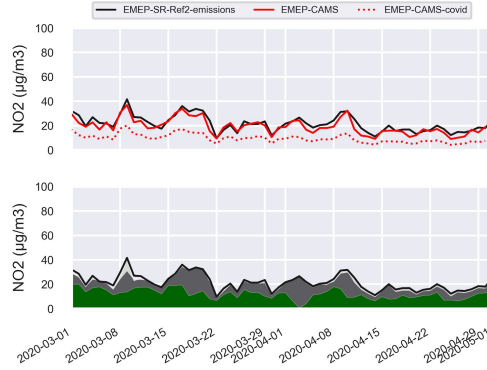
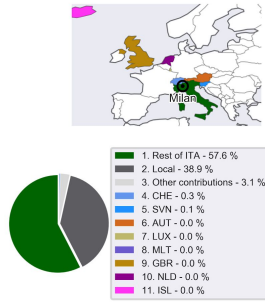
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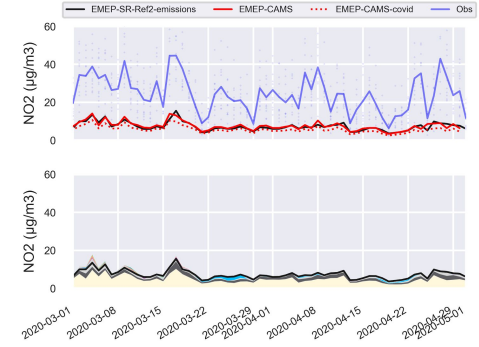
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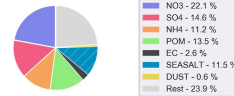
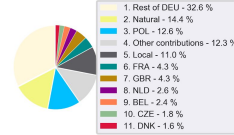
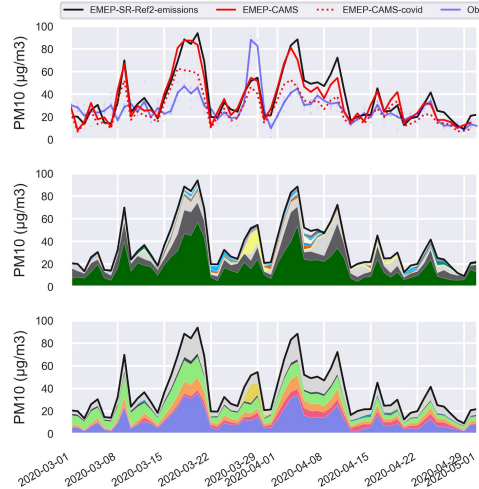
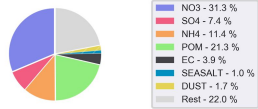
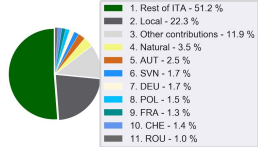
Milan 2020-03-01:2020-05-01



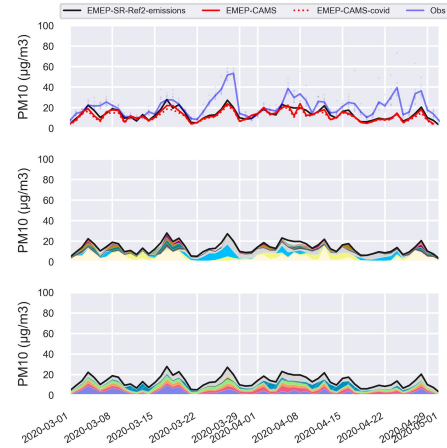
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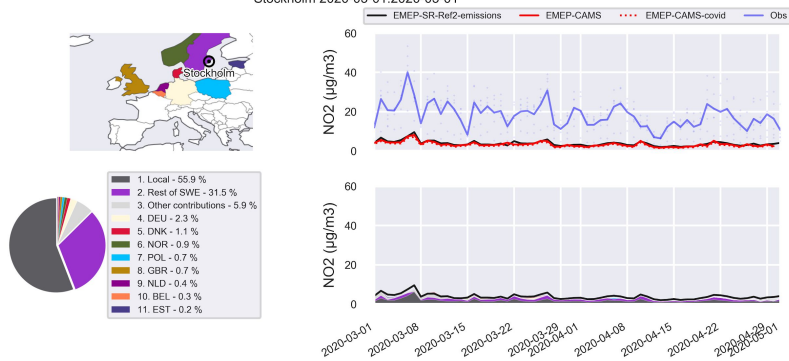
Milan 2020-03-01:2020-05-01



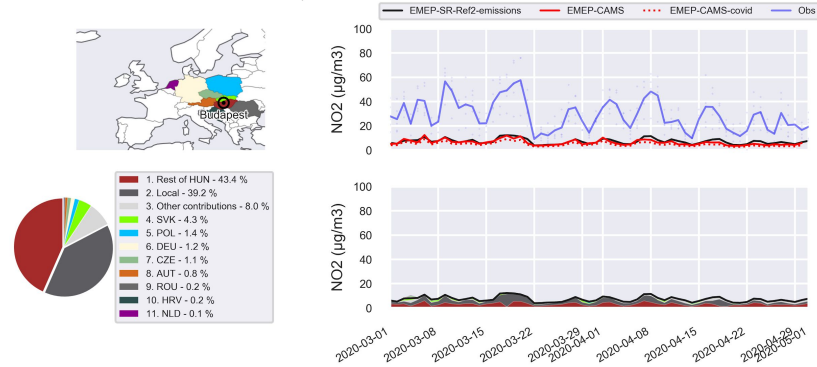
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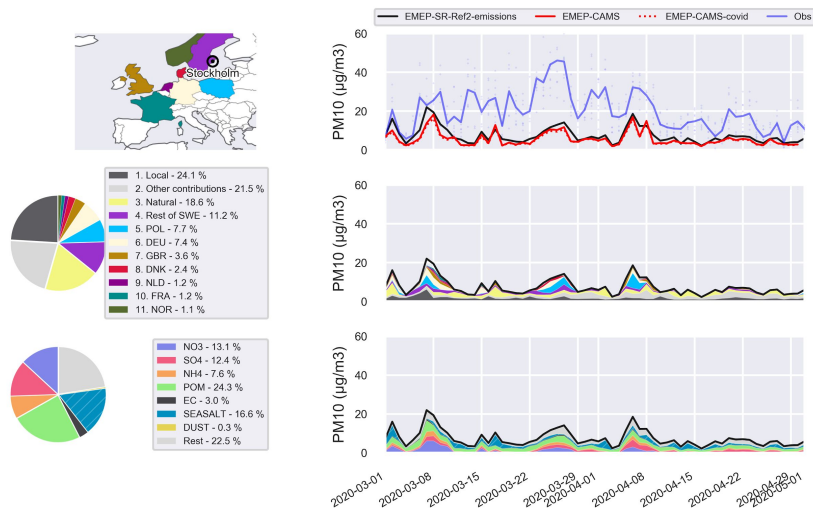
Stockholm 2020-03-01:2020-05-01



Budapest 2020-03-01:2020-05-01



Stockholm 2020-03-01:2020-05-01



Budapest 2020-03-01:2020-05-01

