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Use of homogeneous ground-based networks and satellite observations to investigate the COVID-19 lockdown effects on the atmospheric composition in various Italian urban sites.

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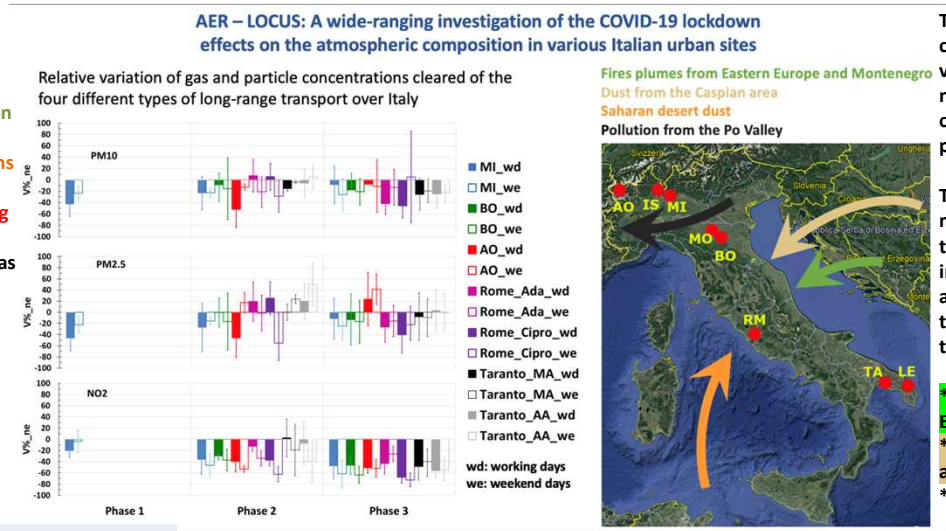
A widE-Ranging investigation of the first COVID-19 LOCkdown effects on the atmospheric composition in five Italian Urban Sites AER–LOCUS was carried out in 2020 with the aim of integrating, for the first time in Italy, observations from different platforms.

Particle and gas concentrations from in situ sampling (by the Regional Environmental Protection Agencies - ARPA), column aerosol and gas properties from photometers (AERONET and SKYNET) and spectrometers (PANDONIA), aerosol vertical profiles from ceilometers (ALICENET) , as well as TROPOMI NO2 determinations, were analysed at five sites distributed along the whole Italian territory: Aosta, Milan, Bologna, Rome, and Taranto.

THE HOMOGENEITY AND COMPARABILITY OF PRODUCTS AMONG EACH GROUND-BASED PLATFORM IS FUNDAMENTAL TO PERFORM A STUDY AT A LARGE SPATIAL SCALE

The period was divided in 3 phases:
phase 1 [24/2- 8/3] restriction only for North Italy ;
phase 2 [9/3-21/3] restrictions to Italy
phase 3 [22/3-4/5] increasing of National restrictions
From May 4 the lockdown was considered as finished for AER-LOCUS purposes



The measured concentration changes are not always due to variations in local emissions, as non-local particles and gases can be carried from distant places.

This synergistic network of measurements, together with the examination of differences in meteorological conditions, allowed to identify 4 different types of medium-to-long-range transport over Italy

*** fires plumes from Eastern Europe and Balkan Area,**
***desert dust from the Caspian area and from the Sahara**
***pollution from the Po Valley.**

TC=Tropospheric Column
VC= Vertical Column
Wd Working days
We = Weekend

		NO2_Tropomi		NO2_Pandora			
		TC	VC	TC Wd	TC We	VC Wd	VC We
MI	Ph.1	-56	-43	/	/	/	/
	Ph.2	-36	-18	/	/	/	/
	Ph.3	-40	-32	/	/	/	/
BO	Ph.2	+5	-13	/	/	/	/
	Ph.3	-42	-26	/	/	/	/
AO	Ph.2	-45	-18	/	/	/	/
	Ph.3	0	-18	/	/	/	/
RM	Ph.2	+16	0	-28	-32	-34	-45
	Ph.3	-50	-29	-55	-58	-47	-35
TA	Ph.2	0	-10	/	/	/	/
	Ph.3	-33	-18	/	/	/	/

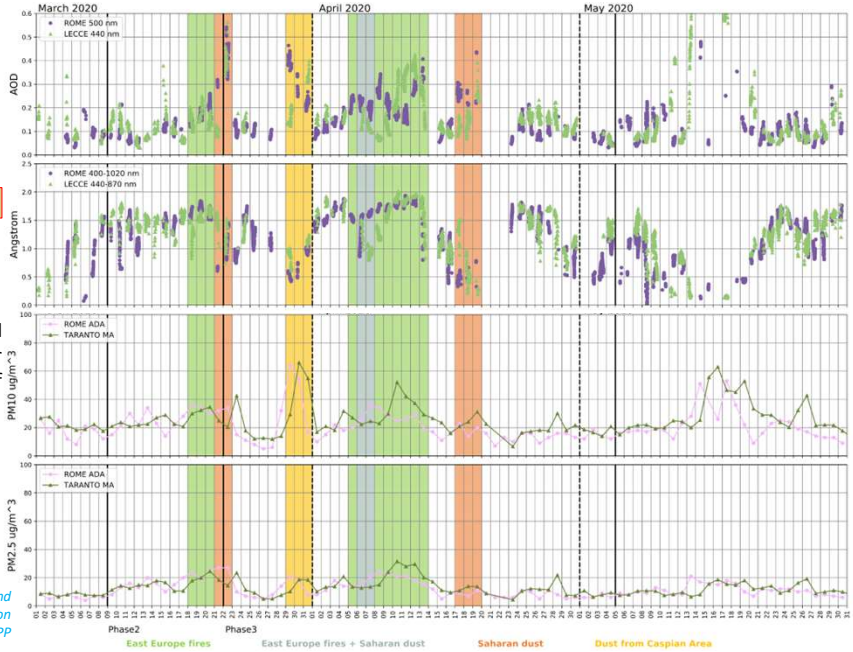
"non local" events are identified and excluded. With respect to a reference period (2015-2019) PM10, PM2, BC, NO2, and benzene showed a general decrease. A positive variation of PM2.5 is found during March in the southern sites due to some stagnation events, and a strong increase of benzene (up to +104%) in the industrial area of Taranto. Ozone is found to increase by an average of about 30% in all urban sites.

Identification of medium- and long-range air mass transport events:

Spotting AOD enhancements and variations of *Angstrom exponent*

Aerosols have a lifetime in the atmosphere spanning from a few days to weeks and they are good tracers for air mass movements

Days with particularly high *AODs:* presence of a greater particle load in the entire atmospheric column, possibly transported from other regions. **Time evolution of the *Angstrom:*** a qualitative indicator of the aerosol size during the enhanced AOD events:
Ang ≲ 1.0: size distributions dominated by coarse aerosols
Ang ≳1.5: size distributions dominated by fine aerosols
Days with enhanced AOD were analysed along with HYSPLIT back-trajectories (96 h) to assess the origin of the air masses, and with Ceilometer profiles to identify the aerosol layer vertical distribution



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REFERENCES: Campanelli et al., 2021, https://doi.org/10.1016/j.uclim.2021.100954