

What are drivers of the tropospheric ozone change during spring 2020?

Session: Interactions between air pollution, meteorology and the spread of COVID-19

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Global simulations of the 2020 COVID-19 lockdowns



- ✓ Tropospheric and stratospheric (ozone) chemistry
- Aerosol scheme: MAM4 VBS (SOA)
- Daily 2020 fire emissions (QFED 2.5)
- Nudged to 3-hourly 2020 meteorology from MERRA-2
- Baseline emissions CAMS-GLOB-ANT-v4.2-R1.1 (includes MEIC over China)



Simulation name	Dynamic / meteorology	Emission effect	Notes
Control	2020 meteorology	business-as-usual 2020 emissions	reference
COVID-AII	2020 meteorology	Lockdown adjusted emissions	emission impacts
Climato	2015-2020 meteorology	repeated 2020, same as control	dynamic impacts
Climo	2001-2020 meteorology	2001-2020 emissions	comparison with ozone sondes
COVID-Surface	2020 meteorology	Surf. only lockdown	Surface emissions on Trop. O3
COVID-Airc	2020 meteorology	Aircraft only lockdown	Aircraft emissions on Trop. O3



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Emissions / Lockdown impacts

CONFORM

(COvid adjustmeNt Factors fOR eMissions)

- Gridded AFs from January to August 2020 as NetCDF files
- Daily and gridded 0.1°x0.1°
- Slobal coverage

Gaubert et al., JGR, 2021

For each species: 7 Sectors



COVID-ALL - Cntrl (%) NOx 202004



Lockdown induced changes (%) Ozone during April 2020

Lockdown impact: emission induced chemical perturbation



Impact of meteorology

Record low ozone, lowest ozone since 1979, in the stratosphere seen by MLS observations (Manney et al., 2020), ozone sondes measurements (Wohltmann et al., 2020) and chemical reanalyses (CAMS, Inness et al., 2020).



Deep intrusions of stratospheric ozone frequently reach the middle and even lower troposphere at midlatitudes during winter and spring.



Concluding remarks

Zonally averaged ozone in the free troposphere during Northern Hemisphere spring and summer of 2020 is found 5 to 15% lower than 19-year climatological values, in good agreement with observations.





Steinbrecht et al., 2021; Bouarar et al., GRL, 2021

- 1. About one third of this anomaly is attributed to the reduction scenario of air traffic during the pandemic,
- 2. another third to the reduction scenario of surface emissions,
- 3. the remainder to 2020 meteorological conditions, including the exceptional springtime Arctic stratospheric ozone depletion.