Quantifying COVID-19 transportation emission reductions: European(1), US(2) and global(3) perspectives

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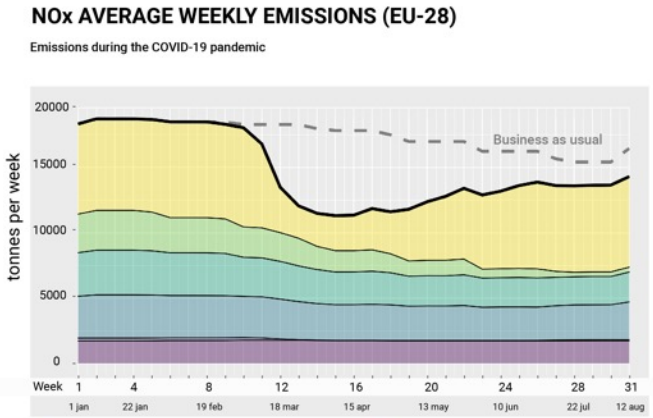
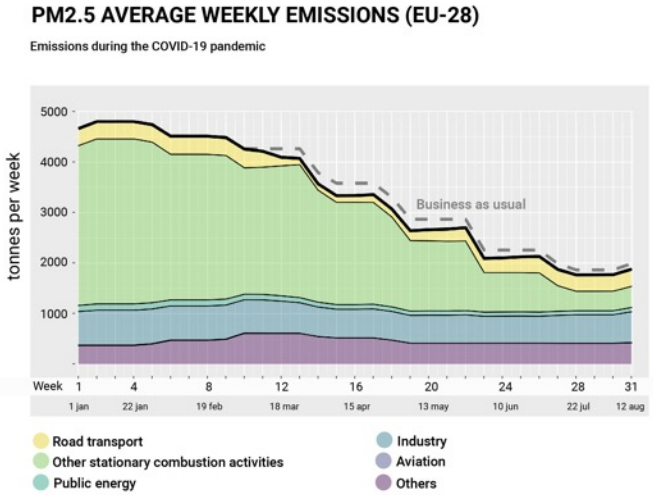
(3) Thierno Doumbia, Centre National de la Recherche Scientifique

IGAC/AMIGO workshop:
Changes in Atmospheric Composition During the COVID-19 Lockdowns
3 November 2020

CAMS/COP_066: Quantifying European emission changes due to COVID-19 restrictions





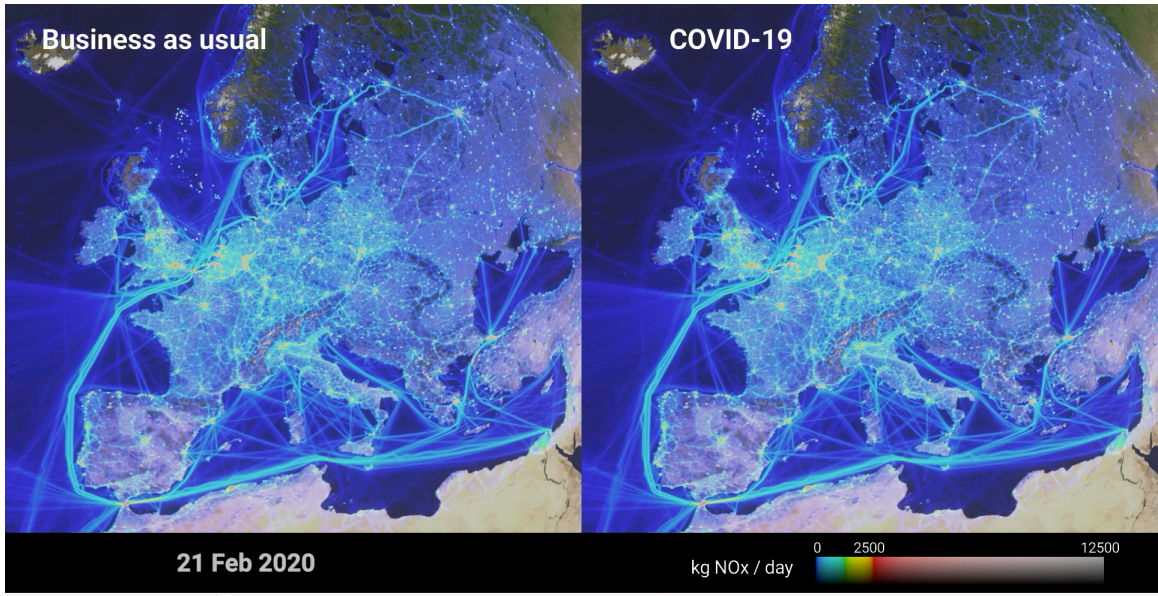
Dataset available soon through the CAMS [Atmosphere Data Store]

Development of daily-, country- and sector-dependent reduction factors (Guevara et al., 2020), to be combined with the CAMS-REG European inventory (Kuenen et al., 2020) for AQ modelling

Sectors considered: Energy and manufacturing industry, residential/commercial combustion, road transport, shipping, aviation

Temporal coverage: 21/02/2020 until 31/07/2020

Data-driven approach: Changes in emissions assumed to follow changes in measured time-series representing the main activities of each sector

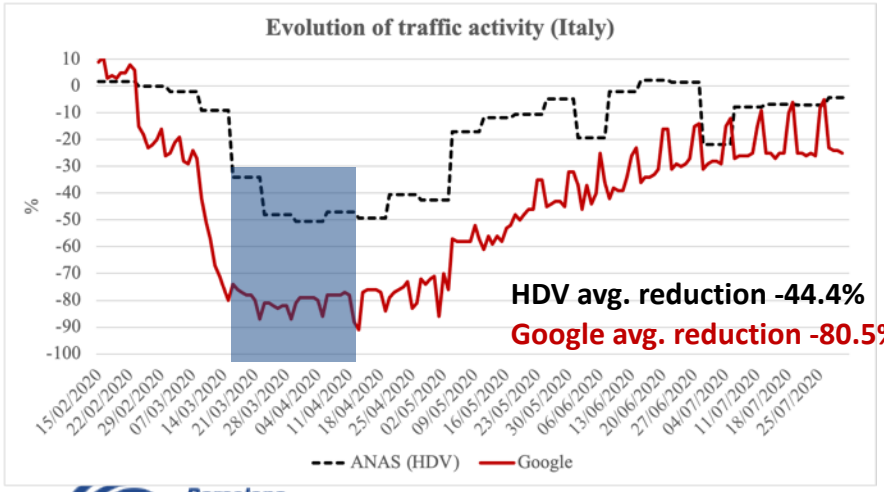


Road transport sector

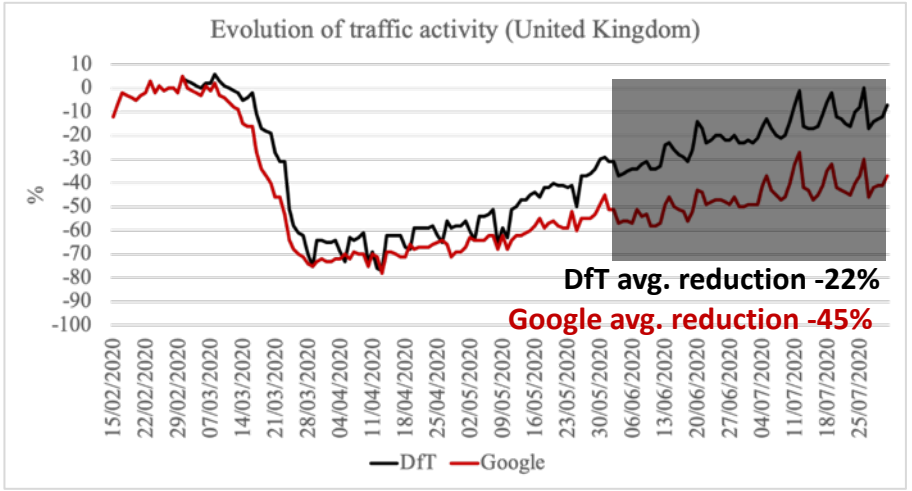
Use of the Google COVID-19 Mobility Reports (Google, 2020) - Transit stations category

- Daily movement trends by country/regions across different categories of places.
- Based on anonymized and aggregated mobility trends in public transport hubs
- Widely used within the modelling community: Adams (2020); Forster et al. (2020); Lee et al. (2020);….
- Very useful, complete, homogenous, continuously updated open-access dataset…
- **But when compared with trends derived from measured traffic counts, certain limitations arise**

Limitation 1:
Google trends are not representative of the observed changes in activity of heavy-duty vehicles



Limitation 2:
Google trends underestimate the recovery of activity during lockdown exit process (i.e. are affected by people's reluctance towards using this mode of transport)

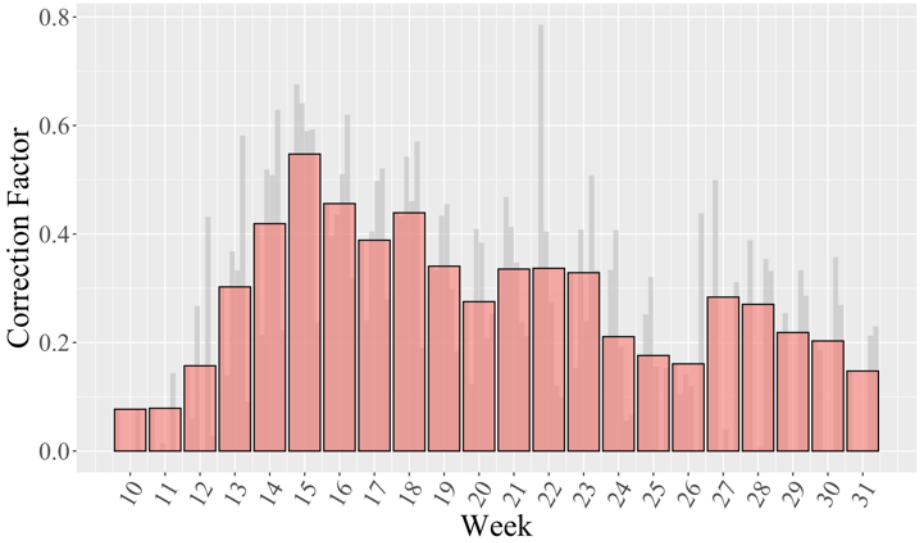


Similar patterns observed in Spain, Poland, Germany, Switzerland, Norway, Denmark, Sweden, France

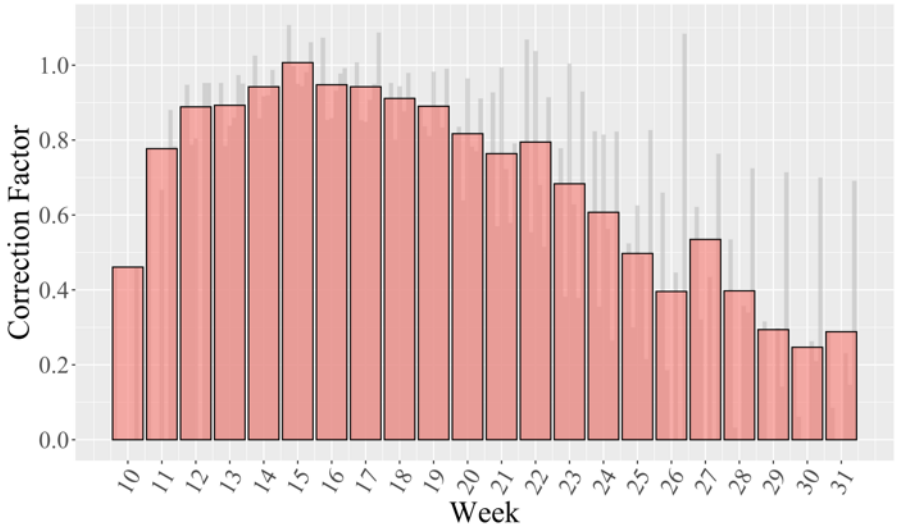
Road transport sector

Use of measured-based trends from United Kingdom, Italy, Germany, Poland, Sweden, Switzerland and Spain to compute two sets of European adjustment factors:

weekly "Google HDV adjustment factors"



weekly "Google lockdown exit process adjustment factors"

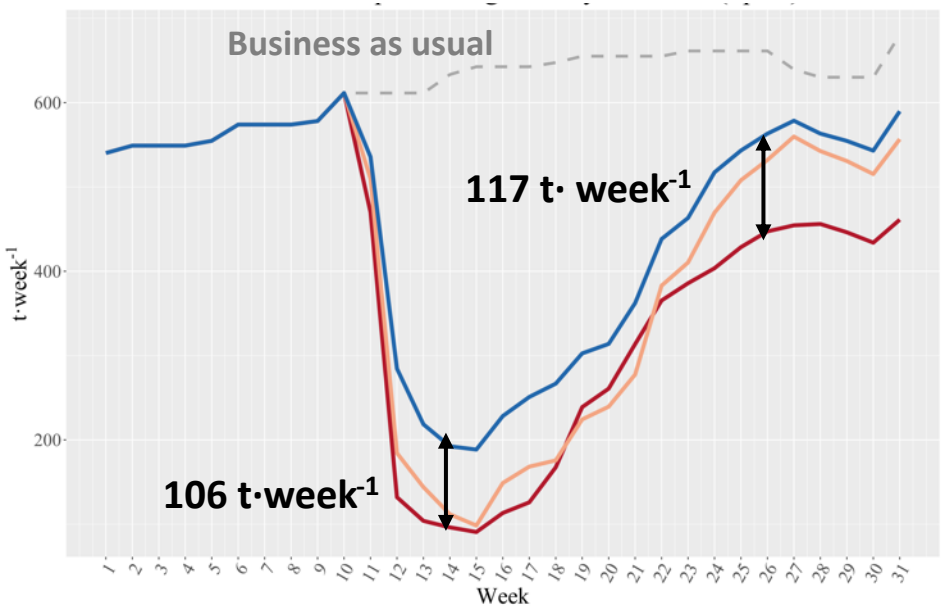


Barcelona Supercomputing Center
Centro Nacional de Supercomputación

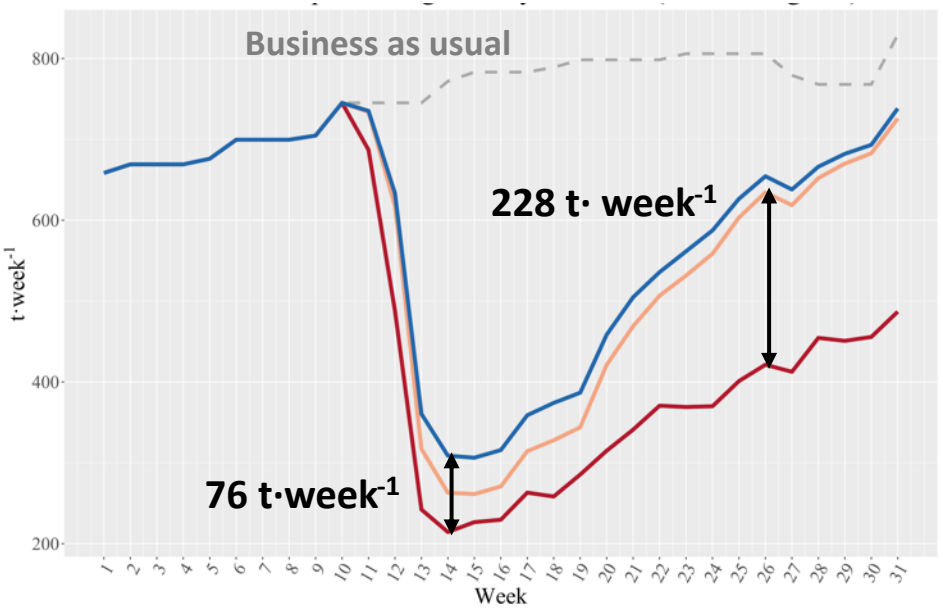
Road transport sector

Emission sensitivity test: Google original trends versus measured-based trends

NO_x road transport average weekly emissions (Spain)



NO_x road transport average weekly emissions (UK)



BAU COVID-19 (Google) COVID-19 (Traffic counts) COVID-19 (Traffic counts + HDV)

Significant impact on the emission reduction results (both during lockdown and exit process)

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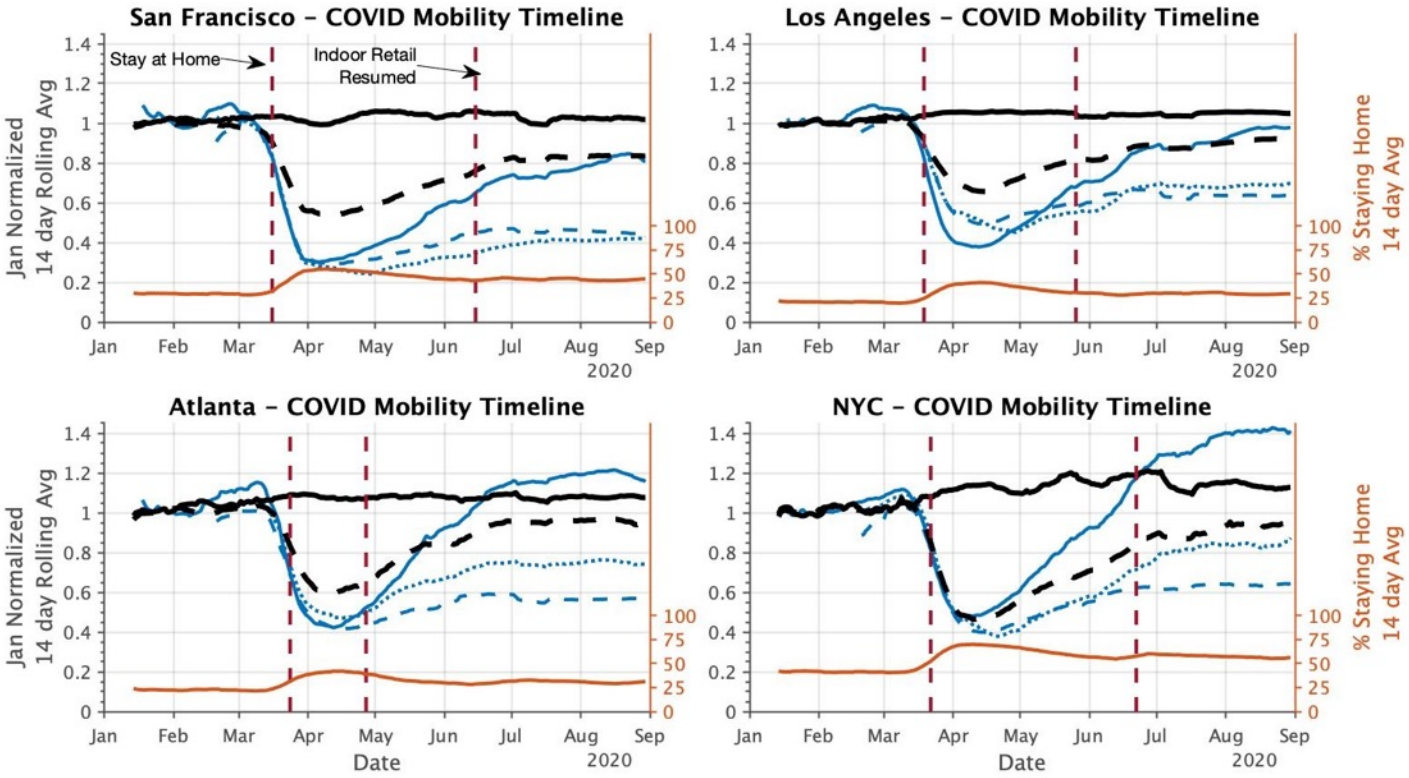
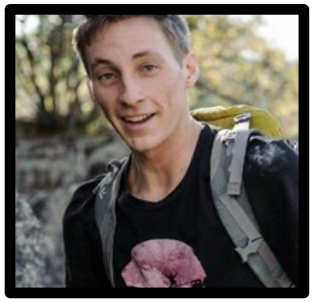
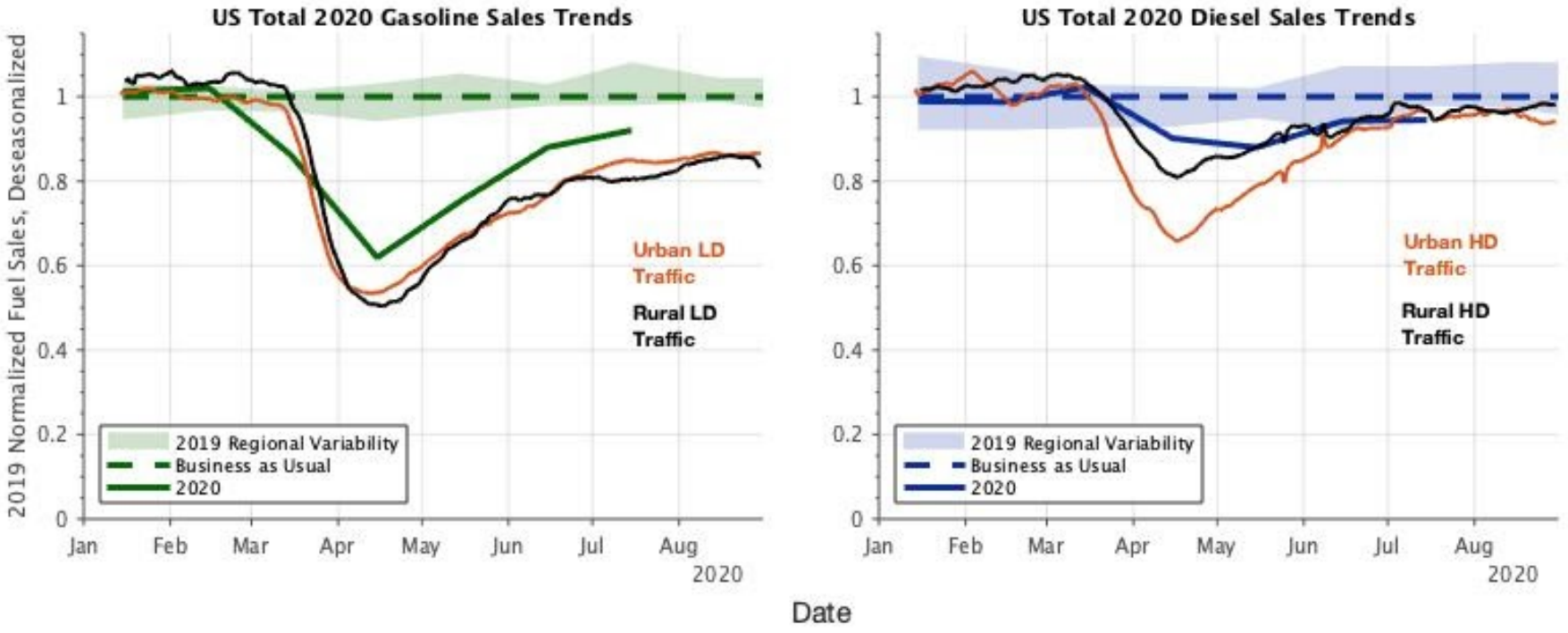
Comparing Traffic Counter and Mobility Datasets Across US Cities





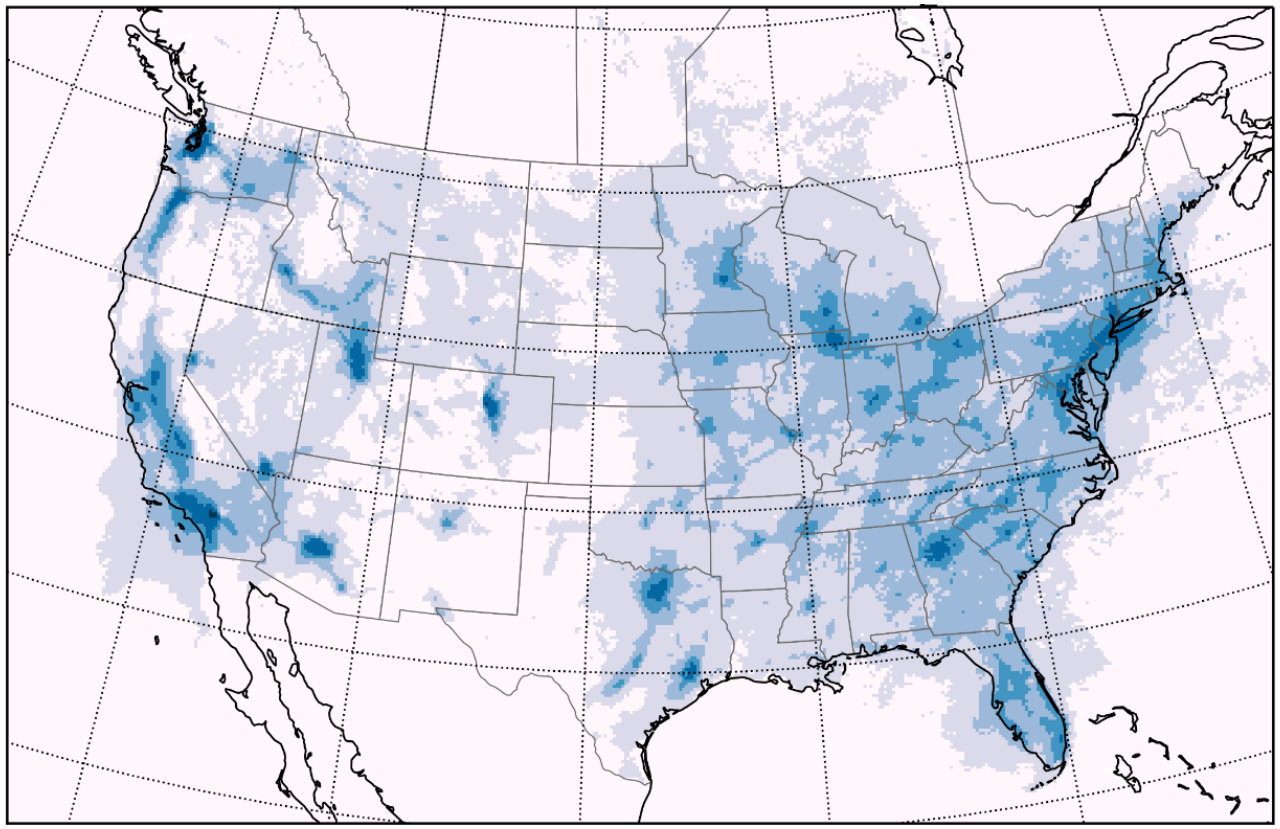
Colin Harkins (CU-Boulder)

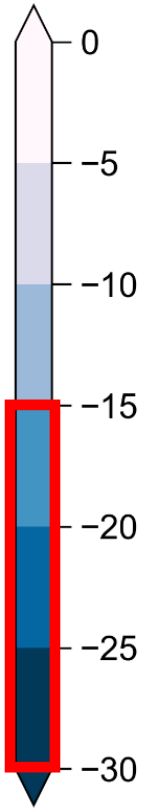
Differences in Changes of Light-Duty Gasoline and Heavy-Duty Diesel

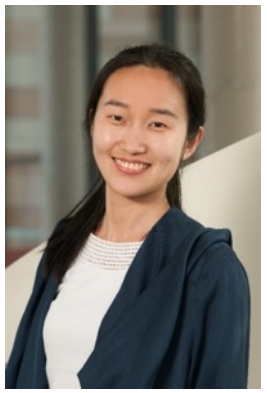


Reduction in Mobile Sources Mainly Affects NO_2 Over Urban Regions

% Change in Model June NO_2 Column (BAU → COVID-19)



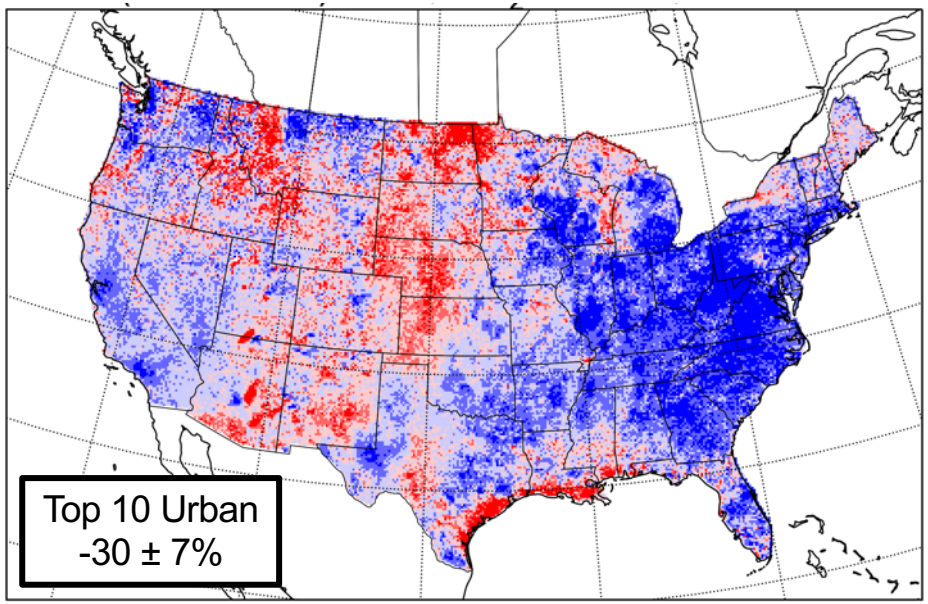




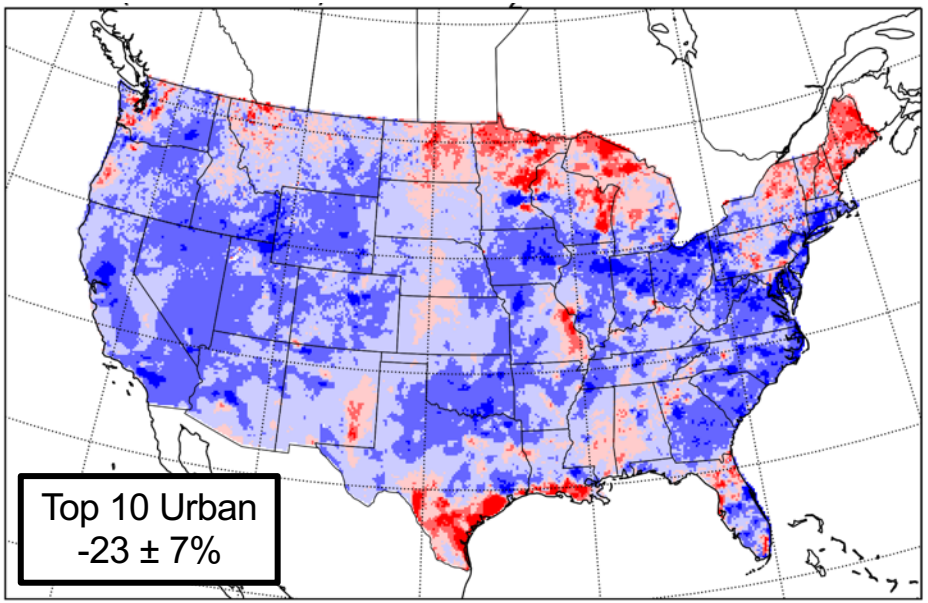
Meng Li (NOAA)

Decrease in Mobile Source NO_x Contributing to Lower Urban NO_2

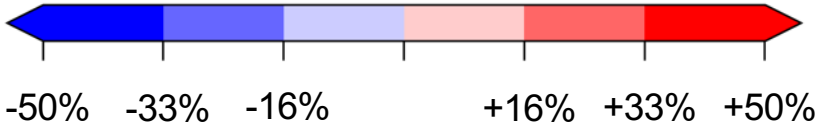
TROPOMI Trop. NO_2



WRF-Chem Trop. NO_2



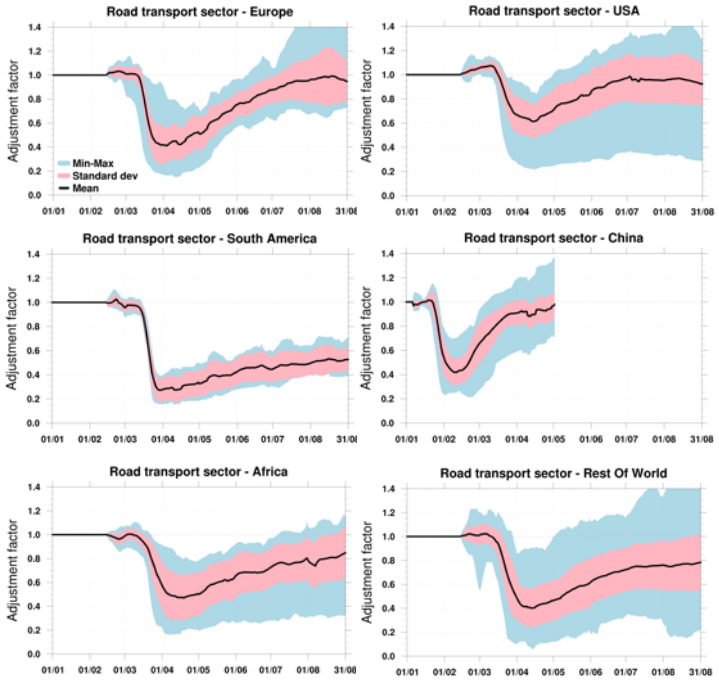
Difference between 2018 and 2020



Changes in Global Air Pollutant Emissions during the COVID-19 Pandemic

Doumbia et al., (**Laboratoire d'Aérologie /CNRS, Toulouse**)
To be submitted to ESSD (Earth System Science Data) soon.

Evolution of daily geographical adjustment factors in road transport based on Google's transit measures and Baidu Migration Index for China



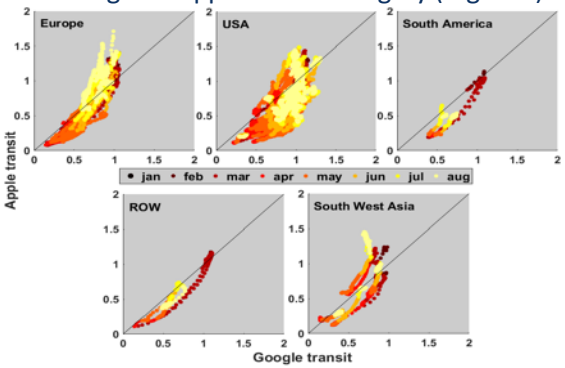
There is a significant decline in activity data for road transport, with an average reduction of up to 60% occurring in mid-April in most regions of the world.

In China, the reductions reached highest level in mid-February, while in the rest of the world the peak occurs late March.

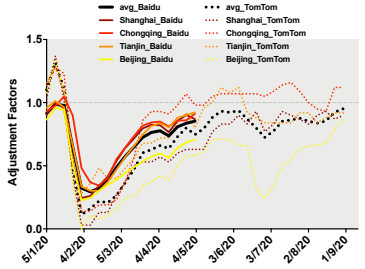
Large differences exist between datasets providing comparative parameters, leading significant uncertainties in our estimations

Use of activity data to estimate worlwide changes in emissions related to the COVID-19 pandemic restrictions.

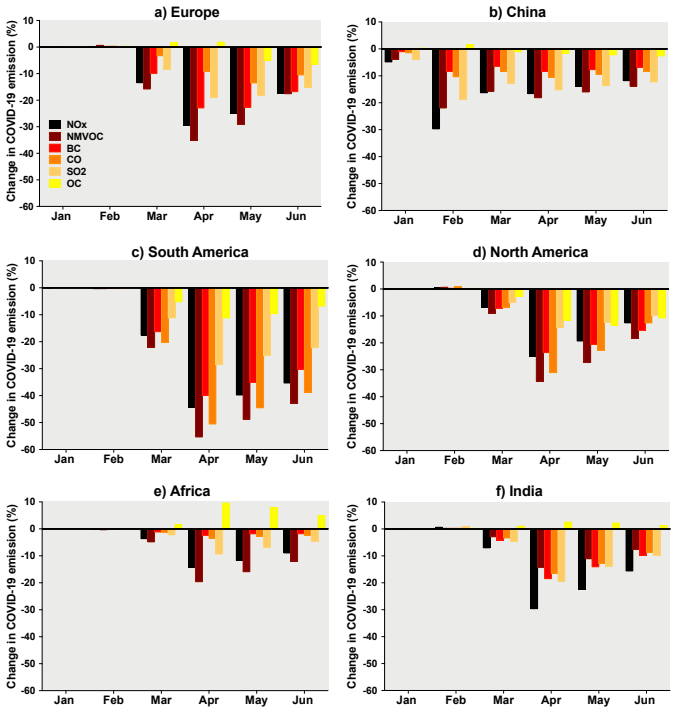
Google vs Apple transit category (regional)



Baidu vs TomTom Mobility Index (China)

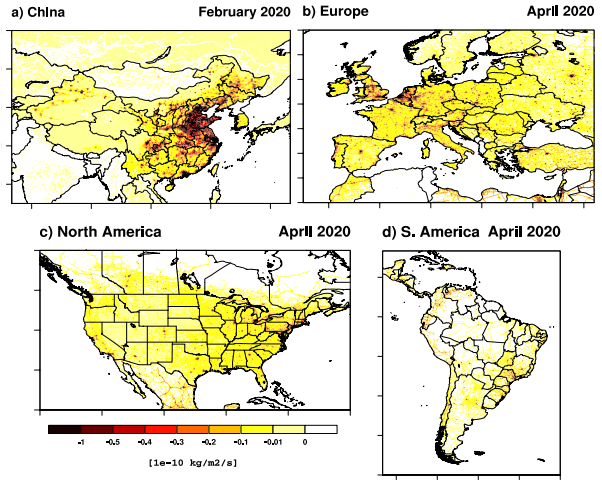


Impact of Changes on CAMS Global Emissions



Analysis of the impact of changes on emissions for different compounds, using the CAMS-GLOB-ANT_v4.2_R.1 inventory (Granier et al., 2019 ; Elguindi et al., 2020).

Spatial distribution of the absolute difference between NOx emission with and without COVID-19 adjustment factors



Adjustment Factors have been estimated for sectors such as **road transport, industry, power, residential, shipping and aviation**.

The global gridded adjustment factors will be available soon on the ECCAD database (https://eccad.aeris-data.fr/), under the name **CONFORM** (**CO**vid adjustme**N**t **F**actor f**OR** e**M**issions)

Take home messages

- Emission reductions during COVID-19 lockdowns were primarily driven by changes in road transport, and the contribution of this sector to total emissions of each pollutant.

- Large variations were observed from country to country, depending on the level of restrictions imposed on mobility.

- Mobility data has proved to be a very useful/powerful proxy to qualitatively understand the drop in traffic activities, but:
  - Quantitively speaking, significant discrepancies appear when compared to traditional metrics (e.g. traffic counts, fuel sales) → Adjustment factors should be considered
  - Certain aspects of the methods used to produce the trends remain unknown → An engagement with data providers would allow a better understating.

- We are forming a new GEIA working group on Emissions and the COVID-19 pandemic (let us know if you want to be part of it: brian.mcdonald@noaa.gov , marc.Guevara@bsc.es)