Air quality in Europe: A closer look at the impact of COVID19 lock-down and the related travel restrictions on NO2 and particles

EGVI
European Green Vehicles Initiative

Report on the Covid-19 Impact On Air Quality Online Workshop

''Air quality in Europe: a closer look at the impact of Covid-19 lockdown and the related travel restrictions on NO_2 and particles emissions'', 21 September 2020.

Experts from EEA, Academia and Public Health Institutes provided a review of the data collected on air quality across Europe during the Covid-19 lockdown. The session was moderated by **Prof. Zissis Samaras** from the *Aristotle University, GR*.

Dr. -Ing. Stephan Neugebauer, EGVIA chairman opened the event, welcomed the participants, and made a short presentation of the objectives of the workshop pinpointing that this conference came into being to help input into our research priorities, perhaps even regulation needs.

Evrim Ozturk from the *European Environment Agency* (EEA) presented data from European cities which show significant decreases in pollutant concentrations during the lockdown. Data on the average NO_2 pollution levels from the year before and during the lockdown showed that hot spots exhibited lower levels during the lockdown. This data is helpful but does not directly quantify the effect of lockdown due to, e.g. meteorology data. Hence, real time data for NO_2, $PM_{2.5}$ and PM_{10}. was checked against dual sourced historical data, collated to give daily data. Comparisons of the daily and/or weekly data for these three pollutants was shown. On this base, all estimates show that NO_2 concentrations were considerably reduced in April 2020 (70% at traffic stations in Spain and Italy and 60% at background stations in France). Concentrations of PM_{10} also fell across Europe, although less than for NO_2 (35-40% at traffic stations in cities and up to 20% at background stations). Copenhagen did not show a corresponding reduction in NO_2: the concentrations increased rather, possibly due to increased use of private cars by the Copenhagen inhabitants to avoid squeezing inside public transport. An increase in PM_{10} concentrations in a limited

number of sites was also observed, indicating that PM_{10} concentrations are influenced by other than road traffic sources (domestic heating, natural sources). Further, it is likely that agricultural emission of PM and NH_3 were not affected during the lockdown.. (**’Impact of Covid - 19 lockdown period on air quality across Europe based on situ monitoring data Evidence presented suggests that the COVID-19 lockdown**.’)

Prof. Ranjeet S Sokhi from the *University of Hertfordshire, UK*, presented the results of an observational study conducted in 20 cities around the world as well as the results of modelling study focusing on the UK. This study started in June this year, there have been more than 200 papers coming out already on this topic. There are about 50 people involved in the work. The study aims to quantify the changes in concentrations of NO_2, NOx, $PM_{2.5}$, PM_{10} and O3 on local to regional scales. Observational analysis shows a reduction of 20 - 60% in NO_2 and up to 40% in $PM_{2.5}$ in cities but with regional differences e.g. in some cities there is an increase in $PM_{2.5}$. Modelling analysis for UK predicts reductions of 30-40% in NOx and NO_2 concentrations in urban areas and of 20-40% in rural areas. Lower reductions are predicted for PM (20% in urban areas and 15% in rural areas), whereas O3 concentrations are predicted to increase near airports and urban areas. Overall, during the lockdown the predicted changes in urban locations were mostly due to reductions in road traffic emissions. For rural areas, most changes could also be attributed to road traffic reductions. (**’First conclusions from the WMO/GAW Coordinated study on impacts of COVID – 19 lockdown measures on air quality: an observational and modelling analysis.**’)

Prof. Nicolas Moussiopoulos from the *Aristotle University, GR*, presented the results obtained from an air quality management system (AQMS) installed in Nicosia (Cyprus) and Thessaloniki (Greece). The AQMS comprises of two operational modules, providing hourly nowcasting and daily forecasting of the air quality status, implemented as an integrated model system that performs nested grid meteorological and photochemical simulations. The AQMSs were shown to be able to retroactively capture the effects of activity reductions (better in NO_2 where measured reduction in concentration was about 40% whereas calculated reduction was about 37%; less good in PM_{10} where measured reduction was 20% and calculated reduction was about 37%). Further, Prof. Moussiopoulos pinpointed the usefulness of air quality models in disaggregating the effect of different contributing factors (emissions per sector, meteorology, and long-range pollutant transport). He also stressed that emissions (and emission reductions), as well as sectoral source contributions, can in principle be estimated using the inverse modelling technique starting from observed lockdown air quality information. (‘**Conclusions drawn from air quality model simulations with emphasis on meteorology and the emissions situation**’.)

Prof. Peter Sturm from the *Graz University of Technology, AT*, presented data from three dedicated periods which relate to different stages of the lockdown in Graz (full lockdown, partial opening, re-opening), with focus on NO_2 and PM_{10}. In agreement with other studies, Graz data suggest that road traffic is the major contributor to NO_2 concentration levels in urban areas, although there were household effects and meteorological effects due to the seasonal change. The statistical models for NO_2 over predicted the effects of the full lockdown but improved in predictive capability as the lockdown eased (as is to be expected with an empirical model based on historical data). Some resolution of different traffic activities was possible: e.g. identification of school runs. With the PM data the model worked quite well, apart from when a Sahara dust event was experienced. Overall, it was concluded that a detailed (physical), rather than a statistical model is needed to correctly predict the effects. (‘**What are the possible effects on air quality of future emission interventions?**’)

Dr. Miriam Gerlofs-Nijland from the *National Institute for Public Health and the Environment (RIVM), NL*, gave a short summary of the relation between Covid-19 and air pollution. She referred to the physiological effects of air pollution and to the increased infection risk because of inflammatory responses which can

be short and long term. Then she explained the two hypotheses made by researchers on the Covid-19/Air pollution relation, (i) air pollution increases infection risk and (ii) air pollution causes a more serious course of the disease, presented innovative sampling systems for aerosols microorganisms, and stressed the need for reliable and complete data. Much research on the Covid-19/Air pollution relation has been published recently: however, there is still much discussion, and it will take time to arrive to good conclusions. Were the spatial variations in NL for the virus infection correlated with those of poor air quality? There might be some correlation, but other factors (carnival, holidays etc.) might be the cause. All the studies suggesting a strong link had significant weaknesses: further research is a must. ('**The role of air pollution in the Covid - 19 pandemic.**')

After the presentations, a panel discussion was organized with all the presenters (along with **Dr. Gladys Moréac-Njeim** from Renault) addressing questions raised by attendants, summarising the lessons learnt and suggesting the next steps.

Summary of the discussion

- The lockdown is associated with considerable reduction of NO_2 concentrations across Europe, independently of the meteorological conditions. The relative reductions varied significantly within cities and across countries; nevertheless, they are strongly related with road traffic reduction.
- The assessment of changes in PM_{10} concentrations due to the lockdown is more uncertain than for NO_2 concentrations. These concentrations vary, not only with meteorology and emissions of primary PM, but also with emissions from many other sources, particularly due to heating, but also natural sources, which are difficult to predict and are highly variable from one year to another.
- The picture for $PM_{2.5}$ concentration is mixed with substantial regional variation. Road vehicles are a major source of $PM_{2.5}$, however, the commercial/institutional and household sectors may be the most significant source. In addition, $PM_{2.5}$ also includes secondary particles formed from the chemical reactions of gases such as SO2 and NOx. Since it is complex to understand the sources for $PM_{2.5}$ and the data collected are limited, further research is needed to clarify this issue.
- In this context it is questioned if PM_{10} or $PM_{2.5}$ are good indicators for road transport contribution to particle related air pollution. Moving to $PM2_{.5}$ is sensible, to filter our natural emissions. However, we should go below these sizes in the future, such as PM_1, $PM_{0.1}$ or even PN, since we have clear evidence that ultrafine particles affect health, but we have no air quality data.
- Operational back and forecast air quality models are a powerful tool in disaggregating the effect of different contributing factors; nevertheless, they need to be fed with reliable and complete data in particular as regards the emission inventories.
- Continued short- and long-term observations under different conditions combined with comprehensive analysis can serve as a guiding tool to see where we go through the economic recovery process and can guide the corrective actions.
- It is plausible that both daily increases and chronic exposures to outdoor air pollution adversely impact prognoses of the disease.
- Reliable and complete data are needed. The work at WMO level is anticipating important feedback related to activity and emissions from industry, authorities, infrastructure operators and interest groups. The community is invited to pose questions to the WMO organisation, so that they can try and take account of specific matters.
- We still cannot understand the differences between PM_{10}, $PM_{2.5}$ and PM_1 with respect to their health effects: we think overall they have the same risk, but we are not sure. We looked at diesel vehicles with and without filters: despite the increase in NO_2 from these vehicles, we saw that health effects were reduced, so overall it is not so easy to unravel effects.

- In road transport we do a lot of effort to minimise the contribution. However, there is a lack of roadside measurement in many areas, so the situation is not fully known. We need better simulation and modelling.
- We also need knowledge and indications about other pollutants (i.e. CO, ozone, ammonia etc.). There is evidence that regional scale ozone levels decreased considerably due to the NO_2 reductions associated with the Covid-19 lockdown measures.

Key messages for follow-up research

- We need to reinforce our confidence to the modelling capabilities. Therefore, we need research to develop better calibrated models, more reliable simulations for pollutant formation estimation. There are still a lot of gaps in our modelling, in our validation, in our causal chains and the understanding of background sources.
- Low-cost sensors are entering in our lives and introduce a gradual shift in the measurement air pollution. We need to work further on these low-cost sensors and the production of on-line emission inventories that can substantially improve the quality of the air quality models with tremendous effects on their forecasting capabilities. We also need to set standards on the use of these.
- Moreover, there is the need to deepen and reinforce our learning that all the above are important not just for air quality but also for climate change.
- Since this is a really complex and important question, we need more work, if we make a wrong conclusion on the sources, we cannot implement actions that will positively impact air quality.

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