2020

A preliminary assessment related to the impact of Covid-19 measures on air quality in Malta

ENVIRONMENT AND RESOURCES AUTHORITY

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Background

The outbreak of COVID-19 late in 2019 became a global health crisis, forced many cities to shut down and impose measures limiting the spread of the virus. As the number of infected persons increased and the disease started spreading to different areas around the world, schools started to close down, transportation systems were shut down, and non-essential business were curtailed. Following these actions, a reduction in the levels of air pollution was noticed, with media reporting clean air in urban areas with blue skies and very good visibility. Observations of the concentrations of air pollution revealed significant reductions in the concentrations of nitrogen dioxide (NO_2) amongst other gaseous pollutants.

The impact of the COVID-19 measures on air quality were also noted in Malta. Hence, the objective of this brief is to provide an overview of the impact and magnitude of the changes in air pollution levels in Malta following the introduction of measures related to the Corona virus pandemic.

Introduction

The first case of Corona virus in Malta was detected on the 7th March 2020. A number of precautionary measures were put into place following this news to stop the spread of the virus. As shown in the timeline in Figure 1, these measures were implemented on the 13th of March and included the closure of schools, university and childcare centers. In addition, many employers allowed their employees to telework. Further measures, which saw the closure of bars, restaurants and gyms were implemented on the 17th March and the Malta International Airport was closed on the 20th March. Furthermore, non-essential and retail services were stopped as from the 23rd March and as from the 28th March vulnerable persons were obliged to stay inside.

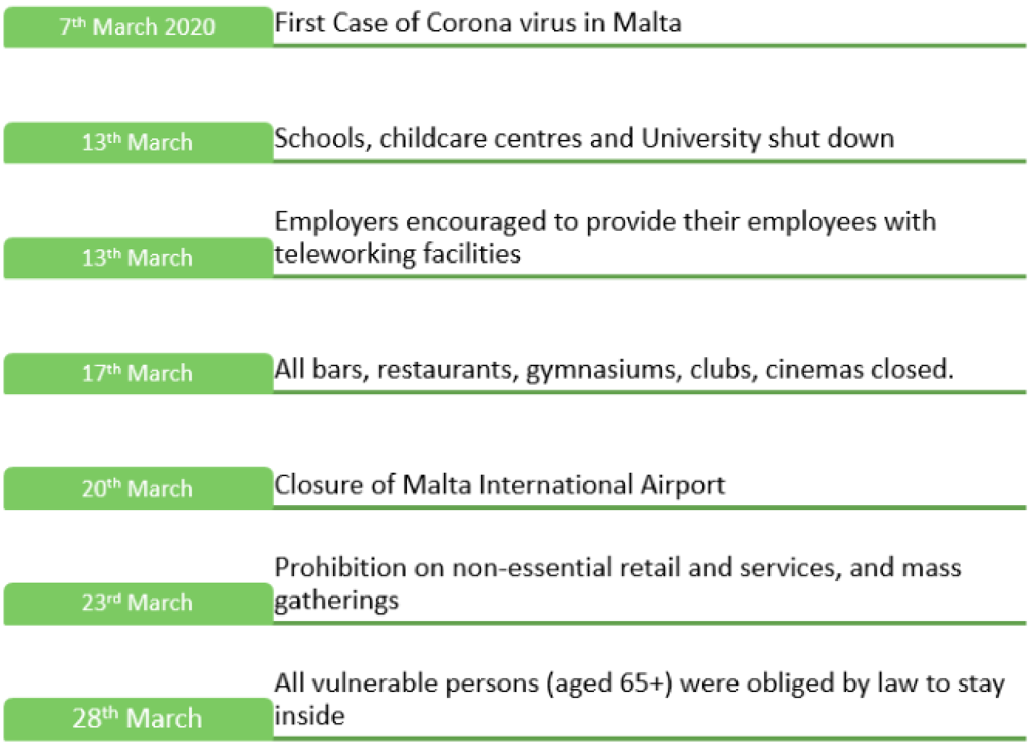


Figure 1 - Timeline of events related to COVID-19 measures

The analysis of the effects of COVID-19 measures on air quality was based on the real-time data from the monitoring network in Malta. This network consists of four stations, located within the agglomeration (shown in red in Figure 2) or the zone having the highest population density and within which air quality monitoring is performed. One of the four stations is based in Msida, which represents a site where the influence from traffic is high. Another two monitoring stations are found in Żejtun and Attard which monitor urban background concentrations. The fourth station is located at a rural background site in Għarb Gozo.

The level of pollutants detected at these stations is not only dependent on their location relative to the agglomeration, but also on the meteorological conditions of the site. Wind speed and direction, amongst other meteorological conditions, are known to have an influence on the measured concentrations of the air pollutants. The prevailing wind in Malta is West – North West, however, there is also a strong Easterly component in Spring. During the days following the implementation of the COVID-19 measures, the wind direction was prevalently from the East (Figure 2b). Such conditions were taken into consideration during the analysis of the COVID-19 measures so as to minimize the effect from meteorological conditions on the variations in the levels of air pollutants which would otherwise mask the changes as a result of the measures.

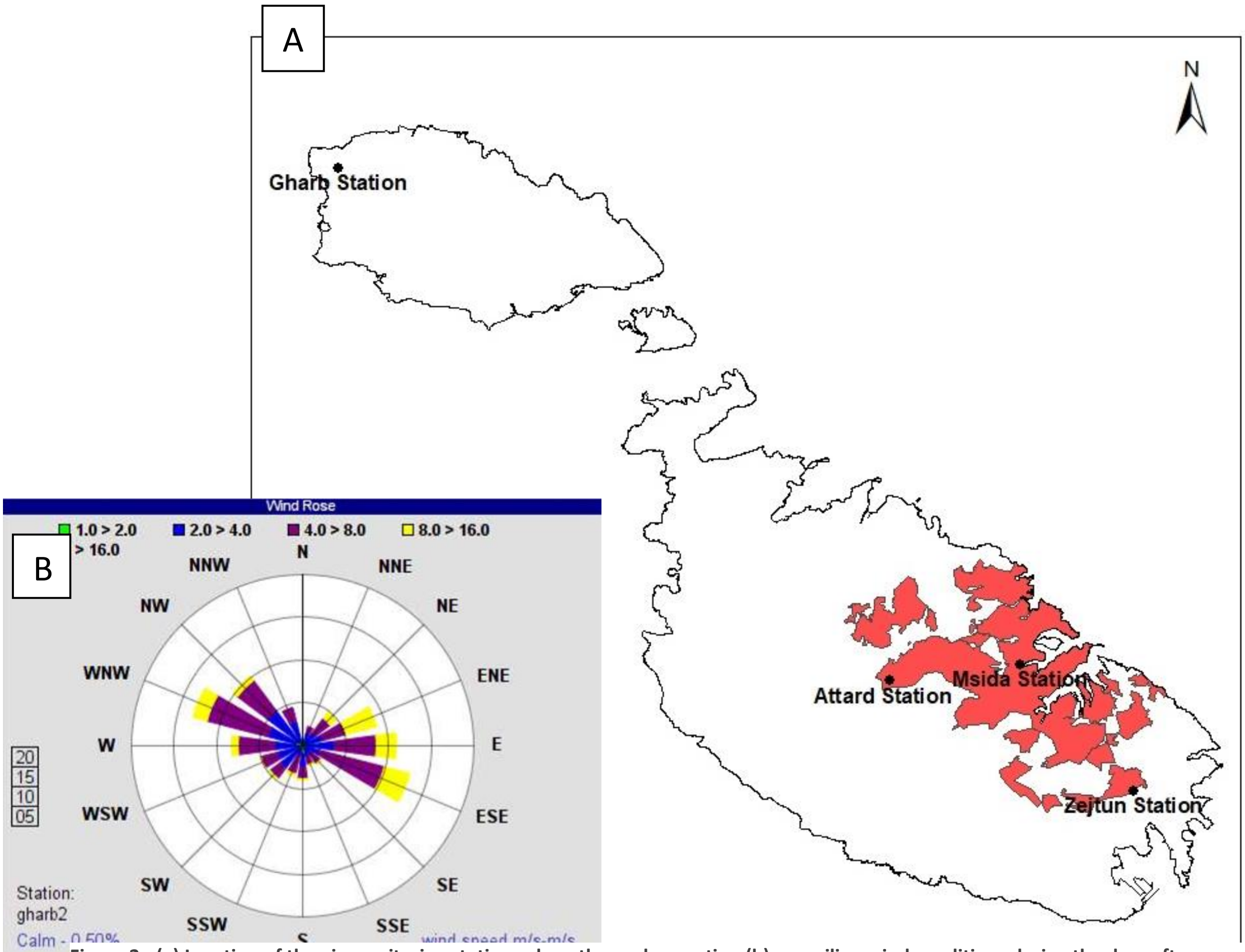


Figure 2 - (a) Location of the air monitoring stations along the agglomeration (b) prevailing wind conditions during the days after COVID-19 measures

The next sections will present the results of the investigations carried with the aim of demonstrating the effects of measures set to limit the spread of the virus, on the air quality in Malta. The analysis is limited to data from three monitoring stations namely Msida, Attard and Żejtun. These sites are known to be influenced from anthropogenic urban activity such as transport and would give a good indication of the effects of COVID-19 measures. The station at Għarb is located at a rural background site with minimal influence from urban activity. Hence, since the effects of the measures would be difficult to assess at this site, data from the Għarb station was not included in this analysis.

The study was based primarily on the levels of nitrogen dioxide (NO_2) which pollutant is known to originate from combustion processes related to transport activities. The choice of this pollutant also allows comparison to similar studies in other countries. The effects of COVID-19 measures on the levels of particulate matter was also investigated in this report.

Results

Changes in diurnal variations of NO_2

As an initial analysis, the effects of COVID-19 measures on the diurnal (or daily) variations in the levels of NO_2 concentrations were analysed. As outlined earlier, for this analysis, the meteorological conditions for the period being analysed were taken into consideration, given the effects that such factors have on the concentration of air pollutants.

Data from days following the COVID-19 measures were compared to data from pre-COVID-19 measures with similar wind conditions. This comparison showed that at all the three monitoring stations (Msida, Attard and Żejtun) there was a reduction in the nitrogen dioxide concentration. This reduction was especially visible during the peaks levels which are usually observed during the morning rush hour.

Figure 3 represents the changes in the diurnal variation of NO_2 at the traffic site in Msida where the 7-day (Monday to Sunday) diurnal average of the levels of NO_2 after the COVID-19 measures were compared to the 7-day average of pre-COVID days in January with similar Easterly wind conditions (blue curve). The overall reduction in the concentration of NO_2 at this site was of 50%.

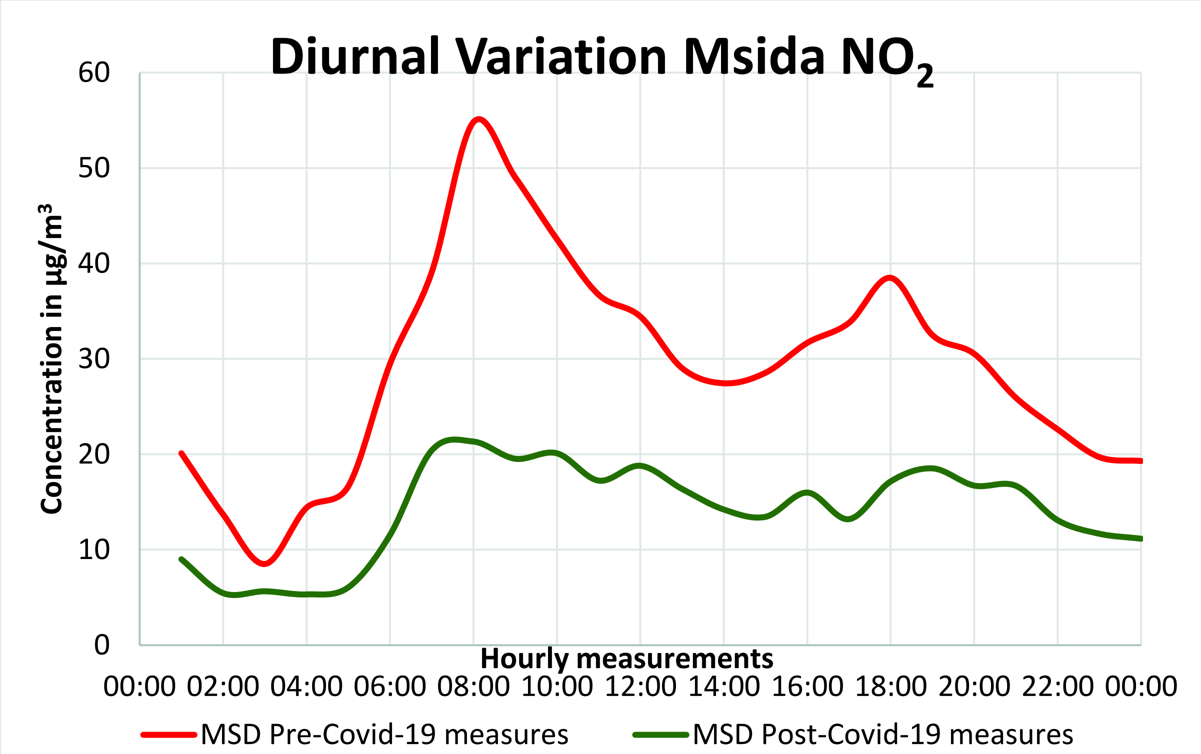


Figure 3 - Changes in diurnal variations of NO2 in Msida as a result of COVID-19 measures

A similar investigation was carried out at the urban background site in Attard (Figure 4) where a 60% reduction in the overall NO_2 levels was observed similar to the urban background site in Attard (60%). When considering absolute concentrations of NO_2, one would expect that the traffic site would show higher concentrations than the urban background site. However, during the period for which the data was analysed, the two sites show similar pollutant levels. This is due to the Easterly wind conditions experienced in the days following COVID-19 measures. With Easterly wind directions, Attard lies downwind of the agglomeration, and receives air parcels from the agglomeration. On the other hand, Msida does not receive a large proportion of emissions from the agglomeration during Easterly wind conditions. This further emphasises the need to take into consideration the meteorological conditions when analysing the data for the effects of COVID-19 measures.

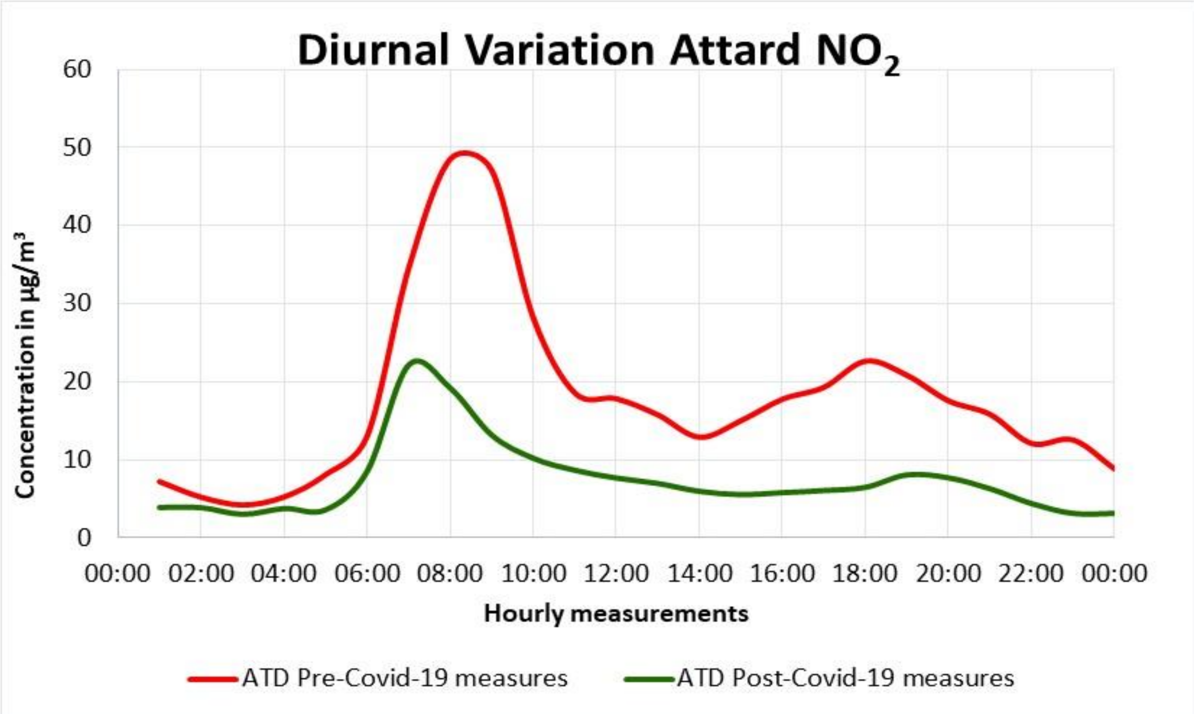


Figure 4 - Changes in diurnal variations of NO2 in Attard as a result of COVID-19 measures

A general reduction in NO_2 levels was also observed at Żejtun station as shown in Figure 5. However, in absolute values this change is very small since with Easterly wind conditions, the levels of NO_2 are due to background sources with little impact from traffic.

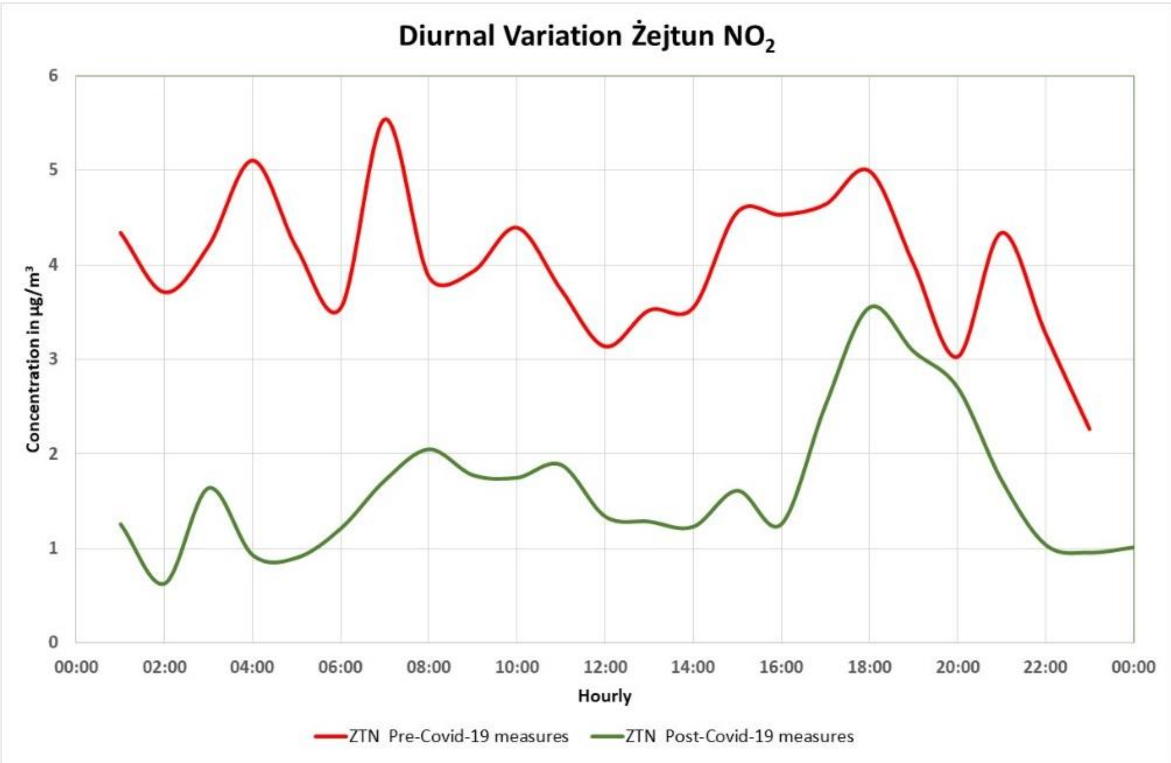
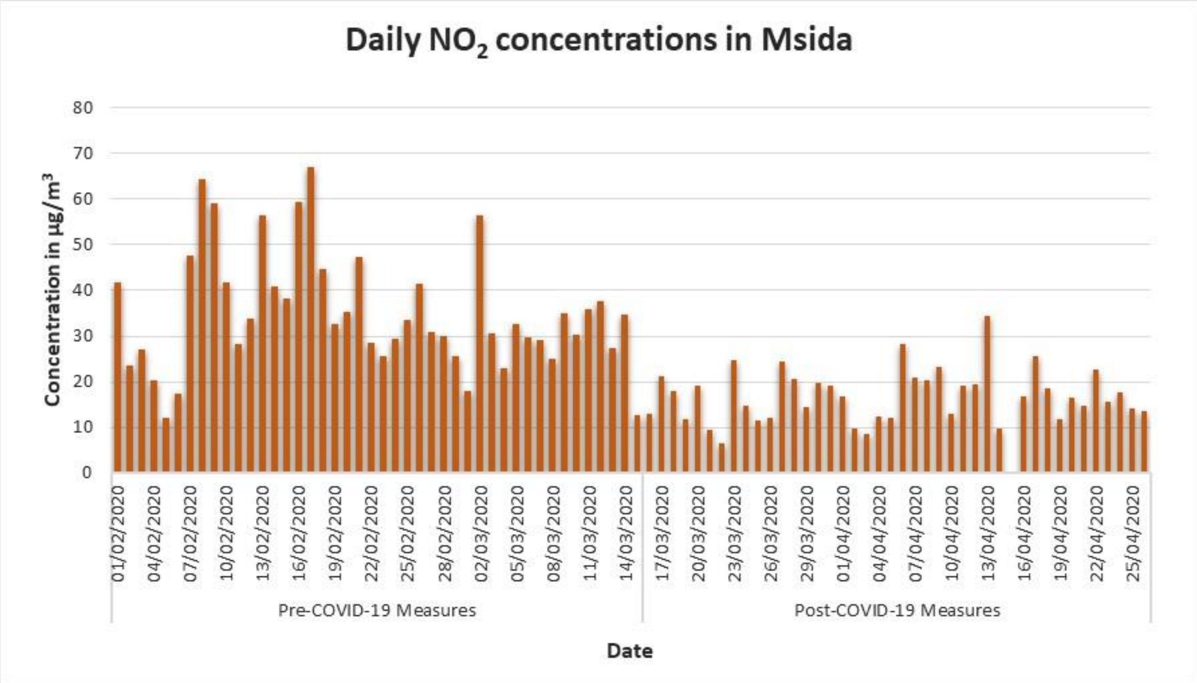


Figure 5 - Changes in diurnal variations of NO2 in Żejtun as a result of COVID-19 measures

Effects on the average daily concentrations of NO_2

Further analysis was performed over a longer period of measurements using the data from the traffic site in Msida. This time, the daily average NO_2 concentrations for 1 ½ months pre-COVID measures



and 1 ½ months post COVID measures were utilized. This investigation showed that there was a clear reduction in the average concentration of NO_2 following the COVID-19 measures on the 16th March (Figure 6).

Figure 6 - Daily NO2 concentrations in Msida pre-COVID and post-COVID measures

A reduction in the peak concentrations of NO_2 was also observed following the COVID-19 measures. This reduction can be seen from Figure 7, which shows the distribution of hourly concentrations of NO_2 prior to the implementation of COVID-19 measures and those measured after the COVID-19 measures were put in place. The graph shows that prior to the measures, the highest hourly concentrations would reach levels of more than 100 µg/m^3 while following the implementation of COVID-19 measures, the highest measured concentration was not more than 70µg/m^3.

In addition, following the measures, the greatest proportion of the measured NO_2 hourly concentrations were those at the lower end of the concertation range as shown in Figure 7.

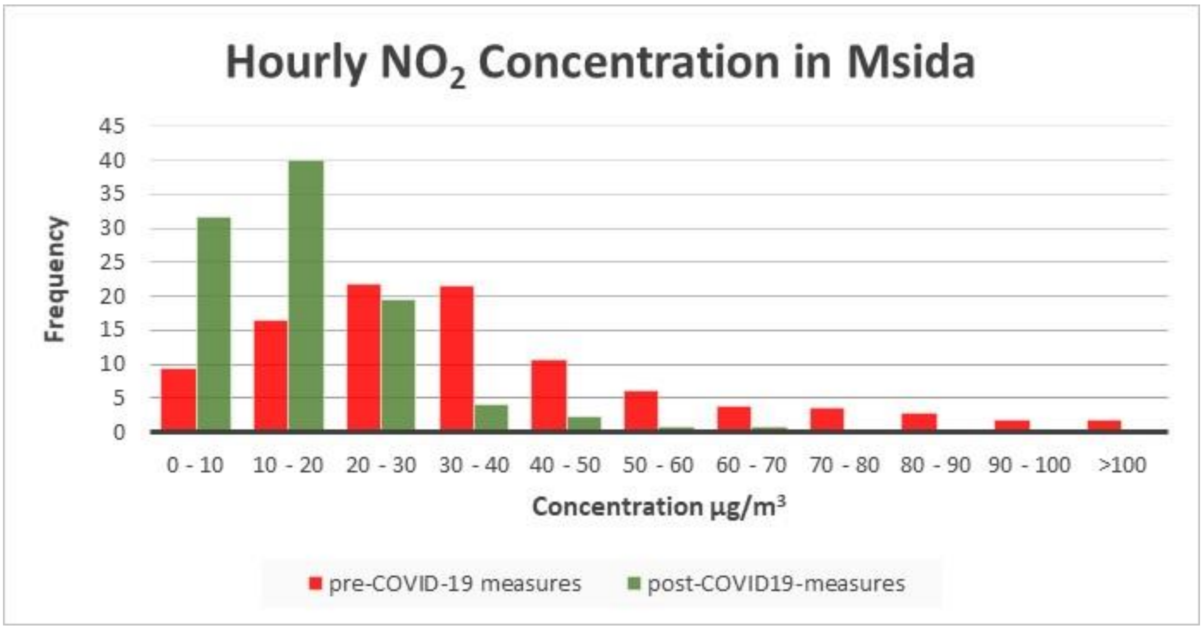


Figure 7 - Comparison of distribution of the hourly NO2 concentrations is Msida pre-COVID and post-COVID measures

Impacts of COVID measures on $PM_{2.5}$ levels

Changes in other pollutants that are usually associated with traffic, such as fine particulate matter ($PM_{2.5}$) were also investigated. Unlike the case of NO_2, $PM_{2.5}$ did not show any reduction in the measured concentrations as a result of COVID-19 measures (Figure 8).

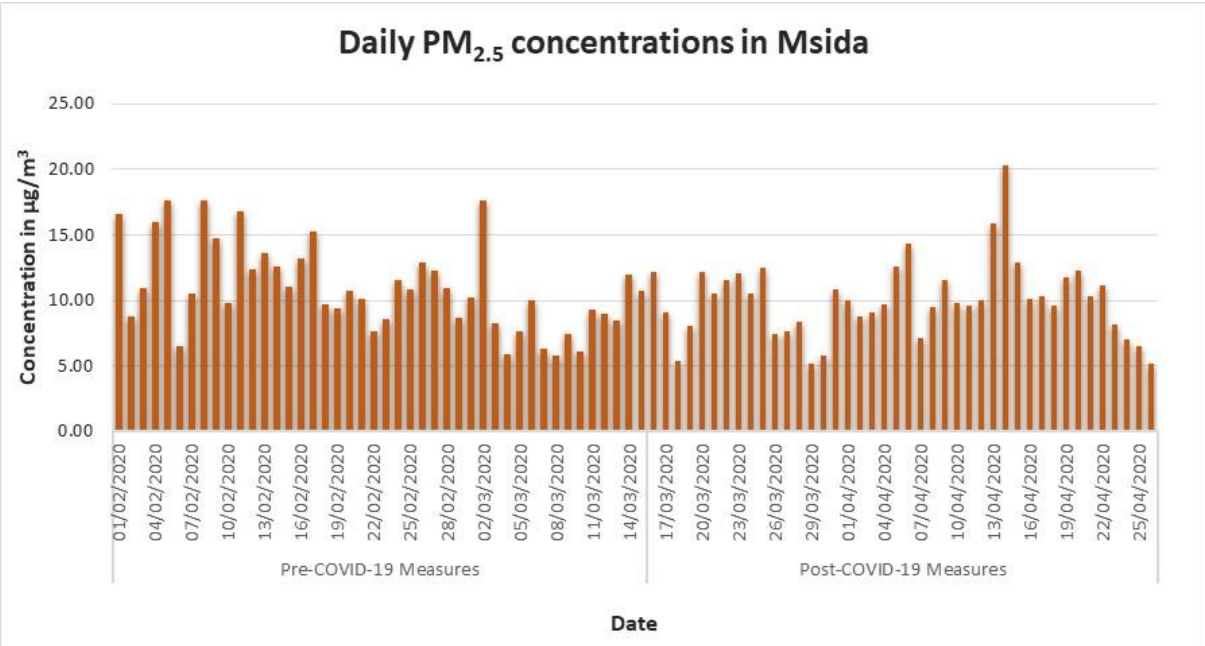
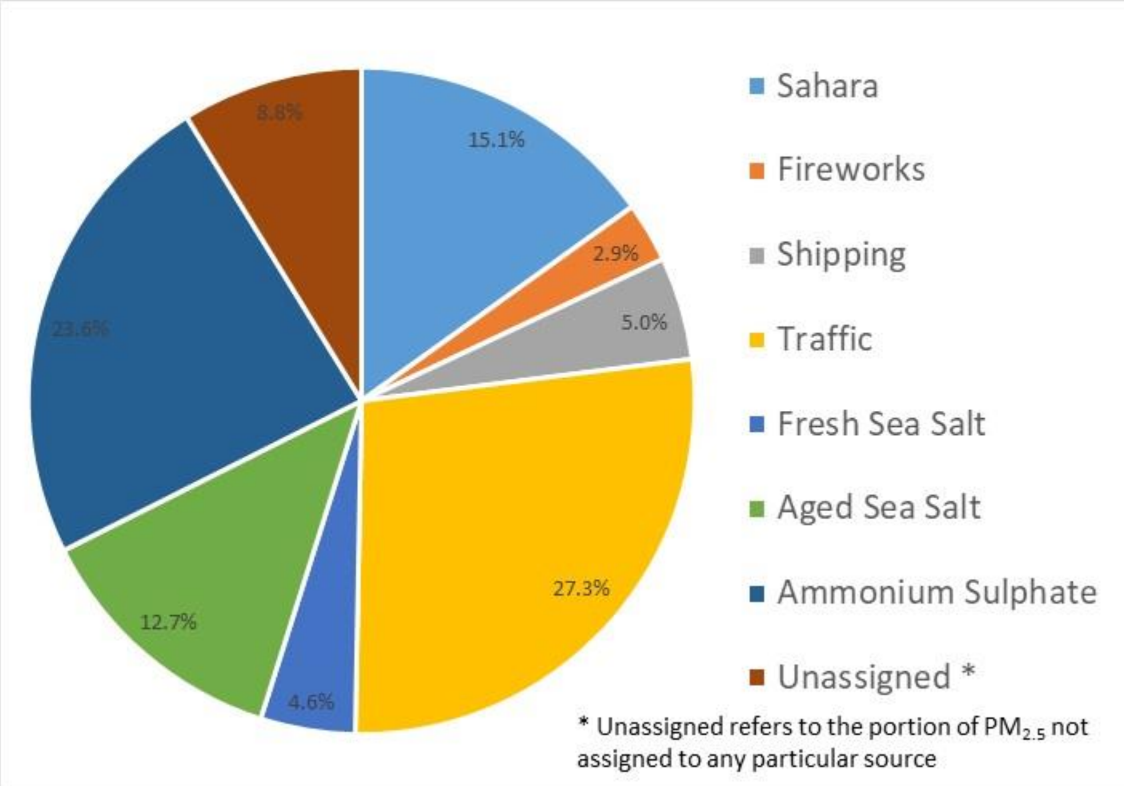


Figure 8 - Daily PM2.5 concentrations in Msida pre-COVID and post-COVID measures

This observation can be explained by the particular situation in Malta, where the major sources of $PM_{2.5}$ are of natural origin such as Sahara dust, sea salt and other secondary formation such as ammonium sulphate (Figure 9). Hence, unlike the case of NO_2, the effect of the reduction of traffic flows experienced as a result of COVID-19 measures had less influence on the levels of $PM_{2.5}$.



[1]

Figure 9 - Sources of PM2.5 in Malta

Conclusion:

The results of this preliminary assessment have demonstrated that the implementation of measures related to COVID-19 have had an impact on the air quality in Malta. The analysis shows what important lessons could be learnt from the impact of measures on air quality and the degree to which different pollutants are affected. A significant decrease in the levels of NO_2 was noticed at both traffic and urban background sites as a result of the decrease in transport activity. Other pollutants were less affected by the changes in traffic due to their multiple sources, which are both anthropogenic and natural.

[1] *Source: Reproduced from Scerri, M.M. et al. "Estimation of the contributions of the sources driving $PM_{2.5}$ levels in a Central Mediterranean coastal town." Chemosphere 211 (2018): 465-481*