NERC Hackathon One – Air Quality

# Methodology

Greenhouse gas emissions (CO2, CH4, N2O, HFC, PFC, NF3, SF6) by industry [1] were combined with other pollutants (PM10, PM2.5, CO, NMVOC) by industry [2]. This list of pollutants does not contain S02, NOX, O3 and other pollutants caused by traffic. The list of pollutants was chosen simply because of the convenience of the data and only contains pollutants generated by industry and not by general traffic. The pollutants were then mapped to the local authority area where they were likely to occur. This was done using Table KS605EW, from the Office for National Statistics, which maps the number of workers in each industry to the local authority area in which they work. The numbers of deaths, by local authority area, in week 16 from all causes and from Covid-19 were added to the dataset from [4], population information from [5] and ethnicity from [6]. Death rates per 100,000 were calculated for each local authority area. Correlation was then tested for between each variable.

# Results

## Correlation between death rates per 100,000 and industrial pollutants (N = 324)

Correlations were either not significant or at the 95% confidence level. All were very small, the largest being -0.120. All were negative suggesting that as industrial pollution increases the death rate decreases. This is unlikely to be the case, but it may indicate that in general UK environmental policies have succeeded in limiting harmful pollution from industry. This being very coarse-grained data however it cannot indicate that harmful pollution is not occurring on a very local scale.

## 2.2 Correlation between death rates per 100,000 and sex (N = 324)

There was a positive correlation between the all deaths (r = 0.140, confidence level = 92.8%) and Covid-19 deaths (r = 0.200, confidence level > 99.9%) and the percentage of males in the population. There was an equivalent negative correlation for the percentage of females in the population. This indicates that men are dying of Covid-19 at a higher rate than women.

## 2.3 Correlation between death rates per 100,000 and population density (N = 324)

There was no significant correlation between all deaths, or Covid-19 deaths and population density. This was unexpected as a higher population density should allow the disease to spread quicker. There was a strong negative correlation (r = -0.819, confidence level > 99.9%) between the percentage of the population being white (English/Welsh/Scottish/Northern Irish/British) and population density. Apart from Gypsies and Travelers all other ethnic groups (including white Irish and white Other) showed a positive correlation with population density indicating that they reside in more densely populated areas, most likely inner cities.

## 2.4 Correlation between death rates per 100,000 and ethnicity (N = 324)

There was no significant correlation between all deaths, or Covid-19 deaths and the percentage of the population being made up of any ethnic group. This was surprising as deaths have been reported as being significantly higher in non-white ethnic groups. The discrepancy between this result and that being reported in the news cannot be explained. The data used here is very coarse-grained and is solely based on deaths reported in week 16, however it should still detect any correlation. It should be noted that the percentage of medical staff in the NHS that are non-white is higher (29.7% Asian, 4.6% Black) than that in the general population (5.5% Asian, 3.4% Black) and hence we would expect to see a higher rate of death in these ethnic groups if they caught Covid-19 from their patients. This would suggest that better PPE and ventilation is needed in hospitals.

# Conclusions

Industrial pollution (greenhouse gases and PM10, PM2.5, CO, NMVOC) is not impacting Covid-19 deaths. The only positive correlation with dying from Covid-19 was being born male. However, the reported higher Covid-19 death rate within non-white ethnic groups might simply reflect the fact that they make up a higher proportion of front-line NHS staff and they are contracting Covid-19 from their patients. Better PPE and hospital ventilation may help prevent this.

[1] Greenhouse gas emissions in the United Kingdom, 1990 to 2017 and (provisional) 2018, Ricardo Energy and Environment, Office for National Statistics

[2] Emissions from other pollutants in the United Kingdom, 1990 to 2017 and (provisional) 2018, Ricardo Energy and Environment, Office for National Statistics

[3] Table KS605EW, 2011 Census: 2011 Census: Industry, local authorities in England and Wales, Office for National Statistics

[4] Weekly provisional figures on deaths occurring and registered in England and Wales by Local Authority, UK Statistics Authority

[5] Table KS101EW, 2011 Census: Usual resident population, local authorities in England and Wales, Office for National Statistics

[6] Table KS201EW, 2011 Census: Ethnic group, local authorities in England and Wales, Office for National Statistics