IBM DIGITAL CREDENTIAL

FORECASTING AIR POLLUTION PARTICULATE MATTER (PM2.5)

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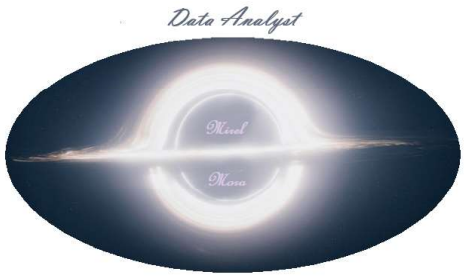

CERTIFICATE APPLIED DATA SCIENCE CAPSTONE

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1 Introduction

1.1 Air pollution in London

It is often assumed that air pollution in London is a recent phenomenon, however, legislation attempting to control air pollution was enacted as early as 1306. Coal smoke and its associated problems remained a matter of concern in London up until the late 20th century with the famous smogs of the 1950s and 60s.

In recent years, the pollutants in the capital's air have altered considerably. This is primarily because of the decline in the use of coal in industry and domestic heating, which has led to large reductions in the emissions of sulphur dioxide and particles of soot over the past 40 years. At the same time the increased number of motor vehicles is producing considerable amounts of nitrogen dioxide and small particles.

1.2 Problem statement

There is mounting evidence of health effects from everyday exposure to air pollution. The modern-day small particles are our main problem for air pollution health effects, whilst other pollutants such as nitrogen dioxide and ozone are also a major cause for concern.

There are different effects depending on the length and intensity of exposure. For example, short term exposure (a few hours) to high levels of NO_2 can irritate the airways and cause severe coughing and exacerbate existing respiratory illnesses, which is uncomfortable at best, and dangerous at worst for vulnerable people (sick and older or younger people for example).

Long term exposure can contribute to someone developing a number of illnesses, such as asthma, pulmonary disease and lung cancer. It has also been shown to stunt the growth of children's lungs. This is particularly worrying, as around one-third of London's schools have been found to be close to busy roads that suffer illegal levels of NO2 pollution.

1.2.1 Important pollutant

The pollutants most widely referred to in the literature are:

- Particulate matter (these are usually split into 2 sizes: PM2.5 and PM10)
- Nitrogen dioxide (NO_2)
- Sulphur dioxide (SO_2)
- Ozone (O_3)
- And occasionally, Carbon Monoxide (CO)

PM and NO2 are commonly seen as the most dangerous forms of air pollution due to their high concentrations and the negative health impacts they create.

Particulate Matter 2.5 and 10 (PM)

PM is made up of a wide range of materials and arises from a variety of sources. Concentrations of PM comprise primary particles emitted directly into the atmosphere from combustion sources and secondary particles formed by chemical reactions in the air. It consists of a complex mixture of solid and liquid particles of human-made (such as diesel soot) and natural substances suspended in the air (such as sea spray and Saharan dust). In the UK the biggest human-made sources are stationary fuel combustion (power generators) and transport.

NO_2

Nitrogen dioxide is human made, with the major sources of emissions of NO_2 being combustion processes (heating, power generation, and engines in vehicles and ships)1. Nitrogen is released during the combustion of fuel and then combines with oxygen atoms to create

nitric oxide (NO). This further combines with oxygen to create nitrogen dioxide (NO2). Nitric oxide is not considered to be hazardous to health at typical ambient concentrations, but nitrogen dioxide is. Nitrogen dioxide and nitric oxide are referred to together as oxides of nitrogen (NO_x). NO_x gases can also react to form smog and contribute to acid rain. NO_x is also central to the formation of fine particles or particulate matter (PM) and ground level ozone (O_3), both of which are associated with adverse health effects.

1.3 Air pollution forecast

Air pollution forecasting is a worthwhile investment on multiple levels - individual, community, national and global. Accurate forecasting helps people plan ahead, decreasing the effects on health and the costs associated.

If people are aware of variations in the quality of the air they breathe, the effect of pollutants on health as well as concentrations likely to cause adverse effects and actions to curtail pollution. Furthermore, there is a greater likelihood of motivating changes in both individual behaviour and public policy [1], as people want air quality information.

[1] Kelly F. (2012). Monitoring air pollution: Use of early warning systems for public health./