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| Class Code/ Title: | ME975 – Satellite Data Assimilation and Analysis |
| Technical paper title: | Individual Project Report |
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| Supervisor: | Dr. Annalisa Riccardi |
| Date: | 03/04/2022 |
| Word count: |  |

Abstract

Contents

[1.0 Introduction 1](#_Toc100279824)

[1.1 Project Objectives 1](#_Toc100279825)

[1.2 Background 1](#_Toc100279826)

[2.0 Literature review 1](#_Toc100279827)

[2.1 NO2 Harmful effects 1](#_Toc100279828)

[2.2 NO2 Sources and Production 1](#_Toc100279829)

[2.3 Previous Research 2](#_Toc100279830)

[3.0 Methodology 2](#_Toc100279831)

[4.0 Results 2](#_Toc100279832)

[4.1 Tabulated Results 2](#_Toc100279833)

[4.2 Visual Results 2](#_Toc100279834)

[5.0 Discussion 2](#_Toc100279835)

[6.0 Conclusions 2](#_Toc100279836)

[7.0 References 3](#_Toc100279837)

# Introduction

## Project Objectives

The main goal of this project is to assimilate, analyse, and present the NO2 levels before, during, and after the COVID-19 lockdown restrictions across the different districts of Scotland. In addition, the population densities of the districts will also be incorporated to investigate the contribution of this variable to the change in NO2 levels.

## Background

It is well established that nitrogen dioxide (NO2) can have a negative effect on the environment and on the human body as a result of contact and exposure. NO2 levels have been both a local and global concern for many decades and have often been a subject of study and analysis, are considered a major component of air pollution and as such, are subject to stringent regulation. Therefore, monitoring NO2 levels around areas with large human population and investigating the effect changes in these levels have on the population as well as the planet and environment, is of great importance.

# Literature review

## NO2 Harmful effects

It is well known that exposure and absorption of NO2 is dangerous, harmful, and can lead to health problems, it has also been found that even small variations in the level of NO2 exposure can have a measurable effect on lung and breathing ability[1], and these effects can be observed within hours of exposure[1]. The negative effects have been shown to be lesser for short-term exposure, and subsequently greater for long-term exposure, regardless of the exposure level, which “might be suggestive for a cumulative effect of air pollution exposure”[1].

In addition to causing the above-mentioned issues, NO2 exposure can also exacerbate the negative effects of pre-existing breathing conditions such as asthma, as well as worsen the state of the immune system[2].

Very high levels of exposure, predictably can cause serious and immediate effects, like constriction and inflammation of the airways and lungs. In the long term, high levels of exposure correlates with a risk of pneumonia and bronchitis[3]. External exposure to the skin and body is also dangerous with NO2 exhibiting corrosivity, resulting in chemical burns and irritation[4].

With respect to nature and the environment, NO2 has been shown to be a major contributor the acid rain, as well as limit plant growth[2]. Considering these effects, it is clear that NO2 levels have a direct effect on the health of the environment, and also on the efficiency of agriculture. NO2 is also responsible for reducing visibility in the atmosphere[2].

## NO2 Sources and Production

NO2 is present through natural sources like, volcanic eruptions, and as a product of bacteria. However, NO2 is most prominently produced as a result of internal combustion engines found in vehicles and industrial equipment[2]. It is generally produced through combustion, with notable domestic sources being smoking, and gas cookers. As a result, strict regulations have been placed on NO2 production and exposure. Notably, the introduction and requirement of catalytic converters to the exhaust systems of internal combustion engines, these devices help to limit the amount of NO2 released[5], as part of the vehicle pollution emissions standards. The accumulation of NO2 around centres of population is also subject to regulation with the city of Glasgow, looking to introduce a “Low Emissions Zone” in 2023, allowing only certain vehicles into the city in order to limit pollution and improve air quality[6]. Similar types of schemes have been implemented with success in other cities, such as the well-known “ULEZ” in London.

## Previous Research

Research into studying and tracking the air quality levels in the USA from the mid 2000’s has shown a continuous decrease in NO2 levels among other pollutants, directly correlated to a reduction on emissions[7].

# Methodology

# Results

## Tabulated Results

## Visual Results

# Discussion

# Conclusions

# References