A Review of Geospatial Application

by

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PART A

Article review for paper titled "the 'just' management of urban air pollution? a geospatial analysis of low emission zones in Brussels and London

1. Introduction

This report is a review of an article by Thomas Verbeek and, Stephen Hincks titled ***"The 'just' management of urban air pollution? A geospatial analysis of low emission zones in Brussels and London",*** focusing mainly of basic principles and applications of key techniques. Furthermore, a look at three major contributions made by the study is reviewed and noted and other observations.

2. Review Preamble

This article examines two Low Emission Zones (LEZs) in Brussels and London, where P.M2.5 contributes to 260 and 300 deaths/million/yr respectively (World Health Organization, 2016), focusing on environmental and transportation justice approaches. It highlights the interdependence of environmental, social, and economic elements in these areas, highlighting the need for social justice measures (Verbeek and Hincks, 2022).

3. Applied Techniques

The two basic techniques used in the study are.

3.1 Ordinary Least Square (OLS)

The study utilized OLS, a multivariate regression technique, to analyze global trends in air pollution exposure and its relationship with socio-economic patterns in a city. OLS served as the baseline model before delving into local variations with GWR.

3.2 Geographical Weight Regressions

GWR is a spatial analysis technique that helps understand local variations in relationships between air pollution, socio-economic patterns, and the impact of Local Environmental Zones on accessibility. It complements conventional multivariate regression, providing insights into local relationships and identifying areas with pronounced air pollution exposure and accessibility inequalities.

4 Contributions of The Study

1. **Examination of Socioeconomic Patterns and Exposure to Air Pollution**
   The study examined the correlation between air pollution patterns and socio-economic status in Greater Brussels and Greater London, revealing that lower-income areas in Brussels had higher exposure, while higher-income MSOAs in London had slightly higher exposure. Correcting the notion that exposure is higher in deprived area.

2. **Insights into LEZ Boundaries and Social Justice Implications**
   The study used GWR to evaluate the spatial boundaries of Local Environmental Zones (LEZs) and their impact on social justice. Results showed that in Brussels, environmental justice was partially supported, while social justice was stronger in London.

3. **Assessment of LEZ Policy Impact on Accessibility and Socio-economic Patterns**
   The study examined the spatial distribution of LEZ accessibility impact and its relationship with socio-economic patterns, finding varied impacts, contrary to the assumption that lower-income areas are hardest hit.

5 Personal Observations

i. The study acknowledges the limitations of household income as a sole socio-economic indicator and suggests using other indicators like the Index of Multiple Deprivation for a more comprehensive understanding. Further exploration into deprivation indicators and their impact on air pollution exposure could enhance the study.
ii. Property Ownership: The report highlights briefly that owning a property can have a substantial impact on socioeconomic position, particularly in London's housing

crisis. A more in-depth examination of the function of property ownership in determining exposure to air pollution and the intricacies associated with it could provide useful insights.

iii. Temporal Interactions: According to the study, the air pollution indicator is based on static exposure modelling and lacks a dynamic aspect during the day. Investigating the temporal dynamics of air pollution exposure, considering changes in daily routines and activities, may provide a more detailed understanding of the relationship between air pollution and socioeconomic characteristics.

PART B

Report on the Importance of Geospatial Analysis In different areas and how these areas benefit from Geospatial Analysis

6 Applications of Geospatial in The Upstream Industry

The combination of geospatial technologies and data-driven insights is redefining upstream operations across the world, encouraging efficiency, responsiveness, and supporting informed decisions through the whole upstream process chain.

This impact is evident in these areas where it has been applied:

Exploration: GIS aids in comprehensive analysis of exploration data, identifying undiscovered oil and gas formations, identifying potential targets, block analysis, and guiding investment decisions. (Liu, et al., 2001).

Land Management: GIS acts as a centralized platform for accessing land asset data, allowing direct analysis in both office and field settings. GIS was used to analyze land use distribution at the Up Stream Ciliwung Watershed in Murniningsih and Anggraheni, (2016).

Production: GIS assists in managing intricate production operations by generating a digital twin of processes, integrating real-time feeds with accurate representations of physical assets (LeBlanc, 2020).

Operations: GIS optimizes the management of diverse operational elements, including wells, pipelines, facilities, and personnel. This ensures safe and efficient operations, minimizing downtime and maximizing revenues (Earl, et al., 2000).

Unconventional Resources: GIS supports the design and optimization of unconventional infrastructure, ensuring safe operations through real-time tracking and coordination. It integrates asset information to create a digital twin of operations.

Carbon Capture Technologies: GIS plays a crucial role in identifying optimal locations for large-scale carbon capture and sequestration projects (Melara, *et al.*, 2020).

7 Applications of Geospatial Analysis iThe Transportation Industry

The transportation industry can benefit from geospatial analysis due to the spatial distribution of transportation-related data. This requires network stage evaluation, statistical analysis, and spatial manipulation techniques. Transportation study methodologies and models include shortest path and routing algorithms, spatial interaction models, network flow challenges, facility location difficulties, travel demand models, and land use-transportation interaction models. (Shaw and Rodrigue, 2006). These methods aid in the resolution of a variety of issues, including.

a. Travelling salesman issues,
b. Vehicle routing issues,
c. Network flow issues,
d. Facility site issues,
e. Travel demand models, and
f. Land use-transportation interaction models

It is possible to identify migratory patterns, commuter flows, and density shifts within cities by conducting an analysis of these movements. Understanding these dynamics is helpful in optimizing transportation systems. The application area of spatial analysis of this information includes.

a. Infrastructure planning and management
b. Transportation safety analysis.
c. Travel demand analysis.
d. Traffic monitoring and control.
e. Public transit planning and operations.
f. Economic and environmental impacts assessment.
g. Routing and scheduling.
h. Vehicle tracking and dispatching.
i. Fleet management.

8 Future Prospect of Geospatial

Research have confirmed that a significant amount of big data is geospatial data i.e. they have location attributes to them, and the size of such data is growing rapidly at least by 20% every year (Lee and Kang, 2015). We can innovate our daily life and business by exploiting the power of location embedded in geospatial big data. (Fig 1 and 2)

Application context	Phase	Benefits
GIS can be integrated with most transport planning tools to save time and to increase quality	Planning	Time
3D design output can be used as input to construction automation using machine control solutions to save time and money and to increase quality	Construction	Time, money, quality and governance
Remote sensing data, combined with a GIS platform, can be used to carry out environmental impact studies of transport infrastructure projects	Planning	Governance, environment
Location measurement technology, such as LiDAR and GNSS, can be used to carry out land surveys more accurately using less time	Construction	Time, cost, quality
Combining remote sensing data with optimisation tools to determine the optimal alignment of the right-of-way	Design	Time, cost
GIS can be used to streamline the land acquisition process and right of way planning for highway and railway projects	Planning	Time, governance
GIS based construction project monitoring systems can be used to efficiently monitor highway and railway construction projects	Construction	Time, cost, governance

Figure 1: Future of Geospatial in Rail and Road (Krishna and Shukla)

GIS forms the basis of highway and railway infrastructure asset management systems	O&M	Time, cost, governance
GIS forms the basis for accident information and analysis systems	O&M	Time, safety, governance
GIS is an integral component of Advanced Traffic Management Systems that will help traffic managers visualise the state of the road or rail network in real time	O&M	Time, safety, environment
GIS and digital terrain models (DTM) are essential for carrying out noise and pollution studies related to transport	O&M	Environment

Figure 2: Future of Geospatial in Aviation (Krishna and Shukla)

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