Doi:

Combined Hazard Analysis of Spatial Distribution of Air Pollution Index in Tehran

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Original Article

Abstract

INTRODUCTION: Urban air pollution, especially in densely populated metropolises such as Tehran, has become one of the most serious environmental and health challenges. NO2, as one of the most important pollutants resulting from human activities, accumulates persistently in the surface layers of the atmosphere, especially in the cold seasons and under temperature inversion conditions. This study aims to analyze the combined risk of spatial and temporal distribution of NO2 in the cold seasons in Tehran city over a 7-year period (2018–2024) and to investigate the interaction between human and natural factors in the formation of this risk.

METHODS: In this descriptive-analytical study with an integrated approach, daily NO2 concentration data were extracted from Sentinel-5P satellite images (TROPOMI sensor) in Tehran during the winter season from 2018 to 2024 (equivalent to 1397–1403 solar year).
Using spatial extraction tools in the GIS environment, data were processed, seasonal averages were calculated, and raster-to-vector conversion was performed, and spatial and temporal distribution patterns of NO2 were plotted and analyzed.

FINDINGS: The findings showed that the distribution pattern of NO2 has undergone significant spatial and temporal changes over the seven years, with the highest concentrations observed in central Tehran and northeastern regions in 2018 and 2019. In 2020 and 2021, coinciding with the restrictions imposed during the COVID-19 era, a significant decrease in pollution levels was observed, but since 2022, NO2 concentrations have increased again, and in 2024, a significant increase was observed in the southern and eastern regions. These changes indicate a shift in pollution centers from the city center to the suburbs and a return to a centralized pattern, which indicates extensive urban development and increased human activities in peripheral areas.

CONCLUSION: According to the research results, NO2 pollution in Tehran is the consequence of a complex interaction between human factors (such as traffic, industry, and urban development) and natural conditions (temperature inversion and topography), therefore, it is considered a "combined hazard." Changes in spatial patterns of NO2 are a reflection of urban physical-functional developments and management policies.

Keywords: Nitrogen dioxide; air pollution; Tehran; Sentinel 5.

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