

多尺度视角下建成地景观格局时空变化与 PM_{2.5} 浓度变化的季节性关联

——以安徽省为例

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摘要:【目的】安徽省连接着中国经济增长最快的长江三角洲地区和中国污染最严重的京津冀地区,其城市建设用地的扩张显著改变了城市景观格局,影响了城市大气污染物的分布。深入探究城市景观格局对 PM_{2.5} 浓度分布的时空演变及影响机制是城市污染治理的基础。在不同时空尺度下,建设用地景观格局与 PM_{2.5} 浓度分布的关系尚不明确,因此,了解不同时空中建设用地景观格局的变化对 PM_{2.5} 的影响,有利于城市格局的合理布局。【方法】本研究采用分段线性回归模型检测 2000-2020 年期间安徽省 PM_{2.5} 浓度的拐点。计算 PM_{2.5} 在上升期和下降期的多尺度时空格局,通过 4 个景观指标来量化安徽省建成地的分布特征,使用双变量空间自相关以及地理加权回归模型分析建设用地景观格局对 PM_{2.5} 浓度在不同栅格尺度、不同季节分布的影响。【结果】(1)2013 年是 2000-2020 年安徽省 PM_{2.5} 浓度变化拐点,第一阶段(2000-2013 年)景观格局变化对 PM_{2.5} 变化主要呈正相关关系,第二阶段(2013-2020 年)呈负相关,且建设用地景观格局变化与 PM_{2.5} 变化之间存在明显的空间自相关和空间溢出效应。(2)安徽省不同区域影响 PM_{2.5} 浓度的主要景观格局指标与地形密切相关,在山地和皖南地区,建成地景观格局变化对 PM_{2.5} 变化的影响更为显著。随着尺度的扩大,不同景观尺度变化与 PM_{2.5} 变化的相关性持续增强。(3)总体而言,建设用地景观格局对 PM_{2.5} 浓度的影响在冬季比夏季更为显著,且在第二阶段更为明显,建成地聚集度和占比上表现出相对较大的季节差异。【结论】我们建议在考虑地形影响的情况下,实施不同区域 PM_{2.5} 污染控制的灵活城市策略规划。

关键词: 建设用地景观格局; PM_{2.5} 浓度分布; 季节差异; 多尺度变化

Temporal and spatial variation of built landscape pattern and seasonal variation of PM_{2.5} concentration from a multi-scale perspective: A case study of Anhui Province

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Abstract:【Objective】Anhui Province, linking the fast-growing Yangtze River Delta and the heavily polluted Beijing-Tianjin-Hebei region, has seen significant urban landscape changes due to the expansion of construction land, impacting PM_{2.5} distribution. Investigating the spatiotemporal evolution and impact mechanisms of urban landscapes on PM_{2.5} is fundamental for pollution control. The relationship between construction land patterns and PM_{2.5} concentration across different spatiotemporal scales remains unclear. Understanding this relationship aids in rational urban planning.【Method】This study used piecewise linear regression to identify inflection points in PM_{2.5} concentrations from 2000 to 2020, analyzed the multiscale spatiotemporal patterns during increasing and decreasing phases, quantified construction land distribution using four landscape metrics, and applied bivariate spatial autocorrelation and geographically weighted regression (GWR) to examine the influence of construction land patterns on PM_{2.5} at various grid scales and seasons.【Result】(1) 2013 marked a turning point in PM_{2.5} trends, with a positive correlation between landscape changes and PM_{2.5} in the first phase (2000-2013), shifting to a negative correlation in the second (2013-2020). Significant spatial autocorrelation and spillover effects were

observed. (2) The impact of construction land patterns on PM_{2.5} varied by topography, being more pronounced in mountainous and southern Anhui. As scale increased, the correlation between landscape changes and surface temperature strengthened. (3) Seasonally, the effect was more significant in winter than summer, especially during the second phase, with noticeable seasonal differences in construction land aggregation and proportion. **【 Conclusion 】** Flexible urban strategies, considering topographic influences, are recommended for regional PM_{2.5} pollution control.

Key words: Construction land landscape; PM_{2.5} concentration; Seasonal variation; Multiscale analysis..