Evaluating the Impact of the Russian Invasion on $PM_{2.5}$ and PM_{10} Concentrations in the Atmosphere above Kyiv and Ukraine

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Abstract

Military operations have significant environmental impacts, polluting water, soil, and, notably, the air. Explosions, gunfire, and fires lead to the release of various compounds and particles into the atmosphere. In this study, we investigate the effects of two years of full-scale Russian aggression on air quality in the atmosphere over Kyiv and Ukraine. Using Merra-2 reanalysis, changes in black carbon, sulfates, $PM_{2.5}$, and PM_{10} before and after the invasion were analyzed. The results indicate a significant increase in concentration following the onset of hostilities and variations compared to longer time intervals. Furthermore, this study analyzed in situ $PM_{2.5}$ and PM_{10} measurements provided in Kyiv using the AirVisual network and the HORIBA APDA-371 environmental dust monitoring gas analyzer. Additionally, measurements from the sun photometer of the AERONET network were employed for aerosol particle analysis. Elevated particle concentrations were frequently observed during days of Kyiv shelling, with a significant spike also recorded during the transport of mineral dust from the Sahara. Moreover, these findings underscore the urgent need for heightened environmental monitoring and mitigation strategies in conflict-affected regions to address the detrimental consequences of military activities on air quality and public health.

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