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Temporal and Geographical Distribution of CTBT-Relevant Xenon Isotopes: Insights into Global Background Patterns

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The detection of xenon isotopes in the atmosphere plays a critical role in monitoring nuclear explosions under the Comprehensive Nuclear-Test-Ban Treaty (CTBT). Understanding the temporal and geographical distribution of CTBT-relevant xenon isotopes, such as ^{131m}Xe , ^{133}Xe , ^{133m}Xe , and ^{135}Xe is essential for distinguishing between natural, medical, and anthropogenic sources and potential nuclear tests. This study provides a comprehensive analysis of global background levels of these isotopes, integrating data from atmospheric monitoring stations, and meteorological data. Key findings reveal significant variability in xenon isotope concentrations. Temporal fluctuations, including seasonal and diurnal cycles, are analyzed to better understand their correlation with atmospheric transport dynamics. The results contribute to refining the detection thresholds and improving discrimination methods for treaty verification purposes.

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