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Characteristics and Source Attribution of Methane In YRD Based on A New Method of Artificial Intelligence

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Methane (CH_4) is a potent greenhouse gas with significant impacts on climate change, but its regional emission characteristics, especially in chemical industrial zones, remain unclear. By integrating ground monitoring, meteorological data, and industrial activity information, we developed a comprehensive method for tracking and quantifying methane emissions at a regional scale using algorithms such as K-means clustering, correlation analysis, and Positive Matrix Factorization (PMF). We analyzed hourly methane concentration data from an industrial park in the Yangtze River Delta from 2020 to 2021, revealing "N"-shaped diurnal variations and significant seasonal fluctuations. Using unsupervised learning algorithms, we quantified the baseline, daily values, regional transport contributions, and abnormal emission impact values of methane concentrations. Through anomaly detection via deep learning prediction models (CNN, LSTM, CNN-LSTM) and discrepancy analysis with actual data, we identified abnormal emission events. Combining inverse modeling of the Gaussian plume model, we estimated methane emissions, finding that the annual methane emission in this region was approximately 1,100 tons, with an interannual increase of 17.3%. This study fills the gap in methane emission and quantification research in chemical industrial zones and provides scientific basis for regional methane reduction policies.