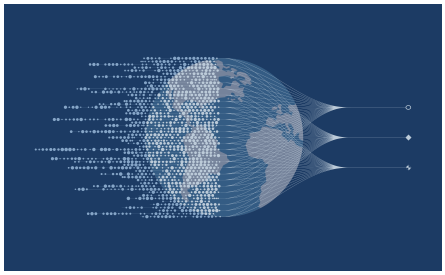

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Early Times of Atmospheric Particle Transport Using a Dual-Stage 3D Super-Resolution Model

When scientists aim to predict atmospheric dispersion of particulates or gases, they rely on physics codes that require significant computational resources and time for accuracy. To address this, we developed a novel artificial intelligence method to speed up modeling with high accuracy. This method includes two components:
1. Temporal Module: Predicts the temporal evolution of the plume using low temporal resolution simulated data.
2. Spatial Refinement Module: Enhances spatial resolution of predictions from the Temporal Module.
Trained on high-resolution data from physics code simulations, this method significantly outperforms previous approaches, enabling accurate and efficient atmospheric dispersion predictions. We evaluated its performance by comparing predictions with simulated data from a real-world experiment conducted in October 2022 at the Nevada National Security Site. This experiment involved sensors monitoring a radiotracer gas release. Physics code simulations replicated experiment conditions, and we assessed the method's predictions against simulated data at sensor locations. Although experimental data's time resolution limited direct validation, the close alignment with validated physics code simulations provides a realistic benchmark for accuracy. This indicates the method can reliably predict tracer gas dispersion in the atmosphere.

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