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Pollution Transport Simulation and Machine-Learning Aided Source Detection in Metropolitan Areas SARAH ZHANG, Thomas Jefferson High School for Science and Technology — Air pollution is one of the worlds largest environmental health threats. This study aims to use remote signals to locate the source of pollution release, which will strengthen our readiness to counter its threat. In urban areas, flow structures advecting pollution are extremely complex: boundary layer separation generates vortical structures that increase pollutant spread and break the plume into smaller patches by dispersion. Flow structures were obtained by solving the two-dimensional Navier-Stokes equations using Computational Fluid Dynamics in a simplified scenario with imaginary urban architectures. The canonical neural network was applied to relate characteristics of pollutant detector signals to the release location. The proposed algorithm identified the source and its uncertainty through a Monte Carlo analysis. When the number of training samples was small, as limited by the number of trial-releases performed in reality, data augmentation was done by introducing noisy measurements as new training samples. As a result, sensors away from the center line of the flow outperformed the ones near it, indicating that boundary layer separation enhanced the differentiability between sensor measurements from various sources and improved source reconstruction for off-center sensors.

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