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Comparison of SCIPUFF Plume Prediction with Particle Filter Assimilated Prediction for Dipole Pride 26 Data

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This paper presents the application of a particle filter for data assimilation in the context of puff-based dispersion models. Particle filters provide estimates of the higher moments, and are well suited for strongly nonlinear and/or non-Gaussian models. The Gaussian puff model SCIPUFF, is used in predicting the chemical concentration field after a chemical incident. This model is highly nonlinear and evolves with variable state dimension and, after sufficient time, high dimensionality. While the particle filter formalism naturally supports variable state dimensionality high dimensionality represents a challenge in selecting an adequate number of particles, especially for the Bootstrap version. We present an implementation of the Bootstrap particle filter and compare its performance with the SCIPUFF predictions. Both the model and the Particle Filter are evaluated on the Dipole Pride 26 experimental data. Since there is no available ground truth, the data has been divided in two sets: training and testing. We show that even with a modest number of particles, the Bootstrap particle filter provides better estimates of the concentration field compared with the process model, without excessive increase in computational complexity.

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