Methane Leak Detection and Sizing using Large Eddy Simulations (LES)

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The NIST Large Eddy Simulation (LES) software is a computational fluid dynamics model that can resolve the turbulent flow field at length scales much smaller than is practical with mesoscale atmospheric transport models. High resolution LES models were used to simulate methane leak tests conducted at the Methane Emissions Testing and Evaluation Center (METEC) at spatial resolution of 2 m. LES simulations have the potential to evaluate the impact of complex urban topography on near-field dispersion and mixing of methane.

Simulations were combined with line integrated measurement data from a dual frequency comb laser spectrometer in an inversion framework to estimate methane leak size and location. Results demonstrate the capability of the LES model to accurately simulate transport and dispersion of methane plumes. The presentation will describe new developments in LES modeling including assimilation of meteorological observation data as well as coupling of lagrangian massless particles to model the sub-grid scale methane leaks and measurements.

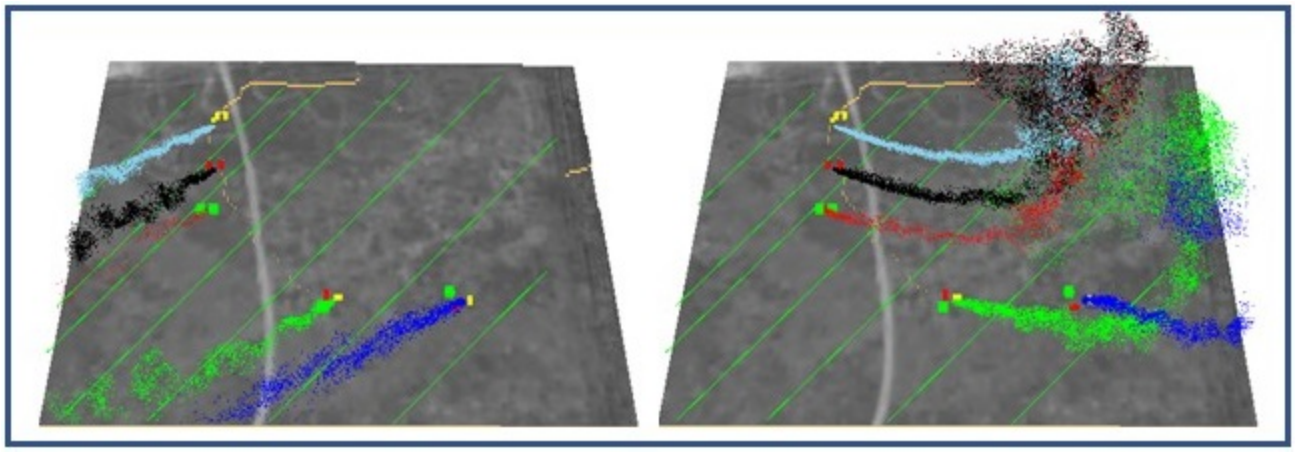

Figure 1. Large Eddy Simulations (LES) of the R1 methane leak tests performed at the METEC test facility. Images show the transport and dispersion of methane plumes from 5 leaks (color coded) located on various well-pads. Topographical data and obstructions such as separator tanks and wells were included in the simulation. The green lines indicate the location of the beams where path integrated measurement data was collected. The domain size was 200 m x 200 m and the spatial resolution of the simulations was set at 2 m.