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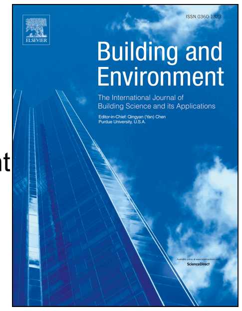

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Evaluation of an inverse modelling methodology for the prediction of a stationary point pollutant source in complex urban environments

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Abstract

The estimation of a hazardous contaminant unknown source characteristics (i.e., rate and location) in a complex urban environment using efficient inverse modelling techniques is a challenging problem that involves advanced computational fluid dynamics combined with appropriate mathematical algorithms. In this paper we further assess our recently proposed inverse source term estimation method (Efthimiou et al., 2017, Atmos. Environ., 170, 118-129) by applying it in two wind tunnel experiments simulating atmospheric flow and tracer dispersion following a stationary release in realistic urban settings, namely Michelstadt and Complex Urban Terrain Experiment (CUTE). The method appears to be robust and to predict with encouraging accuracy the source location and emission rate for both wind tunnel experiments.

Keywords: Inverse modelling; Source term estimation; CFD; ADREA-HF; Urban environment; Source inversion.

1. Introduction

In the event of a dangerous substance being released into the atmosphere, whether intentionally or by accident, the transport of the material as a wind-blown plume can distribute it over a large area and may pose threats to the populations in the course of the plume (Argyropoulos et al., 2010; Argyropoulos et al., 2013; Argyropoulos et al., 2017; Markatos et al., 2009; Nivolianitou et al., 2012).

The Chernobyl (Anspaugh et al., 1988), and relatively recent Fukushima (Ohtsuru et al., 2015) nuclear disasters, the Sarin gas terrorist attacks in Matsumoto town (Morita et al., 1995) and Tokyo (Okumura et al., 1996) in Japan, as well as the well-known chemical accidents of Bhopal (Chouhan, 2005), and Seveso (Pocchiari et al., 1979) are significant events which caused severe environmental and human health and life consequences.

During an event of the type described above and if the source location, the release rate and type of pollutants are known, dispersion models can be used to forecast the plume trajectory of the air pollutants, their dispersion and eventual deposition as well as the level of human exposure to the pollutant(s) (Lioy et al, 2016). The necessary meteorological information may originate from local weather stations or may be forecast data provided by Numerical Weather Prediction models. If the source characteristics, such as location, release rate and pollutant type (collectively mentioned as "source term") are unknown and the only available information is readings at different locations and

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