MSc. Thesis topic

Municipality of Utrecht bans open fires: wood burning impacts on local air quality

urban air quality, modelling of pollutant dispersion

Central aim: Investigate the dispersion of pollutants emitted by wood burning at the local neighborhood scale, using high-resolution modelling.

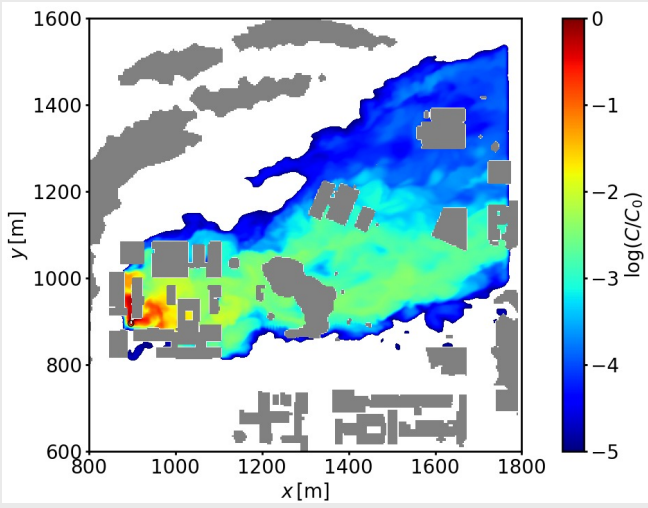
Background: The municipality of Utrecht recently decided to ban outdoor wood burning (e.g., campfires) from 2025 onwards to improve local air quality. Contribution of these sources to total fine particulate matter is estimated to be 2%, whereas contributions from wood-burning stoves ("chimneys") are estimated to reach up to 25%. This ban was met with critical response from different sides. Notwithstanding this response, there is still a need to investigate how resultant pollutants are transported within a neighborhood.

Challenge: Zooming-in on this scale is still challenging because many different processes play a role. The buildings force the air to take varying pathways, potentially leading to hotspots of pollution or ventilated corridors. The nighttime atmosphere suppresses the mixing of pollutants, mainly in the vertical direction. Further, pollutant sources can have strong temperature differences with respect to the surroundings. This interplay therefore makes that you might not smell the chimney of your neighbors but might still smell a chimney in the next street.

Questions:

(1) What is the footprint of individual chimneys, and how far does the pollutant reach?

(2) How does the spread of pollutants depend on, for example, the source buoyancy and on the atmospheric stability in either idealized urban settings, or realistic urban settings (neighborhood of Utrecht)?



Top view of pollutant dispersion at the Utrecht university campus

Method: In the project, you will use high-resolution large-eddy simulations (LES) that resolve turbulent flow in the atmosphere. Our model has recently been extended with realistic buildings, such that simulating dispersion of pollutants within streets becomes possible. You will learn how to set up and perform simulations of the urban area; how to analyse the data; and draw physics-informed conclusions. Depending on your interests, you can also contribute to our code development (e.g., programming of buoyant sources).

If you are interested, please contact:

dr.ir. Steven van der Linden, assistant professor
s.j.a.vanderlinden@tudelft.nl

Publication date: November 2023

TU Delft