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SHORT ABSTRACT

Abstract title: Experimental Study and Modeling of the Meandering effect on plume dispersion under low wind conditions in an urban environment

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Abstract text *(maximum 350 words.)*

In atmospheric dispersion studies, low wind conditions are commonly considered to be the most challenging conditions. The physical process that often drives dispersion in these situations is known as meandering. The modeling of these situations is hampered by a lack of international-level experimental data, especially in built environments, resulting in significant uncertainties in impact assessments.

A statistical study was conducted using a three-year meteorological database collected at SIRTA (Site Instrumental de Recherche par Télédétection Atmosphérique) located in a peri-urban area at different heights in the inertial sublayer and in the roughness sublayer. The objective is to parameterize meandering for modeling purposes by establishing empirical relationships between meandering parameters and other significant flow dynamics characteristics (average velocity, turbulent kinetic energy…, and its horizontal component).

Moreover, we propose an analysis of experimental data related to the dispersion of a tracer gas, helium, under these specific conditions and a comparison with simulations obtained from a CFD model. Four measurement campaigns were realized at SIRTA. Helium concentrations are collected using air samplers and in real time, in the near field of the emission point. These measurement campaigns have already revealed the impact of meandering on the horizontal dispersion of the plume.

The numerical simulations are based on the CFD model code_saturne, which is an open-source code. Three RANS (Reynolds Averaged Navier Stokes) simulation approaches are investigated in this study :

- A steady-state simulation with constant boundary conditions, with the adjustment of the horizontal diffusion coefficient, taking into account the parametrization work on meandering conducted in the statistical study.
- A quasi-steady-state simulation involving a combination of steady-state cases, performed with different inlet conditions representative of the temporal variation of the meteorological conditions during the release.
- Unsteady-state simulation with variable boundary conditions.

A comparison between the results obtained with these different modeling approaches and the measurements will be presented both for dynamic variables (wind speed and direction, turbulence) and tracer concentration.