



## A data-driven methodology for assessing urban runoff pollution risk under climate change scenarios

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In urban areas, surface runoff is a major transport pathway for pollutants washed off by rain from impervious surfaces, contributing to quality degradation of receiving water bodies. However, when not captured by combined sewer systems, surface runoff does not just remain untreated, but also largely unmonitored due to the challenges of consistently sampling such a dynamic and spatially diffuse phenomenon. As climate change increases the variability of precipitation events, understanding the role of runoff in urban pollution is becoming increasingly important for developing comprehensive and future-proof urban water management strategies.

Here, we present a scalable, data-driven methodology for mapping the risk posed by pollutants in urban runoff, developed within the Horizon Europe project D4RUNOFF (Grant Agreement no. 101060638). The approach relies on long-term, rainfall event-based simulations of runoff generation and pollutant emission, as functions of surface permeability and type, and of the consequent surface runoff flow at urban scale to estimate the annual probability of exceeding pollutant-specific water quality standards. The method accounts for both historical precipitation data from ERA5Land and CMIP6 future climate scenarios (based on Shared Socioeconomic Pathways) to assess how risk may evolve under different emission trajectories and incorporates open-source data detailing land cover and land use, curve number for surface permeability, and hydrologically-conditioned elevation data to drive flow accumulation. The methodology has been applied to the three case study cities of the project, namely Odense (Denmark), Pontedera (Italy), and Santander (Spain). Although not yet validated against extensive in-situ data, the methodology is undergoing validation as part of the current D4RUNOFF project tasks. The final mapped outputs, integrated in the Risk Assessment Module of the D4RUNOFF project's AI-Assisted Urban runoff management platform, are intended to help practitioners assess the risk from urban runoff pollution under climate uncertainty, and support the planning and placement of Nature-Based Solutions (NBS) for water pollution management.

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