



Urban windspeed modeling: from physical to data driven

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Cities are known to alter their surrounding atmosphere leading to a distinct urban canopy. The effect of cities on temperature is well understood and can be modeled with different methodologies. However, the urban form also has an impact on windspeed and direction, which are important variables for the ventilation of cities and are also needed to calculate thermal comfort indices. Thus, also the modeling of urban winds is of interest for urban planning and city administrations.

To date, wind is typically modeled through computationally intensive fluid dynamic simulations, requiring prohibitively many CPU hours to model winds over a whole city for longer periods. In this study, we compare two fast approaches to model urban windspeeds at 10m height. The first method is a static morphometric approach where we scale down ERA5 100m windspeeds, taking into account logarithmic, intermediary and canopy wind velocity profiles. The second approach is data-driven using XGBoost and in-situ observations in order to leverage the relationships between coarse ERA5 meteorological drivers and urban features such as buildings and trees. The approaches are developed to be applied to any city in Europe and are tested against wind measurements in select European cities. Their advantage lies in their fast computational times, modeling windspeeds for a whole city at hourly resolution for a year within minutes. However, despite no complex urban characteristics being captured or resolved, the models may still inform policy makers and urban planners on mean windspeeds and their effects on perceived temperature in different neighborhoods.