

## Ethical issues surrounding urban airflow models

The primary goal of our project was to predict wind direction and speeds in the city of Amsterdam at a very detailed scale. Because of how complex urban airflow models turned out to be, this has not succeeded, however this reflection still focuses on these complex urban airflow models, because they are quite interesting to reflect on from an ethical point of view.

The prediction is based on a number of different datasets. Most importantly, the Netatmo dataset is used, a dataset consisting of 562 datapoints in the Amsterdam metropolitan area where various meteorological variables are measured. Secondly, a digital surface model (DSM) is used, which shows the urban topology in 0.5 meters resolution. Also, another more precise meteorological dataset is used as calibration of the Netatmo dataset. It consists of 30 measuring locations throughout the city of Amsterdam.

The main dataset on which the algorithmic predictions are based will be the Netatmo dataset. Naturally, these weather stations are not uniformly distributed throughout the city. Each weather station is owned by an individual that most likely has a particular interest in the weather, and sufficient disposable income to purchase one. It could thus be that the concentration of personal weather stations (PWSs) is higher than average in more affluent neighbourhoods, and lower in poorer areas. Areas without residential buildings will also be underrepresented, as it is unlikely that someone will install a PWS there. Following the Mittelstadt et al classification, we can state that this is an epistemic concern related to misguided evidence. As a result of unequal distribution of PWSs, the data may be partial and imply bias.

Taking into account that this concern could adversely affect the prediction quality and certainty in less affluent neighbourhoods and non-residential areas, which could in turn lead to poor decisions in these areas by policy-makers, we can also argue that a normative concern is present, namely the possibility of unfair outcomes. To mitigate the uncertainty issue posed in low-density PWS areas, the final wind model visualization must be accompanied by an uncertainty map. This map can for example show the standard deviation of the model at every location, to provide an insight into how accurate the prediction is at each location. Policy-makers then know at what locations and to what degree the result can be trusted. Based on this data, they can make decisions about what wind speeds are uncomfortable and how much airflow in the city is desirable.

Also, because policies based on such an urban airflow model would impact citizens, it is necessary to provide traceability. The algorithm that translates the raw data into a wind map must remain available for citizens to explore, such that government decisions based on the model remain understandable and reproducible. Of course, the logic used by policy-makers to set rules based on the model must also be consequent and traceable, so as not to lose public support.