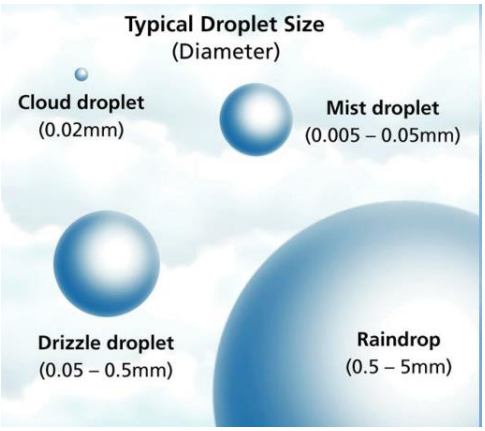
How does rain clean the air?

The influence of raindrop sizes on the removal efficiency of air pollutants

Context: Our current understanding of how rain helps clean the air by removing small particles and pollutants still remains limited. Many believe that the raindrop size distribution (DSD) plays a crucial role in controlling removal efficiencies. But quantitative models for making reliable predictions are lacking.

Challenge: Only a handful of models for predicting removal efficiencies of pollutants are available. Most of them rely on idealized simulations or lab experiments. Their performance in real-life studies are vastly unknown. Also, it is unclear how long the cleaning effect lasts after the rain has stopped. To make progress, model predictions must be compared to in-situ measurements. This is challenging because very few co-located measurements in urban areas exist.



Raindrops come in different sizes. Some are more efficient at picking up air pollutants.

Ruisdael observatory site at Slufter, in the Port area of Rotterdam.

Novelty: Since 2021, TU Delft operates a unique network of 4 urban measurement sites in Rotterdam. This has lead to a unique dataset of co-located measurements of raindrop size distributions and air quality. The goal of this project is to analyze the collected data to study how drop sizes, number concentration, rain duration and intermittency affect the removal of common air pollutants such as PM2.5 and PM10.

Outcome: The results will be used to formulate quantitative models for predicting the effect rainfall has on air quality. Such models can be used to study the long-term effects on air quality caused by changing rainfall patterns for different climate change scenarios. (e.g., longer dry spells, more intense rain etc..)

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