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Fast analysis of urban meteorological observations with the user-friendly MetObs-toolkit

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Working with and analysing data from non-traditional measurement networks, such as urban climate networks, can be challenging and time consuming. After undertaking an observational campaign, researchers often face the issue of missing data due to technical problems such as power cuts or data communication issues. Additionally, data from low-cost networks or crowdsourced data need quality control to avoid the inclusion of measurement errors and biases, which often leads to additional gaps in the time series. Moreover, data storage formats and temporal measurement frequencies are often not consistent or synchronised when comparing data of different measurement networks. MetObs, an open-source Python toolkit, was developed to overcome these issues and fully exploits such valuable datasets. MetObs aims to provide a framework for the entire flow from raw sensor data to a dedicated analysis, with the possibility to apply it to various types of non-traditional networks without any formatting issues. To obtain a clean dataset, the time resolution is firstly resampled to the desired resolution, followed by identifying erroneous and missing records. Finally, missing records are filled in with the most suitable or preferred gap-filling method. Dedicated software for quality control, such as TITAN and CrowdQC+, already existed prior to the development of MetObs and are therefore implemented in the toolkit instead of being reinvented. The toolkit makes it moreover possible to generate analytics with the possibility to incorporate geographical data and create various graphics for the analysis of the meteorological measurements. MetObs was developed in such a way that people without a coding background can utilise it to get insight into their own meteorological measurements by following examples and using tutorials. At the same time, it allows more experienced data scientists to tweak the functionalities in such a way that the toolkit provides a pipeline for their dedicated use case.