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# Towards quantifying why, when and where to engage citizens to participate in weather observation networks

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**Motivation.** Recent research shows promising results in gridding methods that aim to fuse official and citizen weather observations to produce high-resolution weather maps. These high-resolution weather maps are essential to verify weather models at finer spatial resolutions and are crucial for Early Warning Centres to provide measures of risk at neighborhood scale. In this way, citizen weather observations may be the key to better inform communities and decision makers about the local weather and important for future generation's climate adaptation research. Citizen science weather collections like WOW-NL (http://wow.knmi.nl) offer dense monitoring networks, potentially providing sheer volumes of observations. Continuous growth is a desired characteristic of these alternative networks overall. However, a "guided growth" could prove a more robust strategy in the long term. For this purpose, in this research we focus on quantifying the insights of some questions: How important is it to keep increasing the volume of observations? When should we do so? And at which locations in a region should these stations be located?

**Approach.** In this work we apply multi-fidelity adaptative sampling (MF-AS) to daily interpolations of WOW-NL air temperature and wind speed observations. MF-AS is a method developed in the discipline of simulation-based engineering, where it is used to efficiently optimise the design of vehicles. The questions that we try to answer are: what would be the best locations for a sequence of new stations? Should they be official stations or (clusters of) citizen stations? And how much improvement by the network can we expect? We apply and develop MF-AS for the Netherlands:

We identify typical weather patterns and define some important focus areas for gridded weather products. In this example, we focus on three user areas for the accuracy for our weather products: accuracy over the entire country, accuracy in populated areas and accuracy for road traffic. We then develop and apply MF-AS. The performance for the different user areas, evaluated for different candidate station locations, defines the cost function for our MF-AS strategy. Then, during this MF-AS approach – again borrowing heavily from vehicle design optimisation – in each iteration we do not only quantify the expected improvement in accuracy, but we also determine whether the next station should be an official station or a cluster of citizen stations, as well as where in the country it should ideally be located. In this way, we aim to develop a strategy for efficient growth of the combined official / citizen station network.

**Results.** This study acts a proof-of-concept for the use of quantitative methods to optimally design future multi-fidelity weather observation networks. The results will illustrate why, when and where, ideally, we should attract people to engage in citizen weather observation. We are convinced that these quantitative results can contribute to the broader effort to engage people in citizen weather science.