

## ***Interactive comment on “More Science with Less: Evaluation of a 3D-Printed Weather Station” by Adam Theisen et al.***

### **Anonymous Referee #2**

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Review of the manuscript “More Science with Less: Evaluation of a 3D-Printed Weather Station”

This work presents the results of a comparison between a classical commercial weather station and an innovative 3D-printed system. The experiment lasted eight months and was carried out in Oklahoma (USA), using 5-minutes averaged data of the following meteorological variables: temperature, relative humidity, atmospheric pressure, wind speed and direction and UV data. The authors managed an innovative topic that can be of interest for many readers of AMT journal. The 3D-printed weather station might be an appealing solution for a large number of meteorological applications, in which it is necessary to preserve a balance between instruments price and accuracy. However, from a strictly scientific and technical point of view, the paper has some

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relevant point of weaknesses that should be carefully addressed by the authors. As a general comment, the quality presentation of the study is unsatisfactory: therefore, the first suggestion is to perform a formal revision of the manuscript. I think that each of the five sections should be extended and detailed: more information, more discussion and more results are needed. In other words, the manuscript is too short and does not satisfy, in the current version, the minimum standards of an international peer-reviewed scientific journal. Some critical issues and suggestions are provided in the following main comments.

- Introduction: in my opinion, the authors should provide a more detailed and comprehensive state of the art of the considered topic. Moreover, they should better emphasize the added-value of their study compared to the previous work.
- Station configuration: the authors must provide additional details about technical characteristics of each of the meteorological weather stations involved in this study, the commercial one (Mesonet) and the innovative one (3D-printed). More specifically, I suggest adding a table that list the following specifications: range of measure, resolution, update interval, time-constant and uncertainty (or accuracy). Please consider the following WMO manual as reference: World Meteorological Organization: Guide to Meteorological Instruments and Methods of Observation, 2008.
- Deployment: According to Table 2, the traditional weather station includes sensors from different commercial companies (Vaisala, RM Young, Met One, Li-Cor). Why did the authors choose a reference meteorological station with these features and with this configuration? From a comparison with standards required by WMO (see Annex 1.E of WMO, 2008), emerges that those sensors are not an adequate and good benchmark to evaluate the performance of the proposed 3D-printed station. For example, according to WMO recommendations, temperature sensor should have an uncertainty of 0.2 K, which is considerable lower than the uncertainty of the RM Young 41342 RTD Probe (0.5 K). This consideration is easily extendable to other “reference” sensors involved in this study, which do not satisfy the WMO requirements. Probably, the authors chose

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the sensors listed in Table 2 as reference because their accuracy is comparable to that of 3D-printed instruments. However, I am quite skeptical about this approach. At first instance, it may be reasonable, but I think that an additional comparison with sensors that fulfill the WMO standard is necessary, in order to achieve results that are valuable from a “high-level” scientific perspective. Moreover, I suggest adding a figure including a photo of Mesonet station facilities. For a reliable comparison, the sensors of the two stations should be installed at the same height above the ground level: as an example, the wind sensors operated at two very different heights (10 m for the Mesonet, 2 m for the 3D-printed station). The authors seem to be conscious of this limit (Lines 85-87), but in my opinion they should discuss this aspect in a more comprehensive manner and should better highlight the limits of their work.

- Results: the measurements of the two meteorological stations have been compared only in terms of simple scatter plots. It is a very “rudimental”, although useful, analysis. Therefore, I suggest to do more work in this sense: for example, it may be interesting evaluating the performance of the proposed stations as a function of the season and to investigate about the data accuracy in particular “extreme” weather conditions (e.g. strong winds, cold and/or heat waves, strong rainfall, fog, etc.). Furthermore, for rainfall data, I suggest to perform a comparison not only in terms of daily accumulated rainfall but also in terms of rain rate.

- Conclusions: please add an additional discussion about the limits of those preliminary results and about the future planning and evolution of this study.

Finally, I suggest to carefully checking the paper to address some minor typos.

Best regards.

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