

## ***Interactive comment on “Radiosounding HARMonization (RHARM): a new homogenized dataset of radiosounding temperature, humidity and wind profiles with uncertainty” by Fabio Madonna et al.***

### **Anonymous Referee #2**

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Comments on “Radiosounding HARMonization (RHARM): a new homogenized dataset of radiosounding temperature, humidity and wind profiles with uncertainty” submitted to “Earth System Science Data” by Fabio Madonna et al.

The harmonization of radiosonde data recorded by different sensors under different conditions is no doubt a meaningful work for the scientific community and general users. The authors have processed a very huge dataset. As shown in Table 2, 2,205,200 radiosonde launches have been processed. The data processing workload in this paper is significant.

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However I have a few major concerns regarding the paper.

1. The uncertainty equations such as eq. 5, eq. 7, as well as the ones in lines 472 and 473, are not mathematically derived based on the error propagation law. For instance, theoretically the eq. 5 should be derived from the eq. 4 based on error propagation law. It is unknown how the authors get the eq. 5.

2. The quantization of the variance of each term in eq. 5 as well as other equations is not clearly stated. How to estimate the final, total values of the uncertainties of temperature, relative humidity and wind? It is not clearly explained.

3. In line 175, it stated that “IGRA contains observations from several networks and initiatives, including the GCOS Upper-air Network (GUAN), and the universal RAWinsonde OBServation program (RAOB).” So GUAN data (actually the correct name should be GRUAN data) is a part of the IGRA data. You processed data from 650 stations and all the data were also from the IGRA. In the Section 4.1 “RHARM consistency with GRUAN”, the RHARM results are compared with GRUAN result. So authors are regarding the GRUAN data as reference data. This raises one new question. Your RHARM results are derived from GRUAN data and now your results are compared with the GRUAN data. It is a repeated use of the same dataset. I am not sure how you can get an objective assessment of your RHARM result.

In the Section 4.1 “RHARM consistency with GRUAN”, though the title of this section is the “consistency with GRUAN”. However in your Figures 9-13, you also compared your results with the IGRA data. As said earlier, IGRA data set include the GRUAN data set and RAOB data set. So it is confusing to readers: Your results are compared to GRUAN data, and are also compared to IGRA data.

4. In the Section 4.2 “Comparisons with ERA5”, you compared your RHARM results with ECMWF ERA5 results. The derivation of ECMWF ERA5 results have used the global radiosonde datasets already. Therefore your comparison with ERA5 is not an independent assessment either. You repeatedly use the same set of radiosonde data.

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5. In the section 5 “Uncertainties: consistency with GRUAN and independent validation”, the GRUAN datasets are compared again here. It seems to be a repetition of the work in section 4.1. In Fig. 16, only 6 stations are used in the comparison. I am not sure how useful/meaningful it is to compare with only 6 stations’ result, considering you are processing global 650 stations.

6. The conclusion is too long and you should summarize the main findings of the paper. In addition, there is no single numerical value to show your findings, which is surprise to me.

Other minor comments are:

In the paper, in some places it claims it has processed the historical data since 1978. However in some places it states it processed the data since 2004 to present and the 2010 WMO/CIMO radiosonde data. It is confusing to readers which dataset you have processed exactly.

In some occasions, abbreviations are not fully spelled in their first appearance. In some cases, the abbreviations are defined or redefined after its first use.

Lines 187-189, It stated “Beyond the 650 homogenized stations, also the other radiosounding profiles available from IGRA with documented metadata and a radiosonde model compatible with the GDP or the ID2010 have been post-processed using RHARM.” It is very confusing to readers. How many stations did you do the RHARM processing, 650 stations or 650 stations plus some other radiosounding profiles available from IGRA? Why don’t you give an exact value of the total number of stations you have processed?

Line 253, “The station density in North America, North East Asia, and East Africa is lower than in Europe, U.S and South America.” This statement needs to be revised. North America includes U.S. It is not logical to compare U.S. with U.S.

Line 255, It stated “while the stations with largest number of launches are quite uni-

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formly distributed globally (Figure 2)”. This is not true. The red dots (I think they represent the stations with largest number of launches) are not uniformly distributed globally. The Figure 2 clearly show that Europe has the highest concentration.

Line 275, “GCOS Upper Air Network (GUAN) sites” Do you mean “GCOS Reference Upper Air Network (GUAN) sites”? In many places the GRUAN is spelled as GUAN.

The paper is very long and not easy to understand. Some sections contain too many contents and increases the difficulty to comprehend. Some sentences run a few lines and also reduce the readability.

Some tables/figures can be combined to increase readability. For instance, table 7 and table 8 can be combined.

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