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Atmospheric Measurement Techniques Discussions

Interactive comment on "Automatic monitoring of weather and climate in mountain areas. The case of Peñalara Meteorological Network (RMPNP)" *by* L. Durán and I. Rodríguez-Muñoz

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Replies to Referee #2 about interactive comment on "Automatic monitoring of weather and climate in mountain areas. The case of Peñalara Meteorological Network (RMPNP)" by L. Durán and I. Rodríguez-Muñoz Anonymous Referee #2 Received and published: 24 May 2016

1. Referee #2: "Scientific significance. The paper describes installation and operation of several weather stations located in a mountain environment in Sierra de Guadarrama at Peñalara, close to Madrid (Spain). Many of the ideas expressed in the paper, regarding challenges posed to meteorological observations and ways to address them, aren't new and, quite frankly, some of them are just a matter of common sense. In this

sense Chapter 2 isn not really particularly interesting." 1r. Authors: We agree that mostly of Chapter 2 is common sense and that the whole chapter might seem simple and obvious concepts for the mountain observation community. But it seems like more often than ever expected, common sense is not taken into account when designing these kind of networks if we pay attention to the numerous failures we had found all over the world. We wish we had these basic things clear when we first started 15 years ago. We think that presenting this, it would also help to understand the performance of the network in a better context and also help beginners on mountain meteorology observation.

2. Referee #2: "Scientific quality. The scientific approaches to the problems of sensing and data acquisition in remote locations are addressed, but in a rather quick and non exhaustive way. For instance, it would be of great interest to go in deeper detail about the data storage and processing SQL environment, as well as knowing issues, reliability, power consumption and so on of GPRS transfer in such remote and possibly not-thoroughly covered areas." 2.r Authors: As stated in the introduction this paper is expected to be a reference document for future users of the data base, who are not necessarily weather and climate researchers. It is not expected to be a very technical paper neither a paper with scientific results about the climatology of Peñalara. Considering that the space available for this article is limited, It was considered important to show first to the community the technical evolution of the network, the origin of the data gaps and statistical results that will show the consistency of the data base in order to increase the reliability on the observations for future users. Details on the data tables, structure, functions and other details of the SQL environment or details on the power consuption, downloading schedule and other detail would force us to go too technical for the scope of this paper. Not mentioning any detail is in some way assuming that not anything worth to share at this stage is found necessary.

3. Referee #2: "The referee appreciates the preliminary analysis of weather data presented in Chapter 3, which isn't completely within the scope of the journal but it adds

clarity and interesting results." 3.r. Authors: Thank you for the comments. Again the idea is to make some very basic analysis in order to increase reliability on the data series to invite other scientists to use the data base. These statistical results and calculations are not very deep but point out future deeper analysis to be performed by third parties. It has been stressed too, the potential weak points of the observations, just in case they could be relevant for certain applications.

4. Referee #2: "Some issues, though: - we are not entirely sure you can assume the temperature differences between adjacent sites as mean lapse rate (line 258). Maybe a reference would be appropriate" 4.r. Authors: We certainly agree with the comment. Sometimes sites are too local influenced. The sentence has been change to: "Considering the difference between mean maximum and minimum temperature as mean daily temperature amplitude, this figure shows how the temperature amplitude decreases with elevation, as expected, due to a lower influence of the soil at higher altitudes. Bottom valley sites show the higher temperature amplitude. This decoupling between elevations produces episodes of temperature inversion, specially during the first hours of the day. Differences between maximum temperature at higher site (Zabala, 2070 m.a.s.l.) and lower site (Alameda, 1102 m.a.s.l.) are around 10 °C, what gives a value very close to dry adiabatic lapse rate. In winter this value is around 7 °C km-1, which is closer to moist adiabatic lapse rate." We hope now it is more clear. The idea of these calculations are again to show the robustness of the data base. Surely, a finer analysis will be necessary in the future.

5. Referee #2: "- About wind time series (line 273): mechanically driven sensors has been chosen, even though the authors admit they may have been a bad choice in this environment due to rime and ice and mechanic blockages. Why were they chosen? Have the authors considered using sonic anemometers, which do not suffer from these problems? -" 5.r. Reply. The measurement of wind is very difficult under these conditions. Since this was not a specific wind assessment network, first option was to use NRG Maximum 40 anemometers. At that time (1999) this anemometer was the stan-

dard and it is important to mention that during the first years of operation, loggers used here were powered with two nine volts not rechargeable batteries. Sonic anemometers require more power and probably out of budget. Maximum anemometers were affordable and made possible to replace them every two years. This solved also the "calibration" problem. Additionally, sonic anemometers are expected to do better during the first minutes of freezing, but they will freeze the same way after some hours if not heated. Here there is not enough power for heating sensors. This network has been installed, operated (telecommunications, servers), maintained (preventive, corrective and evolutive), and managed (data validation, reporting, on line web graphs, statistics, reports, conferences, data dissemination, papers) with a very low budget (<20 k€year). Helicoid wind anemometers/vanes were found as an intermediate solution. With higher budget we would surely recommend: aspirated temperature wind shields, sonic anemometry like some compact anemometers used in wind turbines, snow height sensors and gravimetric rain gauges. Werther heating the sensors or not requires a deep solar power system analysis and probably the installation of a pilot system to check feasibility.

6. Referee #2: "- Figure 14 describes the relationship between differences between different rain gauges and hours per month with relative humidity over 80% and temperature below 5 âÛęC. In the text (line 334) it is stated that "a significant linear relationship [...] have (sic) been found". Just by looking and the figure this significant relationship isn't evident at all. Maybe the authors can explain this better by adding some statistical evaluator of this fit's goodness. -" 6.r. Authors: We totally agree with the comment. The idea behind this figure was to find a significant relationship between the under estimated precipitation performed by the unheated tiping-bucket rain gauges and the number of days with potential conditions for snow precipitation at one site where we have both: automatic and manual rain gauges. Since all rain gauges of the network are the same model, and temperature and humidity at every site is known, we thought we could calculate the underestimation of every rain gauge and have a better estimation of real precipitation. Even though the results shown by the figure are coherent with this

concept, the scatter plot is far away from showing a linear relationship as mentioned by Referee #2. Since a deeper analysis of this might be necessary and probably is out of the scope of this paper, this graph has been removed. This was an attempt to give an answer to the non meteorology expert researchers working on the area and asking for an estimation of total precipitation on the area. Once assumed that non heated tipping bucket rain gauges are not very accurate from October to May, specially on the higher lands, it was decided to assess precipitation using physical modeling. Results will be published in the near future.

7. Referee #2: "- line 337: how is the mean zero isotherm calculated? Maybe the authors want to go into some details about this." 7.r. Authors: The text has been changed to: "In order to establish if the effect of precipitation underestimation of non-heated tipping bucket rain gauges is also affecting the rest of the rain gauges, the mean zero isotherm has been calculated using hourly temperature and elevation of the sites. A linear adjustment of this pair of data gives an hourly lapse rate that is used to find the height for temperature equal to 0 °C. Figure 14 shows the median, 75th percentile and 25th percentile of elevations of the zero isotherm for winter months. This figure shows how during winter, partly fall and spring most of the sites (except Ontalva and Alameda) have average freezing temperatures. It is them expected that underestimation of precipitation is potentially occurring at all these sites. The precipitation observations should be used with precaution during this period."

8. Referee #2: "- it would be interesting to know something more about the data validation algorithms for precipitation and the two-phase validation process for maintenance." We agree section 2.4.iii was not very clear. Text has been changed. We hope now that section 2.4.iii is more clear now. We have added some text and a new Figure 15 that summarizes the precipitation validation process.

9. Referee #2: "Technical corrections. The paper is clear and its ideas are presented in a comprehensible and well structured way. The referee encourages the authors to let an English mother-tounge collegue do the manuscript proofreading 9.r. Authors:

Our apologies for the numerous spelling and grammar errors found on this version of the paper. We hope that with this new version this is solved.

Please also note the supplement to this comment:
http://www.atmos-meas-tech-discuss.net/amt-2015-248/amt-2015-248-AC1-supplement.pdf

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