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Atmospheric Measurement Techniques Discussions

Interactive comment on "Comparisons of temperature, pressure and humidity measurements by balloon-borne radiosondes and frost point hygrometers during MOHAVE 2009" *by* D. F. Hurst et al.

Anonymous Referee #2

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General comments

The manuscript represent detailed data analysis of the balloon soundings that were made in conjunction of the Mohave 2009 campaign 11–27 October 2009 at the JPL Table Mountain Facility in California. Two modern radiosondes Vaisala RS92 and Intermet iMet-1-RSB plus two frost point chilled mirror hygrometers CFH and NOOA FPH participated. Radiosondes are analyzed for their differences in temperature and pressure measurements. Vaisala radiosondes were also compared against the hygrom-

eters for RH measurements accuracy. Since hygrometers need PTU data to convert the frost point into either RH or VMR the effect of PTU differences in the two radio sondes to hygrometer results were also studied. No distinction was made for the two hygrometer types. Finally hypsometric equation was used to check that user programs produced same altitudes (sufficiently) as operationat Vaisala software used in DigiCora ground system.

This manuscript is aimed to be a contribution in the AMT special issue on Mohave 2009 campaign. There is a small problem that the campaign overview article (Leblanc et al.) already represents some of the main conclusions of the sonde manuscript reducing the informative value of the soundings paper itself. As noted by referee1 the paper is sometimes cumbersome to read. Best way, in my opinion is to approach this paper as a poster presentation: Read the abstract first and then scan through the tables, figures and their captions which already forms almost standalone presentation as such and gives a good understanding of the whole content. Even this way the main analysis in sections 3.1-3.4 is heavy reading because of extremely detailed, somewhat repetitive discussion advancing from one parameter to another following the same formula. This is of course systematic but not a reader friendly way. If the authors could find a more compact and maybe a little less detailed way to discuss the results it would make a great service to readability of the manuscript.

Past scientific sonde campaigns by (partially) the same team have produced useful correction algorithms to operational radiosondes especially what comes to relative humidity measurements. Because of frequent changes of the sondes and sounding software by manufacturers it is good that somebody outside WMO is also keeping eye on the developments. Therefore in my opinion the subject itself is important and results deserve publication in some form, especially if Mohave special issue is published as planned.

What comes to World Meteorological Organization it of course arranges periodically the “official” intercomparisons of the operational radiosondes, lastly in Yangjiang , China in

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August 2010. The same sondes or at least the same manufacturer's products (CHF, Vaisala RS92 and Intermet) as a year earlier in Mohave participated in the latest WMO campaign too (WMO, Instruments and observing methods report no. 107). It would be interesting to have a comment about the similarities and differences of the two campaigns and their results, especially as one of the coauthors also participated in the WMO campaign and the report (e.g. at the summary section).

Specific comments

2.1 Radiosondes PTU differences were compared against the manufacturer–quoted error estimates but manufacturer's own hardware and software was not always used. In case of iMet radiosonde the ground system was not Intermet's own but a radiomodem connected to user's acquisition/analysis software. How might these affect the comparison results e.g valitidy of manufacture specs. (In case of Vaisala the RH dry bias correction was mentioned and quantified roughly.)

3.1 Temperature The authors find a negative bias of half a degree in the iMet readings against Vaisala RS92. Is that specific to this campaign or more common feature of iMet-1 temperature sensor? CHF team should have a lot of experience flying iMet sondes and RS92 together. Aforementioned WMO campaign reports a positive bias in Intermet's next version iMet-2 which participated in Yangjiang. Again it would be interesting to hear expert opinion on this apparent contradiction.

3.2 Pressure There is an interesting comment in the Yangjiang WMO report that the GPS altitudes are becoming so accurate that there might be not necessary to use pressure gauges at all in the future radiosondes. Have authors thought about this possibility of converting radiosonde GPS altitudes to pressures? Could be interesting to try that and discuss briefly. Something new or at least novel.

3.3. Relative humidity The environment in Mohave is quite dry and maybe this makes it possible to have sensible RH from higher altitudes by radiosondes too. Nevertheless, when a manufacturer says that the error in RH measurements can be 5% RH does

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it not mean that instrument is virtually useless in the stratosphere? Further, in these cold temperatures time lag increases rapidly so that no correction is able to correct the readings. What actually is the altitude in these conditions that radiosondes still could provide useful RH measurements? Does RS92 for example detect the hygropause?

Curiously RS92-RS92 differences tend to be on the negative side although not statistically significant e.g. figs. 12 and 13. Was there a systematic way of naming one RS92 as a primary and another one secondary (e.g. position in the rig or sgp- vs. k-type)? I am thinking of possible small effect of rest of the payload to humidity environment, for example.

3.4 Water vapor mixing ratios At the end of the section authors emphasize the importance of accurate pressure data to VMR computation from frost point hygrometer measurements. Since both RS92 and iMet have GPS receivers I return to my previous point of trying calculate pressure from the GPS altitudes. Also the payload might have its own GPS locator and anyway the payload is expensive enough to justify having a good GPS unit attached to it if sonde GPS is not good enough for this purpose. What would be your comment or experience on this point in general?

Section 3.5 (Altitude calculation comparison) Here the user made programs were compared against the Vaisala Digicora program. The lack of use of GPS data in this analysis is surprising. Why was it not used?

Interactive comment on Atmos. Meas. Tech. Discuss., 4, 4357, 2011.