Atmos. Meas. Tech. Discuss.,
doi:10.5194/amt-2017-234-RC1, 2017

Atmospheric Measurement Techniques Discussions

Interactive comment on "Hotplate Precipitation Gauge Calibrations and Field Measurements" *by* Nicholas Zelasko et al.

C. Genthon (Referee)

genthon@lgge.obs.ujf-grenoble.fr

Received and published: 25 September 2017

This paper demonstrates that an original algorithm used in the Total Precipitation sensor TPS-3100 also called ÂńÂăhotplateÂăÂż precipitometer to derive quantities of precipitation has some errors that can be corrected, and has shortcomings that can be reduced. This is based on both theoretical and experimental approaches. The Hotplate concept uses an original method to quantify precipitation: the differential energy needed to keep 2 overlaid hot plates at constant temperature, one facing up and the other facing down, includes the contribution (latent heat) needed to evaporate any condensed water falling on the upper plate (but obviously not affecting the lower plate facing down). There are many other terms to account for though. Both plates loose sensible energy and the loss rate is related to wind speed and ambient temperature.

However the 2 plates are equally affected so the differential is 0. On the other hand, the radiation balance of the 2 plates is not necessary the same and the differential must be accounted for. The issue of the catch efficiency of the instrument is also raised, particularly for solid particles.

The hotplate concept is very attractive for a number of reasons listed in the paper, including the fact that it is immune to frost deposition and snow/frost clogging, thus particularly appropriate in cold regions. Yet, although the instrument is not new (marketed by YES since the early 2000's), it does not seem to be so widely used (the paper mentions that "70 Yankee Environmental Systems (YES) hotplate precipitation gauges have been purchased by researchers and operational meteorologists" which is not a lot). This may (or may not, price is also an issue of course) sign some dissatisfaction with the results obtained, and an improvement of the algorithm may contribute popularize the instrument.

If the approach and methods appear sound, there is one potential major shortfall with the paper: it is not obvious if and how the revised algorithm can be implemented in an existing units. This is admittedly a technical issue but this is "atmospheric measurement techniques" so one expect technical issues to be addressed.

The paper mentions that the hotplate outputs data in 2 files, one (UHP) which "is provided to all YES customers" and the other (SHP) with no indication how it can be accessed. Of course the later has the data needed to design and use a new algorithm but there is no reference to the second file in the YES Hotplate documentation as of 2011. YES no longer markets the instrument and no longer provides any information on its web site. In such a paper, one should not have to bet on obtaining "private communication" from a manufacturer which has terminated production, to learn how to access the data needed to implement the improved algorithm. I believe that the paper has very limited significance and is not acceptable for publication in its current form unless this information,and all information necessary to implement the new algorithm, is clearly provided. On the other hand, it definitively ranks publication status if the information is given so that the reader can implemented the new algorithm, and provided the various issues bellow are addressed, some of which are fairly serious though.

The introduction (lines 33 – 37) states that 2 types of instrumentations to measure precipitation have been developed: the capture and optical gauges. This ignores radars which are powerful tools to measure and even profile precipitation. Because of ground clutter and vertical resolution, radars do admittedly not measure precipitation right at the very surface but because they can profile vertically it may be checked whether precipitation rates vary or not as it reaches closer to the surface. Radars do not “obstruct the wind and deflects falling particles in the measurement zone” (line 38). There is no “clogging with snow” with radars (line 47).

Equation (3) (lines 113 – 120) describes the improvement of the algorithm by the authors by taking into account the solar and thermal radiation contributions the the heat balance of the upper plate. Except for the latent heat term, one would expect a similar expression for the lower plate but this is not explicit. Because the hotplate is immune from snow and frost related problems that affect other sensors, it is expected particularly useful in cold snowy regions but then comes in the short wave power input reflected by the surface. If the sensor only measures the downwelling solar radiation, how is the reflected part factored in the lower plate energy balance?

Line 103: the sensible term is a function of U and T. Figure 1 shows that the temperature sensor is very poorly shaded from solar radiation reflected by the surface. Over a snow covered surface this is a likely major problem. The authors should evaluate the impact on precipitation estimation over snow, possibly bring in an empirical correction?

Then, according to line 202, the upwelling IR is also estimated from this temperature supposed to be the ambient air temperature, but probably largely overestimated over snow.

Line 3176: Define AGL (presumably Above Ground Level)

Line 376: How would a “violation of the steady state assumption” could explain the delay? Would this have to do with thermal inertia?

Lines 422 – 423: This is not clear: the authors use data derived for a flow perpendicular to the plates to determine parameters for a flow parallel to the plates? Does this make sense? Can you clarify?

Table 1: “Hotplate data files”. This table is misleading has long as access to SHP data is not explicit.

Lines 527-530: A synthesis table describing the various algorithms referenced in the paper could be useful. Only here does one clearly realize that none of the above algo discussion applies to the commercial (YES) one. The average hotplate user, presumably a target reader, probably got his/her instrument from YES and expects he/she will be able to improve his/her instrument with the new algo. It is not necessarily obvious from the beginning that R11 is not YES algo and that the authors describe an algo which objectively improve over R11 but not necessarily over the commercial units. Improvement over the commercial algo is verified only in the end. This should be clearly stated from the very beginning.

Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2017-234, 2017.