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Interactive comment on "Accuracy of retrieving temperature and humidity profiles by ground-based microwave radiometry in truly complex terrain" *by* G. Massaro et al.

Anonymous Referee #1

Received and published: 2 April 2015

The paper investigates the retrieval of temperature and humidity profiles by a ground-based microwave radiometry operated in the Inn Valley, Austria. An enhanced radiosonde data is used to develop and test retrieval algorithms against 84 summer radiosondes and the standard retrieval. Classification into seasons is used to improve the results. Virtual observations that could become available from nearby mountain sites might improve the retrieval significantly – in particular in situations in strong inversions.

General Comments:

The paper is well written and the authors provide a good description of the background

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Interactive Discussion

Discussion Paper

of microwave radiometry. The originality of the paper should be the operation of the radiometer "in truly complex terrain". Other studies have already investigated the water vapor in strongly structured terrain (Black forest: Kneifel et al., 2009; GRSL; Corse: Adler et al., 2015) using microwave radiometers that reveal the spatio-temporal variability of water vapor caused by surface processes and circulations at different scale. Unfortunately this paper only investigates the quality of the vertical distribution of temperature and humidity assuming horizontal homogeneity within the valley.

The paper mainly deals with retrieval development using well established statistical procedures via simple regression algorithms. There is no surprise that the algorithm developed by the authors on the base of high resolution, day and night radiosondes performs better than an all year algorithm based on low resolution and night soundings only. The importance of a representative training data set has been pointed out in the literature since decades (cf. Güldner, 2013; AMT) – same for the classification into seasons. In this context, the authors claim that the poor performance in the presence of elevated inversions (P2276, line 10) is due to their limited occurrence in the training data. However, the reason is the poor vertical resolution of the microwave radiometer as the information gathered in most channels comes from a broad range of altitudes. This can easily be seen from the weighting functions for the individual channels or averaging kernels (i.e. retrieved temperature change compared to the true one - see Fig. 7, Löhnert and Maier, 2012). In fact, the major problem with the radiosonde training data sets is that not the full diurnal cycle is considered.

The only original idea in the paper is the consideration of additional measurements as could be gathered from neighbouring mountain slopes and tops. However, this idea needs to be developed in more detail in particular about the representativeness of the measurements for the vertical profile as for example surface heating on hill slopes might cause deviations. What is the correlation among different heights, different sides of the valley, etc.? I would strongly encourage the authors to further pursue this line of work.

There are many interesting questions that the authors already could easily address with their data set:

- How strongly differ the temperature profiles derived from scans in the two directions?

- Is there a dependence on the weather type / stability?

- How does the temperature distributions develop in a situation with low synoptic influence?

Especially, the authors should exploit the continuous observations, as this is the major advantage of microwave radiometer compared to satellite.

Specific Comments: P2265, line 26: Vertical resolution comes from observing spectral features. Therefore exchange infrared "radiometer" with "spectrometer" and two lines later

P2268, line 16: Do not cite PhD thesis but standard textbooks (Petty, Jansen..) or review articles (Westwater) for theory.

P2270, line 10: Why 0.35 K noise? For all channels the same?

P2272, line 8: Also the assumption for water vapor to be horizontally homogeneous (over the path of the beam never holds. For temperature the more optical thick channels receive information within a much narrower region.

P2272, line 21: Scanning in zenith direction?. You mean time series ?

P2275, line 25: Note, that Löhnert et al. 2009 used synthetic data – no real measurements

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Interactive comment on Atmos. Meas. Tech. Discuss., 8, 2263, 2015.