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Atmospheric Measurement Techniques Discussions

Interactive comment on "Matching radiative transfer models and radiosonde data from the EPS/MetOp Sodankylä campaign to IASI measurements" *by* X. Calbet et al.

Anonymous Referee #1

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General Comments:

The manuscript "Matching radiative transfer models and radiosonde data from the EPS/Metop Sodankylä campaign to IASI measurements" by Calbet et al. describes methods and results of comparisons of IASI observed and RTM calculated radiances using best estimates of the atmospheric state vectors over the Sodankylä site in Finland.

The manuscript is written in an appropriate style. It is relevant to the AMT community and worth publishing.

The new generation of advanced satellite-based atmospheric sounders with the capability of obtaining high–vertical resolution profiles of temperature and water vapour has already been in existence for a number of years. The Atmospheric Infrared Sounder (AIRS) as the first advanced sounder was launched in May 2002, four years before the IASI – instrument (Infrared Atmospheric Sounding Interferometer) on Metop reached space. However, comparisons between radiances observed by hyper spectral infrared sounders and radiances computed from coincident in situ profile data using RTMs are rare. Some published studies (for instance Strow et al. 2006, Tobin et al. 2006, both included in the reference list of the manuscript) focussed on AIRS on board NASA's Aqua satellite.

Comparisons of space borne sounder observed radiances and RTM calculated radiances suffer from difficulties in making accurate ground based measurements of the atmospheric state. Tobin et al. (2006), for instance, introduced a "microwave scaling" technique to correct radio soundings. However, measurements of low water vapour amounts in the upper troposphere remain difficult.

Calbet et al. are not the first to publish comparisons of IASI data and in situ profile data. Pougatchev et al. (2009), not included in the reference list of the manuscript, have already presented first results earlier. However, the Pougatchev study was limited to a comparison of obtained IASI profiles of temperature and water vapour (Level 2 data) and uncorrected RS92-radiosoundings. As a consequence, Pougatchev et al. (2009) described a significant difference between IASI water vapour profiles and in situ water vapour profiles measured by RS92 radiosondes in the upper troposphere. However, the humidity difference is suspected to be due to effects of solar radiation on the Vaisala radiosonde water vapour sensors.

Calbet et al. turn to IASI Level 1 data (radiances and spectra, respectively), limiting their studies to a wavenumber range between 1500 and 1800 cm^{-1}, thus to wavenumbers most insensitive to low level clouds and surface properties like emissivity and skin temperature and, they estimate the atmospheric state vectors by a combination of frost

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point hygrometer measurements und ECMWF data together with a testing of different RTMs. In this respect, the paper presents novel concepts and data.

The substantial conclusion could be drawn, that it is possible to reproduce IASI measurements within the accuracy of one sigma instrument noise.

Below is a list of specific comments and questions.

Specific Comments and Questions:

p. 4500 Line 20: In my opinion, the spatial resolution of IASI-measurements is 25 km and more. At nadir, the instrument samples data at intervals of 25 km along and across track, each sample having a maximum diameter of about 12 km. The diameter of IFOV is not equal to the spatial resolution!

p. 4504 Line 29: A reduction of 5% of the radiation dry bias appears to be low. If it means 5% in absolute terms of relative humidity, I recommend adding "ΔRH".

But I doubt that this is the correct number. Assuming that the true rH in 300 hPa is 60%, then "RS92 old" measures 45% and "RS92 new" (new coating of humidity sensor contacts) measures 49.75% under cloudless daylight conditions (the reduction of bias is about 5% ΔRH).

Assuming that the true rH in 300 hPa is 10%, then "RS92 old" measures 7.5% and "RS92 new" (new coating of humidity sensor contacts) measures 8.3% under cloudless daylight conditions (here is the reduction of bias lower than 1% ΔRH).

5% is likely deduced from Kivi et al. (2009) Figure 6, right panel and means an averaged value of (RH old – RH new) / RH new. If that was the case, it should be corrected.

p. 4506 Lines 9-11 In addition, it would be interesting to find out where (exactly) the sondes have drifted away from the launch location passing UT und LS (compare remarks p. 4509 lines 27 -29).

p. 4509 Line 12 I recommend restructuring the text for clarity purposes. Consider

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adding the headline “5.4. Comparisons”.

p. 4509 Lines 27 - 29 In a first study, it should be allowed to make certain assumptions about spatial IASI radiance variability in a special wave number region; but in further work the spatial variability should be discussed. Question: Where can I find the definition of corresponding IASI-IFOV, is it the nearest to the Sodankylä site?

p. 4510 Lines 8 – 9 It’s obvious, that a correction of RS92-humidity profiles is needed. Without a doubt, an interpolation is better than a single profile. But why are the spectra of interpolated profiles so closely related to the corrected RS92 spectra and noticeably deviant from the CFH spectra?

We know that the atmospheric layers that most significantly contribute to the top of the atmosphere radiances in the spectral region between 1500 and 1800 cm^{-1} are located in the mid to high troposphere and lower stratosphere. My own testing of LBLRTM 11.7 reveals the highest sensitivity between 500 and 350 hPa.

CFH sondes usually fly through this layer (see Fig. 3) approximately 40 min before satellite overpass, RS92 sondes fly through this layer approximately 15 min after satellite overpass. Thus, the interpolation should be closer to RS92, but not this close.

p. 4510 Line 19 I’m not sure about the following wording “slight displacement of one Gaussian figure with respect to the others”. Does it mean “slight displacement of one histogram . . .”?

p. 4510 Lines 24-25 I’m not sure about the following wording “In this case, all three Gaussian curves overlap”, it might be better to separate Gaussian curve and histogram or distribution of residuals . . .

p. 4511 Lines 10-11 . . . and two time interpolated?

Technical Comments:

p. 4499 Line 14: Insert "Schlüssel“ in "(e.g., Calbet, 2006)“.

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p. 4500 Lines 14, 15: Insert "et al.“ in "(. . . Blumstein, 2004)

p. 4502 Line 13: Remove “r”, insert "f“ in Hormann (correct is “Oltmans and Hofmann”)

p. 4504 Line 3: Consider replacing “types” to “type” in “.. but it corresponds to the newer sonde types that we used”

p. 4506 Line 24: Remove “in blue”, change “gray” [am] to “grey” [br]

p. 4507 Line 24: Consider removing “s” in “corrections, which consists”

p. 4510 Line 20: Correct “fir” to “fit”

p. 4511 Line 6: Insert "Schlüssel“ in "(e.g., Calbet, 2006)“.

p. 4511 Line 15: remove “to”

p. 4520: Change “gray” [am] to “grey” [br]

p. 4521: Change “gray” [am] to “grey” [br]

Reference (of the comment)

Pougatchev, N., T. August, X. Calbet, T. Hultberg, O. Oduleye, P. Schlüssel, B. Stiller, K. St. Germain, G. Bingham: IASI temperature and water vapor retrievals – error assessment and validation, Atmos. Chem. Phys., 9, 6453–6458, 2009

Interactive comment on Atmos. Meas. Tech. Discuss., 3, 4497, 2010.