

Interactive comment on “Improvement of numerical weather prediction model analysis during fog conditions through the assimilation of ground-based microwave radiometer observations: a 1D-Var study” by Pauline Martinet et al.

Anonymous Referee #1

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General comments

The manuscript describes the assimilation of brightness temperatures measured by a ground-based microwave radiometer under fog conditions with a 1D-Var approach. It is shown how the profiles of temperature and humidity are corrected in the analysis. The manuscript is well written (structure, language) and comprehensible with illustrative figures. The topic is highly relevant as a first step towards the assimilation of the MWR

C1

data in numerical weather prediction models and the findings of the study give valuable hints how to assimilate this kind of data successfully with respect to the background covariance matrix and bias correction and what kind of increments are to be expected on the profiles. The content of the manuscript is closely related to the measurements and thus still fits the scope of AMT, however a follow-up paper focusing more on the impact of the data on model forecasts might fit better to another journal. In some paragraphs of the manuscript, however, the explanations are kept very short, here the manuscript could benefit in terms of comprehensibility, also for a broader readership, if the statements would be explained a bit better. Thus I suggest the manuscript for publication with some minor corrections and clarifications which I list below.

Specific comments

Abstract: The authors should mention already in the abstract that the brightness temperatures are assimilated directly over a forward operator (RTTOVgb)

Line 31-33: This formulation is not exact: it is true that satellite data provide limited information on the ABL, but not because of the complexity of data assimilation over lands, to be exact this issue makes the use of the data for NWP more difficult. Please rephrase.

Line 44: it could be emphasized here that the study by Otkin and Hartung et al. (2011) with 140 MWRs was an OSSE (in contrast to your study using real data)

Line 123: For clarification for readers not familiar with (MW) remote sensing you could add half a sentence why transparent channels are omitted at low elevation angles

Line 134: The authors could add a sentence, why it is inadequate for fog areas

Line 150-151: This is not clear. What kind of tests?

Section 3.2: This section is not structured well. First it is about obs errors, then bias correction, then obs errors, then both. . .

C2

Line 176: what do the authors mean by the “individual errors which were added in quadrature”? Not really clear to me.

Line 214-215: not fully clear. . . So the authors want to say the dataset consists of stratus clouds, profiles with fog, and some clear-sky profiles?

Line 251-256: Please give more explanations in this paragraph, why the underestimation of specific humidity at nighttime is due to an overestimation of saturation, and why most of the model increments are produced by the B matrix cross-covariances.

L264: For clarification this could be rephrased to “. . . During the period where the model fails to simulate the stratus cloud, the LWP is significantly increased in the 1D analysis with values between. . .”

L279: The authors could add one sentence on what the visibility diagnosis is based.

L317-318: This is not clear. Does it mean the profiles used are not forecasts but taken from an analysis with conventional data already assimilated?

Technical corrections

L31: Better: “. . . which is undersampled by observations. “Even though satellite data provide a global coverage. . .”

L48: Better: impact of this network was found to be neutral..”

L51: Better: “AROME model with a one-dimensional..”

L55: correct to: “. . . and evaluates the impact. . .”

L122: correct to: “. . . consists of..”

L129: replace “spatially” by “horizontally” (because spatially comprises vertical and horizontal directions)

L144: Better: “. . .with a horizontal resolution set to 3.2km and . . .” (“finally” should be omitted)

C3

L167: no comma here

L167: better: “but also on an adequate specification of. . .”

Line 201: do you mean Config1 here?

General: References to figures in the text should be with capital “F”. “Figure X” instead of “figure X”.

L222: Typo: “almost”

L229: Typo: cloud base height

L232: better: “. . . fog is observed at 10m altitude during 40 minutes at midnight and. . .”

L257: better: “. . . by night leads to the effect that the fog layer is not saturated any more in agreement. . .”

L262-64: Better: “. . . with a maximum reaching 90gm-2 at 7UTC. This value, however, decreased down to. . .”

L269: Better: “While the previous focuses on an extreme. . .”

L382: Better: “. . . has been investigated with. . .”

L429: Better: “. . . on temperature and LWP and small but. . .”

Figure 8 Caption: should be re-phrased to: “. . . differences compared to tower measurements. . .”

Figure 13: The axes are difficult to read. Maybe the figure could be enlarged to improve this.

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C4