

Interactive comment on “A neural network approach to estimate a posteriori distributions of Bayesian retrieval problems” by Simon Pfreunds Schuh et al.

Referee comment:

P. 15: in the comparisons between QRNN and the BMCI, as the training data or a-prior get smaller, the BMCI uncertainties need to be increased beyond the sensor noise to account for a sparse a-priori. If that was not done, it likely explains the divergence in the performance for smaller training sets. That said, finding the uncertainty due to a sparse a-priori is not at all trivial so it might still be an advantage for the QRNN but perhaps slightly different than presented. A bit more explanation by the author on this topic would help the paper. The conclusion mentions this as well.

Author response:

This is a very valid point that has indeed not been considered in the presented calculations. However, in particular since there is no formal way of doing this, it seems that finding suitable ways of handling scarce databases with BMCI would merit a study of its own. Applying just any ad-hoc solution to increase the measurement uncertainty is unlikely to do the BMCI method justice, so the authors judge it to be out of the scope of the study to investigate this further.

To address this in the manuscript, the following paragraph has been added:

A possible approach to handling scarce retrieval databases with BMCI is to artificially increase the assumed measurement uncertainty. This has not been performed for the BMCI results presented here and may improve the performance of the method. The difficulty with this approach is that the method formulation is based on the assumption of a sufficiently large database and thus can, at least formally, not be handle scarce training data. Finding a suitable way to increase the measurement uncertainty would thus require either additional methodological development or invention of an heuristic approach, both of which are outside the scope of this study.

Referee comment

P. 12, line 12: Maybe I missed it but I don't think Rectilinear Linear Unit was ever defined in the paper.

Author response

The ReLU activation function is now introduced as Rectified Linear Unit the first time the acronym is used in the text.

Referee comment

I am quite certain that neither “Gaussianity” (p.3, line 2) nor “overproportionally” (p. 12, line 20) are real words.

Author response

The word *Gaussianity* has been replaced. The sentence now reads:

Nonetheless, even neglecting the validity of the assumptions of Gaussian a priori and measurement errors as well as linearity of the forward model, the method is unsuitable for retrievals that involve complex radiative processes.

Similarly, *overproportionally* (which correctly should have been overproportionately) has been replaced by *excessively*.

Referee comment

p. 4, line 15: There is an extra “from” in front of “directly”

Author comment

The word *from* has been removed.