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Atmospheric Measurement Techniques Discussions

Interactive comment on "Neural network cloud top pressure and height for MODIS" *by* Nina Håkansson et al.

Anonymous Referee #2

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Overall quality of the discussion paper ("general comments")

In the paper a novel retrieval of cloud top pressure and height using neural networks is presented. The presented retrieval technique is state of the art and an accurate technique. To account for different availabilities of channels on different satellites, a few modification of the neural network are investigated revealing the information content of the different channels. The new algorithms are compared to two reference algorithms, the CTTH algorithm of the NWCSAF PPS-v2014 and the MODIS collection 6 L2 height product. Additionally the algorithms is compared to CALIOP and CPR measurements. The quality of the algorithm is evaluated in terms of the mean absolute error (MAE). The improved quality of the results is impressive. From my point of view, I would request for at least another quality measure like standard deviation (similar to Tables 6 and 7). In

overall, good work!

Individual scientific questions/issues ("specific comments")

p1 line 23: CTH might also be used in data assimilation of atmospheric motion vectors. Introduction: A short description of the traditional technics to retrieve cloud top pressure and height could be added to the introduction. (or cite an overview paper like Hamann et al. "Remote sensing of cloud top pressure/height from SEVIRI: analysis of ten current retrieval algorithms." Atmospheric Measurement Techniques 7.9 (2014): 2839-2867.)

The introduction should motivate, why it is expected that using machine learning, in particular neural networks, could improve the expected results.

Merge chapter 2.1.1 into chapter 3.2. (and skip the sentence (p3 line 10) "The MODIS Collection 6 cloud product were used as an independent. . .", you said that before).

Chapter 2.2 Add a short sentence, why you chose the CALIOP 1km product and not also 5km or 10km product which are more sensitive to optically thin clouds.

Chapter 2.4 add the version number of the ECMWF model and add product name and version number of the OSISAF data used in this study.

You might consider to add the PPS-v2014 and MODIS C6 algorithm to table 3 and 4.

Please make the order of algorithms in table 3, 4 and 5 consistent.

p5 line 5: how often is a pressure lower than 70 hPa retrieved?

p5 line 10: Why did you choose this number of levels? Is it sufficient to use 6 levels to represent the boundary layer inversions or other small scale features?

p5 line 21: do you skip non cloudy pixels in the 5x5 pixel standard deviations?

p5 line 20: the B_3.7 has a solar component. Did you correct for this during day/night?

p6 chapter 3.3.2: You chose to use specific days for training and others for validation.

Given that you only use a limited number of days, wouldn't it be more to randomly select independent pixels from all available dates for training, validation, and testing to represent a larger variety of weather situations?

p 6 line 19: Did you test other configurations that 30/15 neurons in the first/second layer? If yes, how was the performance?

Chapter 3.3.3: May batch size and momentum be changed during the training process?

p 7 line 27: consider to discuss the solar component of the 3.7 mue m channel. To my opinion this NN could perform better when corrected for that (e.g. adding the solar time as input variable).

p8 line 5: Maybe express it positively: All NN can reproduce a clear bi-modal pdf very similar to CALIPSO, the pdf of PPS-v2014 deviates from this shape . . .

p8 line 7: It is written "for the best performing network". Did you train several networks for one channel configuration? If so, could you describe the number of trained networks in chapter 3.2.2, please?

p 8, line 11: according to my table 6, the NN-MetImage is better than the NN-MetImage-NoCO2.

p 8, line 15: do you have an idea, why the MAE against CPR is larger than the MAE against CALIOP for NN-MetImage and NN-MetImage-NoCO2?

p 9, line 9: could you please describe a bit more in detail the differences seen in Figure 7?

Chapter 5 Discussion: Could you also comment on applying your NN technique on geostationary satellites? What would be the main differences/challenges?

A compact listing of purely technical corrections ("technical corrections": typing errors, etc.)

Please check consistent spelling of NWC SAF (e.g. p2 line 11) and NWCSAF (e.g. p1 line 19)

Please check consistent spelling of PPS-2018 (e.g. p1 line 19) and PPS-v2014 (e.g. p2 line 23)

Please check the space between numbers and units and the typeset of the units.

Try to reduce number of paragraphs in the abstract, e.g. p1 line 8 is a one sentence paragraph.

please check capital letters, e.g. Neural network (p3 line 26), neural network (p2 line 14) or Neural Network.

p3 line 22: (change . to ,) . . . of the networks, see Table 1 for selected Dates

Move p4 line 9-14 to line 6.

p4 line 27: introduce abbreviation GDAS (as written in line 30)

p4 line 28: add "the": . . . and the PFAAST radiative transfer model. . .

p5 line 3 add: The "uppermost cloud" top layer. . .

p5 line 11: reformulate "much of what"

p5 line 19: introduce physical unit "B" (in the lines before)

p5 line 23: B_11 "for" neighboring pixels -> B_11 "of the" neighboring Pixels

p5 line 25: avoid brackets

p 15 line 7, add "and": BT for water vapour channels at 6.7 "and" 7.3 mue m

p15 line 9/10/11, remove "." at the end of first entry, e.g. BT differences ""

p5 line 29 and thereafter: don't write CO2 with cursive letters

p 6 line 19: hidden layer "for" the neural network -> hidden layer "of" the neural network

p 6 line 17-32: reduce the number of paragraphs. Don't create one sentence paragraphs.

p 7 line 18: write Ciwv in cursive letters

Chapter 4 (Table 5) use same order of retrievals as in table 3 and 4 (e.g. NN-NWP first)

p 7 last line: N-VIIRS -> NN-VIIRS

consider to write NoCO2 (in MetImageNoCO2) not in cursive letters.

Figure 1 (p21): consider to have the figures in the same order as the algorithms are mentioned in table 3, 4, and 5.

p 8, line 34 and following: avoid the abbreviation NN-CTTH, e.g. change: that the NN-CTTH all have -> that all NN retrievals have . . .

Figure 7 (p27): Could you please add a color scale instead of describing it with words.

p 9, line 11 and thereafter: cloud heights -> cloud "top" heights, avoid NN-CTTH abbreviation (which one do you mean? all NN retrievals or NN-MetImage or another one?)

p 10, line 12: avoid NN-CTTH -> specify which retrieval you referring to

p 10, line 15: The NN CTTH retrievals all have better results for low, medium and high clouds . . . (Clouds don't show results. . .)

p 10 line 16 "neither of which could be applied for the AVHRR1 instrument" can be skipped

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