

Interactive comment on “Characterisation of the artificial neural network CiPS for cirrus cloud remote sensing with MSG/SEVIRI” by Johan Strandgren et al.

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We thank the reviewer for taking the time to read and review our manuscript. Each comment from the reviewer (roman style) is listed below along with the corresponding reply from the authors (in italic font style) as well as possible changes in the manuscript (in blue italic font style).

Specific comments

Section 3.2

A table would be useful here for better visualizing which input variables were used in

C1

each ANN. Since this is provided in Strandgren et al. (2017), the authors could refer to Table 2 of that study.

We thank the reviewer for the good suggestion, a reference to Strandgren et al. (2017) has been added in the end of Sect. 3.2: “please see Table 2 in Strandgren et al. (2017) for a tabular overview of all input variables.”

Section 4

While the OPF flag is an output of CiPS, it is not clear how it was treated in this study; was it just used for excluding opaque cirrus retrievals when characterising other CiPS output? Please clarify.

For the input variable importance analysis, the CiPS opacity flag (OPF_{CiPS}) is treated just like the other CiPS output variables. For the surface type as well as for the vertical cloud-aerosol structure analysis the OPF-flag is not used at all. OPF_{CALIOP} , rather than OPF_{CiPS} , is used to identify and exclude opaque retrievals since CALIOP is more accurate. For opaque retrievals, neither the surface type nor the vertical cloud-aerosol structure analysis makes sense since we don't know about possible cloud/aerosol layers below the cirrus. Also when the retrieval errors are investigated as a function of IOT_{CALIOP} and CTH_{CALIOP} only transparent cirrus retrievals, as defined by OPF_{CALIOP} , are included. Only for the noise sensitivity analysis, where no CALIOP data are used, OPF_{CiPS} is used to exclude opaque IOT_{CiPS} and IWP_{CiPS} retrievals.

For the input variable importance and the noise sensitivity analysis we consider it clear how OPF_{CiPS} was used. But for the other parts of the characterisation, we agree with the reviewer that there is room for clarification. The following changes in the manuscript have been made to clarify this aspect: In Sect. 4.3.2 we now write “The goal of the opacity flag retrieved by CiPS is to detect cirrus clouds that are opaque, i.e. where the vertical structure below the cirrus is unknown for CiPS/CALIOP.”

C2

Consequently, the opacity flag of CiPS is not characterised for the different surface types as it cannot be ruled out that there are no liquid water clouds or aerosol layers with $AOT > 0.2$ below an opaque cirrus. Please note that the more accurate opacity flag of CALIOP is used to identify profiles with opaque cirrus clouds that are excluded from the analysis, as explained in Sect. 4.4.1." In Sect. 4.4 we now write: "Again, only the CiPS quantities CCF_{CiPS} , CTH_{CiPS} , IOT_{CiPS} and IWP_{CiPS} are characterised for the different vertical cloud-aerosol structures. The OPF_{CiPS} is excluded from the analysis since its goal is to detect cirrus clouds where the vertical structure below the cirrus cannot be resolved by CALIOP. Opaque cirrus clouds are identified and excluded using the opacity flag of CALIOP as described in the following section.". In Sect. 4.5 the sentence "To remove any effects from different vertical cloud-aerosol structures, again only those profiles with transparent cirrus clouds and possible faint aerosols ($AOT \leq 0.2$) are used (class C1 in Sect. 4.4.1)" has been rephrased as: "To remove any effects from different vertical cloud-aerosol structures, again only those profiles with transparent cirrus clouds and possible faint aerosols ($AOT \leq 0.2$) **as defined by CALIOP L2 data** are used (class C1 in Sect. 4.4.1)".

Section 4.3.2

First paragraph: It would be helpful for the reader if Fig. 5 was also referred here.

A reference to Fig. 5 has been added.

Section 4.5

Page 17, lines 8-10: This sentence provides general information on the CiPS training and evaluation data sets. The authors should consider adding this information to Section 2.3, in order to make more clear how the collocation, training and validation data sets are related.

This information has been added as proposed by the reviewer. The last part of Sect.

C3

2.3 now reads as follows: "This dataset was originally used to validate CiPS and contains 5 million collocations collected over a time period of almost 6 years (April 2007 to January 2013). This represents a random subset containing 10% of all quality-screened collocations of CiPS input data and CALIOP cirrus cloud properties obtained during this time period. The remaining 90% of the collocations were used to develop and train CiPS. Hence, the collocation dataset, as well as the training datasets used to develop CiPS, do to some extent (limited by the sun-synchronous orbit of CALIPSO) represent the natural distribution of cirrus clouds and cirrus cloud properties. A detailed description of the collocation dataset can be found in Strandgren et al. (2017), where it is referred to as the internal validation dataset."

Technical corrections

Page 3, line 27: the word "used" is repeated.

Revised

Page 10, line 12: Please replace "... are visualised..." with "... is visualised..."

Revised

Page 11, line 3: Please replace "liquid water/aerosol" with "liquid water cloud/aerosol".

Revised

Page 13, line 22: Please omit the second "the".

Revised

C4

Page 14, line 12: "...liquid water..." should be replaced with "...liquid water clouds..."

Revised

Page 21, line 28: Please replace "increases" with "increase".

Revised

Page 22, lines 13-14: "...adjacent liquid water clouds..." should be "...adjacent to liquid water clouds..."

Revised

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