Referee report: "Absolute calibration of the colour index and O₄ absorption derived from Multi-AXis (MAX-) DOAS measurements and their application to a standardised cloud classification algorithm"

General comments:

* This papers presents a continuation and improvement of the cloud-screening scheme presented in Wagner et al. 2014. The different calibration procedures enhance the usability of their cloudclassification scheme. However, the paper assumes a very detailed knowledge of concepts presented in the 2014 paper. It could be helpful if some concept are re-introduced or quickly summarised in the current paper. For some of the calibration/threshold procedures discussed by the author, the added value remains unclear.

Specific remarks:

- * For the reader, it would be good to see the direct impact of the proposed new calibration scheme on the cloud-classification scheme as presented in Fig.14 in Wagner et al. 2014. As some steps in the flowchart are not possible/advised using the new method, how does this affect the different sky conditions that can be distinguished?
- * p3: When referring to the old wavelengths used (p3 and figures further), the author sometimes refer to 420nm, and sometimes to 440nm. This needs to me harmonised.
- * p3 128: The authors define the calibrated CI as proportionally to CImeas. Are there instances when an additional constant offset is expected (CIcal=CImeas* β + constant), and how does this affect the calibration?
- * p4 134: The calibration procedure is a bit hidden in the text. It would be easier for the reader if it would be a bit more separated from the previous text, and the different steps more clearly itemised.
- * p4 135: The term "simulated minimum" should be defined better, also in the corresponding figure. To what optical depth does the minimum belong?
- * p4 135: This simulated minimum values that are needed for the calibration should also be tabulated in Table A1, so the reader can easily reproduce the calibration procedure, without having to run his own radiative-transfer simulation.
- * p5 l4: It should be noted that for sites with predominantly clear skies, an accumulation point will also be present, but at higher CI values, indicating clear skies.
- * p5 18: "after cloud sky data were removed": Does the author mean: after removing non-cloudy data?
- * p5: It is at this point of the paper unclear what the added value is of the O4 measurements on the cloud classification, as this is not mentioned anywhere in the introduction. Especially since at p6 116 the authors state that cloudy measurements need to be removed by the CI information, to perform a good O4 calibration.
- * p5: I would like to see here again a definition of the calibration AMF, to make it clear for the reader: thus AMFcal=.....

- * p6 l26: As before, the simulated AMF values used for the calibration should be in TableA1, allowing the reader to immediately follow the same procedure.
- * Fig9: Are the CI given here already calibrated? If so, it should be specified in the caption.
- * p8 l4: The meaning of the sentence "Note that the ..." is unclear. Please rephrase.
- * p7 133: Some more information on why AOD=0.75 is a good threshold would be useful. Is this still a good threshold for sites which are more polluted than Cabauw, and often experience high AOD values, which are not related to clouds?
- * Fig 10 and similar: These figures in my opinion do not give a good idea on the comparison between the old and new method. In Fig10 a very big difference is seen between the new method and the old, but no further explanation is given as to where these differences come from, or whether the this means an improvement in the classification of clouds or the opposite. I would like to see figures which give a better qualitative and quantitative comparison between the old and new method: are there more misclassifications, are some conditions no longer present, etc.
- * p8 131: A visual representation of the TSI and threshold would be beneficial to the reader. Furthermore, a definition or formula for the TSI should be given.
- * p9 118: The spread is calculated using the minimum and maximum CI in a scan. What happens if there are strong outliers, do these need to be removed first, or do they not impact the procedure strongly?
- * FigA2: Caption: 'ange' should be 'angle'
- * p9 128: Where does the threshold of 0.14 come from? And are cases with optical depths > 6 not already identified by the CI value itself? It remains a bit unclear what exactly the added value is of the CI spread in the end given the restrictions discussed by the authors.
- * p10 sect4.3.1: The author end by noting that the layer height makes it difficult to distinguish between clouds and aerosols. Can multiple scattering in clouds be identified in the O4 DSCDs, and in this way be used to distinguish between optically thick clouds and aerosols?
- * p10 l21: The use of this value of AOD=0.2 should have already been discussed on p6 l26. What is the impact of choosing a different AOD value. Will this value of AOD=0.2 be too big for very clean sites (e.g. Jungfraujoch/Antartica)?
- * p10 122: The authors talk of a constant threshold for the O4 AMF, but in the table they give a polynomial expression for the threshold? Again, a visual representation for an example day, of the full data set, of the O4 AMF calibration and threshold would be beneficial.
- * p10 sect4.4.1: Again, some information on what the added value of the radiance is would be good. Do you need information of the radiance/O4 for the detection of thick clouds. Are these not already identified by the absolute CI value? Also, in stead of radiance, 'signal' should be used both in the text and in the figures.
- * Fig17: Also plot the lines using the other albedo value (as used in Fig15).
- * p13 113: What if no measurements under clear sky conditions are available?