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Atmospheric Measurement Techniques Discussions

Interactive comment on "Cloud and aerosol classification for 2 $1/2$ years of MAX-DOAS observations in Wuxi (China) and comparison to independent data sets" *by* Y. Wang et al.

Anonymous Referee #1

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General comments

The paper is a continuation of the previous work of Wagner et al. (2014) on using ground-based MAX-DOAS observations for characterizing cloudiness and aerosol presence in the atmosphere. The observations are performed in Wuxi, China, with very different atmospheric conditions than in Cabauw for which Wagner et al. developed their method. The results are compared to other ground-based measurements and to satellite measurements of aerosols and clouds.

The paper is useful as a refinement of the classification method of Wagner et al., and

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as a comparison of ground-based and satellite measurements of atmospheric conditions regarding clouds and aerosols. Especially sub-pixel cloudiness and the radiance similarity of clouds and aerosols at subpixel scale are important issues for satellite measurements. The interpretation of these effects is aided by using collocated MAX-DOAS measurements from the ground. The referencing is very complete.

The results shown in Figs. 12-17 are interesting, and deserve a good discussion.

Main comments

- The paper lacks clarity of text. The paper is too long and too technical. It is important to focus on method and results. The text can be more condensed. In fact, a major rewriting of the paper is necessary.

- The use of the term radiance in the paper is confusing and often unspecific, e.g. missing information on viewing direction; calibrated or uncalibrated radiances; spectral dependence. The most problematic section of the paper is Sect. 2.2.1. Here in the first sentence radiances are given in units of counts per second: so these are not radiances but measured signals! From measured signals radiances can be derived (in radiance units, e.g. photons or Watts) by calibration. Please stick to common nomenclature.

In this section first the calibration of the instrument is beinig performed using an RTM in which a simple Henyey-Greenstein model is used. This is of course too simplistic and can cause large deviations, as shown in the paper. It would be better to use the Mie phase function that belongs to the Aeronet microphysical aerosol retrievals (particle size, shape, refractive index) as a function of wavelength. So this remains to be done. The error due to the empirical calibration technique that is chosen should be assessed as good as possble. (p. 4661). It is essential for this cloud and aerosol classification method that a good calibration procedure is developed.

- In the paper a good error analysis is missing. In general, a satellite-ground observation comparison suffers from many potential errors/uncertainties/representativeness

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differences. These errors should be discussed in the paper.

- Several figures are unreadable due to small texts. The figures are not nice. Please spend more time on making professional, well readable figures. Please give units for quantities along the axes.

- The English text should be improved regarding clarity, grammar, and spelling. Many sentences are too long and unclear. An example: Abstract, line 21-24. Please shorten and clarify such sentences.

Specific comments:

Title and rest of paper: 2 $\frac{1}{2}$ > 2.5

Abstract, p. 4654: - l. 19: indicate > confirm; cloud classification > MAX-DOAS cloud classification - l. 21: clear sky: do you mean cloud free? Because a high aerosol loading does not belong to the category “clear sky”.

p. 4656, l. 10: Please define CI in a separate formula, because it is an important quantity in this paper. For which directions are the radiances used in CI ? Please explain the behaviour of CI in words: if CI is large, the sky is blue, if CI is small the sky white due to multiple scattering by aerosols and clouds (etc.)

p. 4657: sect. 2.1: please give the relevant geographical situation of Wuxi.

p. 4658:that - l. 9: clouds may change in a 12-minute cycle: could that be a problem in the interpretation? - l. 20: is this radiance absolutely calibrated?

p. 4659, l. 14: radiance > zenith radiance (?)

p. 4660, l. 20-23: please clarify this sentence

p. 4661, l. 1âĂŤ5: “there are reasons to believe ...” is a very unscientific statement. Please remove this sentence, and give instead an error estimate of the empirical method.

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p. 4662, l.17: which “both the measured spectra” are meant?

p. 4672, l. 20 – p. 4673, l. 5: please put these percentages in a table.

p. 4677: l. 4-5: Since GOME-2 and OMI observe the cloud mid-level pressure (by means of the FRESCO O2 A-band and O2-O2 retrieval methods) and MODIS retrieves the cloud top pressure (by means of the IR method), this difference is expected.

Table 1: what do the super and subscripts of the symbols mean? In principle acronyms should not be used as symbols. Please use commonly accepted symbols: \sigma for spread, L for radiance.

Figure 1: Are these all data, unfiltered?

Figure 4: which viewing direction? Calibrated radiance? Which unit?

Figure 5: caption: what is what? Give subplot numbers. What is FRS? Measured spectra are in red, I assume?

Figure 6: which direction?

Figure 7: Give the quantity in the legend of each subplot. What is the explanation of the peak in CI around noon?

Figure 8: clear or cloudy ?

Figure 13: please reverse the x-axis to agree with the x-axis order of Figure 12.

Figure 18: what is the message of this figure? Please remove it, and give the numbers in a table.

Interactive comment on Atmos. Meas. Tech. Discuss., 8, 4653, 2015.