We would like to first express our thanks to the reviewer for his/her constructive comments. The responses to these are below after the reviewer points that are in italics.

General comments

The present paper assesses the influence of diurnal variability of aerosol optical depth (AOD) on aerosol direct radiative effect (ADRE) at the top of atmosphere (TOA). To my knowledge it is the first time the specific problem is addressed in literature contrary to the diurnal variability of AOD which has been examined in a number of previous studies. In this aspect, the paper deserves to be published and concerns a great number of scientists interested on aerosol radiative and climatic effects. The authors make use of the libRadtran package together with hourly resolved AERONET data to estimate hourly ADREs and then to yield daily mean values which are then compared to ADREs computed using mean daily AOD. They also attempt a similar comparison and estimation of dADREs but using MODIS Terra and Aqua AOD values obtained at their overpass times. Both RTM and input data are adequate to perform such a study and to fulfil the defined objectives. Also, the paper is in general well organized and written in a concise way. Nevertheless, there are a number of issues mainly related to the presentation and discussion of the obtained results, as described below (Main and other comments).

Main Comments

1. Are the used AERONET AOD data cloud screened? It seems so, since Level 2 data are used. This may be an important issue in terms of the impact that can have on the appropriate estimation of the average daily cycle of AOD for each site using multiyear seasonal values. Can the authors comment on this?

It was indeed an important issue to select cloud-screened data for our study. And since AOD was the most crucial parameter, we selected Level 2. So it was not only cloud-screened, but also quality assured.

2. In calculations, some smoothing has been applied, for example by: (i) estimating an averaged diurnal cycle of AOD based on more than 30 multiyear (hourly) data from each season, instead of working on an individual daily-hourly basis, e.g. case by case, (ii) in terms of insolation, the hourly solar radiation of the 15th day of each month was used instead of hourly solar data for each day of each month. This smoothing has potentially dumped the effect of daily AOD variability on ADRE values. Can the authors at least comment on these issues, since specific sensitivity studies can be performed to assess the magnitude of induced uncertainties?

Our objective was to assess the systematic bias that one may introduce into the estimated aerosol direct radiative effect at TOA, if not accounting for true diurnal cycle of AOD. Therefore, for this purpose, it was appropriate to include all available data in forming the observed averaged AOD cycle. The point (i) above would be interesting but separate research question, to look at some very specific rare cases, however it was not in the scope of this study. The point (ii), however, would have likely a negligent effect; we calculated the impact assuming 15th day of January, April, July, and October, and results would not have been likely significantly different, if we had monthly data instead of seasons.

3. Relative percent (%) values of dAODs and dADREs should be shown apart from absolute ones, in order to better assess the magnitude of differences. This is only done on Table 1 but can be further done on Figures.

Given the objective of this study, the absolute values of dADRE are much more relevant, still we decided to include the relative values also in the Table 1. However, now in the revised version this reviewer comment was addressed, by including additionally the relative values of dADRE in the

histogram (new Figure 6).

4. The paper lacks an essential discussion of much of the presented results, e.g. those of Table 1 or the diurnal variability of AODs, while assessments of potential explanations and causes of features of the results are not sufficient.

There are now more explanations, for instance regarding the possible reasons for diurnal cycles.

5. It would be informative to provide a map with the location of AERONET stations that are considered in the study.

The map is included in the revised version.

6. Explain why are ADRE values computed only at TOA and not at other levels, for example at surface.

We actually looked at surface dADRE as well. However, since the relative effect is understandably very similar to TOA, we included TOA values only, which are more relevant and most often reported for the climate impact of aerosols.

Others

1. Abstract, last line: also give relative percent values apart from absolute ones.

This has been added.

2. Section 1, Introduction, second paragraph: reference Christopher et al. (2003) is not consistent with the list of references (2006).

This has been corrected.

3. Sub-section 2.1, AERONET data: state how many stations are used and what aerosol regimes are covered. Also, provide a relevant global map indicating the stations.

Number of sites per each season is mentioned and map is included.

4. Sub-section 2.2, Calculation of the radiative effect: only a single line is devoted to the radiative transfer model used. Although it is a well know tool, this is not enough and a few more information is necessary. Also explain why computations are only performed at TOA and not at other levels, e.g. surface or in the atmosphere.

More information about RT calculations is provided.

5. Sub-section 2.2, Calculation of the radiative effect: referring to linear extrapolations applied to derive surface albedo at longer than 1020 nm wavelengths, how realistic is doing this so to have the albedo decreased at 0.01 at 5000 nm?

It is very realistic for grass, but not for dry sand, for example. However, there are two particular reasons to justify this fixed single choice for the interpolation. First, since we calculated the broadband SW effect, those longer wavelengths do have a minor influence. Second, our focus was on the difference between two simulations of this SW effect, so cancellation takes place regarding albedo effect.

6. Sub-section 2.2, Calculation of the radiative effect: similarly to previous comment, but referring to interpolation/extrapolation applied to four wavelengths in order to cover the full solar spectrum range, how realistic is this? Also provide the values of the four wavelengths.

Similar justification, that was given to the point 5 above, applies here too. Since we simulated broadband SW effect, the AERONET wavelengths cover quite well the most relevant wavelengths. Interpolation between them gives likely a reasonable estimate, while larger uncertainty is introduced by the extrapolation (below 440nm and above 1020nm).

7. Sub-section 2.2, Calculation of the radiative effect, last paragraph: a reference to the relative role of changing AOD, SSA (single scattering albedo) and AP (asymmetry parameter) for ADRE values should be made, based on existing literature (e.g. Hatzianastassiou et al., 2004, Tellus-B).

Understandably the diurnal variability of SSA would give a very strong effect. However, we looked at the systematic diurnal patterns of all parameters (also SSA and g), not only AOD. It would have been very interesting to find systematic morning to afternoon contrast in SSA and estimate this effect, however we did not find. This is why only the relative role of AOD was relevant and was included in our study.

8. Sub-section 2.2, Calculation of the radiative effect: a reference should be made to the rest of radiative transfer model input data.

RT calculations are discussed in more detail in the revised version.

9. Sub-section 3, Results, 1st paragraph: here a reference to the aerosol regime of the considered sites can be informative. Also, a short discussion on the diurnal AOD variability can be added. For example, features and causes of the hour to hour, and especially morning to afternoon, changes can be reported.

These issues, like morning to afternoon contrast, are discussed in more detail in the following paragraphs of this same section.

10. Sub-section 3, Results, 2nd paragraph: state what are the values (absolute terms) of ADREs and comment on their sign and nature of DREs (cooling, warming).

These issues are discussed to some extent. Since we wanted to keep the discussion very much to the point, “dADRE discussion” was more thorough than “ADRE discussion”. However, now also the ADRE evolution is shown in the figures, which should make it easier to interpret dADRE pattern, when ADRE can change from cooling to warming.

11. Sub-section 3, Results, 3rd paragraph, 5th line: here reference is made only to the role of changing sign of ADREs due to changing solar zenith angle (SZA). However, no comment is made on the role of changing magnitude of ADREs due to changing solar radiation (taking maximum values at around solar noon for clear skies).

Obviously, our discussion was about the overall effective influence (that is still a function of SZA).

12. Sub-section 3, Results, 4th paragraph: explain/discuss in more detail the results of Table 1.

Table 1 includes now also the overall statistics and some more discussion.

13. Sub-section 3, Results, last paragraph, last sentence: do you have any idea for explaining this

behavior?

No. It is very difficult to speculate about the reasons for this very small difference.

14. Section 4, Conclusions, last paragraph: delete "As Figure 4 suggests".

It is deleted.

15. Table 1: compute overall results per season and station. Also compute annual results for each station.

Overall results are now included in the revised version.

16. Table 1: why there are largest differences for Mexico (dADREs) for MODIS (Terra and Aqua, 5th and 6th columns)?

Because Terra overpass is before noon and Aqua overpass after noon. For instance, AOD from Aqua in Mexico City means significantly larger AOD than the daily average, thus a positive dADRE.

17. Table 1: why there are largest differences for Hamim (dADREs, 4th column)?

This is explained when the Figure 3c is discussed.

18. Table 1: how can be explained the differences between MODIS Terra and Aqua (for example, smaller dADREs for Terra than Aqua for all seasons except for winter)?

I cannot conclude from Table 1 that they would be consistently smaller for Terra in other seasons than winter either.

19. Figure 2: it is important to show relative percent values of dADREs as well, apart from absolute ones in order to assess their magnitude.

These are now included in the table (also for overall statistics).

20. Figure 2: I suggest to show the evolution of absolute values of AOD and dADREs as well. This will make easier to follow the discussion often referring to positive/negative ADREs.

This was a good suggestion and now in the revised figures absolute value of ADRE is included, to make it easier to interpret the dADRE pattern, when ADRE can change from cooling to warming.

21. Figure 4: report the mean dADRE values on each (seasonal) plot.

These are included in the text. Since we added ADRE into these figures, there is no room left to add anything more and still keep them readable and clear.

22. Figure 4: specify y-axes on plots.

Y-axis is explained in the caption. It is "somewhat arbitrary", since they are scaled to be comparable.

23. Figure 4: produce similar graphs with percent dADRE values in x-axes.

This kind of figure is now added in the revised version.