**Atmospheric
Chemistry
and Physics
Discussions**

Interactive comment on "Direct SW aerosol radiative forcing over Portugal" *by* D. Santos et al.

Anonymous Referee #1

Received and published: 19 June 2008

General

The paper deals with the assessment of the direct radiative forcing at the top-of-atmosphere by aerosols in Portugal, at two locations, in 2004/5. The interesting aspect of these Portugese locations is that three different types of aerosols, namely desert dust, biomass burning, and urban/industrial aerosols, are encountered. This leads to the estimate of the direct radiative forcing efficiency of these types of aerosols (expressed in W/m2/AOT). The assessment is done by means of radiative transfer simulations using aerosol input data from sunphotometry and surface albedo information from satellite (MODIS). The results contribute to more quantitative knowledge of the direct radiative forcing of three types of aerosols. The paper is in general well written.

Main comment

The paper is limited - in contrary to the title which is very general - to the radiative forc-

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

ing of aerosols at the top of the atmosphere. However, aerosols also cause forcing of the radiation throughout the atmosphere and especially at the surface. The combination of TOA and surface forcing of aerosols would give a much more complete picture of the radiative effect of aerosols. The combination would also enable to calculate the absorption due to aerosols. This is a very interesting and important aspect, especially in a comparison of the three different types of aerosols. For instance, if some aerosols have a weakly negative radiative effect at TOA, they may have a strong negative effect on the radiation at the surface, and they may heat the troposphere. So only looking at the TOA radiative forcing is not sufficient to decide whether aerosols are "cooling" or "heating"!

In my opinion it is a pity that the authors did not extend their study with the radiative forcing of aerosols at the surface. This would have been a simple addition to the current study, because the same radiative transfer model and same aerosol input parameters could have been used (in Sect. 2.3 it is even mentioned that the irradiances at the surface are computed).

I would like to call upon the authors to extend their study with estimating the surface radiative forcing and the amount of absorption in the troposphere, and thereby contributing much more useful information than they do now. If they do not wish to do so, they should clearly state the limitation of their study in title, abstract and introduction, and clearly and consistently state that their heating and cooling effect estimates due to aerosols only refer to TOA.

Specific comments

1. Abstract: The abstract is too general, and looks more like an introduction. Please condense and add more specific aspects (which instruments, which models are used) and quantitative results.

2. Sect. 1: Introduction: Discuss the aspect of radiative forcing of aerosols throughout the atmosphere, including absorption, and say that here only TOA forcing is considered

which is a limitation.

3. Add in introduction (or in the abstract) for which period the results hold.

4. Section 2: Methodology: Please explain Fig. 1.

5. Sect. 2.3:
- Why are only three MODIS bands, all below 1 micron, used to cover the surface albedo in the SW range? MODIS has several bands in the SW range at wavelengths larger than 1 micron, which would enable to have better coverage. Fig. 3 shows that the constraints from MODIS on the surface albedo spectrum are limited.
- Gaseous absorptions: Ozone Chappuis band absorption should be included for MODIS band 1 (around 650 nm).

6. Sect. 2.4: summarize here the procedure of Costa et al. (2004).

7. Eq. 1:
- μ is the cosine of the viewing zenith angle, not the solar zenith angle
- How is I calculated? Are gas absorptions included, like O_3, O_2, H_2O, CO_2?

8. RT modelling of DSWARF: Is H_2O absorption included ? Where is the H_2O information taken from?

9. Sect. 2.4: Say that LW forcing by aerosols is not included in the forcing efficiency of aerosols.

10. Sect. 3.1: Why are concrete surfaces not included? How large is their contribution?

11. Sect. 3.2: What about the maritime aerosols in Cabo da Roca? Are these aerosols filtered from the analysis? Can their contribution also be assessed?

12. Sect. 3.2: What is missing is a quantitative interpretation of the DSWARF as a function of the main parameters: AOT, SSA, SZA and surface albedo. This could done by showing the dependences from simulations, for the relevant aerosol scenario types of this paper. This extension - together with results on the forcing at the surface -

Interactive
Comment

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

would strengthen the statement in the third paragraph of Section 4, which is a main conclusion of the paper, but which remains vague.

13. Sect. 3.2.1: How does the DSWARF depend on aerosol absorption optical thickness, AAOT: AAOT= AOT $\times$ (1-SSA) ?

14. Fig. 10, 12, 14: are these spectral SSA values measurements or calculations? Please explain.

15. Fig. 12: how can the SSA of FF aerosols on 19 Jun be so close to 1? These must be absorbing aerosols.

16. The number of figures is very high. Most of the figures are model input information, like the spectral surface albedo and spectral SSA, or auxiliary information like the trajectory plots. The figures with real results on DSWARF and Δ Fe are only a few. Please reduce the number of figures, by removing and combining. This would also make room for more results on radiative forcing at the surface and absorption.

Textual comments per page

page 8586:
l. 13: originate > cause ?
l. 20 ff.: use articles: *the* Evora region, *the* Cabo da Roca region

8587:
l. 18: of primary importance for the estimation

8588:
l. 10 and l. 15: it should be: upwelling, downwelling (this also occurs later)
l. 16: TOA is already introduced earlier.

8589:
l. 7: wavelength

8590:

Interactive
Comment

l.2/l.3: remove "of" (2x)
l. 28: of the Angstrom exponent

8591:
l. 12: rather true? please rephrase.
l. 24: of > on

8592:
l. 5: why do you perform calculations with 6S in 10 spectral windows whereas you only need to do it for 3 MODIS channels?

8593:
l. 3: on > in ?
l. 13: visible> shortwave
l. 24: Where > where

8594:
l. 1: then: remove.
l. 5: please use a dot at the end of the formula. Equations belong to the sentence. This also also holds further on.
l. 11: the scattering and sometimes absorption > scattering and absorption
l. 18: written > written as
l. 25: the Δ Fe > Δ Fe

8595:
l. 14: within > over
l. 16: pixels > MODIS pixels

8596
l. 10: the Evora site,
l. 26: the Aspen curve? please explain

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

8597
l. 4: of > as
l. 13: until September 2005. Therefore, ...
l. 16: This is notable for the Cabo da Roca ...
l. 21: write DSWARF in full this time

8598
l. 9: near zero > close to zero
l. 13: Completely > Conservatively
(Note: conservative scattering occurs if SSA=1).
l. 15-19: this is well-known; text should be shortened
l. 25: the HYSPLIT model
l. 27: which, > which

8599
l. 1: significant, because
l. 15: present > have
l. 18: the days > those days?
l. 18: present > have
l. 25: population? Please rephrase

8600
l. 1: Urban/industrial
l. 1-5: please shorten this sentence.
l. 26: in correspondence of > in correspondence with

8601
l. 6: originate > cause
l. 11: different types of burning vegetation

8602:
l. 4: different: by how much?

l. 7: To note > We note
l. 8: present > have
l. 8-9: thus leading to a warming instead of a cooling effect at TOA.
l. 16: more scattering > scattering
l. 18: ... more absorbing as they mix with Urban/industrial aerosols over the Greater Lisbon area ...

8603
l. 2: estimated > estimated to be (this occurs also later on)
l. 4: being the absolute ... > with absolute correlation coefficient (R) of ...
l. 16: give R value

8604
l.9: for all cases: this seems to contradict the statement in lines 6-7
l. 15: regions becoming > regions, thus becoming
l. 18: in Evora than in Cabo da Roca
l. 22 ff: the comparison with results from others does not belong to the conclusions but to the results in Sect. 3.

8605:
l. 24: explain DGRF
Refer also to the Dubovik et al. (JAS, 2002) climatology of aerosol properties from Aeronet.

Table 3: Explain the symbols used in Table 3. Is the averaging procedure explained in the main text? What does "the database" mean?

Figure 2: give units for the coordinates.

Figure 3: label subplots with a, b, etc. (for other figures as well)

Combine Fig. 4 with Fig. 3, and combine Fig. 6 with Fig. 5.

Add a legend with information on: Summer/Winter/Year/ Location to the plots.

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

Figure 7: Explain DSWARF, DD, FF in caption.

Figure 8: Explain CR, Urb in caption.

Figure 14: explain numbers in legend

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 8585, 2008.

Interactive
Comment

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper