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Atmospheric Chemistry and Physics Discussions

Interactive comment on "An investigation into seasonal and regional aerosol characteristics in East Asia using model-predicted and remotely-sensed aerosol properties" *by* C. H. Song et al.

Anonymous Referee #2

Received and published: 21 May 2008

General Comments

Aerosol form a central component of both climate and air quality. The ability to model aerosol mass and the resulting optical properties is critical for determining the impact upon the radiation budget as well as predicting conditions that are hazardous to health.

Regional spatial and temporal changes in AOD are investigated using both MODIS data, the CMAQ model and AERONET ground-station observations to develop a chemical weather forecasting system for East Asia.

Two different retrieval methods, the NASA collection 5 algorithm and the Bremen Aerosol Retrieval (M-BAER) algorithm, are used to calculate AOD from MODIS L1B data. The results from the two retrievals are compared against the CMAQ model results and also AERONET ground-based observations.

The model is used to determine concentrations of various aerosol species and their contribution to the AOD. It is found that sulfate contributes to the AOD most during the summer in industrial regions and nitrate contributes most significantly during the winter. The effect of nitrates upon AOD is comparable to that of sulfate in regions of East Asia.

There are some interesting results in this paper - the seasonality of sulfate and nitrate and the high AOD predicted due to nitrates and secondary organic aerosol. The conclusion that nitrates are important when determining AOD is one of the more significant features of the paper. Nitrates are often not included in large-scale models and the implications of this should be highlighted and discussed in more detail.

In general the discussion is qualitative and although statistical values are given for comparison of the model, MODIS and AERONET AOD the cases showing poor agreement are not explored in much detail. If the model AOD differs significantly from that of AERONET and MODIS can this be explained by the emissions or by wet scavenging or by spatial sampling etc? Something should be learned from the comparison in order to justify the observations being shown.

The demonstration of a new AOD retrieval method from MODIS data is interesting but does not contribute much to the primary purpose of the paper - the M-BAER retrieval is shown to correlate almost as well with AERONET as the NASA C005 retrieval but how does this benefit the paper more than using just the NASA C005 retrieval? The paper is a study of seasonal and regional aerosol characteristics rather than a new retrieval mechanism. The authors should either highlight the significance of the two retrievals or use just one in the paper. Are there specific cases when the M-BAER retrieval out-performs the NASA retrieval and can be considered more reliable?

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Significant further work is therefore needed before the paper is acceptable for publication as conclusions are not developed fully and in the current state the contribution to furthering scientific knowledge is limited.

Specific Comments

Pg. 8666, line 17+: How are the modes fixed within the model? In effective radius and size parameter? The number of modes should be specified. Also, as the AOD is based upon the mass concentrations has any evaluation of the species mass concentrations from the model been performed? If so, references to this should be included.

MODIS and CMAQ AOD Comparison, section 4.1.2, p8677: This section details a qualitative comparison of MODIS AOD with the CMAQ model AOD. MODIS cloud screening is cited as a possible reason for discontinuities in the AOD due to the dust plume. If the model and MODIS AOD are to be compared then the comparison should not include model data where MODIS has been cloud-screened, otherwise, as the authors point out, this comparison is limited and potentially misleading given cloud-aerosol correlation.

MODIS retrieval comparison: There needs to be further justification for using the modified M-BAER algorithm as well as the NASA C005 algorithm. It should be made clear whether the M-BAER method produces better agreement with AERONET AOD than the C005 algorithm. If agreement is similar then this shows that the retrievals are reasonably robust however it does not necessarily justify the use of another retrieval than the NASA C005 algorithm. Can cases or regions be shown where one retrieval consistently shows better agreement with AERONET?

Pg. 8687, line 2+: Can the poor agreement between AERONET and M-BAER AOD in the Fall really be attributed to lack of data when the NASA AOD shows a better correlation?

Nitrates: The conclusion that nitrates are important when determining AOD is one of

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the more significant features of the paper. Nitrates are often not included in large-scale models and the implications of this should be highlighted. A figure showing the fraction of AOD attributed to nitrate for each of the seasons would be a powerful message.

Secondary Organics: As the impact of SOA upon AOD is found to be significant I feel you should discuss the uncertainties in estimating SOA burden. It appears that the multiplication of the SOA concentration by a factor of four in equation 7 accounts for the substantial AOD of the SOA. I have had trouble locating a copy of Malm et al. (US EPA, 2000) from which the empirical relationship is taken. I think it is worth explaining the reasoning of Malm et al. for using this multiplication factor and quoting any available error estimates given.

Figures: Continental outlines not visible on Figure 4. Text is illegible in Figures 4 and 7.

Technical Comments

Pg. 8662, line 10: Please define what is meant by 'reasonably well'.

Pg. 8663, line 16+: Remove 'monitoring' and 'measurements' in brackets to improve the flow of the sentence.

Pg. 8664, lines 26 & 27: 'AERONETR' written in the subscript should be 'AERONET'

Pg. 8665, line 16: 'in the link with' should be 'in conjunction with'

Pg. 8668, line 10: Reference for Four-D Data Assimilation (FDDA) techniques.

Pg. 8669, line 1+: It is stated that some studies underestimate NOx emissions by 30% and Streets et al. estimate uncertainties of +/-37%, however it is also said that 'it is generally believed that the uncertainties in their emissions are relatively small'. Please clarify this statement – are the numbers quoted considered small or is there evidence to suggest these are over-estimates?

Pg. 8669, line 17+: Are there any references for the evaluation of the BC/OC emis-

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sions?

Pg. 8669, line 25: Equation 1 contains a delta-t term however the E(Dust) is said to be a mass flux which is per unit time by definition.

Pg. 8672, line 7: 'Look up tables' should be 'look-up tables'

Pg. 8672, line 28: 'good agreement' - please define what is considered good agreement or quote a quantitative measurement used by Lee et al.

Pg. 8673, line 16: Delete 'this will be'.

Pg. 8677, line 4: 'CAMQ' should be 'CMAQ'

Pg. 8677, line 24+: Please provide a reference for 'dust plumes are typically transported behind or below the cold frontal clouds'

Pg. 8677, line 16: Delete '/can'

Pg. 8704: If NOAA data is to be shown to detail position of dust plume then it would ideally be on same grid projection as model plots, if possible (Figure 5).

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 8661, 2008.