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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Validation of the GRAPE single view aerosol retrieval for ATSR-2 and insights into the long term global AOD trend" *by* G. E. Thomas et al.

Anonymous Referee #1

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General: The authors present the validation of results from the GRAPE algorithm applied to ATRS-2 to retrieve aerosol properties: AOD at 550 nm and effective radius are the primary parameters. I do not understand how these properties are retrieved. The authors refer to other publications where the methods are explained, however, they should provide sufficient information to understand the current paper; one of the references is a book chapter which may not be readily accessible. The authors do provide a summary in section 2.3, bujt the actual retrieval is not explained. In particular, they use variable mixtures of aerosol types and in DISORT to create LUTs, how are these used? What criteria are sued to determine the optimum aerosol model, especially because only one single wavelength is used? Furthermore, part of section 2.3

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is on retrieval over land, but the rest of the paper shows and discusses only results over ocean. Why is retrieval over land discussed if not used? Why are the over land results not validated? The reader would be much helped with a statement in the beginning that this paper focuses on results over ocean, so there is no expectation for results over land. Furthermore, the results are presented without much explanation or critical analysis. For instance, the authors show results on the seasonal variation of AOD, wind speed and chlorophyll, but do not attempt to correlate these. Sea spray aerosol production is known to vary with wind speed to the power of approximately 3, so there should be a strong correlation between wind speed and AOD, as shown in recent publications by Mulcahy et al. or Glantz et al. Chlorophyll has been shown to be correlated to the chemical composition, especially there appears to be much more organic material in the sub-micron fraction in the summer (biologically active water with high Chl concentrations). This is also the optically active size range and organics likely change the hygroscopic and optical properties of sea spray aerosol as opposed to sea salt aerosol. There are quite some typos and there are references to Thomas et al 2009a and b, in the references list there are 2 for 2009 without the a or b.

Detailed comments: (page nrs indicated by last 2 digits, refer to (page,line))

Introduction: satellite remote sensing is presented as the solution to obtain global measurements. Although I agree with that, at the same time should be mentioned that there are many shortcomings and even results from dedicated instruments often do not agree over large regions and there are substantial discrepancies over certain areas. I suggest to add a few sentences on the immaturity of satellites.

(84, 17)'The Along Track Scanning Radiometer series of instruments1 are: indicate what these series are

Section 2.1: (84,8) The instrument ceased operation in 2008, which instrument? ATSR-1 or 2?

Section 2.3: (86,15) The aerosol types and geographical distribution used in GRAPE

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are shown in Fig. 1.: I suggest to add a table with the aerosol microphysical properties to help the reader understand without going back to OPAC

(86, 18) the size distribution of the aerosol types are perturbed by varying the mixing ratios of the different components which make up each 20 aerosol type from the values prescribed in OPAC: How is the mixing ratio determined? I see only an AOD at 550 nm (87, 8), if other wavelengths would be included there would be info on the Ångström coefficient to fit

(87, 4) As the MODIS BRDF product is only available from 2000 onwards, data for the 5 equivalent date and location from 2002 are used to provide the surface reflectance. This should be better explained. Are 2002 BRDF used for the whole data set?

(87,6) Errors resulting from this approximation are a major limiting factor to the accuracy of the GRAPE aerosol product over land Can this be shown?

(87, 9) the algorithm allows small changes in the overall surface reflectance, How is that done, how big are these changes and what determines them? Why is the spectral shape of the surface fixed? Is this over ocean or land? Why is NDVI used over ocean? Over land the scheme by Birks (2004) is used, please summarize what this scheme implies. Next par: (87, 22) why is it not possible to use the dual view? What is the implication of assuming a Lambertian surface that does not allow to use the dual view? Why could it be used for GlobAEROSOL (provide reference) and not here? Above was said that the single view MODFIS BRDF was used. ORAC has limited sensitivity to effective radius, so how can this be a primary product as stated a few par above (87, 8) ?

Section 3:

Bullits on top of p. 89 should be better explained, it is not at all clear what procedure is followed here. The closest “ground-pixel” of the satellite instrument (i.e. 4 km grid box) is identified. What does that mean? Closest to what? Ground pixel of AERONET? How

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does that work for a coastal site which is compared to over-ocean retrieval? Certainly there cannopt be an exact collocation

2nd bullit: I don't have a clue what is done here: there is an AERONET pixel from bullit 1, at the coast, and there is supposed to be an over sea pixel within 5 pixels? How is that verified? What is flagged? What area? Why is it important that the area is of similar size as Ichoku et al?

3rd bullit: what is a 'typical aerosol transport speed'? Isn't that just the wind speed? 40 km / hour is about 11 m/s which is quite high wind speed, even over most parts of the open ocean.

(89, 17) How were sites determined to be representative? I believe that Kinne is an authority, but what has he said, and why? Are coastal stations indeed representative for open ocean conditions? Below is said that they are not? Please clarify here what you mean. Why was MAN (http://aeronet.gsfc.nasa.gov/new_web/maritime_aerosol_network.html) not used? (89,20) Looking at Fig 2, I see at least 10 (out of 22) that are not in North America or Europe. . ..

(89, 23) What is in table 1: quality control criteria? Are data rejected when they do not meet these criteria?

(89, 26) Which are the conditions in which the retrieval works poorly? Please specify

(90, 1) How were standard deviations in either satellite data or AERONET determined?

(90, 18) assumed spectral shape of the surface reflectance is typically fairly poor Why is spectral shape needed if AOD is only retrieved at 550 nm?

(90, 25) However, since the majority of the AERONET comparisons are coastal, many of them will contain some retrievals using the aerosol type assigned to the neighbouring land mass. Here an explanation is needed how aerosol types are assigned, what are the implications?

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Section 4: AVHRR has been validated (92,1). Below appears that there are substantial differences between AATSR-GRAPE and AVHRR. If both are validated, how can there be such differences? To appreciate these differences, it is necessary that not only the GRAPE validation results are presented but also those for AVHRR. Furthermore, the authors should discuss the accuracy and reproducibility of AVHRR.

Since a comparison is made with AVHRR, wouldn't it be useful to briefly describe the pros and cons of AVHRR retrieval, so the reader can appreciate the differences?

Figure (4): comparison is difficult to see especially since the figures are very small I strongly recommend that the authors show the difference between GRAPE and AVHRR rather than separate maps for each instrument. Such difference map will reveal the good and weaker points, before the causes are discussed.

(94, 4) Why are marine aerosol model used in areas that are clearly influenced by other aerosol types?

(94, 1) The par starting with 'The GRAPE product also shows' is very qualitative and speculative. I suggest to add substance.

Section 4.2: In the above, uncertainties and biases were discussed for GRAPE. Next the authors use GRAPE products to compare with AVHRR products and infer conclusions on time series and trends, but the uncertainties and biases in AVHRR are not discussed, nor are they accounted for any of the two instruments in the comparison. How is that justified? How representative are the GRAPE and AVHRR data?.

p. 98: Bullits discussing Figure 7: Please help the reader by identifying what you are discussing: which figures are for Northern regions (98, 12) (etc.)? As regards the cycle (98, 15): GRAPE does not use Chl as explained above, how dies that affect the retrieval? Chl has a seasonal cycle. What could cause the difference in phase?

(98, 21) Bullit on tropical oceans: the biomass burning season is clearly identified. Why is it not accounted for in the retrieval?

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Figure 8 shows the seasonal wind speed and Chl, are these in phase with AOD? I'd expect a strong correlation with wind speed since sea spray production goes with the cube of the wind speed as mentioned above.

(98, 20) What is the solar zenith angle limit?

(98, 22) Figure 9 shows the latitude limits of both datasets throughout the period of comparison. In the case of the GRAPE dataset, the actual limit lies equatorward of the defined 60_ limit for November–January in the Northern Hemisphere and for May–July 25 in the Southern Hemisphere, with a maximum discrepancy of 12_. What are the implications of these observations?

(98, 26) Due to the changes in AVHRR overpass times, the GACP dataset shows a more complicated story, with an increase in both the size of the truncation of the the high latitude limits of the northern and southern regions, and in the number of months a year so effected, as the lifetime of each individual AVHRR instrument progresses Not clear what is meant with this statement or the next: please elaborate

(99,6) Given the band of elevated AOD observed at around 60_ S in the GACP results, a decreased sampling of the lower boundary of the southern ocean regions can explain the negative AOD trend observed in these regions during the period covered by the GRAPE data. This also explains why no such trend is observed in the GRAPE results.

Figure 10 (99, 22): Although not temporally or spatially coincident with the majority of GRAPE time-series, this cycle is in phase with that seen in the GRAPE data, suggesting that the cycle seen by GRAPE is real. According to Figure 2 these stations were used in the validation; how is that possible if they are not spatially or temporally coincident with GRAPE? Are there other stations that are and would illustrate the temporal trends and phase?

(00, 6) Last par of Section 4: what are these valuable insights'? Please list them so the reader gets these insights too.

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(00, 15) Section 5, 1st par: sampling differences between the two instruments: explain. Could it be in the retrieval?

(00, 20) The GRAPE data also show noticeably higher AOD in regions affected by transportation of heavy aerosol loading from the continents. Conversely, the band of elevated AOD seen in the southern oceans in the GACP data is not apparent in the GRAPE data I don't understand this: SAO and SPOI show the best agreement.

(00, 27) Showed the origins of the disagreement: was this indeed shown?

(01, 15) Not only wind-generated aerosol determines the AOD, DMS plays a role as well

(01, 26) Why are the GLOBaerosol, the SWANSEA and the GRAPE data sets not compared instead of AVHRR?

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 21581, 2009.