Long term aerosol trends over the ocean
What the GRAPE ATSR-2 aerosol product tells us

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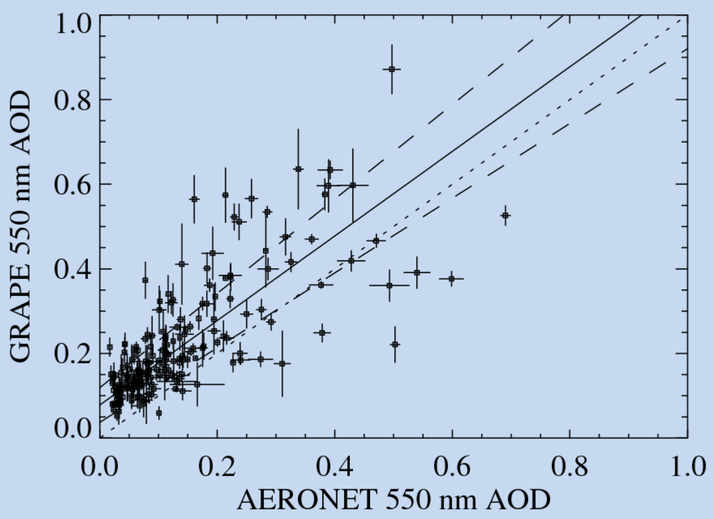
Introduction

Recent work (Mishencko et al. 2007, Zhao et al. 2008) has suggested a decreasing trend in the global aerosol optical depth over the oceans measured by the AVHRR instruments.

The Global Retrieval of ATSR Cloud Parameters and Evaluation (GRAPE) project has, in addition to cloud properties, produced a dataset of aerosol optical depth over the oceans for the ATSR-2 mission (1995-2001). This can be compared to the AVHRR data for this period, which predates the products now widely used (e.g. MODIS).

We find that the GRAPE dataset shows an increasing, rather than decreasing, trend in global AOD. Careful comparison of the two products reveals that the AVHRR trend, for the period GRAPE data, can best be explained by a change in the sampling due to the orbital drift suffered by the NOAA-14 satellite.

GRAPE



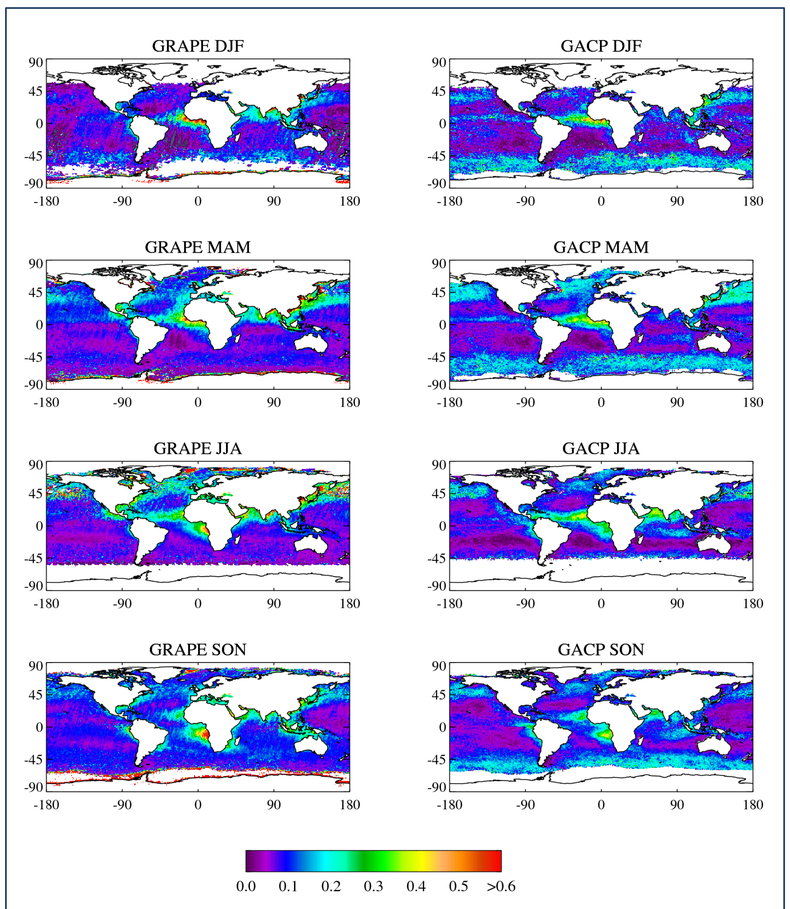
The GRAPE project applied the Oxford-RAL Aerosol and Cloud (ORAC) optimal estimation retrieval scheme to ATSR-2 data with the primary aim of producing a high quality cloud product. However, in pixels which do not contain cloud, aerosol optical depth (AOD) and effective radius have been retrieved instead. Although the aerosol retrieval made several simplifying assumptions, which limited its accuracy over land, good estimates of AOD have been produced over the oceans, which provide global coverage between 1995-2001.

The dataset is currently being extended to include ATSR-2 data from 2002 and 2003, as well as the full AATSR record (giving coverage from 1995-2009) with the support of the NERC Centre for Earth Observation.

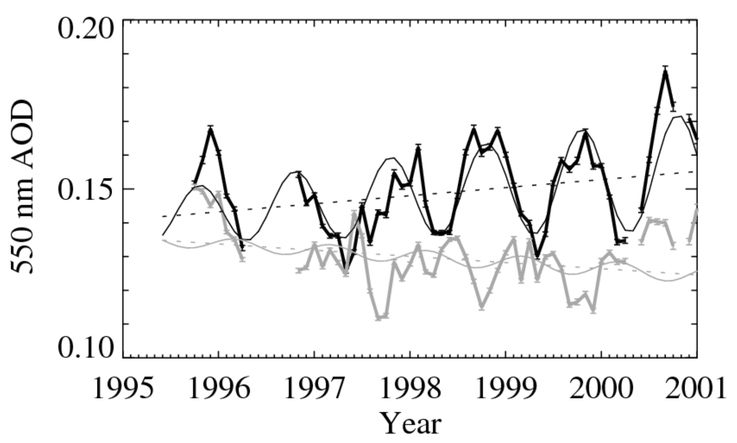
Further information on the GRAPE product can be found on the BADC (http://badc.nerc.ac.uk/data/grape/) and a detailed description and characterisation of the algorithm is given by Thomas et al. (2009a).

GACP

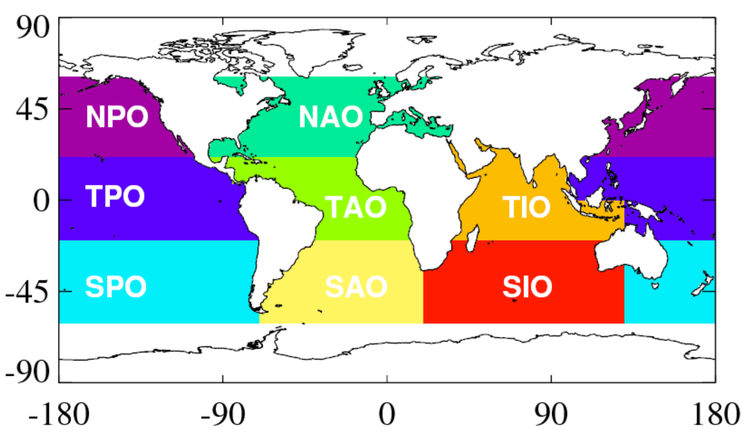
The AVHRR dataset used here is the Global Aerosol Climatology Project (GACP). GACP provides a 23 year global climatology of aerosol over the oceans using the AVHRR instruments. Data are available as 1x1° monthly mean fields of AOD and Angstrom coefficient. The retrieval and it's validation are described by Geogdzhayev et al (2005).



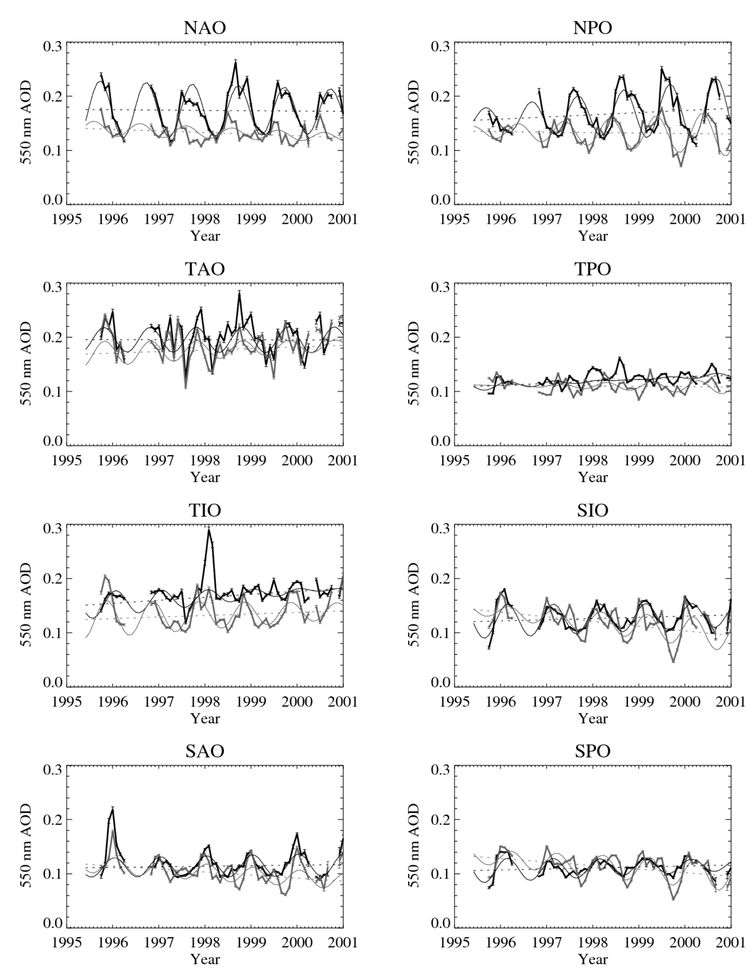
Seasonal means (1995-2001) of GRAPE and GACP AVHRR AOD



Time-series of global ocean AOD from GRAPE (black) and GACP (grey). GRAPE shows an increasing trend of 0.024±0.007 per decade, while GACP show a decrease of 0.018±0.009 per decade (similar to that found by Mishchenko et al (2007) using a longer time-series.)

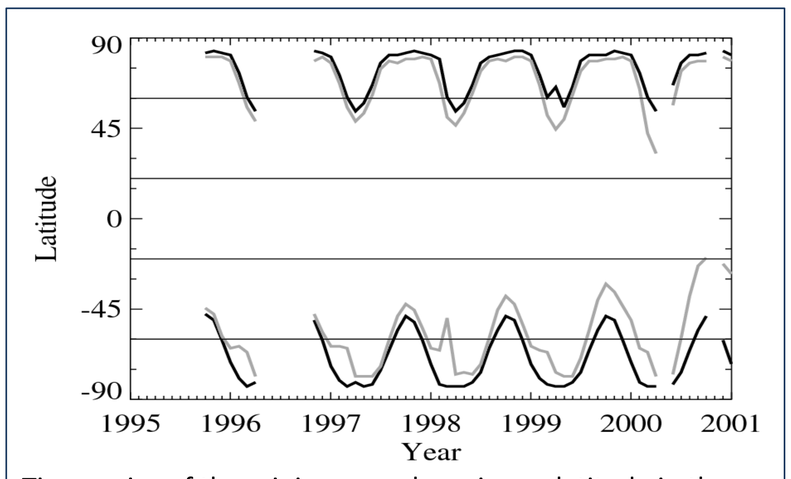


Ocean regions, based on those defined by Quaas et al. (2008), used in regional comparisons.



Regional time-series of GRAPE (black) and GACP (grey) AOD. Note that GRAPE trend is driven by NPO, TPO and TIO regions, while GACP trend is driven by SIO, SAO and SPO regions.

The presence of a decreasing AOD trend in the Southern Ocean is difficult to explain, since aerosol loading in these regions is controlled by wind generated sea-salt and dimethyl sulphide emission from phytoplankton.



Time series of the minimum and maximum latitude in the GRAPE (black) and GACP (grey) data sets. Note the change in the GACP data caused by the orbital drift of NOAA-14.

Conclusion

Comparison of the GRAPE and GACP AOD datasets reveals several significant and interesting differences. Of particular note is the lack in the GRAPE data of the decreasing trend seen in GACP. The fact the GACP trend is dominated by changes in the Southern Ocean, where GACP suffers from a time-dependant sampling bias, calls this trend into doubt.

For further analysis of the comparison presented here and the accuracy of the GRAPE AOD data, see Thomas et al. 2009b.

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References

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GRAPE

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