Characterizing the distribution of Aerosols in the South Atlantic Ocean

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MyScience Cruise

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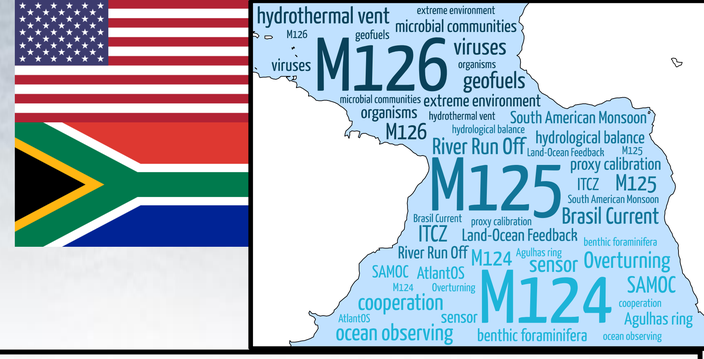


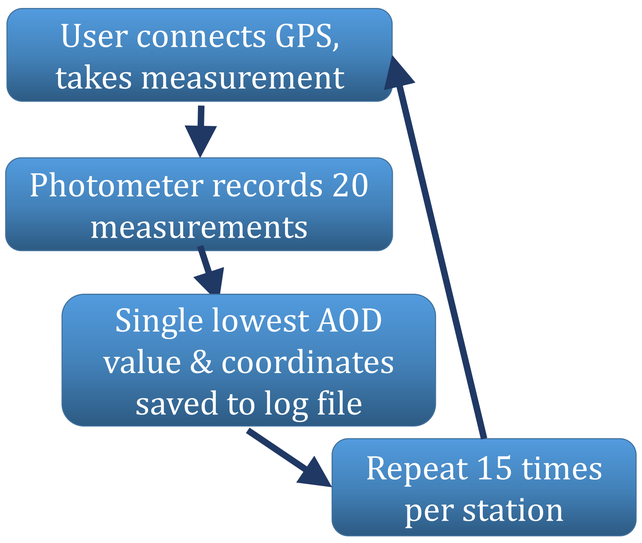
Introduction

The distribution of aerosols over the global oceans directly influences the radiation budget and indirectly forces global climate change. As of present, many uncertainties remain regarding marine aerosols due to the remoteness and the resultant infrequent sampling periods of the global oceans. The Southern Atlantic Ocean is a region characterized by very low amounts of aerosols, which can be attributed to it's remote nature and subsequent low anthropogenic influences. The aerosols identified in this region are mostly formed from sea salts, as the surface wind is relatively low in this region, only a small amount of aerosol is generated. The aim of this study is to investigate the spatial distribution of aerosols with respect to air parcel source in the South Atlantic using ship based measurements.

Instrumentation/ Data Collection

The Microtops II Sun Photometer is a handheld instrument specifically designed to measure columnar optical depth and water vapor content [Wilson et al., 2010]. Sampled during cloud-free conditions in the South Atlantic Ocean, per wavelength the AOD is typically smaller than 0.1.

Spectral Channels:
- 380 nm
- 440 nm
- 500 nm
- 675 nm
- 870 nm



Logic schematic for data collection. NOTE: does not include iterative postprocessing routine which removes data contaminated by pointing errors.

Air Mass Source Region	τ_a	σ	α	σ_α	N
NA polar marine (30^0–50^0 N)	0.07	0.01	0.41	0.29	2
African dust (0^0–16^0 N)	0.23	0.06	0.35	0.11	4
Mod SA tropical marine (6^0–21^0 S)	0.15	0.03	0.61	0.24	4
SA subtropical marine (25^0–34^0 S)	**0.08**	**0.02**	**0.51**	**0.14**	**7**
SA polar marine (34^0–55^0 S)	0.06	0.02	0.38	0.28	20

(table from Smirnov et al., 2006)

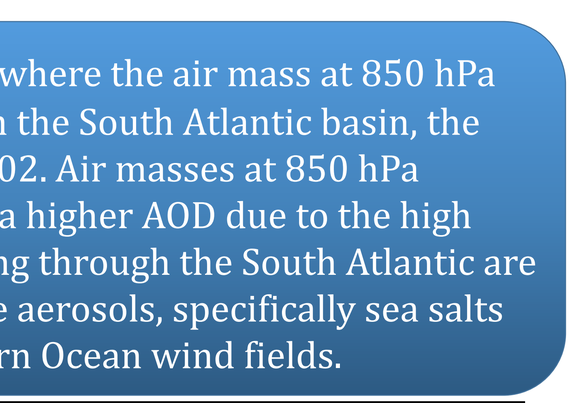
τ_a – average aerosol optical depth at 500 nm

σ – standard deviation of the aerosol optical depth

α – average of the Angstrom parameter

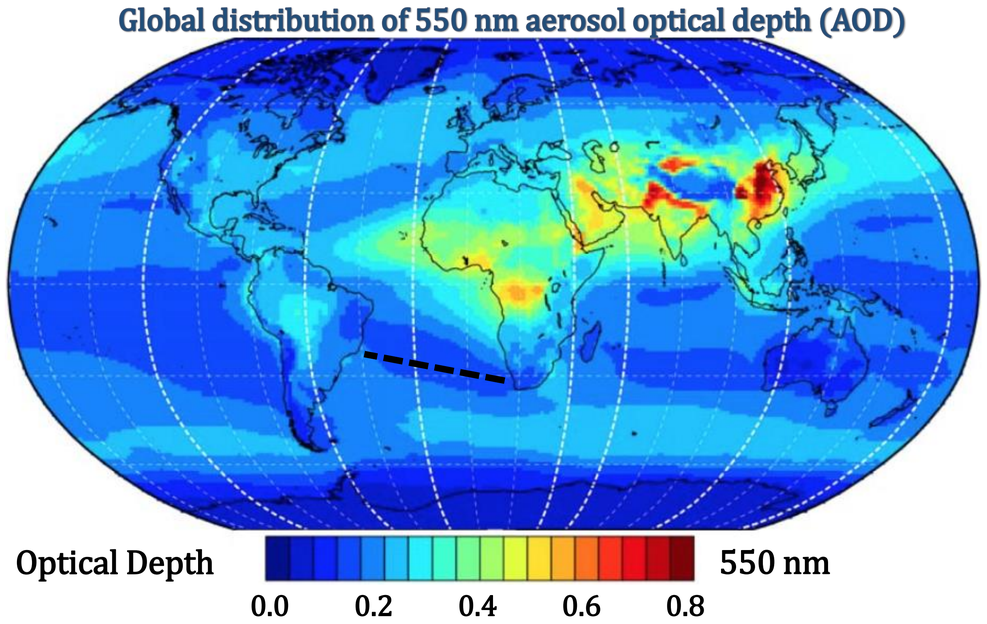
σ_α – standard deviation of the angstrom parameter

N – number of days



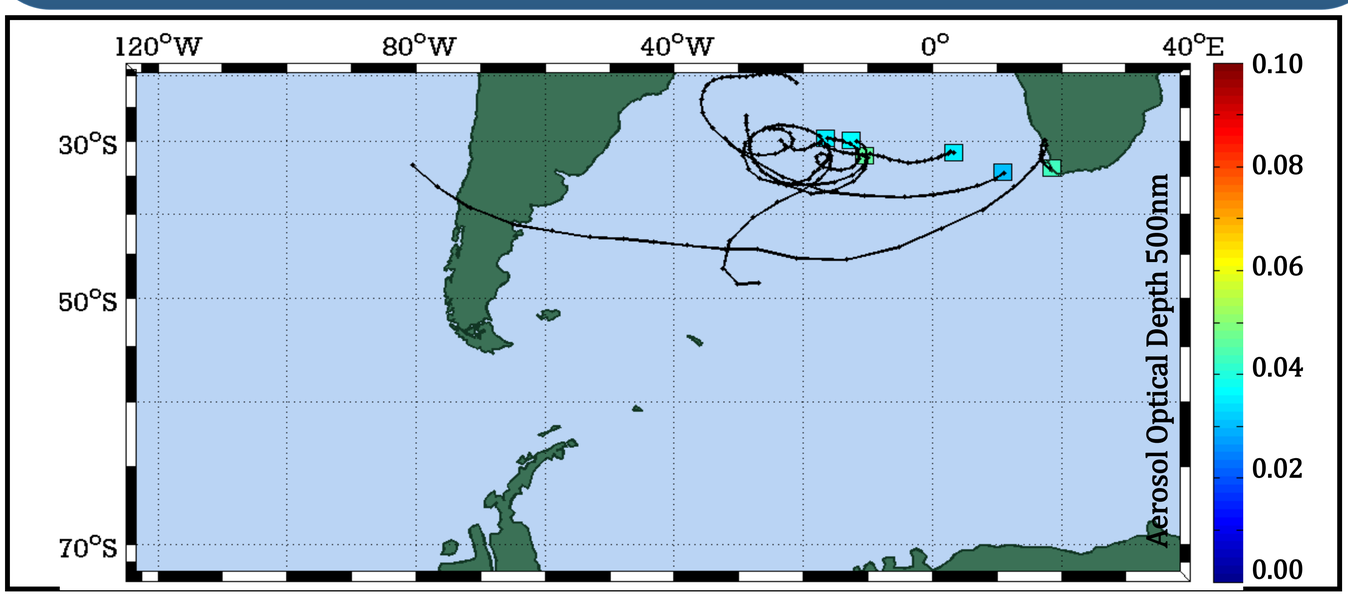
Microtops II Sun Photometer in use on board the R/V Meteor on the M124 cruise

Global distribution of 550 nm aerosol optical depth (AOD)

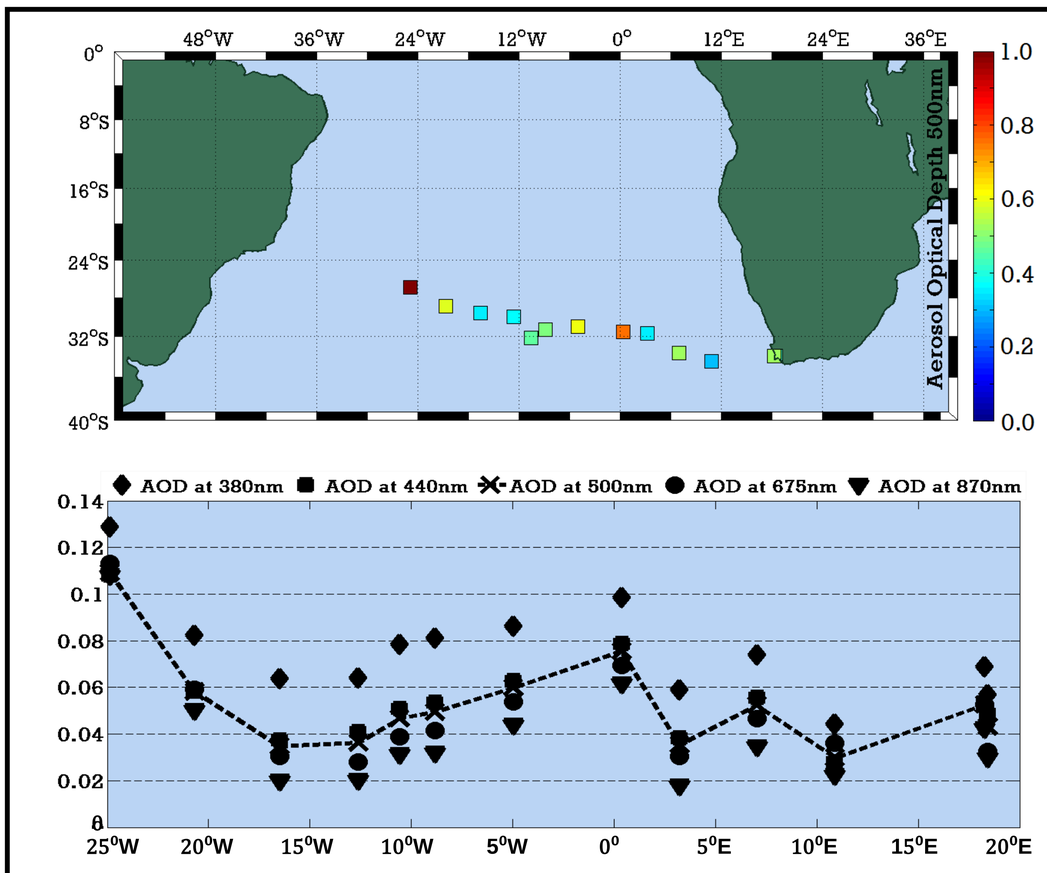


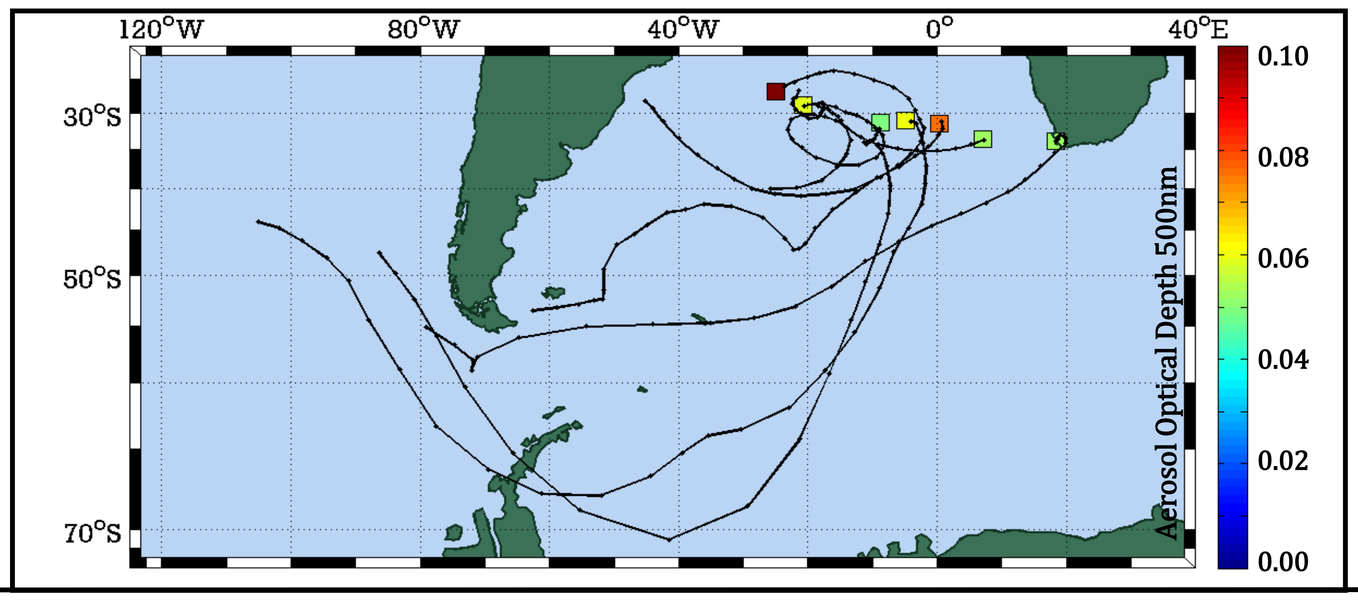
Data averaged over the period of 2003-2010. Assimilation of MODIS AOD data with ECMWF Integrated Forecast System model.
- Figure from the 5th assessment report ("AR5") of the Inter- governmental Panel on Climate Change (IPCC, 2013)

CONCLUSION: At the point sampled locations where the air mass at 850 hPa (~1.5 km height above sea level) originated from the South Atlantic basin, the AOD was observed to be lesser by the order of 0.02. Air masses at 850 hPa originating from the Southern Ocean could have a higher AOD due to the high wind characteristics of the region. Winds traveling through the South Atlantic are susceptible to facilitating the transport of marine aerosols, specifically sea salts which are created by the gustiness of the Southern Ocean wind fields.



LEFT: AOD at 500nm of all sampled points along the M124 Cruise
ABOVE: AOD at 500nm [<0.05] with wind trajectories of air masses at 850hPa
BELOW: AOD at 500nm [>0.05] with wind trajectories of air masses at 850hPa





MyScience Cruise: Cape Town – Rio de Janeiro
29th February – 18th March 2016, M124

References:
- Smirnov et al. (2006) Ship based aerosol optical depth measurements in the Atlantic Ocean. Geophysical Research Letters. 33:L14817
- Wilson et al. (2010) Aerosol optical properties over the South Atlantic Ocean during the 140th cruise of the M/V S.A. Agulhas. Atmospheric Research.98: 285-296
- 5th Assessment Report (AR5) of the Inter-Governmental Panel on Climate Change (IPCC). (2013)