

# Comparison of MODIS ocean aerosol retrievals with ship-based sun photometer measurements from the Around the America's expedition



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## 1. Introduction

- Our atmosphere is filled with tiny, enigmatic particles known as aerosols.
- Even though they have profound impacts in our global climate system, the distribution and dynamics of aerosols remain poorly understood.

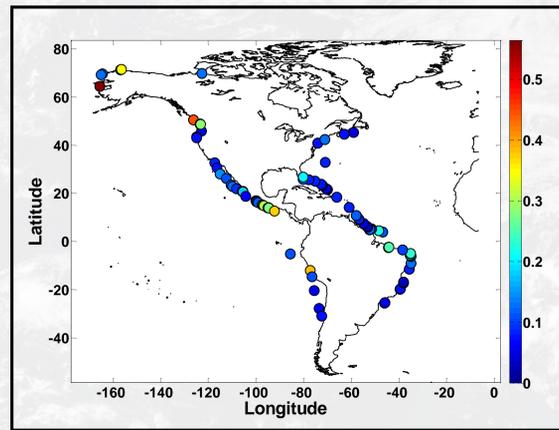


Fig. 1: Locations of the Ocean Watch RV measurements in the Around the America's expedition and the location of comparison with MODIS

- We report results from boat measurements compared to satellite derived data from the Moderate Resolution Imaging Spectroradiometer (MODIS).



## 2. Methodology

- Obtained aerosol optical depth (AOD) measurements were compared with data from the ARM site at Barrow, Alaska to assure data quality.
- A spatio-temporal technique was incorporated to compare Microtops measurements with MODIS swaths.
- Compared data was interpolated to appropriate wavelength.

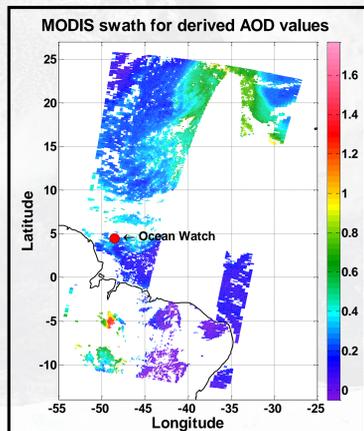


Fig. 2: Graph depicting a MODIS swath and the location of the Microtops measurement.

## 3. Ground Based Instrument Comparison

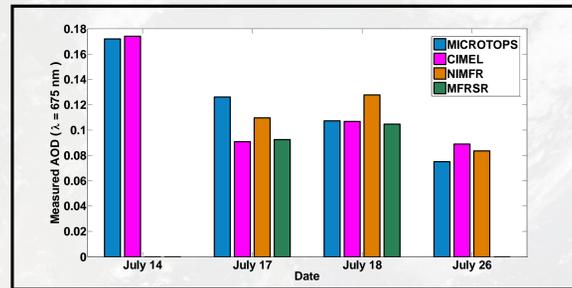


Fig. 3: Comparison of Microtops measurements with three instruments located at the ARM site in Barrow, AK, for the 4 days during which Microtops measurements were made.

## 4. Around the America's Data

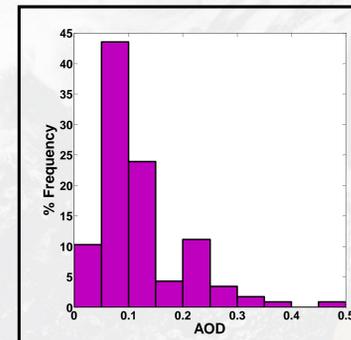


Fig. 4: Frequency distribution of all AOD measurements ( $\lambda = 500$  nm) taken during ATA.

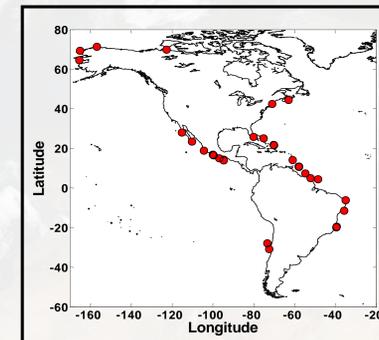


Fig. 5: Sites of collocated Microtops measurements with MODIS retrieved aerosol products.

## 5. Results-Comparison with MODIS retrievals

- A total of 35 retrievals from MODIS are compared with Microtops measurements (Fig 5). A comparison of obtained AOD from both sensors is shown in Fig. 6.
- The Angstrom exponent, a qualitative indicator of aerosol particle size, was derived. Their differences in relation to AOD are shown in Fig. 7.
- Results from AOD are correlated with wind speed measurements from a Vaisala Weather Transmitter WXT520 aboard OW.
- The expectation error is used as a means to quantify the magnitude of the difference in AOD from both sensors in relation to uncertainty estimates. Expectation error as a function of wind speed is shown in Fig. 8.

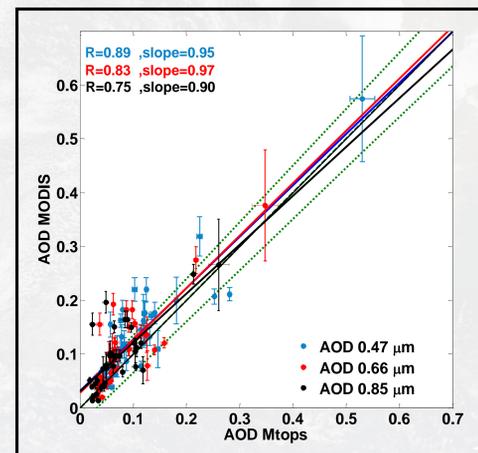


Fig. 6: Scatterplot of measurements for both sensor at three wavelengths. The two green dotted lines denote the expectation error boundaries for MODIS while the green dashed line represents the 1-1 line.

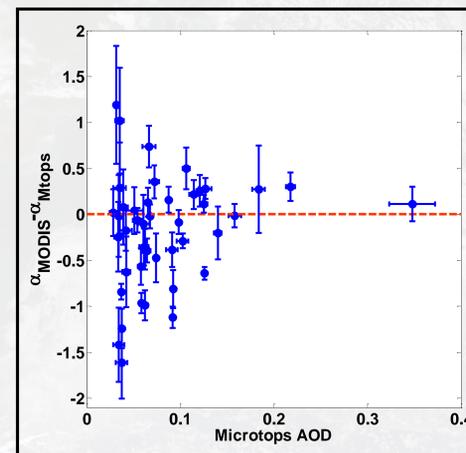


Fig. 7: Difference between MODIS 550-870nm Ångström exponent and Microtops derived Ångström exponent as a function of Microtops optical depth at  $0.66 \mu\text{m}$ .

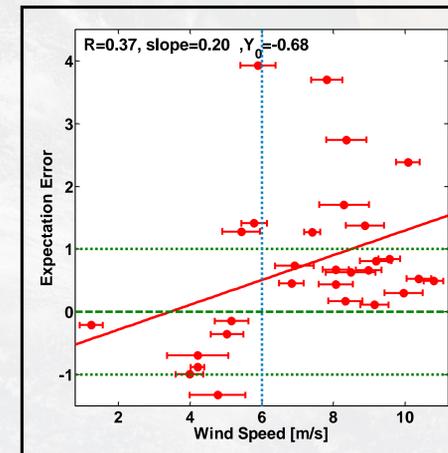


Fig. 8: Expectation error (at  $0.66 \mu\text{m}$ ) as a function of average wind speed. The solid line represents the linear fit, dotted lines represent the uncertainty boundaries and the dashed line denotes a perfect AOD retrieval. The vertical dotted line indicates a value of  $6 \text{ m/s}$ , which is used in the MODIS standard algorithm.

## 7. Conclusions

- A dominance of low AOD values is seen, with 78% of these values being less than 0.15.
- Microtops data is within expected accuracy for 3 out of 4 days at Barrow site.
- Microtops and MODIS AOD correlate strongly and slopes are found to be near 1.
- However, MODIS values are biased high relative to surface observations for small optical depth values.
- Propagation of error for low AOD measurements causes higher discrepancies in Angstrom exponent measurements.
- When wind speed is taken into consideration, a positive bias is seen for wind speeds near or above  $6 \text{ m/s}$ . The opposite is seen for calmer conditions.
- This might be due, in part, to MODIS's assumption of surface wind speed being constant at  $6 \text{ m/s}$ .
- This could cause an underestimation of surface reflectance in windy conditions, the opposite being true for calm oceans.

## 8. Acknowledgements

This research is funded by the Joint Institute for the Study of the Atmosphere and Ocean (JISAO) under NOAA Cooperative Agreement No. NA17RJ1232.



Sun photometer data from Around the America's was obtained through NASA's Maritime Aerosol Network (MAN) program.

MODIS data was made available through NASA's Level 1 and Atmosphere Archive and Distribution System (LAADS Web).

## 9. Selected References

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