Improved Aerosol Optical Depth retrieval using combined MODIS-CALIOP sensor

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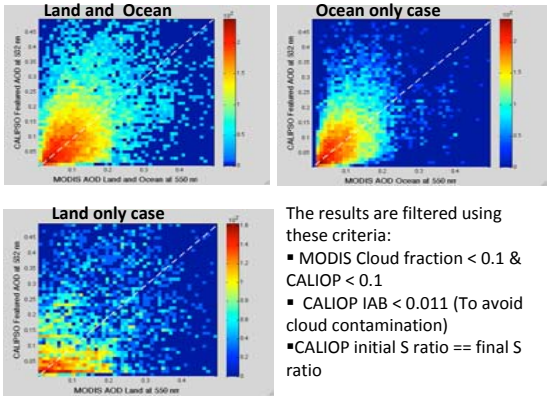
Introduction

This work aims to both evaluate the MODIS and CALIOP Aerosol Optical Depth (AOD) retrieval and develop a combined MODIS/CALIOP AOD retrieval leveraging the vertical resolved CALIOP and multi-spectral MODIS observations. Preliminary results suggest a significant variability between the CALIOP and MODIS AOD for both ocean and land comparisons. The MODIS and CALIOP AOD appear to be correlated with the aerosol model selected in the CALIOP AOD retrieval. This suggests that a more sophisticated method to determine the CALIOP S ratio is needed. Combining the MODIS multi-spectral observations with CALIOP could provide additional information for this selection. This poster investigates current biases and the potential for a combined MODIS/CALIOP AOD retrieval.

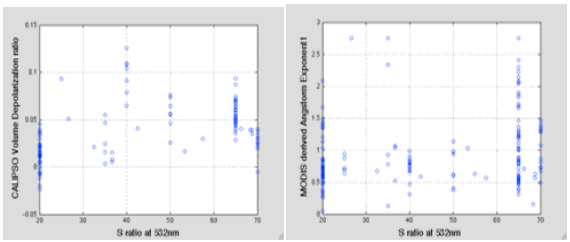
One Month (August 2007) Comparison of the MODIS AOD and CALIOP AOD



The results are filtered using these criteria:

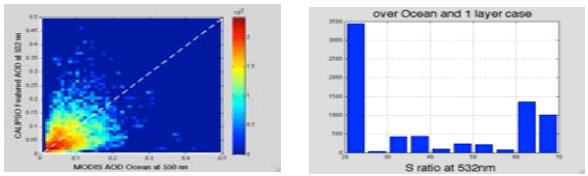
- MODIS Cloud fraction < 0.1 & CALIOP < 0.1
- CALIOP IAB < 0.011 (To avoid cloud contamination)
- CALIOP initial S ratio == final S ratio

Correlation of CALIOP Volume Depolarization ratio and the MODIS Angstrom Exponent to S -ratio

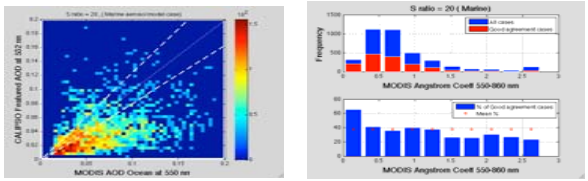


Accuracy of CALIPSO derived AOD is directly related to the accuracy of the S ratio selected. In most cases (except from lofted aerosol layer case) , selection of S ratios heavily depends on IAB, Depolarization ratio and underlying surface type. Collocated MODIS derived Angstrom Exponent can be use as extra information to check CALIPSO defined S ratios. These figures presents the relationship between the MODIS Angstrom exponent and the CALIOP assumed S-ratio.

Single Layer Ocean MODIS-CALIOP AOD

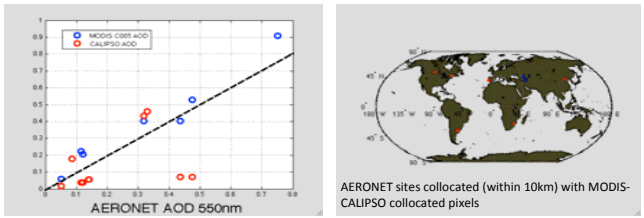


Conclusion: CALIOP selects an marine aerosol S-ratio for most ocean retrievals



The results were filtered for only marine aerosol cases. When compared to MODIS, cases with smaller angstrom coefficients are more likely to agree with MODIS AOD.

Validation with AERONET sites measured AOD

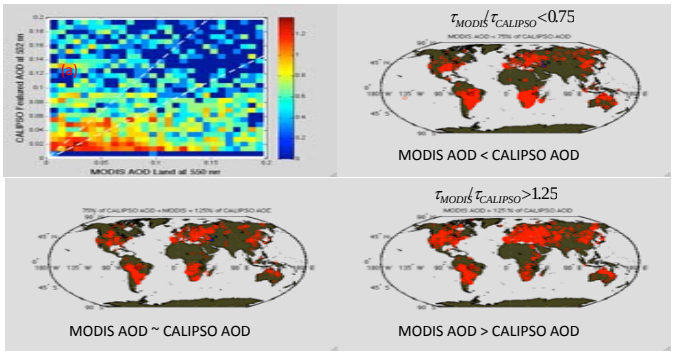


Number of collocated MODIS/CALIPSO FOV with AERONET sites are limited due to small CALIPSO footprint size and lack of cross-track scanning. MODIS derived AOD has better agreement with AERONET AOD than CALIPSO derived AOD.

Conclusion and Future Work

- There are significant differences between the CALIOP and MODIS derived AOD.
- These differences are correlated with both geographical location and aerosol type selection.
- CALIOP derived AOD over ocean using a marine aerosol model overestimates the AOD. Further investigation is needed
- Over land, CALIOP and MODIS derived AOD differences are related to the underlying surface type. Additional examination with other AERONET will be conducted to investigate these biases.
- Future work will include adding ground base observations (AERONET sites and MFRSR network) to the collocated CALIOP-MODIS comparisons.
- The comparison of MODIS-CALIOP AOD shows that the joint MODIS-CALIOP sensor has the potential to improve the total column aerosol optical depth retrieval

MODIS-CALIOP AOD comparison over Land

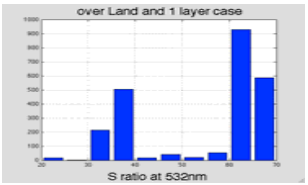


CALIPSO and MODIS derived AOD differences are correlated with the underlying surface type. Uncertainties in the MODIS AOD is strongly related to the assumed surface reflectance. The figures investigate the geographical relationship between the AOD differences.

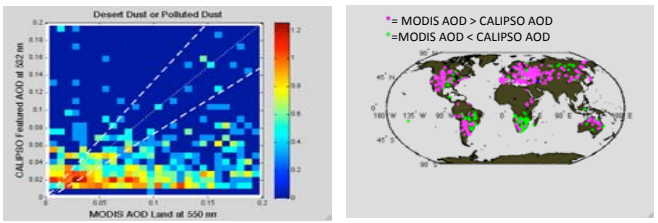
Frequency of CALIOP defined aerosol types over land

- Biomass burning (S ratio =70)
- Polluted continental (S ratio =70)
- Polluted dust (S ratio= 65)
- Desert dust (S ratio = 40)

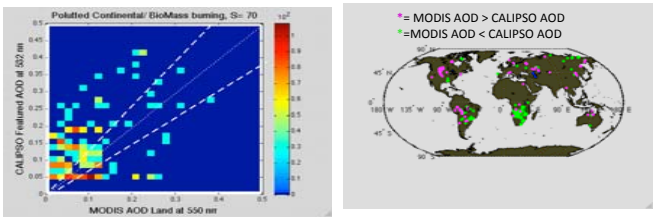
We will focus on the correlation between selected aerosol type, geographic location, and AOD uncertainties.



Geographical distribution of MODIS- CALIOP AOD differences of major aerosol types over land



MODIS derived AOD is over estimated relative to CALIOP for desert locations. We suspect that MODIS underestimates the underlying surface reflectance for deserts.



The MODIS AOD is under estimated relative to CALIOP in South-East of Africa. This is region of significant biomass burning. We suspect that MODIS incorrectly defines the aerosol type.