Mapping Modeled Aerosol Species to Measured Lidar Ratios for the MIRA Project

G.L. Schuster[1], T.D. Toth[1], C.R. Trepte[1], M. Chin[2], H. Bian[2,3], D. Kim[2,3], J. Kar[1,4], E.J. Welton[2]
[1]NASA Langley Research Center, Hampton, Virginia (USA)
[2]NASA Goddard Space Flight Center,Greenbelt,Maryland (USA)
[3]Univ Maryland Baltimore County, Baltimore (USA)
[4]Science Systems and Applications Inc. (USA),

Session number 11

50 years of lidar observations: the tip of the laser remote sensing iceberg?

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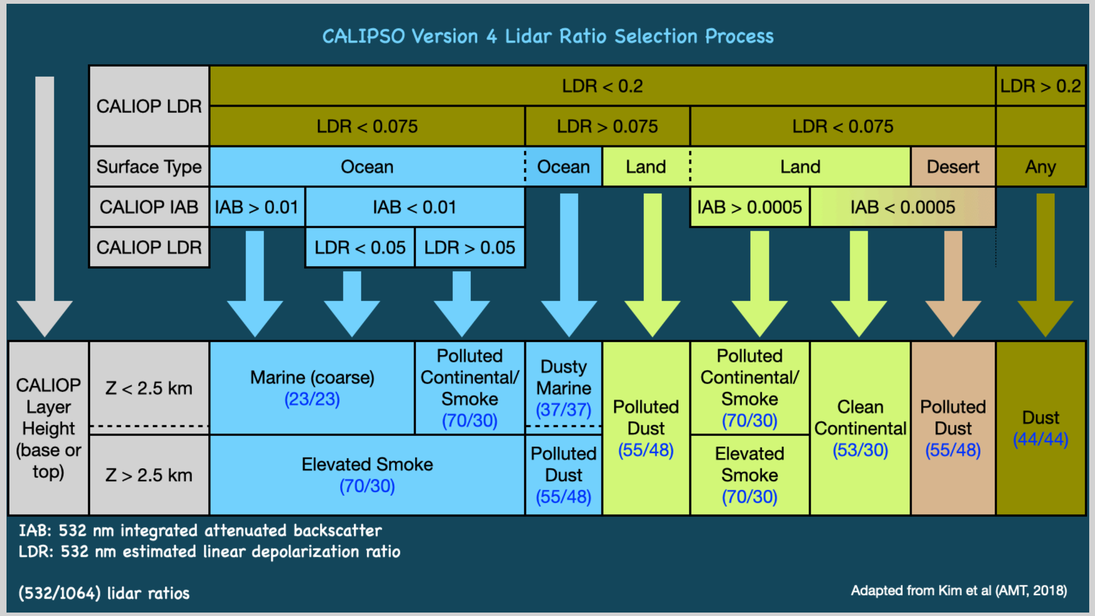
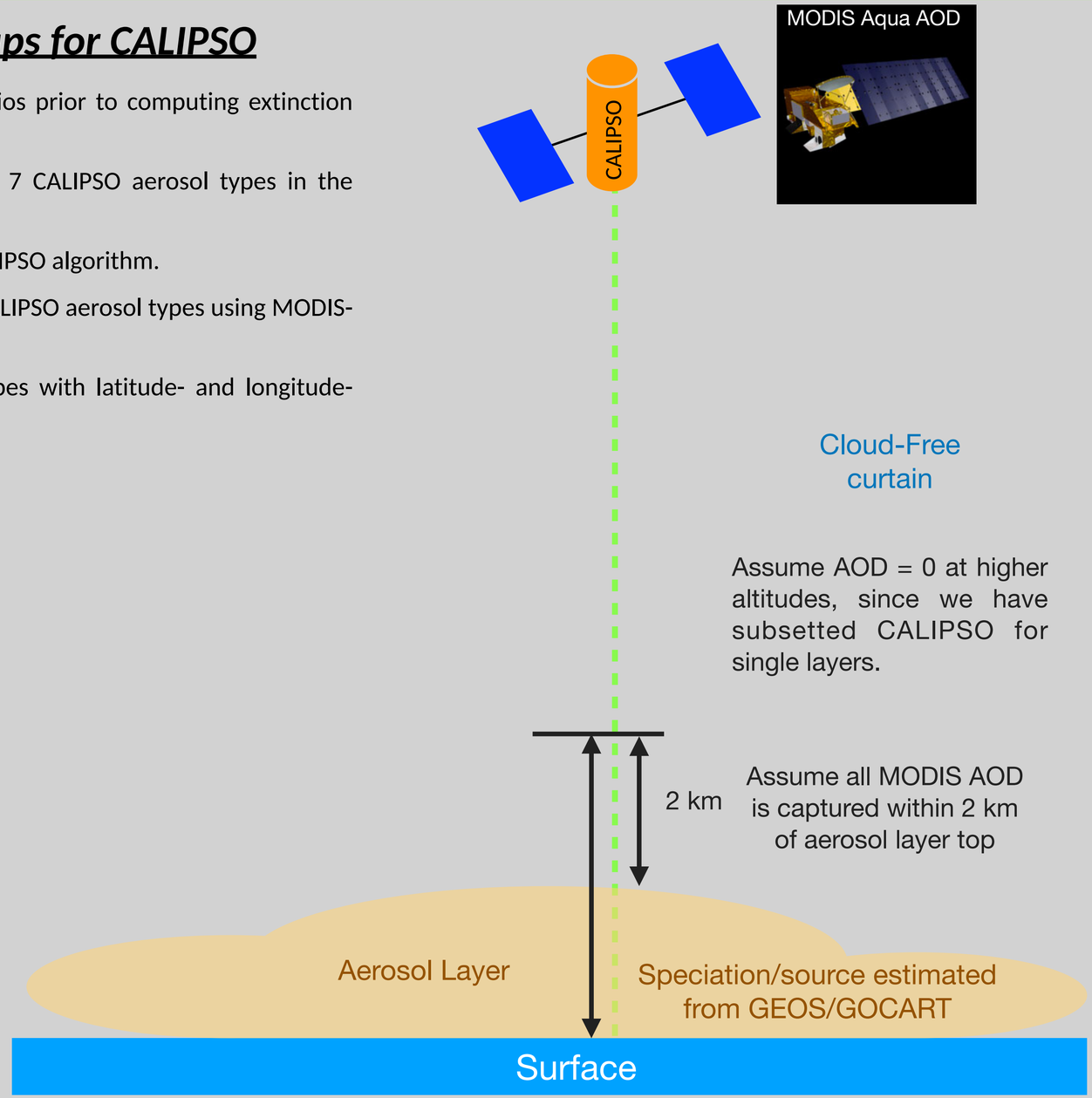
Overarching goal: Create Climatological Lidar Ratio Maps for CALIPSO

- Since CALIPSO is an elastic backscatter lidar, it is necessary to select *a priori* aerosol lidar ratios prior to computing extinction profiles.
- Presently, the CALIPSO lidar ratio selection process uses *a single lidar ratio* for each of the 7 CALIPSO aerosol types in the troposphere.
- Consequently, regional and seasonal variability of the lidar ratio is very limited in the present CALIPSO algorithm.
- Here, we describe an approach for creating new climatological lidar ratio maps for each of the CALIPSO aerosol types using MODIS-CALIPSO constrained retrievals and global model simulations.
- The purpose is to eventually replace the seven single-valued lidar ratios for the CALIPSO types with latitude- and longitude-dependent maps for each of the seven types.





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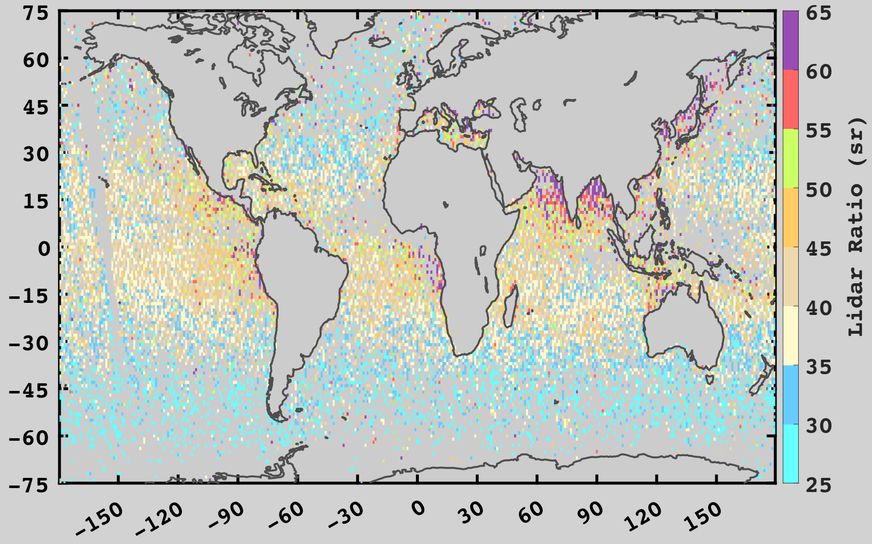
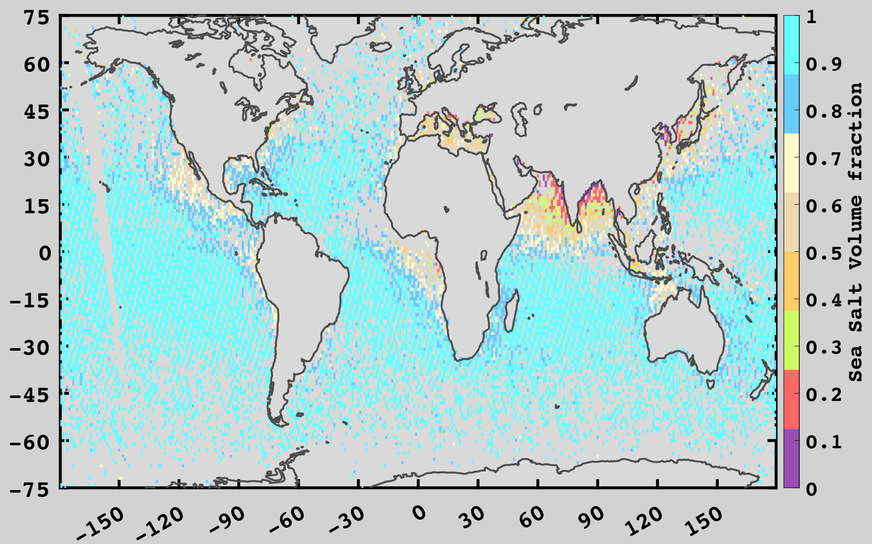
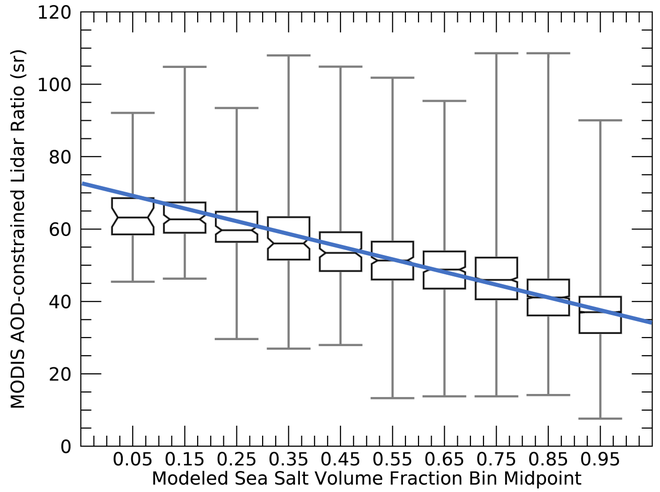
MODIS-CALIPSO constrained Lidar Ratio (532 nm) for CALIPSO Clean Marine Aerosol Type, 2017



GEOS/GOCART Volume fraction of Sea Salt (no dust), sub-sampled for CALIPSO Clean Marine, 2017



Constrained Lidar Ratio vs Sea Salt Volume Fraction for CALIPSO Clean Marine Aerosol Type, 2017



N = 14613, R = -0.58, S_{sea} = 34.7 sr, S_{oth} = 73.5 sr

Results

- We present a technique for creating global maps of lidar ratios that is linked to MODIS-CALIPSO Fernald inversions and GEOS/GOCART aerosol speciation
- We apply this technique to CALIPSO's Clean Marine aerosol type.
- We demonstrate a clear relationship between the MODIS-CALIPSO AOD-constrained lidar ratios and the modeled sea salt volume fractions (right panel).
- We can also use the retrieval-model relationship (right panel) to create seasonal lidar ratio maps (shown in poster).
- Advantages of this approach are
  1. Empirical method does not require Mie Theory or other single-scatter computations to compute lidar ratios
  2. Model provides results in perpetually cloudy regions where the constrained retrieval fails (middle panel)
  3. Model provides smooth transitions at coastlines because sea salt fractions can be non-zero over land and less than 1 over ocean.

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MIRA This project is using the MIRA forum to solicit sub-orbital lidar ratios and global model output of aerosol speciation. https://science.larc.nasa.gov/mira-wg/