On the CALIOP Aerosol Typing Algorithm

David M. Winker*, Mark A. Vaughan, and Jason L. Tackett

NASA Langley Research Center, Hampton, VA 23666, USA

**Presenting author (david.m.winker@nasa.gov)*

The standard CALIOP algorithm for retrieval of aerosol extinction requires an estimate of the particulate lidar ratio. When we began designing the CALIOP aerosol retrieval algorithms 25 years ago, we realized the retrievals would require global estimates of aerosol lidar ratio, S_a. The only practical way of doing this was to use the CALIOP observations themselves and we created a scheme to identify a number of aerosol types, with a characteristic S_a defined for each type.

The most direct information on aerosol type comes from CALIOP depolarization signals, which identify non-spherical particles and proved useful in characterizing desert dust aerosols globally. We wanted to also identify other major aerosol types such as smoke, pollution, and marine, and later realized a need to include two types which explicitly represented mixtures of dust and either smoke (Omar et al. 2009) or marine aerosol (Kim et al. 2018).

The concept underlying the typing scheme was that the variety of emission sources and atmospheric processes will act to produce air masses with typical mixtures of aerosol species, creating an identifiable aerosol "type" with a characteristic S_a value. We realized there would be variability within a given airmass, and possibly larger variability between airmasses of the same "type" but in different parts of the globe. Comparisons with airborne HSRL observations (Rogers et al. 2014) have shown where improvements in the scheme are desirable.

Information on aerosol properties has greatly improved over the last 25 years. A MIRA activity is now underway to see if CALIOP aerosol typing (and thus retrieval accuracy) can be improved by relaxing the requirement that the S_a of a type is constant everywhere around the globe. This presentation will discuss the thinking behind the design of the original typing algorithm and its evolution, point out some of the weaknesses, and consider the potential for improvement. Any improvements in the current approach to estimating S_a values could be used to produce an improved CALIOP data record, by reprocessing, and could also improve the information derived from future satellite backscatter lidars.

References

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