DEVELOPMENT OF A MULTI-FILTER ROTATING SHADOWBAND RADIOMETER NETWORK FOR DISTRIBUTED MONITORING OF AEROSOL OPTICAL DEPTH AND FINE MODE FRACTION

Miguel Bustamante , Barry Gross, Fred Moshary and Sam Ahmed

Optical Remote Sensing Laboratory, City College of New York, NY, NY, USA 10031

1. INTRODUCTION

Information about global distributions of aerosol optical thickness (AOT) and size categorization is necessary to quantify the aerosol radiative forcing as well as a method to monitor air-quality such as fine particulate matter. While global efforts are clearly meant for satellite observations, the retrieval of aerosol properties including optical depth, single scattering albedo and angstrom coefficients are quite difficult and rigorous validation of these type measurements are critical. Clearly, the development of suitable radiometer networks is central to this effort. Modern robotic solar instruments for retrievals of aerosols optical depth and other microphysical parameter retrievals, such as the CIMEL Sky Scanning Radiometer [1] as part of the Aeronent Network are crucial to this effort but are unfortunately quite sparse and very expensive. In fact, only a few such radiometers exist on the North East corridor where some of the most significant aerosol compliance issues occur. To deal with this, it has been proposed that the use of more cost effective devices (with less sensing capability might prove sufficient. An example is the Multi-Filter Rotating Shadow-band Radiometer [2] computer controlled device. Direct observations of the effects of aerosols are quite limited even with current advances in satellite base aerosols remote sensing. Unfortunately, the use of the MFRSR has been limited by the crudeness of the algorithms which ignores information carried in the diffuse channel. For calibration, an extrapolation of the extraterrestrial irradiance I_0 or zero airmass signal via Langley method [3] was needed but such an approach needed very clear and homogeneous conditions which are not well met in urban areas. In fact, langley regressions which requires a stable aerosol optical depth result in errors which can go to as high as 30% in optical depth in periods between recallibration

2. RESULTS

To improve on this approach, we have implemented a novel algorithm based on the ratio between the direct and diffuse radiance developed at NASA GISS in which only the optical depth ratios during the calibration procedure are required to be stable [4-5]. In particular, we find this approach significantly improves optical depth time series measurements when compared to AERONET CIMEL and this improvement is traced to the fact that the normalized optical depth variability is approximately three times larger than the optical depth ratio variability. In addition to validating the new MFRSR data processing for aerosol optical depth, we have also extended our time series data analysis to include comparisons of fine and coarse mode AOD's and angstrom coefficients. In particular, we fine that the MFRSR is suitable for determination of the fine mode component but is much less accurate in the coarse mode which is understandable from the limited wavelength range. We have also begun demonstrations between multiple MFRSR sites. At present, instruments have been calibrated and integrated at NASA GISS (NY,NY), Lamont Doherty Earth Observatory (Westchester,NY), Medger Evers as well as Princeton University (NJ) at http://earth.engr.ccny.cuny.edu/noaa/wc/Shadowband/

In addition, we discuss our progress towards the full network availability of the network retrievals of both an inner and outer MFRSR network around NYC as seen in figure 1. Furthermore, we present multiple site measurements that we use to estimate the mass fraction of PM2.5 locally generated as well as the use of the MFRSR network for distributed validation of satellite AOD

Figure2. MFRSR Ring Networks under development. Left Panel is Outer ring. Right Panel is Inner ring.

3. REFERENCES

[1] Multi-Filter Rotating Shadowband Radiometer http://www.arm.gov/docs.instruments/static/mfrsr.html

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