The Nation-first Sun-sky-moon-polarimetric Multi-spectral Radiometer for Aerosol and Precursor Gas Studies at AUH, Gurugram, India

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Abstract

Studies relating to the effects of atmospheric aerosols at regional and global scales on climate change, environmental evolution and health are sparse over pristine locations (Holben et al., 1998) and are critical for future of our planet sustainability challenges that balance economic growth, social well-being, and ecological stewardship. To address these issues, aerosol measurements during daytime using the instrument, CE318-AERONET have been in progress at Amity University Haryana (AUH), Panchgaon, a pristine location in the Haryana State, India since August 2017 (Vijayakumar et al., 2020). To acquire more detailed information on round-the-clock aerosol products, as a part of the ongoing long-term research collaboration between NASA-AERONET, GSFC, USA and AUH, this system has been upgraded to a new sun-sky-lunar-polarimetric multiband photometer (CE318-T) in June 2023. Thus, the present system provides daytime and nighttime measurements and yields additional enhanced operational functionalities including the depolarization ratio. It started regular operation from June 2023 onwards. The initial results indicated diurnal variation in Aerosol Optical Depth (extinction) and Angstrom Exponent (microphysics) with larger mean daytime values as compared to their nocturnal counterpart, while the water vapor exhibited lower values during daytime and higher during nighttime, which is consistent. Other results together with the future plan of AMINET will be presented in this communication.

Material and Methodology

A new NASA-AERONET photometer system (CE318-T) that has been presented in this paper involves basically the standard instrument, CE318-AERONET, coupled with the principles behind the lunar/star photometry (Bayat et al., 2013), light polarization (Li et al., 2021) and associated calibration procedures. Thus, it performs daytime and night-time measurements and provides additional and enhanced operational functionalities including the lidar ratio, LR (ratio between backscattering and extinction coefficients) and depolarization ratio, DR (ratio between peak intensity of parallel and perpendicular component).

Principle behind the operation

Results and Discussions

The sun-sky photometric observations using the CE 318-AERONET have been in progress at AUH since August 2017. The new Cimel sun-sky-lunar-polarized multiwavelength photometer has been installed and observations during day and night, as per the protocol have been in progress since 18 June 2023. Some sample (first) results of AOD, AE, PWV, LR, DR and SSA, amongst many others, are displayed in the Figure overleaf.

(A), (B), (C), (D), (E) and (F), respectively. It is clear from the figure that diurnal variations in AOD and AE show larger mean daytime AOD as compared to its nocturnal counterpart, while the water vapour exhibits lower values during daytime and higher values during night-time, which is consistent. As the 1.0 level data were used here, the larger AOD values could be due to multiple scattering effects due to clouds. The variations in LD and DR portray inverse relationship with wavelength.

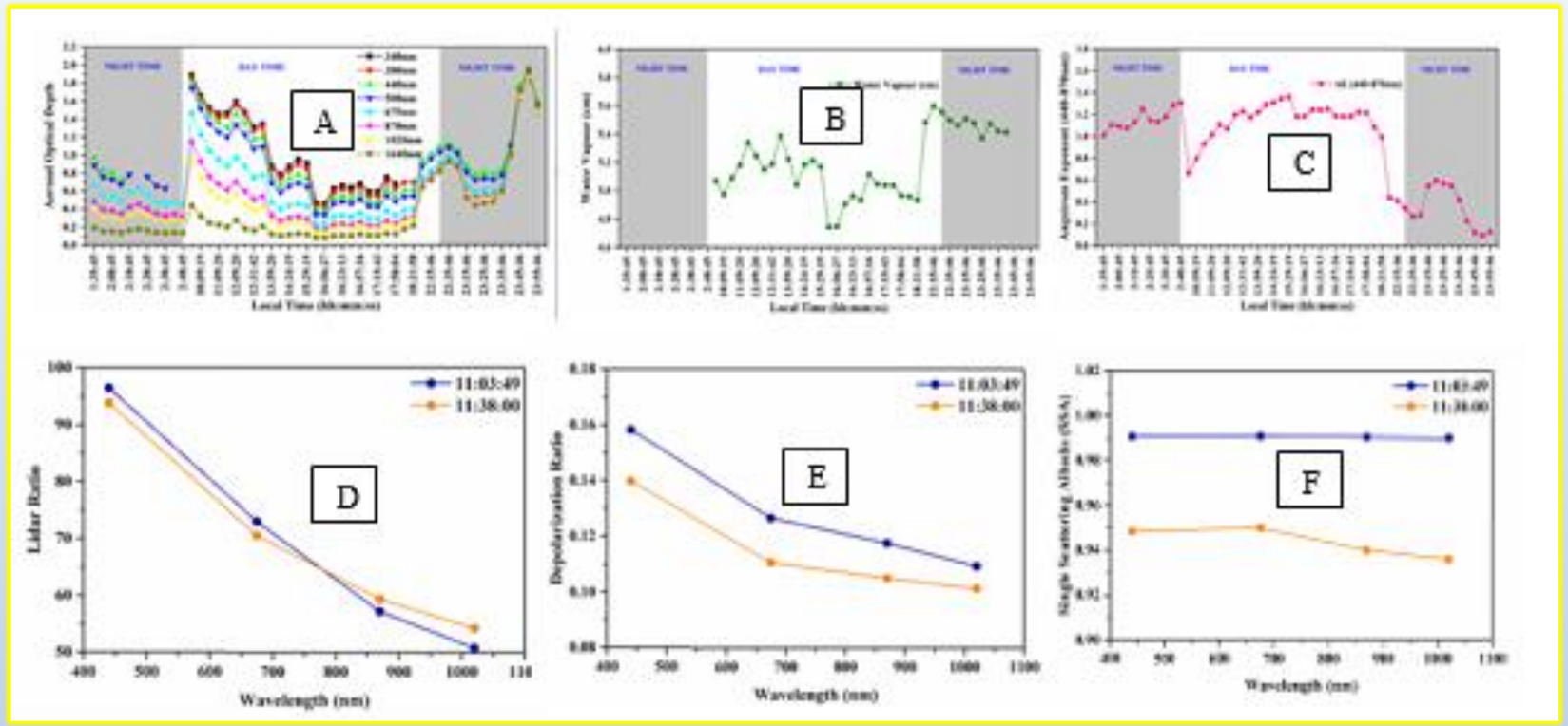

Figure: Diurnal variation of (a) Aerosol optical depth (AOD), (b) precipitable water vapor (PWV), (c) Angstrom Exponent (AE), and Spectral variation of (d) Lidar Ratio, (e) Depolarization Ratio and (F) Single Scattering Albedo (SSA) during 0235 h – 2355 h of 31 July 2023.

Conclusions

The new sun-sky-moon-polarized multiband photometer, installed at AUH, Gurugram, is described and the salient features observed and future programs that highlight the potentiality of the new system for better understanding of the integrated impact of aerosol and gas constituents under different environmental and meteorological conditions.

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