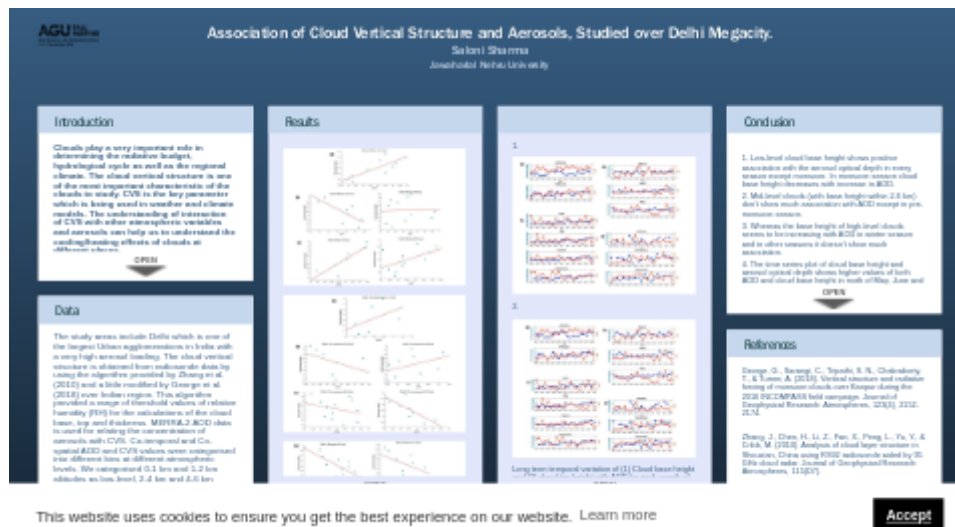


Association of Cloud Vertical Structure and Aerosols, Studied over Delhi Megacity.



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PRESENTED AT:



INTRODUCTION

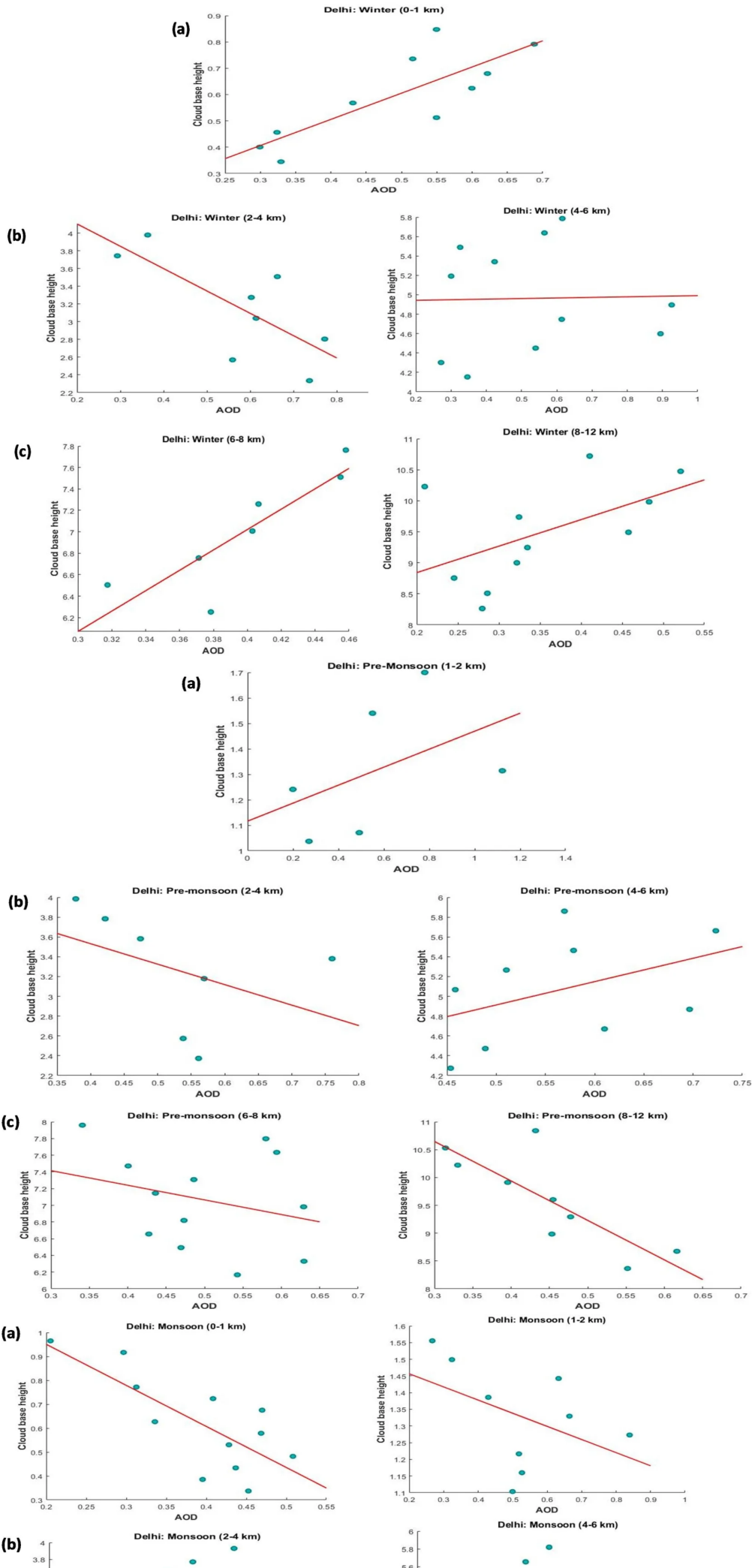
Clouds play a very important role in determining the radiative budget, hydrological cycle as well as the regional climate. The cloud vertical structure is one of the most important characteristic of the clouds to study. CVS is the key parameter which is being used in weather and climate models. The understanding of interaction of CVS with other atmospheric variables and aerosols can help us to understand the cooling/heating effects of clouds at different places.

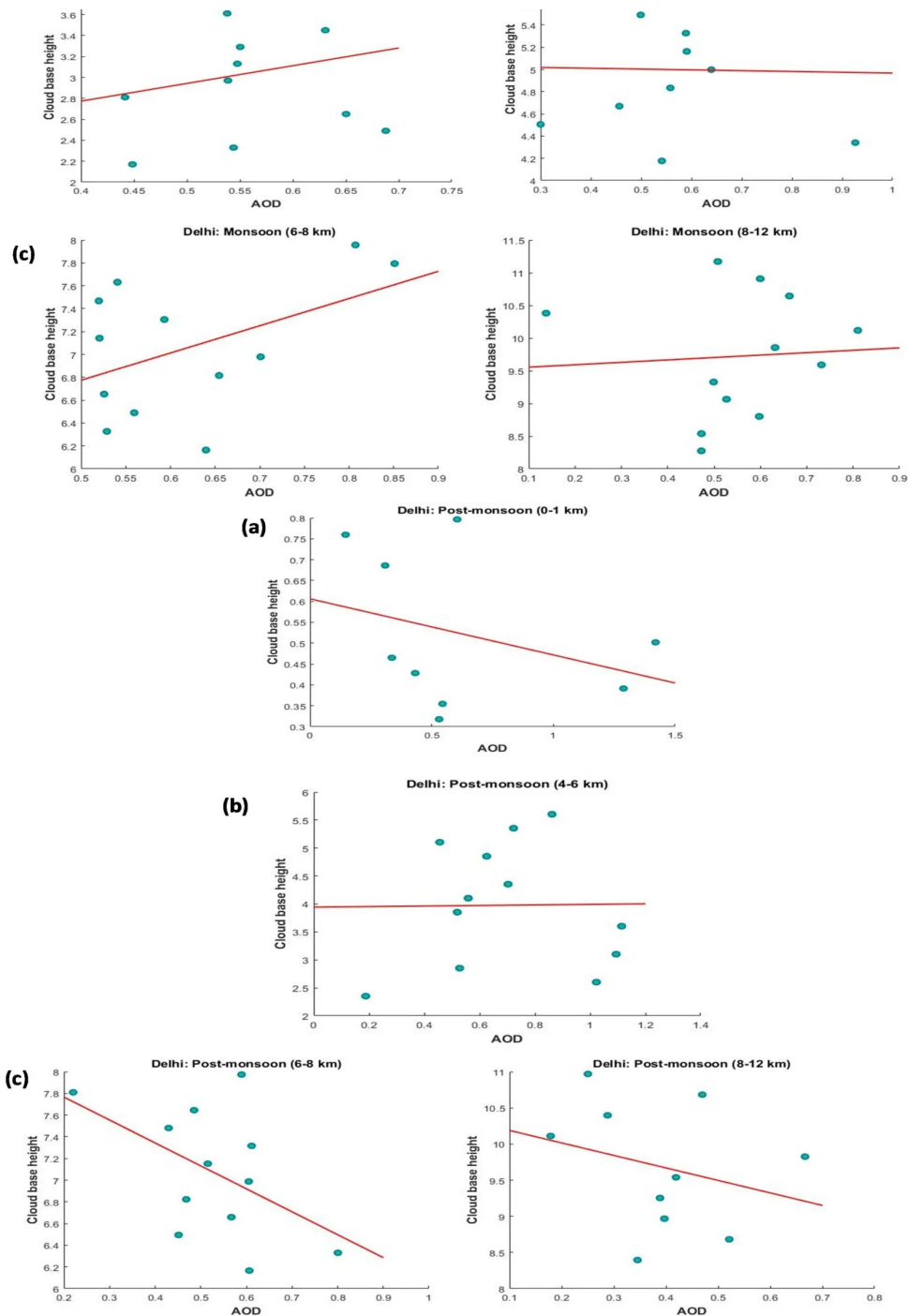
In polluted condition when there is a high loading of aerosols the effective cloud droplet radius decreases which implies a higher number of smaller cloud droplets with the same amount of moisture. Depending upon the availability of moisture such condition gives rise to either thick stable clouds or thin volatile clouds. Aerosols also modify the cloud microphysical properties which also influences its lifetime. All of such processes have significant impact on cloud radiative forcing. This work shows an attempt to understand the effect of aerosols on Cloud base height and cloud top height.

DATA

The study areas include Delhi which is one of the largest Urban agglomerations in India with a very high aerosol loading. The cloud vertical structure is obtained from radiosonde data by using the algorithm provided by Zhang et al. (2010) and a little modified by George et al. (2018) over Indian region. This algorithm provided a range of threshold values of relative humidity (RH) for the calculations of the cloud base, top and thickness. MERRA-2 AOD data is used for relating the concentration of aerosols with CVS. Co-temporal and Co-spatial AOD and CVS values were categorised into different bins at different atmospheric levels. We categorised 0-1 km and 1-2 km altitudes as low-level, 2-4 km and 4-6 km altitude as mid-level and 6-8 km and 8-12 km altitude as high-level.

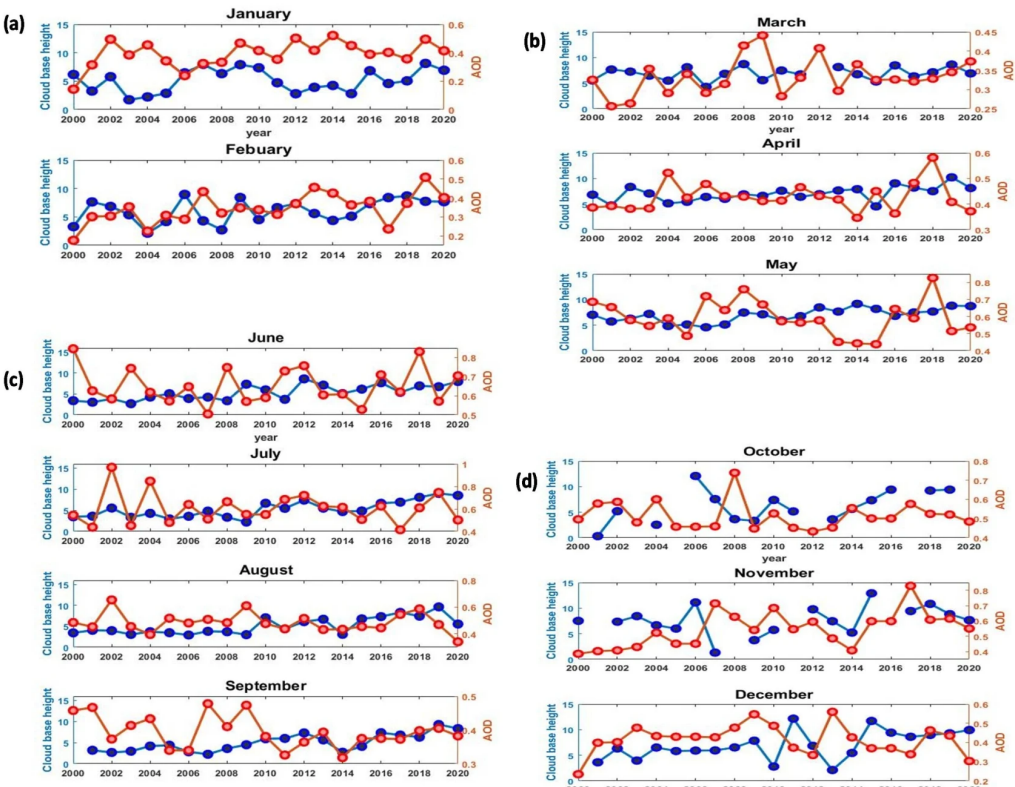
RESULTS



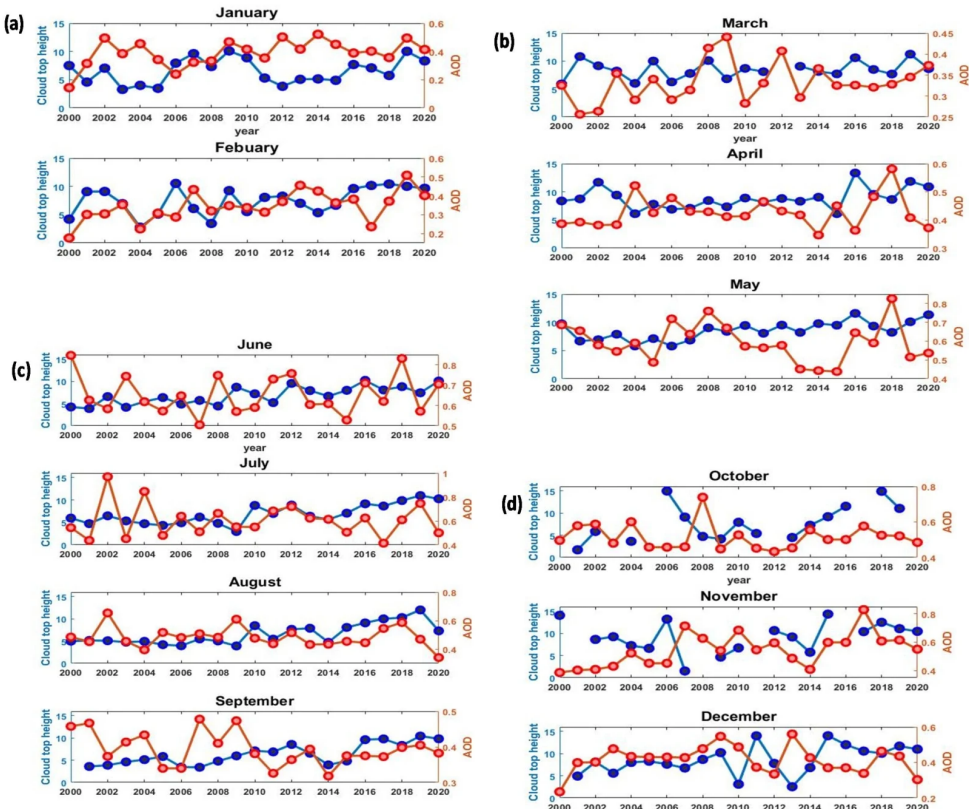


Scatter plots (with regression line) of cloud base height and aerosol optical depth categorized into various bins in different seasons (winter, pre-monsoon, monsoon and post-monsoon season from top to down above) for (a) low-level, (b) mid-level and (c) high-level clouds.

1.



2.



Long term temporal variation of (1) Cloud base height and (2) cloud top height with AOD for each month of different seasons i.e., (a) winter, (b) pre-monsoon, (c) monsoon and (d) post-monsoon.

CONCLUSION

1. Low-level cloud base height shows positive association with the aerosol optical depth in every season except monsoon. In monsoon season cloud base height decreases with increase in AOD.
2. Mid-level clouds (with base height within 2-6 km) don't show much association with AOD except in pre-monsoon season.
3. Whereas the base height of high-level clouds seems to be increasing with AOD in winter season and in other seasons it doesn't show much association.
4. The time series plot of cloud base height and aerosol optical depth shows higher values of both AOD and cloud base height in month of May, June and then October and November. These months characterised by dust storms and crop burning seasons. High pollution in these months seems to be associated with high cloud base height as well as higher cloud top height.

REFERENCES

George, G., Sarangi, C., Tripathi, S. N., Chakraborty, T., & Turner, A. (2018). Vertical structure and radiative forcing of monsoon clouds over Kanpur during the 2016 INCOMPASS field campaign. *Journal of Geophysical Research: Atmospheres*, 123(4), 2152-2174.

Zhang, J., Chen, H., Li, Z., Fan, X., Peng, L., Yu, Y., & Cribb, M. (2010). Analysis of cloud layer structure in Shouxian, China using RS92 radiosonde aided by 95 GHz cloud radar. *Journal of Geophysical Research: Atmospheres*, 115(D7).