High Altitude Cloud Physics Laboratory (HACPL)

Research Highlights

On the precipitation susceptibility of monsoon clouds to aerosols using high-altitude ground-based observations over Western Ghats, India

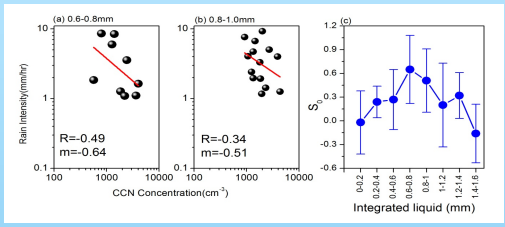
Precipitation susceptibility of monsoon clouds to changes in aerosols has been studied by utilizing ground based observations from a High Altitude Cloud Physics Laboratory (HACPL, 17.92°N, 73.66°E, 1348 m), Mahabaleshwar, India collected during monsoon seasons.

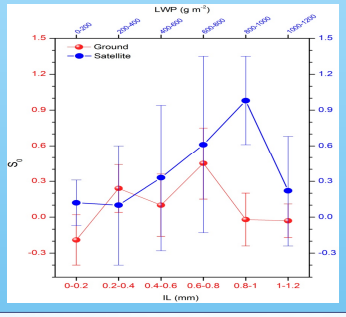
Methodology

Studies by **Feingold and Siebert (2009)** and **Sorooshianet al.(2009)** introduced a method to quantify sensitivity of precipitation to changes in aerosol or in other words to quantify the precipitation susceptibility (S_0). The precipitation susceptibility is defined as

$$S_0 = -\frac{d\ lnR}{d\ln N_d}$$

Where R is the precipitation or rain rate, N_d is the cloud drop number concentration. It is to be noted that alternative formulations that replace N_d with an aerosol measurement





✓Precipitation susceptibility has been estimated using CCN as aerosol proxy and it is higher ~0.65 for the integrated liquid water ranging from 0.6-0.8mm.

✓Compared ground based observation with satellite observations carried out using aerosol optical depth (AOD), rain rate and liquid water path.

✓Satellite observations showed that precipitation susceptibility, S_0, using AOD as aerosol proxy is higher (S_0=0.98) for liquid water path ranging from 800-1000 gm^{-2}

✓Present study using ground-based and satellite observations, confirmed that the precipitation is getting suppressed at medium range of integrated liquid / liquid water path, which is in agreement with the earlier reports.

***Leena P.P.**, Anil Kumar V., Sravanthi N., Patil R., Chakravarty K., Saha S.K., Pandithurai G. (2018), On the precipitation susceptibility of monsoon clouds to aerosols using highaltitude ground-based observations over Western Ghats, India. Atmospheric Environment, 185, DOI:10.1016/j.atmosenv.2018.05.001, 1-9*

Evidence of precedent wind role on controlling PM1 wet scavenging of aerosols during monsoon rain events.

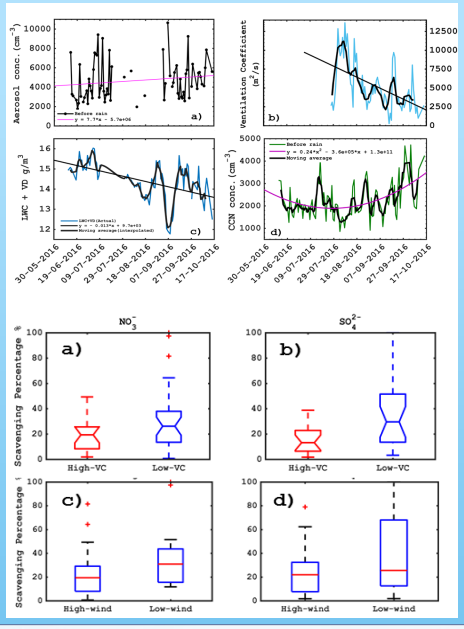
In this study, we show that concomitant wind actions influence over scavenging process during 2016 south-west monsoon rainfall at High Altitude Cloud Physics Laboratory, Mahabaleshwar.

Methodology

❑ The combination of various surface based observation intruments were downscaled to impact disdrometer time intervals (1 min) and were utilized to calculate before and after rain event bulk scavenging percentages.

❑$PSC_{\%} = \frac{\sum_{t1=1}^{t2=N} Q.(N_{K_{(n-1)}} - N_{K_{(n+10)}})}{\sum_{t1=1}^{t2=N} Q} \times \frac{1}{\frac{1}{N}\sum_{t1=1}^{t2=N} N_{K_{(n-1)}}}$

❑Positive scavenging percentage (PSC%) is the number of aerosol particles denoted by Nk(n-1) before and after Nk(n+10) rain event in the equation positively scavenging out after a rain event divided by number of particles before being washed out.



✓Ventilation Coefficient maxima ~12500m2/s was found to have stronger impact over CCN concentration reduction ~1000/cm3 before rainfall events.

✓High and low VC days showed clear distinction in decrease in scavenging percentage up to ~55% and ~26% for sulphate and nitrate species.

✓The strong/very high preceding winds of ~6-7m/s decreased the scavenging percentage up to ~10-40% of free aerosols.

✓High and low wind days suggest reduction in ~13% and ~37% in scavenging percentage for sulphate and nitrate.

***Yang L.**, Pandithurai G., Chate D.M., Rao P.S.P., Waghmare V., Iyer U. Evidence of precedent wind role on controlling PM1 wet scavenging of aerosols during monsoon rain events. Atmospheric Environment, 201, February 2019, DOI: 10.1016/j.atmosenv.2018.12.041,265-277*

Future/ongoing studies

✓**To study aerosol physical and chemical properties in detail to understand their influence on climate and society.**

✓**Detail study of cloud microphysical properties over Mahabaleshwar using long term data sets for the parameterization of cloud properties.**

✓**Impact of wind speed and scavenging process in sea salt generation and sink pathways. And there viable interaction with size segregation impact over the clouds.**

✓**Influence of Carbonaceous aerosols over the monsoon.**