High Altitude Cloud Physics Laboratory (HACPL)

Research Highlights

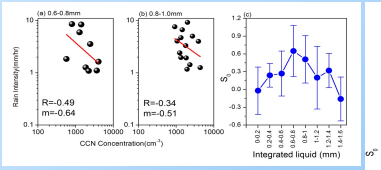
On the precipitation susceptibility of monsoon clouds to aerosols using high-altitude ground-based observations over Western Ghats, India

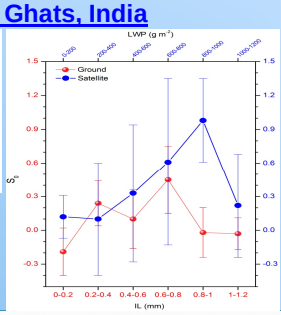
Methodology

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.

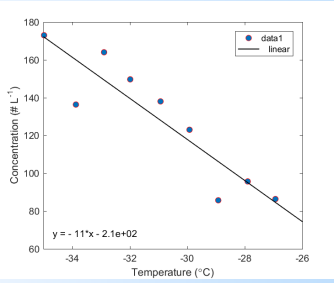
✓Compared ground based observation with satellite observations carried out using aerosol optical depth (AOD), rain rate and liquid water path.

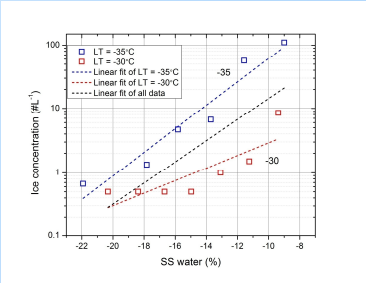
✓Satellite observations showed that precipitation susceptibility, S_0, using AOD as aerosol proxy is higher (S_0=0.98) for liquid water path ranging from 800-1000 gm^{-2}

✓Precipitation is getting suppressed at medium range of liquid water path which is in agreement with the earlier reports.

P.P.Leena.et al., (under revision)

Ice nuclei and their characteristics measured over high altitude site





✓Measurement of Ice nuclei (IN) and CCN are very important for realistic production of cloud ice in model.

✓Spectrometer for Ice nuclei (SPIN) is operating in HACPL to measure IN in different seasons.

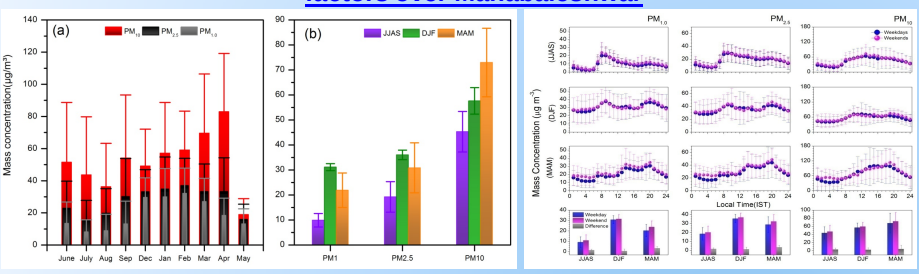
✓Observations of IN at different temperatures, water super saturation and ice super saturation are obtained to understand their physiochemical properties.

✓Heterogeneous ice nucleating properties and onset conditions of atmospheric aerosol particles are studying.

✓Figure shows the relation of IN concentration with aerosol temperature and SSw.

V. Anil Kumar, G. Pandithurai

Analysing temporal variability of particulate matter and possible contributing factors over Mahabaleshwar



✓Temporal variability associated with mass concentrations of PM_{10}, $PM_{2.5}$, and $PM_{1.0}$ were analysed using ground observations

✓Concentrations of PM_{10}, $PM_{2.5}$, and $PM_{1.0}$ showed strong diurnal, monthly, seasonal and weekday-weekend trends.

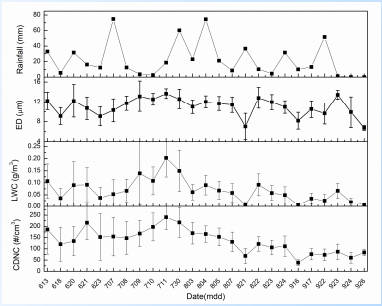
✓The seasonal variation of $PM_{1.0}$ and $PM_{2.5}$ has showed highest concentrations during winter season compared to monsoon and pre-monsoon. PM_{10} showed highest concentrations in pre-monsoon season.

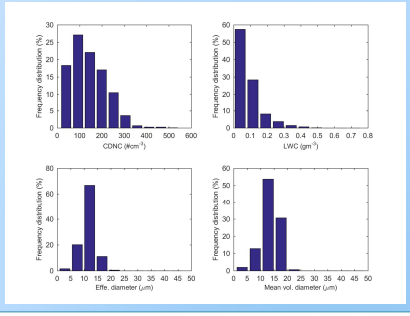
✓Slightly higher PM concentrations were observed during weekends compared to weekdays.

✓Possible contributing factors to this temporal variability has been analysed based on the variation of secondary pollutants such as NO_2, SO_2, CO and O_3 and long range transport of dust.

P.P.Leena.et al., JASTP (2017, published)

Variation of Cloud Microphysical parameters over Mahabaleshwar during monsoon 2017





✓Observation of long term cloud microphysical parameters are important to study their connection with monsoon.

✓Cloud microphysical properties during monsoon 2017 has been measured using the Cloud droplet probe (CDP) is obtained from HACPL, Mahabaleshwar.

✓There is a clear monthly variation in effective diameter (ED), liquid water content (LWC) and cloud droplet number concentration (CDNC).

✓Higher CDNC and ED observed during July (2393 mm accumulated rain fall) and lowest observed during Sept (671 mm rain fall).

✓Graph shows the seasonal variation and frequency distribution of cloud microphysical parameters during monsoon 2017.

P.P.Leena, V. Anil Kumar

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.

✓Utilize CCN and IN measurements for parameterization and testing.

✓Assimilate the information's from aerosol, cloud and IN to study their influence on precipitation process.