NCAP-COALESCE
CarbOnaceous AerosoL Emissions, Source apportionment & ClimatE impacts
Understanding scientific complexities related to carbonaceous aerosols focussing on issues underlying their origin and fate, and their role as drivers of regional climate change over India.

Research BRIEFS

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

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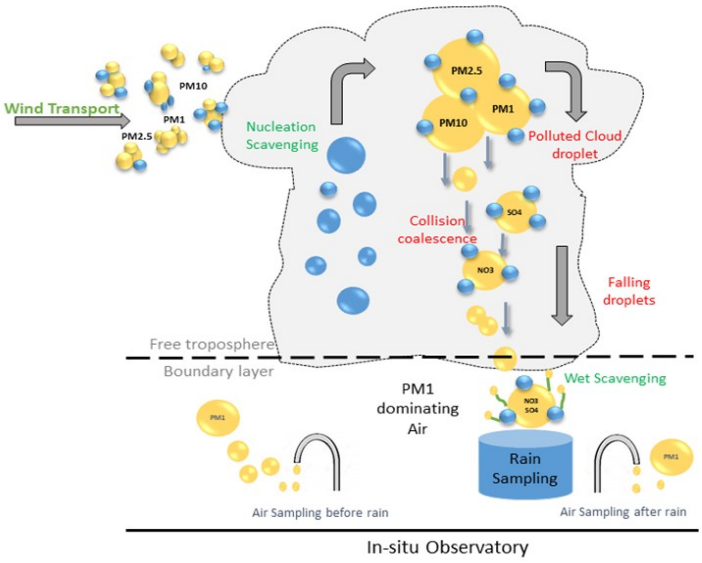

Key highlights:

- PM1 wet scavenging before minus after rainfall events by using multiple in situ instrument showed dependency over winds.
- High and low ventilation coefficient days showed decrease in scavenging up to ⍰55% and ⍰26% for SO42− and NO3− fine mode aerosols.
- High and low wind days suggest change of ⍰14% and ⍰37% in scavenging percentage for SO42− andNO3−.

Summary:

The analysis based on monsoon 2016 rainwater chemistry data and measurements from multiple in-situ instruments at HACPL (High Altitude Cloud Physics Laboratory), Mahabaleshwar site imparts, before rain CCN number concentration during high rain days showed a decrease in number concentrations of up-to ⍰1864 cm-3. On the other hand, during low rain periods before rain CCN number concentration median values were found to be high as ⍰2274 cm-3. Moreover, the Ventilation Coefficient (VC) maxima ⍰12500 m2/s was found to have a stronger impact over CCN concentration reduction ⍰1000 cm-3 before rainfall events on during monsoon. And high and low VC days showed clear distinction with decrease in scavenging percentage up-to ⍰55% and ⍰26% for SO42- and NO3- during high VC days. A negative correlation ⍰0.36 (at 99% significance level) was found between wind speed and before rain CCN concentration.

The strong/very high winds of ⍰6–7 m/s preceding the active phase rainfall event led to decrease in scavenging percentage up-to ⍰10–40% of ambient aerosols. While rainfall preceding a high and low wind events suggested a reduction in ⍰13% and ⍰37% in scavenging percentage for SO_4^{2-} and NO_3^-. The anthropogenic sources of SO_4^{2-} and NO_3^- showed on-road vehicles highest during initial and final phase of monsoon, which varied between ⍰4 × 104 and 2 × 104 respectively. The spatial pattern of monthly lightning also known be a high source for NO_3^- in rainwater depicted maximum lightning activity pre-dominant in the south-west direction to the site reached up to ⍰104 lightning events with the highest frequency of these monthly activities in June and a ⍰2 orders lower compared to final phase of rains during October. The CWT analysis revealed episodic long-range transport and local origin from metropolitan cities Mumbai affected Mahabaleshwar SO_4^{2-} and NO_3^- concentration in rainwater and its ionic concentration reducing pH ⍰4 during departure and break phases of monsoon.

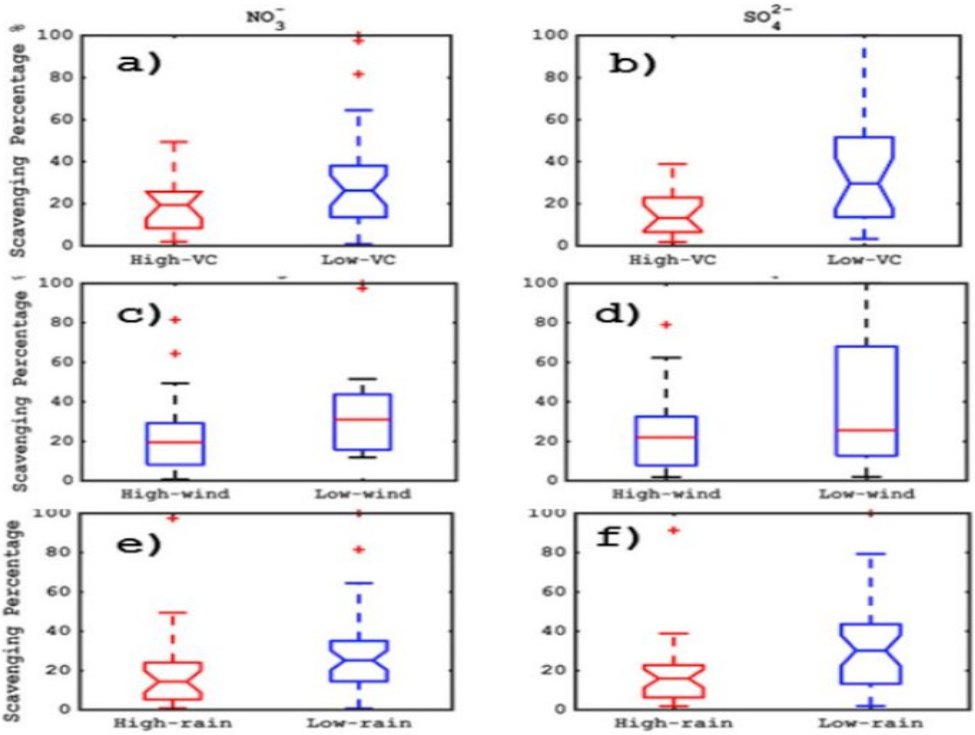

Figure 1. Box Whisker plot for scavenging percentages for ACSM NO3− and SO42− during High and Low ventilation coefficient (a, b), wind (c ,d), rain days (e, f) during south-west monsoon, 2016.

Major findings :

- During monsoon, PM1/PM10 mass ratios revealed dominance of PM1 for June, July, August, September and October as ~80%, 90%, 98%, 97%, and 95% respectively.
- Fine mode aerosols and rains associated with lower precedent wind speeds ~2 m/s were found to enhance the scavenging from ⍰60 to 90% based on Aerosol Chemical Speciation Monitor (ACSM) mass (SO42−, NO3−) concentrations.

Research Article

Citation

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