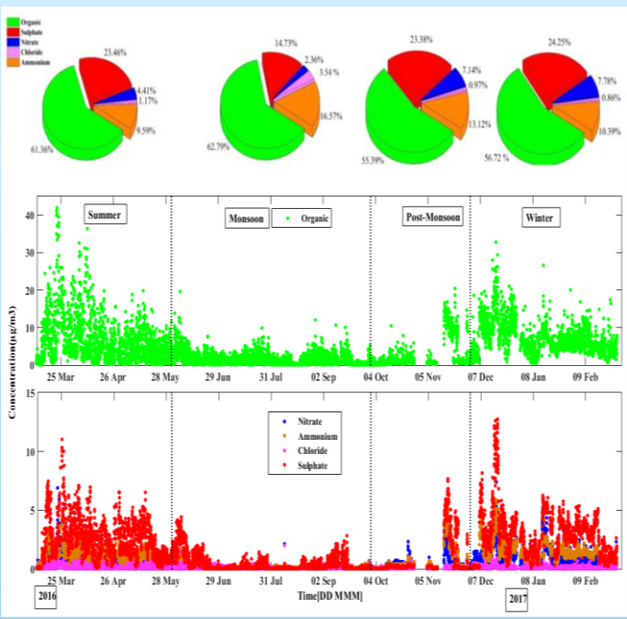
High Altitude Cloud Physics Laboratory (HACPL)

Research Highlights

Seasonal variability in chemical composition and source apportionment of sub-micron aerosol (PM_1) over a high altitude site

Time series obtained from ACSM



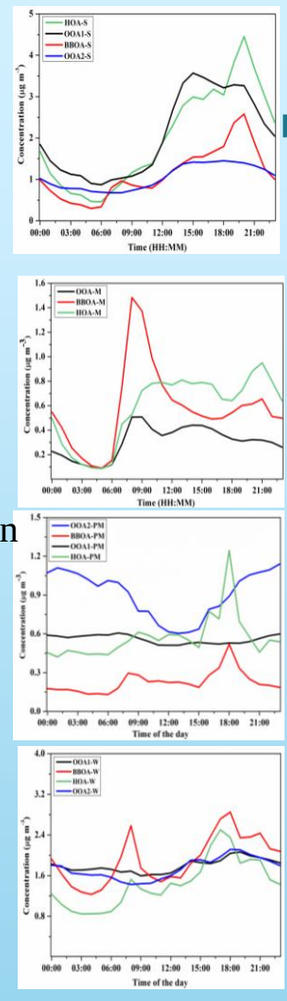
PMF was performed for each season to extract source factors

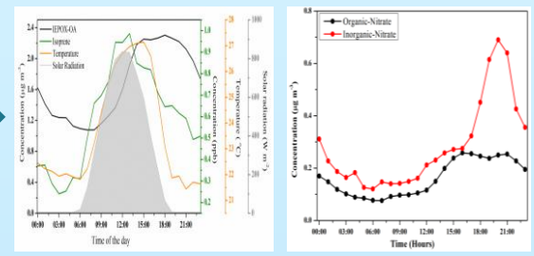
Summer

Monsoon

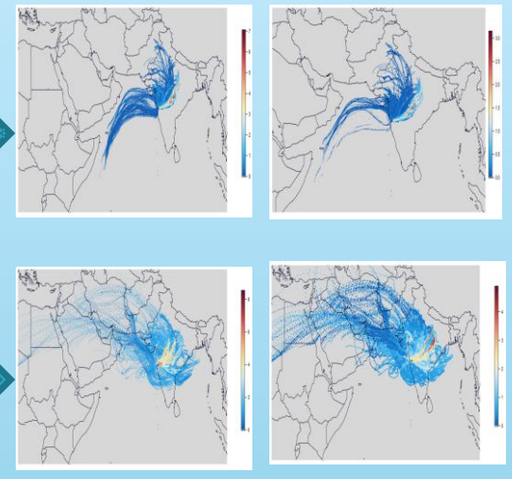
Post-monsoon

Winter





IEPOX-OA and Organo nitrate formation from Isoprene

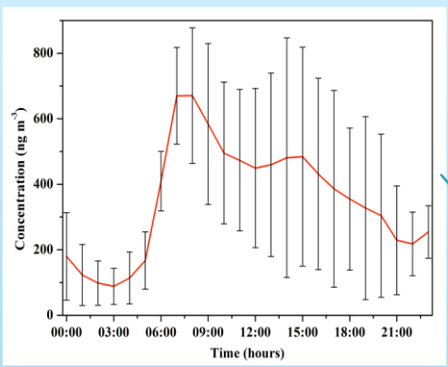


CWT analysis

- Organics dominated through out the year with contribution of > 55%.
- PMF identified the secondary organic aerosol as dominant during summer.
- During monsoon, the emission from local sources governed the organic diurnal.
- During post-monsoon and winter, the combined effect of local emissions and the long-range transport contributed.
- The presence of IEPOX-derived SOA during summer season was identified.
- Cluster analysis and CWT analysis revealed that Mumbai and Central India were majorly responsible for the regional transport during summer and winter respectively.

Atmospheric Environment, *Minor* revision

On the variability of Black Carbon over Mahabaleshwar in Monsoon

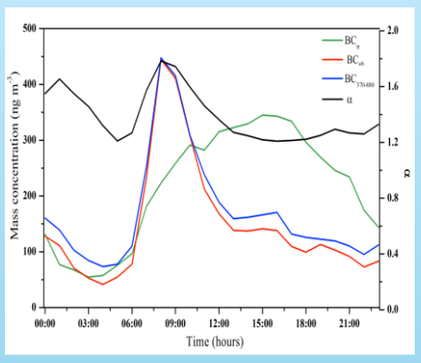


BC diurnal variation

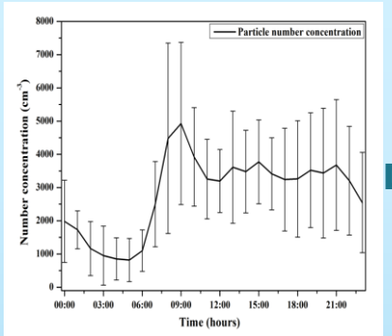
$$\frac{b_{abs}(370\,nm)_{tr}}{b_{abs}(880\,nm)_{tr}} = \left(\frac{370}{880}\right)^{-\alpha_{tr}} \qquad \frac{b_{abs}(370\,nm)_{bb}}{b_{abs}(880\,nm)_{bb}} = \left(\frac{370}{880}\right)^{-\alpha_{bb}}$$

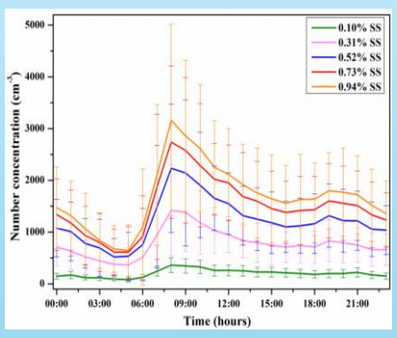
$$b_{abs}(\lambda) = b_{abs}(\lambda)_{tr} + b_{abs}(\lambda)_{bb}$$

$$BC_{tr} = BC_{tot}\cdot\frac{b_{abs,tr,880nm}}{b_{abs,tot,880nm}} \qquad BC_{bb} = BC_{tot}\cdot\frac{b_{abs,bb,880nm}}{b_{abs,tot,880nm}}$$

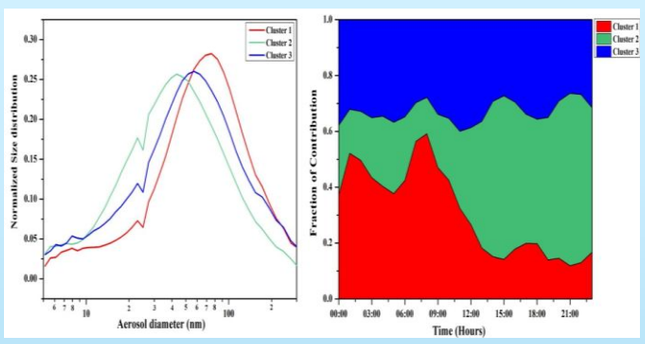


Source apportionment of BC





Aerosol and CCN concentration



K means clustering with Fuzzy algorithm

- The source apportionment study revealed high biomass burning activity (~50 to 60%) from 07:00 to 09:00 hrs hours and high traffic emissions (~75 to 80%) from 10:00 to 21:00 hrs at Mahabaleshwar.
- The traffic and biomass burning emissions lead to different volume size distribution with varying particle number size distribution (70-100 nm in morning and 30-60 nm in daytime and evening).

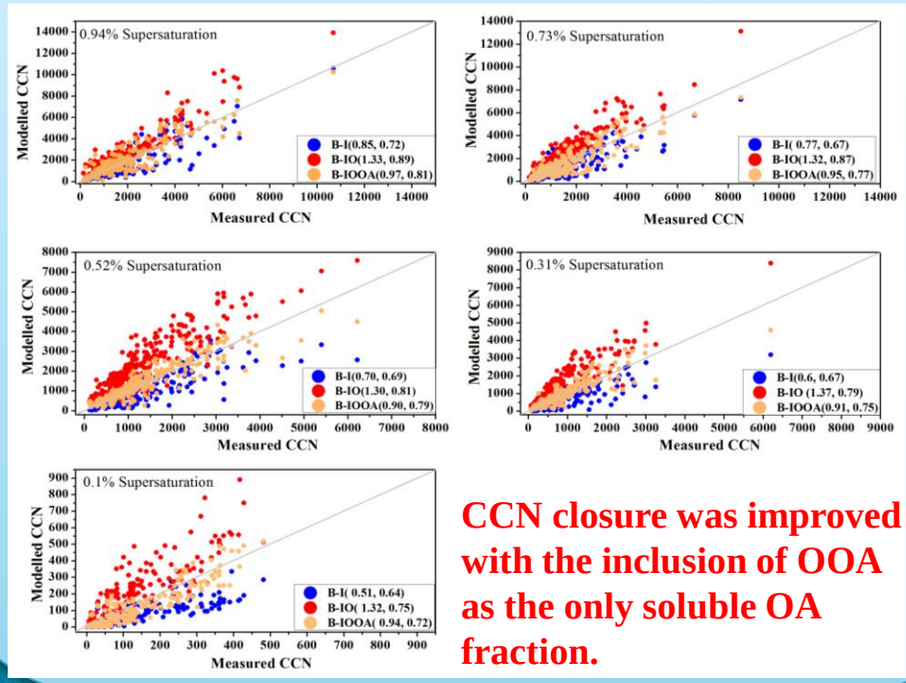
Atmospheric Research Submitted

CCN activation and closure over a rural background site in Western Ghats

$$\kappa_{total} = f_{org}\kappa_{org} + f_{inorg}\kappa_{inorg}$$

$$S = \left(1 + \kappa\frac{D_p^3}{D_{drop}^3 + D_p^3}\right)^{-1} \exp\left(\frac{4\sigma M_w}{RT\rho_w D_{drop}}\right)$$

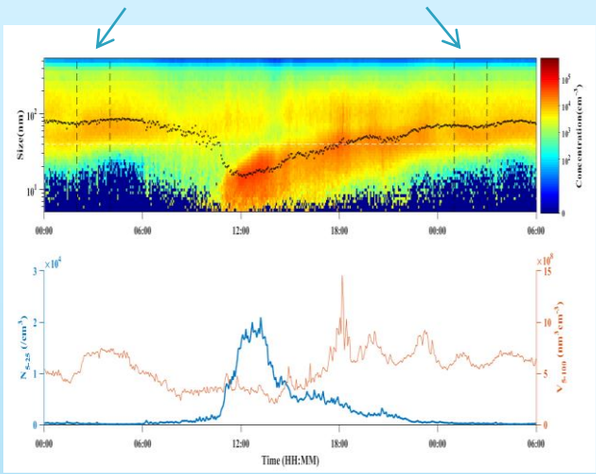
Atmospheric Environment, 2017

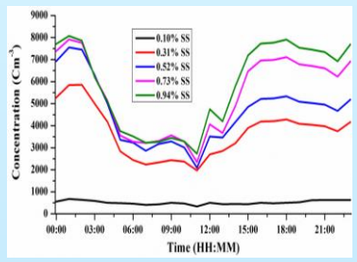


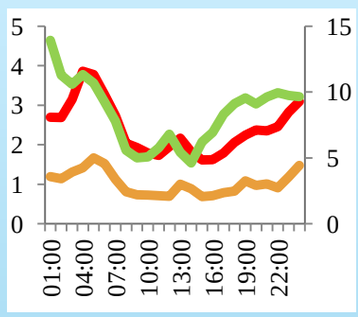
CCN closure was improved with the inclusion of OOA as the only soluble OA fraction.

NPF formation over Mahabaleshwar

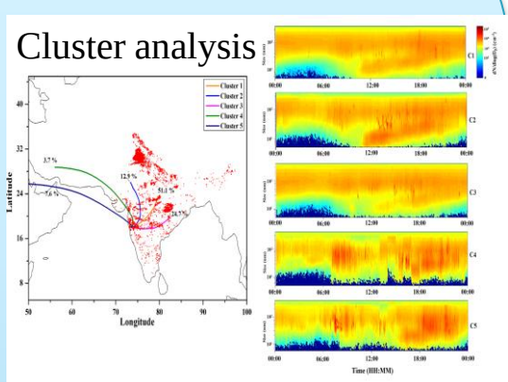
CCN enhancement is 158 %







Cluster analysis



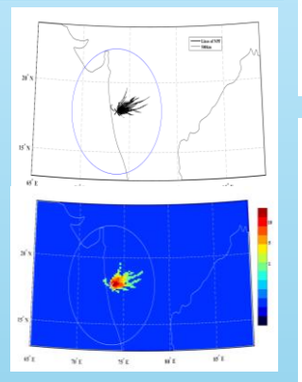
NanoMap procedure

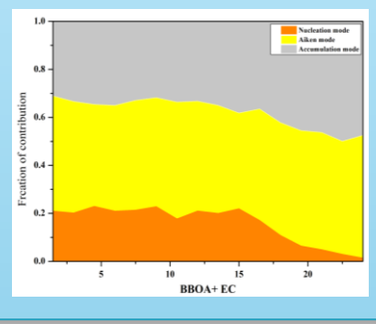
Classification of NPF

Formation time analysis

End of growth analysis

Number map plotting





Gradual increase in mass concentration suggested that the particle growth was driven by secondary aerosol species.

Cluster analysis suggest that the origin of NPF formation lies north east to the sampling site