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Characterization of particle number size distributions and new particle formation in different Indian locations

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Particle number size distribution has critical importance in characterizing the number, size, surface area, volume, and evolution of aerosols in the atmosphere. Atmospheric new particle formation (NPF) is one the largest source of aerosol numbers to the terrestrial atmosphere and greatly impact the evolution of particle number size distribution. Here, we analyzed at least one year of asynchronous measurements of particle number size distributions from six different locations in India. We found that NPF frequently occurs at all locations in the pre-monsoon season (March through May) and is the least common in the post-monsoon season (October-November). Considering all sites (mountain background, mountain semi-rural, coastal semi-urban and urban), the particle formation rate of lowest detectable size (J_{LDS}) varied by more than an order of magnitude (0.01 - 0.6 cm^{-3} s^{-1}) and the growth rate between the lowest detectable size and 25 nm ($GR_{LDS-25nm}$) by about three orders of magnitude (0.2 - 17.2 nm h^{-1}). The site-specific J_{LDS} and $GR_{LDS-25nm}$ are positively correlated, indicating their co-dependence on gas-phase production rates of low-volatility vapors, driven by the source and atmospheric conditions. Our results also showed that NPF events significantly modulate the shape of particle number size distributions, particularly in the pre-monsoon season. The NPF-associated CCN concentrations were higher in urban locations than the mountain background sites. Although using asynchronous measurements, our results implicate the process-level characterization of particle number size distribution.