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Interactive comment on "Air mass physio-chemical characteristics over New Delhi: Impacts on aerosol hygroscopicity and CCN formation" *by* Zainab Arub et al.

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The manuscript represents the first ever long-term measurements of non-refractory PM1 species and size distribution measurements at New Delhi, in order to gain insight of particles' hygroscopicity and the ability to act as CCN. Air masses arriving to the site were divided depending on their origin and frequency of occurrence. The respective chemical composition of the different air masses was determined, and their hygroscopicity parameter estimated. Air masses originating from South Asia were found to exhibit the highest mass loadings, featuring high chloride and organics, followed by air masses from the Bay of Bengal, featuring high organic and nitrate concentrations. For all air masses the hygroscopicity parameter was found to be around 0.3. CCN and CN concentrations were both found to follow the trend with higher concentrations from South

Asia, followed by the Bay of Bengal and finally the Arabian Sea. Activation fractions were also found to follow the same trend. Finally it is concluded that while the physical properties such as size impact directly CCN, they are, in turn, governed by the chemical properties.

The paper is well written and easy to follow, nevertheless there are some issues and more thorough discussion should be made in specific sections. Other than that the paper can be recommended for publication after addressing the issues listed below.

General comments:

It would be easier for the reader if all figures representing the same regions were all placed in the same order, e.g. as seen in Fig. 2 and keep the same regions in all other figures. For example, in Fig.2 SA branches (L, R1, R2, R3) are in the far right panels, while in Fig. 3 they are in far left panels and in Fig.4 they are in the middle. It may be a detail, but it would help uniformity and help the reader.

Specific comments:

- The standard deviation of κ ($\sigma(\kappa)$) around κ is often used as an estimate of the degree of heterogeneity (chemical dispersion) of particles (Psichoudaki et al., 2018; Lance et al., 2013). This could further be associated with the diurnal variability in the observed activation fractions as well as the chemical composition.

- Since an AE33 aethalometer was used, the contribution of BCwb can be estimated (e.g. Sandradewi et al. 2008) in order to further verify the presence of biomass burning aerosol in the SA branches (P11,L7-8 and elsewhere (e.g. P11,L20-21)). The second component (BCff) could also verify traffic emissions (e.g. P13,L8-11).

- P2,L1-3: High activation fractions as high as 0.8% at 0.38% SS have been observed at the eastern Mediterranean for air masses originating from the South (Bougiatioti et al., 2009)

- Fig.3 BB (middle panels) for BC: it seems that many points are missing in the diurnal

variability for B region, which is not commented in the text (P11,L20-28, P12,L21-28). Why is that?

- P14, L14-15: Also for the city of Athens, Greece, during wintertime when biomass burning is an important source of organic aerosol, overall hygroscopicity parameter ranged from 0.15 to 0.25 with lower values (around 0.16) being observed during night when biomass burning particles prevailed (Psichoudaki et al., 2018)

Technical corrections:

P3,L7 Detailed CCN and κ measurements have been carried out (delete "in India")

Fig.2 (c) should read PM1 species, as now it is identical to (a)

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