RESPONSE TO REVIEWERS

Anonymous Referee #1

We thank the Reviewer for the complimentary comments and are pleased to respond to the specific points as follows:

We agree with the Reviewer that the use of the word "cluster" could be confusing and have modified the abstracts so as to refer to "clusters of particle size distributions" in order to overcome the problem. The potential confusion over the word "group" has also been clarified by a minor modification to the abstract so that instead of referring to "the first category" we now refer to the "first group" which relates back to the main groups referred to in the previous sentence.

The reference to Arctic Haze has been amended from "resulting in Arctic Haze" to "contributing to Arctic Haze". Particles arriving in the Arctic after a South to North trajectory have grown to well in excess of 100 nm diameter, which implies they could make a significant contribution to light scattering and hence Arctic Haze.

A reference is given in the paper to a publication (Beddows et al., 2009) in which the cluster analysis method is explained in detail, and in the interest of brevity we prefer not to repeat it here.

In terms of literature beyond our own work, there is a huge literature in this field, but we believe that we have cited the most relevant papers.

Regarding harmonization of the data, this is described in the earlier paper of Asmi et al., (2011) to which we refer, and we have clarified details in our methodology section.

The Reviewer suggests that we include more recent data in our data analysis. Unfortunately this is not possible. The data analysis work presented in our paper has been hugely time consuming, even though it benefitted from the prior harmonization of the data in its use for the Asmi et al., (2011) paper. While we would very much like to have analysed a more recent data set, the resources available to us are far too limited to allow this.

We have revised Figure 6 which we believe to be a highly valuable outcome of the work as it demonstrates average rates of particle growth, and we prefer to keep it in the main text of the article.

Anonymous Referee #2

We are grateful for the generous comments made by the Reviewer and are pleased to respond to the specific comments.

We have clarified the text concerning the size range of particles measured and have removed reference to the temporal resolution in the interest of clarity. These changes appear in the methodology section.

It would be a huge amount of work and of relatively limited value to generate size distribution clusters for each site individually. Apart from the heavy workload, it was deliberate that this was not done as we believe that the findings of the work are more powerful having analysed data from all sites together (which the Reviewer also points out). The clustering methodology which we used identifies an optimal number of clusters, and we feel confident that the nine cluster solution well represents the typical size distributions in this data set. With regard to Figure 8, circles are clearly marked on the modes in the distributions and dotted coloured lines are included to guide the eye, as explained in the legend. Details of the mode fitting procedure and reference to the software package used is now included in Section 4.2.

It would be great to exclude the influence of fresh emissions of particulate matter, but this seems impractical as it would involve ideally the closure of sources, and if not, the relocation of some of the sampling sites. In the latter context, emissions between sampling sites, even though occurring at some distance from the sites, would still be influential, and avoiding this influence is an impossibility.

We have addressed the recommended technical corrections in as far as is practicable and while we understand the reasons for the minor adjustments to Figure 4 and 8 our choices have been made based on ease of use and the maximisation of impact for the given space while retaining the detail. The orientation of the heat maps in Figure 4 is such that a comparison between the *D*p scales can be made between the left and right plots and the colour bars were omitted to de-clutter the whole figure. This omission can be accounted for by the instruction in the caption. With regards to Figures 8 onwards, it was very difficult to reduce several graphs down into one panel whilst still retaining the detail. This results in the apparent compromise of not using standardised scales meaning that we could maximise the visual impact of proportions of space and graph whilst still keeping the technical detail.