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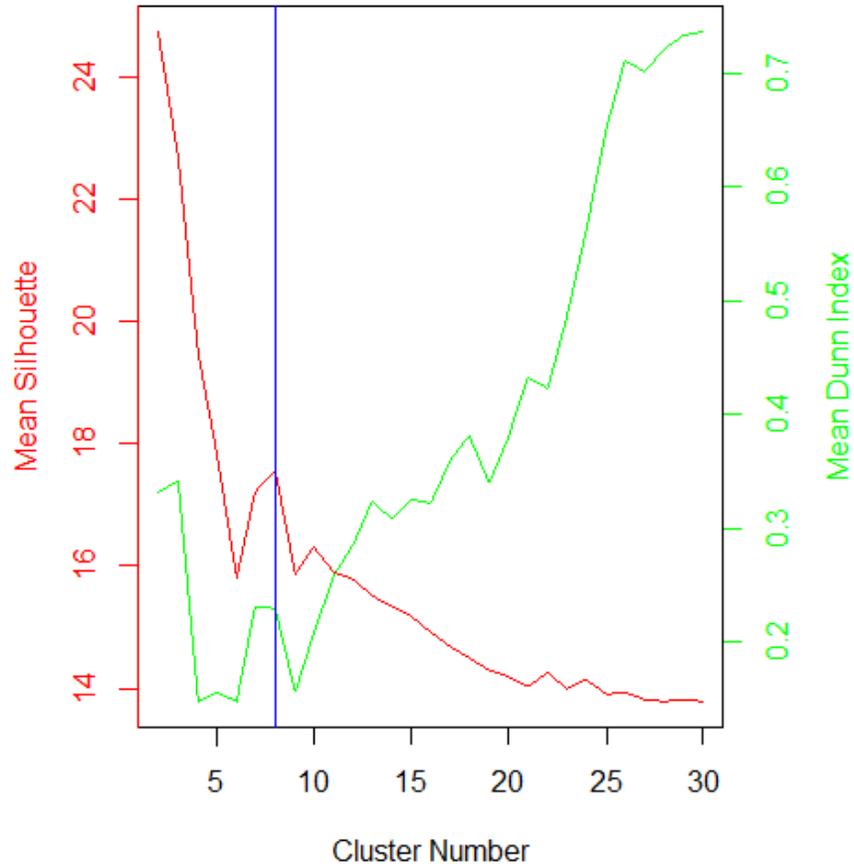
*Supplement of*

## **On the annual variability of Antarctic aerosol size distributions at Halley Research Station**

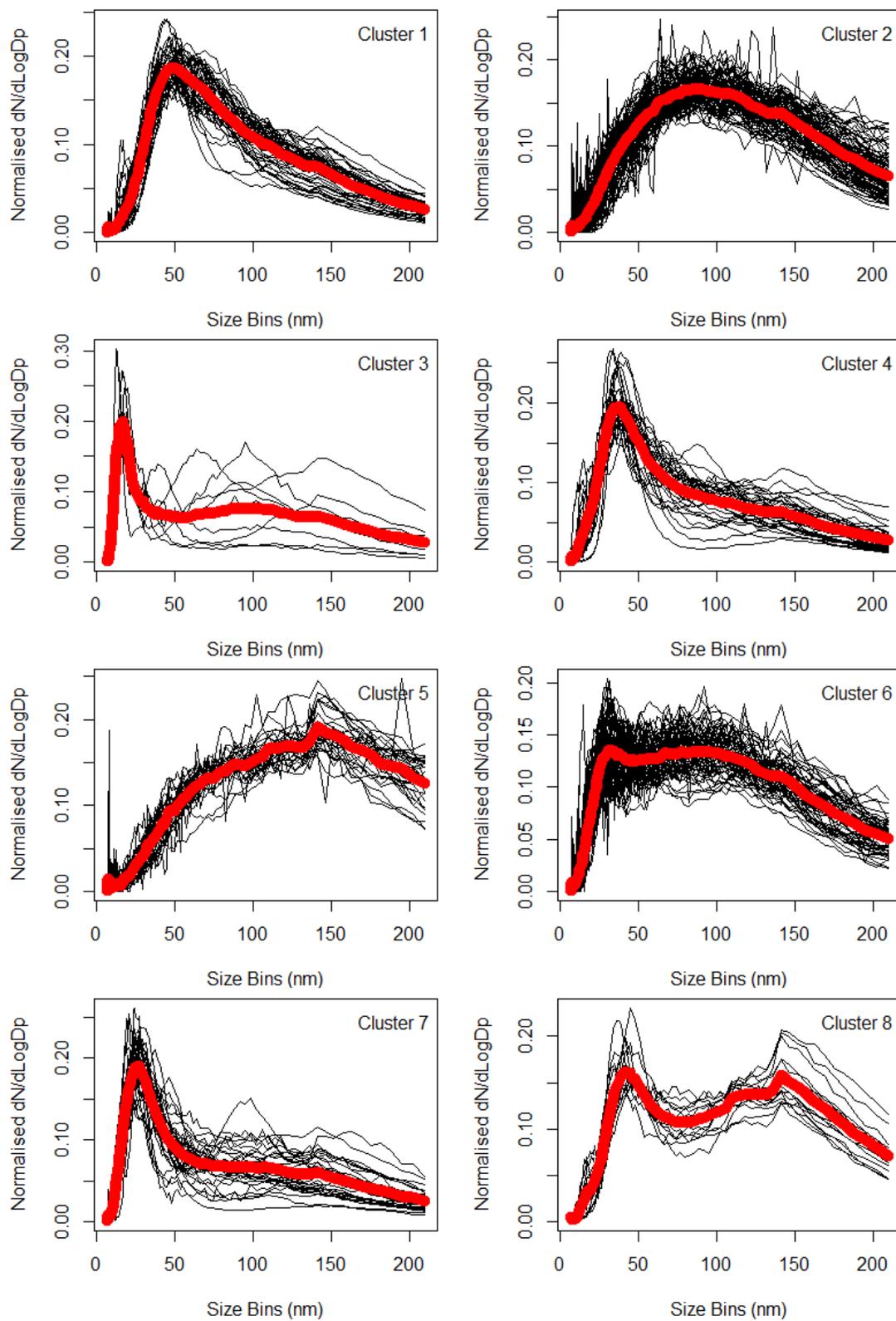
**Thomas Lachlan-Cope et al.**

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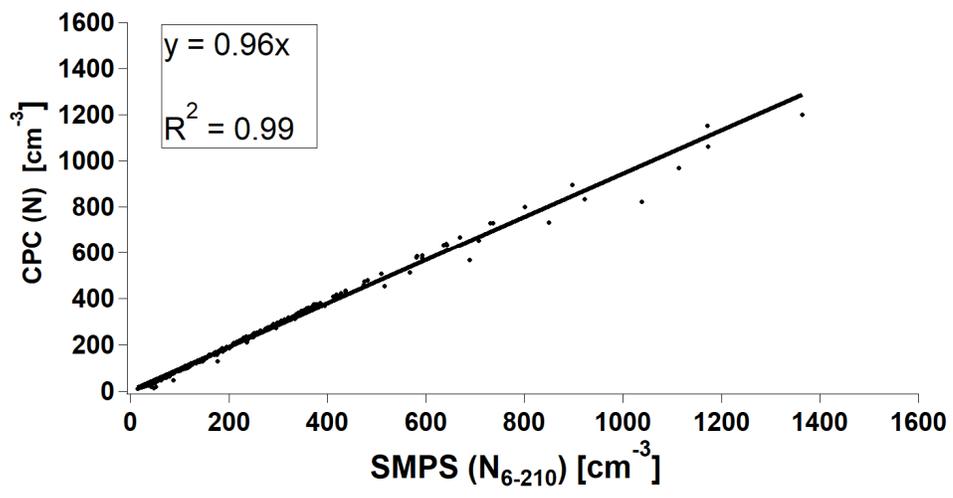
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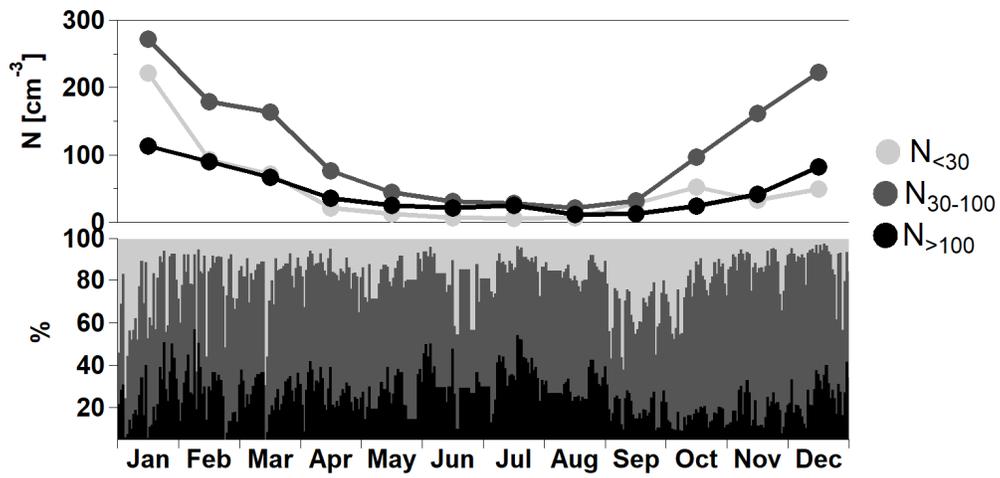
**Figure SI 1.** Cluster validation metrics plotted against cluster number. [Mean Silhouette Width (SW – red line) and mean Dunn Index (DI – green line); vertical blue line indicate the optimum number of 8 clusters).



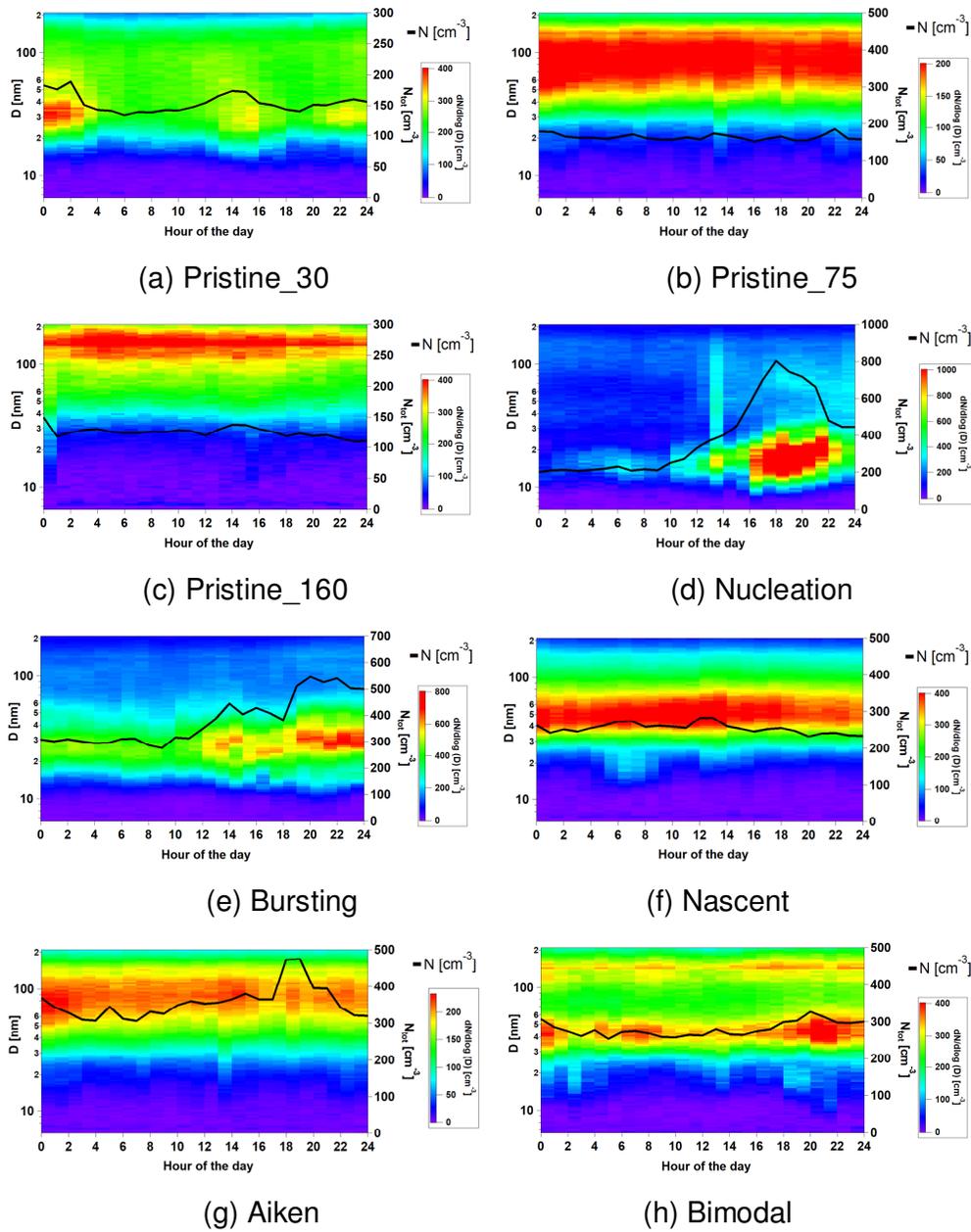
**Figure S12.** Daily normalized number size distributions plotted for each cluster (black lines) and overlaid by the mean number size distribution for the cluster.



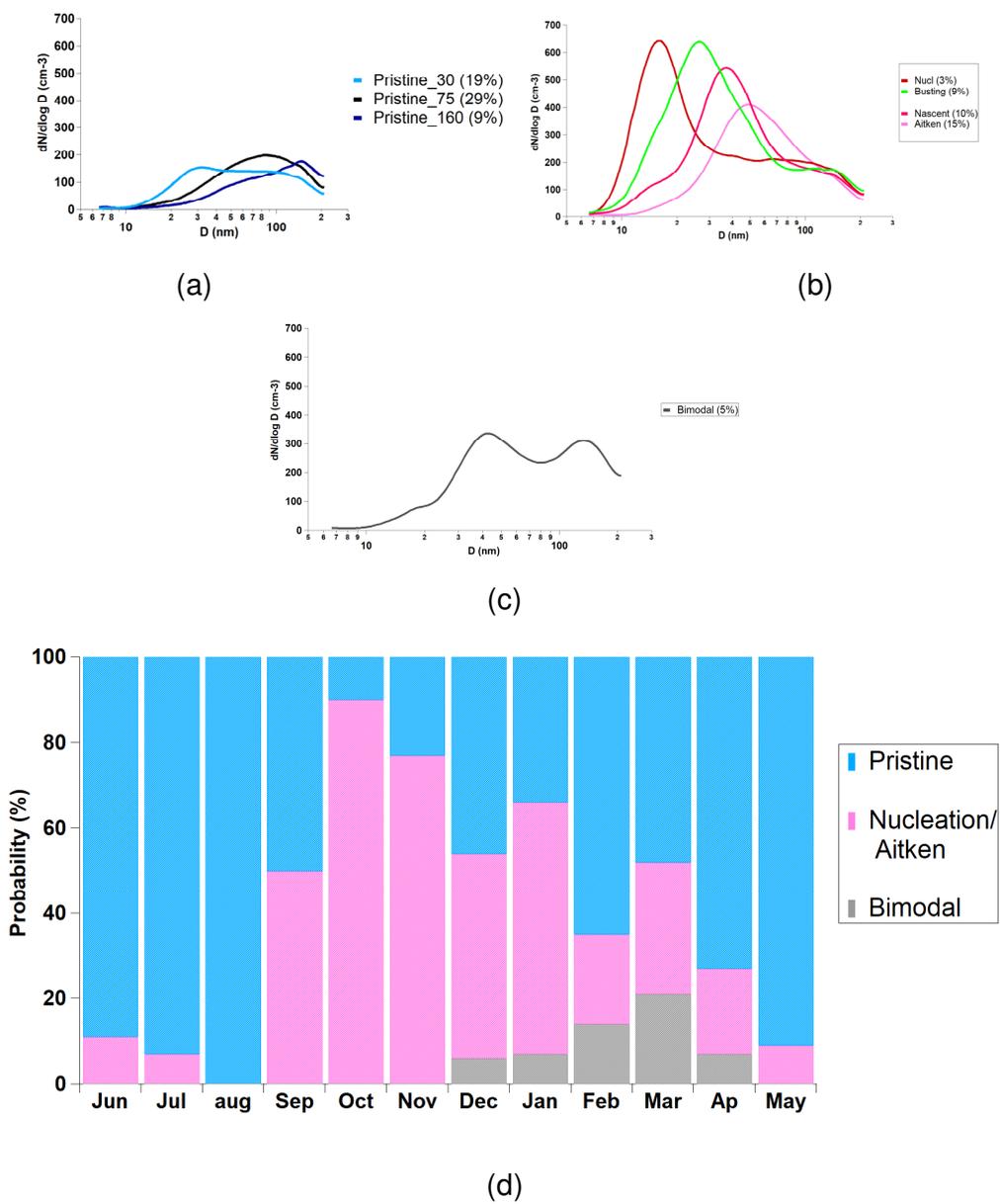
**Figure SI 3** Intercomparison between CPC (TSI 3010) and SMPS (TSI 3082)



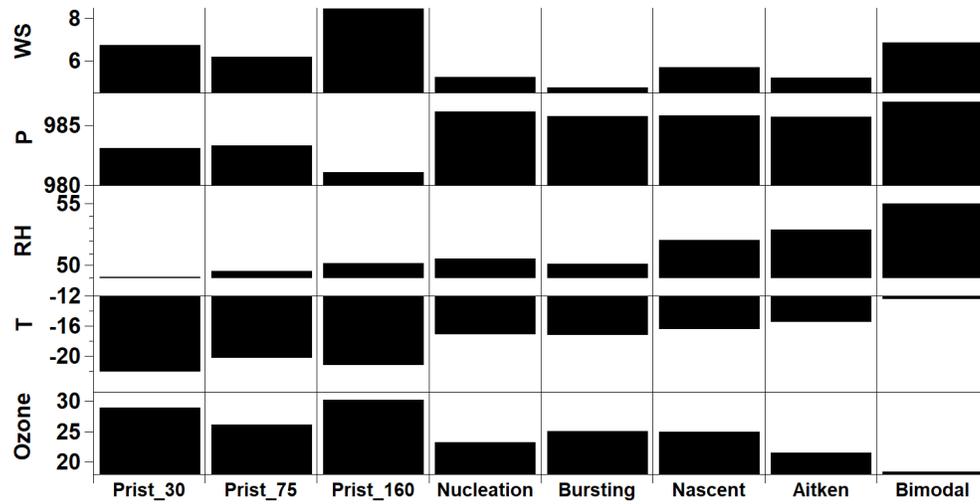
**Figure SI 4** Temporal variation of different aerosol modes at Halley during the year 2015 for  $N_{<30}$ ,  $N_{30-100}$  and  $N_{>100}$  particle number concentrations ( $\text{cm}^{-3}$ ).



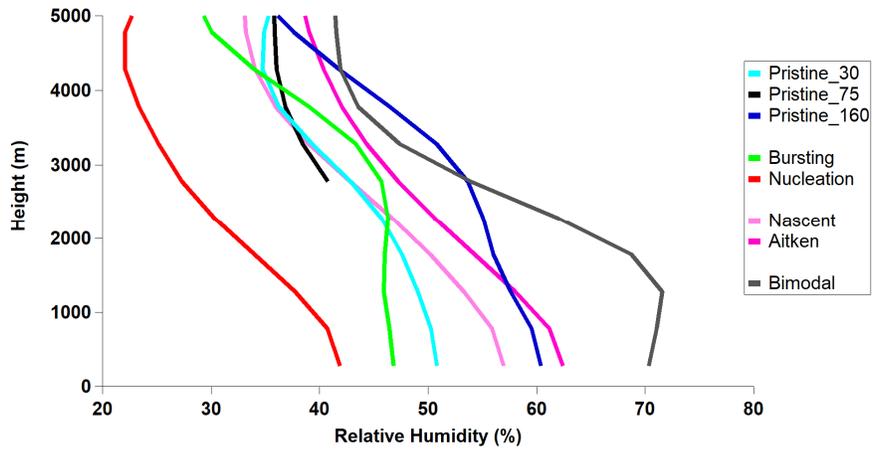
**Figure SI 5** Diurnal profiles of aerosol size categories for the 8 K-means categories.



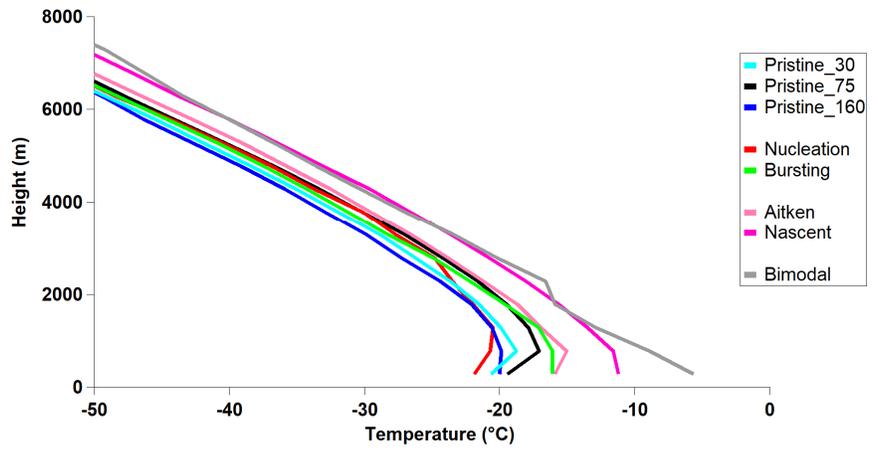
**Figure SI 6** Average daily aerosol distributions grouped for different broad categories: (a) pristine, (b) nucleation-Aitken, (c) bimodal and (d) annual temporal trend expressed as monthly means.



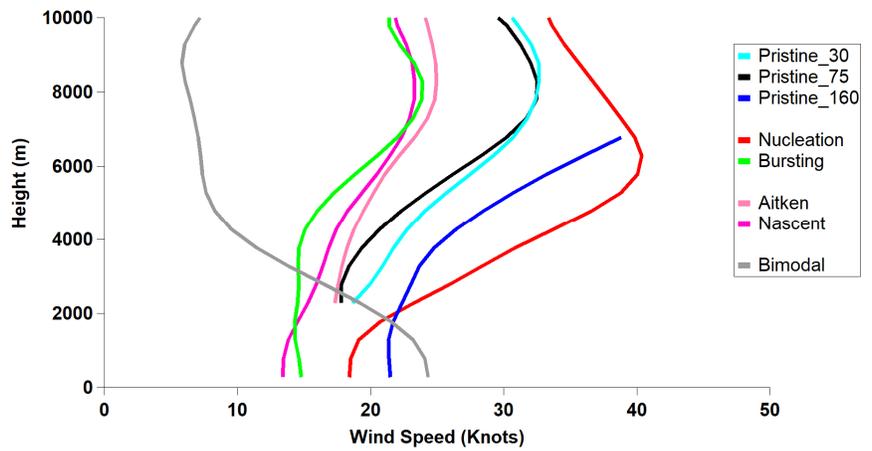
**Figure SI 7** Average values of selected parameters (ozone, Temperature T, Relative Humidity RH, Pressure P, Wind Speed WS) for the 8 K-means categories.



(a)

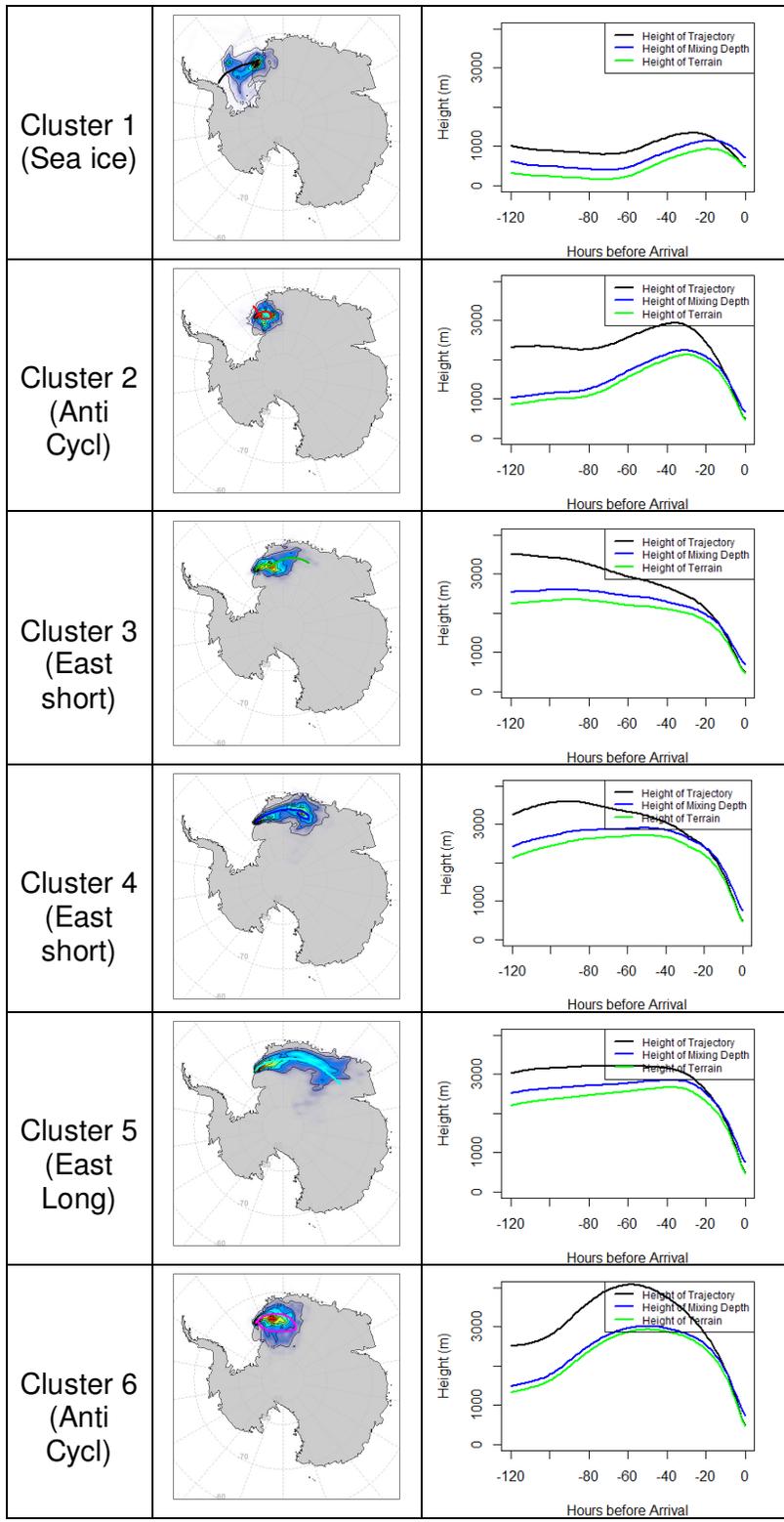


(b)

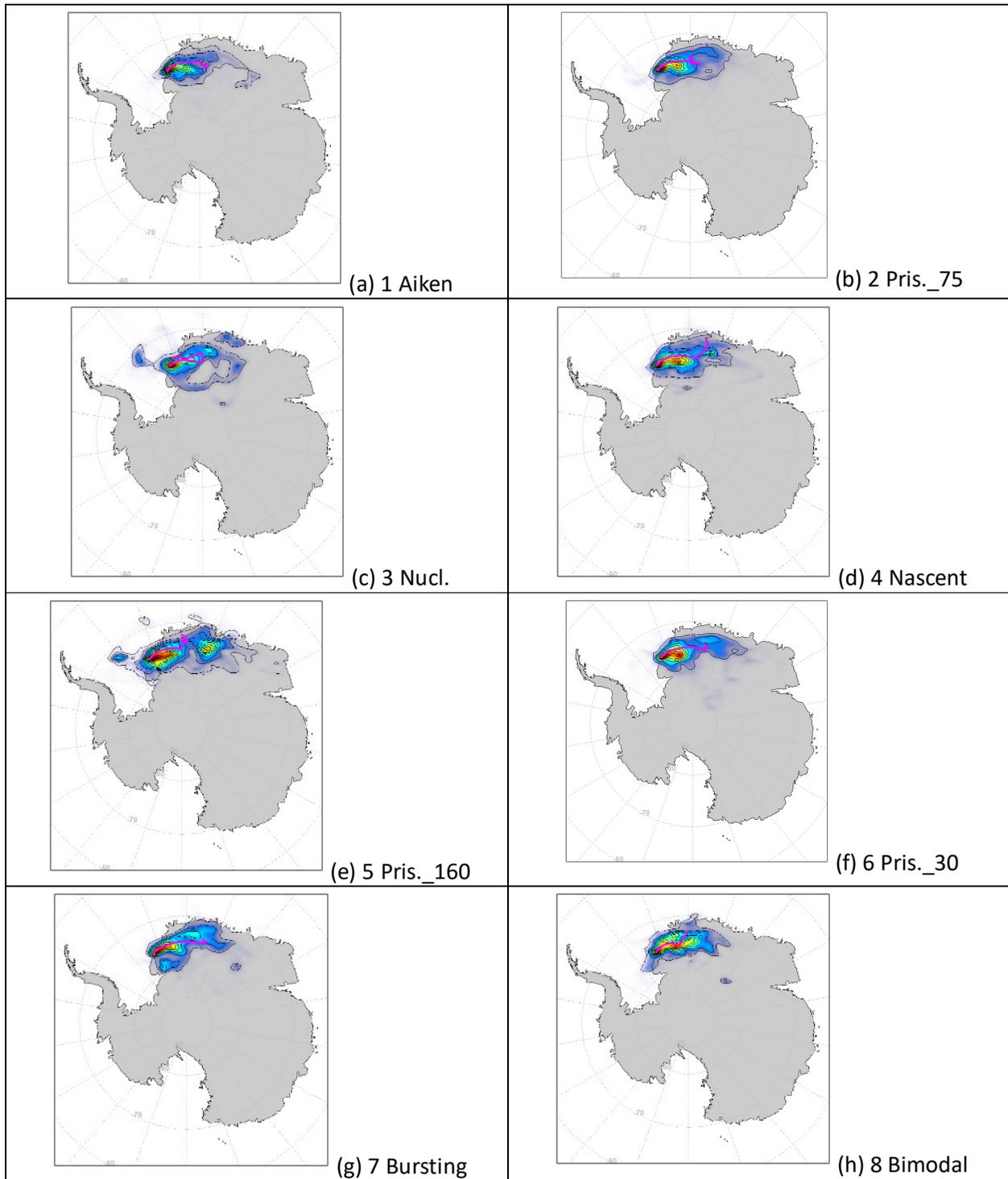


(c)

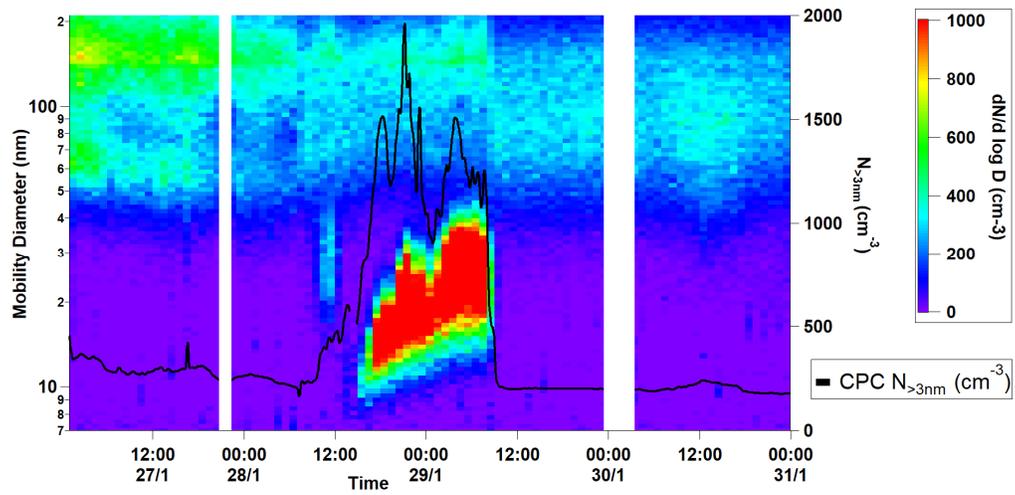
**Figure SI 8** Average vertical profiles of (a) Relative Humidity, (b) Temperature and (c) Wind speed for the 8 K-means aerosol categories



**Figure SI 9** Heights of the air mass back trajectory clusters arriving at Halley station through 2015. Also shown are heights of the mixed layer depth and terrain height, all in meters above sea level.



**Figure SI 10 (a-h).** Air mass trajectories according to the PSD clusters.



**Figure SI 11** Case study of a NPF events detected at Halley Station.