Supplementary Information

The derivation of the step-wise method is as follows:

$$\frac{\mathrm{d}R}{\mathrm{d}s}(s_\mathrm{i}) = \int_0^{+\infty} K(s_\mathrm{i}, d_\mathrm{p}) \times \frac{\mathrm{d}N}{\mathrm{d}d_\mathrm{p}} \mathrm{d}d_\mathrm{p}$$

$$s_\mathrm{i} \Leftrightarrow d_\mathrm{i} : \int_0^{+\infty} K(s_\mathrm{i}, d_\mathrm{p}) \times \mathrm{d}d_\mathrm{p} = \int_{d_\mathrm{i}-\delta}^{d_\mathrm{i}+\delta} K(s_\mathrm{i}, d_\mathrm{p}) \times \mathrm{d}d_\mathrm{p}, \delta \to 0$$

$$\begin{aligned}
\therefore \frac{\mathrm{d}R}{\mathrm{d}d_\mathrm{p}}(d_\mathrm{i}) = \frac{\mathrm{d}R}{\mathrm{d}s}(s_\mathrm{i}) \times \frac{\mathrm{d}s}{\mathrm{d}d_\mathrm{p}} = \frac{\mathrm{d}s}{\mathrm{d}d_\mathrm{p}} \int_0^{+\infty} K(s_\mathrm{i}, d_\mathrm{p}) \times \frac{\mathrm{d}N}{\mathrm{d}d_\mathrm{p}} \mathrm{d}d_\mathrm{p} \\
= \int_{d_\mathrm{i}-\delta}^{d_\mathrm{i}+\delta} K(s_\mathrm{i}, d_\mathrm{p}) \times \frac{\mathrm{d}N}{\mathrm{d}d_\mathrm{p}} \times \frac{\mathrm{d}s}{\mathrm{d}d_\mathrm{p}} \times \mathrm{d}d_\mathrm{p} \\
= \frac{\mathrm{d}N}{\mathrm{d}d_\mathrm{p}}(d_\mathrm{i}) \int_{s_\mathrm{i}-\varepsilon}^{s_\mathrm{i}+\varepsilon} K(s_\mathrm{i}, d_\mathrm{i}) \times \mathrm{d}s \\
= \frac{\mathrm{d}N}{\mathrm{d}d_\mathrm{p}}(d_\mathrm{i}) \int_0^{+\infty} K(s_\mathrm{i}, d_\mathrm{i}) \times \mathrm{d}s \\
= \frac{\mathrm{d}N}{\mathrm{d}d_\mathrm{p}}(d_\mathrm{i}) \times \eta(d_\mathrm{i}, s_\mathrm{max}),
\end{aligned}$$

where d is the derivate symbol; R is the raw concentration; s is the saturator flow rate; K is the kernel; dp is the particle diameter; s_i and d_i are the saturator flow rate and diameter at the ith point, respectively; δ is Cauchy's definition of the limit; ε is the error; s_max is the maximum saturator flow rate; η is the overall detection efficiency; and $\int$ is the integral symbol. In the stepwise method, the resolution of the kernel is assumed to be positive infinity and hence, there is a one-to-one relationship between each saturator flow rate and the retrieved particle diameter.

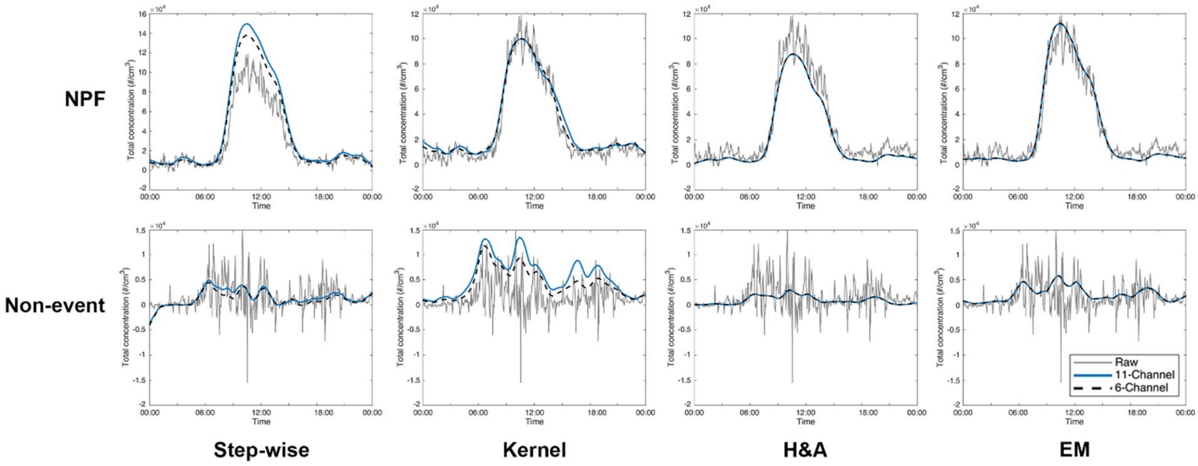

Fig. S1. Comparison of the 6- (dotted) and 11-channel (solid) size bins. The grey line indicates the raw estimation, $R_{1.2\text{-}2.8}$ (calculated as difference between saturator flow rate at 1.3 lpm and 0.1 lpm). Top figures are during an NPF event (30 Jan.) and bottom figures are from a non-event day (6 Mar.).

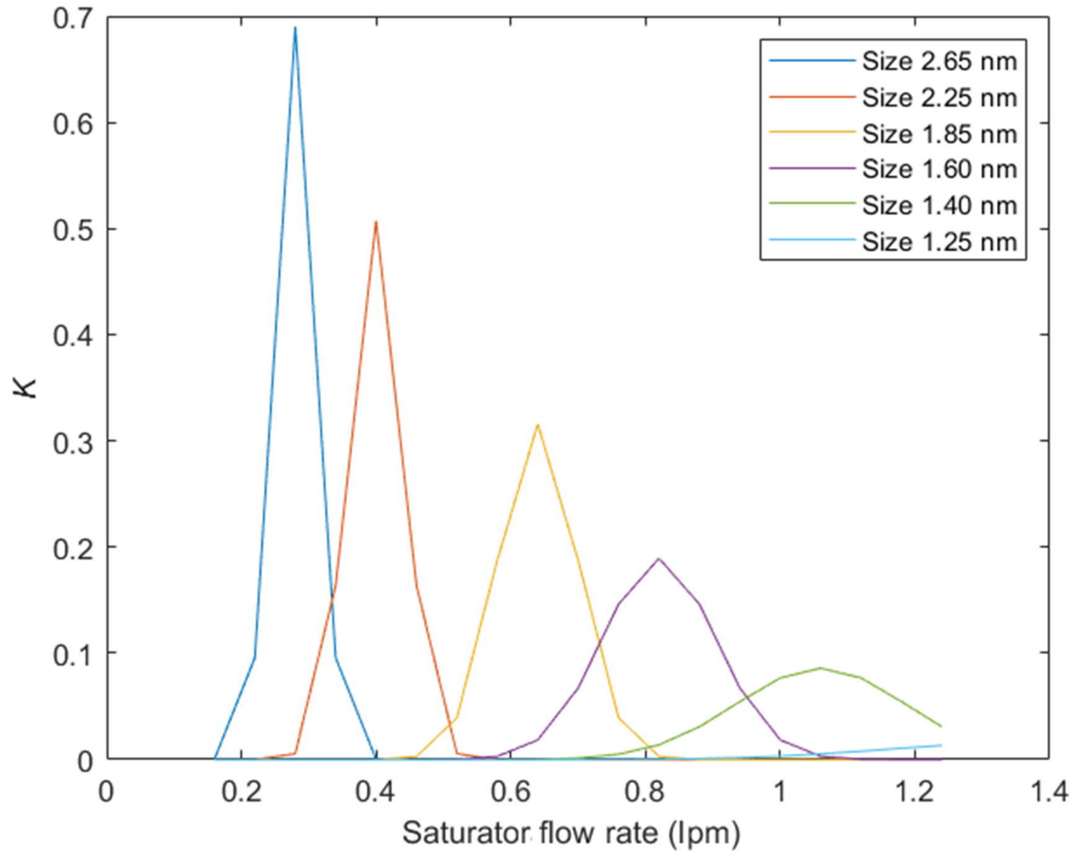

Fig. S2. Inversion kernel using 6-channels. Note that these kernels were theoretically calculated and not implicitly used for the current study.