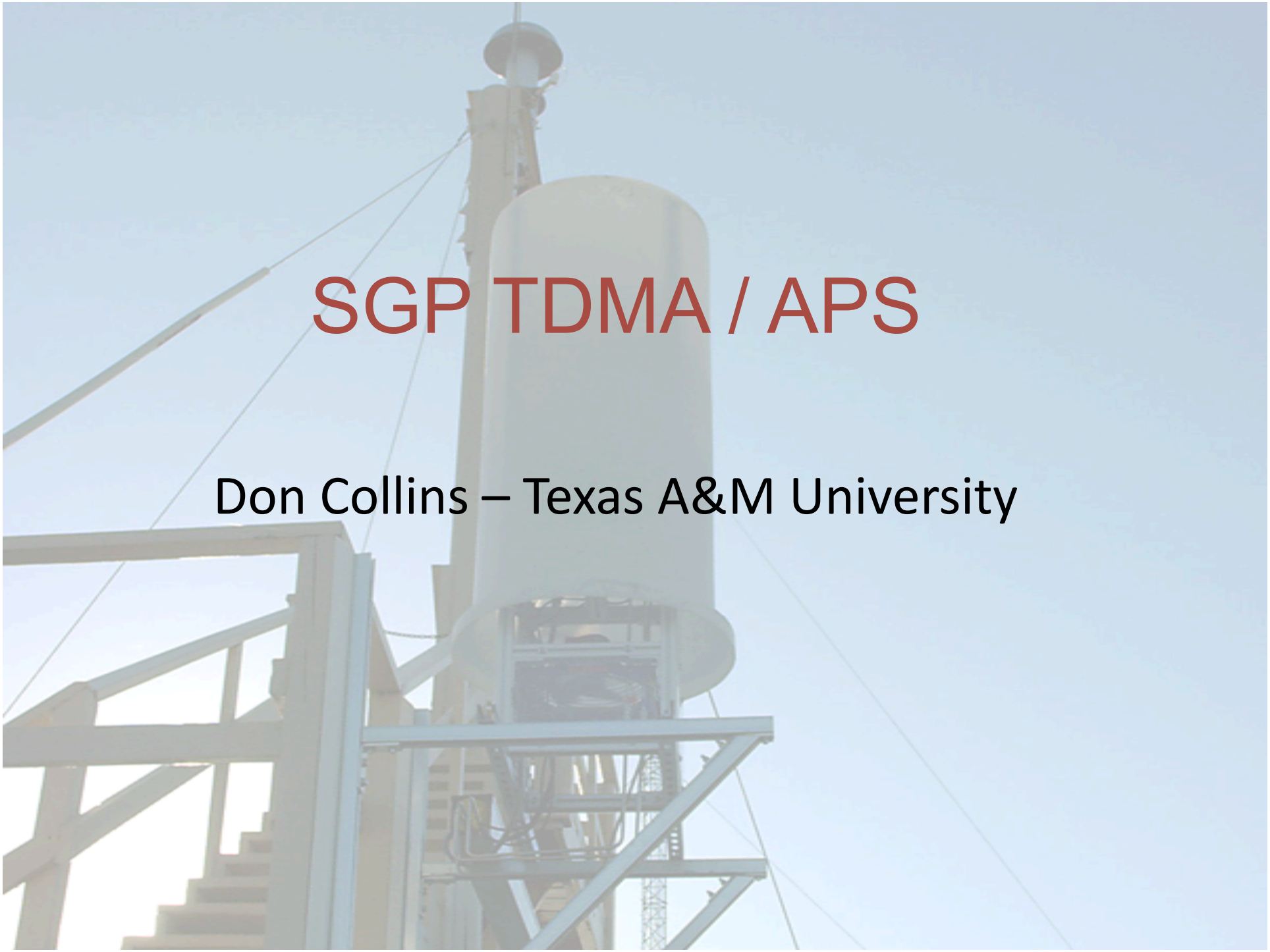


SGP TDMA / APS

Don Collins – Texas A&M University

Outline

1. Instrument overview
2. DMA / APS data inversion
3. Example distributions and time series

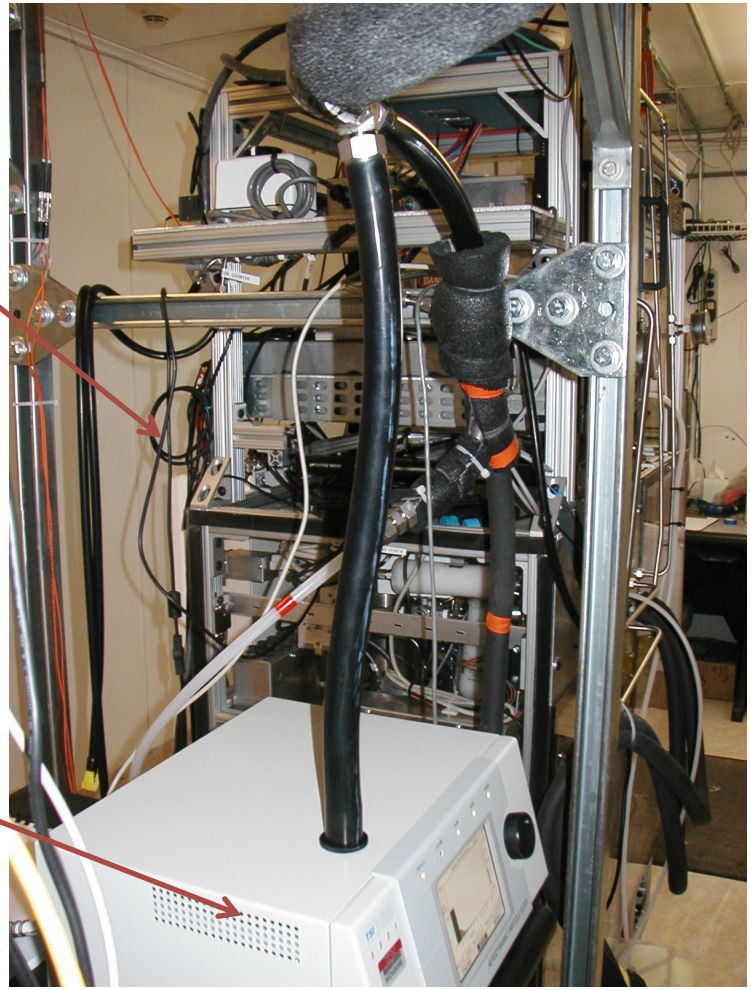
TDMA / APS Installation

TDMA

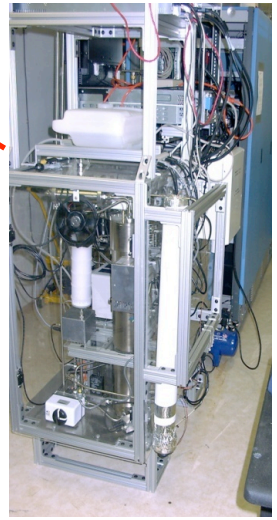
- installed 10/05

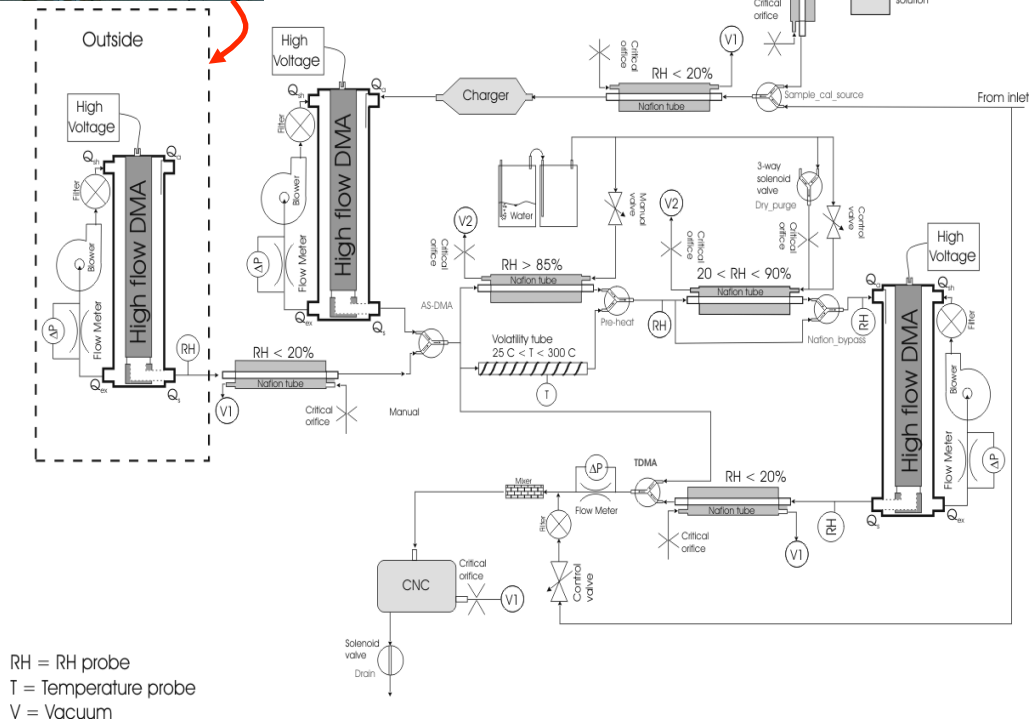
APS

- installed 7/08



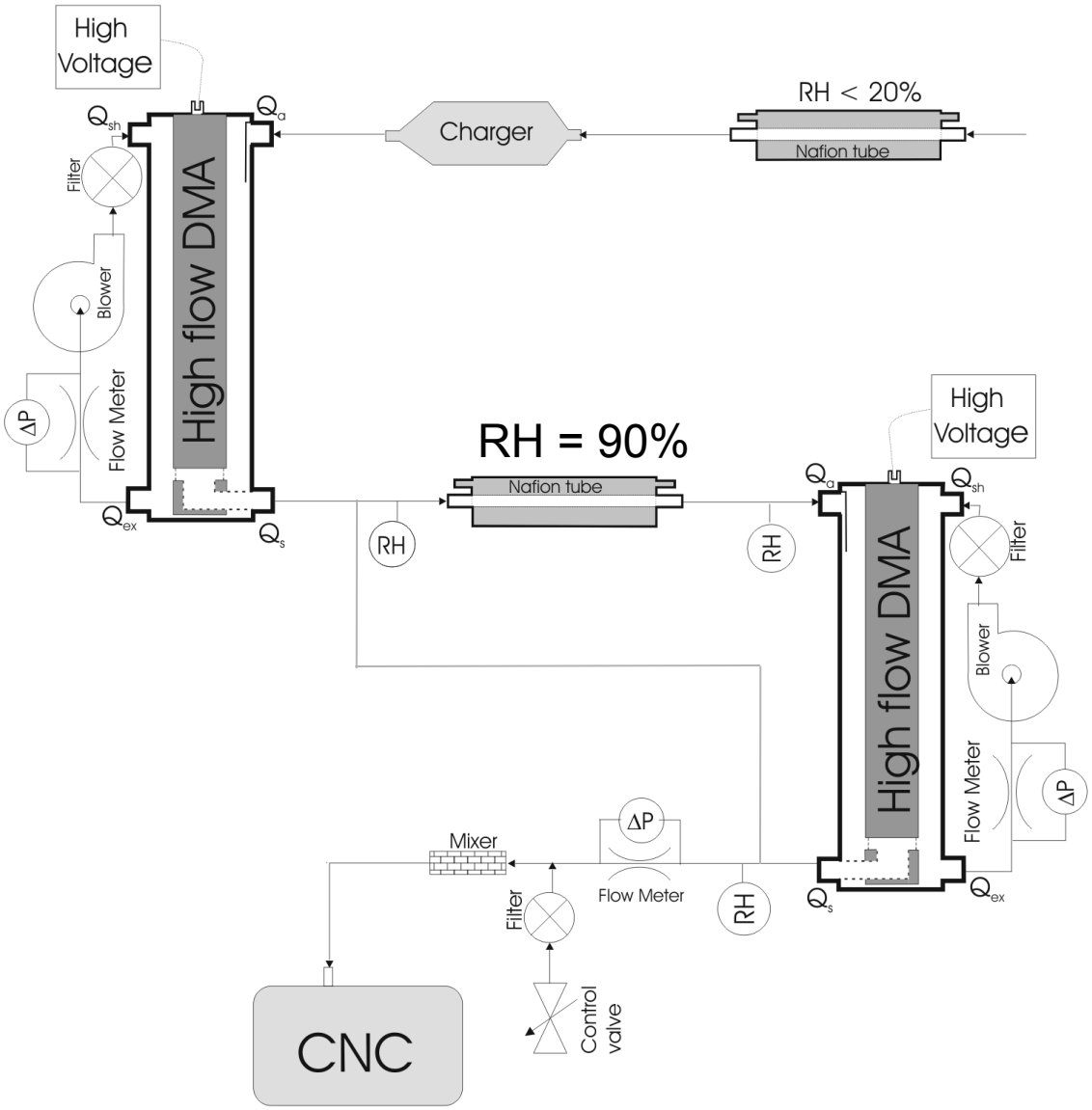
Schematic / component location





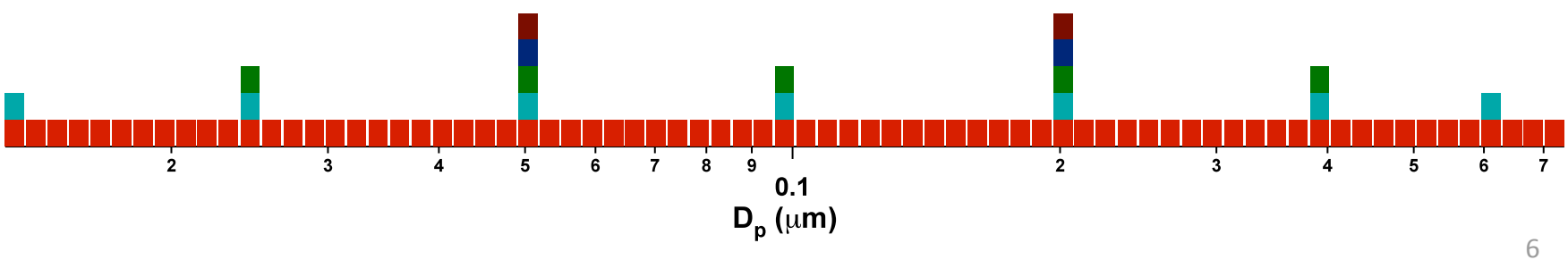
RH = RH probe
T = Temperature probe
V = Vacuum

Simplified schematic

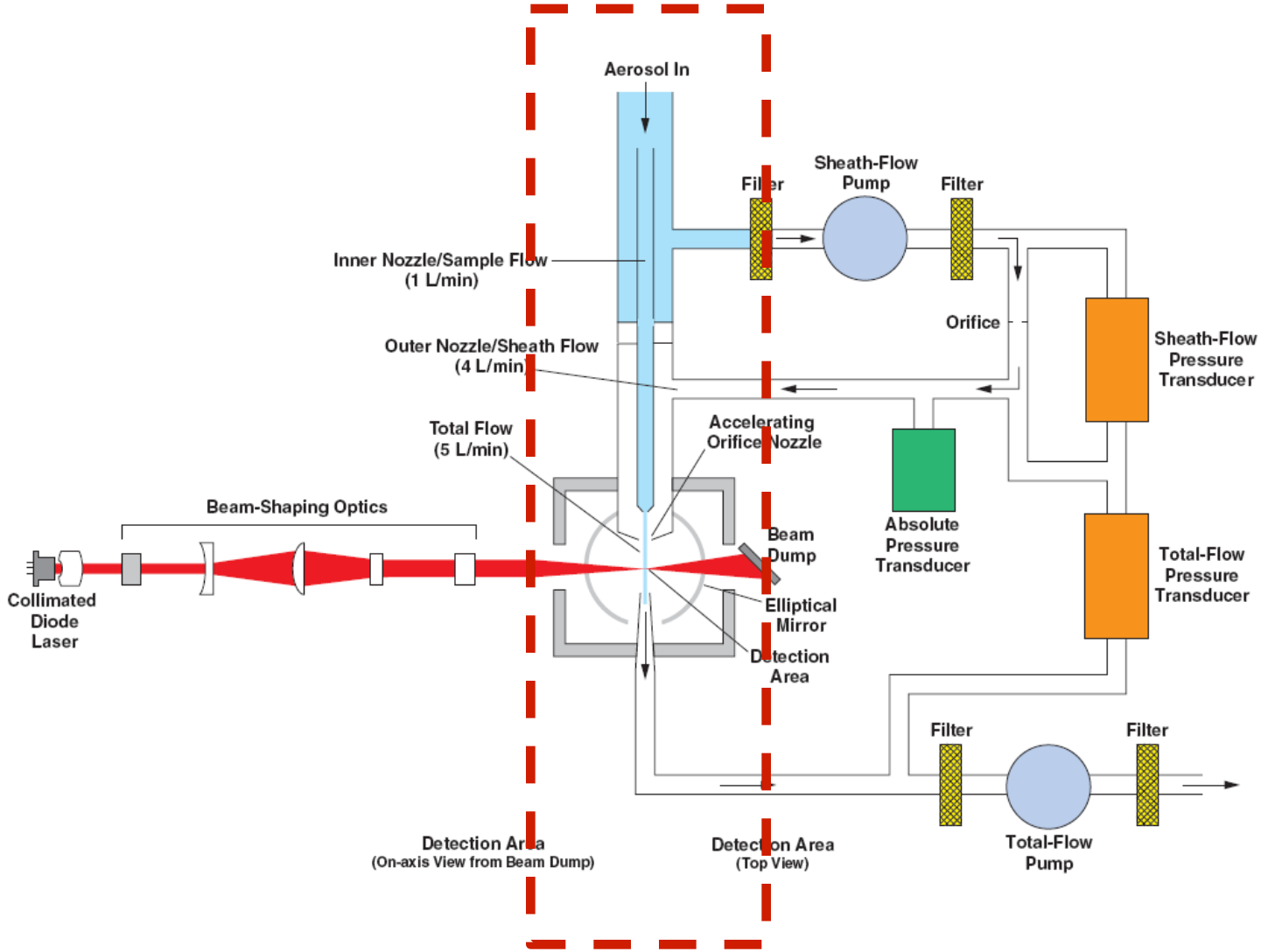


Daily measurements

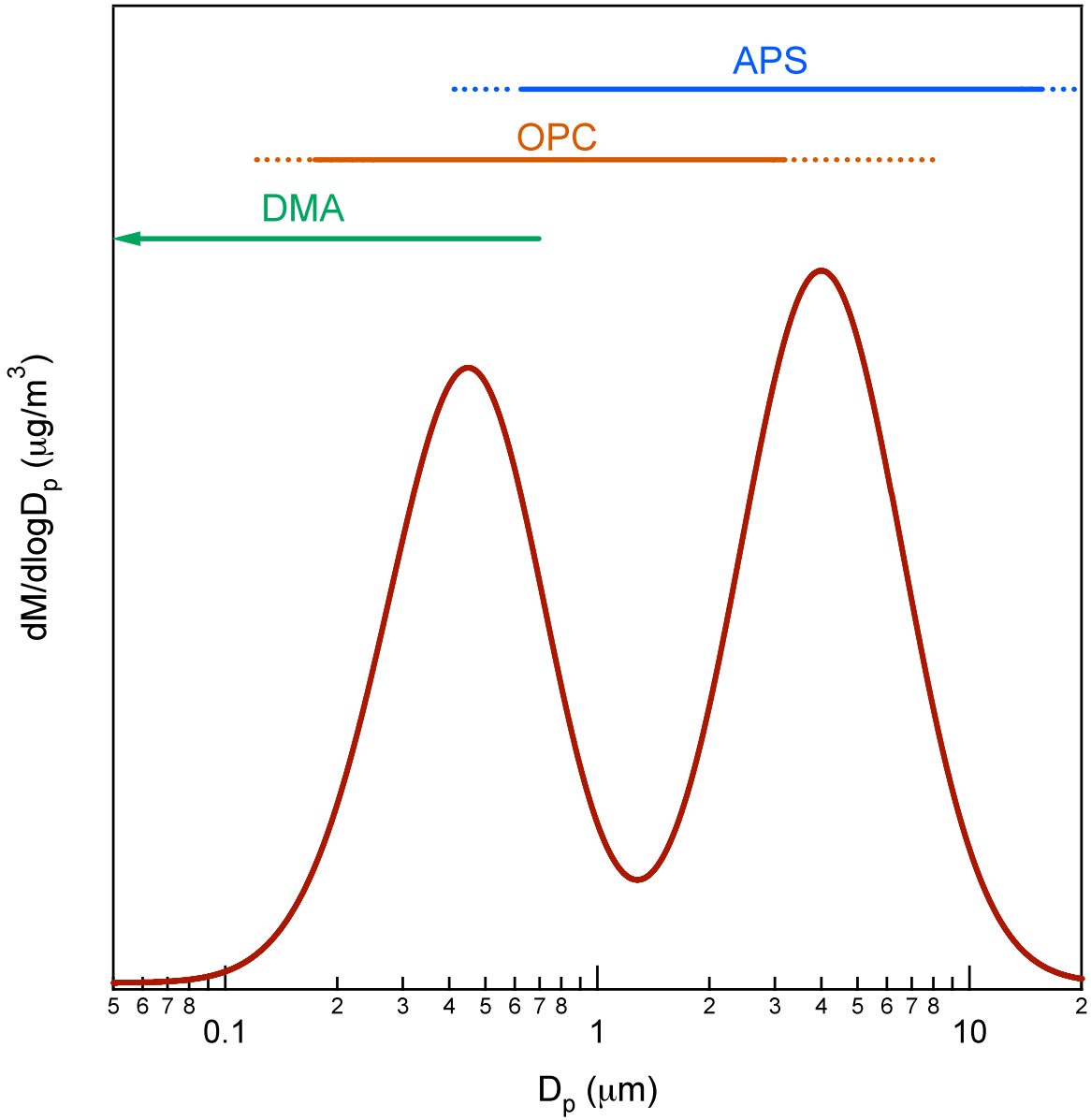
Measurement	Quantity measured	Time	Frequency
DMA	Dry aerosol size distribution	5 min	~ 25 times daily
TDMA	Size-resolved hygroscopic growth at fixed RH (90%)	40 min	~ 25 times daily
RH scan	Size-resolved hygroscopic growth over wide RH range (30 – 90% RH)	2 hr	once daily
T scan	Size-resolved aerosol volatility over wide temperature range (25 – 300 °C)	2 hr	once daily
AS TDMA	Size-resolved ambient hydration state	2 hr	≤ once daily
Auto-calibration	○ Growth of NaCl particles at low (~10%) and high (90%) RH ○ False count rate	2 hr	once daily



APS schematic



Instrument size ranges



Size distribution processing procedure

Recorded size distributions

↓

Size-resolved probability of 1, 2, 3, or 4 + charges
Diffusionally-broadened transfer function
Size-resolved diffusional particle loss

Inversion

↓

Inverted distributions

↓

Integrated number concentration
Integrated volume concentration
($dV/dlogD_p$ @ 0.5 μm) / ($dV/dlogD_p$ @ 0.6 μm)
Correlation between up and down scans

Data checks

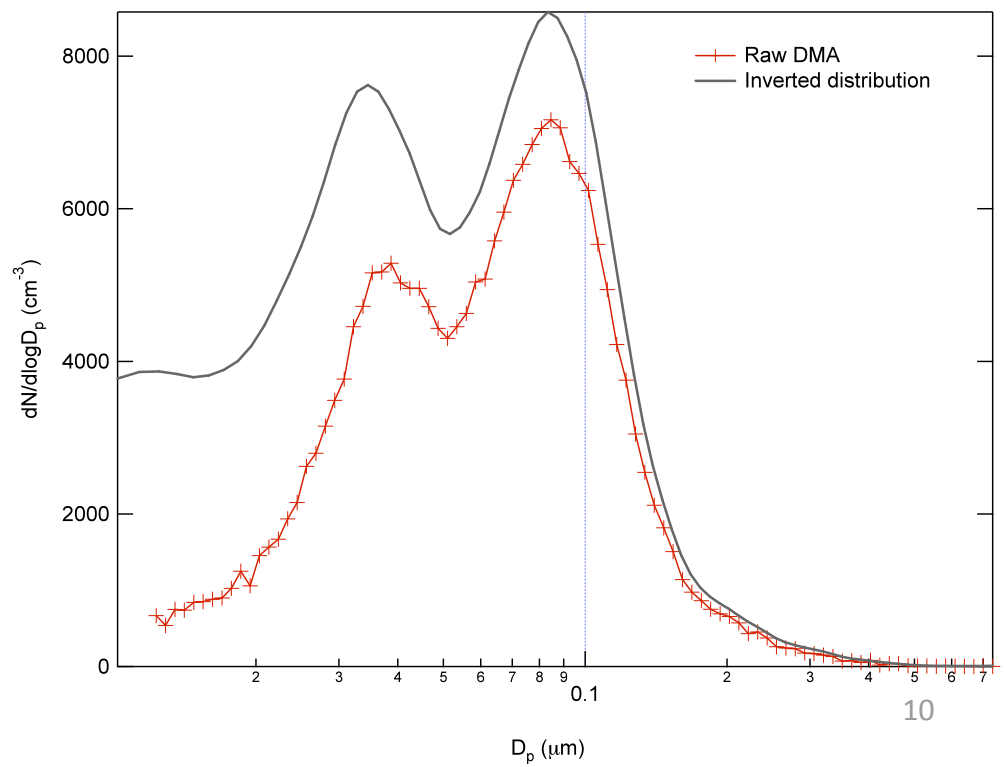
↓

Level 0, 1, and 2 inverted distributions

DMA data inversion

$$\vec{N}\mathbf{R} = \vec{C}$$

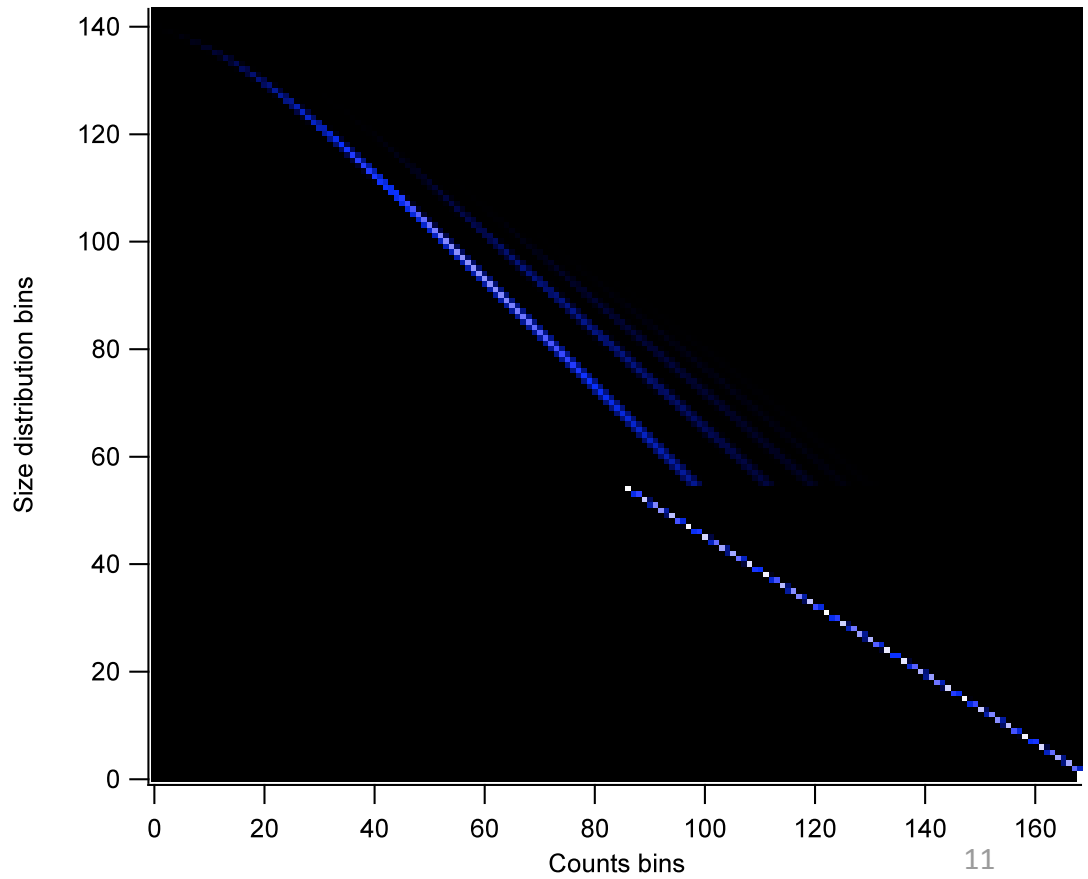
$$\begin{bmatrix} n_1 \\ n_2 \\ \vdots \\ n_{j-1} \\ n_j \end{bmatrix} \begin{bmatrix} R_{DMA_{11}} & R_{DMA_{12}} & & & \\ R_{DMA_{21}} & R_{DMA_{22}} & & & \\ & & \ddots & & \\ & & & R_{DMA_{x-1\,j-1}} & R_{DMA_{x-1\,j}} \\ & & & R_{DMA_{xj-1}} & R_{DMA_{xj}} \end{bmatrix} = \begin{bmatrix} C_{DMA_1} \\ C_{DMA_2} \\ \vdots \\ C_{DMA_{x-1}} \\ C_{DMA_x} \end{bmatrix}$$



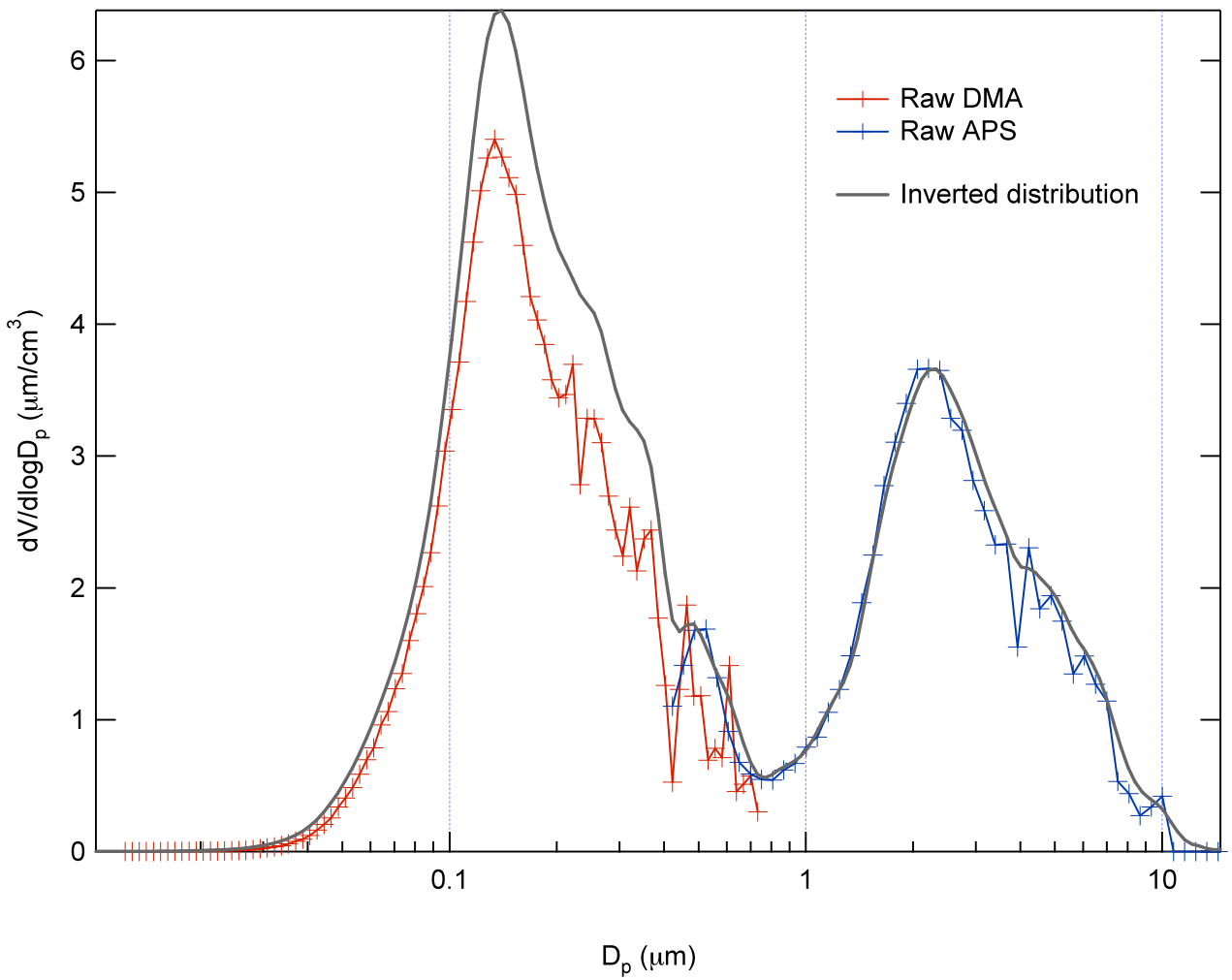
DMA+APS data inversion

$$\vec{N}\mathbf{R} = \vec{C}$$

$$\begin{bmatrix} n_1 \\ n_2 \\ \vdots \\ n_{j-1} \\ n_j \end{bmatrix} \begin{bmatrix} R_{DMA_{11}} & R_{DMA_{12}} & & & \\ R_{DMA_{21}} & R_{DMA_{22}} & & & \\ & & \ddots & & \\ & & & R_{DMA_{x-1\,j-1}} & R_{DMA_{x-1\,j}} \\ & & & R_{DMA_{xj-1}} & R_{DMA_{xj}} \\ R_{APS_{11}} & R_{APS_{12}} & & & \\ R_{APS_{21}} & R_{APS_{22}} & & & \\ & & \ddots & & \\ & & & R_{APS_{y-1\,j-1}} & R_{APS_{y-1\,j}} \\ & & & R_{APS_{yj-1}} & R_{APS_{yj}} \end{bmatrix} = \begin{bmatrix} C_{DMA_1} \\ C_{DMA_2} \\ \vdots \\ C_{DMA_{x-1}} \\ C_{DMA_x} \\ C_{APS_1} \\ C_{APS_2} \\ \vdots \\ C_{APS_{y-1}} \\ C_{APS_y} \end{bmatrix}$$

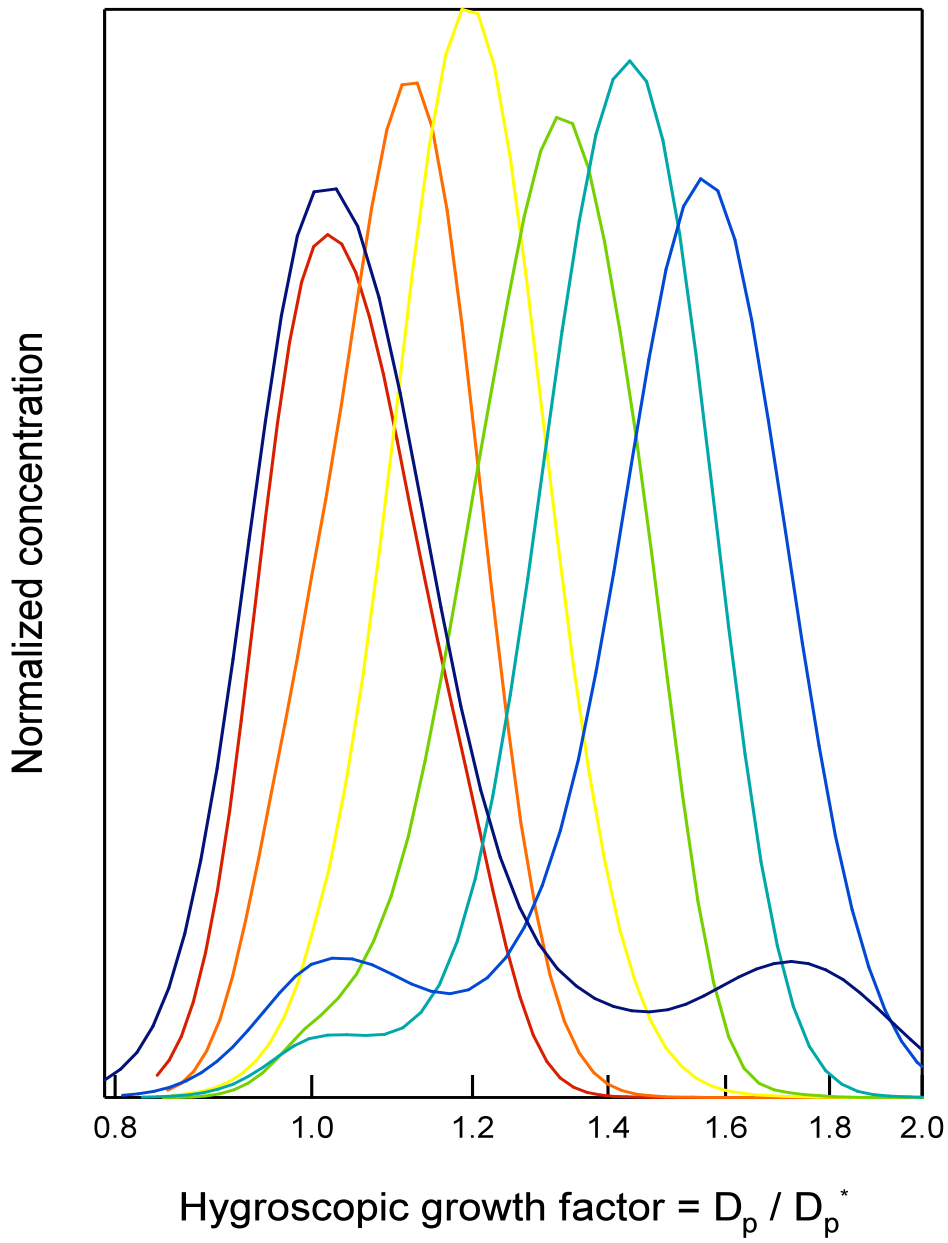


DMA+APS data inversion



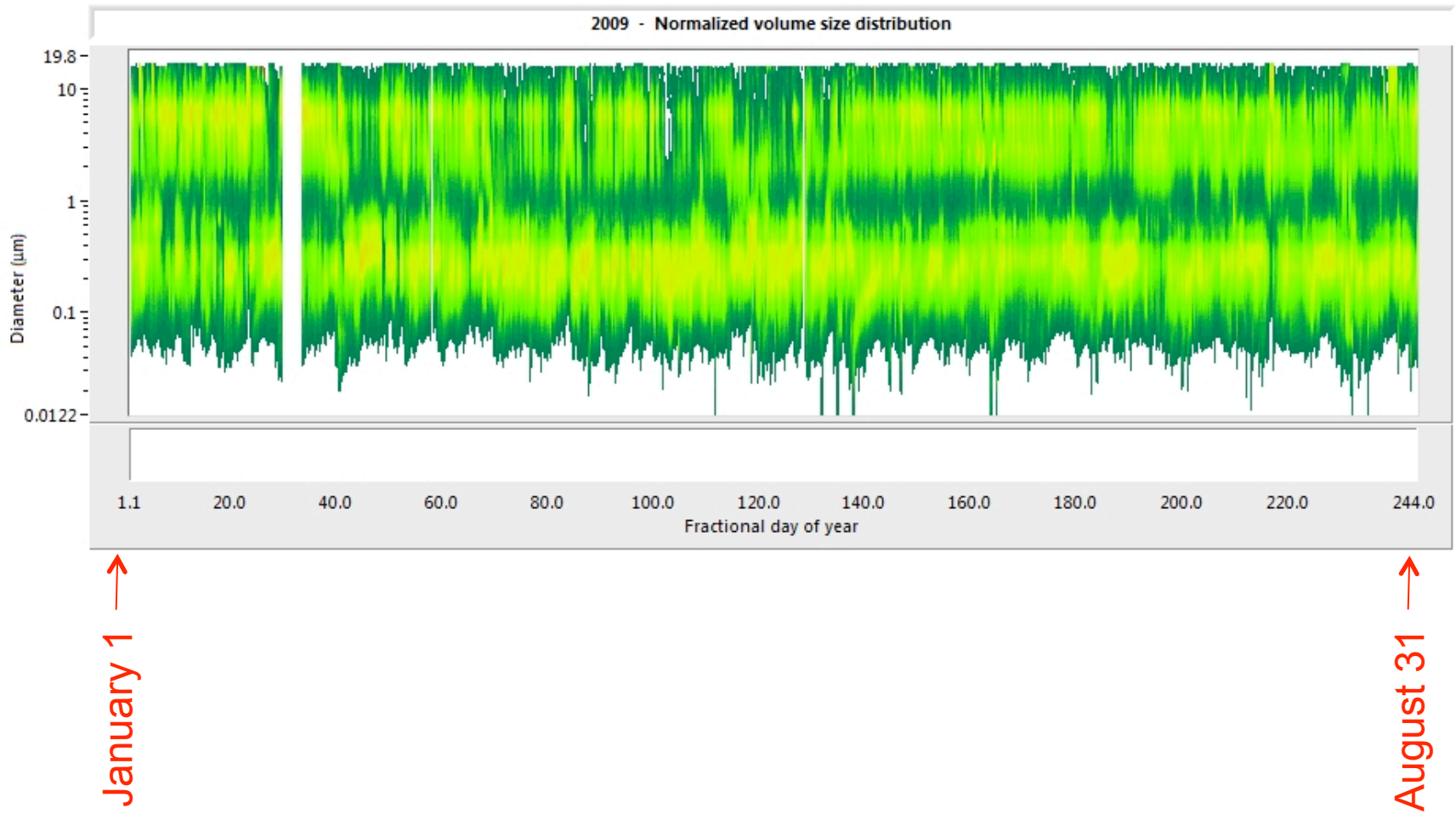
DMA-only, APS-only, and combined DMA+APS distributions saved in archive

Example hygroscopicity distributions



2009 Normalized size distribution

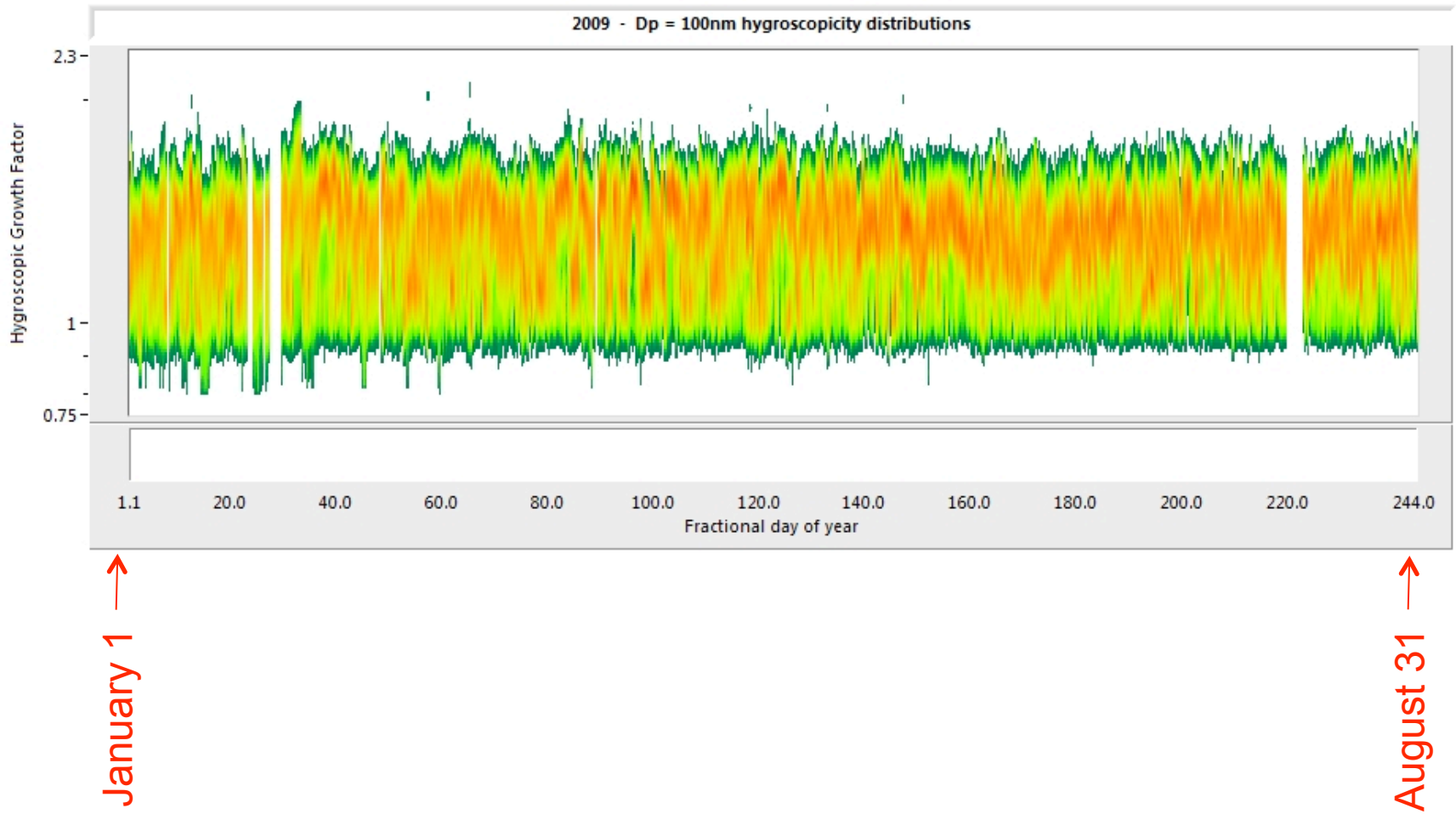
2009 Normalized volume distribution



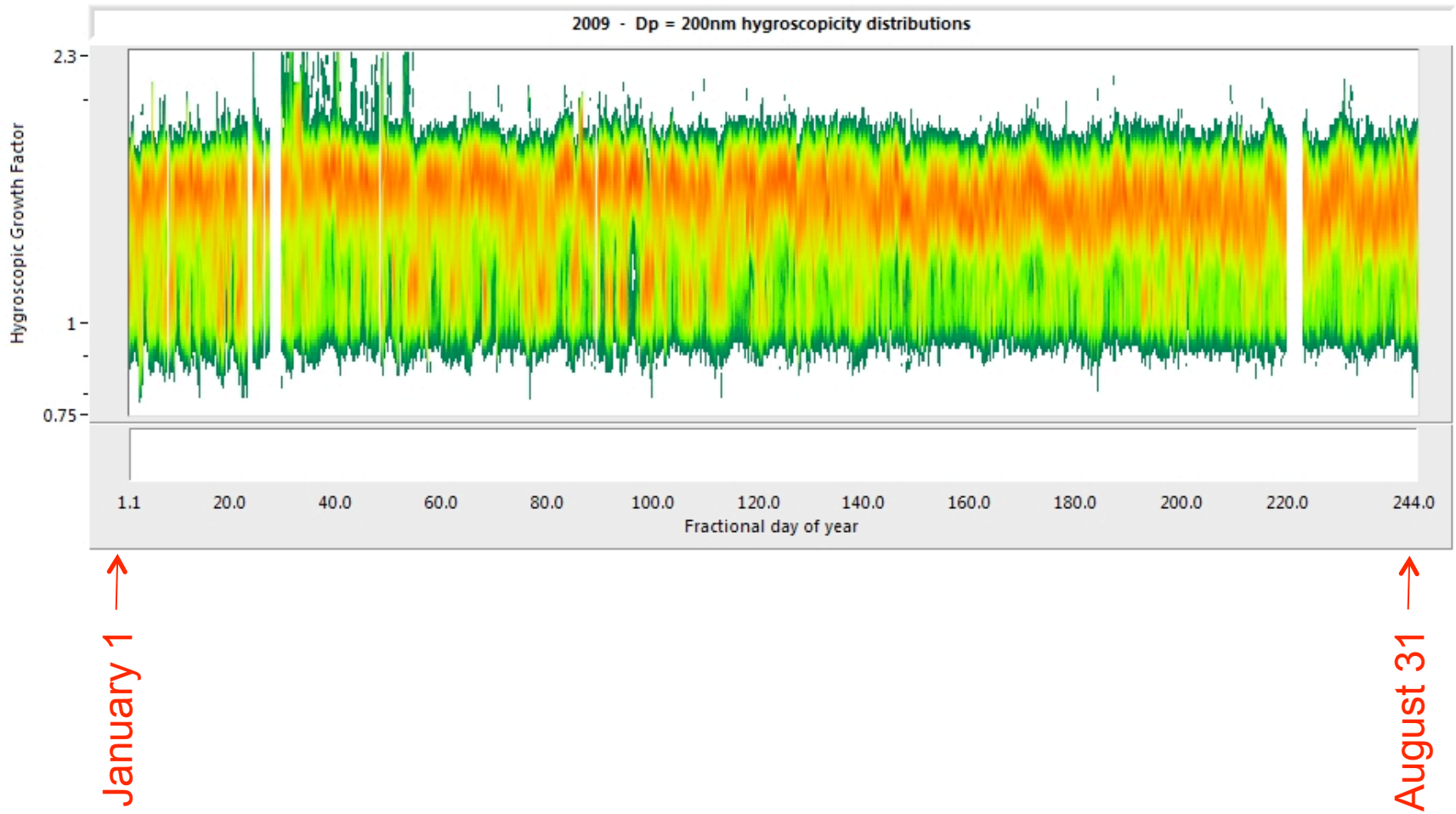
0.025 μm hygroscopicity distributions

0.05 μm hygroscopicity distributions

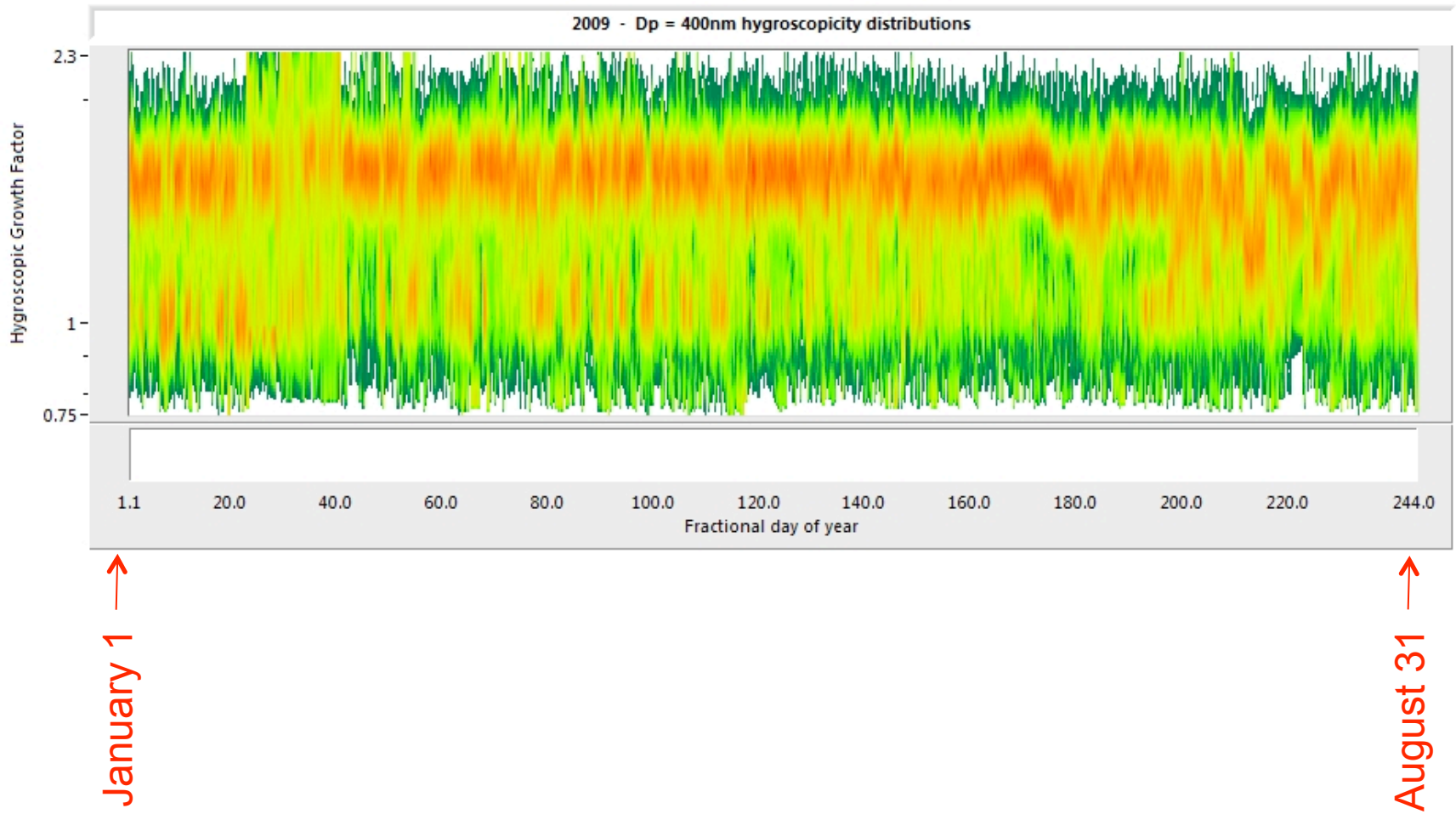
0.1 μm hygroscopicity distributions



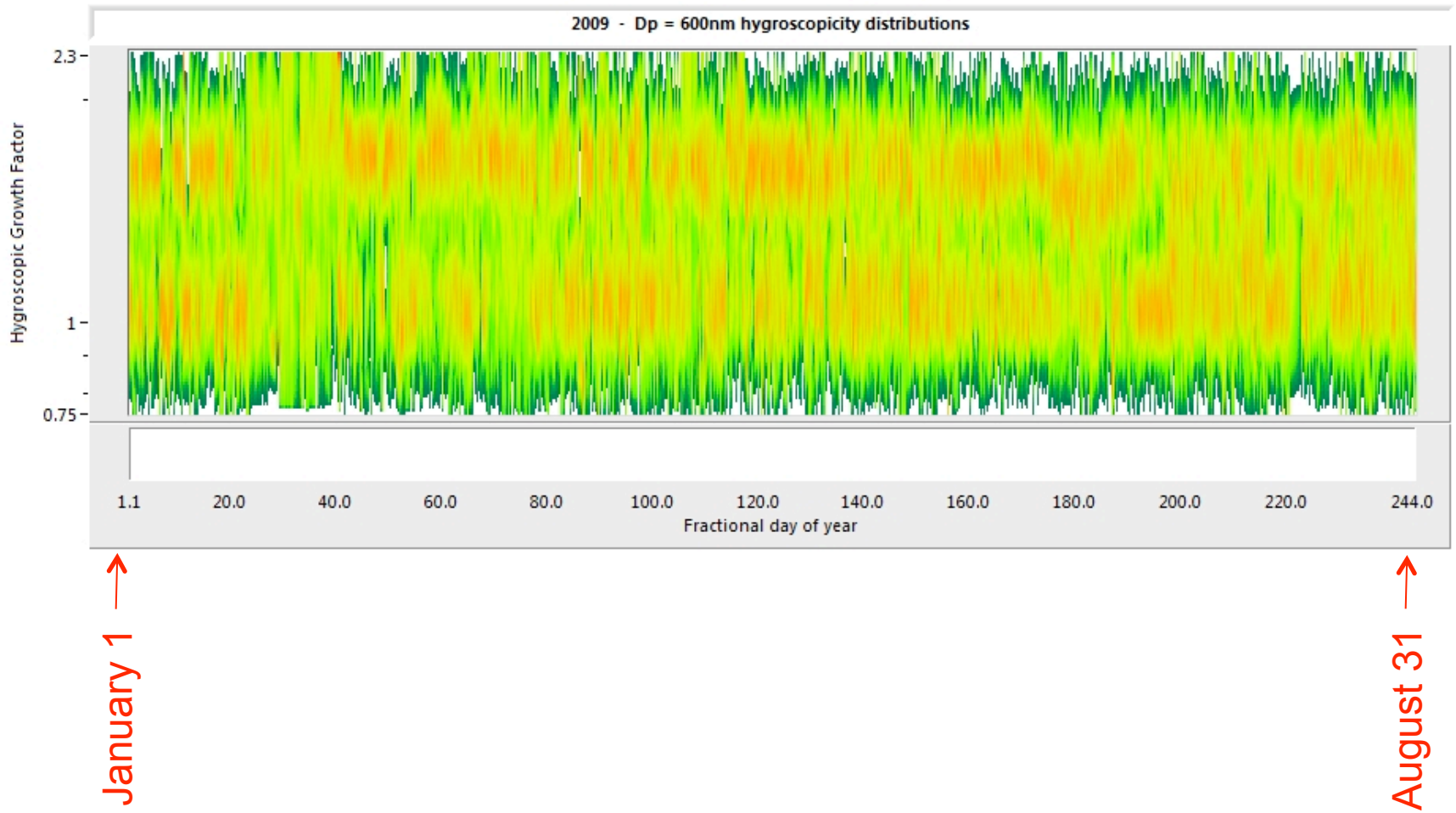
0.2 μm hygroscopicity distributions



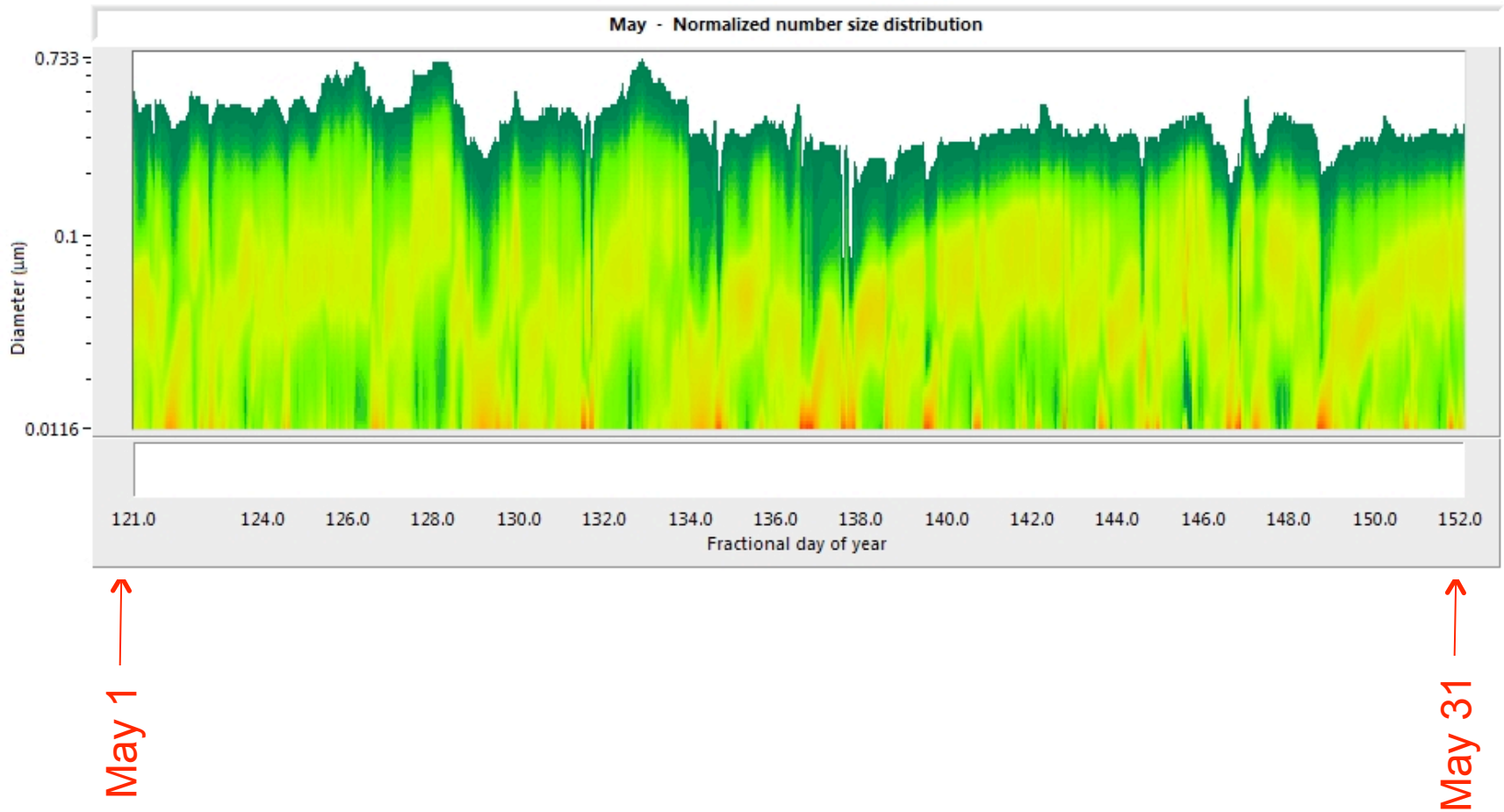
0.4 μm hygroscopicity distributions



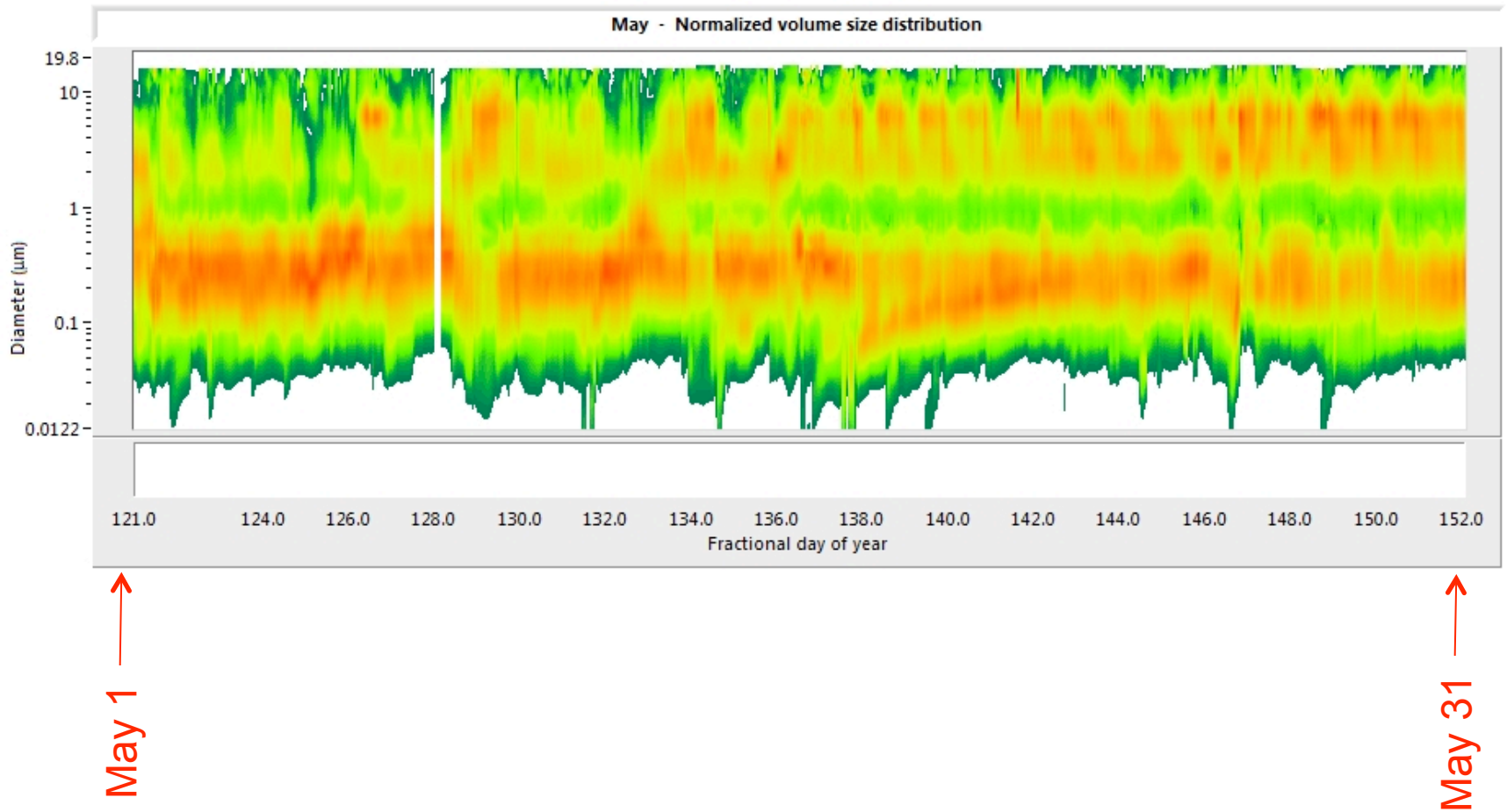
0.6 μm hygroscopicity distributions



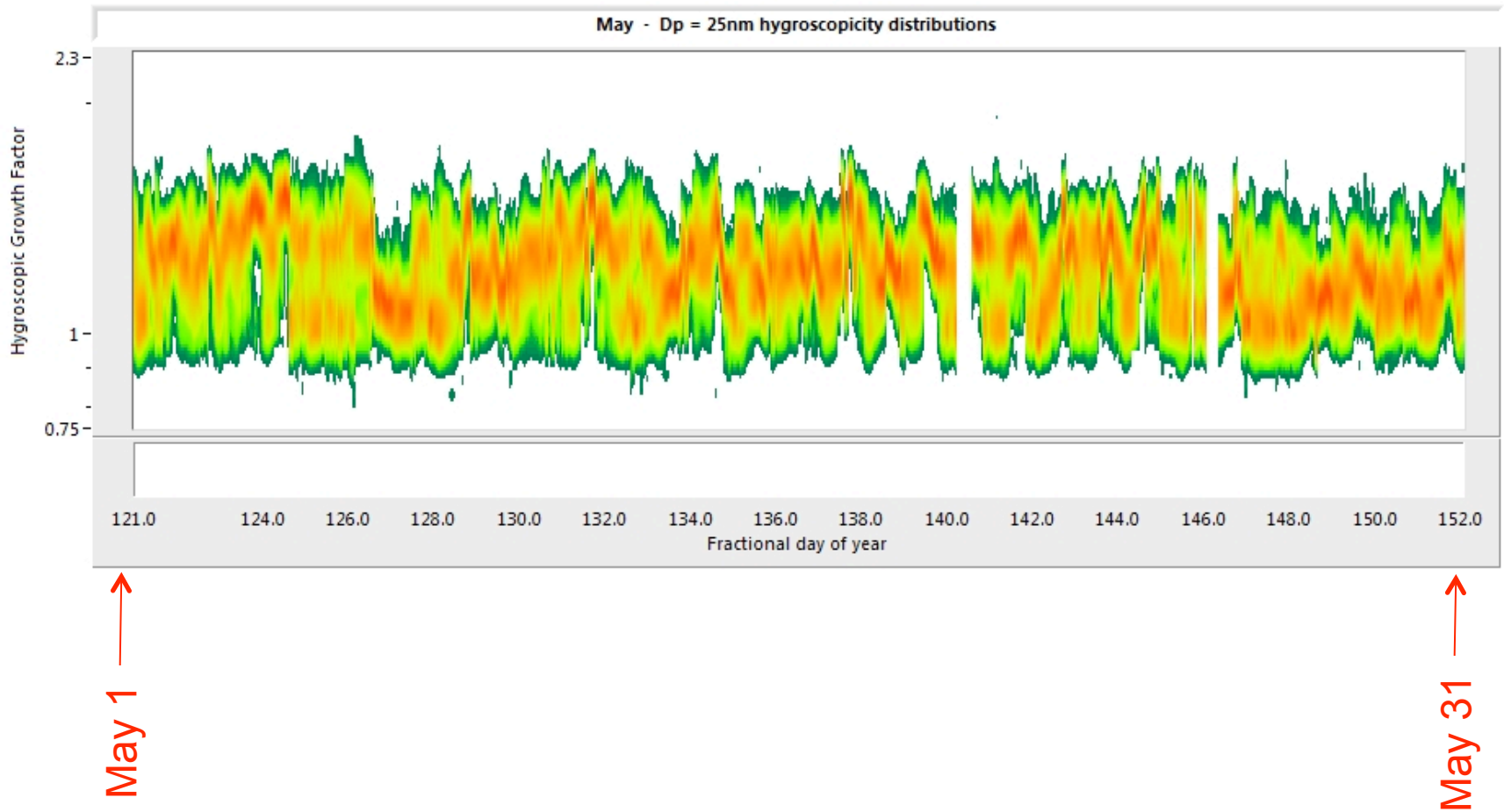
May, 2009 Normalized size distribution



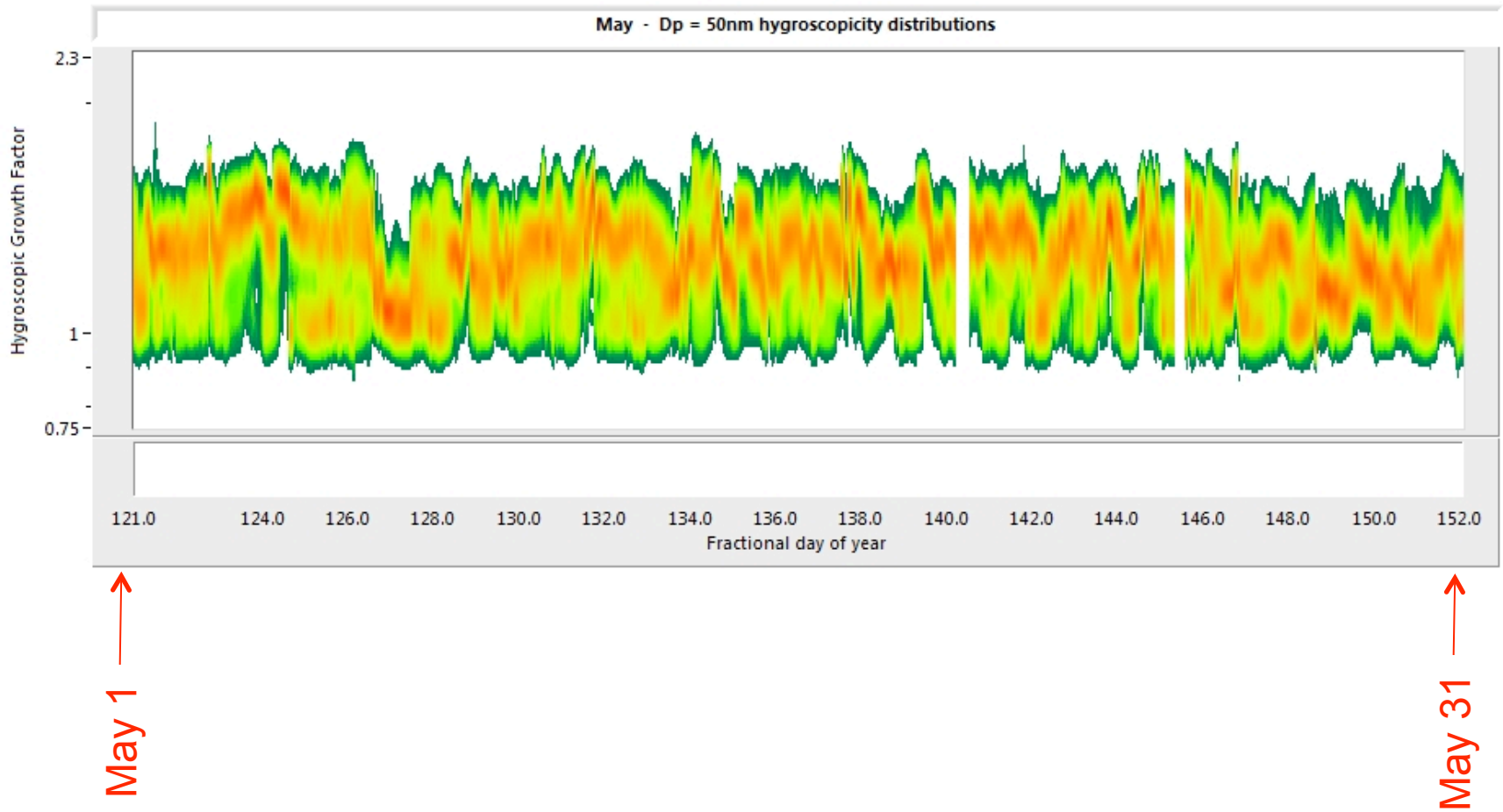
May Normalized volume distribution



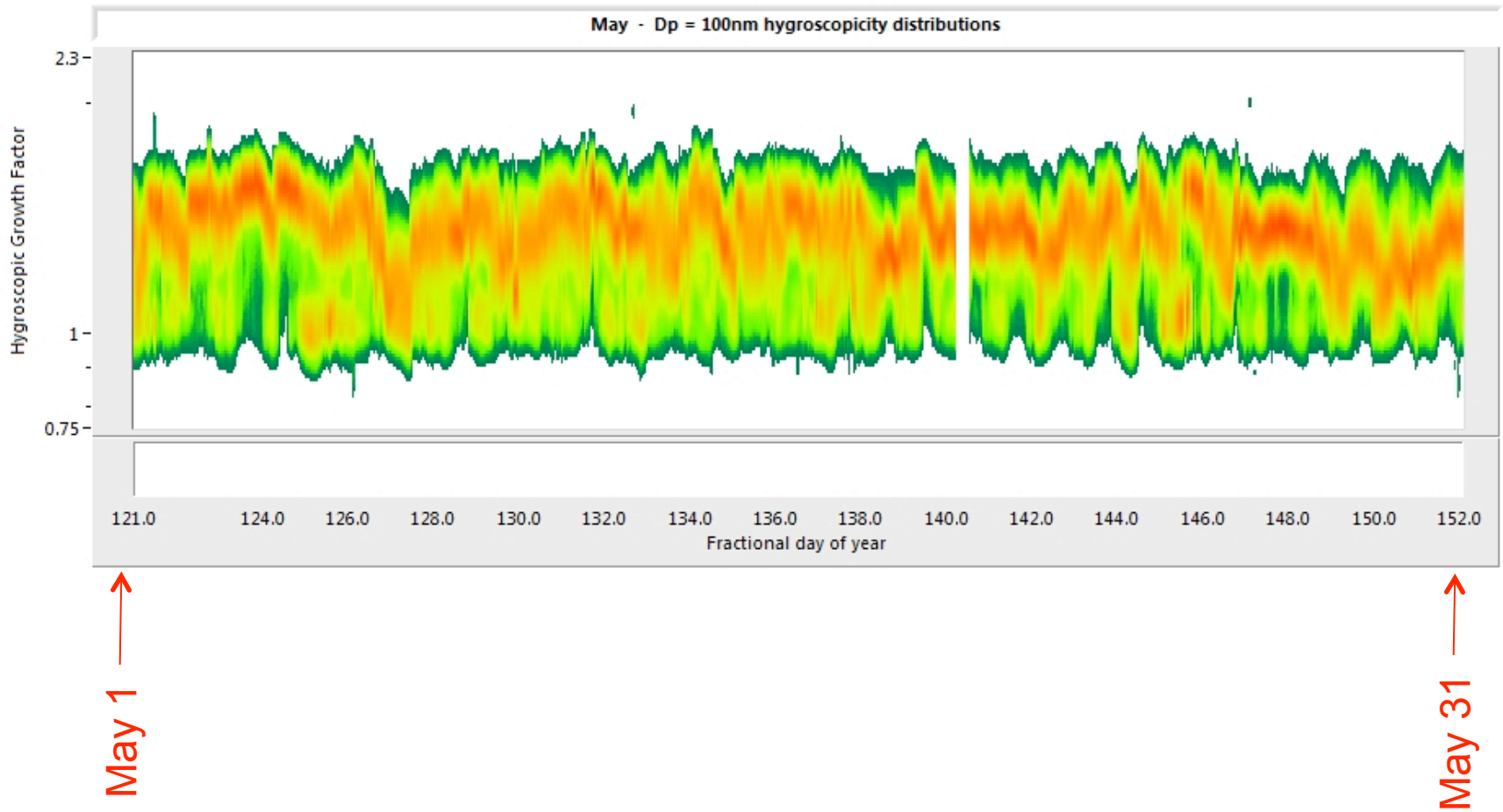
0.025 μm hygroscopicity distributions



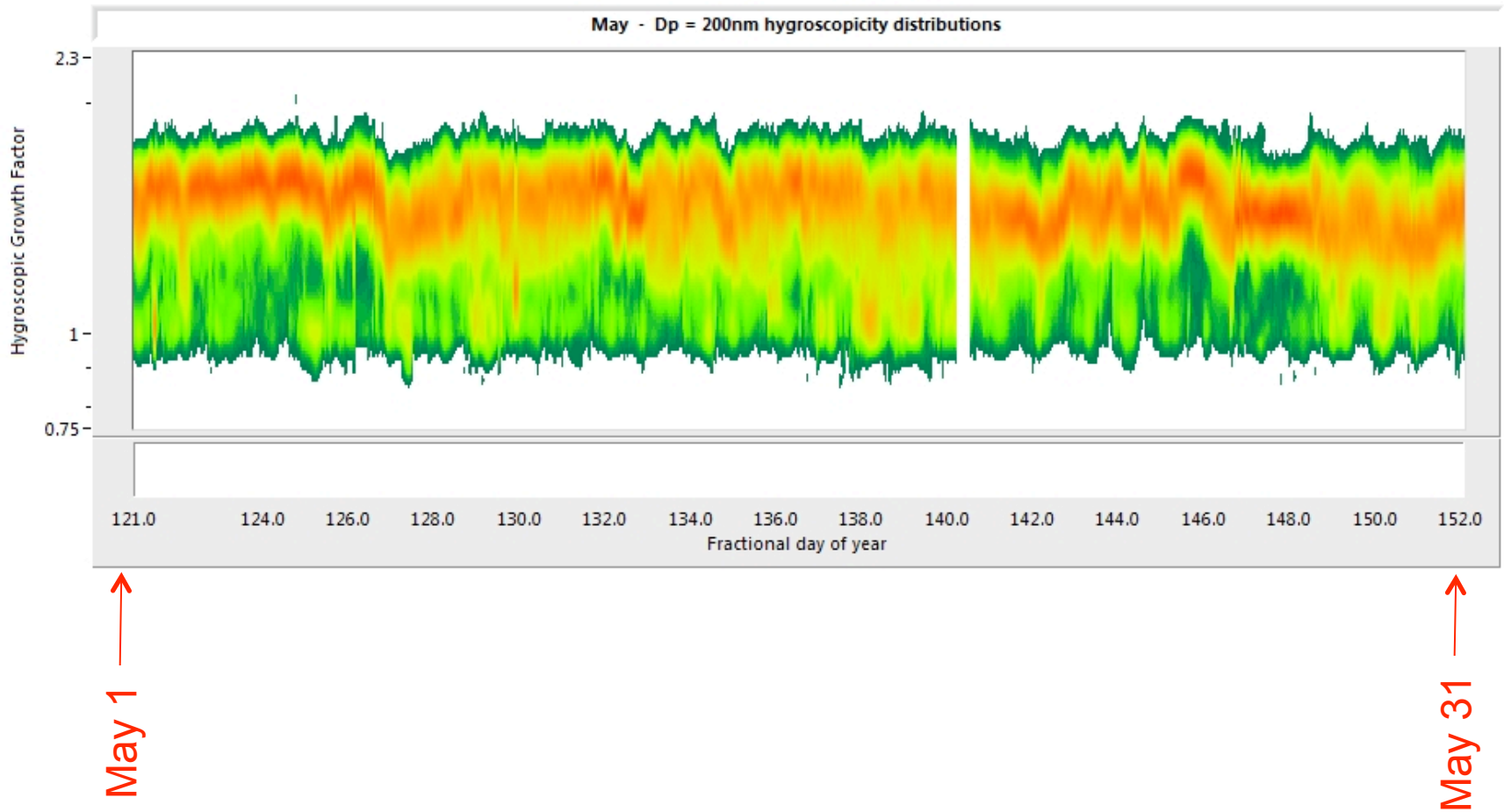
0.05 μm hygroscopicity distributions



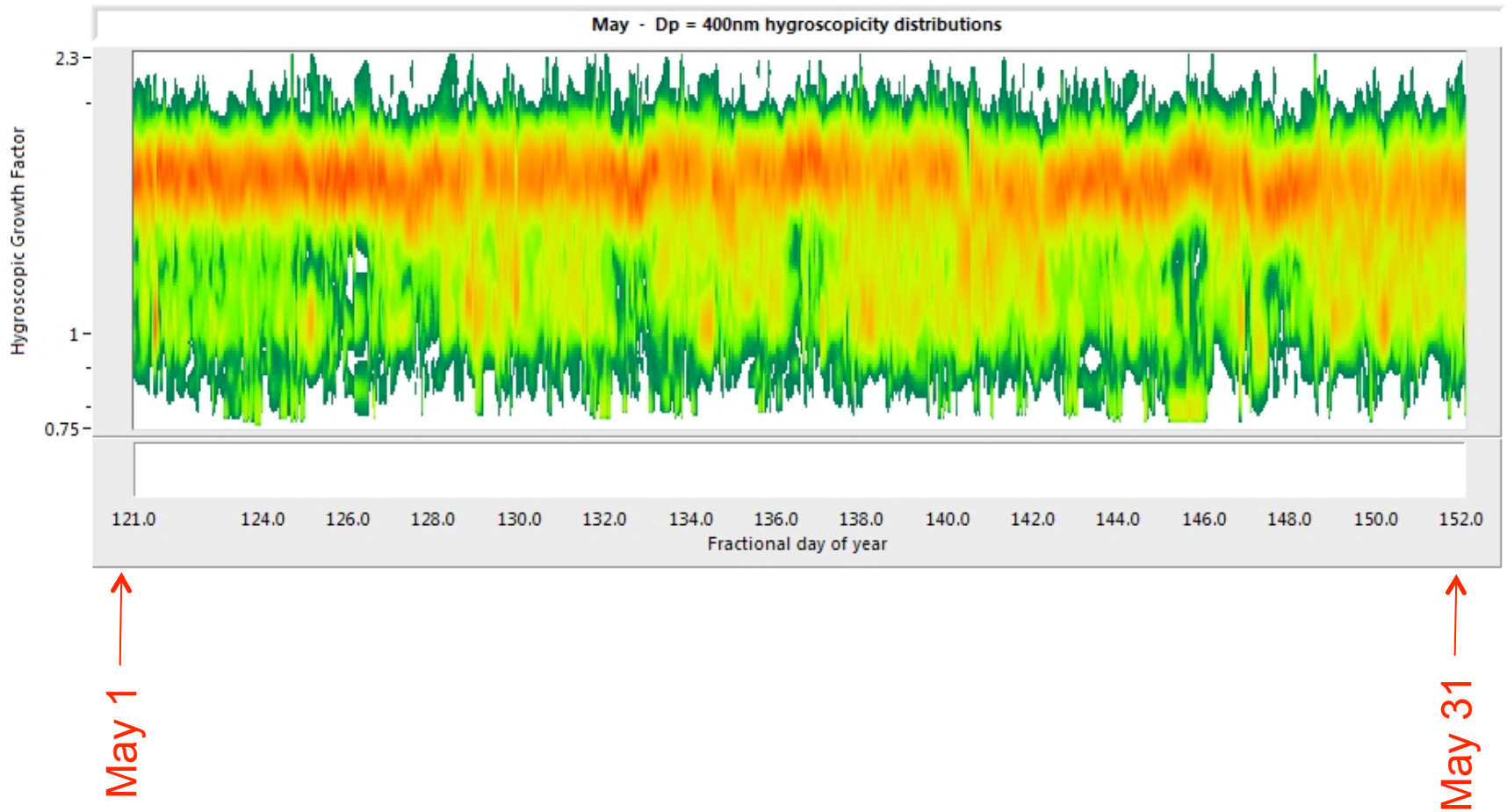
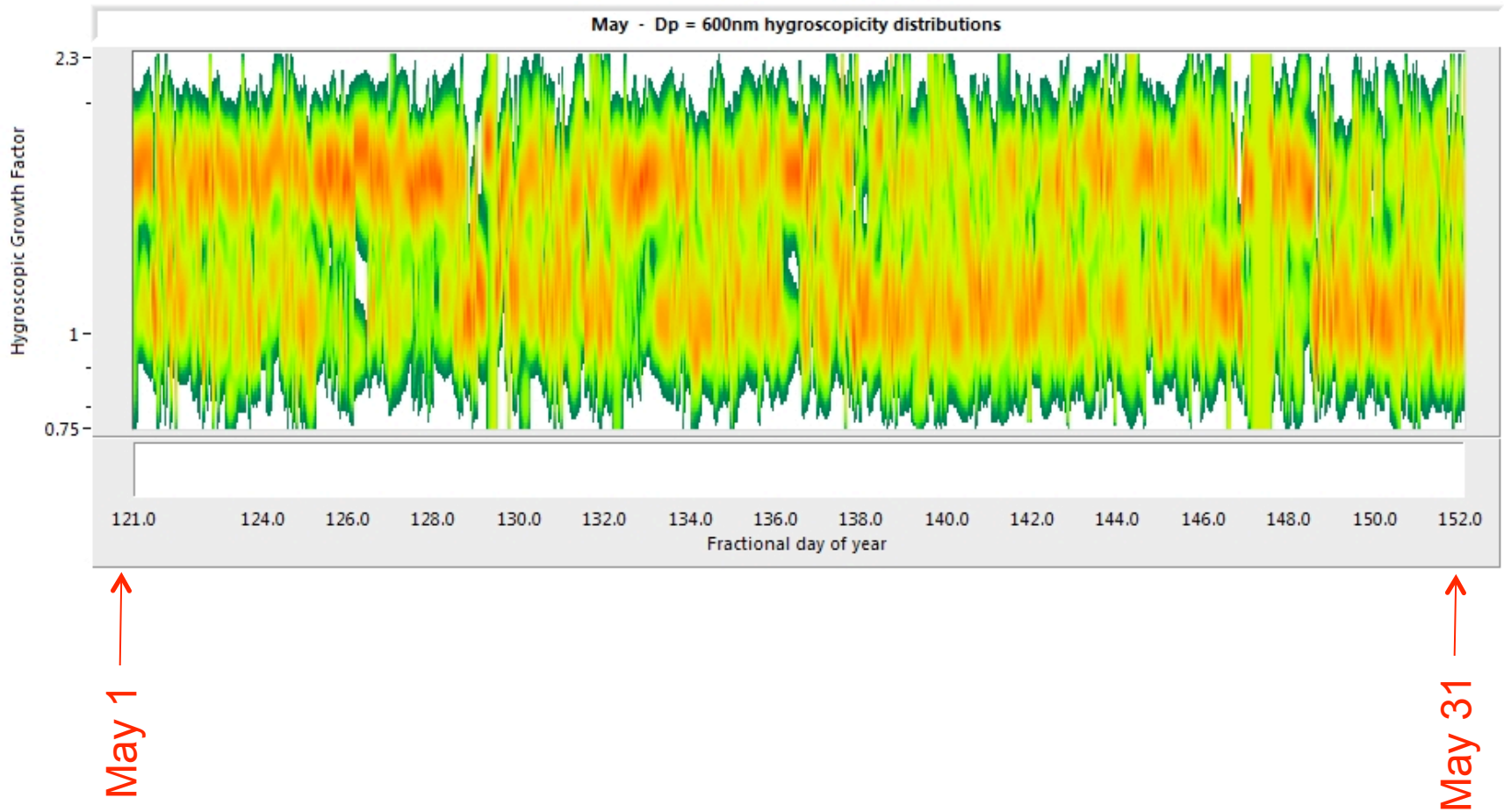
0.1 μm hygroscopicity distributions



0.2 μm hygroscopicity distributions



0.4 μm hygroscopicity distributions



0.6 μm hygroscopicity distributions