Hygroscopic Properties of Aerosol as measured by CCN, HT-DMA and f(rh)

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Aerosol Hygroscopic Properties

CCN (Cloud Condensation Nuclei) Counter
DMT

f(rh) or humidigraph measures change in aerosol optical properties with humidity
Nephelometer: blue, green and red total and back scattering
Cziczo and Pekar, PNNL

HT-DMA (Humidified Tandem Differential Mobility Analyzer)
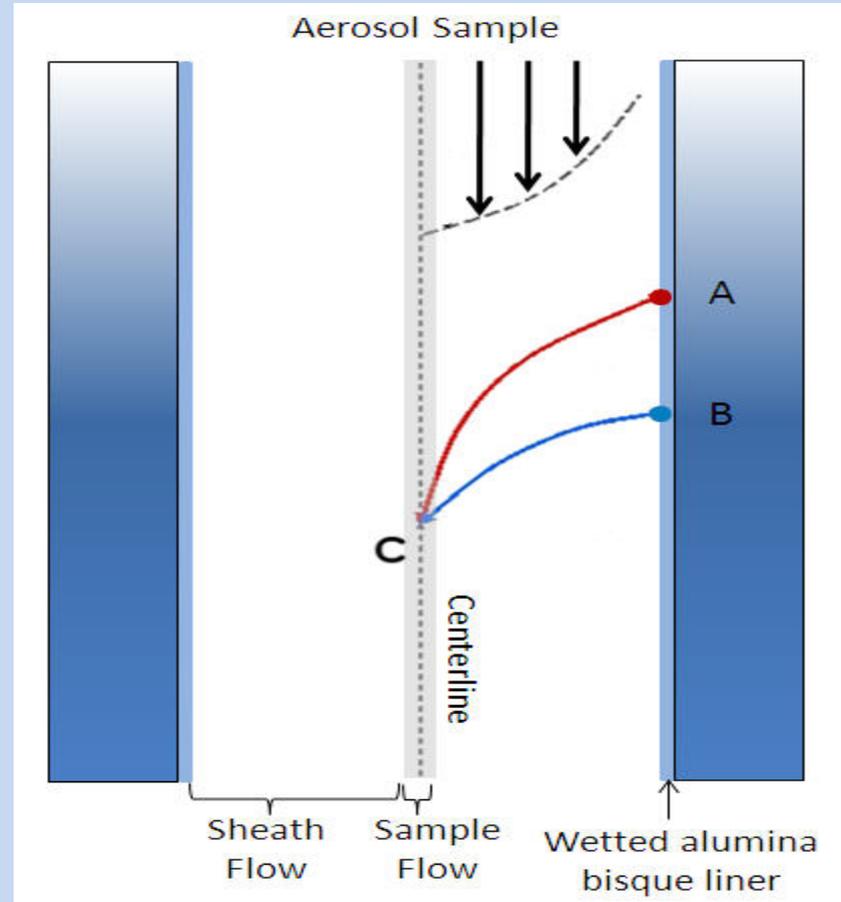**Measures change in aerosol particle size with humidity**
Brechtel Manufacturing Inc
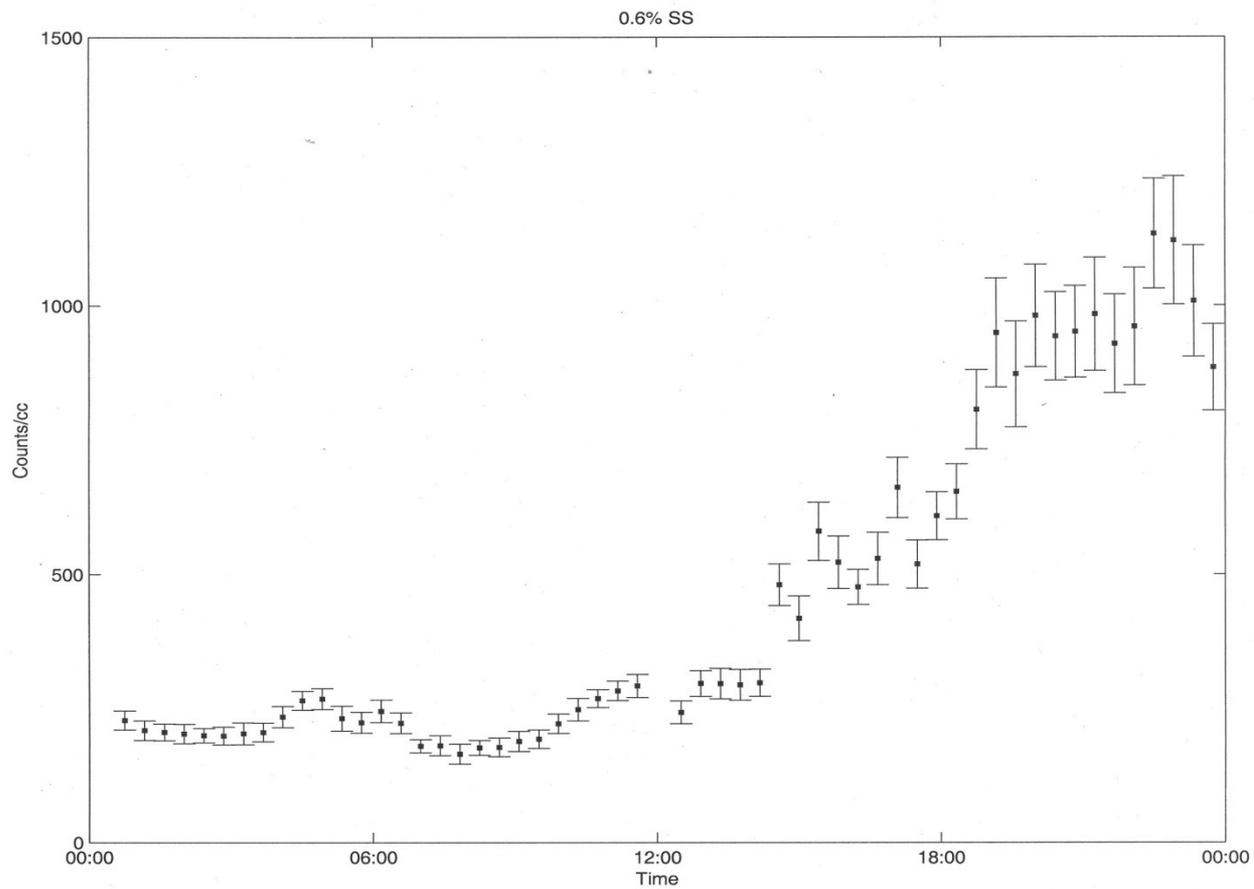
Three units of each
AMFII-AOS   TWP-AOS   MAOS-A

CCN Counter
Measures the CCN at selected supersaturations

CCN Counts at 0.6% Supersaturation
Data from 8/3/2011
Aerosol Lifestyle IOP

f(rh)

The f(rh) consists of two components
two nephelometers ,
ambient and sample
and an aerosol
humidifier

Sample flow 7.5l/min

f(rh)

The aerosol humidifier part of the f(rh) consists of six Nafion permeation tubes, the first three are for preconditioning. The last three are the sample tubes. The aerosol sample is separated from the drying/humidify gas stream by the Nafion membrane.

Two types of aerosol experiments
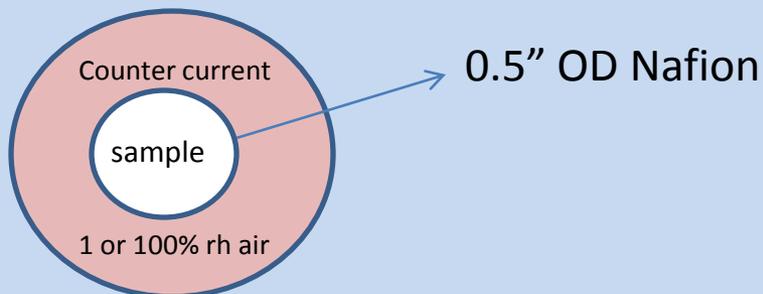- **Deliquescence** (1 hr)
    Precond.   Held at 30% rh
    Sample Scanned 30 to 80% rh
- **Efflorescence** (1 hr)
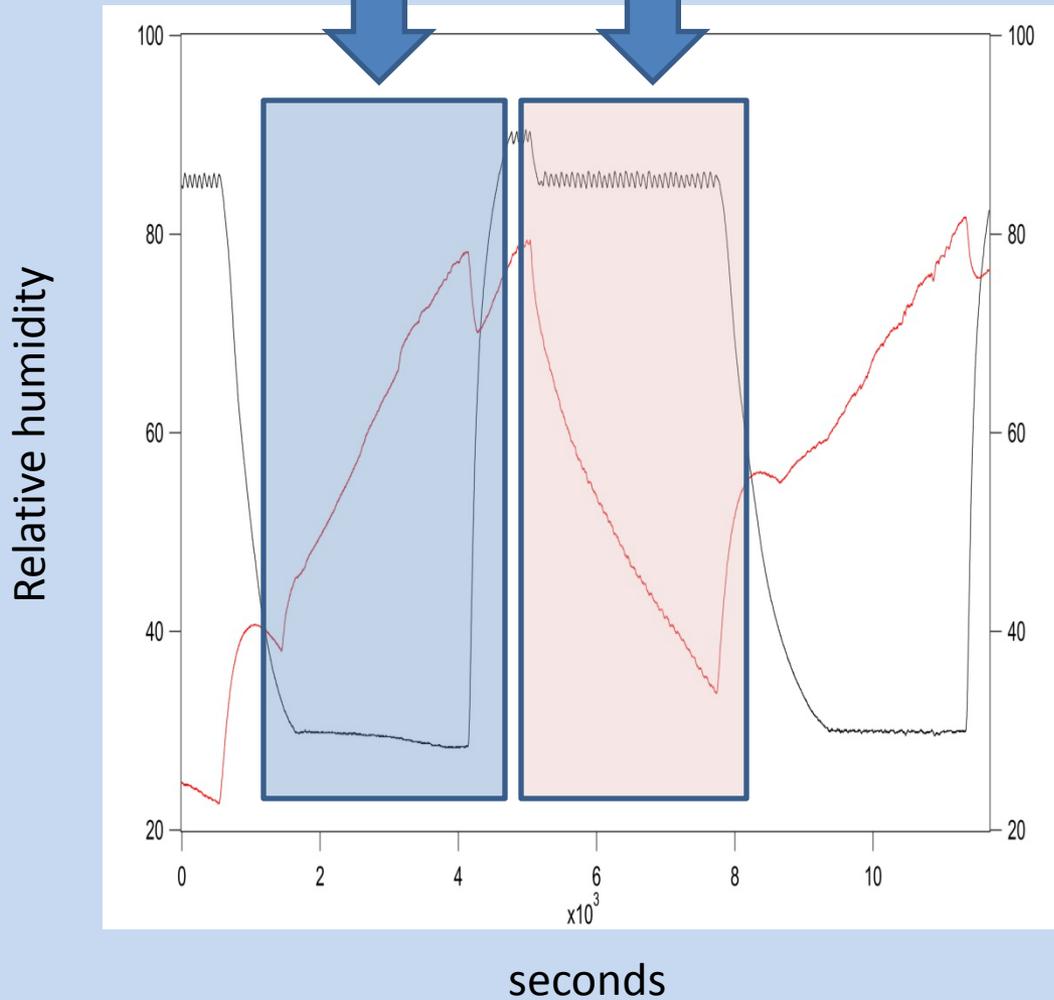   Precond.   Held at 85% rh
    Sample Scanned 80 to 30% rh

Counter current

sample

1 or 100% rh air

0.5" OD Nafion

Needs source of 5-20 l/min of dried air (~ 1%rh) and 5-20l/min humid air (~100%rh).
Dried air from a Pentras air drier
Humidified air from a water bath

f(rh)

Deliquescence experiment

Efflorescence experiment

Relative humidity

seconds

Red Trace
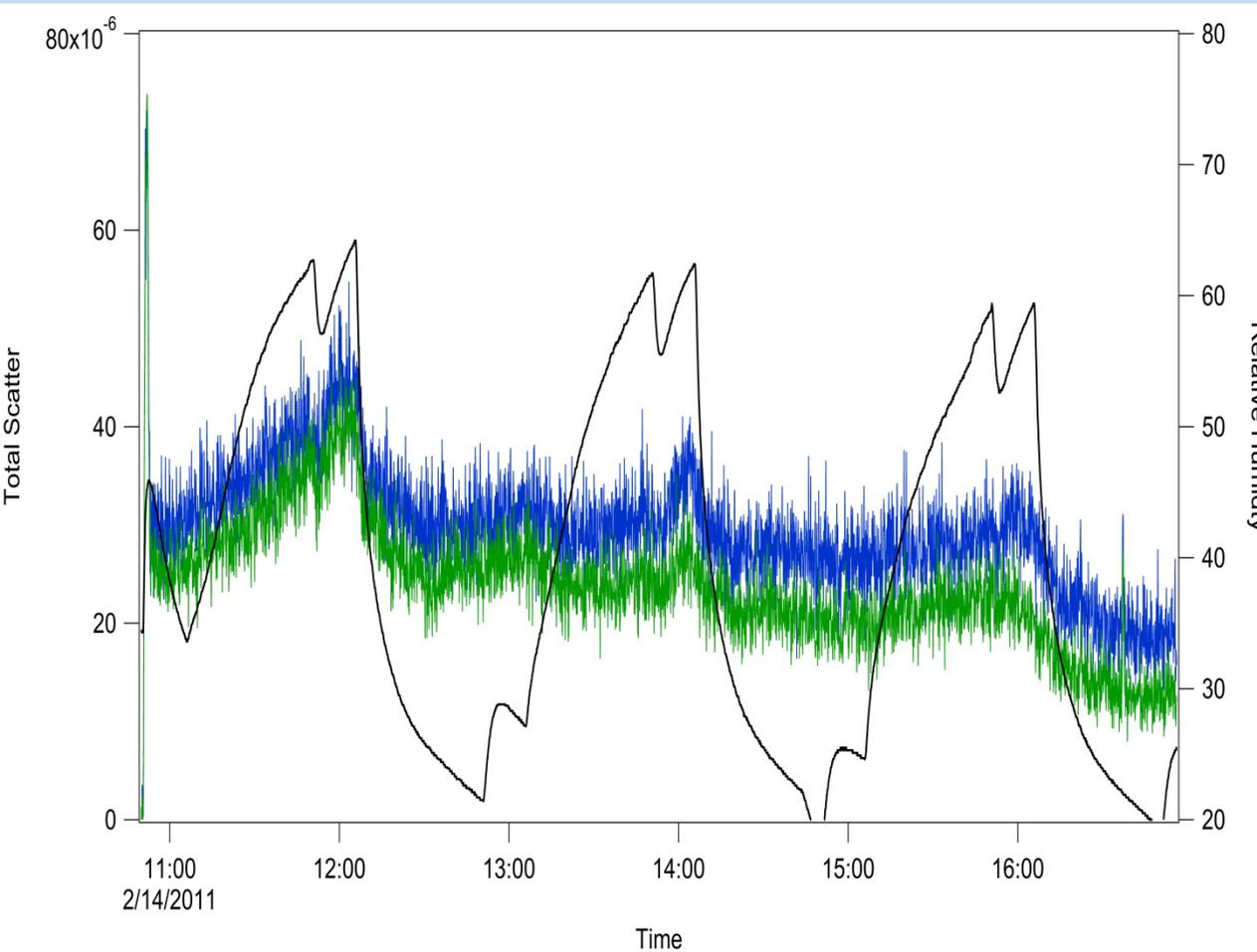Scanning RH at outlet of the sampling Nafion tube 6 to sample nephelometer

Black Trace
RH at outlet of the preconditioning Nafion tubes Between 3 and 4

f(rh)

Humidigraph of ambient air

Note the maximum in the scattering every two hours corresponding to the maximum humidity in the deliquescence cycle

All is not perfect, very dry winter air---need to increase humidity. Need different programs for winter and summer

HT-DMA

Consists of 3 components

Aerosol Generator

$(NH_4)_2SO_4$ soln to aerosol, HT-DMA,
CCN and f(rh) cal with SEMS and CPC
Aquadag soln to aerosol (SP2 cal)

Selection DMA **(SEMS)** (10 to 2500 nm)
Charge neutralizer and Nafion
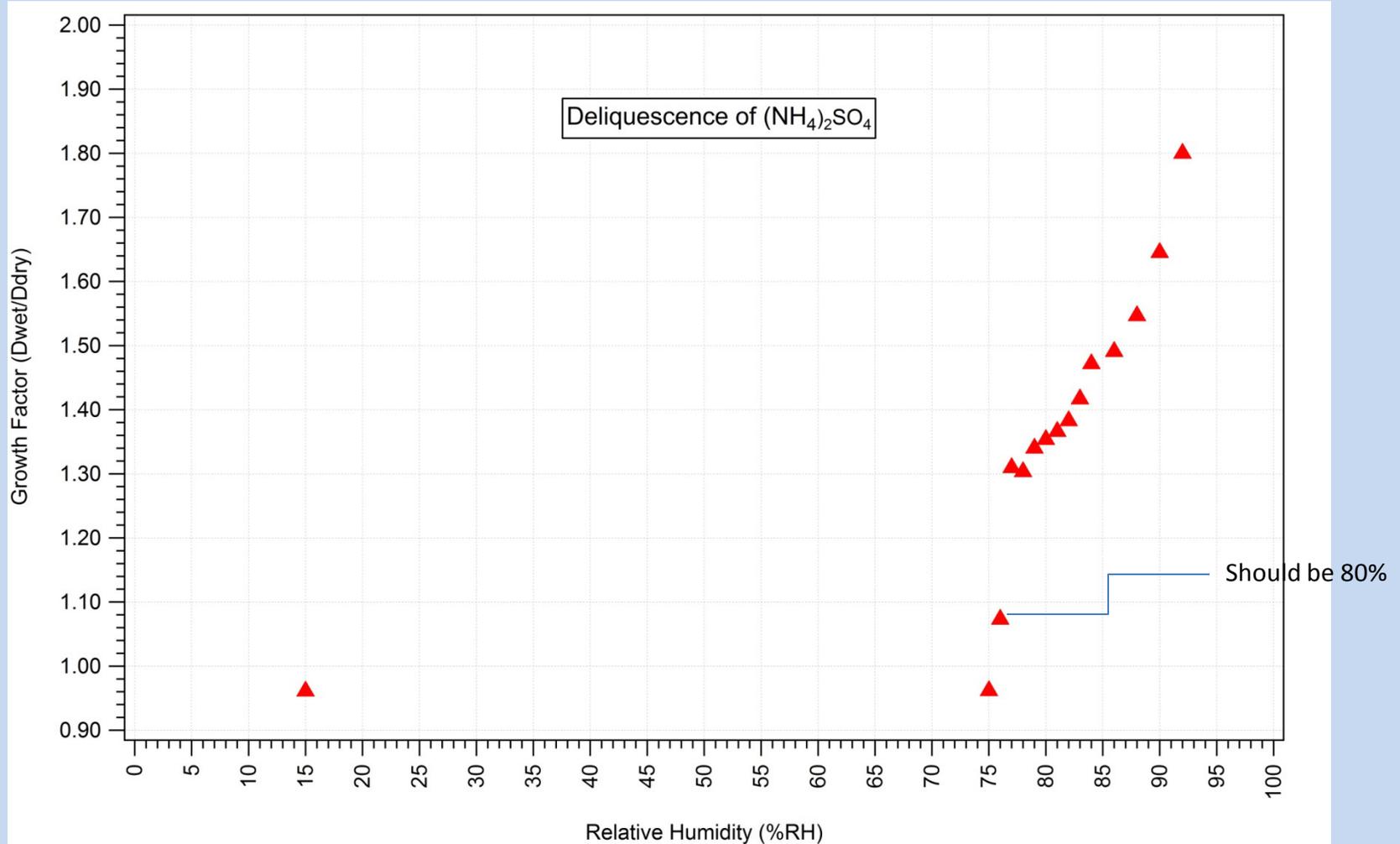aerosol drier, select initial dry aerosol size

Aerosol humidifier (diffusion) and scanning
humidified DMA **(HSEMS)** (10 to 2500 nm)
Exposes aerosols to programmable RHs
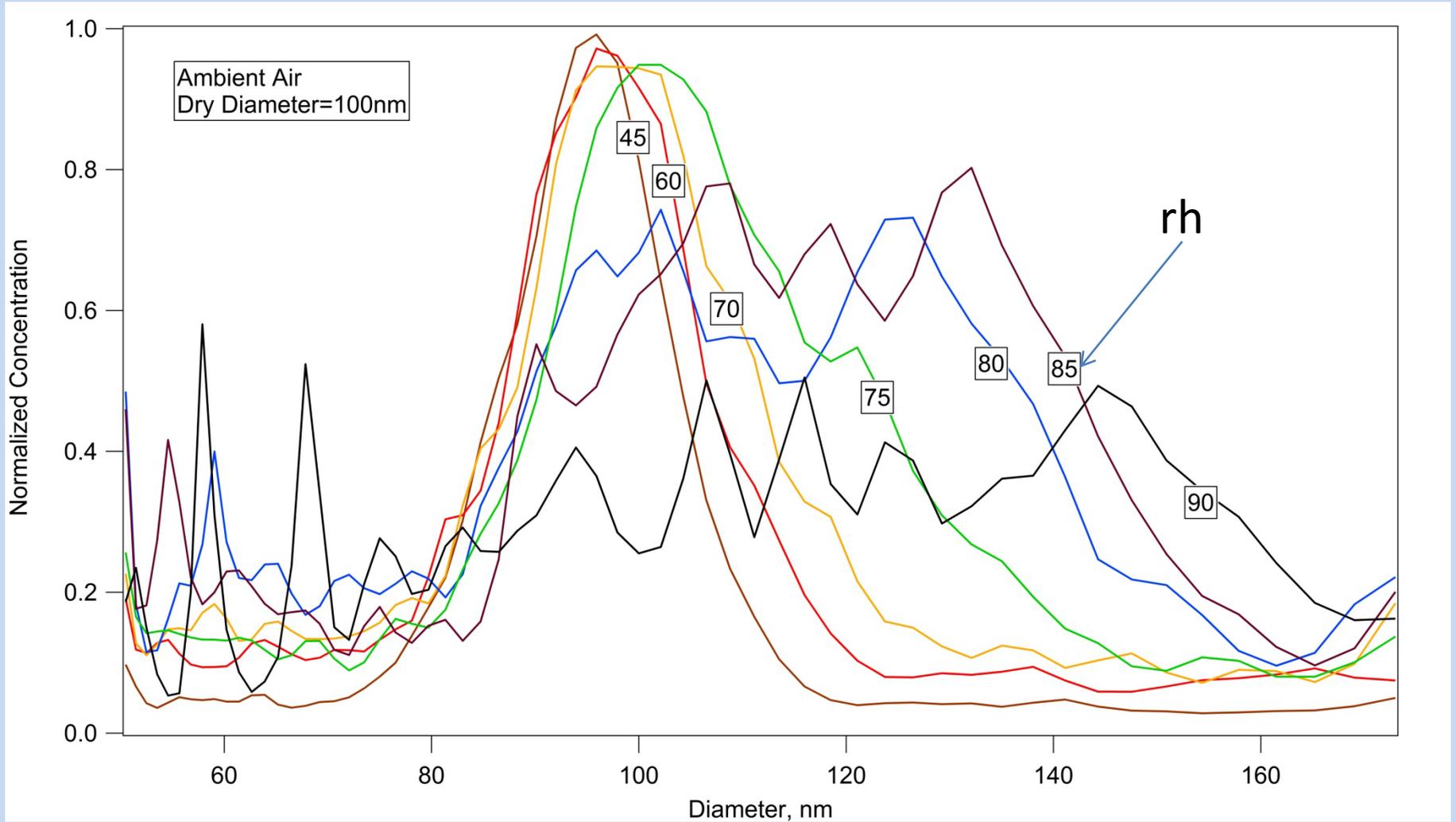between 10 to 93%

Very Programmable

HT-DMA

Calibration of the HT-DMA

Total Scan Time was about 2 hrs
Dry aerosol size 125nm

HT-DMA

Scan Time about 1 hr
Ambient aerosols have a range of hygroscopicities