Optical Monitoring Network

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Network	Nephelometer	Transmissometer
NPS	12	12
Arizona	15	3
USFS	6	2
Wyoming	2	2
Wisconsin	2	0
TRPA	2	0
LADCO	2	0
VISTAS	1	0
CDPHE	2	2
Clark County	0	2
Total	44	23

Fully Instrumented Sites

- Grand Canyon (NPS/AZ) Rim and In-canyon
- Big Bend (NPS)
- Petrified Forest (NPS/AZ)
- Cloud Peak (WY)
- Thunder Basin (WY)
- Urban Sites: Ft Collins, Denver, Phoenix, Tucson

Data

- Nephelometer data submitted 90 days after end of quarter: Winter 2004 will be delivered in July, 2004

- Transmissometer data submitted yearly. 2003 data to be delivered in July, 2004.

Transmissometer Tests

Extinction From Transmissometer

- Transmissometer measures transmittance (T) of an atmospheric path (r)
- $T = I_r/I_o$
- $b_{ext} = (1/r)\ \ln(1/T)$

Transmissometer Calibration Equation

$$I_O=(CP/WP)^2 \times (WG/CG) \times (WA/CA)^2 \times (1/FT) \times (WT) \times (1/T) \times I_{rcal}$$

CP = calibration path
WP = working path
CG = calibration gain
WG = working gain
CA = calibration aperture
WA = working aperture

FT = neutral density filter transmittance = 0.0275
WT = window transmittance = 0.80
T = calibration path transmittance = $\exp(-b_{ext}CP)$

I_{rcal} = calibration counts

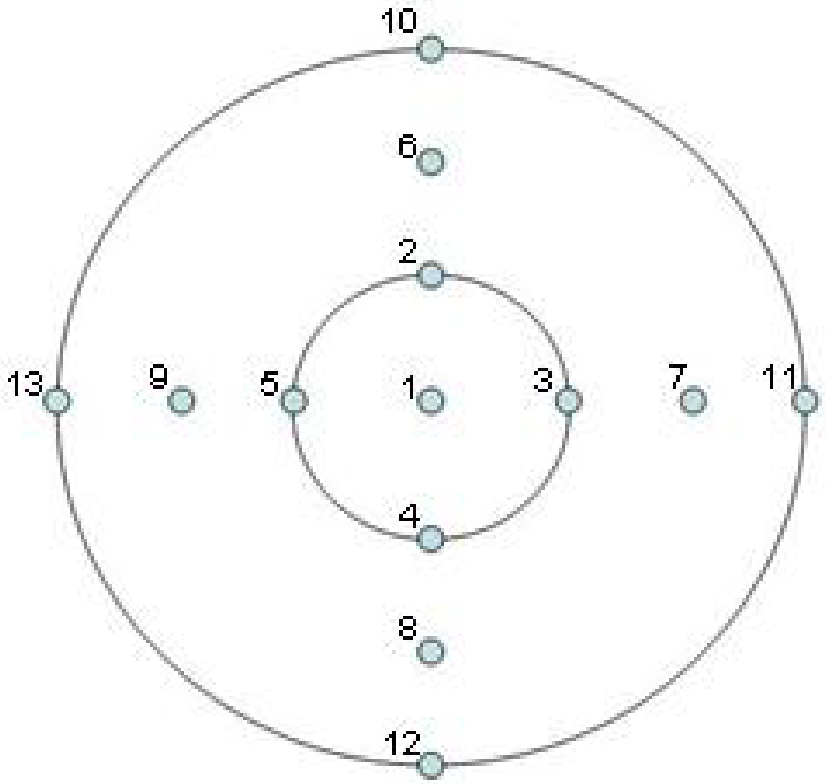
Transmissometer Uncertainty

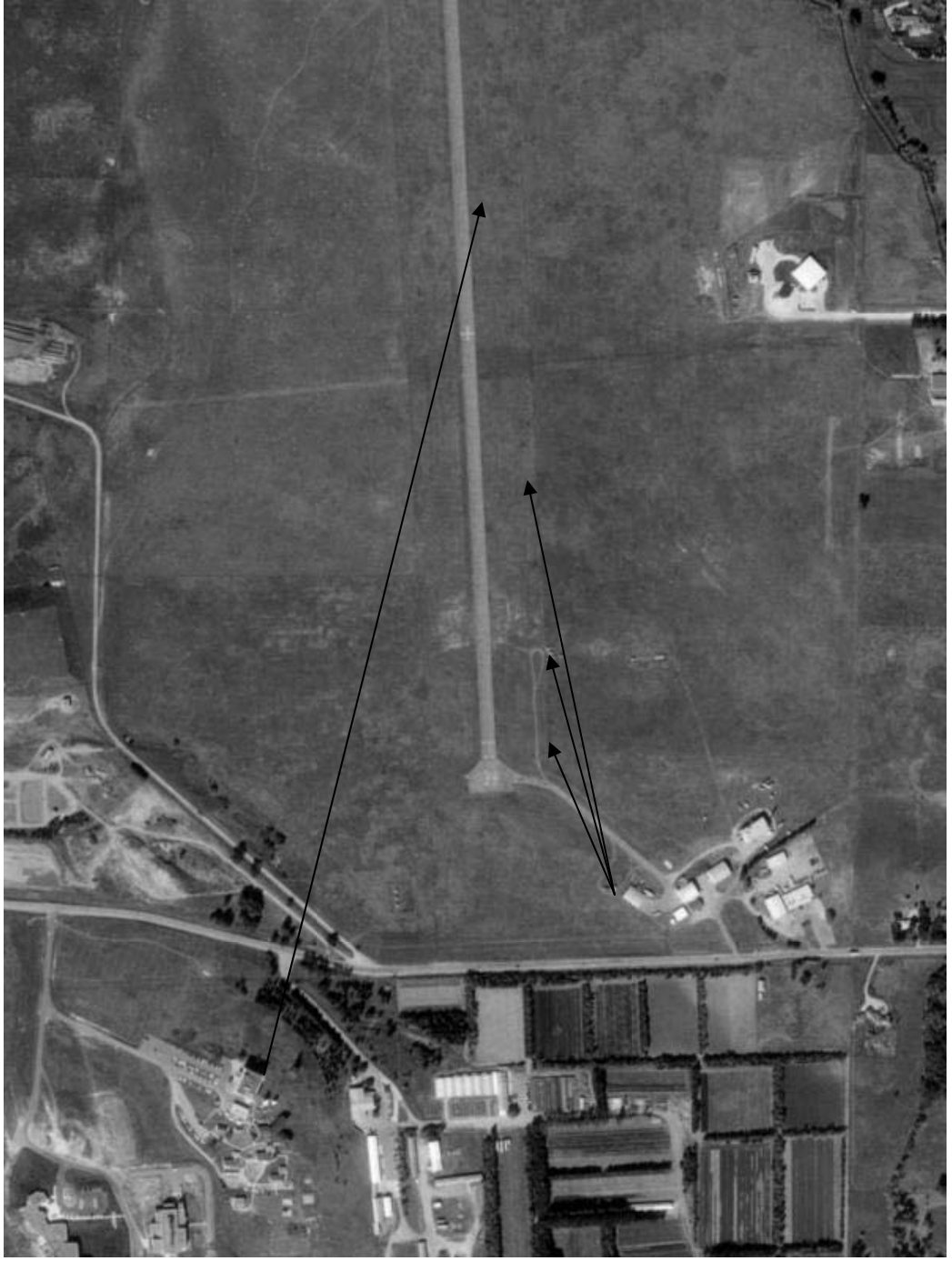
- A percentage uncertainty in transmittance measurement results in a bias in extinction calculated from transmittance measurement

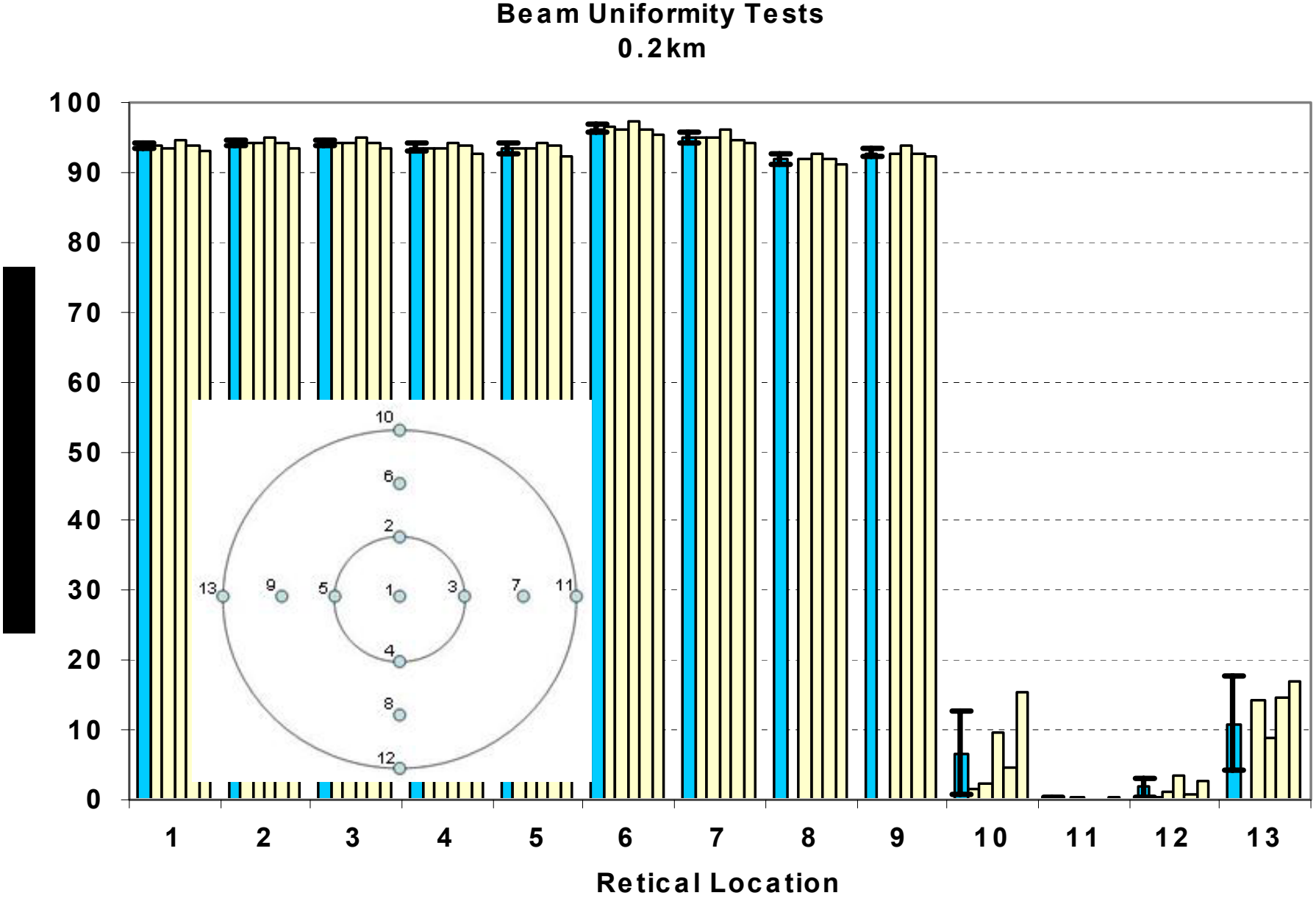
- For a 5 km path a 1% error in transmittance results in a 2 Mm^{-1} bias (offset) in calculated extinction

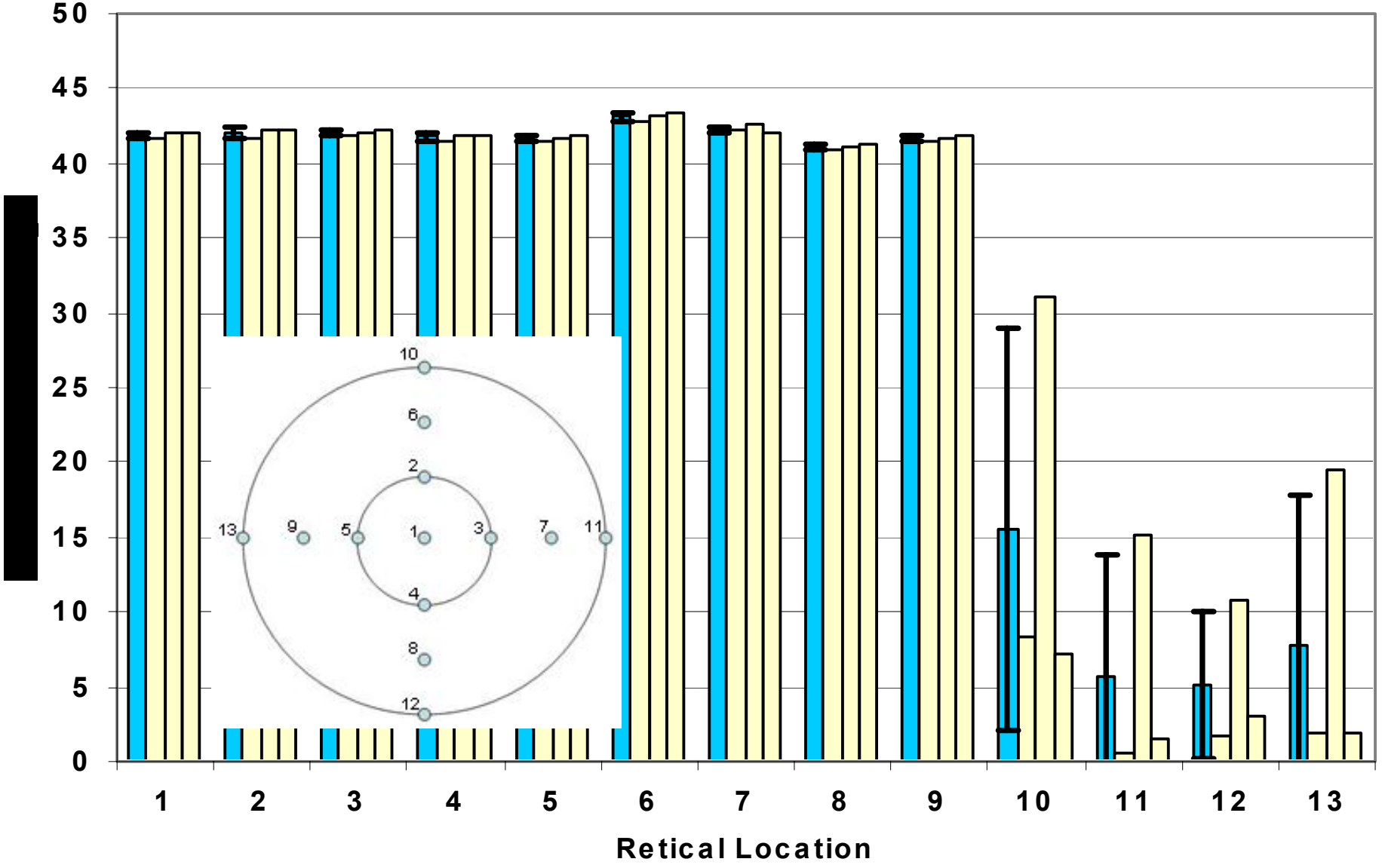
Beam Uniformity Test

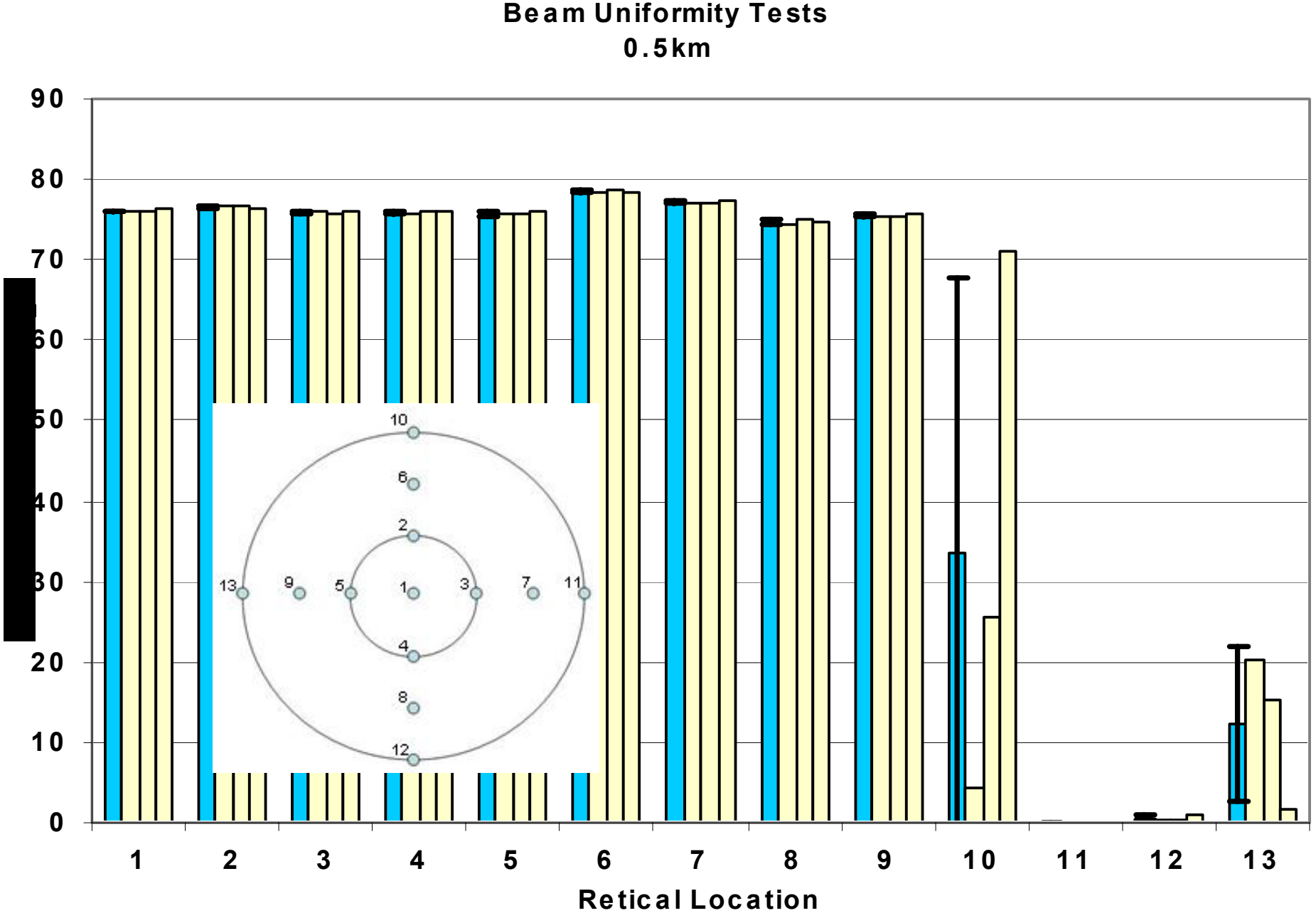
- LPV-2
- Path Length:
  - .2 km
  - .3 km
  - .5 km
  - .8 km
- Receiver aligned at 13 inner and outer reticle points

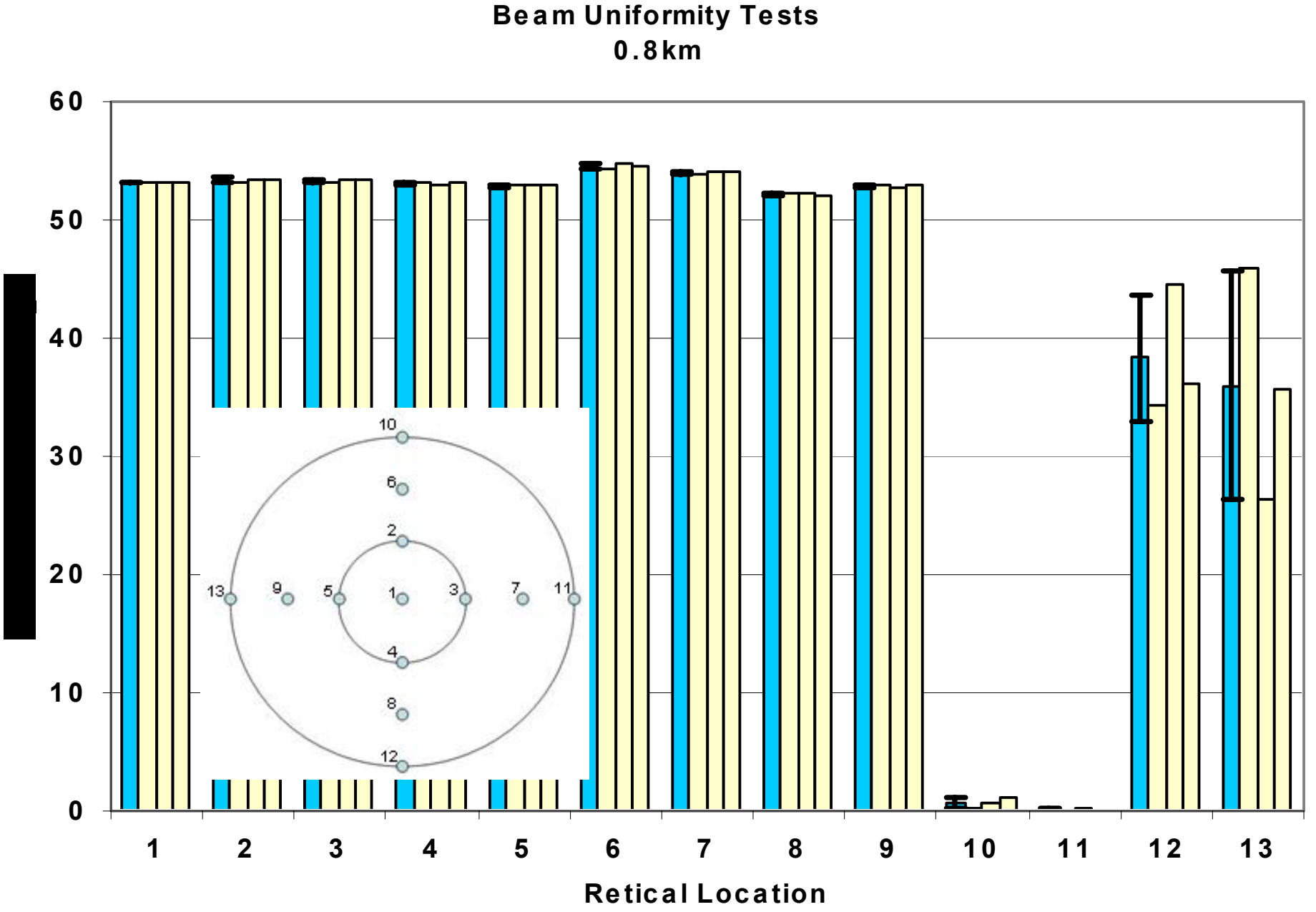


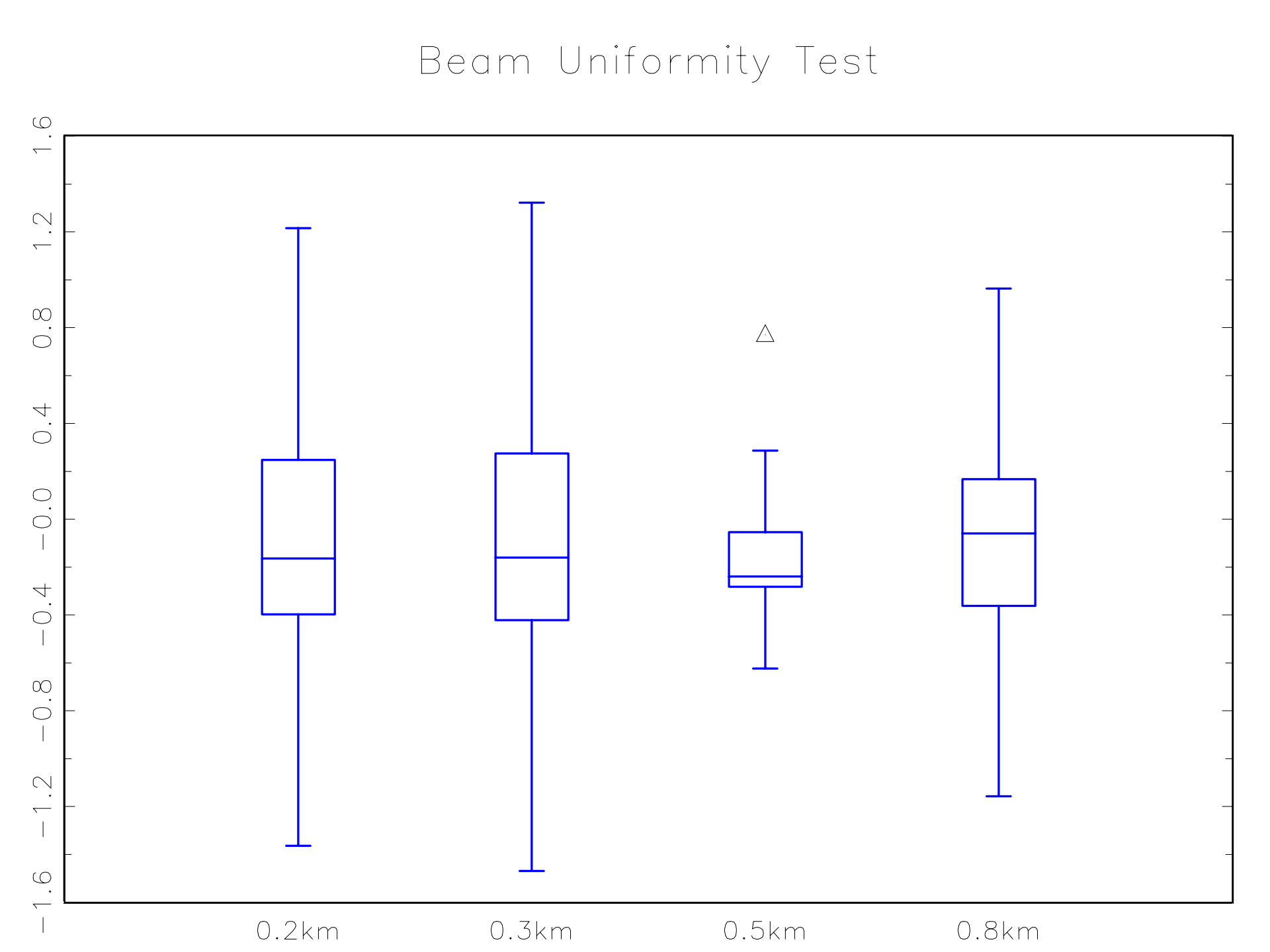



Beam Uniformity Tests
0.2km
100
90
80
70
60
50
40
30
20
10
0
1
2
3
4
5
6
7
8
9
10
11
12
13
Retical Location
10
6
2
13
9
5
1
3
7
11
4
8
12


Beam Uniformity Tests
0.3km
50
45
40
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
8
9
10
11
12
13
Retical Location
10
6
2
13
9
5
1
3
7
11
4
8
12


Beam Uniformity Tests
0.5km
90
80
70
60
50
40
30
20
10
0
1
2
3
4
5
6
7
8
9
10
11
12
13
Retical Location
10
6
2
13
9
5
1
3
7
11
4
8
12


Beam Uniformity Tests
0.8km
60
50
40
30
20
10
0
1
2
3
4
5
6
7
8
9
10
11
12
13
Retical Location
10
6
2
13
9
5
1
3
7
11
4
8
12


Beam Uniformity Test
1.6
1.2
0.8
0.4
−0.0
−0.4
−0.8
−1.2
−1.6
0.2km
0.3km
0.5km
0.8km

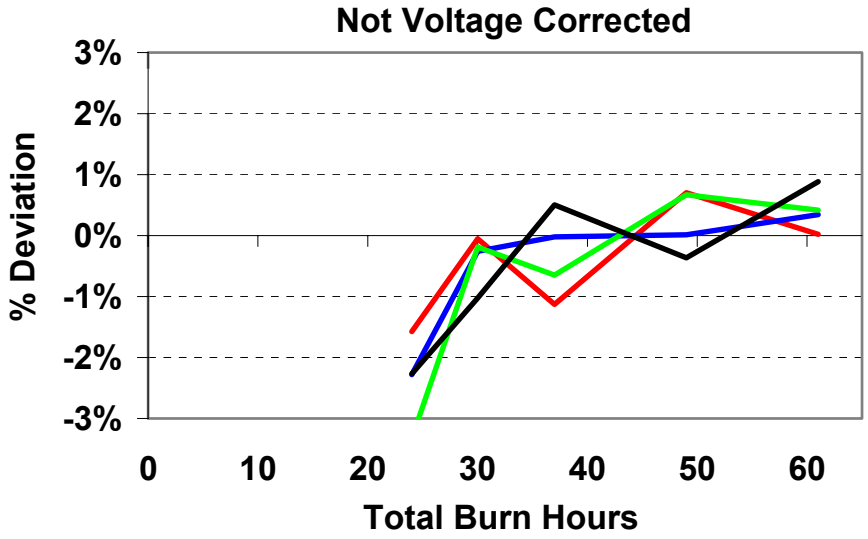
Lamp Burn Time Test

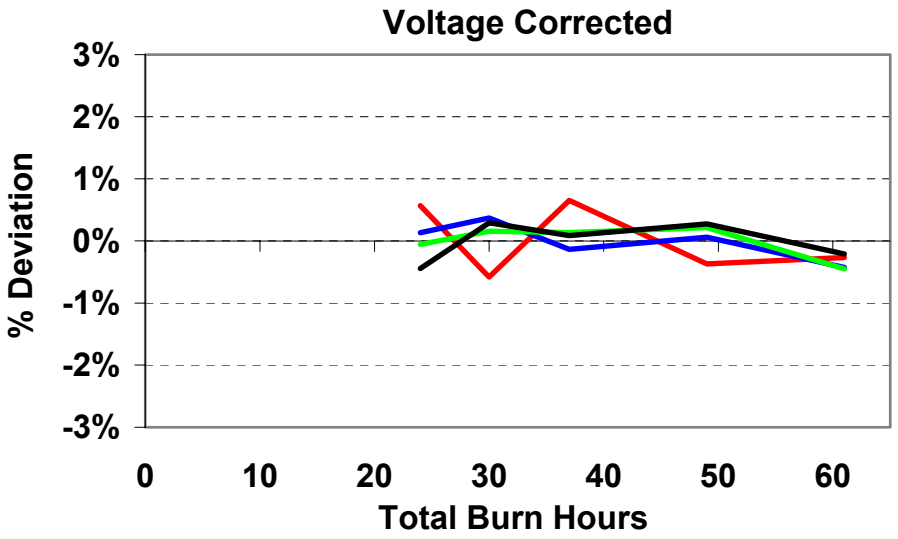
- LPV-2 (.3 km path)
- 4 lamps burned continuously
- 4 lamps cycled (15 on/15 off)
- Calibration performed at 0, 24, 30 ,37, 49 and 61 total burn hours.

Note: Current SOP calls for 36 total burn hours (cycled)

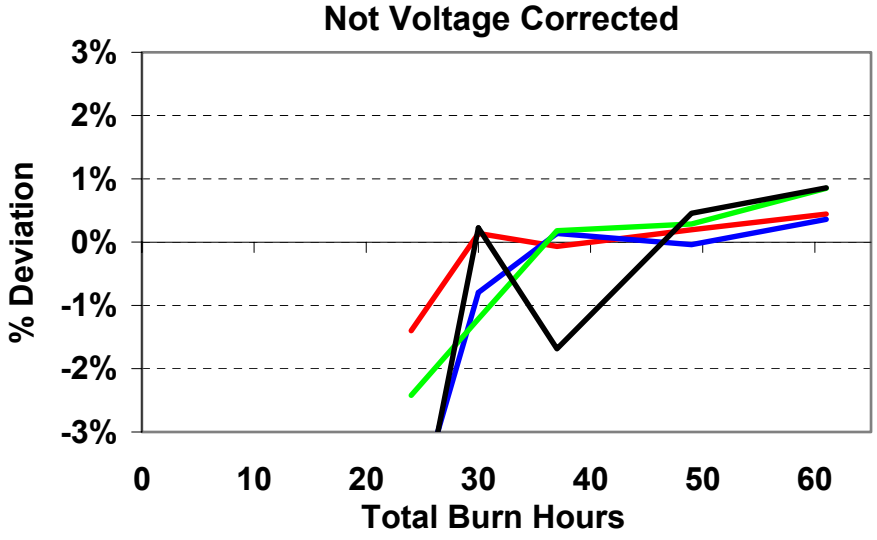
Calibration Numbers: Percent Deviation from the mean
For Lamp Burn Hours: 24, 30, 37, 49, 61

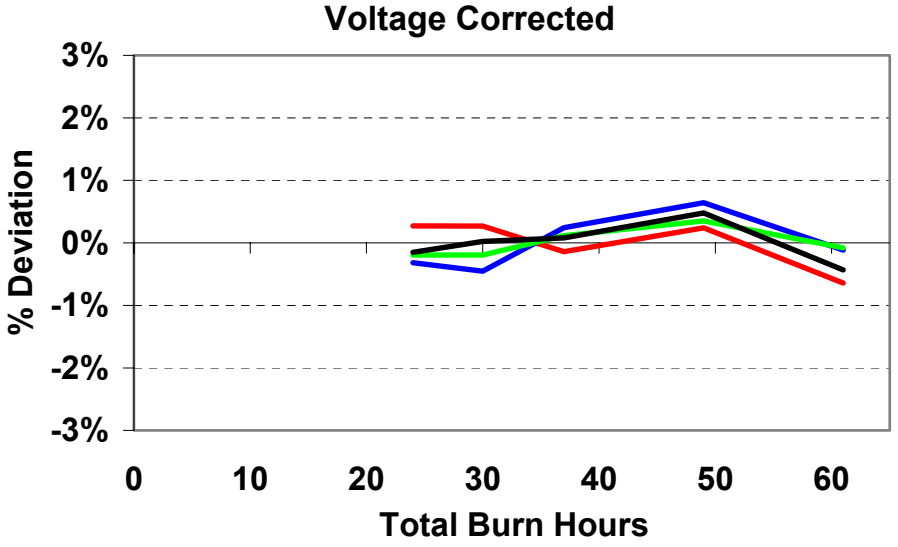
CONTINOUS LAMPS



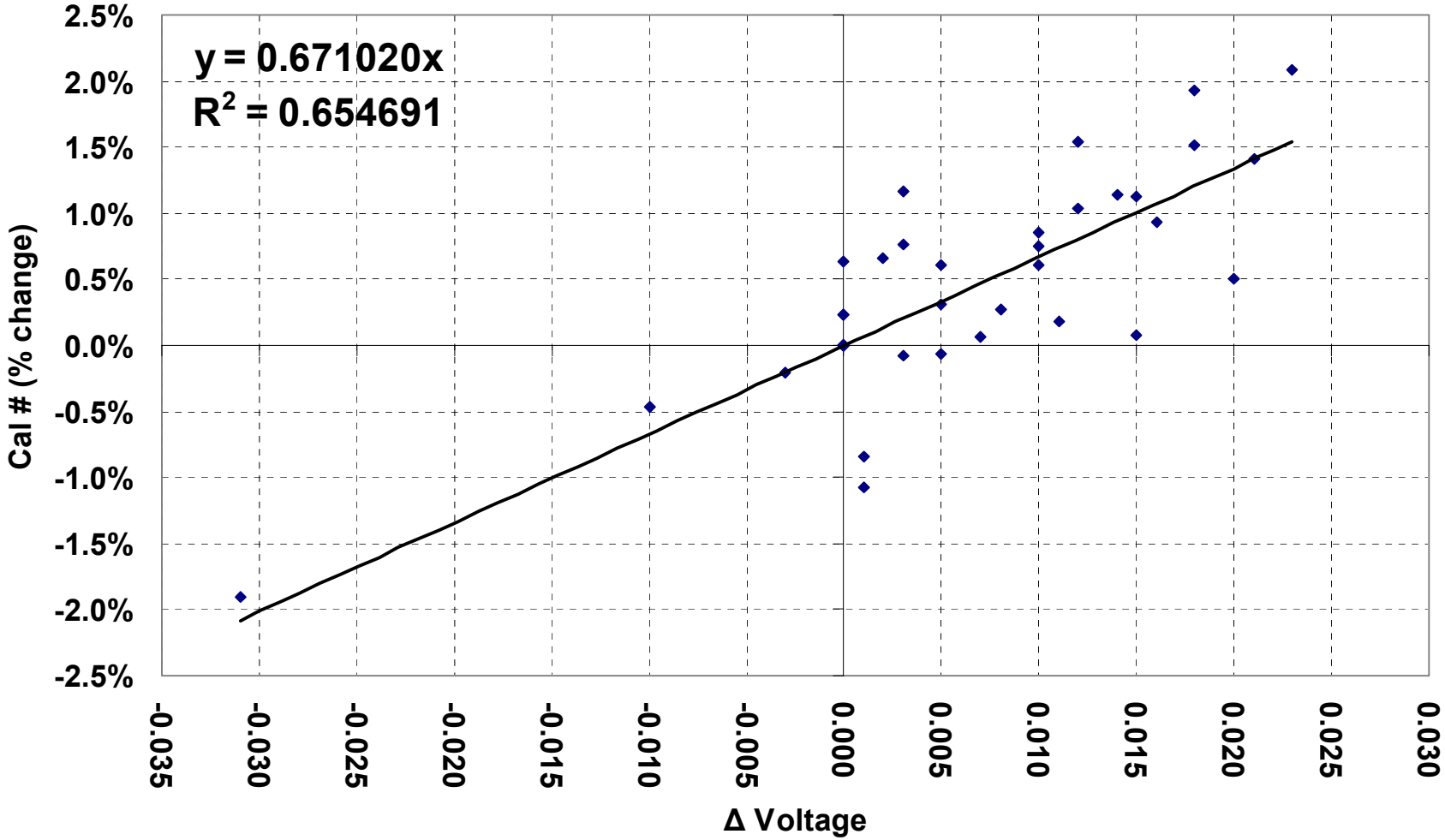


CYCLED LAMPS





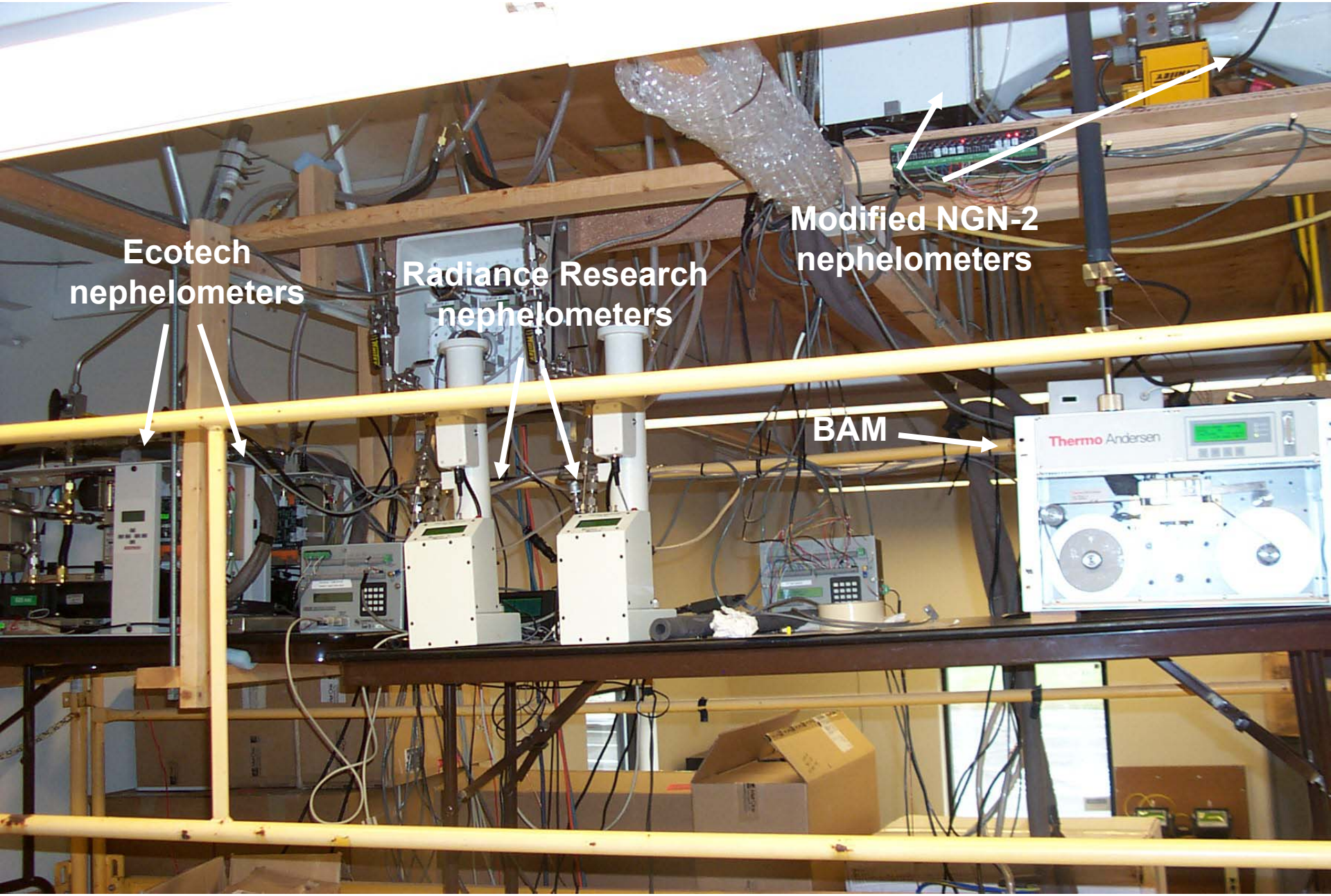
Voltage Correction used for Lamp Burn Time Test

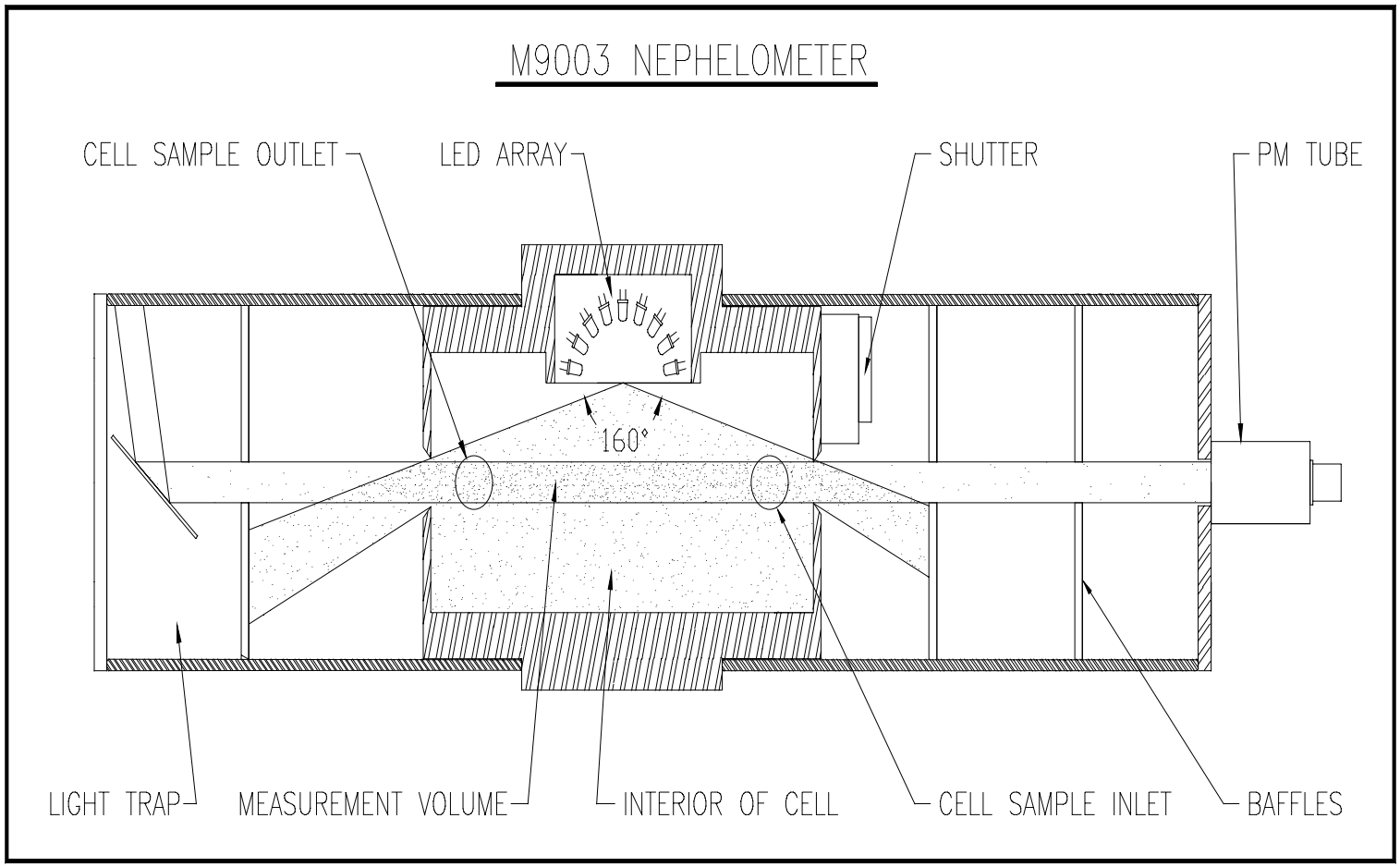


Nephelometer Tests

Operational Comparison of Optec, Radiance Research and Ecotech Nephelometers

- One (1) Optec NGN-2 Ambient Nephelometer
- Two (2) modified size-cut Optec NGN-2 Nephelometers
- One (1) Optec NGN-3 Size-Cut Nephelometer
- Two (2) Ecotech M9003 Integrating Nephelometers
- Two (2) Radiance Research M903 Nephelometers
- Meteorological parameters


Ecotech
nephelometers
Radiance Research
nephelometers
Modified NGN-2
nephelometers
BAM
Thermo Andersen



Measurement Cell of Nephelometer

NGN-2

(Mm-1)

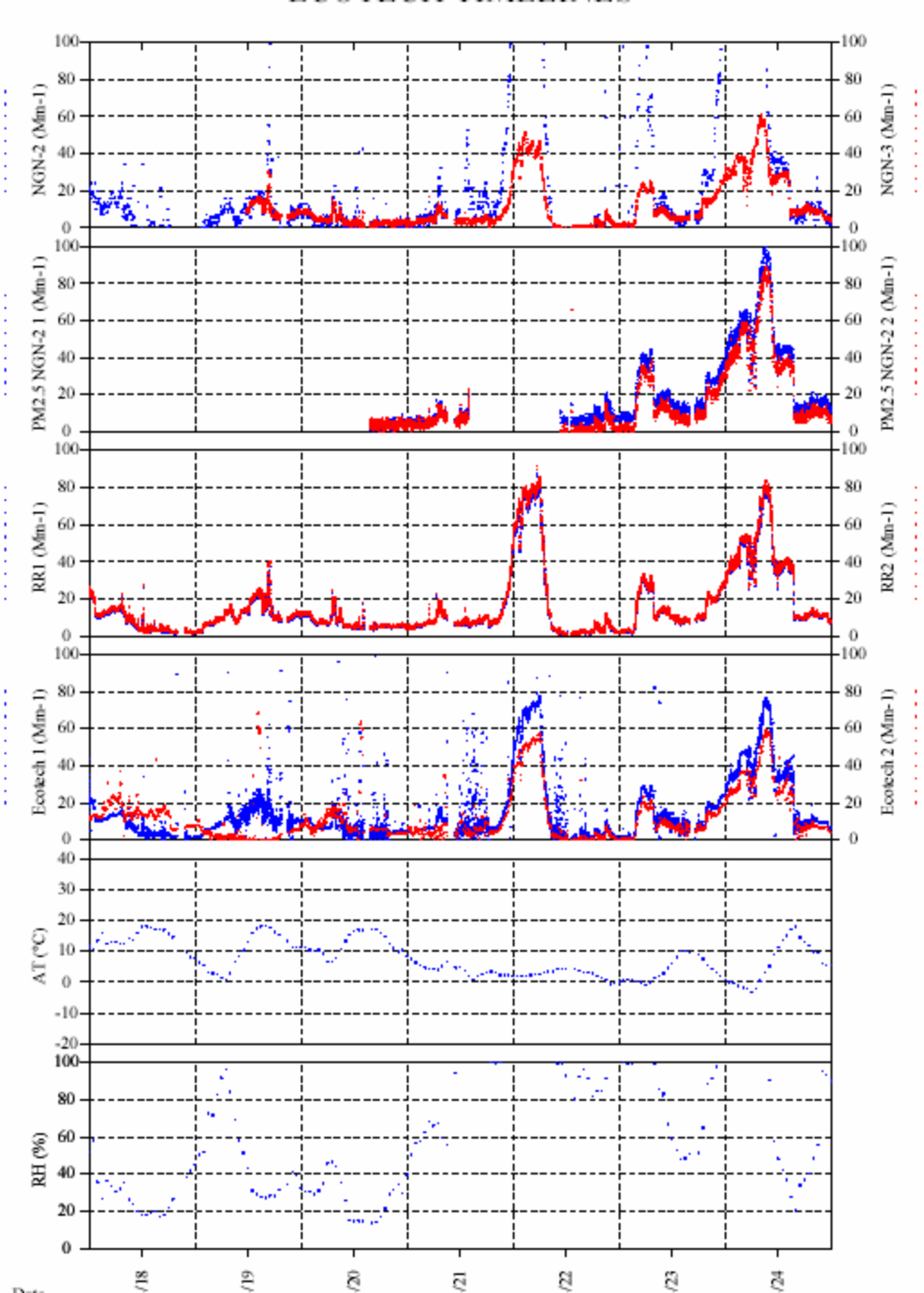
PM 2.5 NGN-2
(Mm-1)

Radiance Res.
(Mm-1)

Ecotech (Mm-1)

AT (°C)

RH (%)



NGN-3

(Mm-1)

PM 2.5 NGN-2
(Mm-1)

Radiance Res
(Mm-1)

Ecotech (Mm-1

NGN-2

(Mm-1)

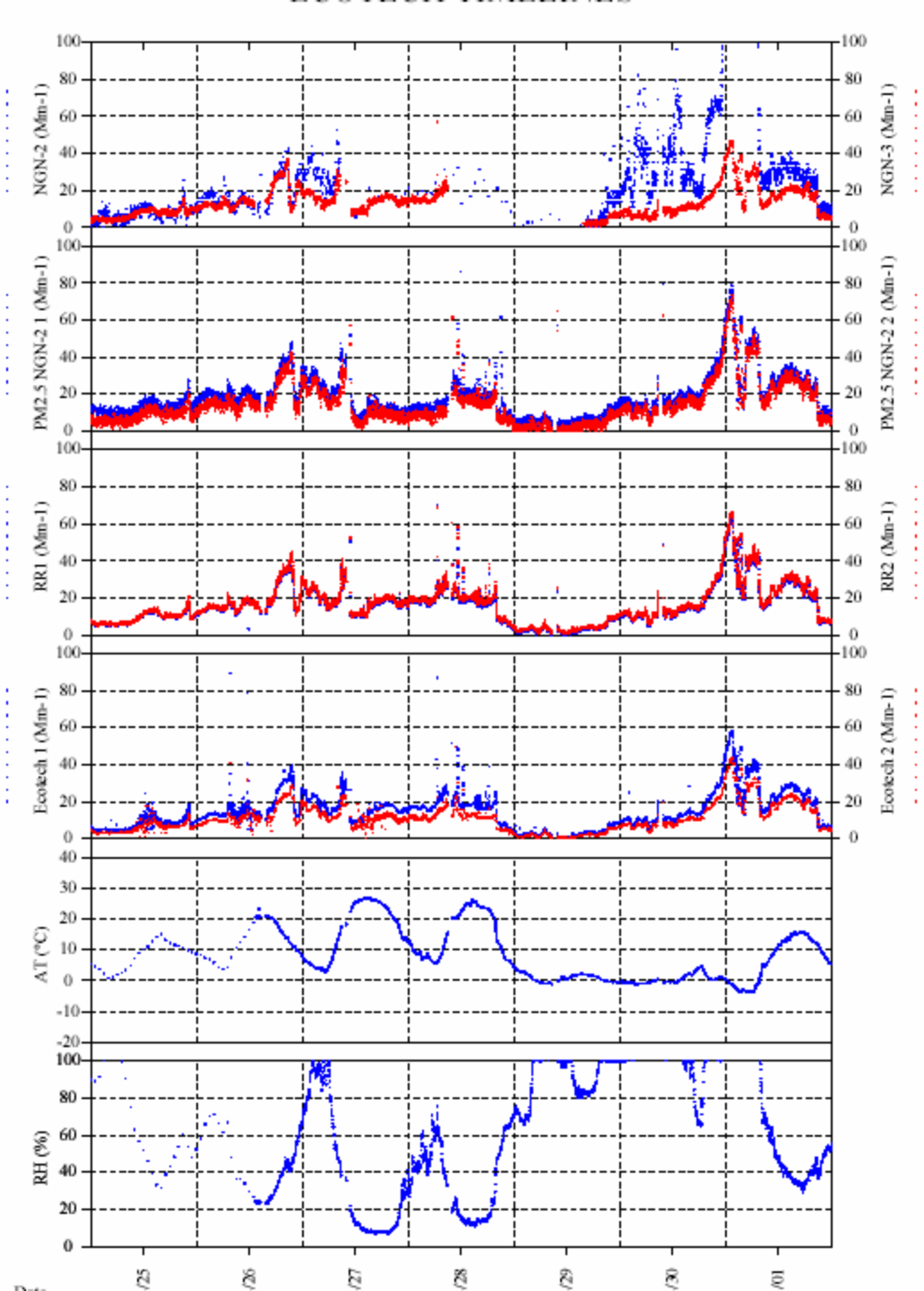
PM 2.5 NGN-2
(Mm-1)

Radiance Res.
(Mm-1)

Ecotech (Mm-1)

AT (°C)

RH (%)



NGN-3

(Mm-1)

PM 2.5 NGN-2
(Mm-1)

Radiance Res
(Mm-1)

Ecotech (Mm-1

NGN-2

(Mm-1)

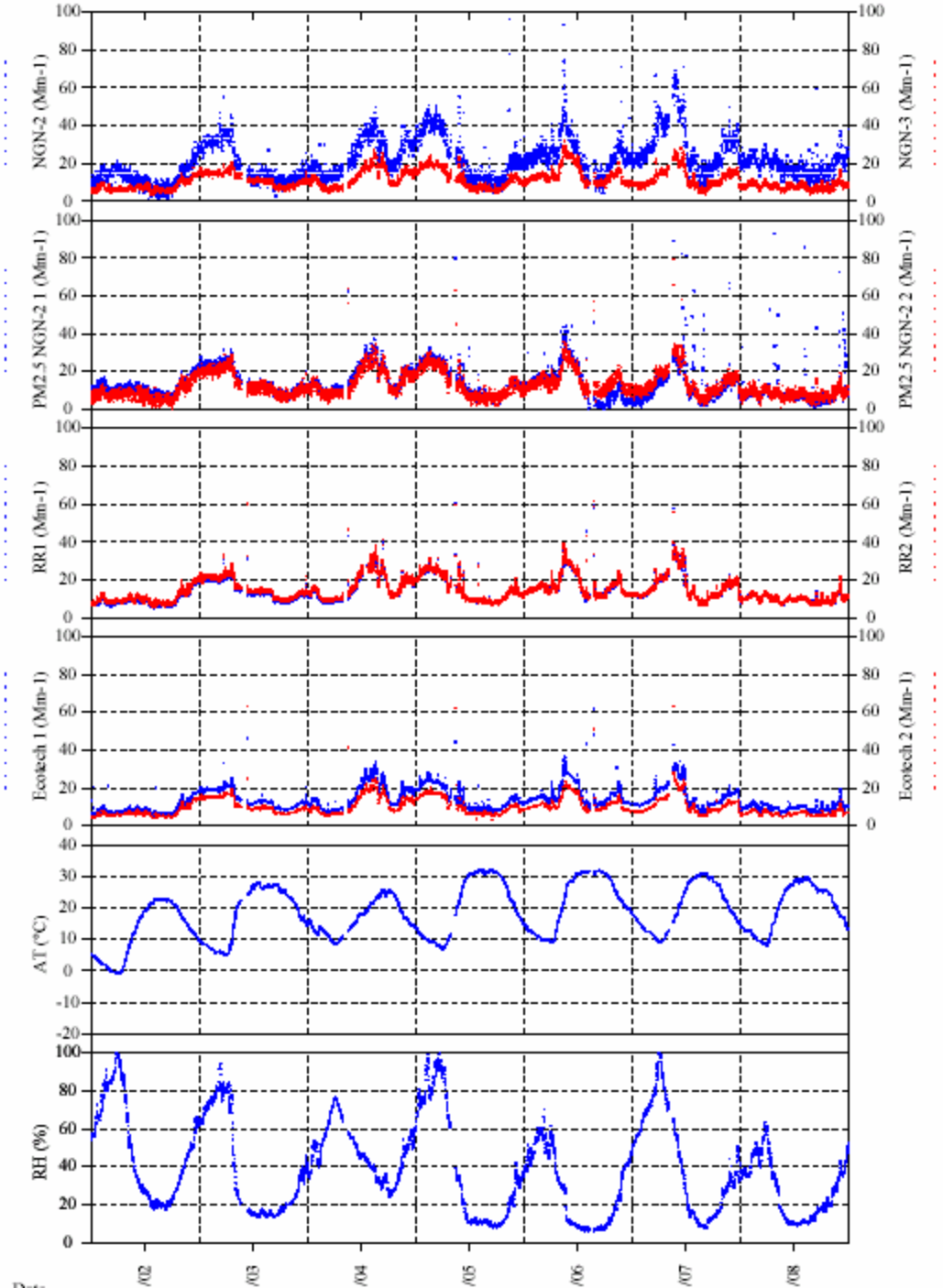
PM 2.5 NGN-2
(Mm-1)

Radiance Res.
(Mm-1)

Ecotech (Mm-1)

AT (°C)

RH (%)



NGN-3

(Mm-1)

PM 2.5 NGN-2
(Mm-1)

Radiance Res
(Mm-1)

Ecotech (Mm-1

NGN-2

(Mm-1)

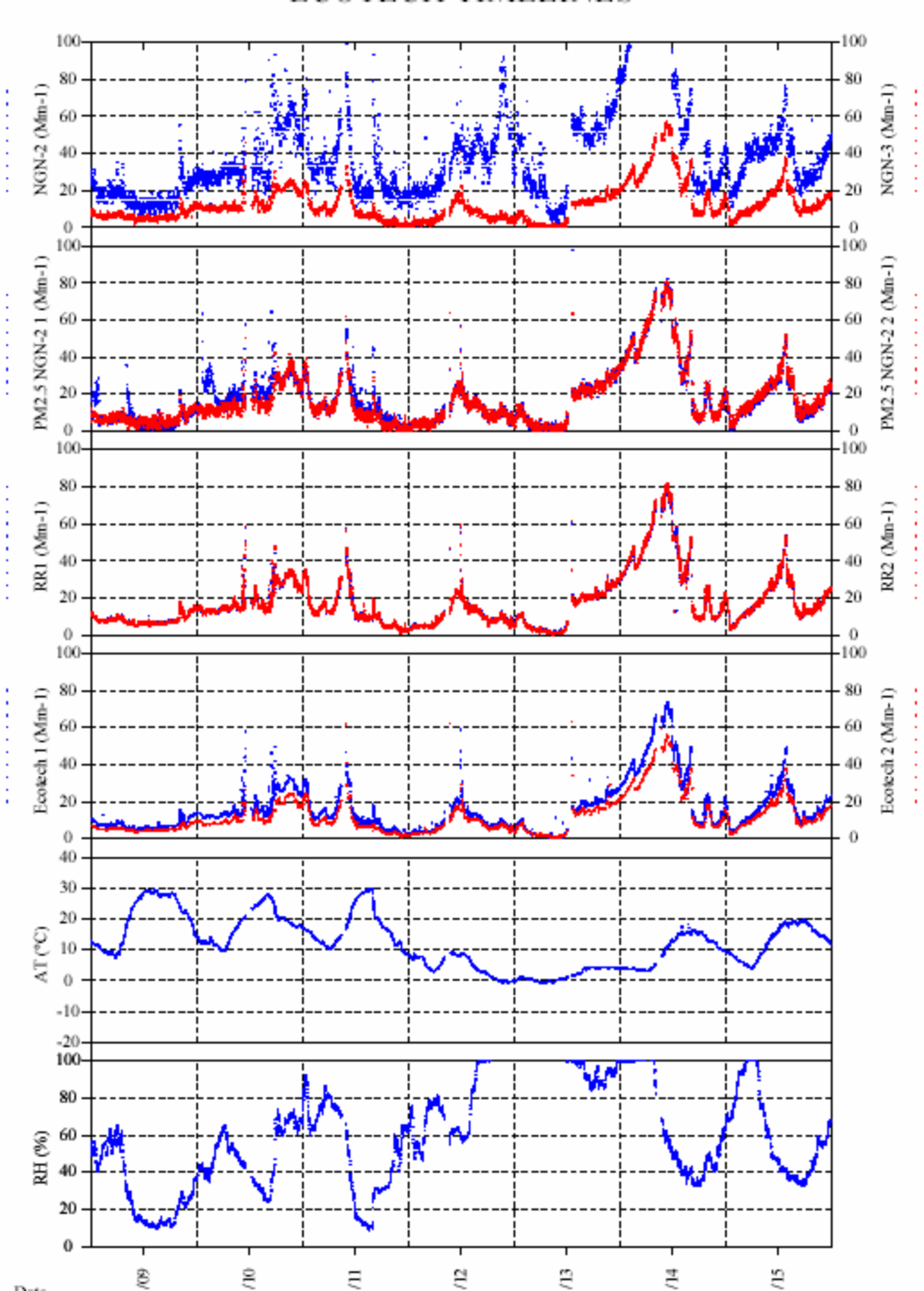
PM 2.5 NGN-2
(Mm-1)

Radiance Res.
(Mm-1)

Ecotech (Mm-1)

AT (°C)

RH (%)



NGN-3

(Mm-1)

PM 2.5 NGN-2
(Mm-1)

Radiance Res
(Mm-1)

Ecotech (Mm-1

NGN-2

(Mm-1)

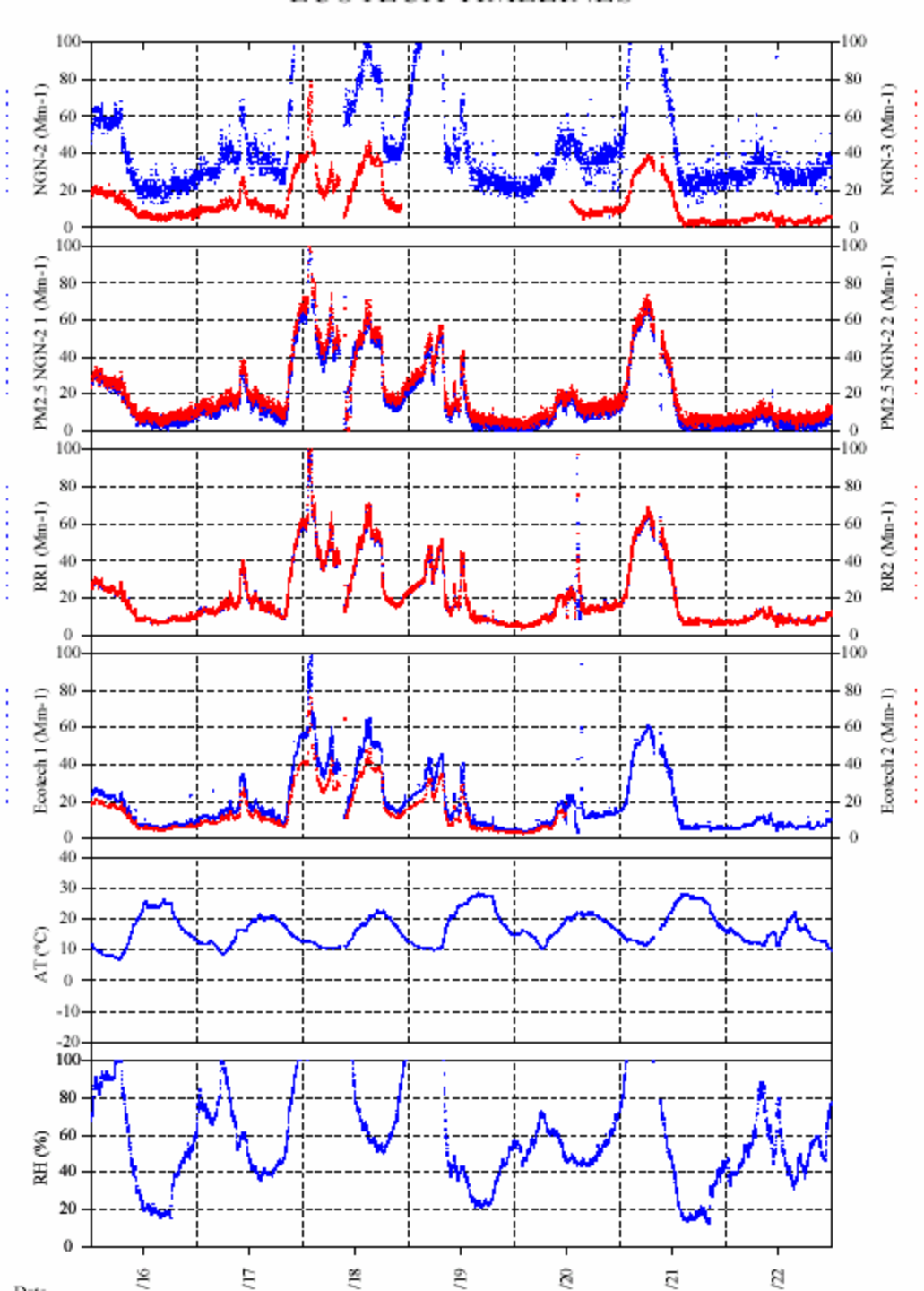
PM 2.5 NGN-2
(Mm-1)

Radiance Res.
(Mm-1)

Ecotech (Mm-1)

AT (°C)

RH (%)



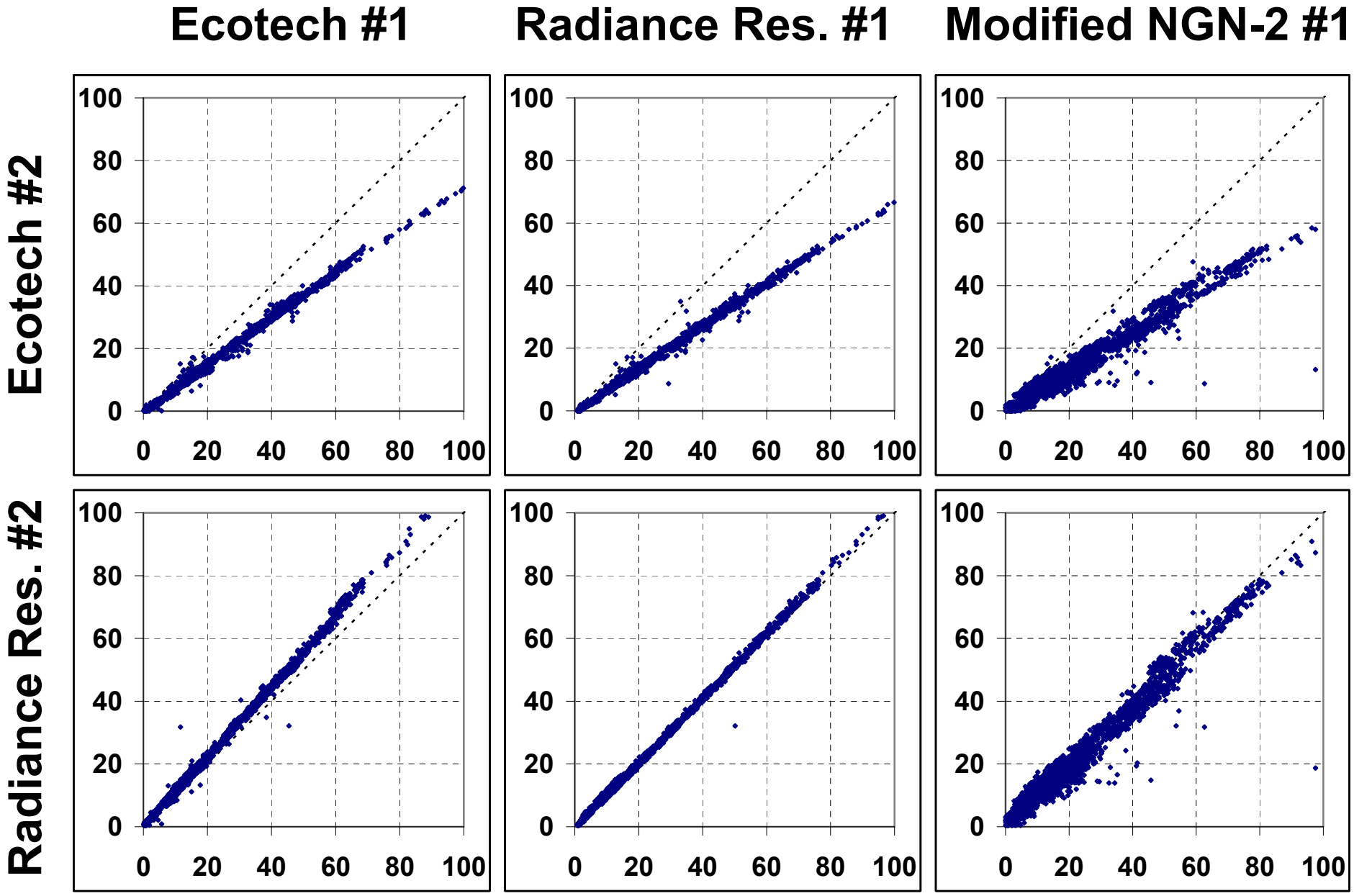
NGN-3

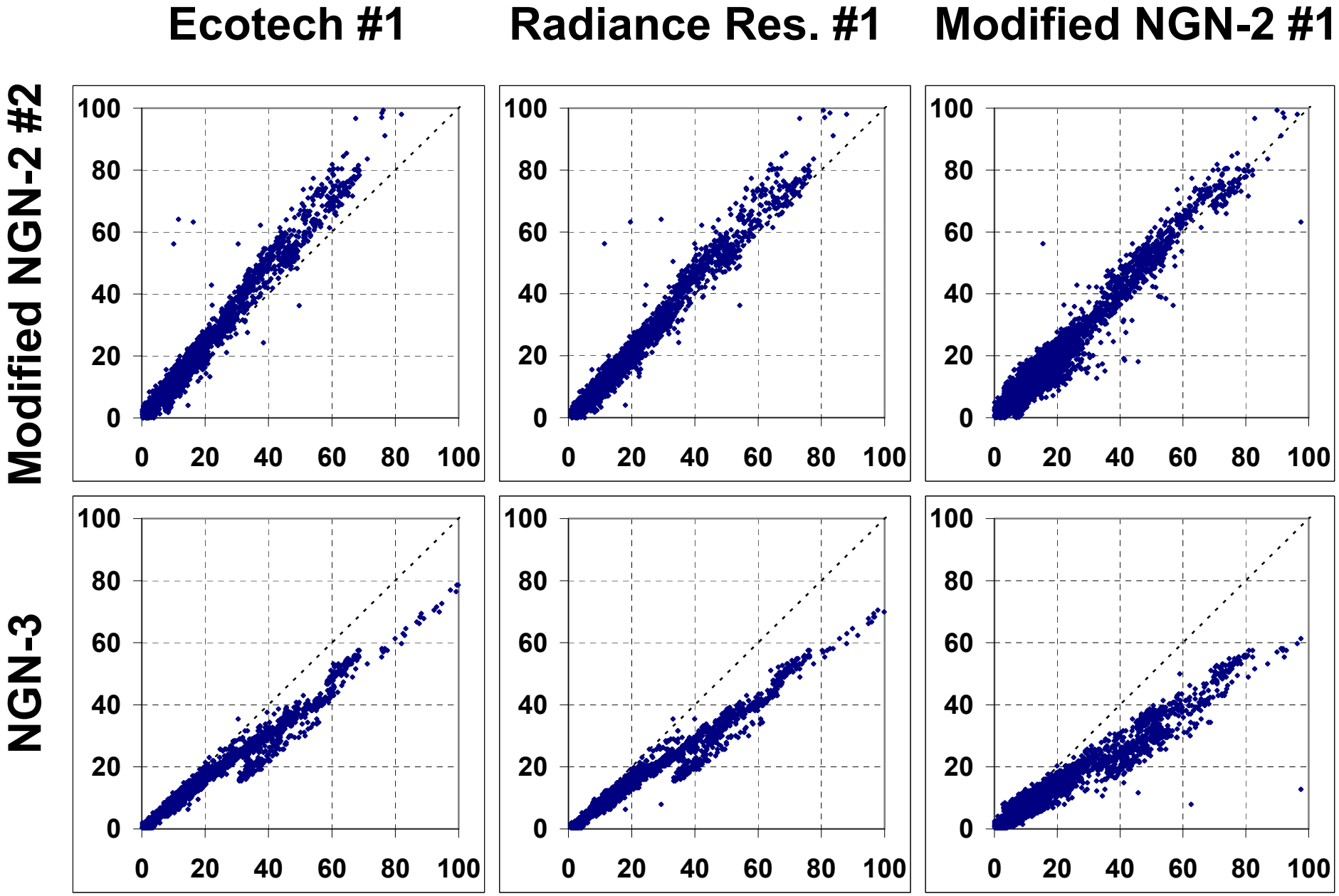
(Mm-1)

PM 2.5 NGN-2
(Mm-1)

Radiance Res
(Mm-1)

Ecotech (Mm-1


Ecotech #1
Radiance Res. #1
Modified NGN-2 #1
Ecotech #2
Radiance Res. #2
0
20
40
60
80
100


Ecotech #1
Radiance Res. #1
Modified NGN-2 #1
Modified NGN-2 #2
NGN-3
0
20
40
60
80
100