



# **PM2.5 ja PM10-mittaaminen ilmanlaatuasetuksen mukaisesti**

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**Ilmatieteen laitos**

**Tutkimus ja menetelmäkehitys**

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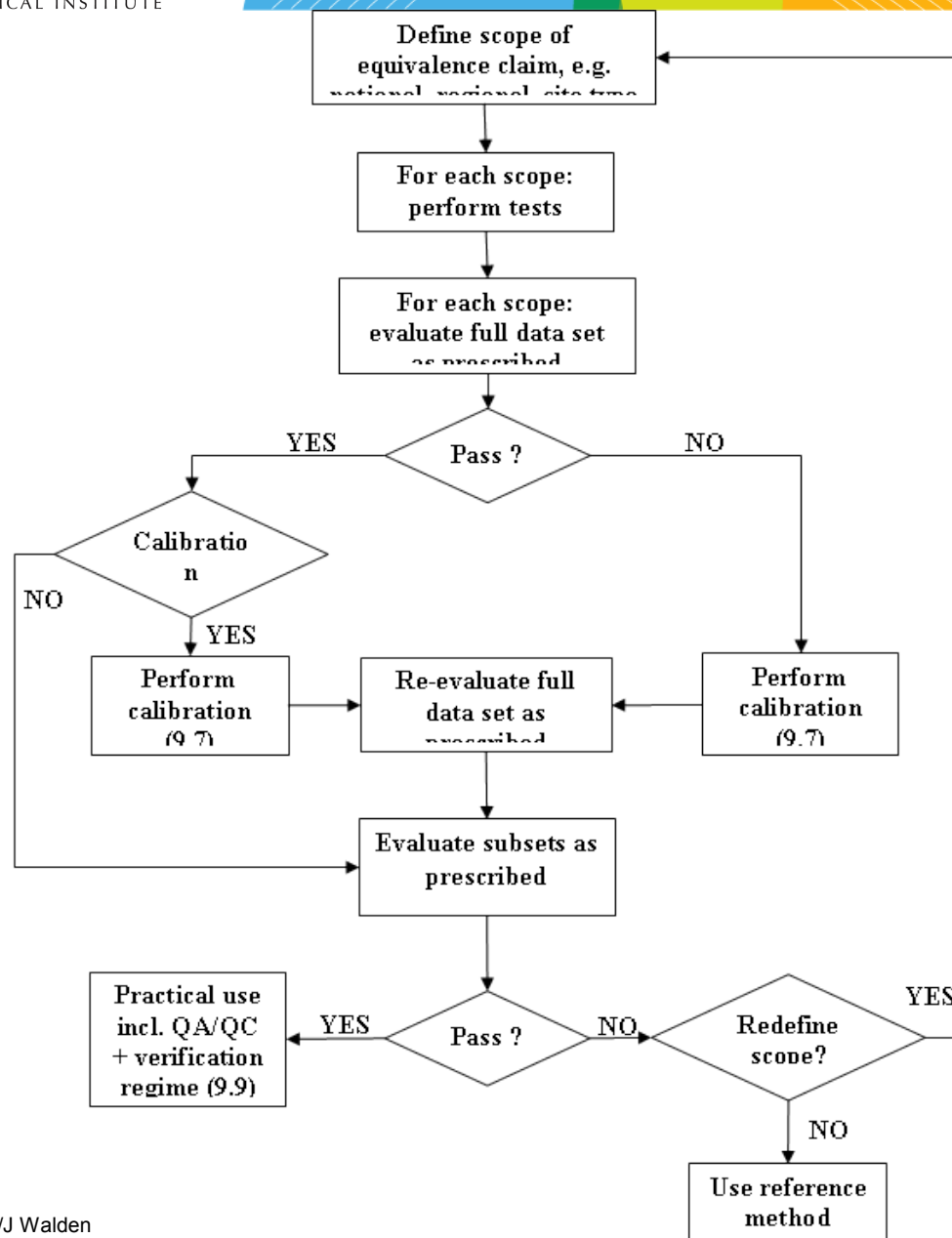
ILMATIETEEN LAITOS  
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FINNISH METEOROLOGICAL INSTITUTE

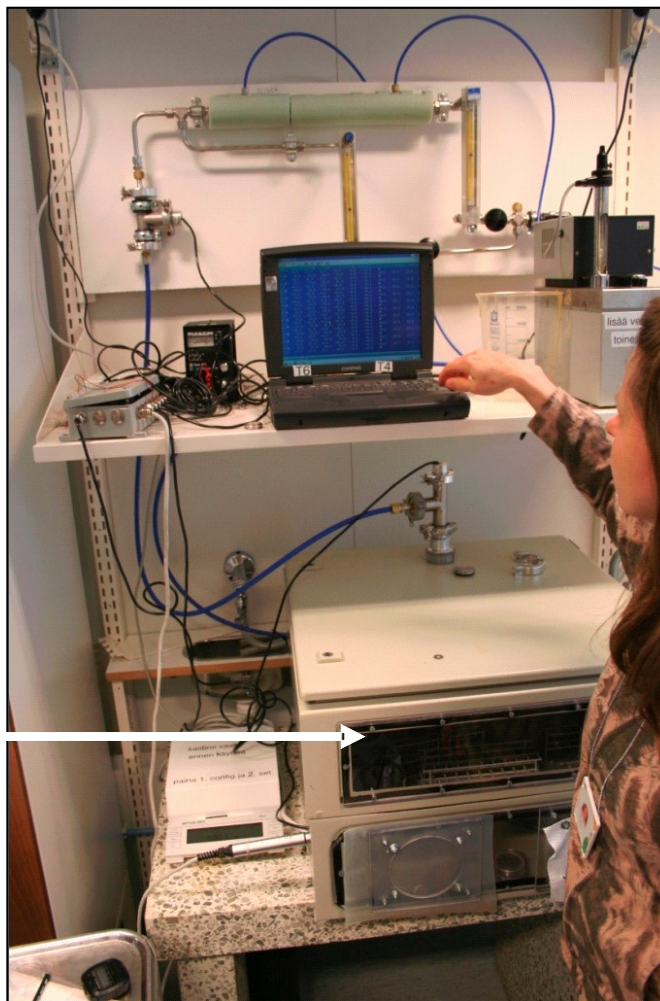
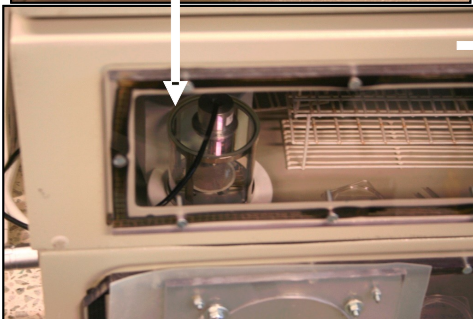
# PM2.5- ja PM10- ekvivalenttisuusmittaukset 2007-2008

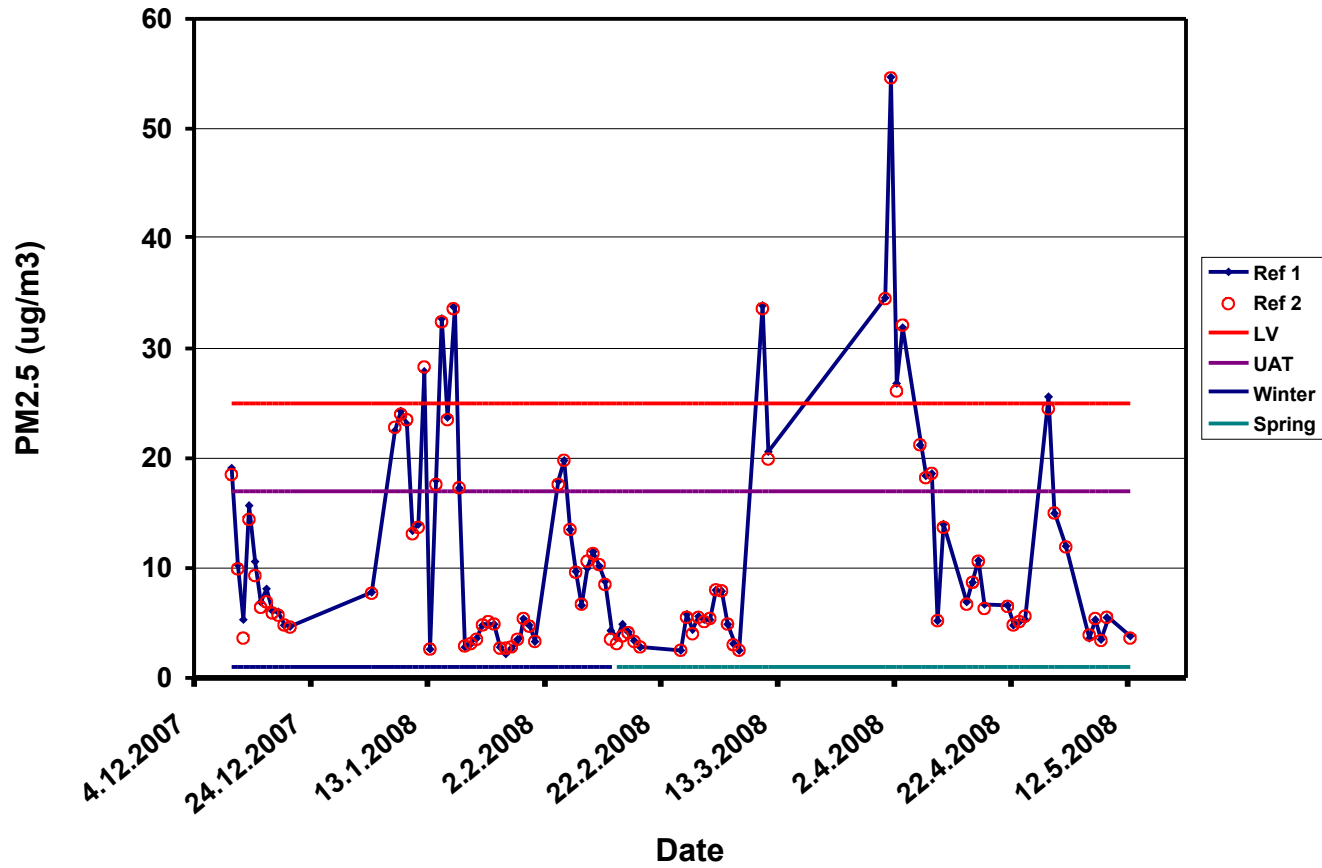


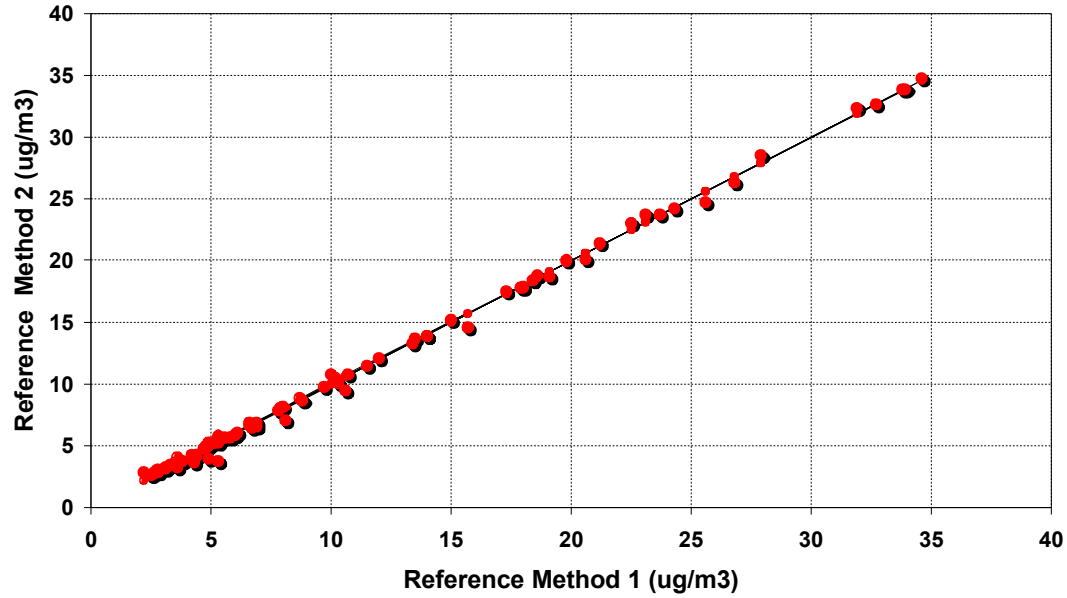


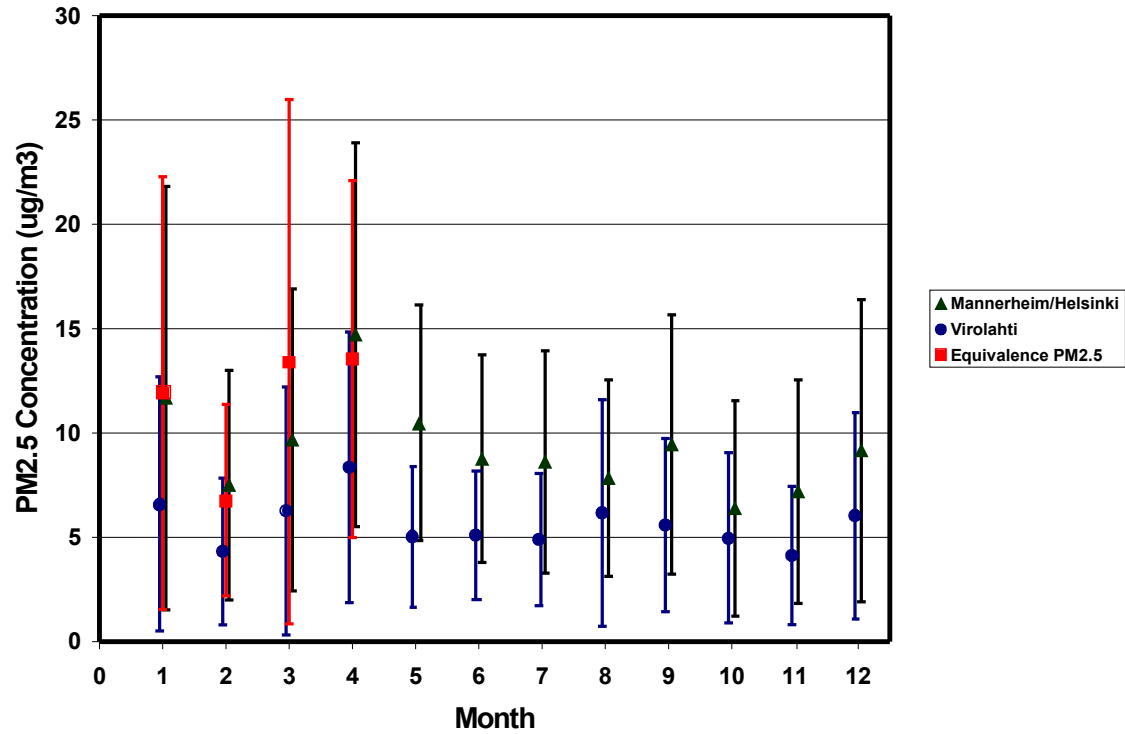
INSTRUMENTS	REPRESENTATIVE / MANUFACTURER	Method	PM2.5/PM10 inlet	Sample flow rate (m <sup>3</sup> /h)	Sample tube	Comparisons: PM2.5/PM10
REFERENCE SAMPLER (KFG)	FMI + MCZ (Germany)	Manual sampler, gravimetric	Digitel / EN	2.3 m <sup>3</sup> /h		PM2.5/PM10
ELPI-impactor	DEKATI (Finland)	Impactor, gravimetric	Digitel TSP	1.8 m <sup>3</sup> /h		PM2.5
Environnement MP-101	ENVIRONNEMENT SA (France)	β-attenuation	Environment EN	1.0 m <sup>3</sup> /h	Shield tube, ambient temp	PM2.5/PM10
GRIMM-180	EKONIA (Finland) / Grimm Aerosol Technique, GmbH&Co (Germany)	Optical (light scattering)	Grimm	0.072 m <sup>3</sup> /h	Shield tube,	PM2.5/PM10
SHARP	FMI / THERMO Electron Co, (USA)	Light scattering photometer	Digitel /EN	1.0 m <sup>3</sup> /h	Heated 35 °C	PM2.5/PM10
FH-62-IR	FMI / Estonian Environmental Research Centre (Estonia)	β-attenuation	Digitel /EN	1.0 m <sup>3</sup> /h	Heated 35 °C	PM2.5/PM10
VEREWA	PPM-Systems (Finland)	β-attenuation	Verewa EN	1.0 m <sup>3</sup> /h	Heated 40 °C	PM2.5/PM10
TEOM-1400A	Helsinki Region Environmental Services Authority, HSY (Finland), City of Turku (Finland) & University of Lund Sweden	Tapered Element Oscillating Microbalance	TEOM PM + 2.5 cyclone/EN ; TEOM PM10/EN	1.0 m <sup>3</sup> /h	Heated 50 °C	PM2.5/PM10
OSIRIS	Hnu-Nordion (Finland) / Turnkey Instruments	Optical (nephelometer)	Osiris	0.036 m <sup>3</sup> /h	Heated 35 °C	PM2.5/PM10
TEOM FD 1405	Kontram (Finland) / THERMO Electron Co (USA)	Tapered Element Oscillating Microbalance	TEOM PM 2.5 cyclone/EN	1.0 m <sup>3</sup> /h	Shield tube,	
IVL-SAMPLER	Institute for Water and Air (Sweden)	Gravimetric	IVL-inlet	1.0 m <sup>3</sup> /h		

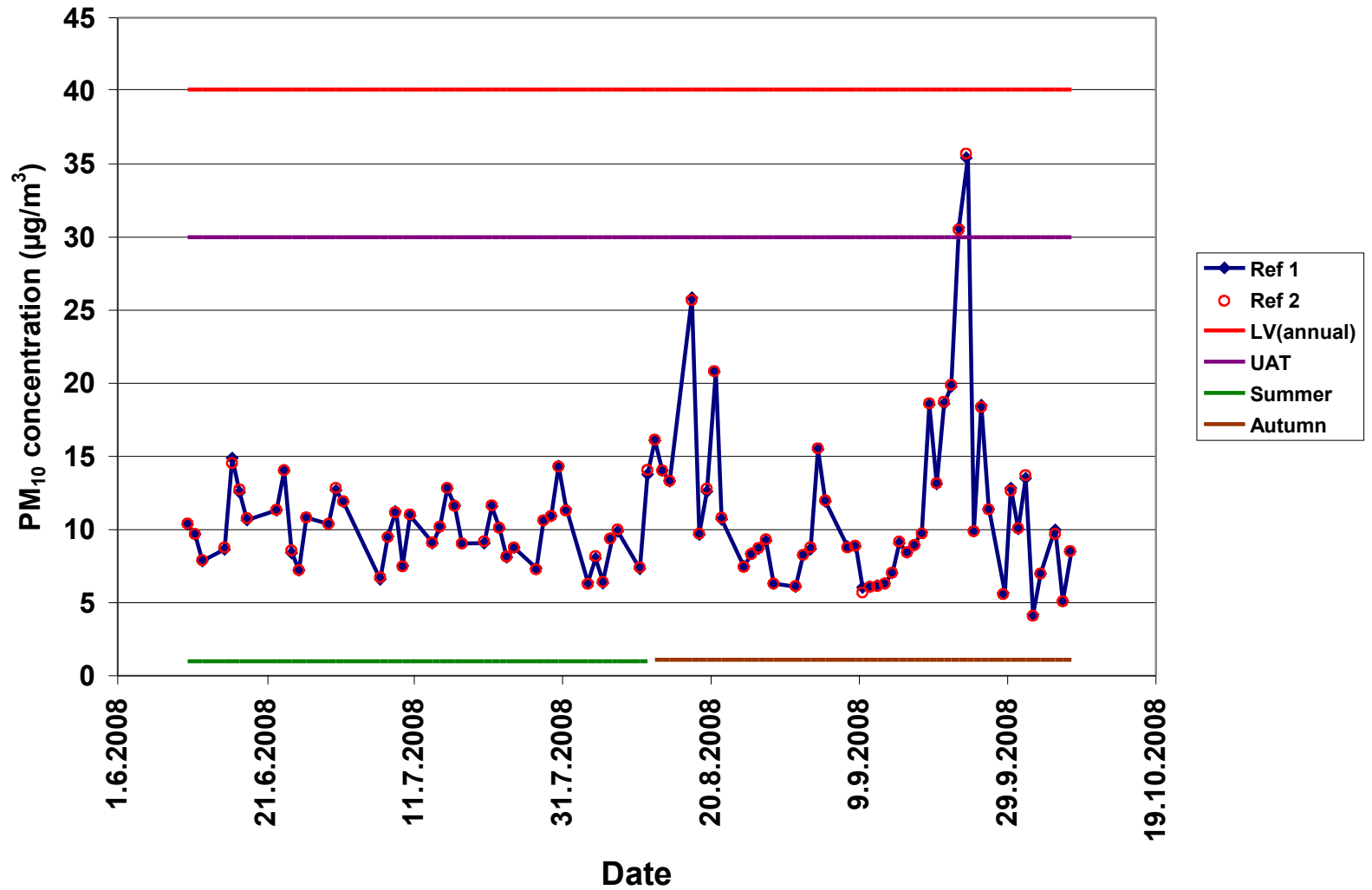


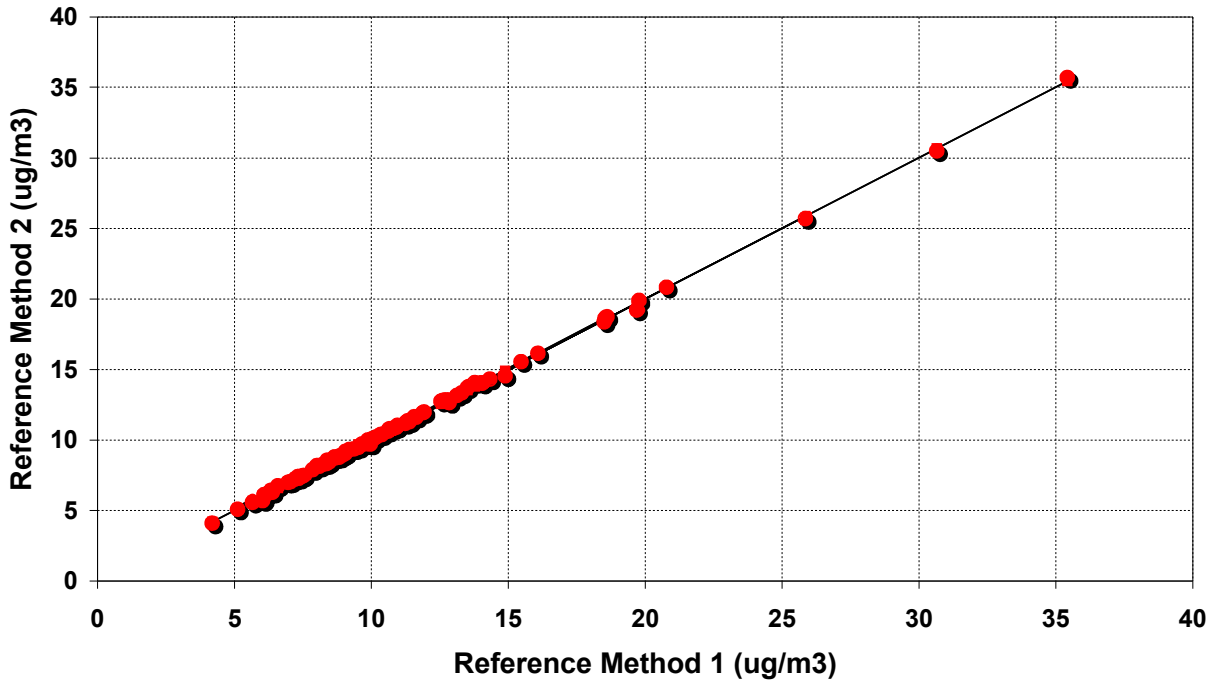


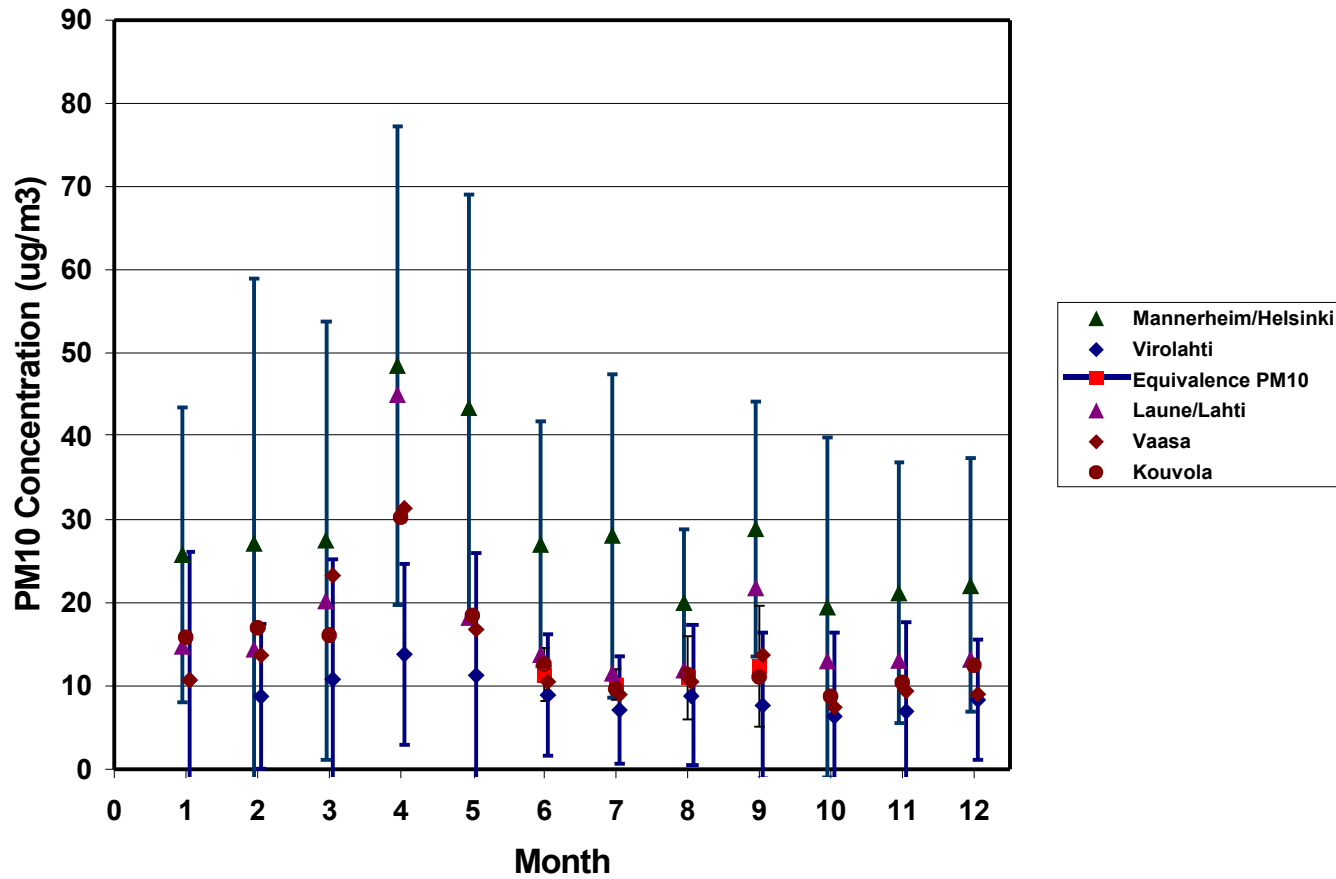












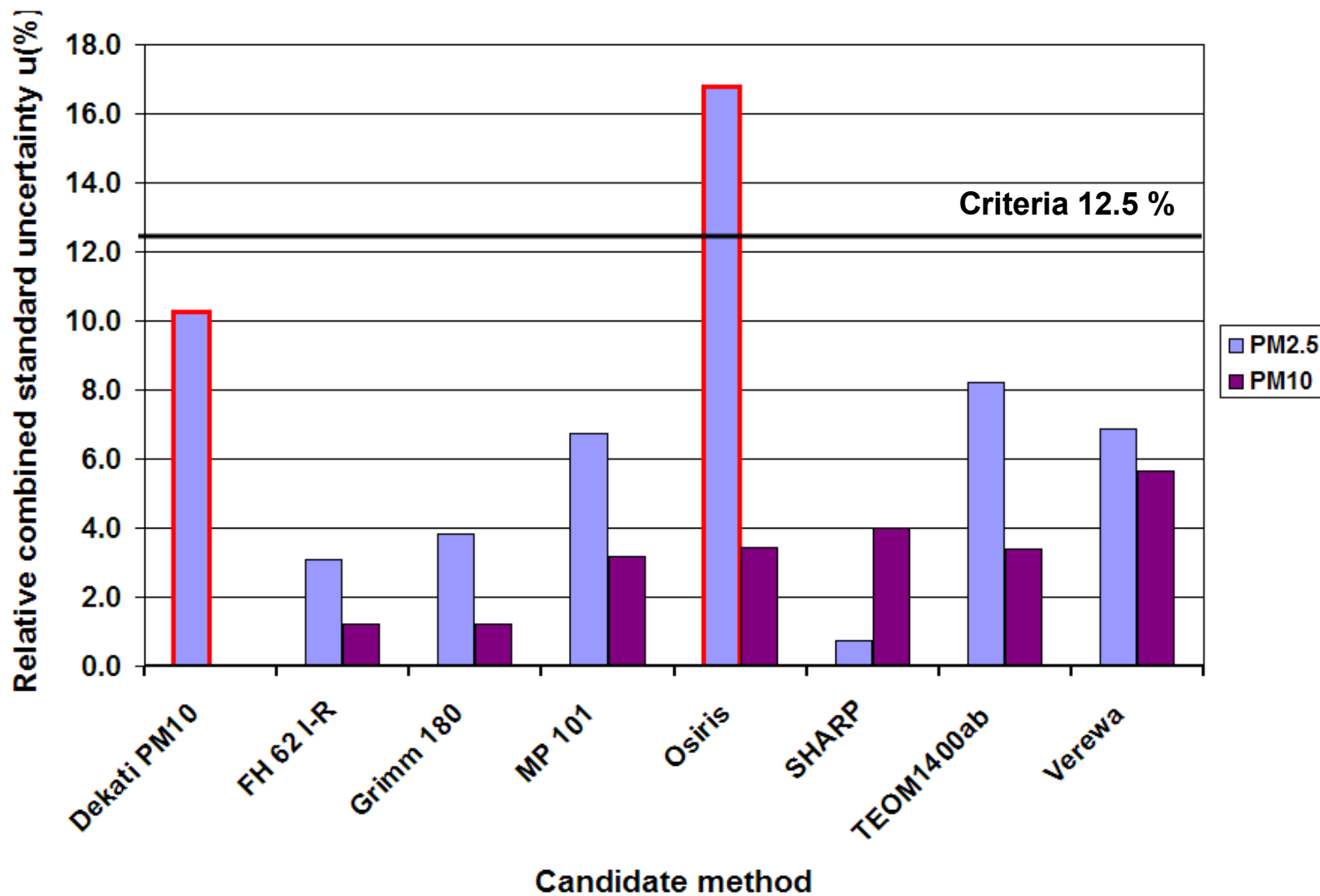


## Yhteenveto kalibroitikertoimista

Test PM <sub>2.5</sub>	<u>Dekati PM10</u>	<u>FH 62 I-R</u>	<u>Grimm 180</u>	<u>MP 101</u>	<u>Osiris</u>	<u>SHARP</u>	<u>TEOM1400ab</u>	<u>Verewa</u>
Calibration range ( $\mu\text{g}/\text{m}^3$ )		<u>0 - 55</u>	<u>0 - 55</u>	<u>0 - 55</u>		<u>0 - 55</u>	<u>0 - 55</u>	<u>0 - 55</u>
Calibration equation								
Slope	<b>0.89</b>	<b>1.35</b>	<b>0.75</b>	<b>1.92</b>	<b>2.15</b>	<b>1.09</b>	<b>1.28</b>	<b>1.39</b>
Intercept ( $\mu\text{g}/\text{m}^3$ )	<b>-0.95</b>	<b>-0.73</b>	<b>-0.31</b>	<b>0.98</b>	<b>-1.7</b>		<b>1.7</b>	<b>-1.1</b>
Relative combined standard uncertainty (%)	<b>10.2</b>	<b>3.1</b>	<b>3.8</b>	<b>6.7</b>	<b>16.8</b>	<b>0.7</b>	<b>8.2</b>	<b>6.9</b>
Test PM <sub>10</sub>								
Calibration range ( $\mu\text{g}/\text{m}^3$ )		<u>0 - 36</u>	<u>0 - 36</u>	<u>0 - 36</u>	<u>10 - 36</u>	<u>0 - 36</u>	<u>0 - 36</u>	<u>10 - 36</u>
Calibration equation								
Slope		<b>1.25</b>	<b>0.71</b>	<b>1.85</b>	<b>1.42</b>	<b>Not needed</b>	<b>1.12</b>	<b>1.30</b>
Intercept ( $\mu\text{g}/\text{m}^3$ )		<b>-0.50</b>	<b>1.45</b>	<b>1.10</b>	<b>-1.10</b>	<b>Not needed</b>	<b>1.26</b>	<b>-0.61</b>
Relative combined standard uncertainty (%)		<b>1.2</b>	<b>1.2</b>	<b>3.2</b>	<b>3.4</b>	<b>4.0</b>	<b>3.4</b>	<b>5.6</b>



## Relative combined standard uncertainty





## Ekvivalenttisuustestit Itävalta

### PM2.5

#### Digitel PM2,5

$$c \text{ Equivalence} = c_{\text{Kan korr}} = (c_{\text{Kan}} - 2,40)/0,97$$

#### FH 62 IR mit TRS (Software Version 2.23), PM2,5

$$c \text{ Equivalence} = c_{\text{Kan korr}} = c_{\text{Kan}}/0,824$$

#### Sharp PM2,5

$$c \text{ Equivalence} = c_{\text{Kan korr}} = (c_{\text{Kan}} - 1,48)/0,99$$

#### TEOM FDMS PM2,5

$$c \text{ Equivalence} = c_{\text{Kan korr}} = (c_{\text{Kan}} - 2,23)/0,95$$

#### Metone PM2,5 (EPA Kopf)

$$c \text{ Equivalence} = c_{\text{Kan korr}} = (c_{\text{Kan}} + 1,37)/0,99$$

#### Grimm 180, PM2,5

vorläufiges Ergebnis, 2 weitere Messkampagnen bis Mitte 2009

$$c \text{ Equivalence} = c_{\text{Kan korr}} = (c_{\text{Kan}} - 2,02)/1,12$$



## Ekvivalenttisuustestit Itävalta

### **PM10:**

**Digitel PM10 als automatischer Filterwechsler, im klimatisierten Container eingebaut:**

**c Equivalence = cKan korr = (cKan -1,76)/0,94**

**FH 62IR mit TRS (Software Version 2.23), PM10**

**c Equivalence = cKan korr = (cKan +1,43)/0,85**

**Sharp PM10**

**c Equivalence = cKan korr = cKan /1,013**

**TEOM FDMS 1400, PM10 (EPA Kopf), Trockner Typ C, 10°C  
Filtertemperatur**

**c Equivalence = cKan korr = (cKan -1,35)/1,02**

**Metone PM10 (EPA Kopf)**

**c Equivalence = cKan korr = (cKan +1,59)/1,06**

**Grimm 180, PM10**

**vorläufiges Ergebnis, 2 weitere Messkampagnen bis Mitte  
2009**

**c Equivalence = cKan korr = (cKan+1,45)/1,18**



## Testiraportteja: OPSIS SM 200: PM2.5 & PM10

Grimm 180

Amsterdam:



## Mittausmenetelmien hyväksyntä:

- Vertailumenetelmä:
    - tyyppitestaustusprosessi (akkreditoitu laboratorio)
    - testitulokset hyväksyttäviä + testiraportti → hyväksytty kaikissa jäsenmaissa (38/2011-Liite 1V + asetuksen muistio: 17.1.2011/Tarja Lahtinen)
  - Ei-vertailumenetelmä:
    - vastaavuus vertailumenetelmän kanssa osoitetaan ekvivalenttisuusohjeen mukaisesti (Demonstration of Equivalence of Ambient Air Monitoring Methods 2009, EC-working group on guidance for the demonstration on equivalence) (
- (DoE); [http://ec.europa.eu/environment/air/pdf/equivalence\\_report.pdf](http://ec.europa.eu/environment/air/pdf/equivalence_report.pdf)
- hyväksyntä: kansallinen vastuutaho hyväksyy menetelmän (edellyttää ilmasto-olojen ja hiukkasten koostumuksen arvioinnin)
  - vertailtavuus osoitettava kentällä QA/QC toimien avulla (DoE + PrENxxxxx)



## Ongoing QA/QC maintenance and verification of the equivalent method

- To ensure the ongoing quality of the particulate measurement results obtained using the equivalent method
- The results of these tests shall be evaluated yearly
- When the resulting uncertainty falls into a different category, the extent of tests for the next year shall be changed accordingly.
- When the relative expanded uncertainty is  $> 25\%$ , corrective actions shall be taken. These shall include a recalibration of the method
- Minimum of 80 samples/CM/year/Network according to the table need to perform



## Ongoing QA/QC maintenance and verification of the equivalent method

### Requirements for ongoing comparisons with the reference method.

$W_{AMS}$ , %	$\leq 10$	10 - 15	15 - 20	20 - 25
% of sites (number $\geq 2$ ) *	10	10	15	20
Nr of sites (number $\geq 2$ ) *	2	3	4	5

\* The smaller of the two resulting numbers may be applied.

- Esim.  $W_{AMS}$  10 – 15 %: vertailu suoritetaan 2 – 3 asemalla, vähintään 80 vertailunäytettä
- Testituloksia arvioidaan 3 vuoden välein: jos  $W_{AMS}$  muuttuu, muuttuu testattavien asemien lkm taulukon mukaisesti
- DoE-testit uusitaan 5-vuoden välein



## QA/QC-toimet automaattisille PM-laitteille (luonnos)

Calibration, checks and maintenance <sup>a</sup>	Section	Frequency	Lab/ field	Action criteria <sup>b</sup>
Checks of status values of operational parameters (see 7.5.3)	8.4.3	Daily	L	See below
Checks of sensors for temperatures, pressure and/or humidity	8.4.4	Every 3 months <sup>c</sup>	F	± 2 °C ± 1 kPa ± 5% RH
Calibration of sensors for temperatures, pressure and/or humidity	8.4.5	Every year	L / F	
Check of the AMS flow rate(s)	8.4.6	Every 3 months <sup>c</sup>	F	4%
Calibration of the AMS flow rate(s)	8.4.7	Every year	L / F	
Zero check of the AMS reading	8.4.8	Every year	L / F	3 µg/m <sup>3</sup>
Check of the AMS mass measuring system <sup>d</sup>	8.4.9	As recommended by the manufacturer and after repair, but at least every year	L / F	3%
Regular maintenance of components of the AMS	8.5	As required by manufacturer	L / F	

<sup>a</sup> The activities may be performed in the laboratory or in the field.

<sup>b</sup> With reference to nominal values.

<sup>c</sup> The frequency of the checks may be relaxed when sufficient history exists demonstrating that drifts of sensor readings and flow rates remain within the specified requirements. Calibrations shall be performed every year.

<sup>d</sup> For optical AMS this calibration can only be performed by comparison with the reference method or with a transfer standard.



## Yhteenveto

- **Loppuraportti valmis ([www.ilmanlaatu.fi](http://www.ilmanlaatu.fi))**
- **Yhtenäinen käytäntö kalibrointikertoimien suhteen**
- **DoE:n mukainen raportti**
- **Hyväksytyjen laitteiden lista: linkki ilmanlaadun portaalista**
- **Jatkuva vertailu referenssimenetelmän kanssa järjestettävä hiukkasmittauksille**