

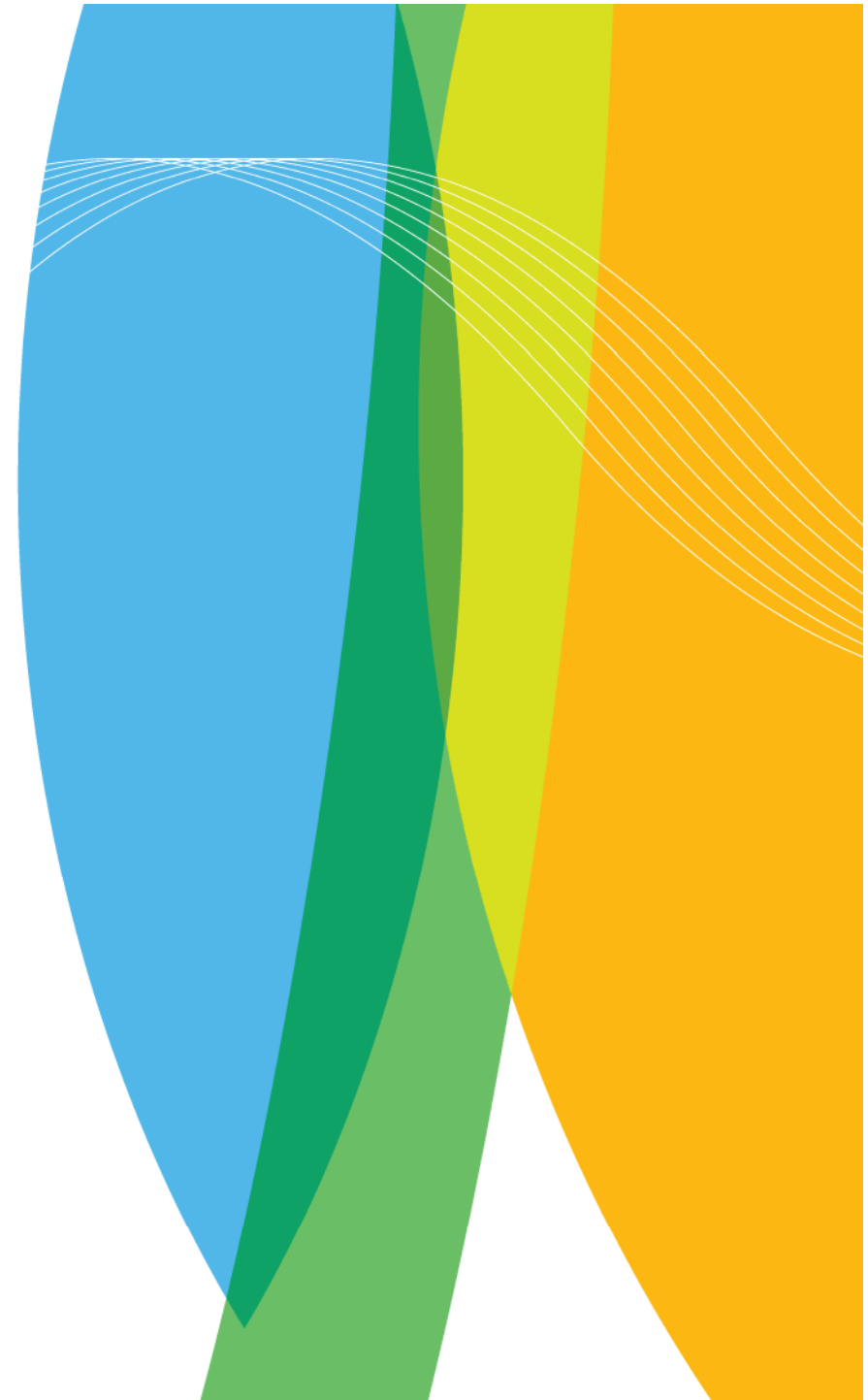


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Assessment of PAH and HMs in Finland

Harri Pietarila, Birgitta Alaviippola
Air Quality Improvement
Study Tour to Finland, May 2007

7.5.2007





Content

- **Preliminary assessment in Finland**
- **Zones and agglomerations**
- **Requirements for on going AQ assessment**
- **National legislation**
- **Dispersion modelling**



Background

- **Framework Directive on ambient air quality assessment and management (96/62/EC)**
 - Monitoring of ambient air quality with standardized measurement techniques and common criteria in EU member states
- **4 Daughter directives**
 - To establish limit/target values and assessment thresholds for concentrations of air impurities
 - To harmonize measurement techniques in order to obtain reliable data throughout the Community



The preliminary assessments of ambient air quality

- **2001: Sulphur dioxide, nitrogen dioxide, oxides of nitrogen, particulate matter (PM₁₀) and lead**
- **2002: Carbon monoxide and benzene**
- **2003: Ozone**
- **2006 June: Heavy metals and polycyclic aromatic hydrocarbons (=PAH-compounds)**
- **Next 2007-2008: fine particles (PM_{2,5})**



Aims of preliminary assessments

- **To define the concentration levels with respect to limit/target values and assessment thresholds**
 - zones and agglomerations for AQ assessment and management
 - methods and level of continuous AQ assessment
 - continuous monitoring of ambient air quality
- **To present assessment methods and data used:**
 - Air quality measurements
 - Dispersion modelling
 - Emission inventories
- **Reporting to the Ministry of Environment in Finland**
 - **Finnish local and regional environmental authorities & public**
 - **EU Commission**



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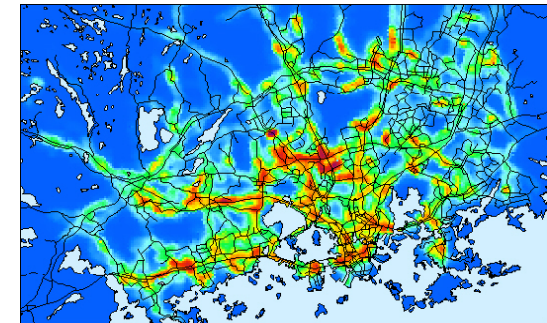
Assessment thresholds and related ongoing assessment methods



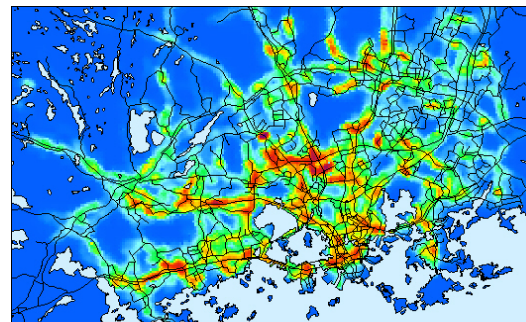
Upper assessment threshold



&



Lower assessment threshold



& objective assessment

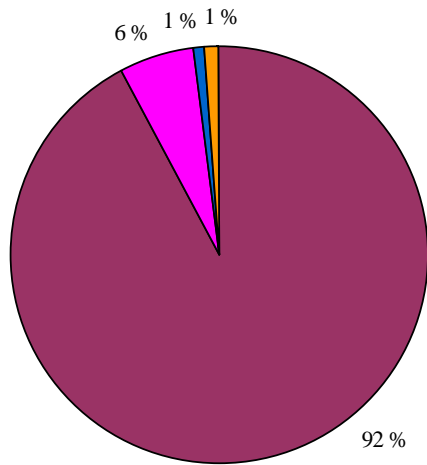


Air quality objectives for heavy metals and PAH-compounds

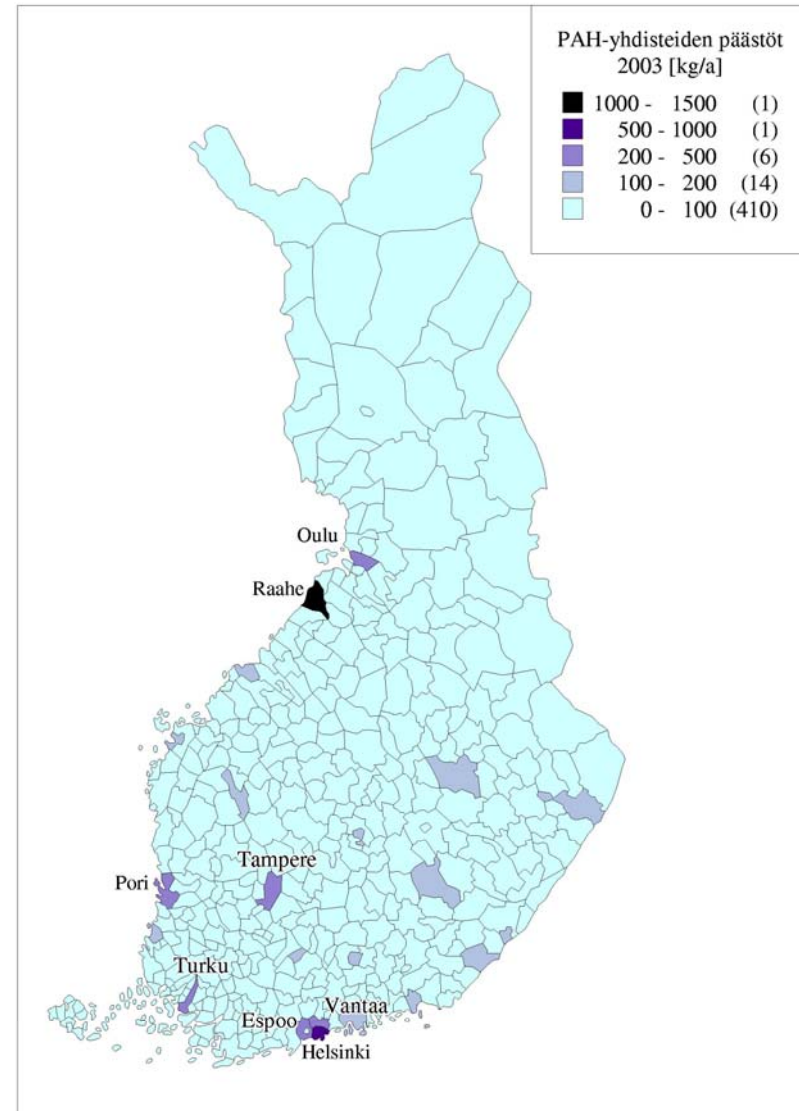
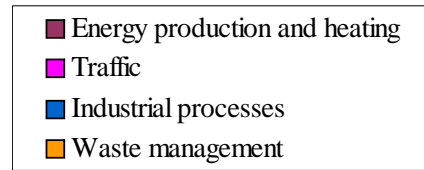
	Time period	Arsenic	Cadmium	Nickel	Benzo(a)pyrene
Target value ng/m ³	calender year	6	5	20	1
Upper assessment threshold ng/m ³	calender year	3,6	3	14	0,6
Lower assessment threshold ng/m ³	calender year	2,4	2	10	0,4



PAH-emissions 2003



In total 16,7 tons

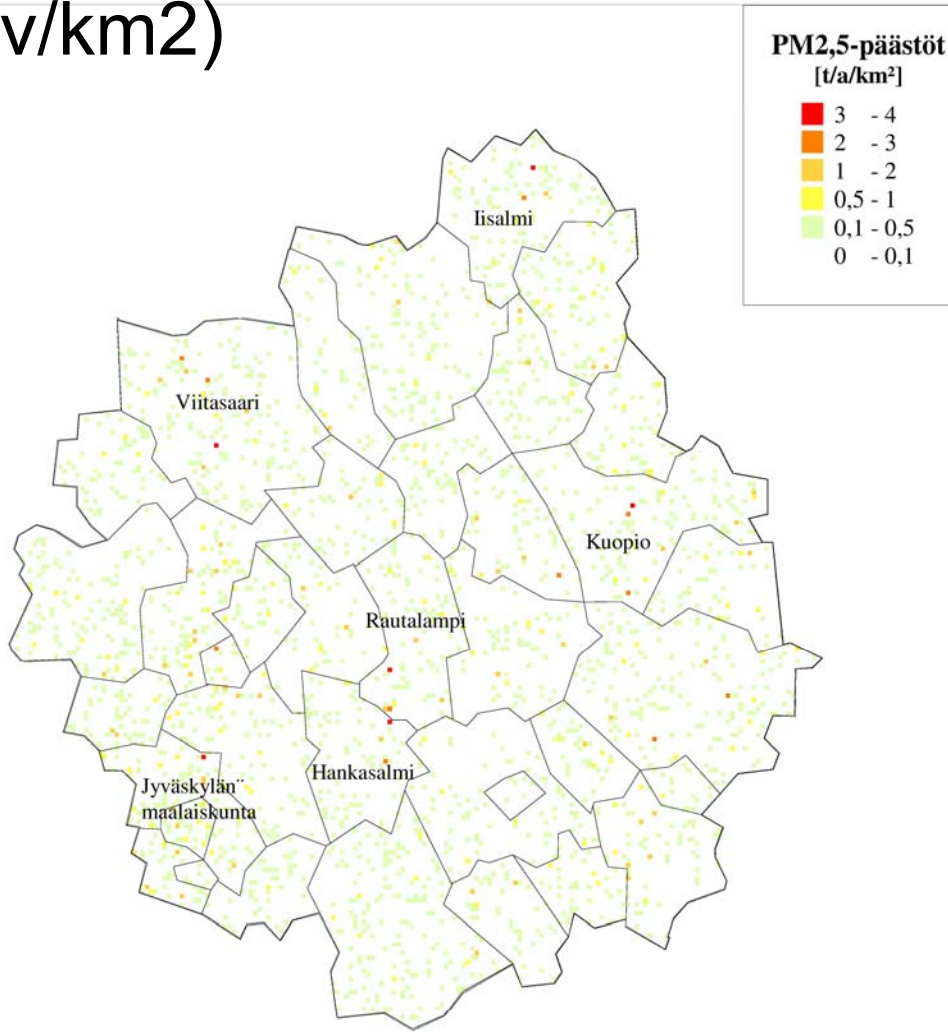


Reference: Finnish Environmental Institute



Emissions from small scale wood burning (PM_{2,5})

(t/v/km²)



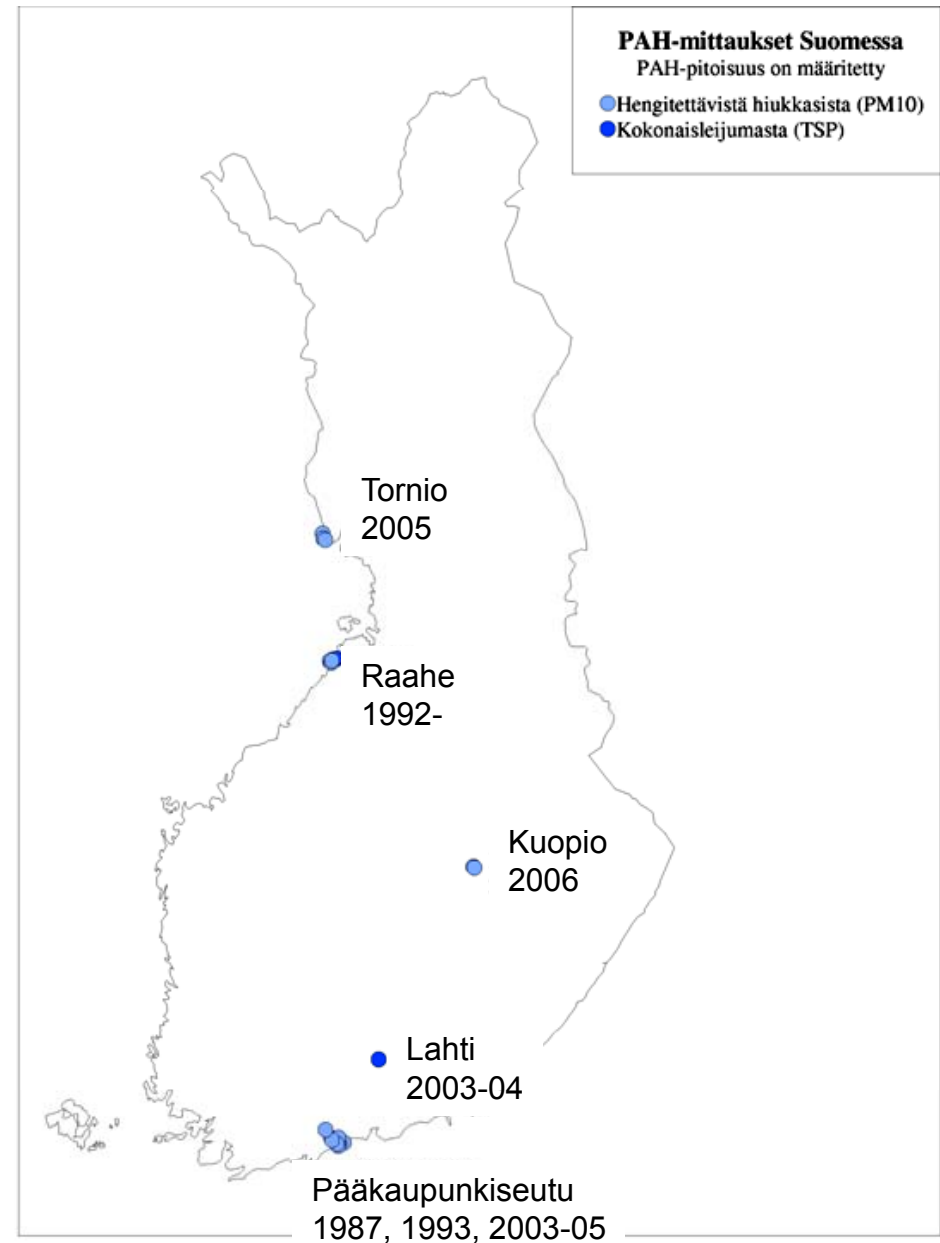
Kunta	PM _{2,5} -päästö (t/a/km ²)
Vesilahti	6,9
Suomussalmi	4,8
Hausjärvi	4,3
Lehtimäki	4,2
Saari	4,1
Viitasaari	3,9
Köyliö	3,8
Ikaalinen	3,7
Rautalampi	3,7
Hankasalmi	3,5
Kuopio	3,5
Pattijoki	3,5
Enontekiö	3,4
Iisalmi	3,4
Virrat	3,3
Ilmajoki	3,1
Mäntyharju	3,1
Iitti	3,1
Pernaja	3,1
Koski Tl	3,1
Jyväskylän mlk	3,1





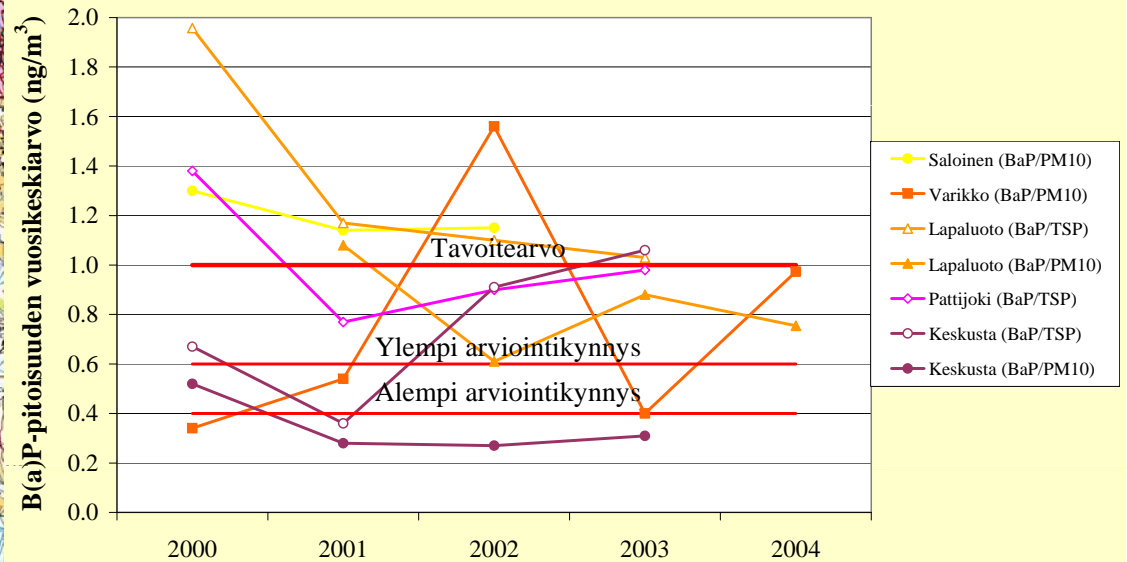
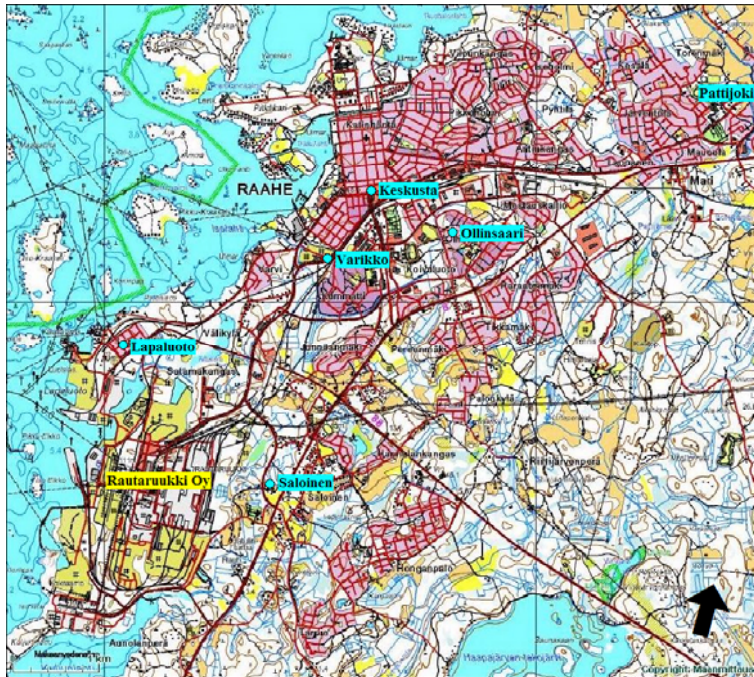
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Measurement of ambient air PAH-compounds in Finland 1992-2006



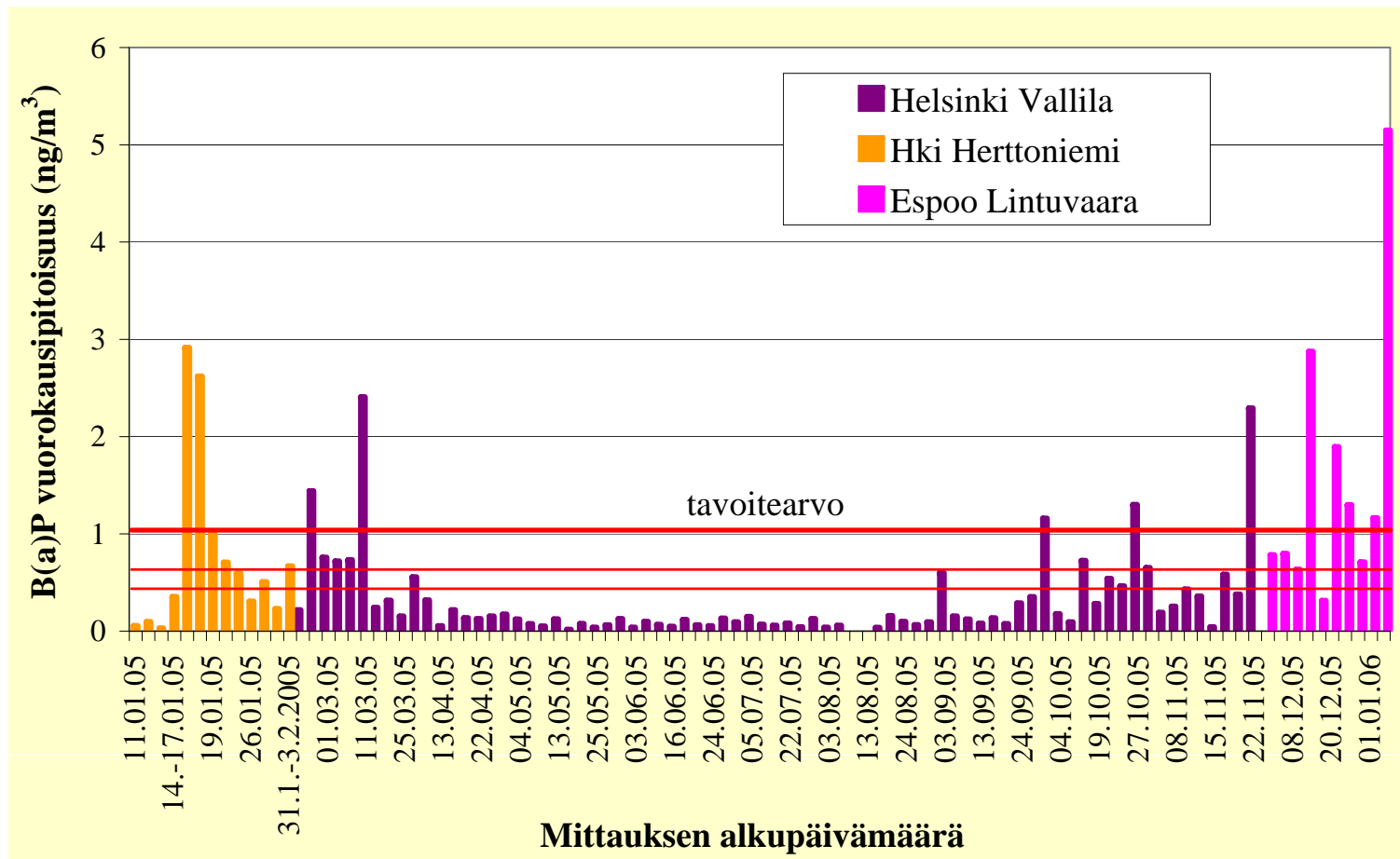


BaP concentrations In the city of Raahe Industrial source



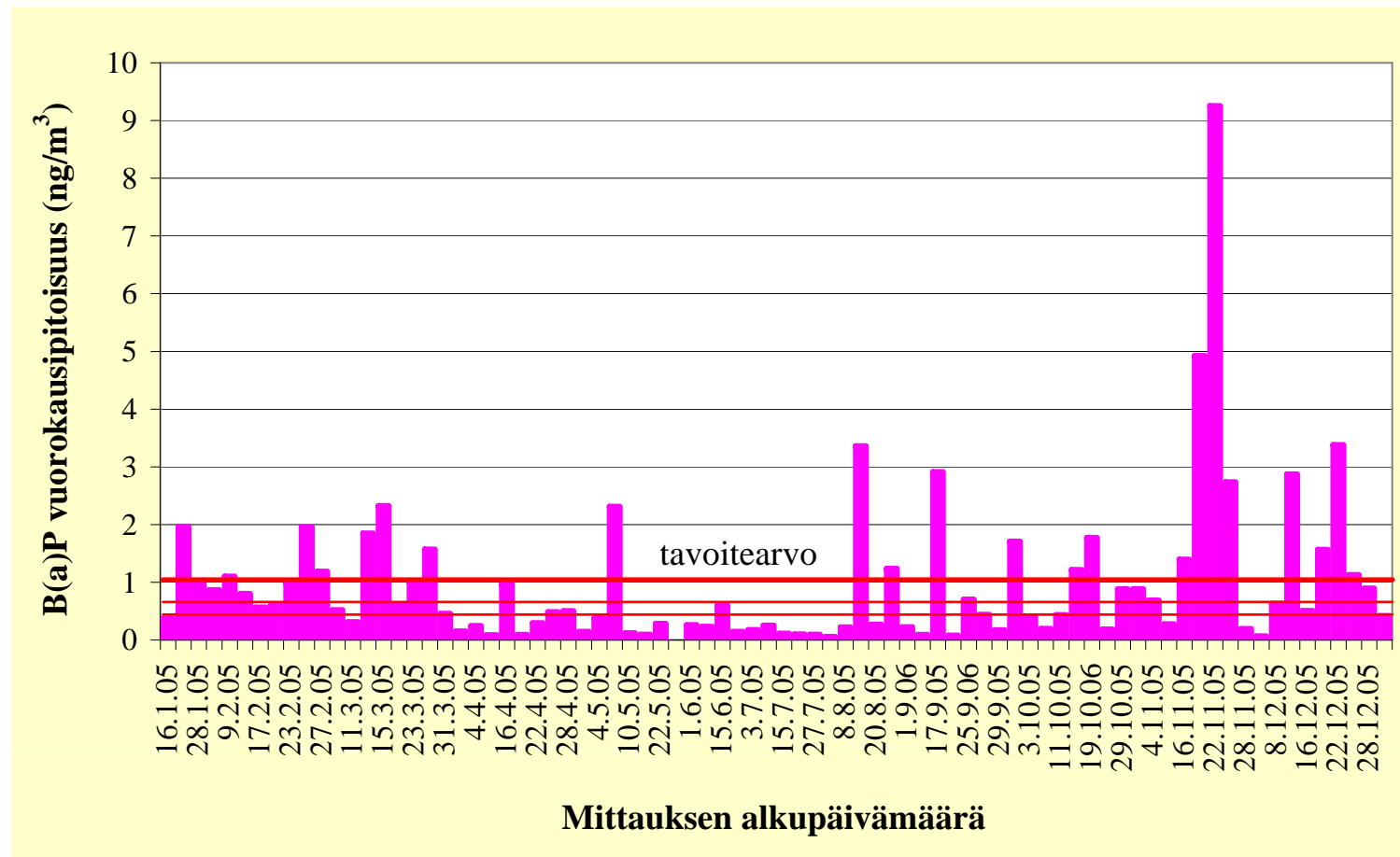


BaP concentrations In the Helsinki Metropolitan Area, traffic and wood burning





BaP concentrations In the Helsinki Metropolitan Area, wood burning





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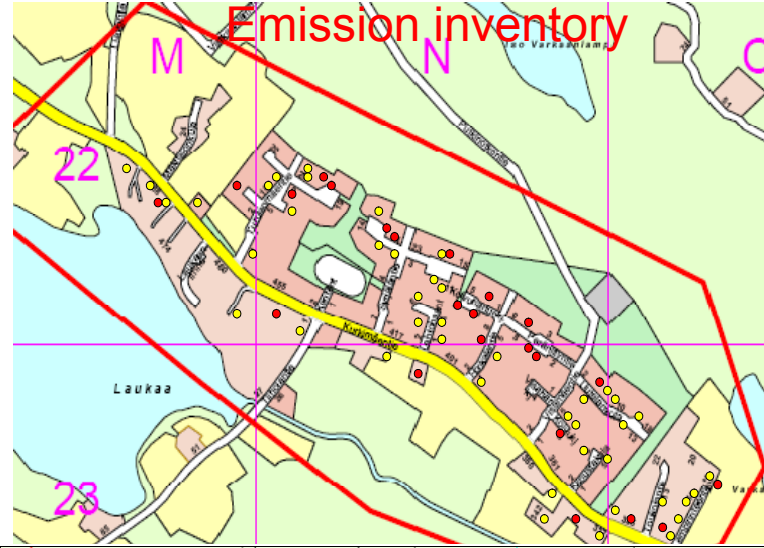
Research project PUPO

small scale wood burning and Air Quality

Emission measurements



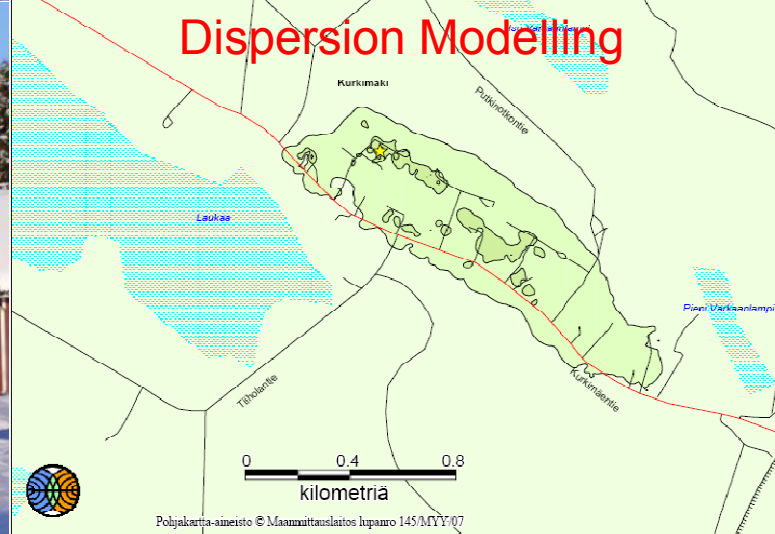
Emission inventory



Air Quality measurements



Dispersion Modelling



PAH vuosikeskiarvo [ng/m³]

- > 1,0
- 0,9 - 1,0
- 0,8 - 0,9
- < 0,8

★ = maksimi = 1,1 ng/m³



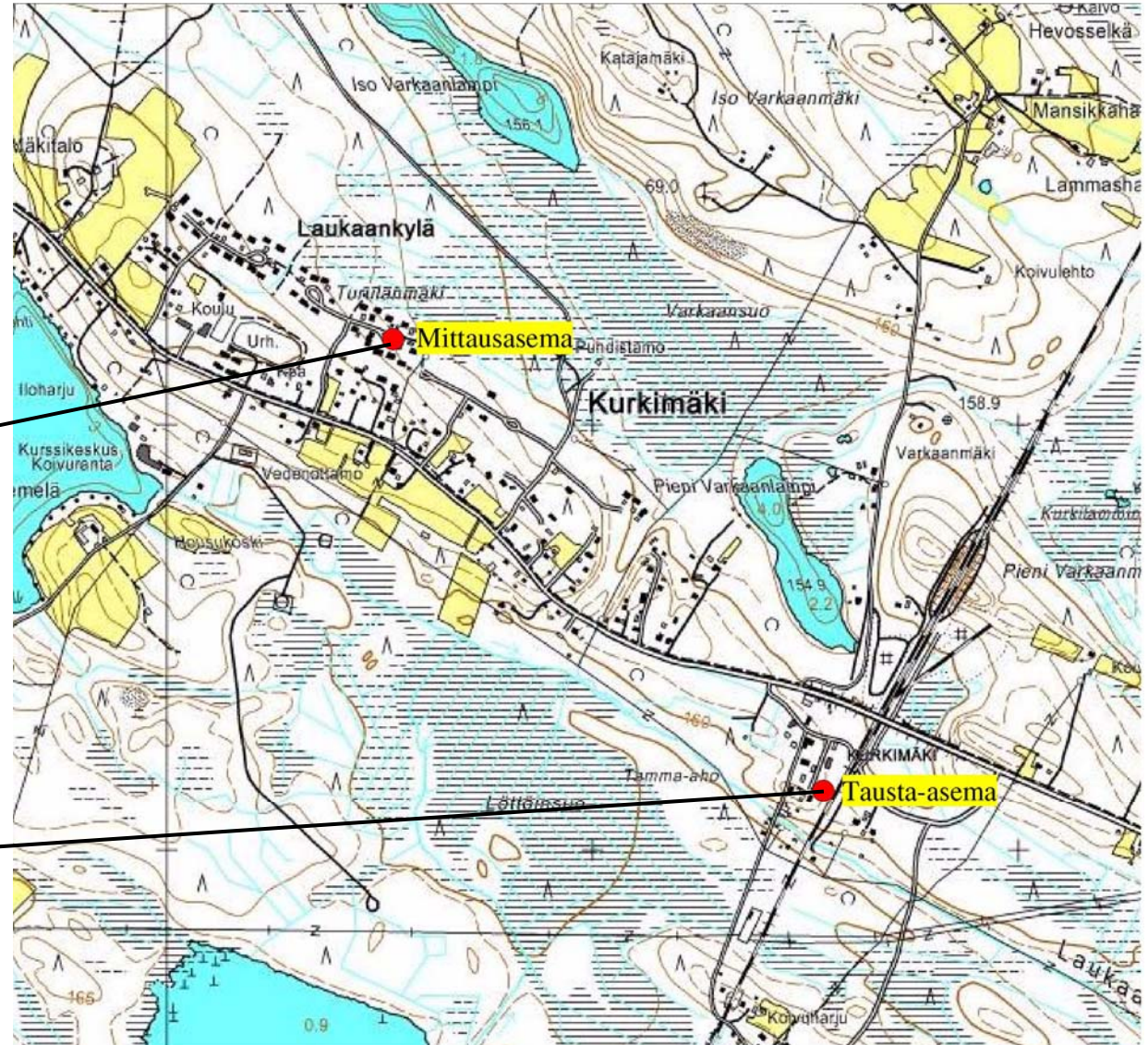
Pohjakartta-aineisto © Maanmittauslaitos lupanro 145/MYY/07

Ilmatieteen laitos 2007



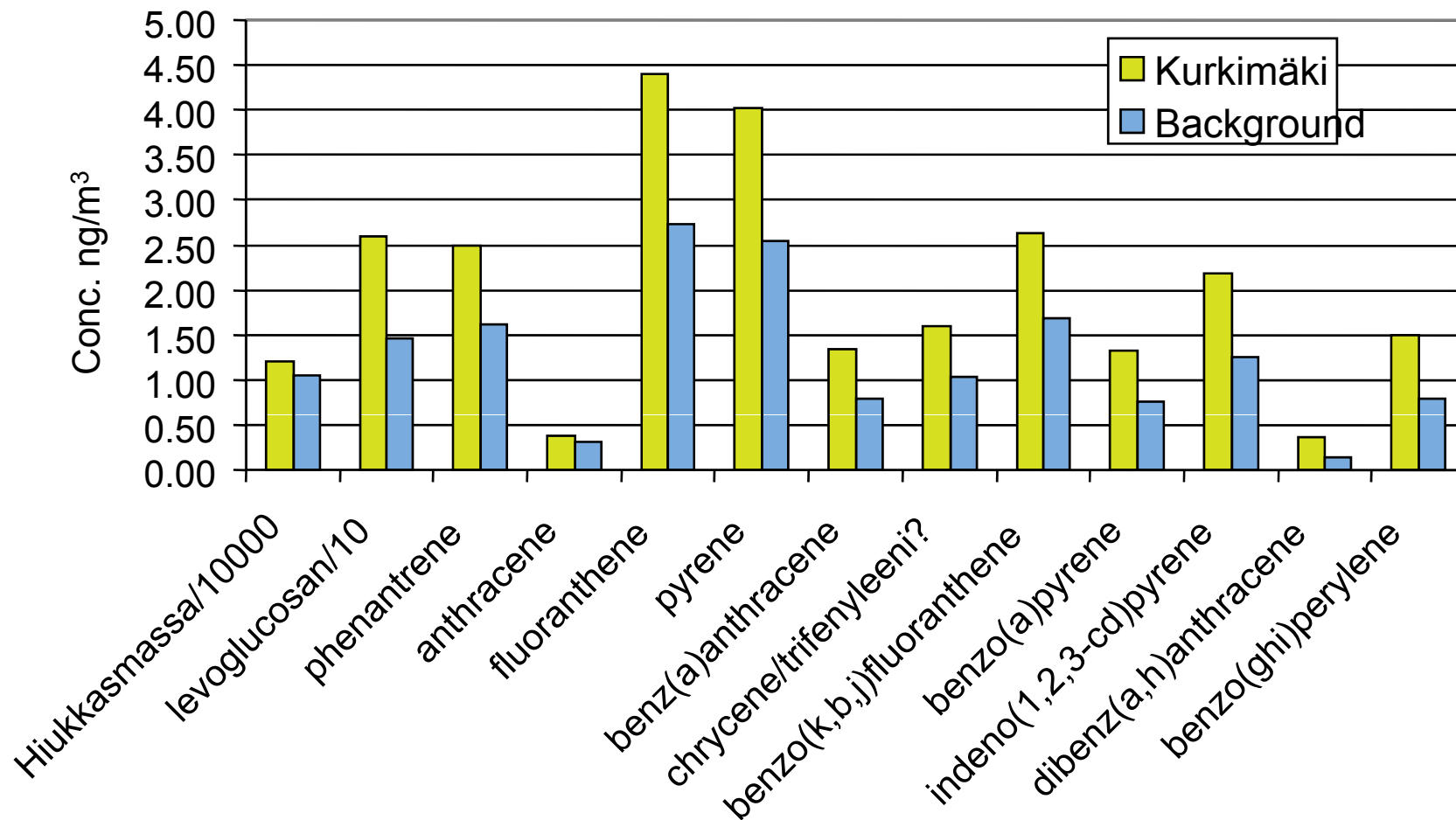
Kurkimäki

AQ stations



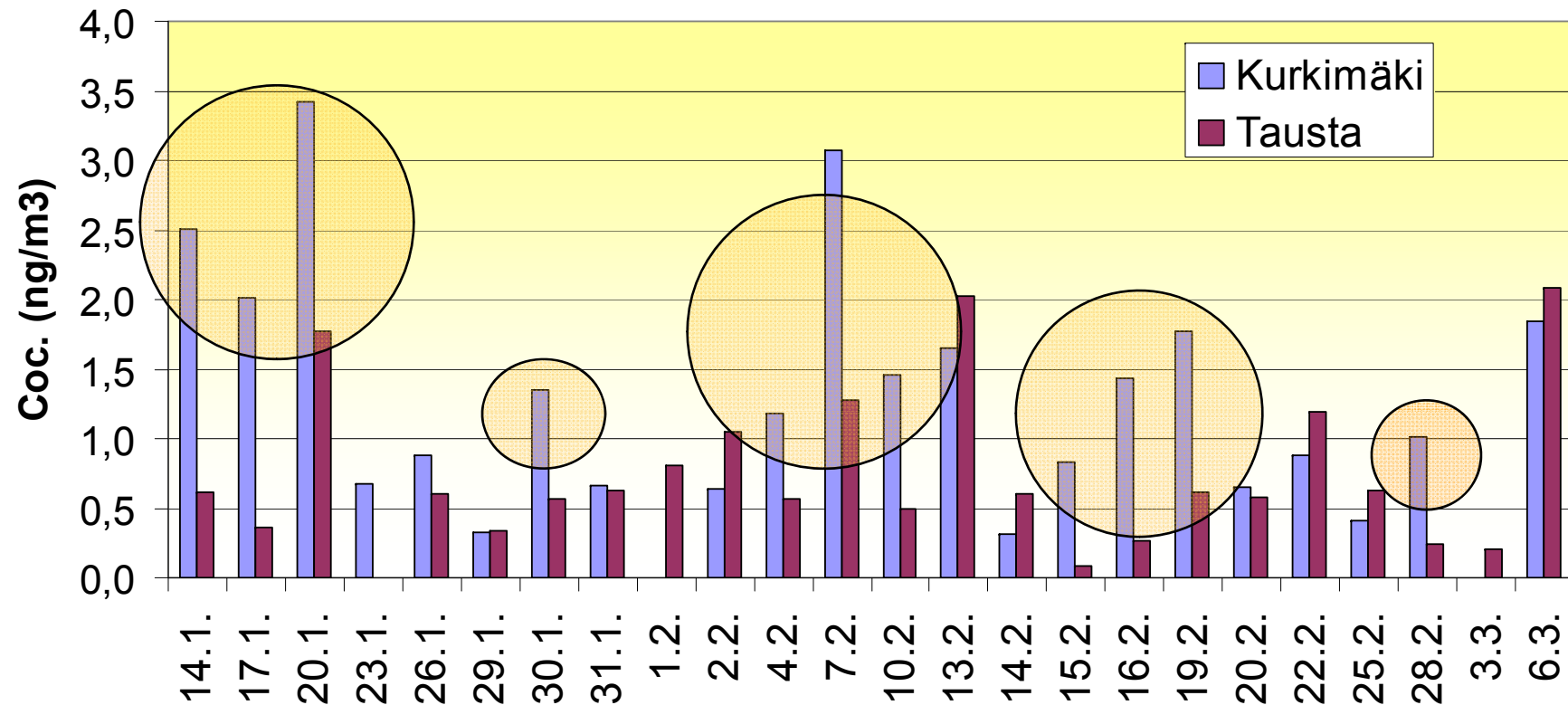


PAH-concentrations



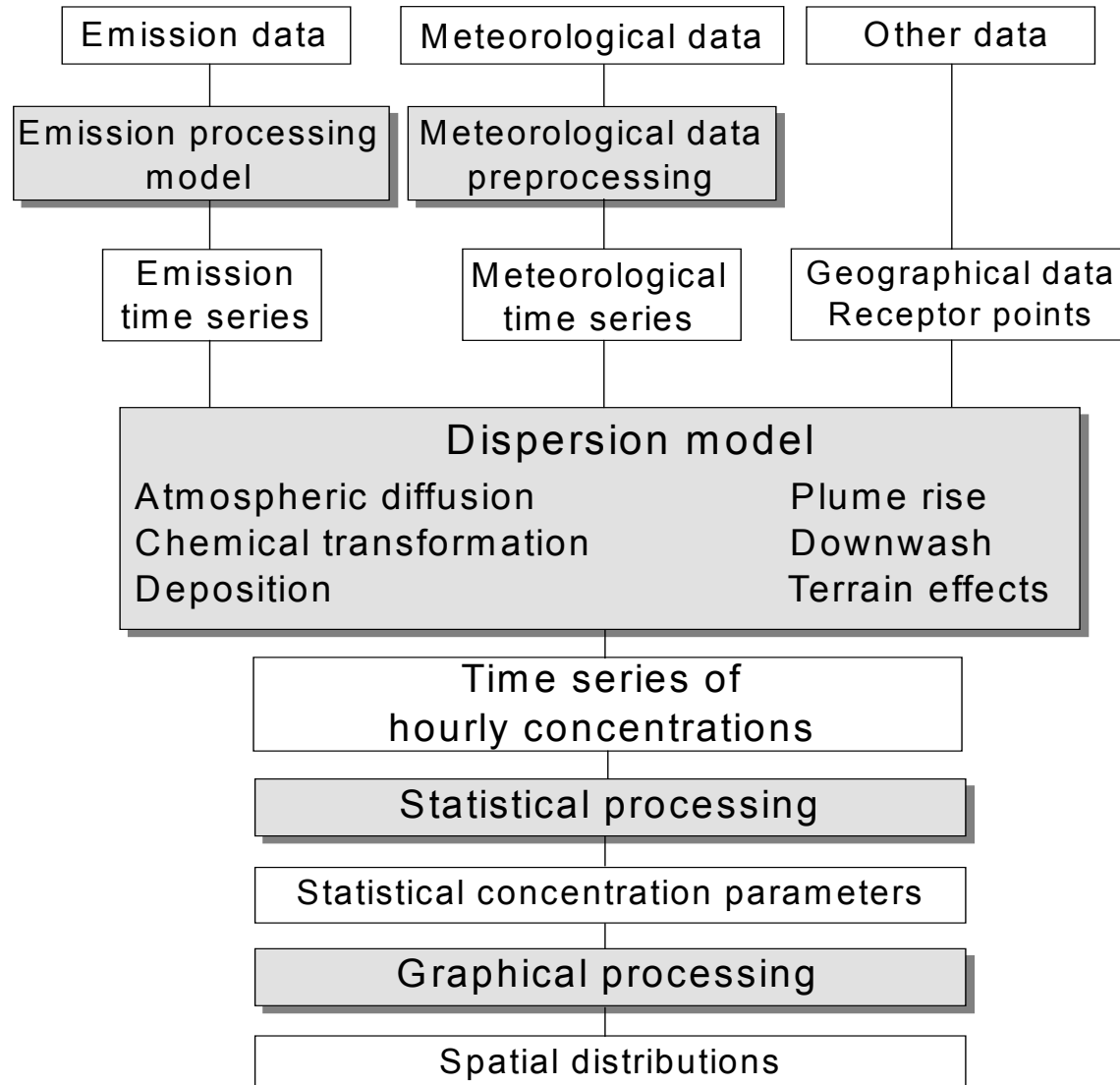


Bentso(a)pyren concentrations





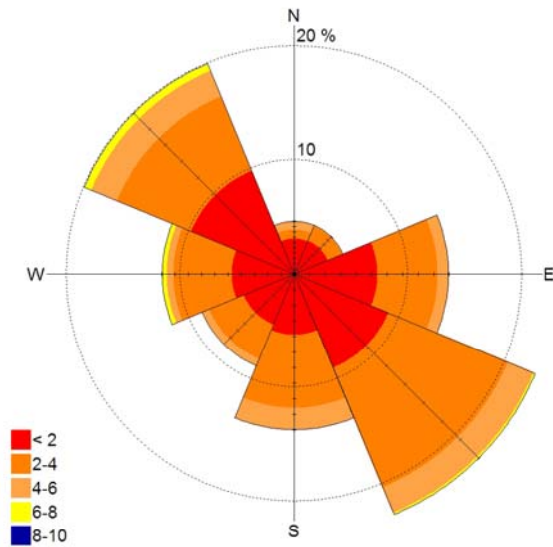
Urban Dispersion Modelling System UDM-FMI



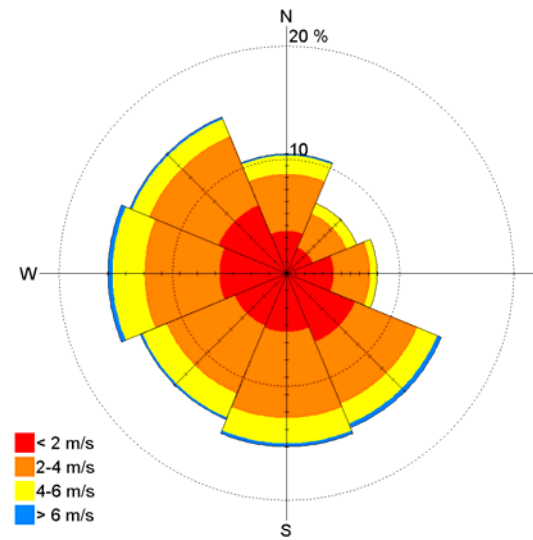


Kurkimäki meteorology

Winter 2006



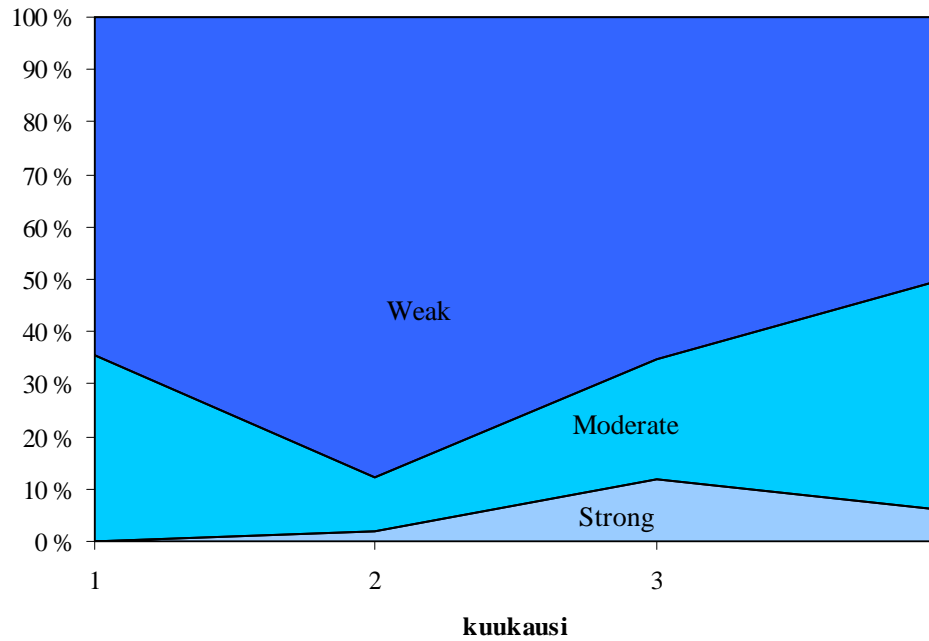
2002 – 2004



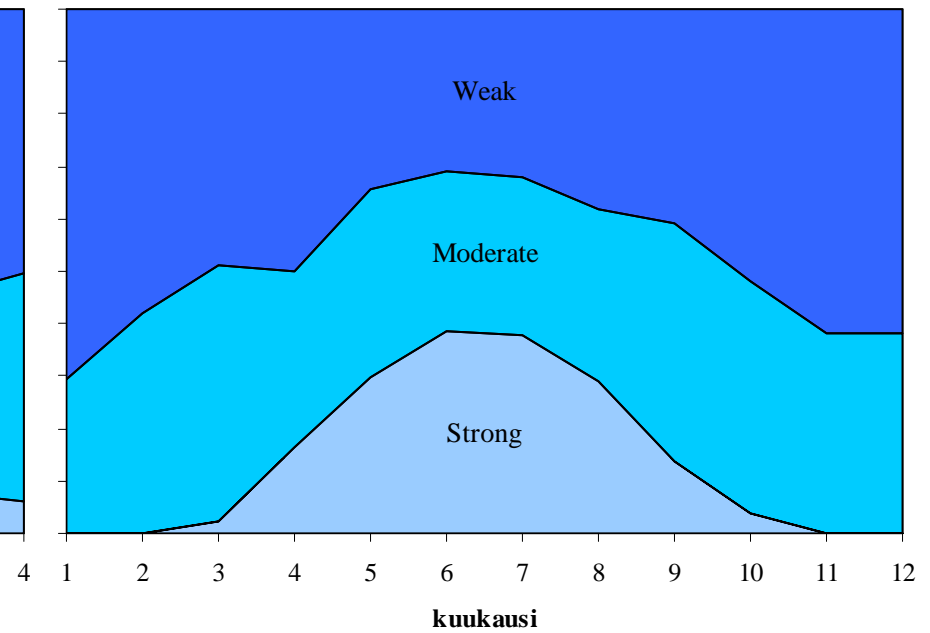


Kurkimäen meteorology, stability

winter 2006



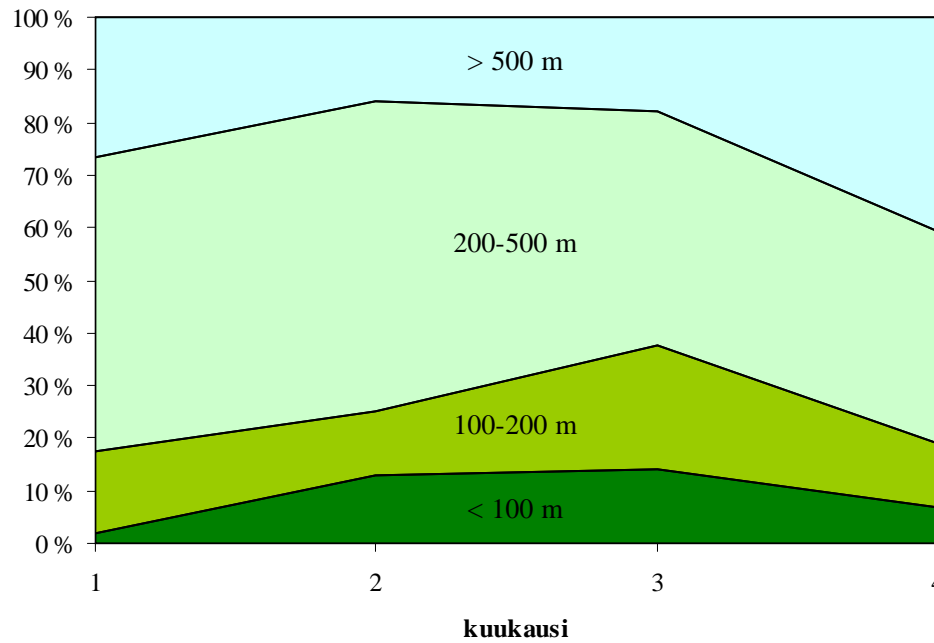
2002 – 2004



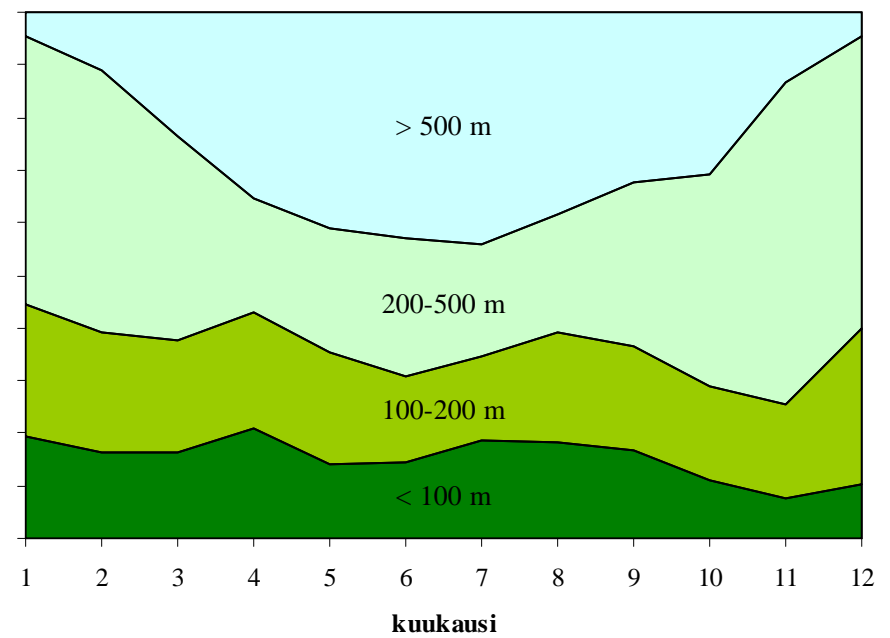


Kurkimäen meteorology, mixing height

Winter 2006

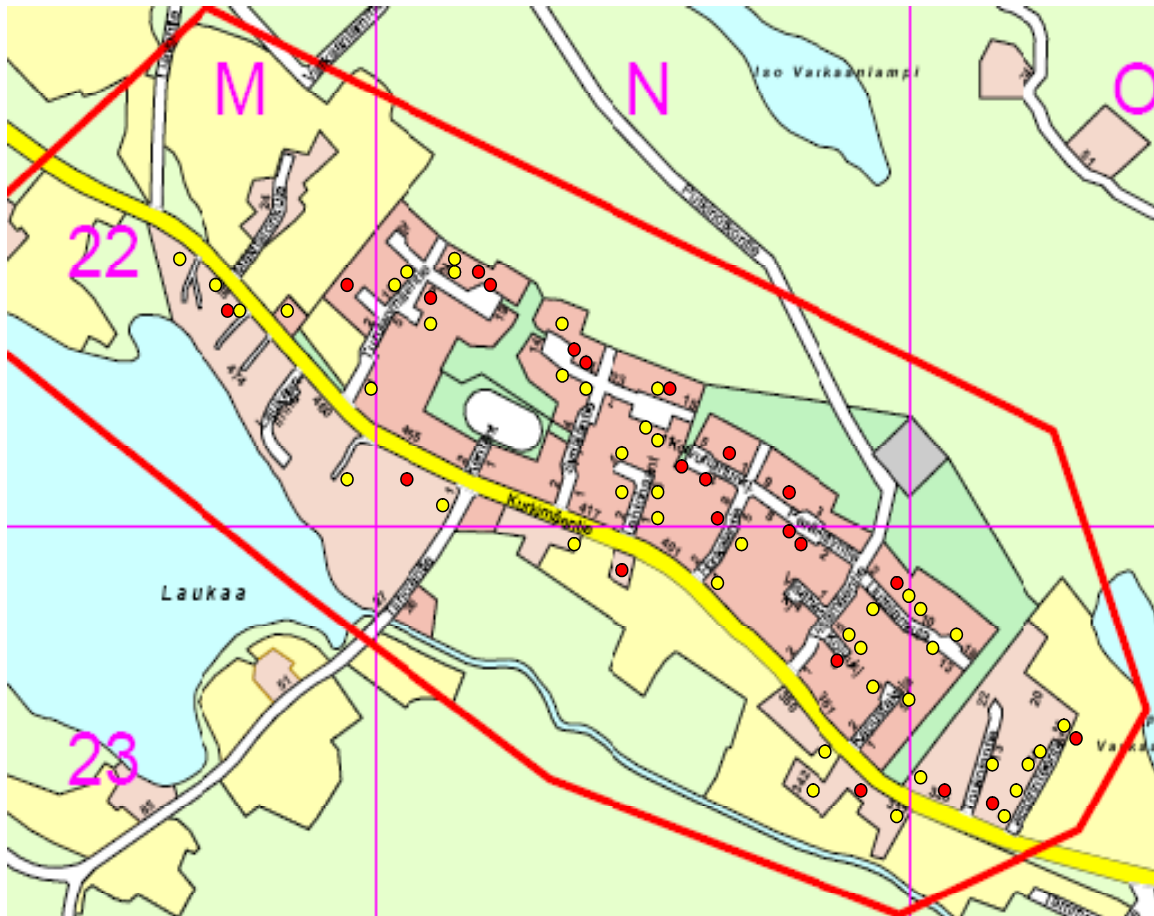


2002 – 2004





Questionnaire on use of wood for heating



- Private houses 164 kpl
- Fire places 154 kpl
- Questionnaire 69 kpl
- Detailed inquiry 19 kpl

● Seurantakohde

Lähde: Seppo Tuomi, Työtehoseura



TULISIJOJEN KÄYTÖN SEURANTA KURKIMÄESSÄ HELMIKUUSSA 2006

Sivu: _____

Nimi: _____ Osoite: _____

Tulisijatyyppi: *Varaava takka*

Merkki: *Kumakivi TTT100U*

Lisätietoja:

Seppo Tuomi, Työtehoseura, 050 - 3879517

Päivä-määrä	Tulisijan sytytys-aika klo	Lämmityksen lopetus-aika klo	Poltettujen pesällisten lukumäärä kpl	Poltettu puumäärä yhteensä kg	Käytetty puulaji					Huomioita, selityksiä (<i>Puun kosteus, veto-olot, poikkeuksellinen tulisijan toiminta tai käytötapa, ongelmat yms.</i>)
					Koi-vu	Haapa, leppä	Män-ty	Kuu-si	Muu (paperi, pahvi)	
1.2.	17:00	19:30	2	15	x	x			x	Sytty huonosti, märät puut
4.2.	18:30	19:45	1	7		x	x			Sytytys puiden päältä sytytyspaloilla

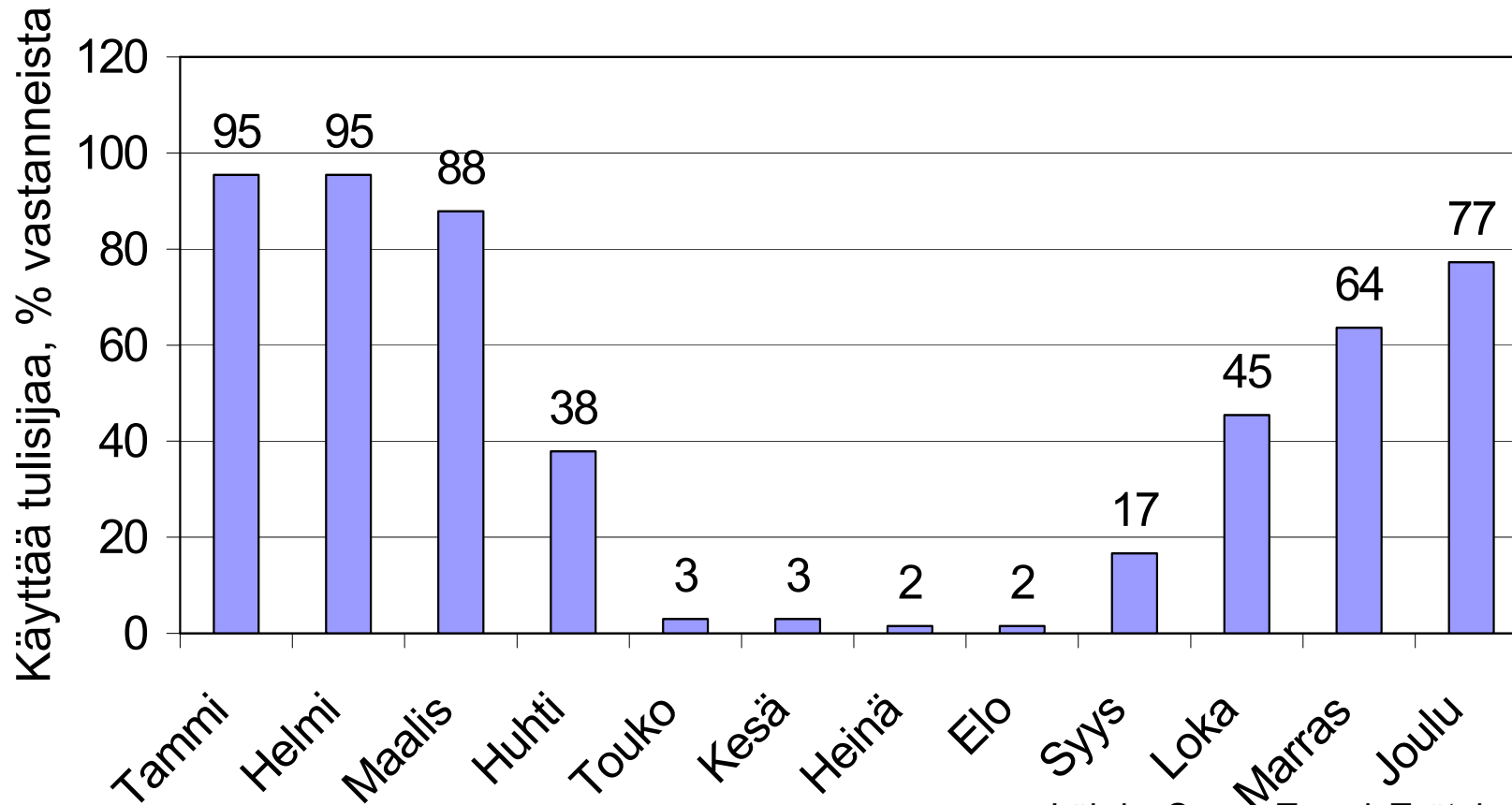
Käännä

Lähde: Seppo Tuomi, Työtehoseura



Monthly usage of wood in heating

Eniten käytetyn tulisijan lämmityksen yleisyys
kuukauden mukaan

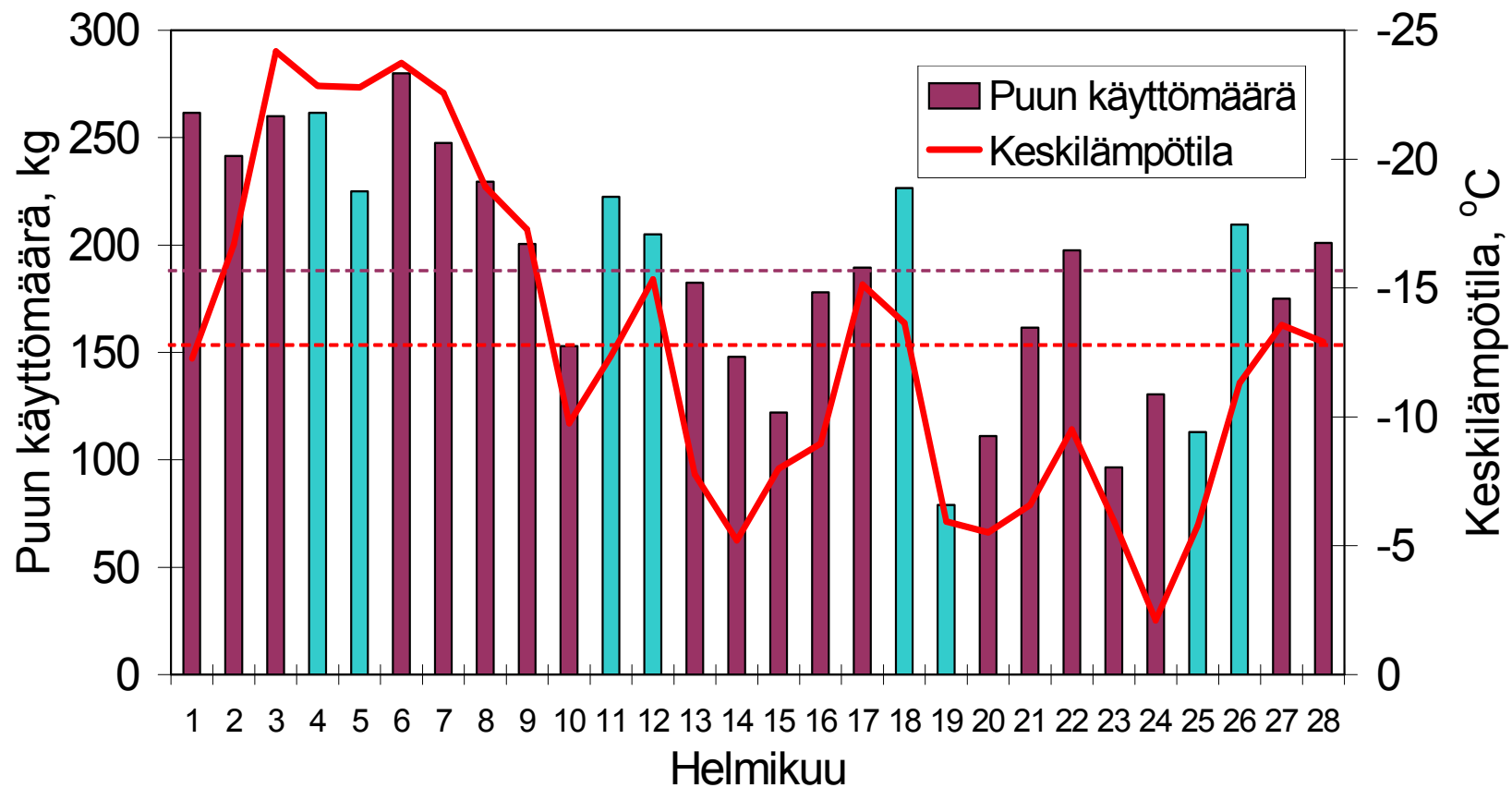


Lähde: Seppo Tuomi, Työtehoseura



Usage of wood in heating and air temperature

Polttopuun käyttömäärä ja ulkoilman keskilämpötila
seurantakohteissa (N=19) helmikuussa 2006

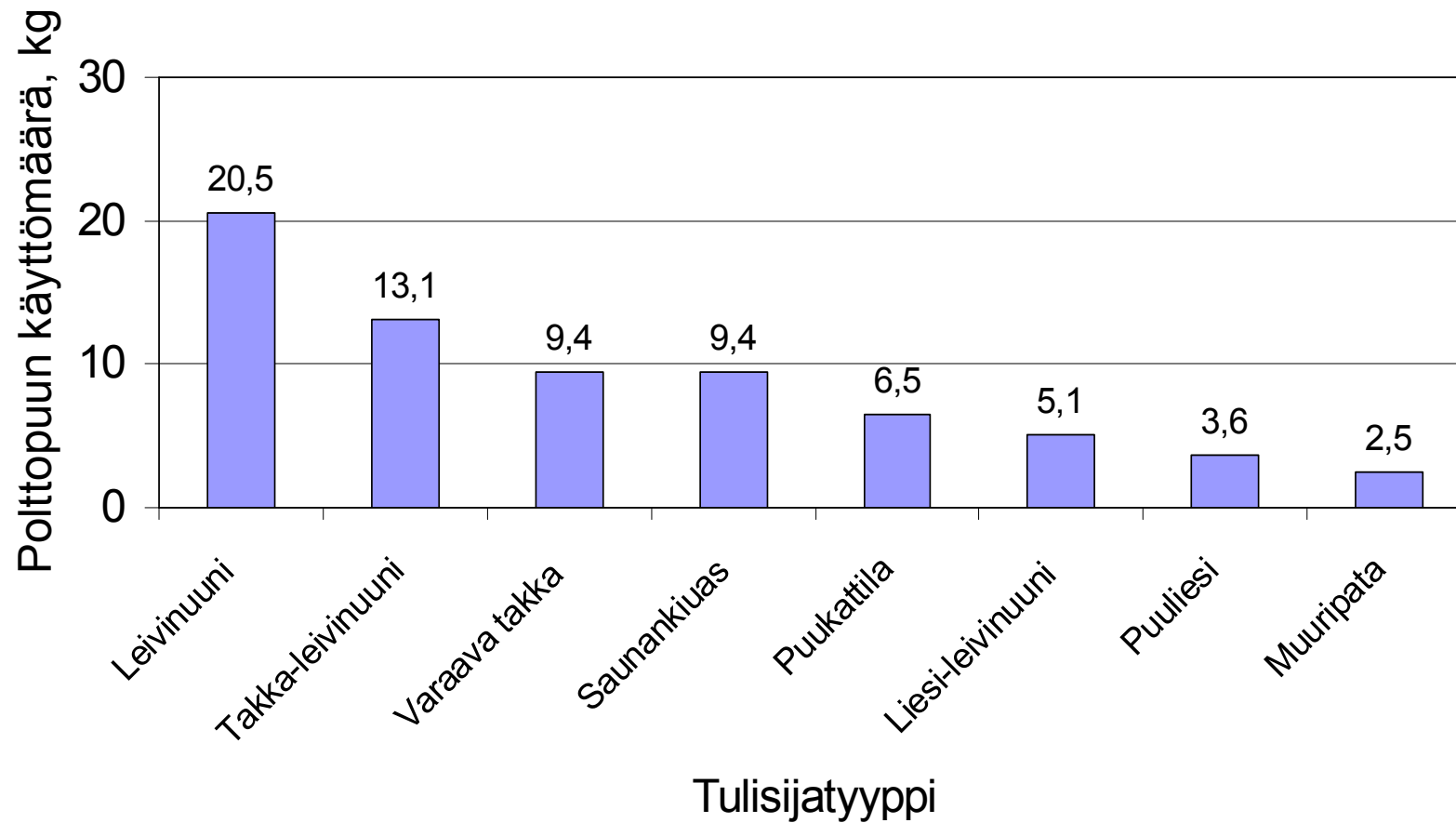


Lähde: Seppo Tuomi, Työteho-seura



Usage of wood in heating with different fire places

Polttopuun kesikäyttö lämmityskertaa kohti tulisijatyyppin mukaan seurantakohteissa helmikuussa 2006

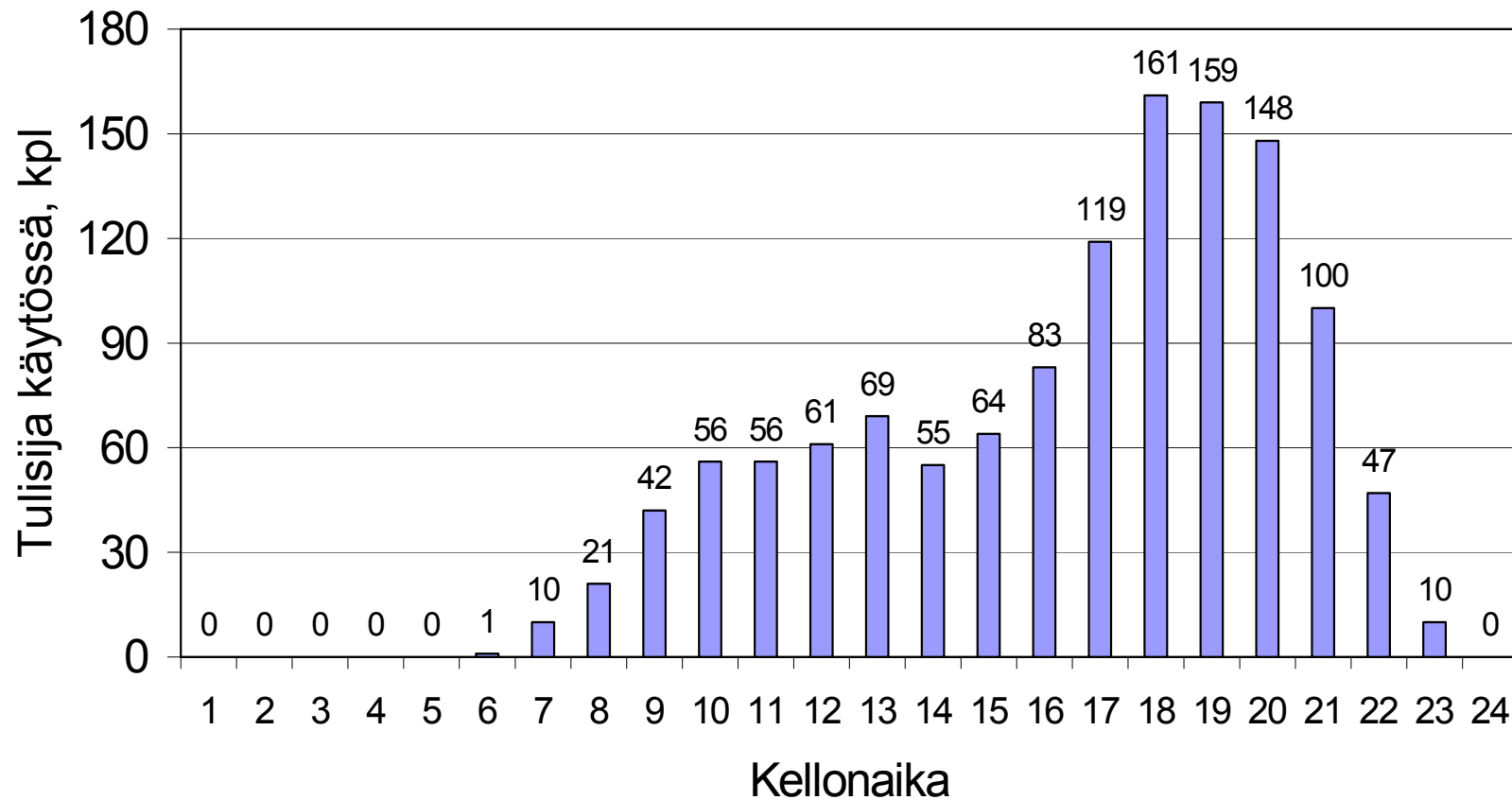


Lähde: Seppo Tuomi, Työtehoseura



Hourly usage of wood in heating

Tulisijojen käytön jakautuminen vuorokauden ajan mukaan seurantakohteissa helmikuussa 2006

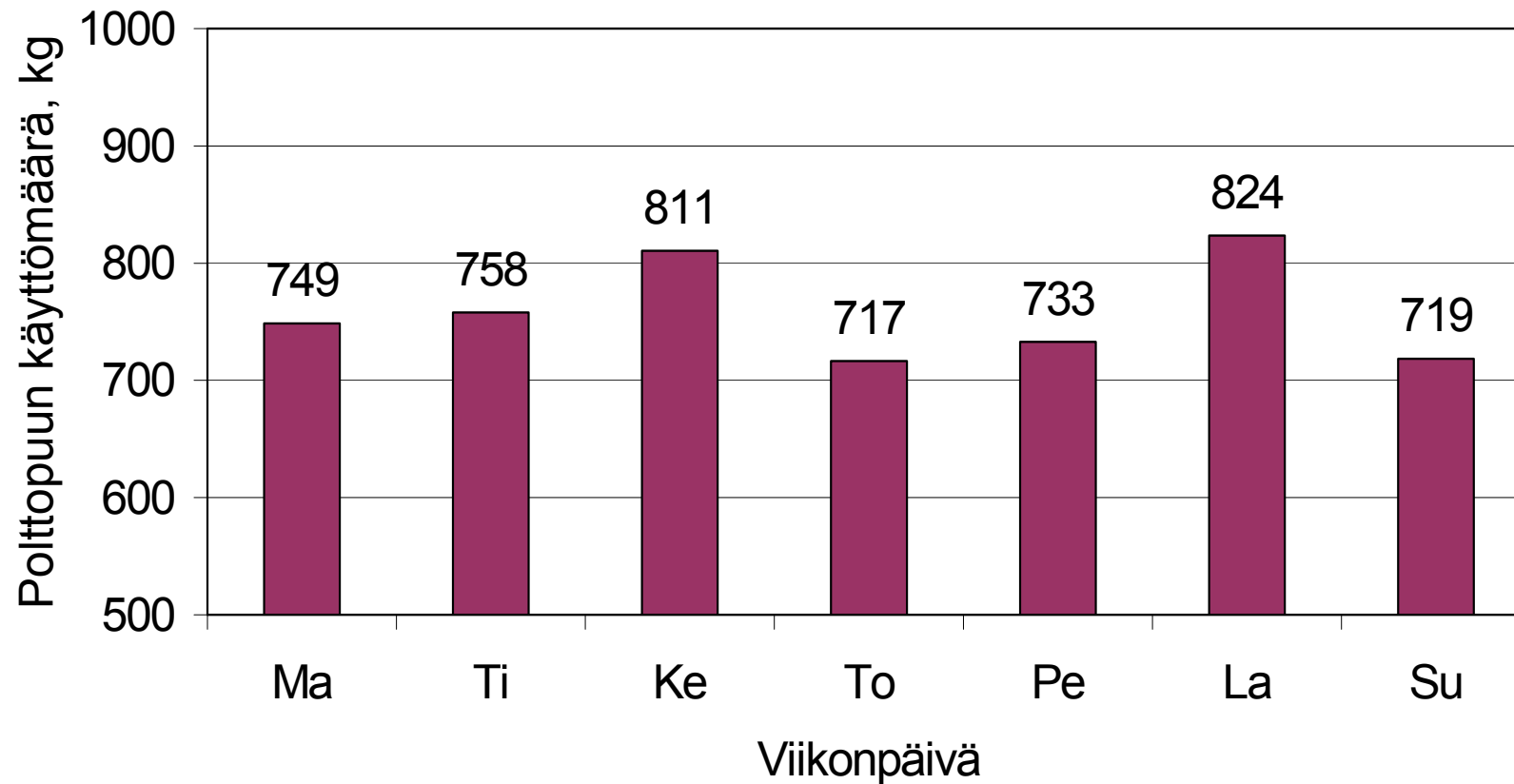


Lähde: Seppo Tuomi, Työtehoseura



Daily usage of wood in heating

Polttopuun kokonaiskäyttömäärä viikonpäivän mukaan seurantakohteissa helmikuussa 2006



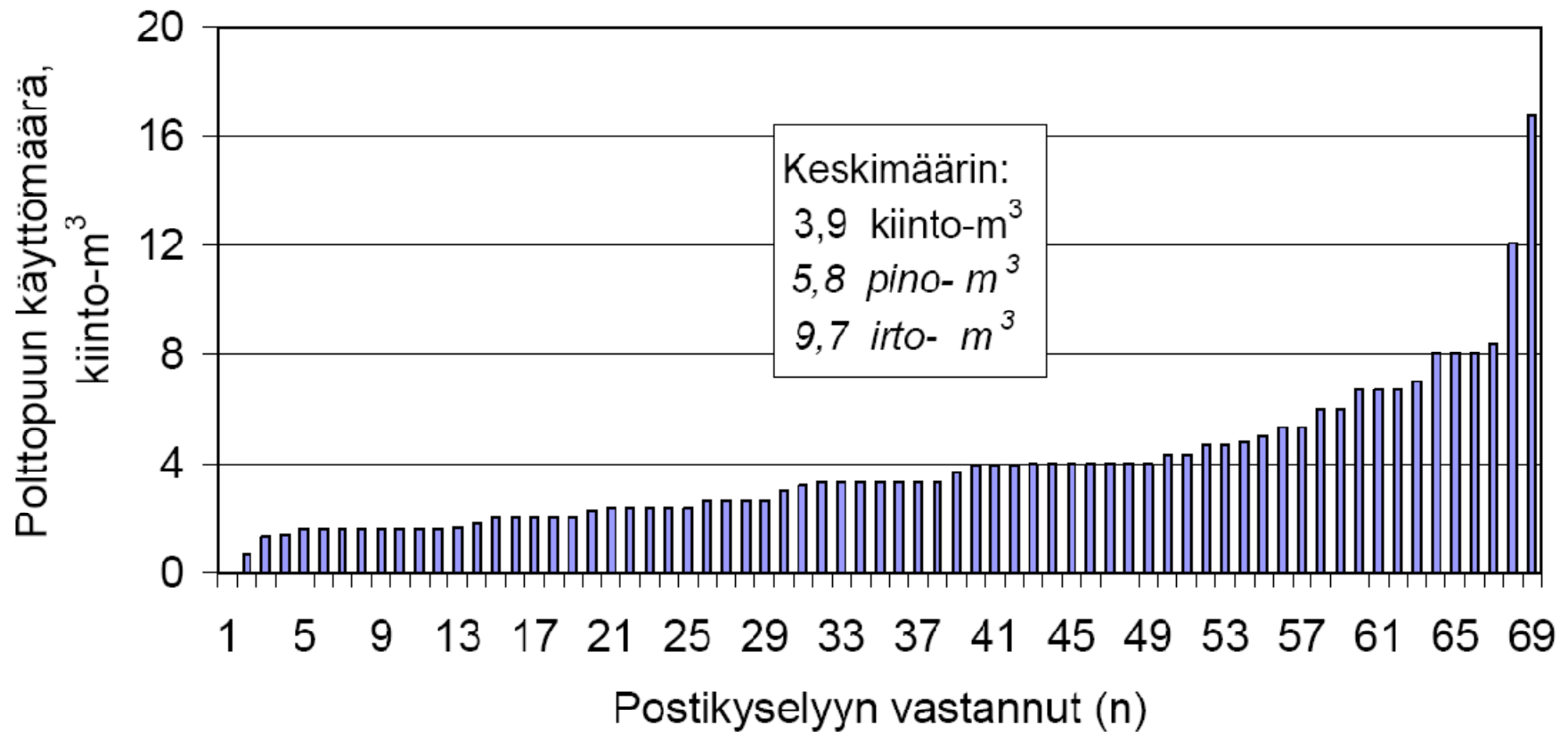
Lähde: Seppo Tuomi, Työtehoseura



Usage of wood in heating in different houses

Polttopuun käyttömäärä postikyselyaineistossa

(N=69)



Lähde: Seppo Tuomi, Työtehoseura



Emission factors based on emission measurement in real conditions

Päästökertoimia

(Jarkko Tissari, Kati Hytönen, Kuopion yliopisto)

	Kiuas	Arvioitu vaihteluväli	Muut laitteet	Todellinen vaihteluväli (n = 6)	
NMVOC	10.4	(6 ... 19)	2.8	(1.5 ... 5.0)	gC/kg
CH₄	3.0	(1.9 ... 5.2)	0.54	(0.34 ... 0.93)	gC/kg
C₆H₆	2.3	(1.3 ... 2.7)	0.37	(0.21 ... 0.42)	gC/kg
PM₁	2.7	(1.8 ... 4.8)	0.9	(0.6 ... 1.6)	g/kg

Bentso(a)pyreeni

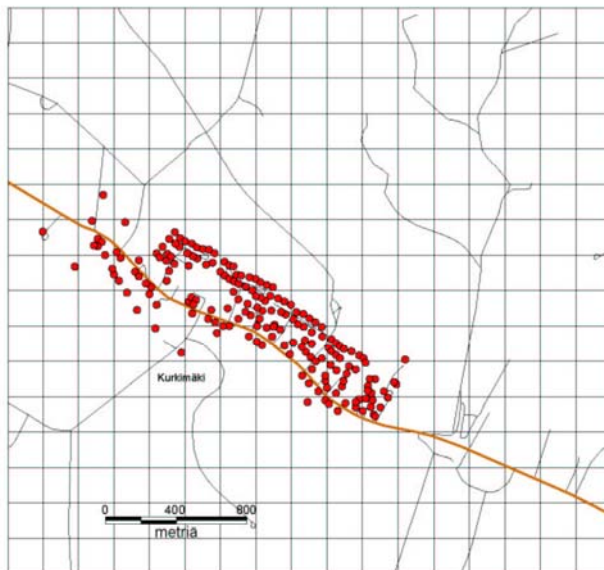
- kiuas noin 15 000 µg/kg
- muut noin 25 – 380 µg/kg



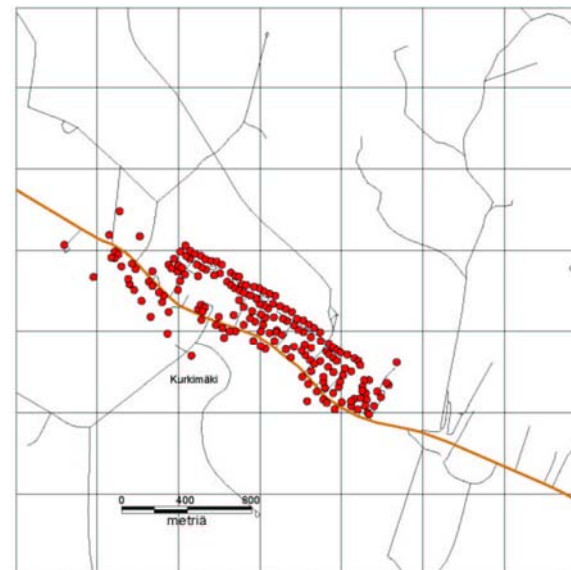
Emission sources

Pistelähteet & pintalähteet

Rkoko 200 m

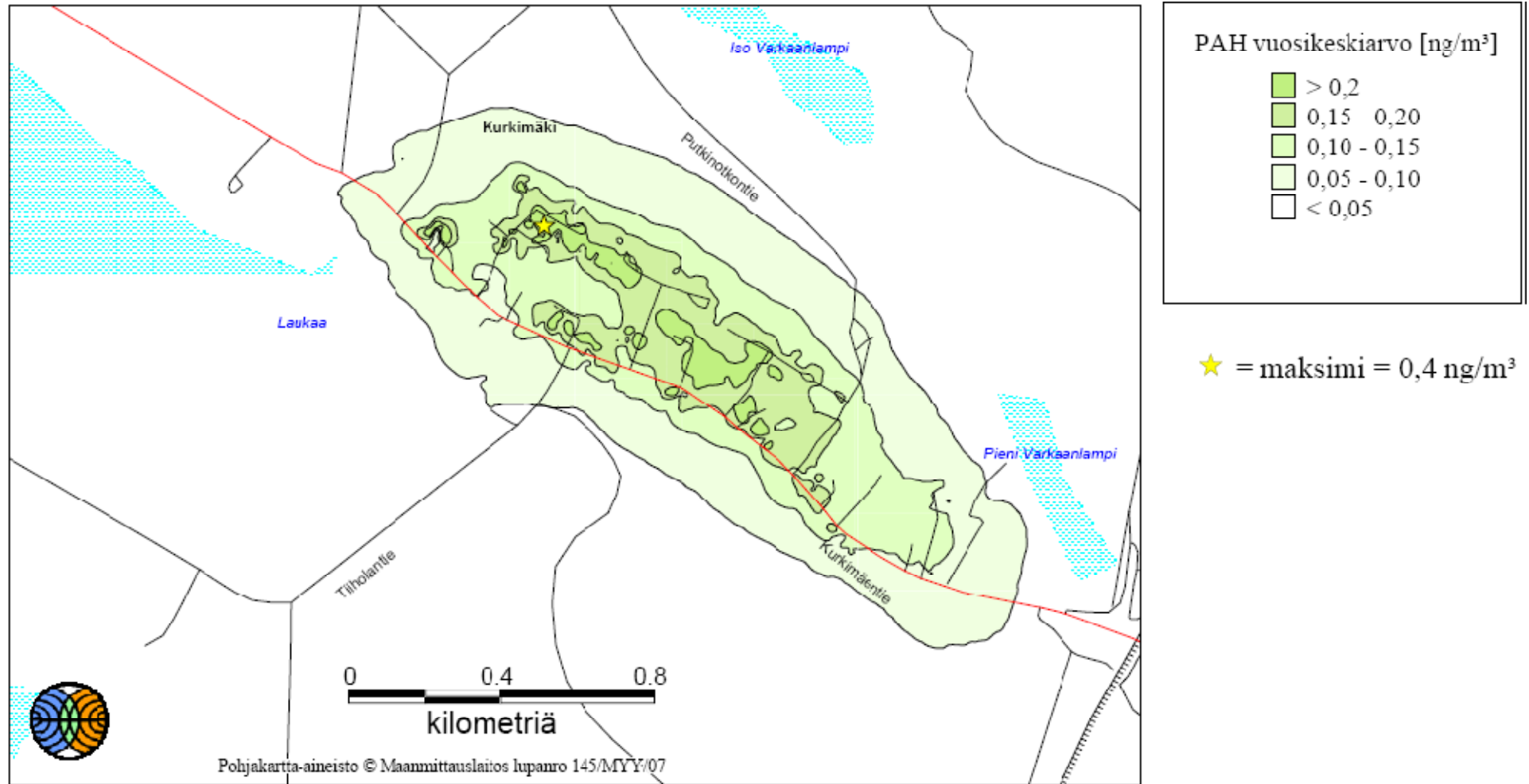


500 m



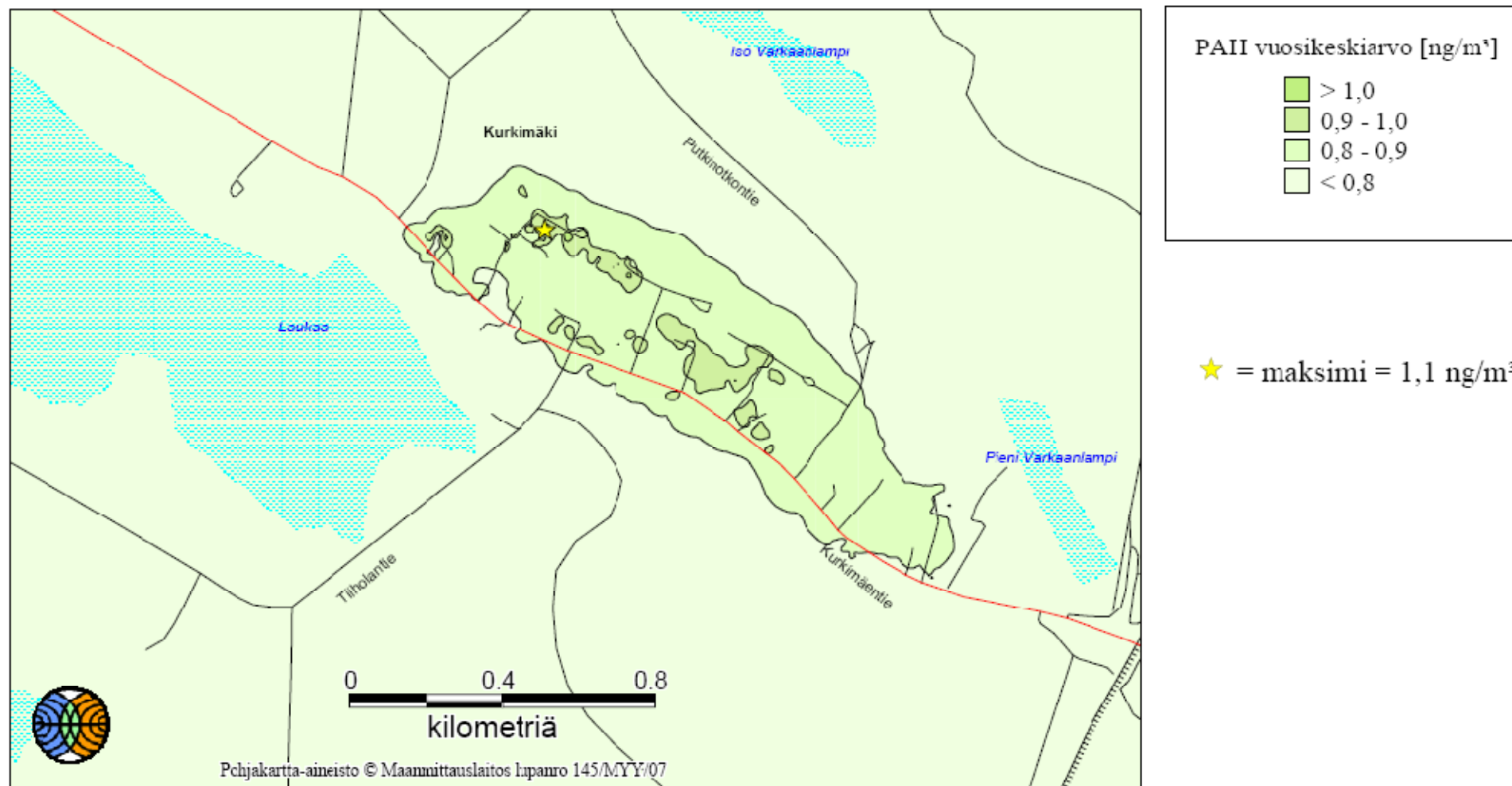


Bentso(a)pyren concentration – wood burning



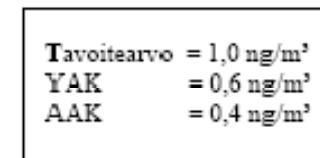
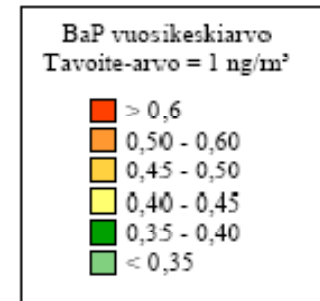
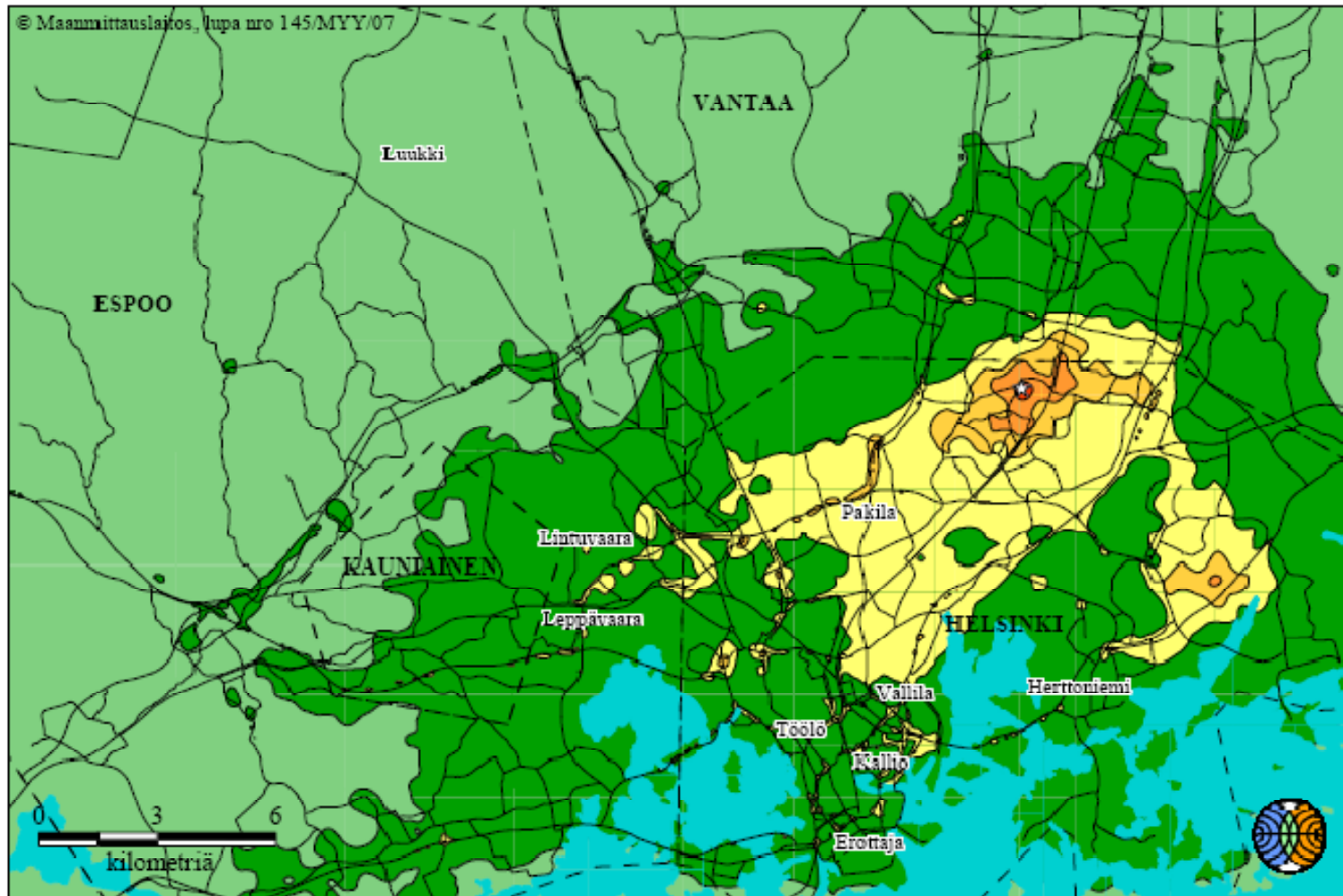


Bentso(a)pyren concentration - TOT





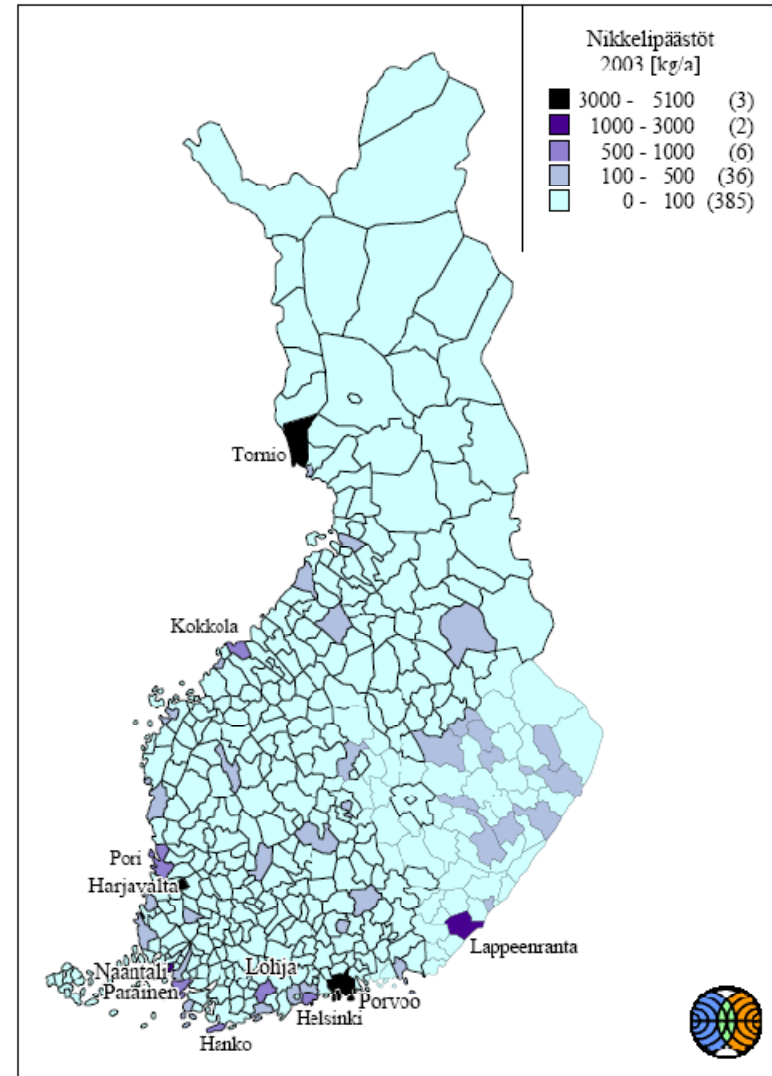
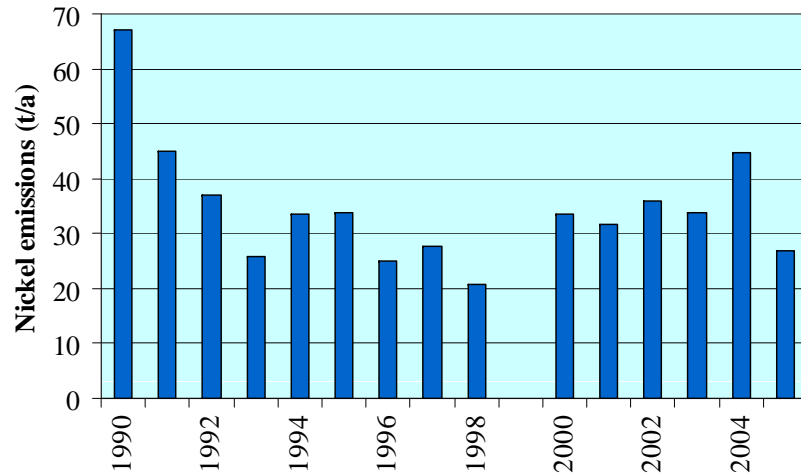
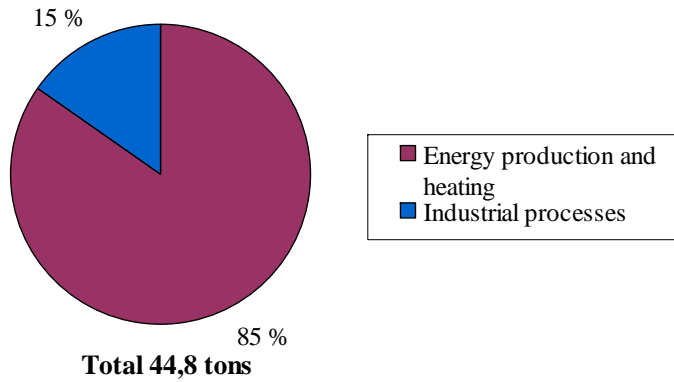
Dispersion modelling, BaP concentration Helsinki Metropolitan Area



☆ = maksimi = 0,61 ng/m³

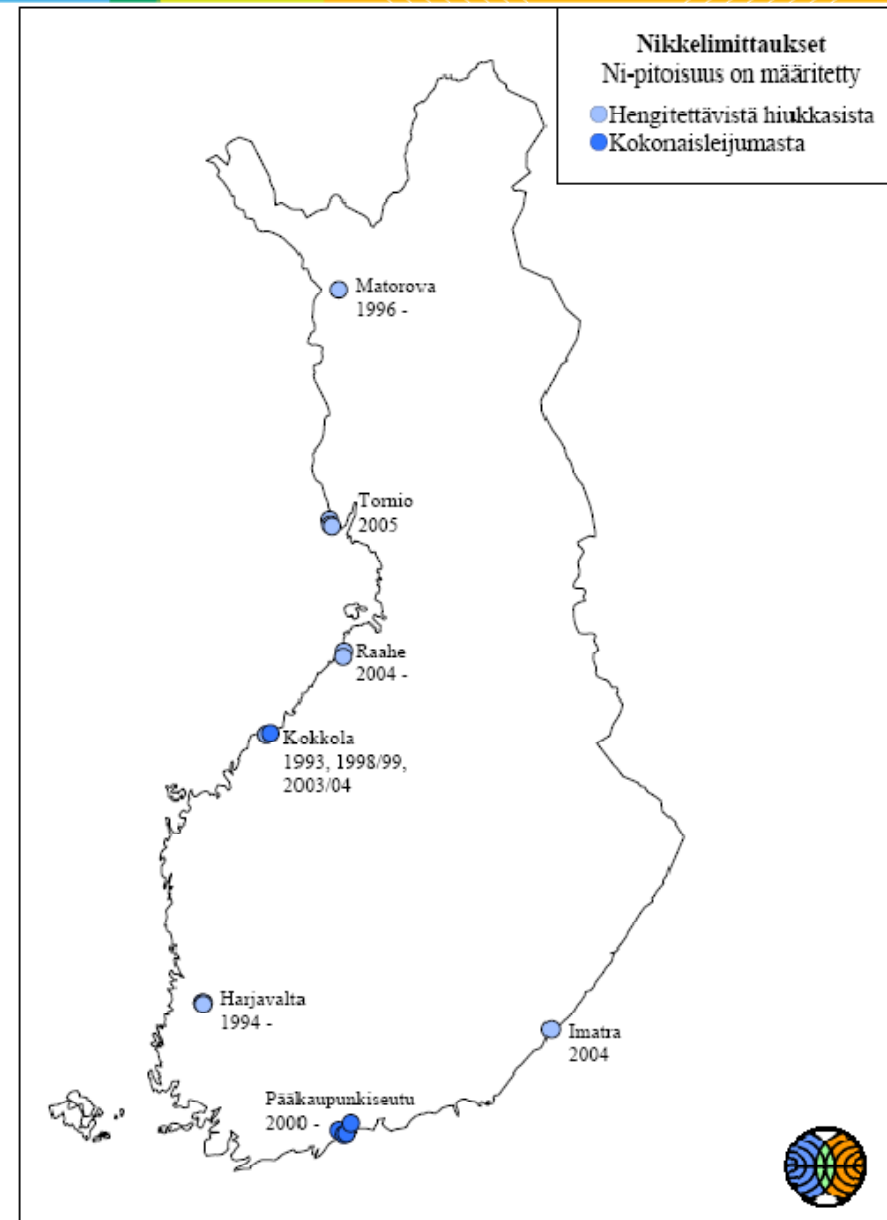


Nickel emission 2003



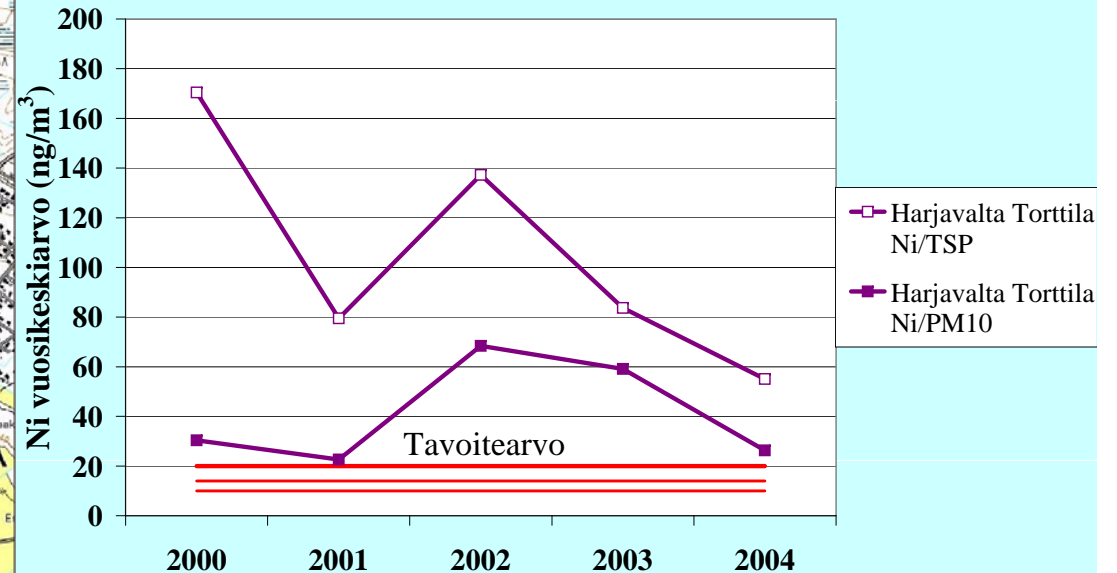
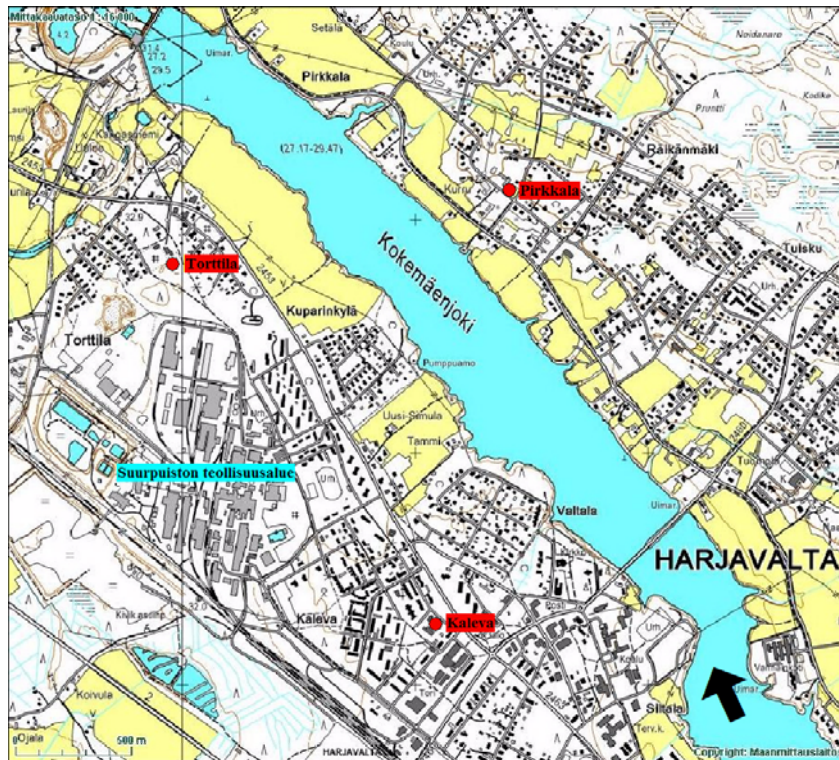


Measurement of Nickel concentration in ambient air in Finland 1993-2006





Nickel concentrations In the city of Harjavalta, industrial source

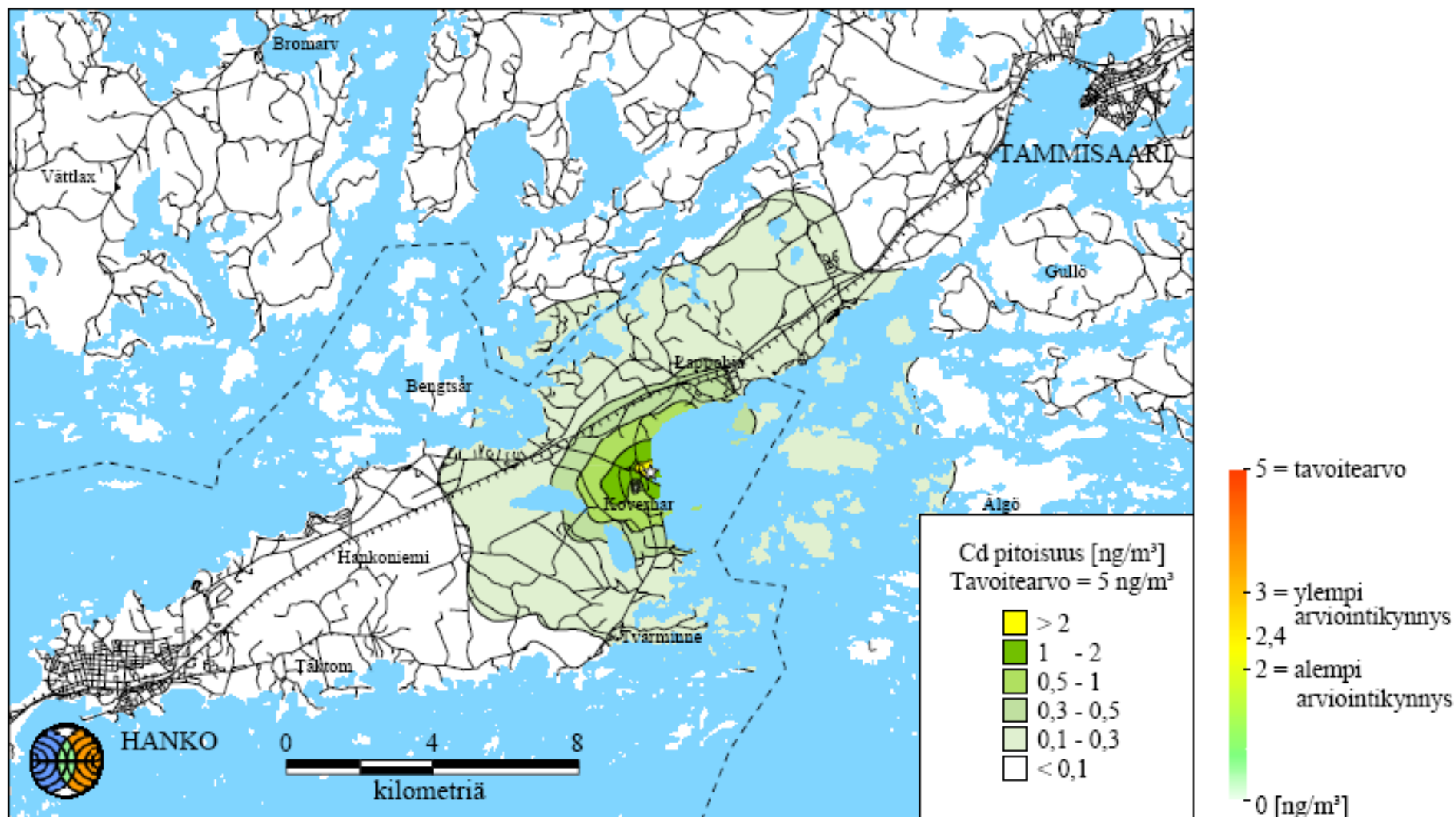




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Dispersion modelling - Cadmium concentration

FUNDIA WIRE OY AB, KOVERHARIN TERÄSTEHDAS





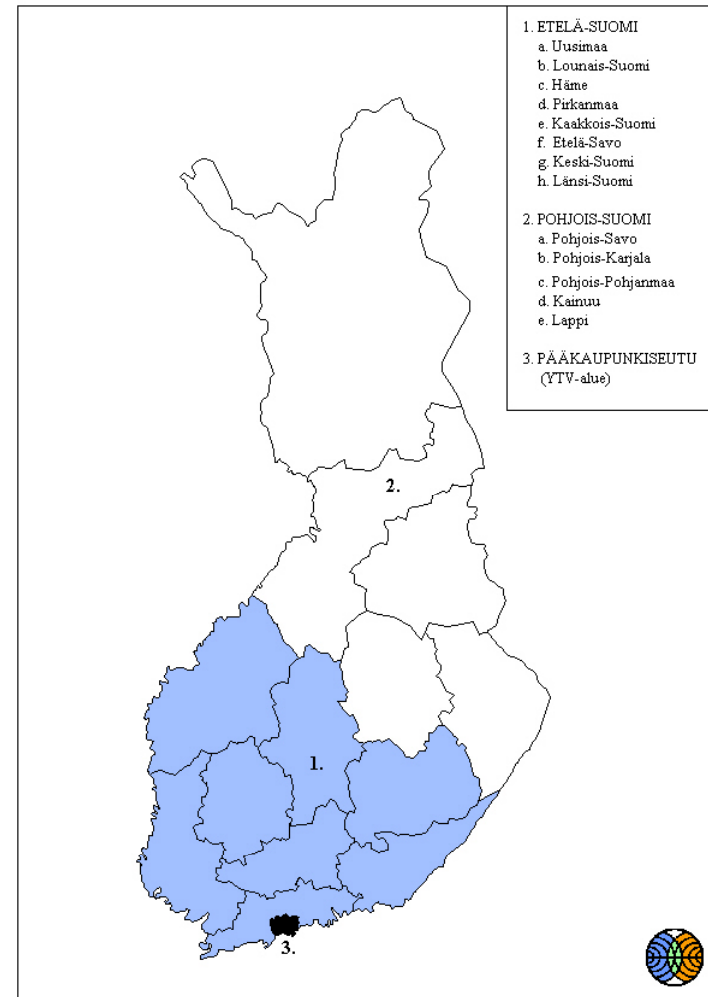
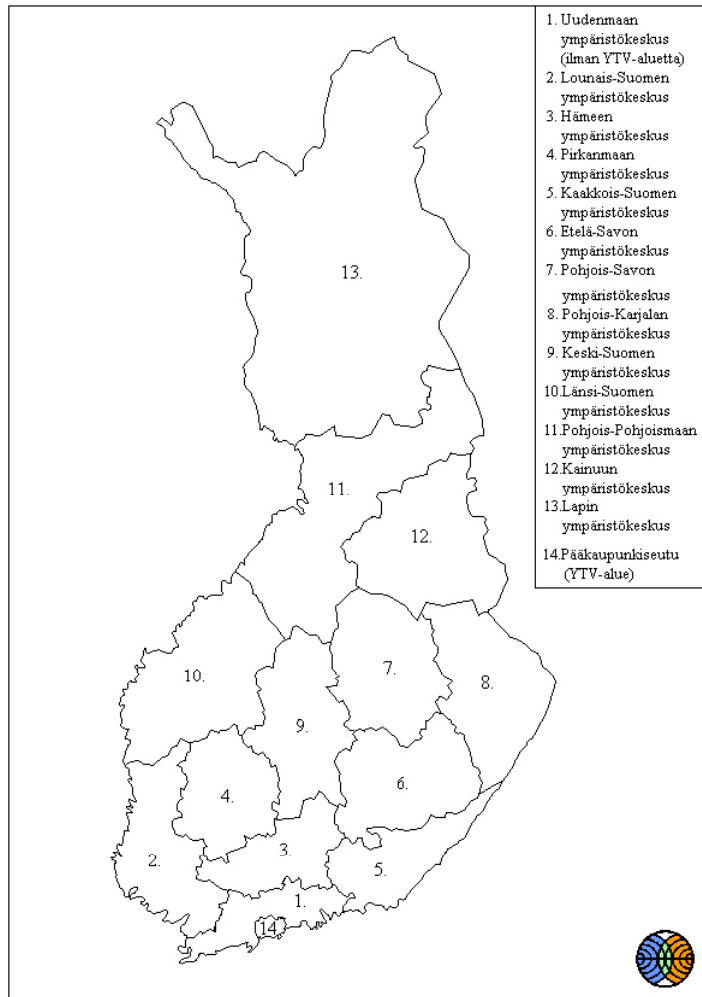
Zones and agglomerations in Finland

- **One agglomeration : Helsinki Metropolitan Area, 1 milj. inhabitants**
- **Zones based on Regional Environmental Centers (13)**
- **Different zoning for different pollutants**
 - based on concentration levels and sources of pollution
 - to optimize assessment burden
- **SO₂, NO₂, PM₁₀, Pb, CO : 1 aggl. + 13 zones**
- **Benzene : 1 aggl. + 2 zones**
- **SO₂&NO_x nature, O₃, BaP, HMs : 1 aggl. + 1 zone**



Zones and agglomerations in Finland: SO₂, NO₂, PM₁₀, Pb, CO

benzene





National legislation for PAH and HMs

- **Secondary legislation in force 15.2.2007**
- **AQ measurements from the beginning of 2008**
- **Sets target values to be met 2013**
 - No stricter emission control than BAT required from industry
- **Zones and assessment requirements**
 - 1 aggl. + 1 zone
 - 3 regional background stations: concentration and deposition measurements
 - Distributed emission sources : minimum measurement points
 - Point sources : to be defined case by case in environmental permitting
- **Quality requirements**
- **Reference methods**
- **Reporting**



Required measurement stations

Zone	Area (km ²)	Population	Number of stations
HMs			
Helsinki Metropolitan	743	971 947	0
Rest of Finland	118 110	4 264 664	0
Point sources (Harjavalta)			2
Background	303 070		3
PAH			
Helsinki Metropolitan	743	971 947	1 ^{1/2} ²
Rest of Finland	302 327	4 264 664	2 ^{1/4} ²
Point Sources (Raahe)			2
Background	303 070		3

1) LAT < conc. < UAT

2) conc. > UAT



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