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Fine and ultrafine particles in 20 French dwellings related to time-activity diaries

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French Observatory of Indoor Air Quality (OQAI)**

French national survey on IAQ in dwellings (2003-2005)

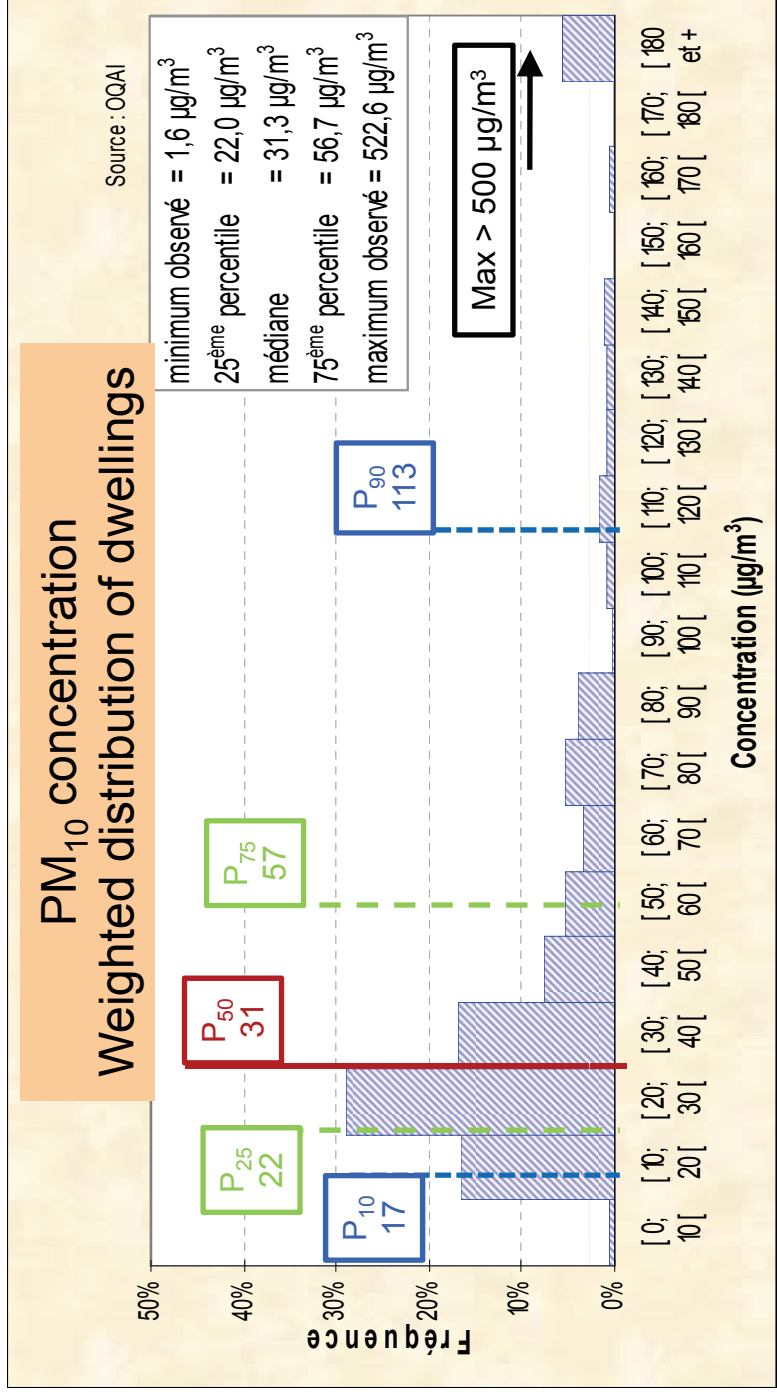
Kirchner *et al.* (2007), *Env. Ris. San.*, 6(4), 259-269.

National survey on IAQ inside dwellings in mainland France (sept 2003 to dec 2005)

- **567 dwellings** were investigated
- **1612 individuals** questioned
- 290 validated data $PM_{2.5}$ (297 for PM_{10})
- Collection of $PM_{2.5}/PM_{10}$ on PTFE membranes
- Flowrate 1.8 L/min, $V_p = 13 \text{ m}^3$.
- LD = 0.1 $\mu\text{g}/\text{m}^3$, LQ = 0.8 $\mu\text{g}/\text{m}^3$
- Sampling duration : 7 days with programmed schedule (from 5 pm to 8 am on working days, 24 h / 24 h during week end),
- Sampling location : Living room (no outdoor measurement)
- In a subset of 20 dwellings : UFP and FP monitoring



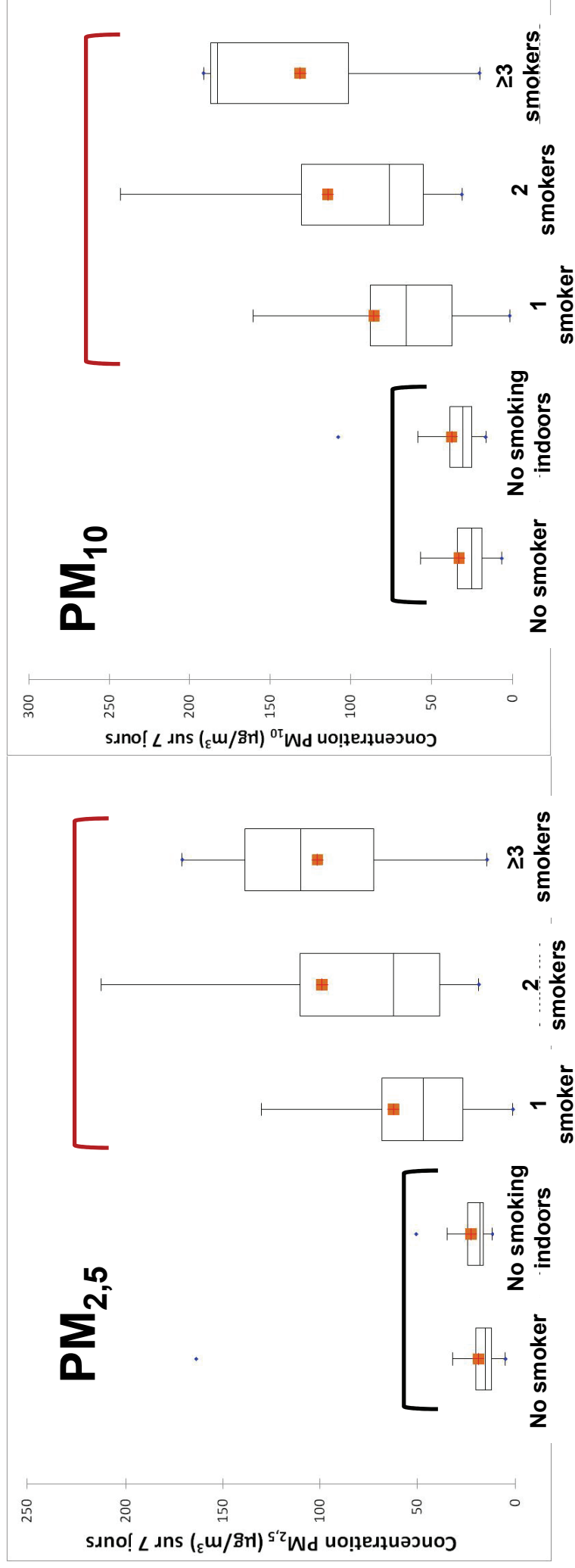
Distribution of PM₁₀ and PM_{2.5} in French dwellings (2003-2005)



	PM _{2.5} (µg/m ³)
Mlin	1.2
P10	11
P25	14
Median	19
P75	35
P90	76
Max	568

- Indoor PM₁₀ concentrations are of the same order compared to annual means found in outdoor traffic areas (25 to 28 µg/m³)
- 90% dwellings exceed WHO outdoor air guidelines for PM_{2.5} (75% exceed PM₁₀ guideline)

Impact of the presence of smokers on $PM_{2.5}$ and PM_{10} levels

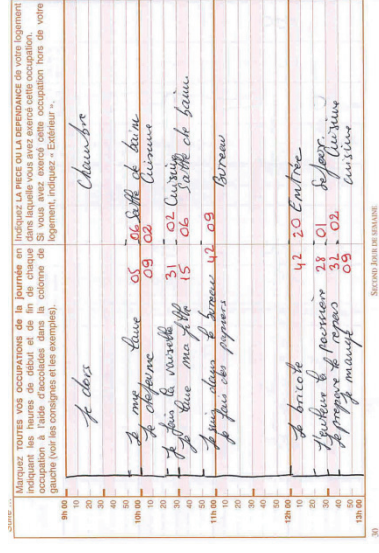
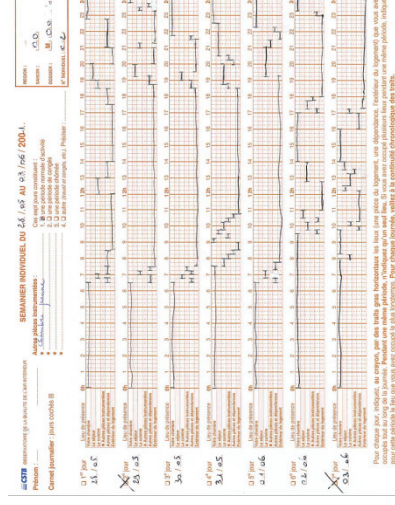


→ Significant impact of the number of smokers in the dwelling

Particle monitoring in a subset of dwellings

20 dwellings monitored:

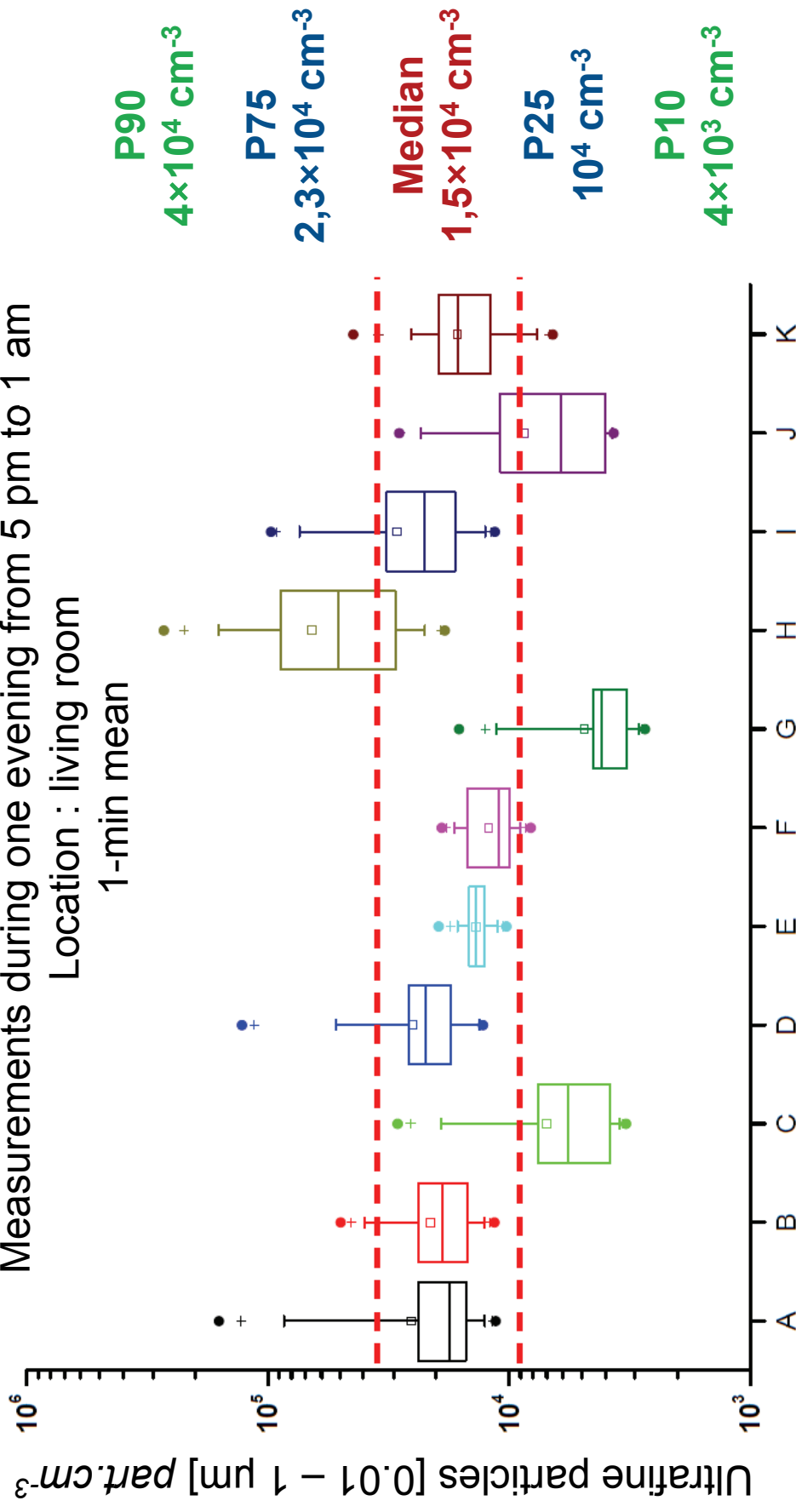
- 1 measurement in the living room (no outdoor sample)
- 2 monitoring instruments (timestep: 1 min)
 - CPC : measurement of UFP (0,01 – 1 μm) over 8 h [5 pm to 1 am]
 - OPC : measurement of fine particles (0,3 – 20 μm) over 7 days
- Time-activity diary (weekly occupancy + daily activities)



Mean completion rate = $67 \pm 23\%$

UFP [0.01-1 μm] results in 10 dwellings

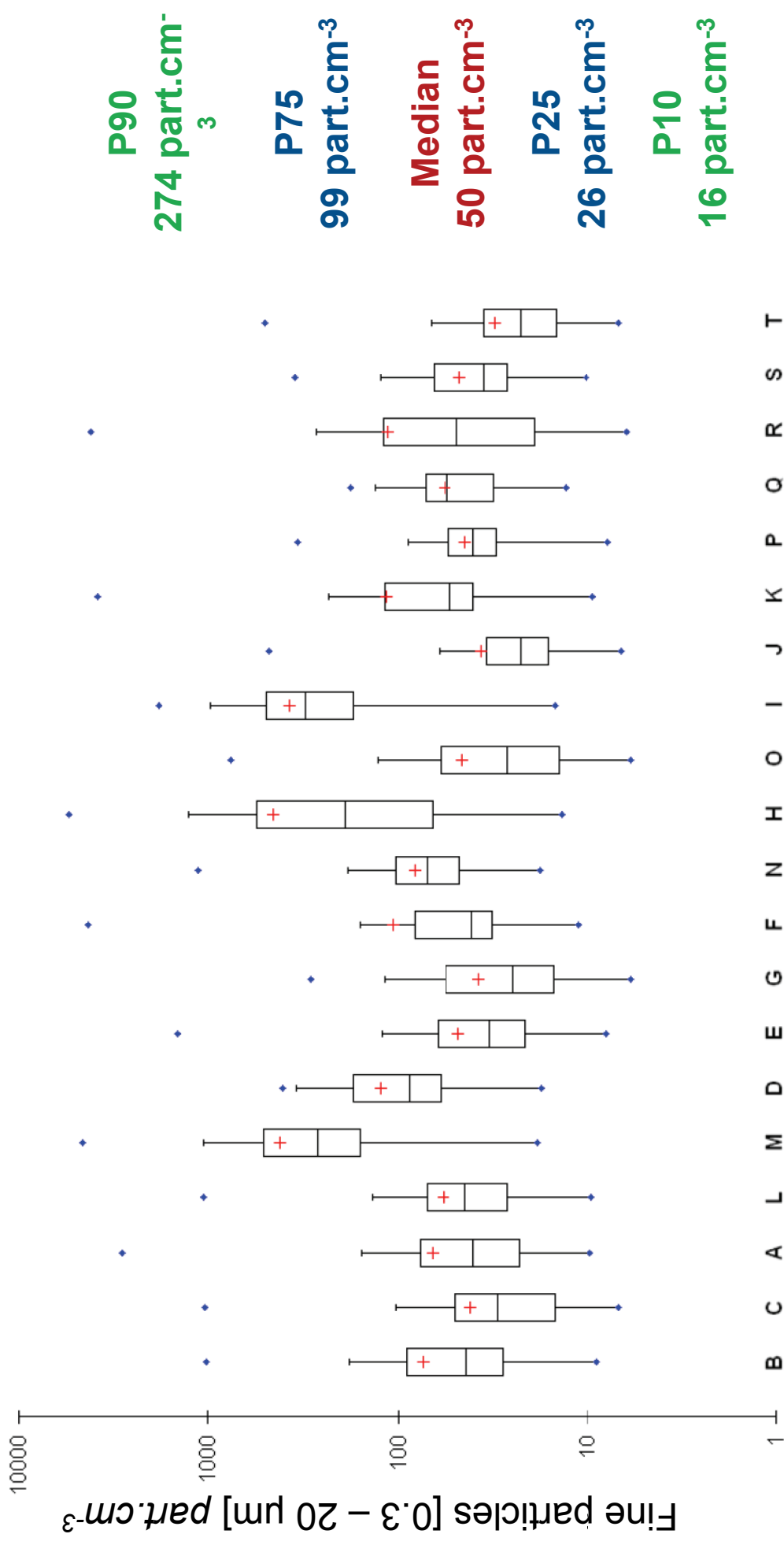
Measurements during one evening from 5 pm to 1 am
Location : living room
1-min mean



Dwellings

Max/min ratio = 1 to 15

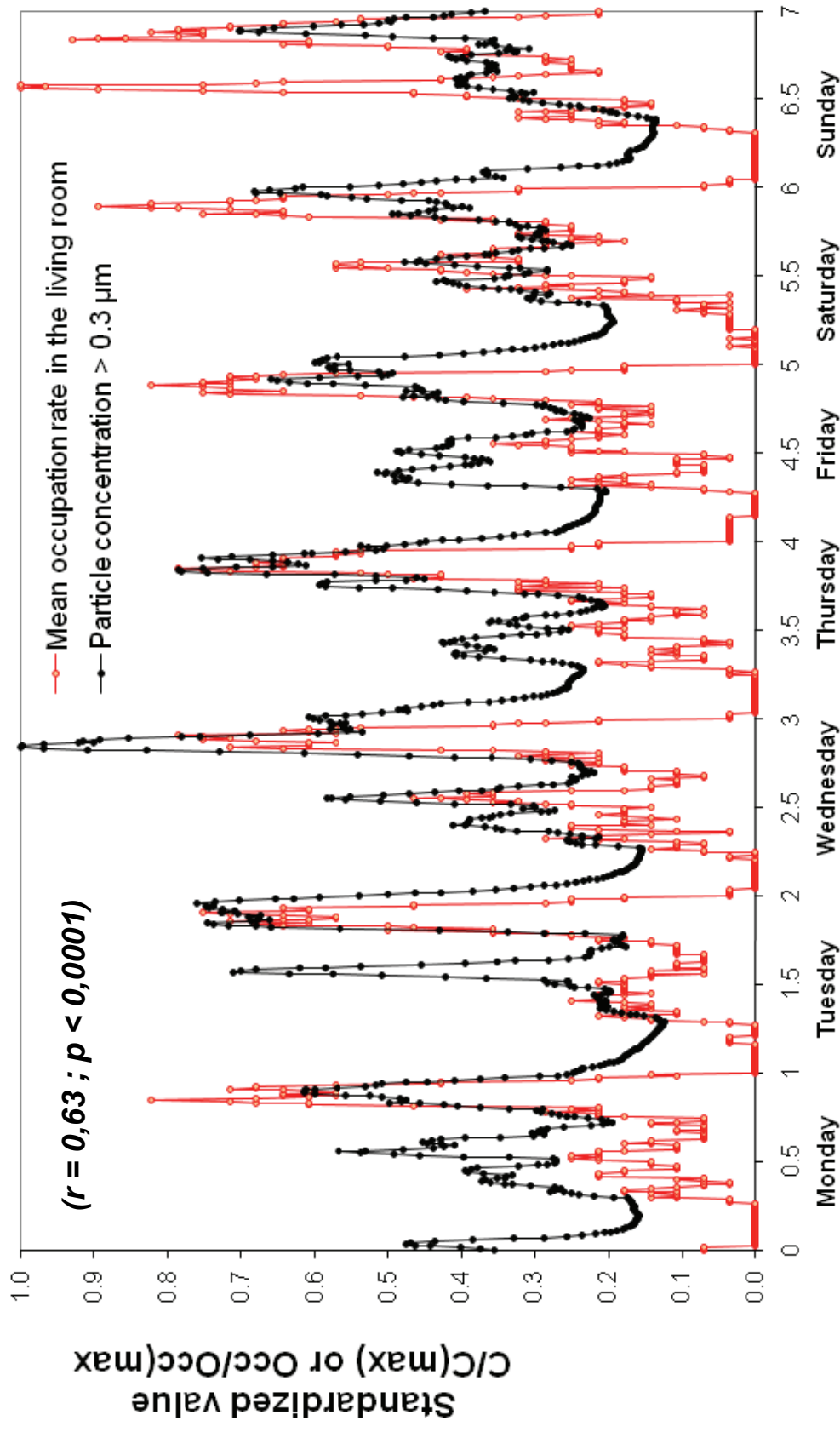
Fine Particles ($> 0,3 \mu\text{m}$) - 20 dwellings



Dwellings

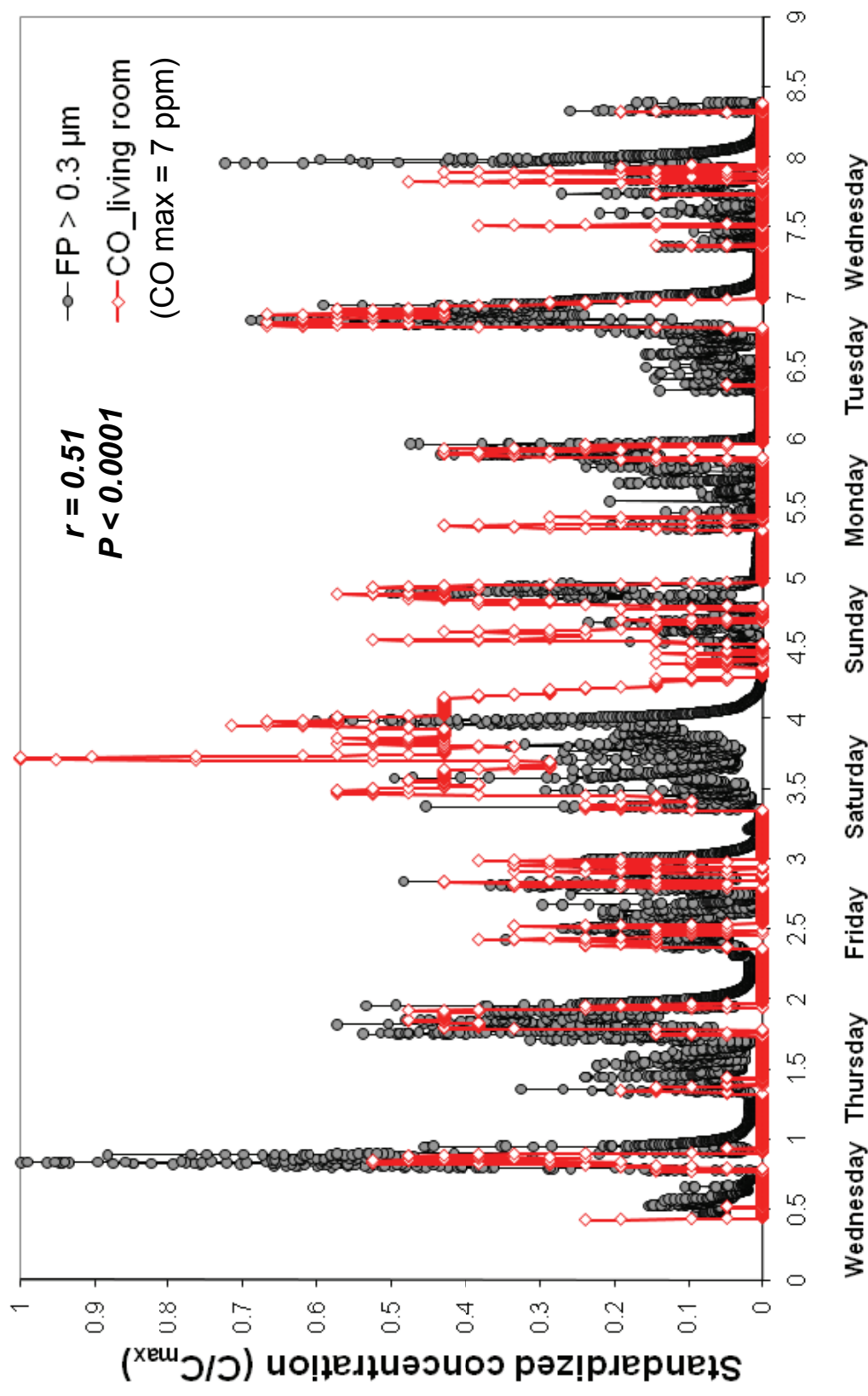
Max/min ratio = 23 to 323

Correlation with mean occupancy rate in the living room for all 20 dwellings

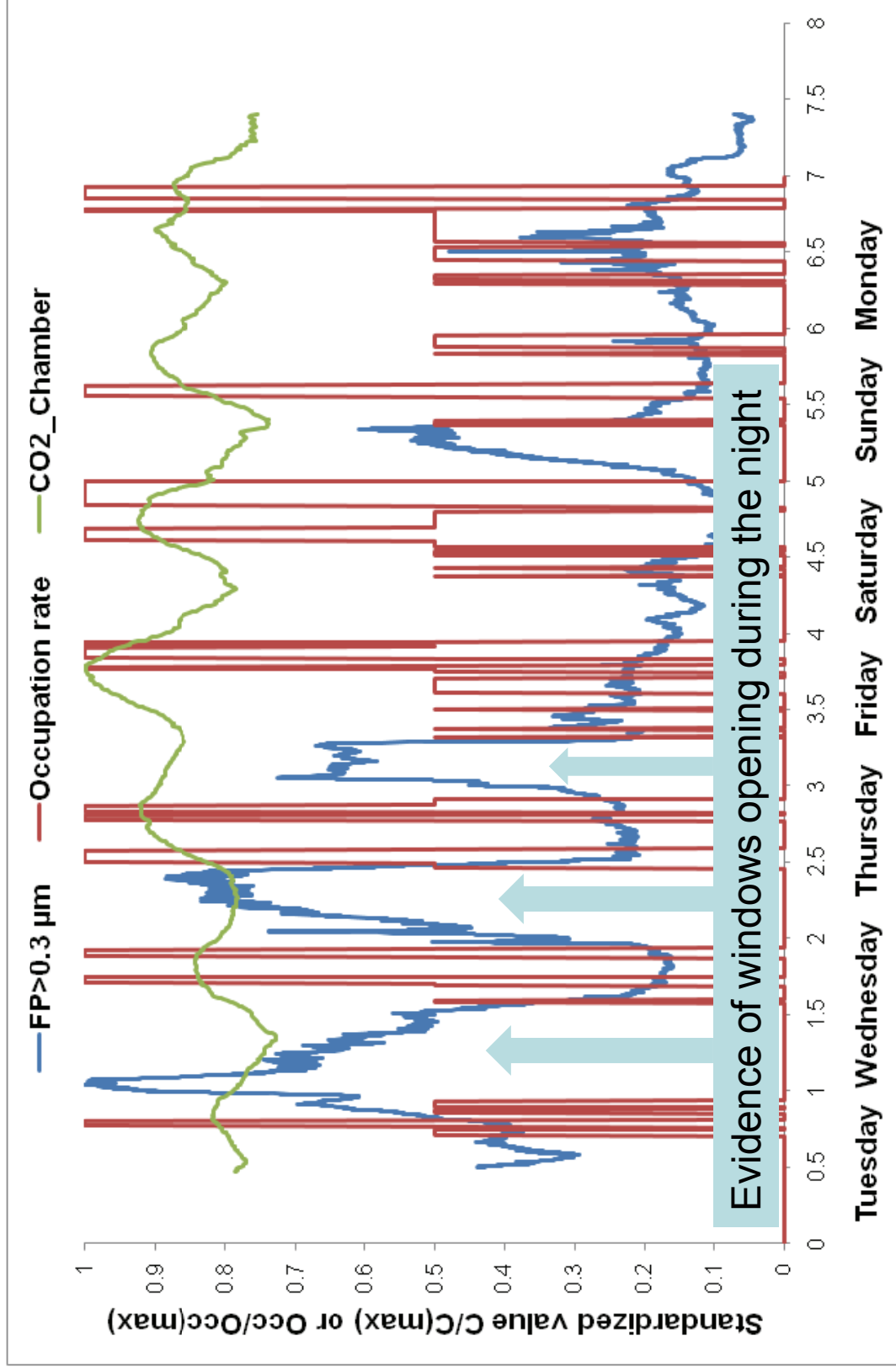


→ Significant association between mean occupancy and mean particle level

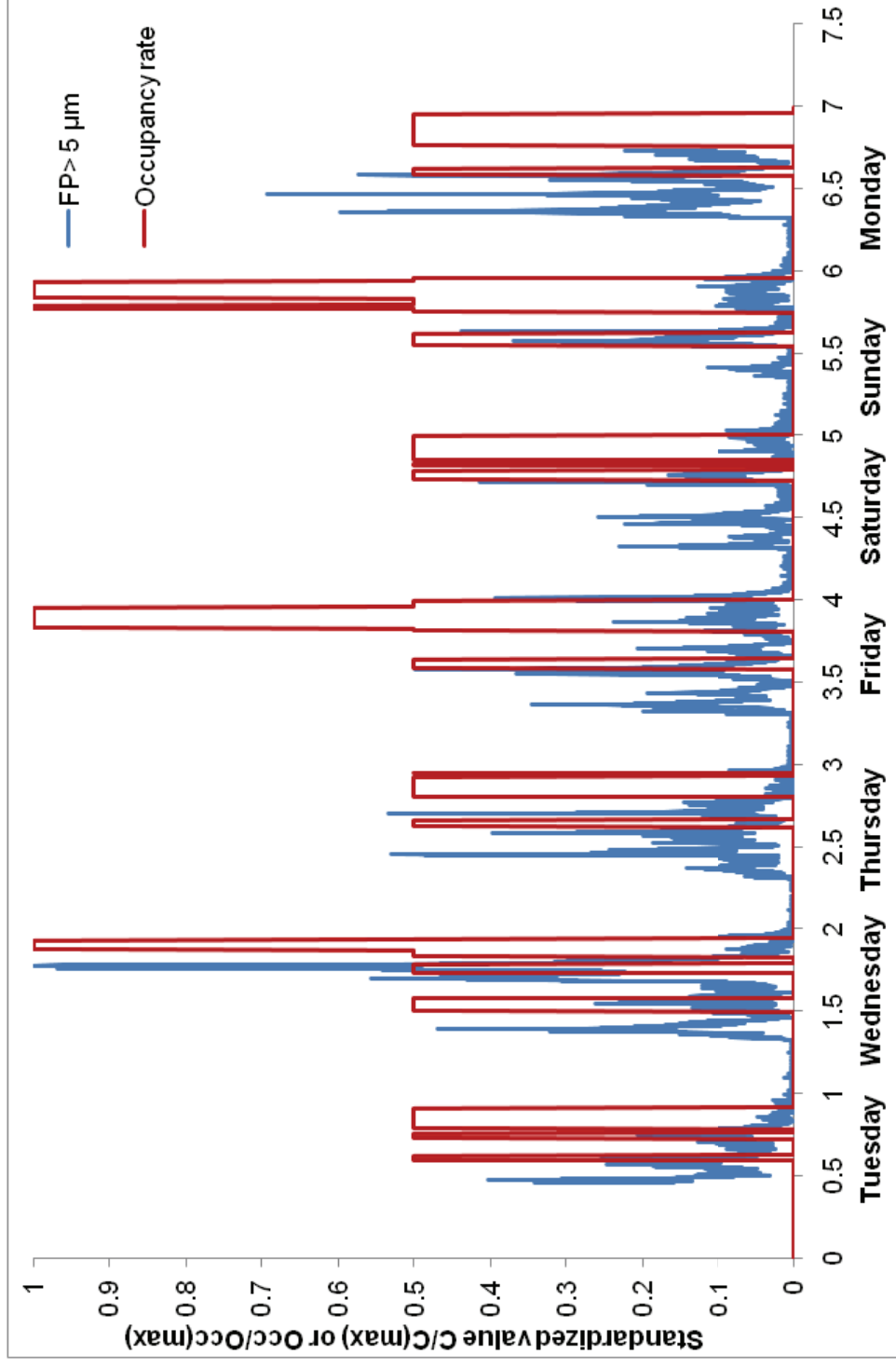
Correlation of FP with CO level in the living room (dwelling H)



Non-smoking dwelling investigated in July (dwelling D)



Relation of FP with occupancy depend on particle size (dwelling R)



→ No relation of FP > 5 μm with occupancy rate

Conclusion

- Peaks of particle concentrations are generally associated with maximum occupancy in the living room (especially during evening).
- During occupancy, particle levels are mostly defined by indoor activities (mainly tobacco smoke).
- The impact of outdoor air is mostly seen when indoor activities are negligible (i.e. no occupants or during the night). There are however exceptions.
- Indoor activities contribute significantly to the population exposure to particles. However, the associated health risk is not known as indoor particle composition (especially the organic fraction) remains largely unknown.

Thank you for your attention

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