Crawl space and moisture, how to prevent problems?

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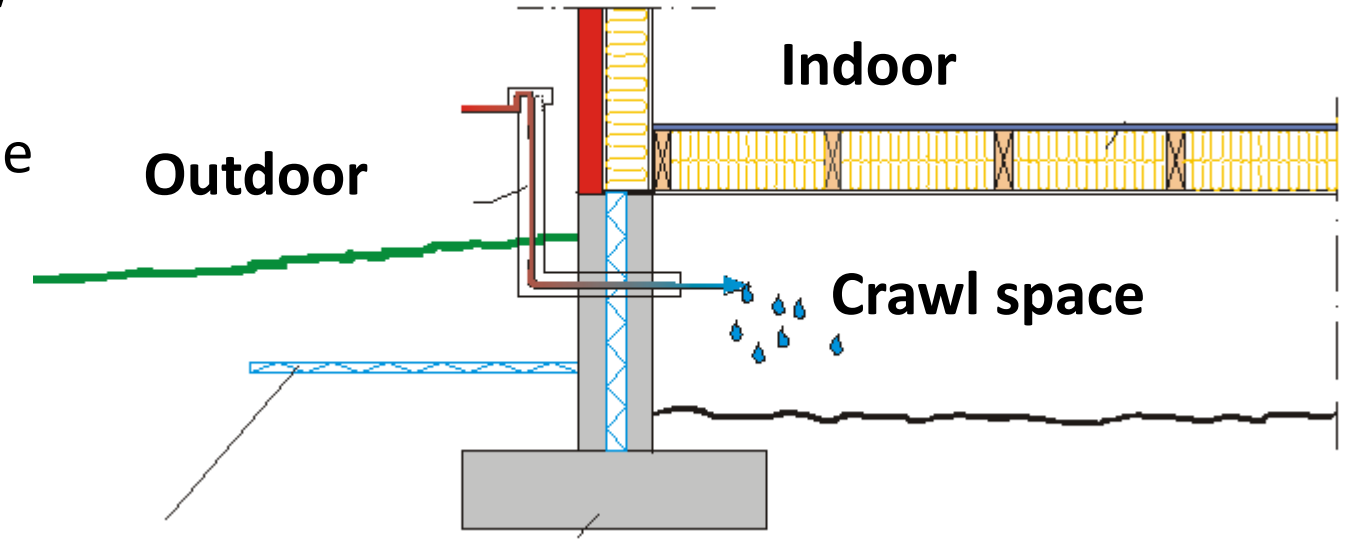
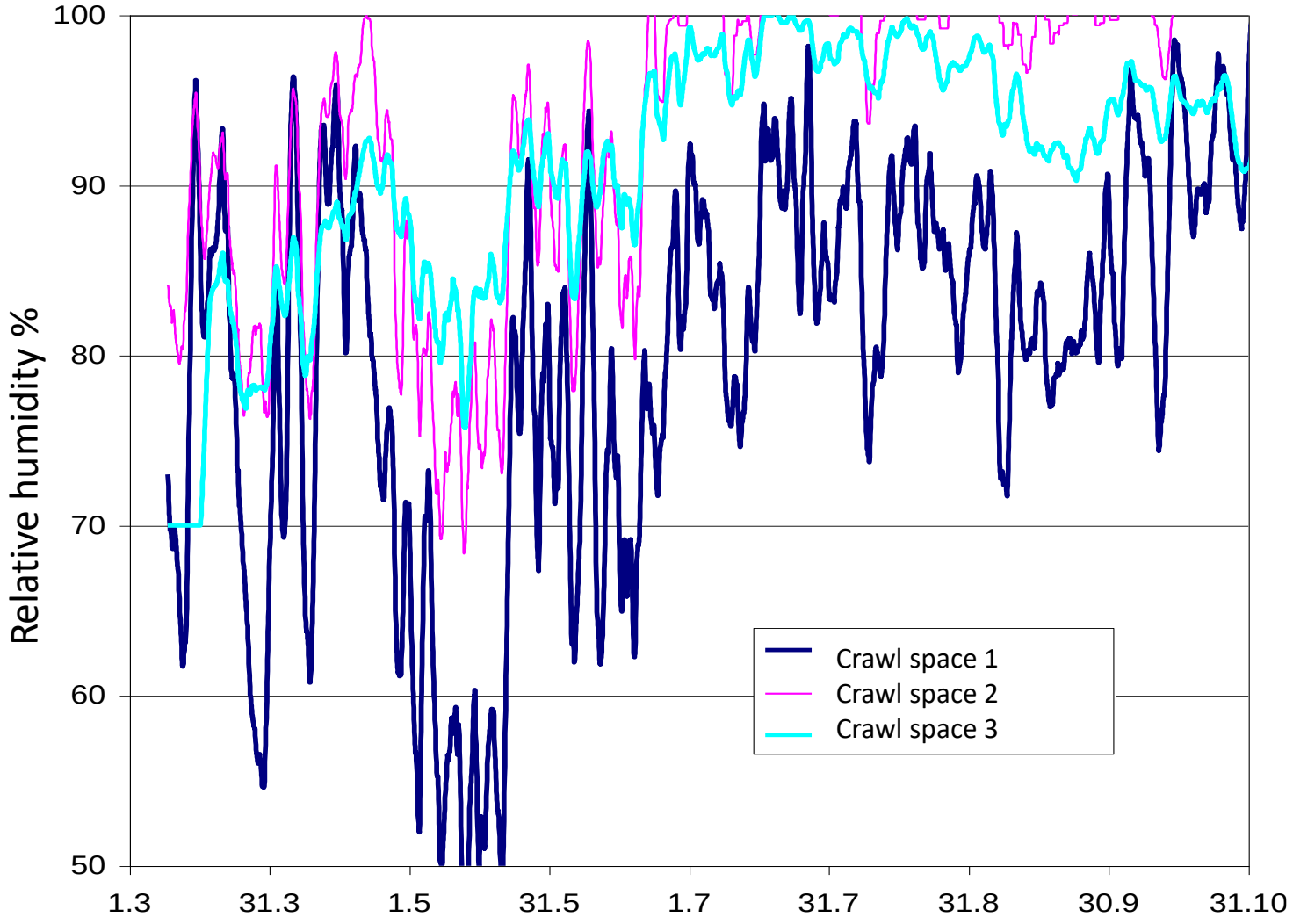
Introduction

- Crawl space is widely used in northern countries both in new and existing buildings
- In respect of Radon, crawl space is advantageous solution
- But for moisture behavior especially summer is problematic due to time lag



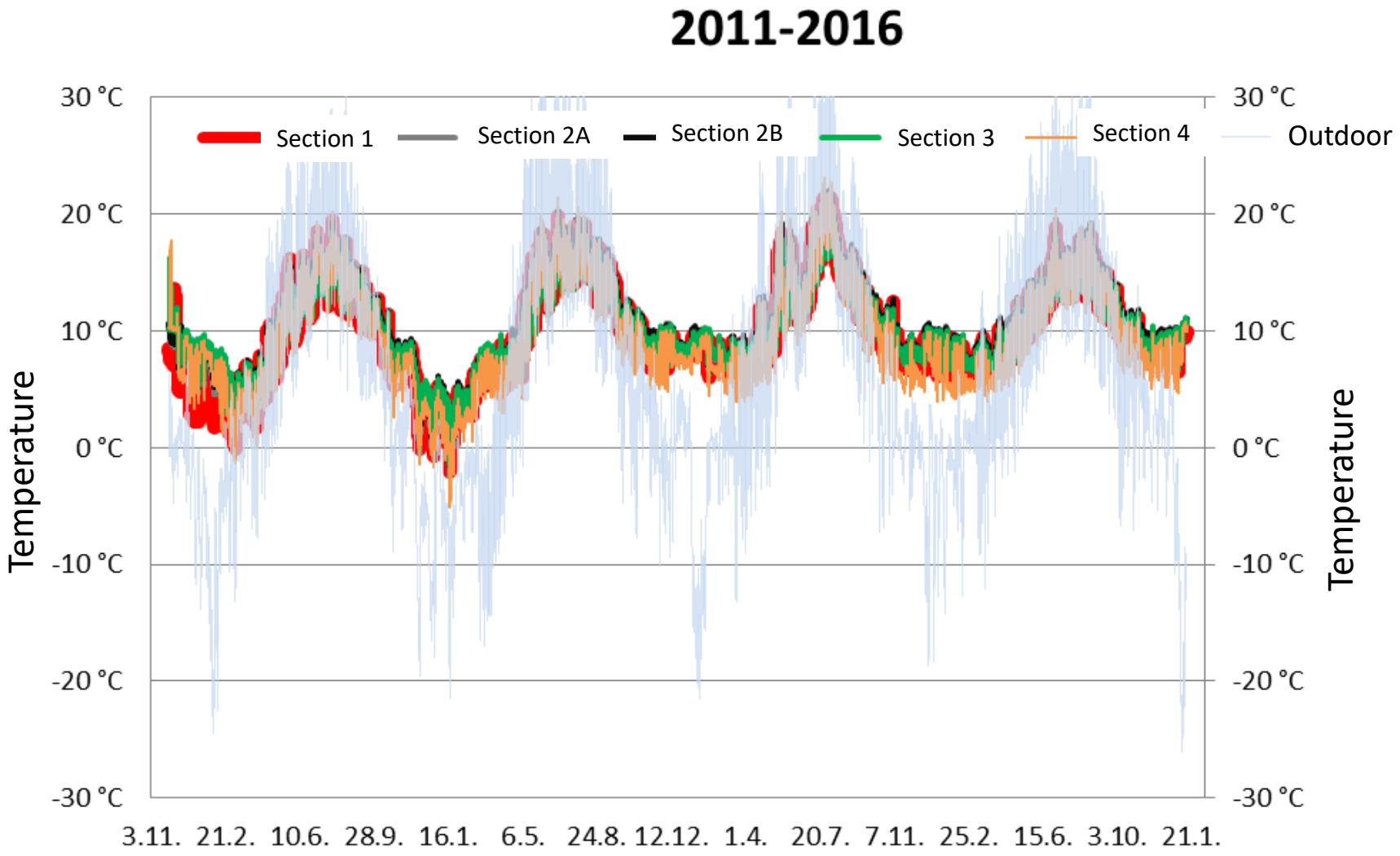
Very high relative humidity reported in previous studies, typically being 80-90%, even condensation
=> very good conditions for mold growth

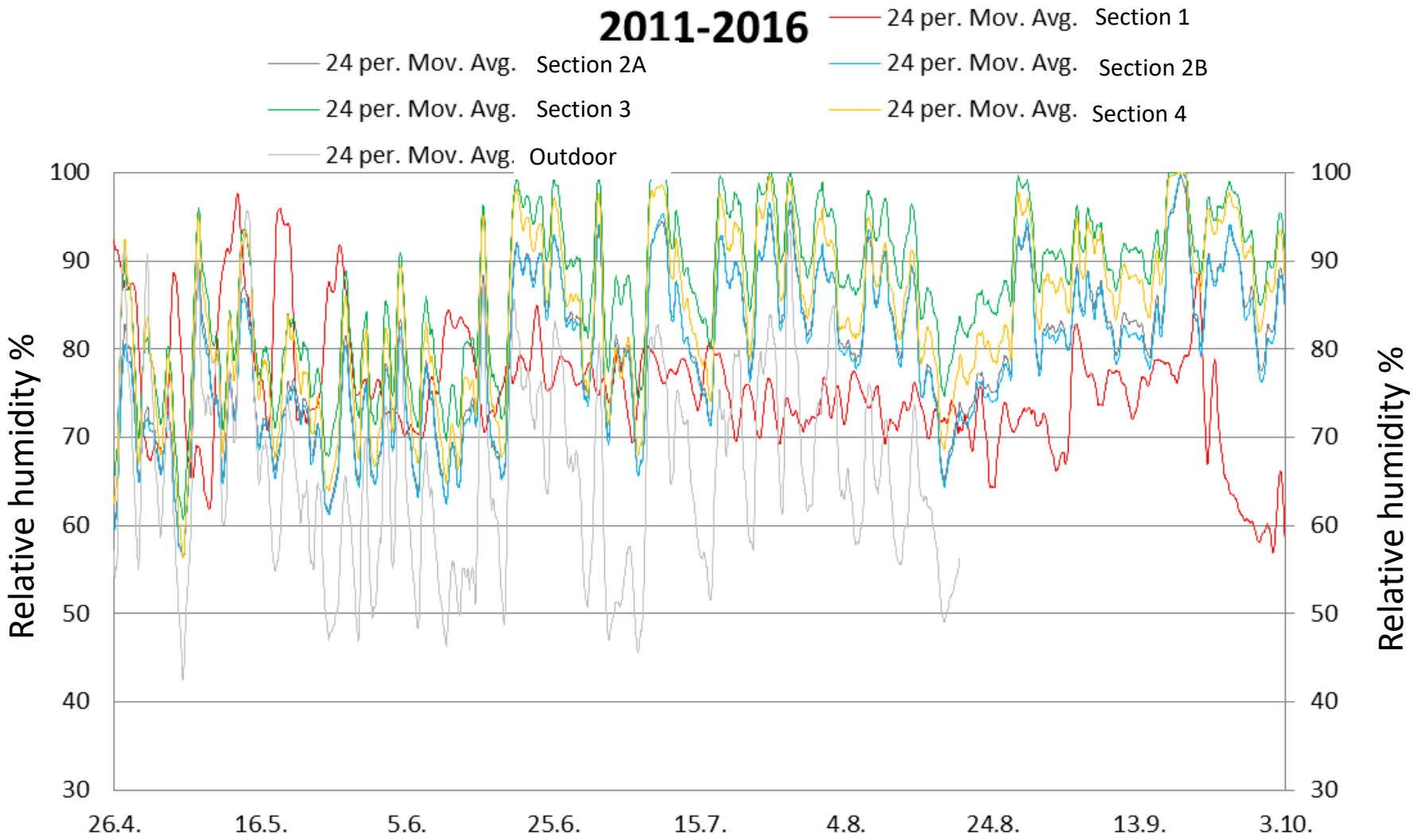


How to reduce the time lag?

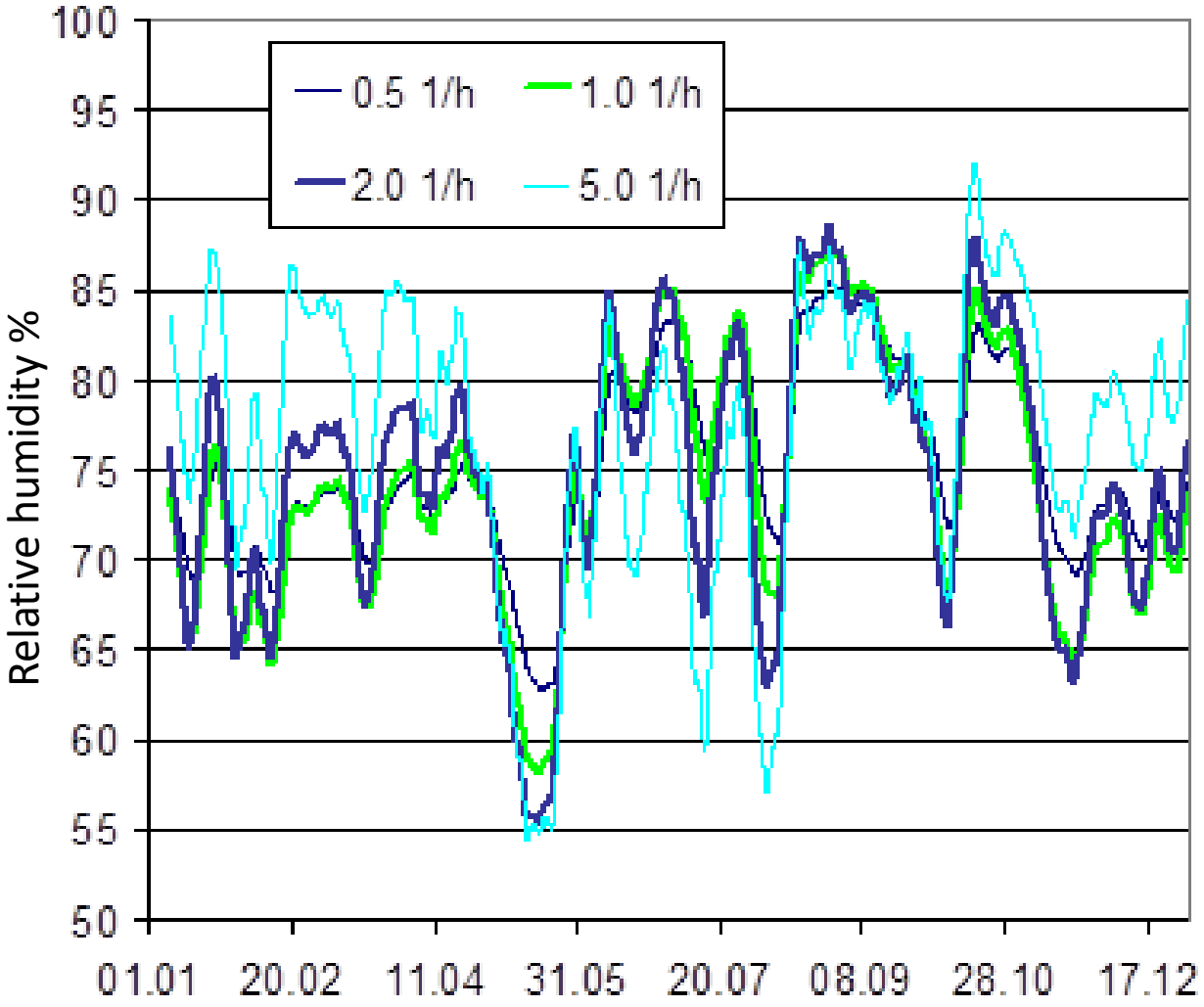
- Increasing ventilation
- Increasing thermal insulation

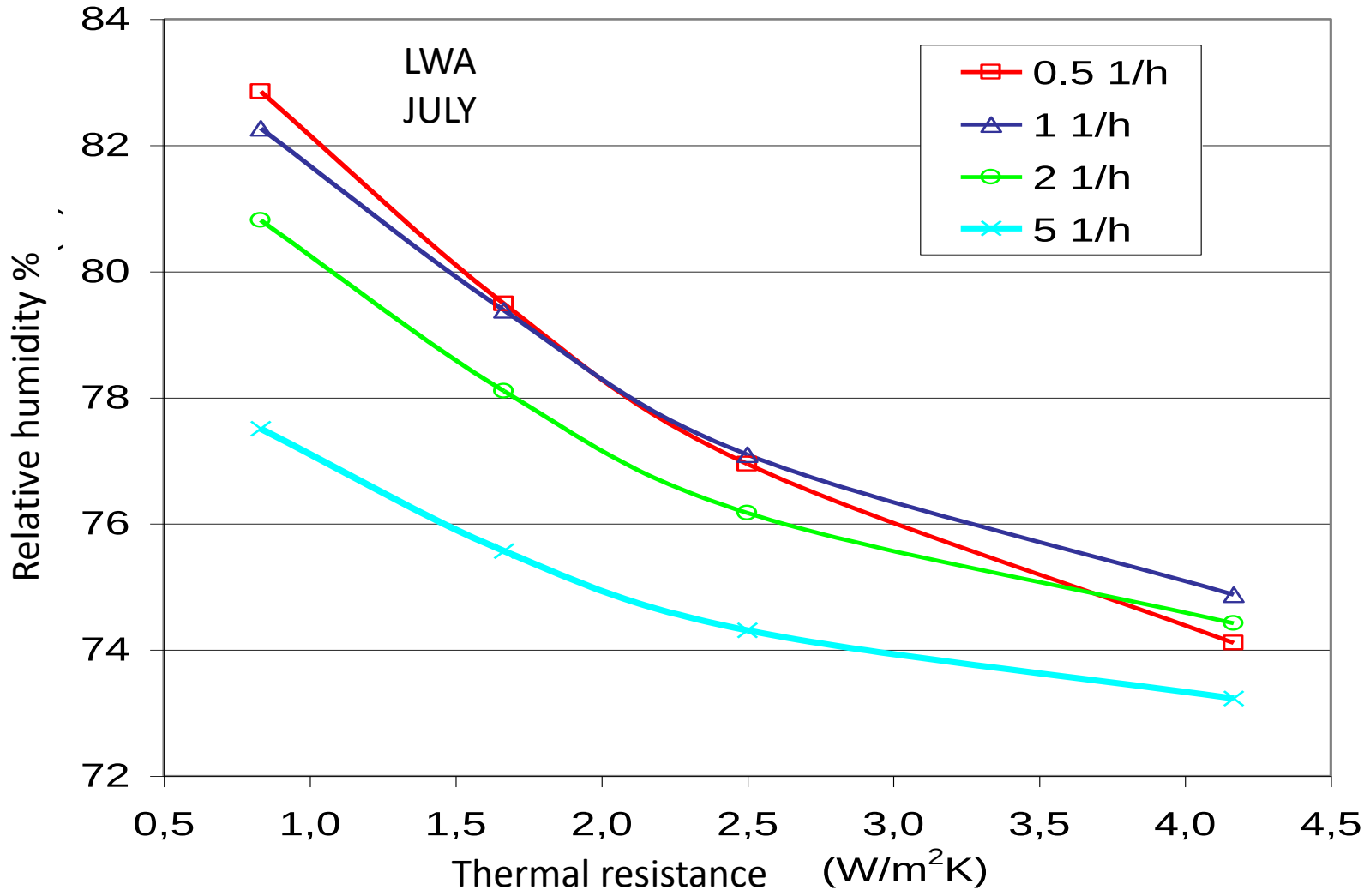
Efficient ventilation
Measured crawl space, 4 years measurement period



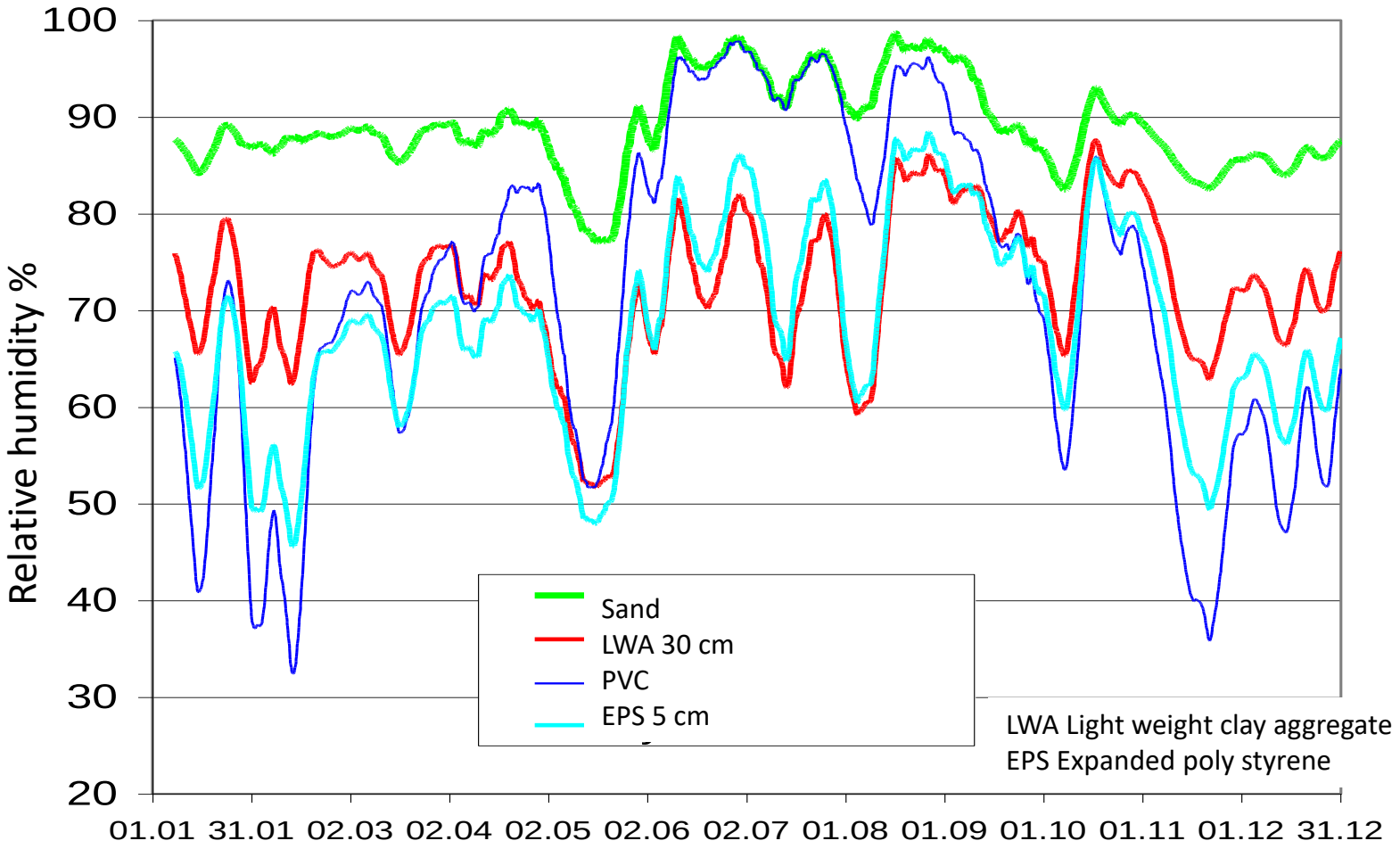

2011-2016
24 per. Mov. Avg. Section 1
24 per. Mov. Avg. Section 2A
24 per. Mov. Avg. Section 2B
24 per. Mov. Avg. Section 3
24 per. Mov. Avg. Section 4
24 per. Mov. Avg. Outdoor
Relative humidity %
100
90
80
70
60
50
40
30
26.4.
16.5.
5.6.
25.6.
15.7.
4.8.
24.8.
13.9.
3.10.

Ventilation



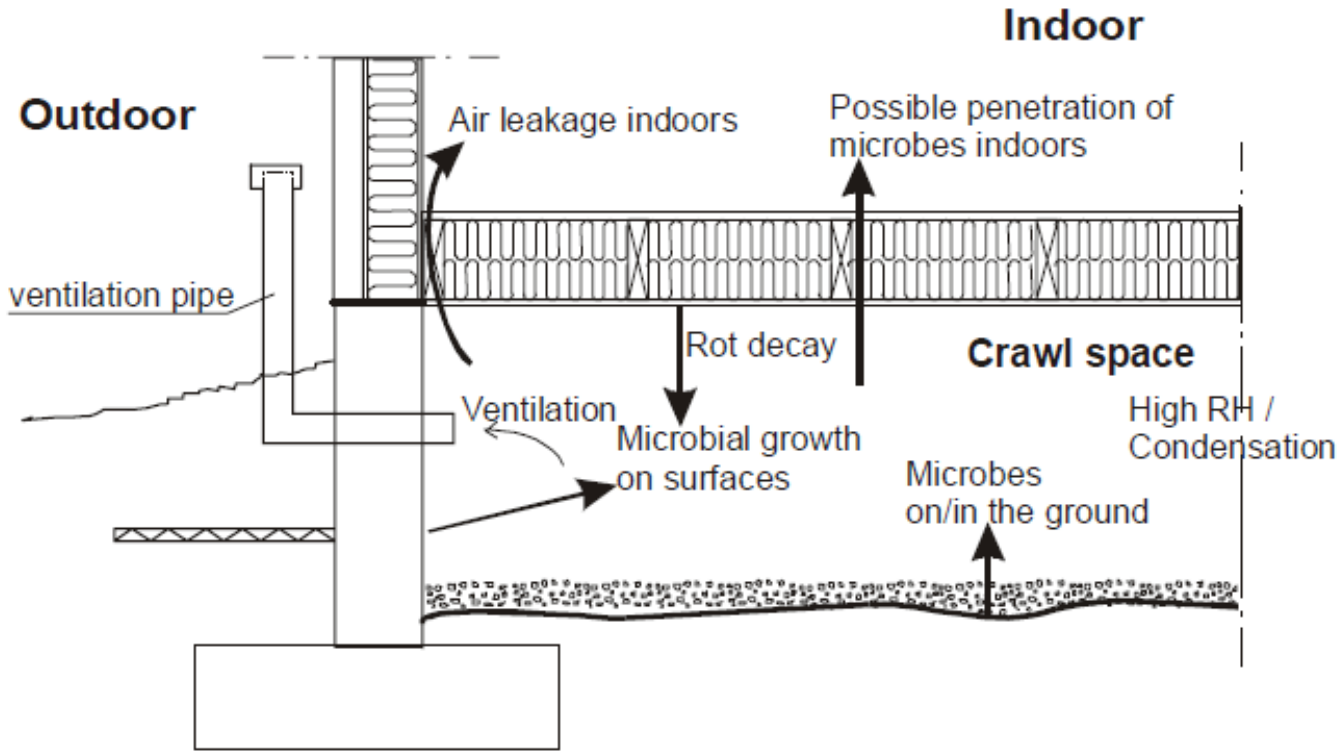

LWA
JULY
0.5 1/h
1 1/h
2 1/h
5 1/h
Relative humidity %
84
82
80
78
76
74
72
0,5
1,0
1,5
2,0
2,5
3,0
3,5
4,0
4,5
Thermal resistance (W/m²K)

Thermal insulation

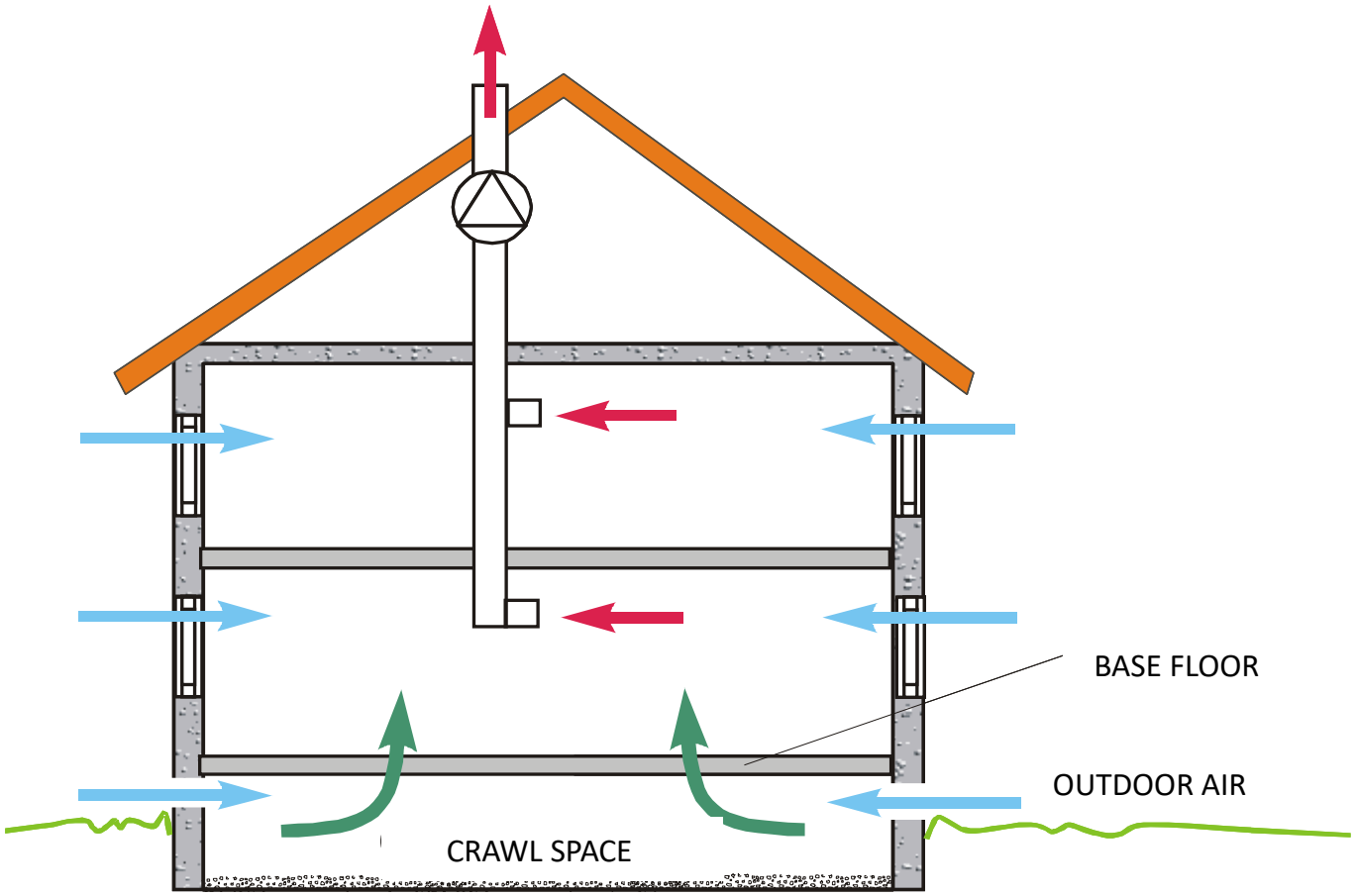


Pressure difference

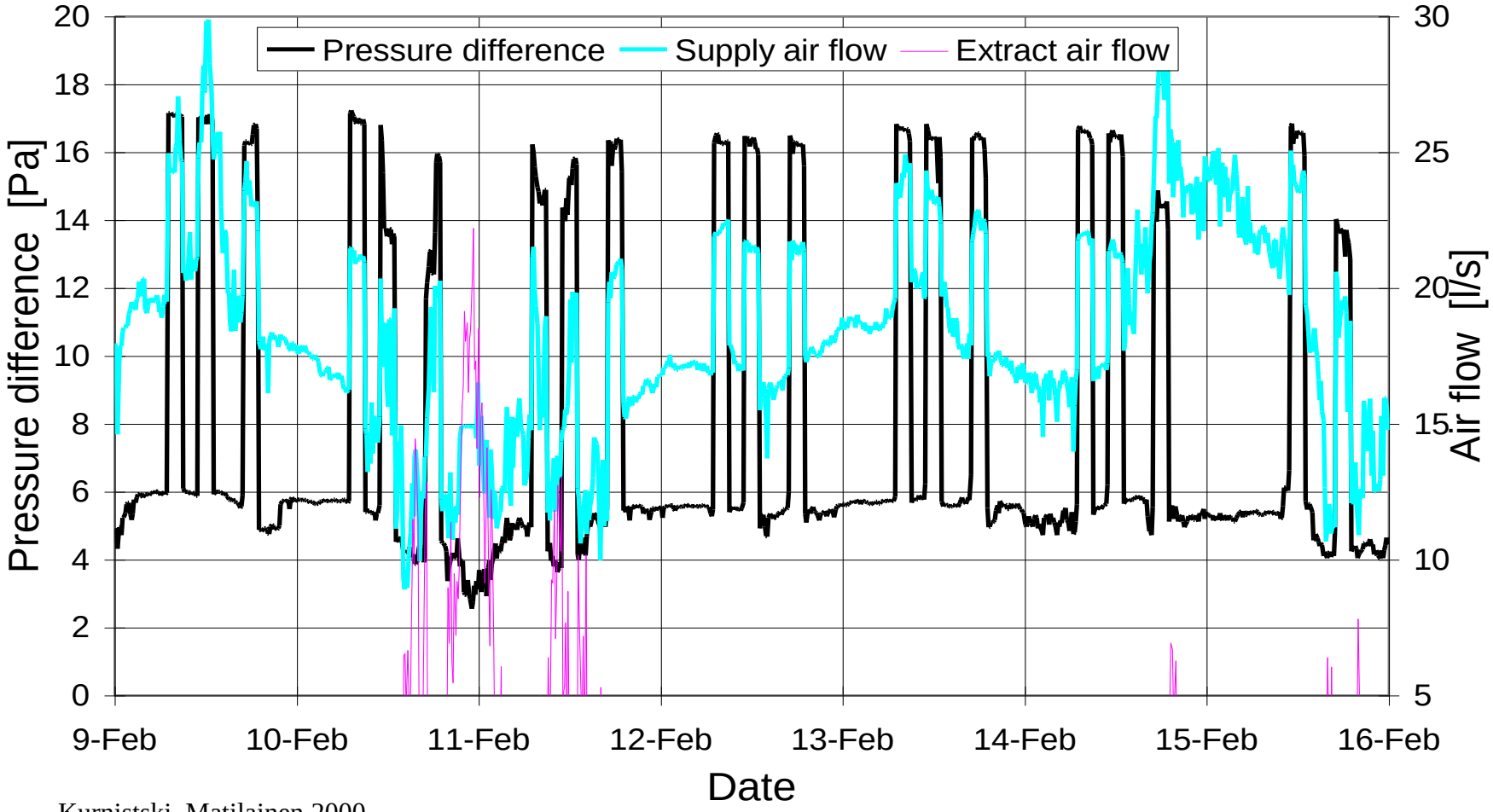
- Ventilation of the crawl space and the pressure difference between indoors and crawl space influence on penetration of impurities to indoors
- According to previous results even a small under pressure compared to indoors can prevent convective flow of fungal spores and MVOCs.



Mechanical exhaust ventilation in the apartment and crawl space

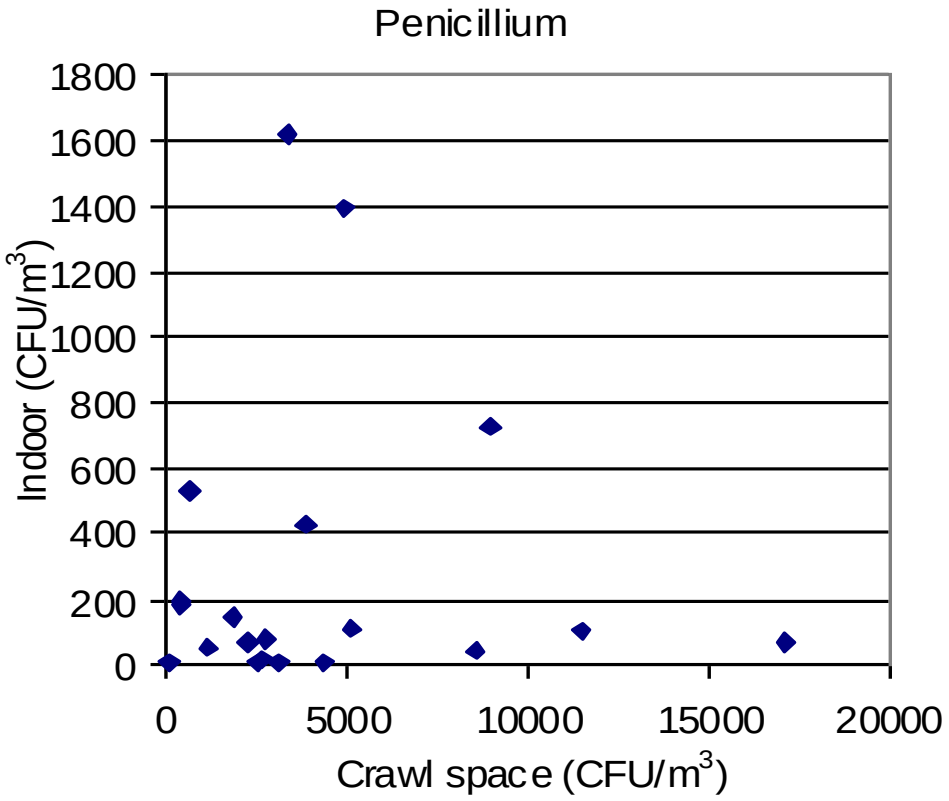


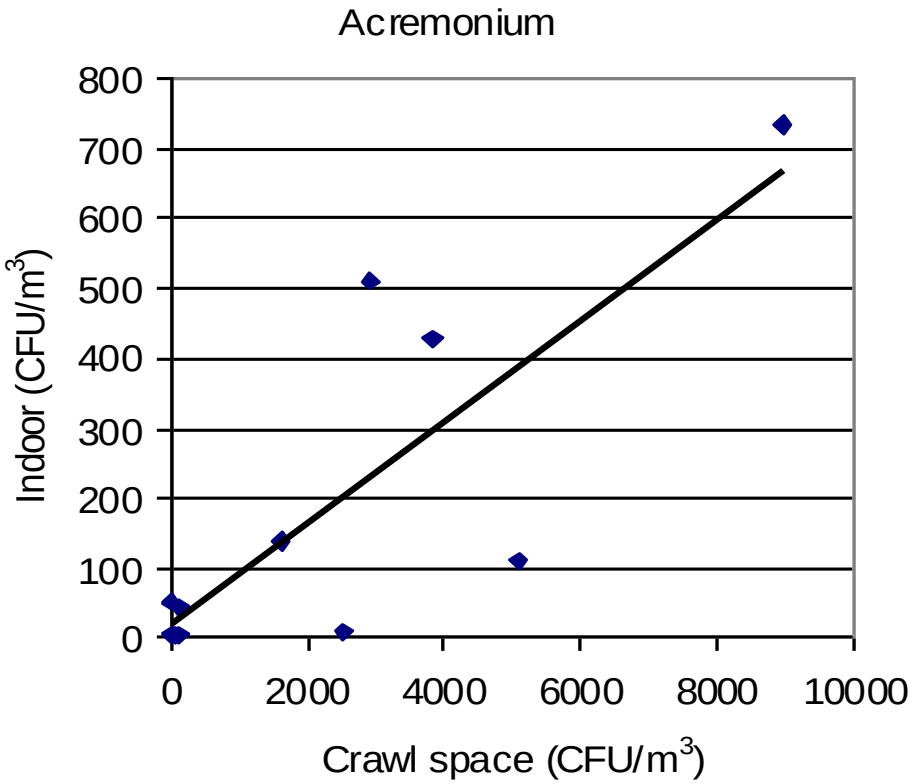
Mechanical exhaust ventilation



Kurnistski, Matilainen 2000

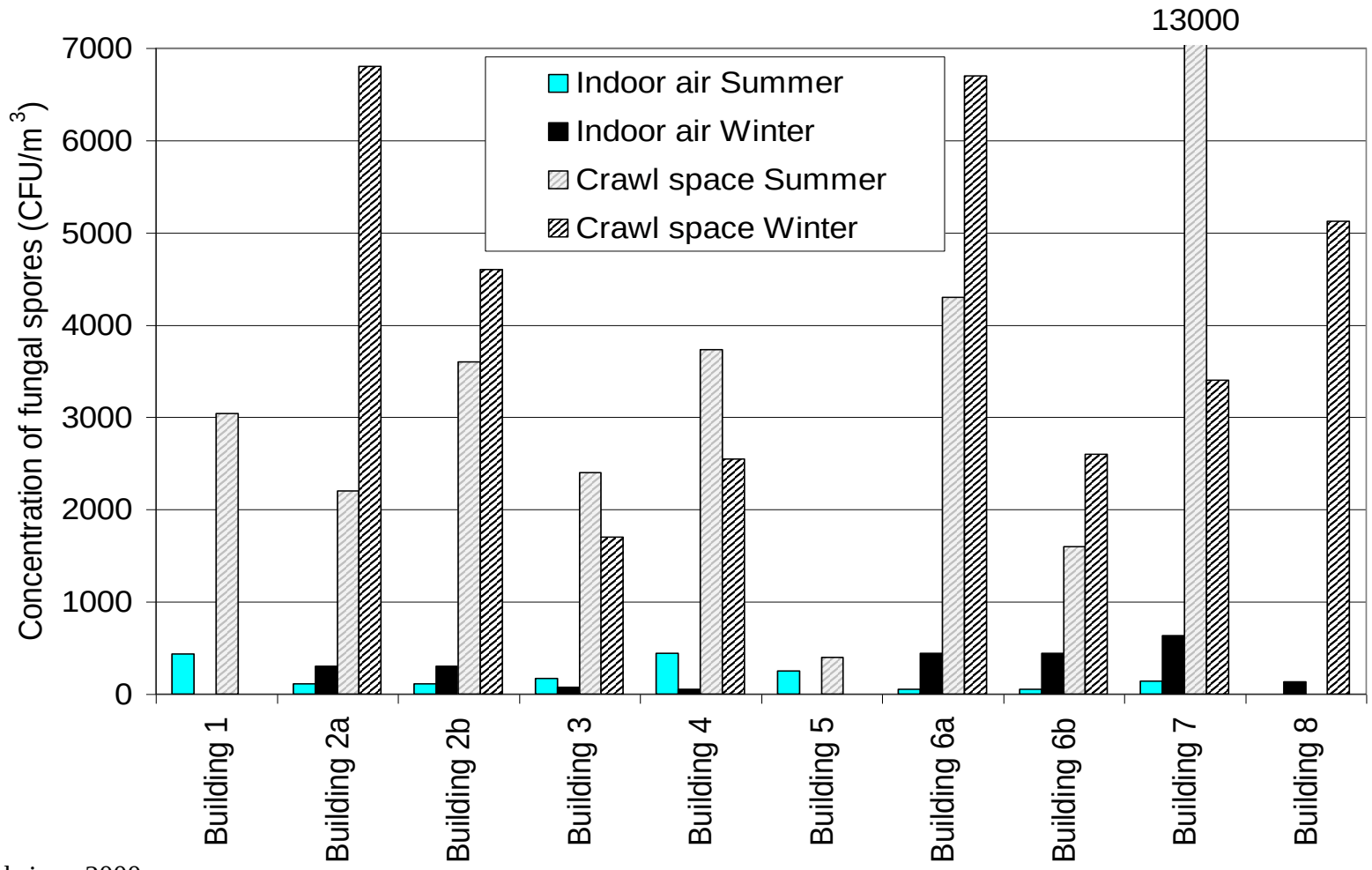
Correlation between indoor air and crawl space fungal spore concentration





Airaksinen 2003

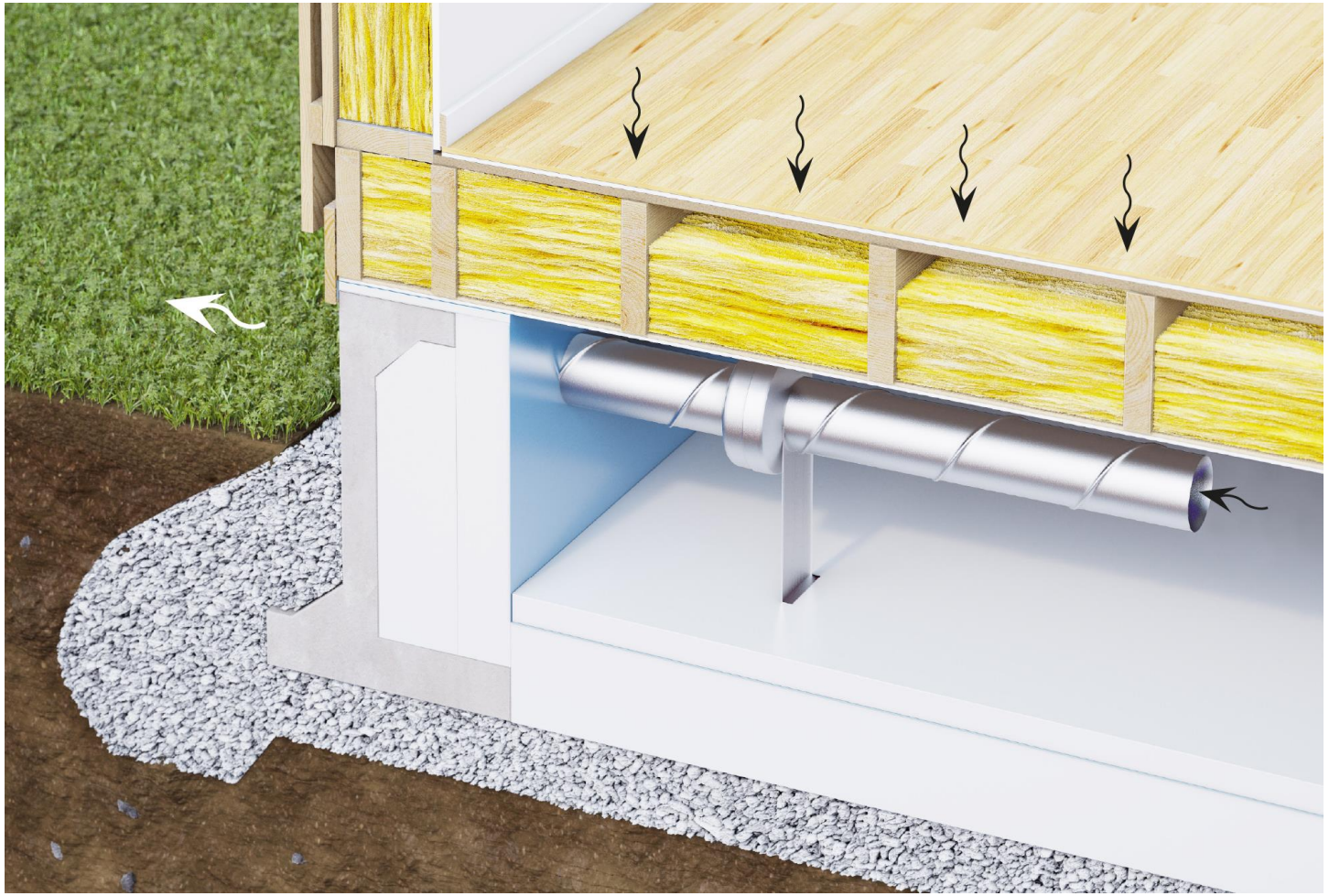
Concentration of fungal spores



Airaksinen 2000

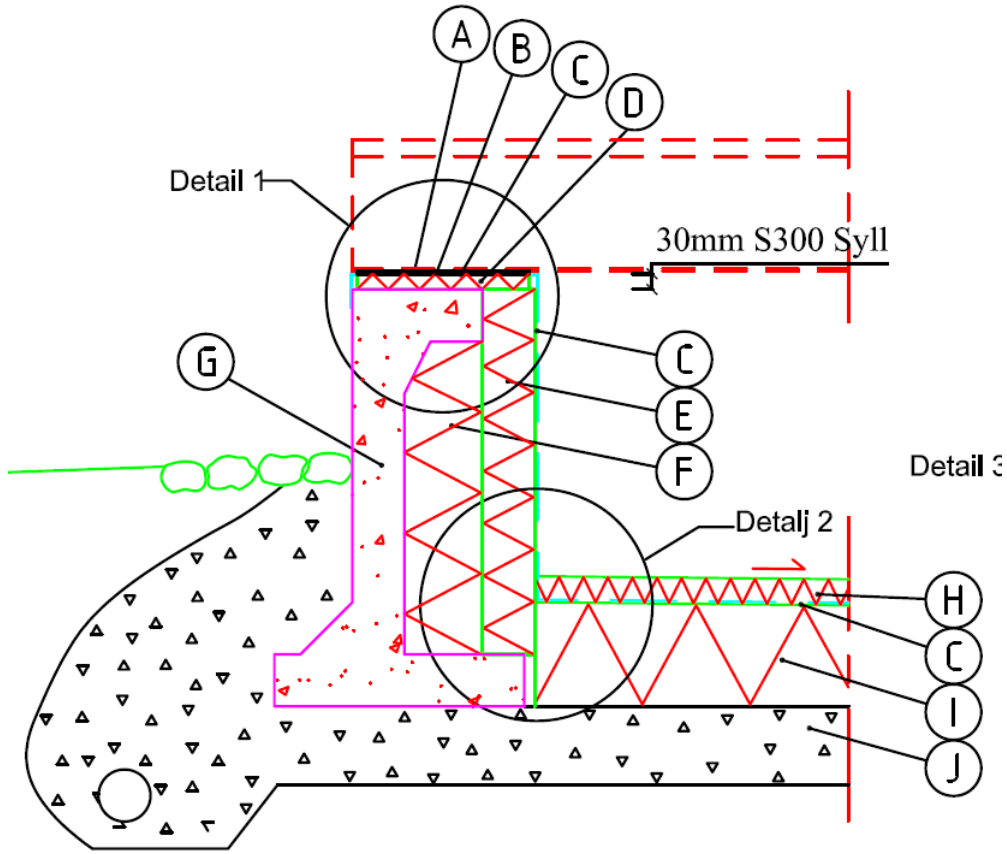
Highly insulated crawl space with minimum ventilation

- Ventilation rate was controlled with speed-controlled extract fan
- Pressure difference between crawl space and indoors 2-3 Pa
- Average flow 10 litr/sec (100 mm duct)
- Base floor air tightness were between 0.05-0.31 l/sm^2 (at 50Pa) and crawl space structure 0.31-0.66 l/sm^2



Thermal insulation

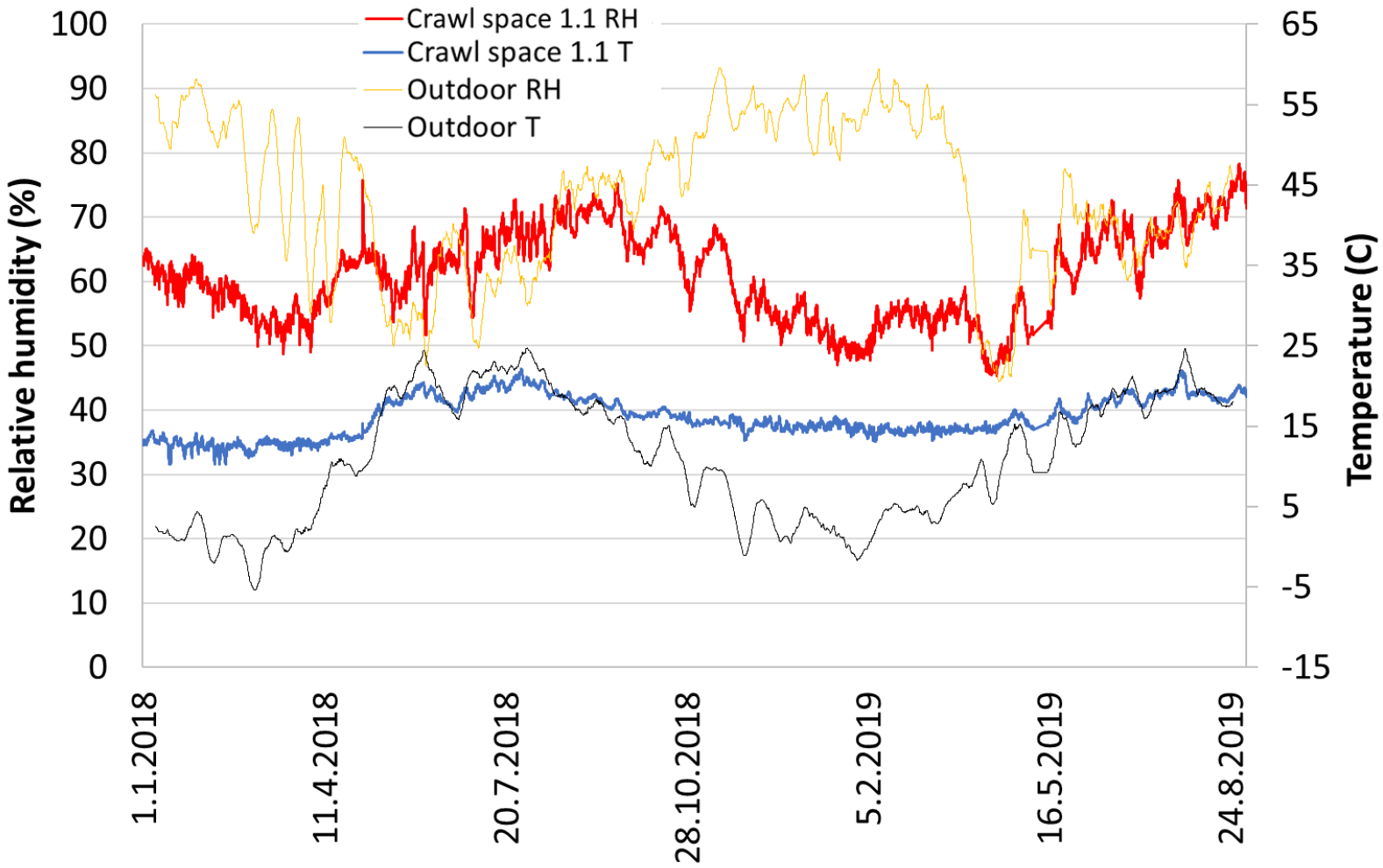
- All the studied crawl spaces had a high thermal insulation and 0.2 mm plastic foil applied as a damp proof membrane, which serves as a vapor and air barrier.
- Thermal insulation was between 110 -200 mm tapered insulation and on top of it 50 mm EPS
- Crawl space 2-4 had 200 mm insulation against soil and 170 mm in the base floor
- Crawl space 1 had 300 mm insulation against soil and 250 mm in the base floor



OUTER CONCRETE BEAM TYPE S-0000

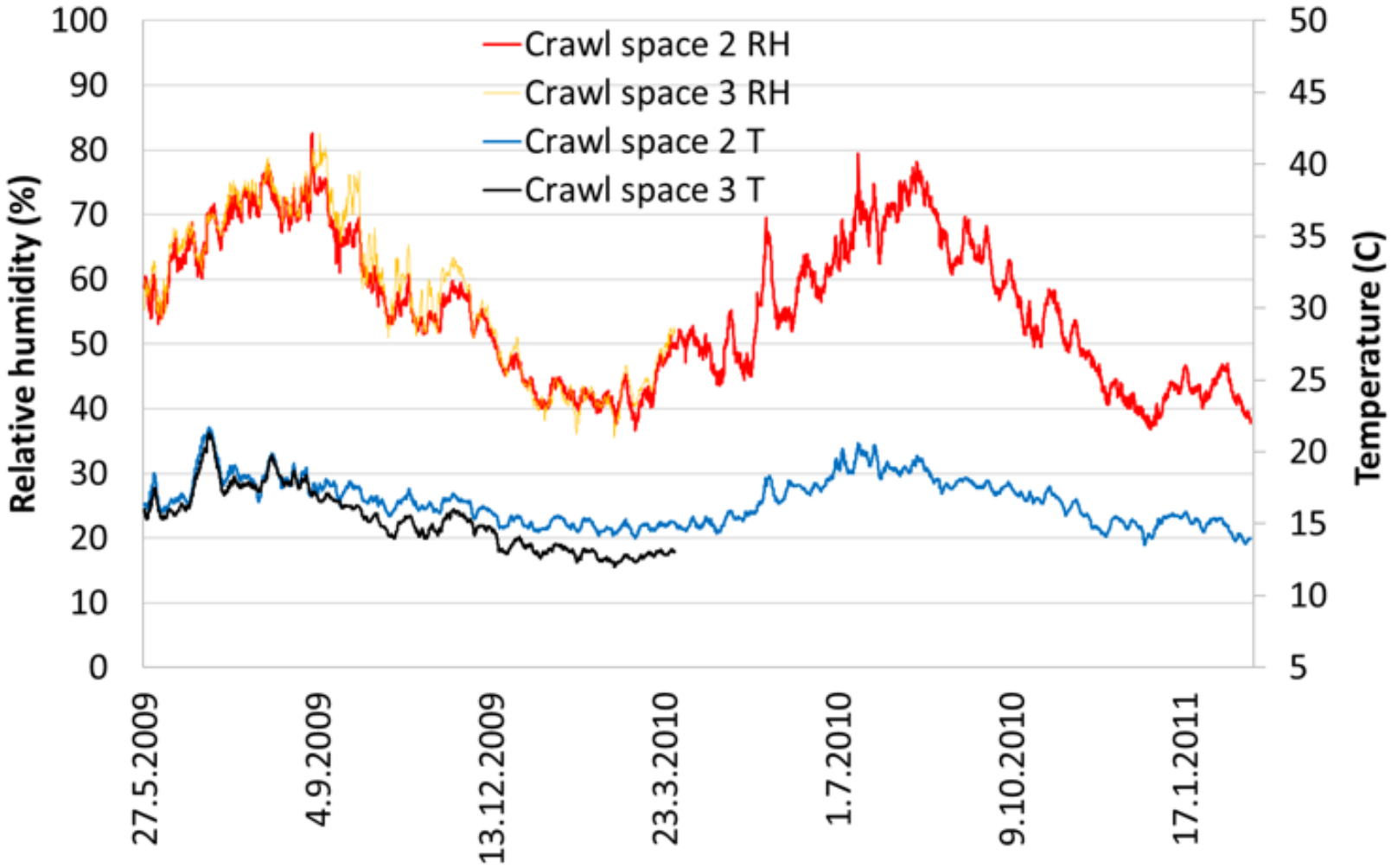
Results, crawl space 1

- RH below 75% most of the time
- Temperature in winter to 10°C, and in the summer rather high being over 20°C.



Results, crawl space 2 and 3

- The relative humidity in the crawl spaces 2 and 3 was most of the time below 75%.
- These crawl spaces were slightly cooler than crawl spaces 1



Discussion and Conclusions

- High relative humidity in summertime is one of the key problems in crawl spaces in cold climates due to time lag
- Time lag can be reduced by increased ventilation or by decreasing thermal lag with increased thermal insulation in the crawl space
- If only increased ventilation is used, many studies have show that high relative humidity can still occur in some periods
- The higher thermal resistance the ground soil has, the less ventilation is needed
- Highly insulated crawl space concept with minimum controlled ventilation provided moisture safety and can be recommended for all buildings with wooden floor
- Crawl space should have slightly lower pressure compared to indoor to prevent impurities to penetrate

Acknowledgements

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