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Comparison of measured and calculated temperature and relative humidity with varied and constant air flow in the facade air gap

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Background

Air flow in the air gap behind the faced panel:

- Affects the climate conditions in the wall outside the vapour barrier (Hägerstedt 2010)
- Wind dependent (Falk 2010)
- Radiation/ temperature dependent (Falk 2010)
- Etc.....



Aim

Investigate how different airflow rate in the air gap behind the facade panel will influence the hygrothermal conditions in the wall

- WUFI calculations
- Wind dependent air flow (Nore 2009)
- Constant air flow
- Verify with measurements



Method

Boundary conditions

Meteorological outdoor climate data from SMHI

- 114 km from the building
- Climate check

Indoor measurements

- Relative humidity
- Temperature

Material data from WUFI material data base

Comparison moves

Blind calculations with constant (30 ACH) or wind dependent (10 or 100 ACH) air flow in the facade air gap



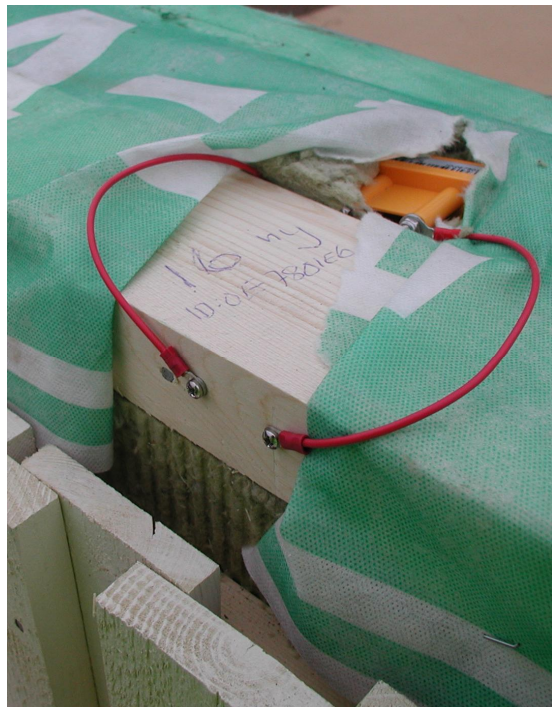
Comparison of calculations *2 and measured values

Comparison with measured values in different places

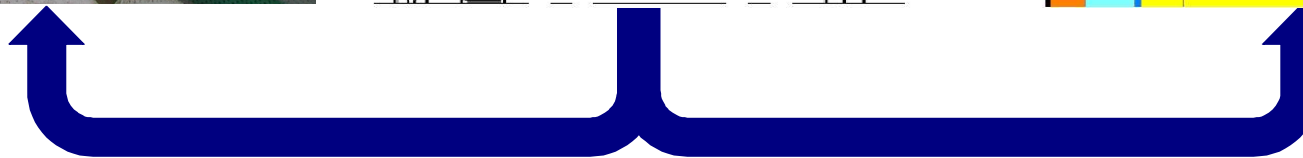
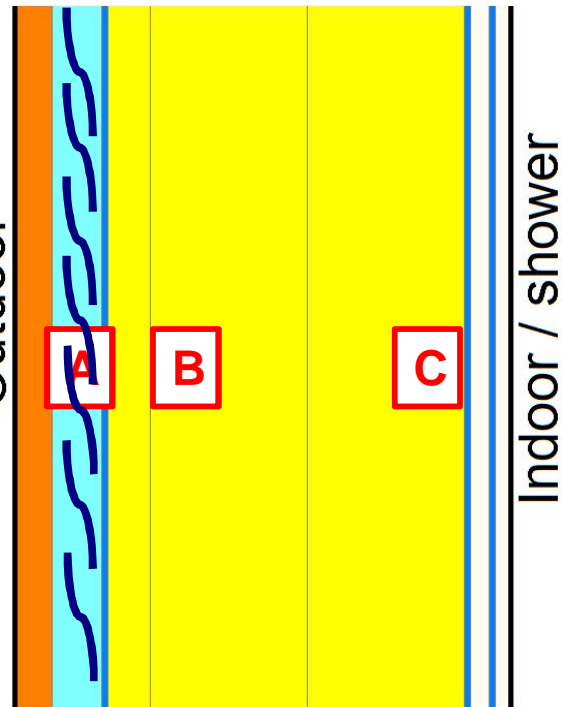
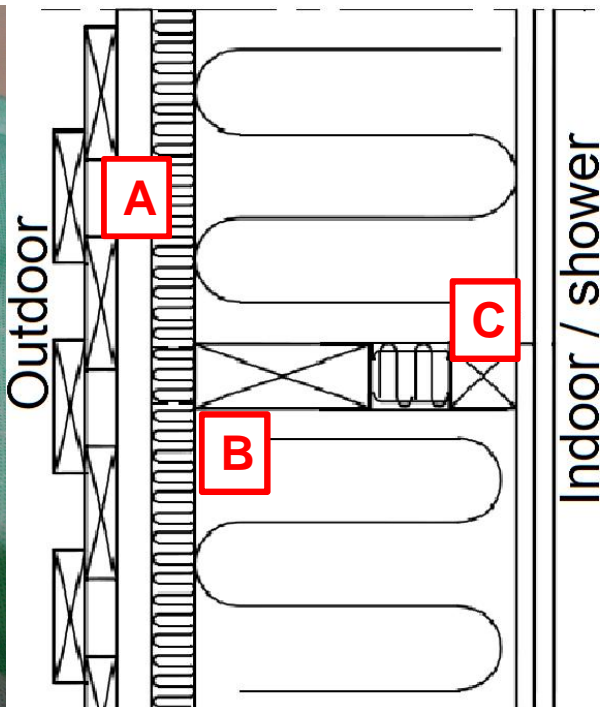


Method

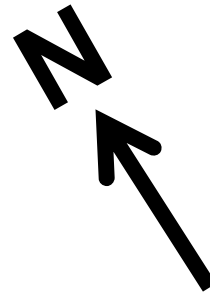
Field measurements



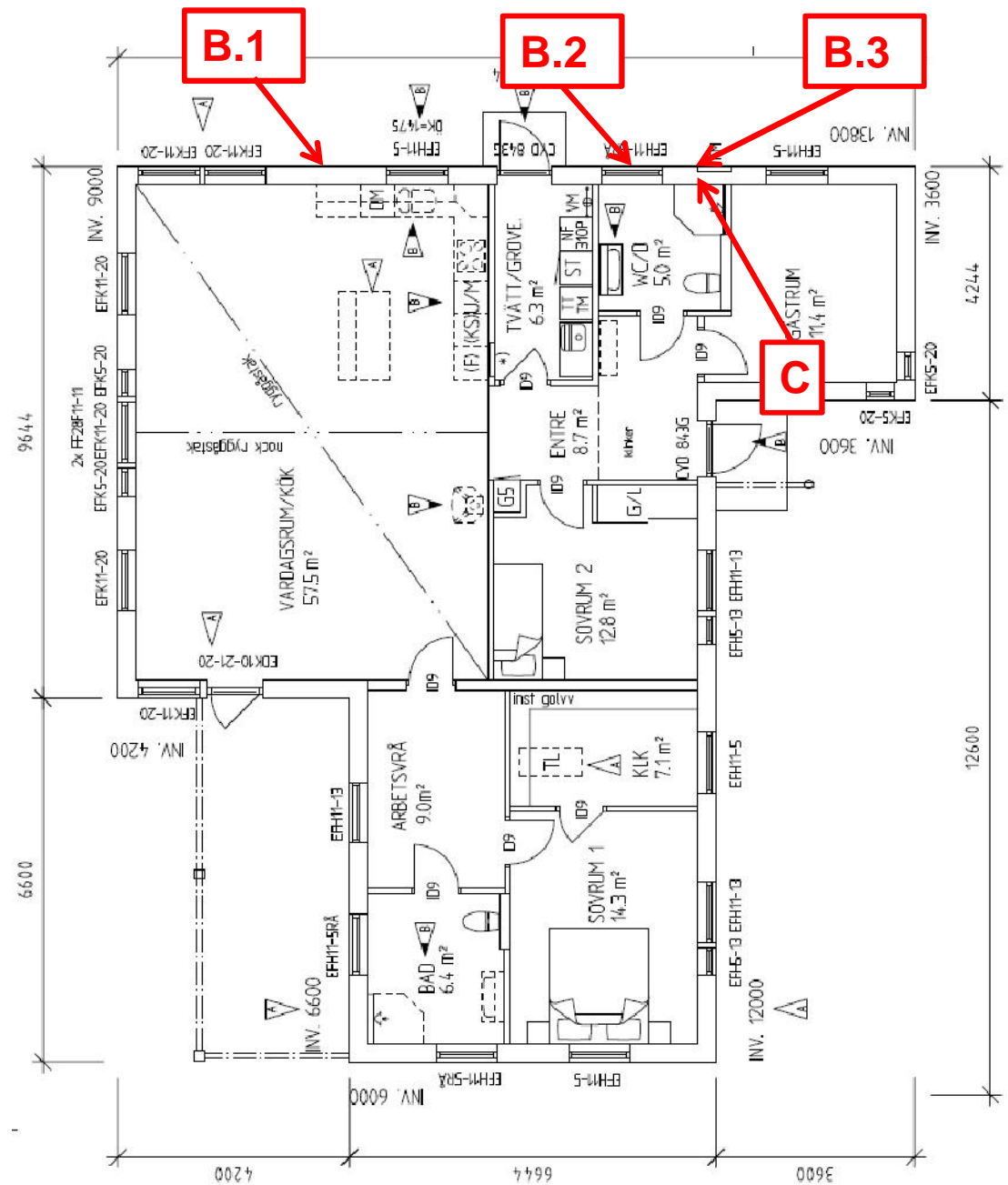
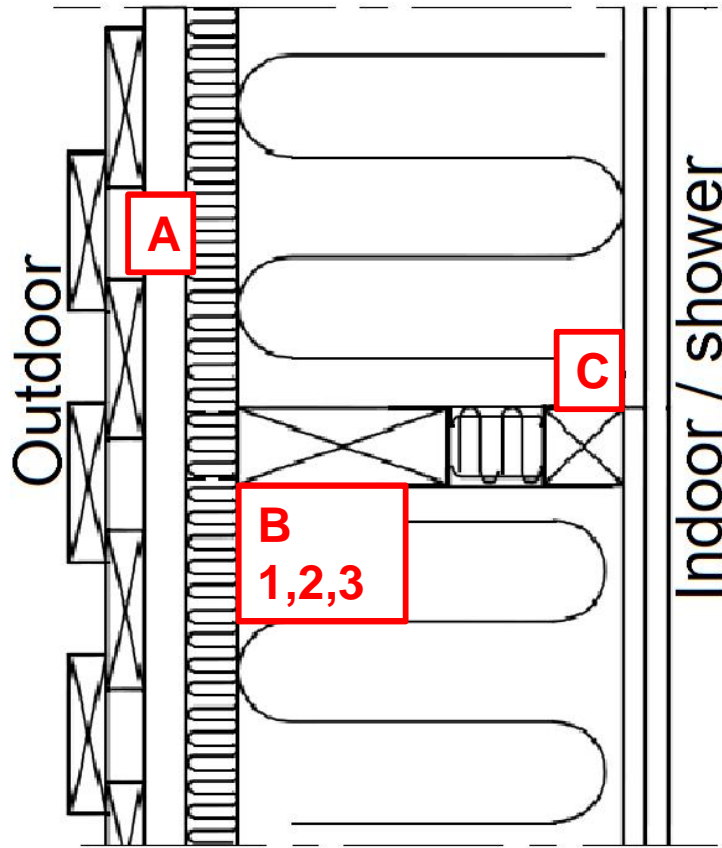
WUFI 1D Calculation model



Method



Measuring positions



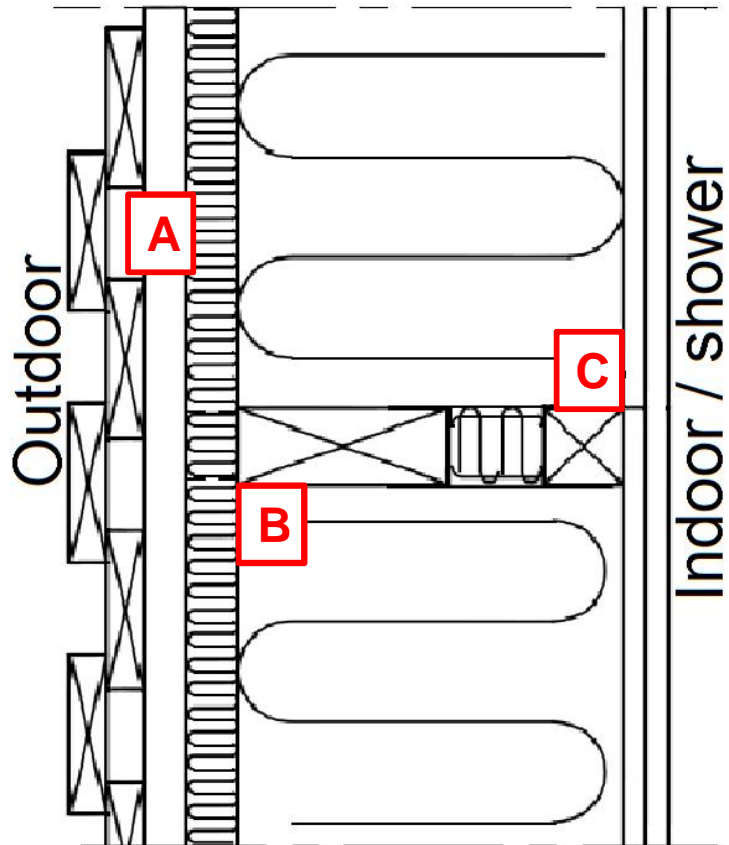
Sources of error

- Field study = Field measurements
- Boundary conditions – climate data
 - Distance between measuring and climate data station
 - Lack of data in indoor measured climate
- Boundary conditions in the air gap
- 1D model
- Measurements and equipment
- Calculation model
- Material data
- Etc

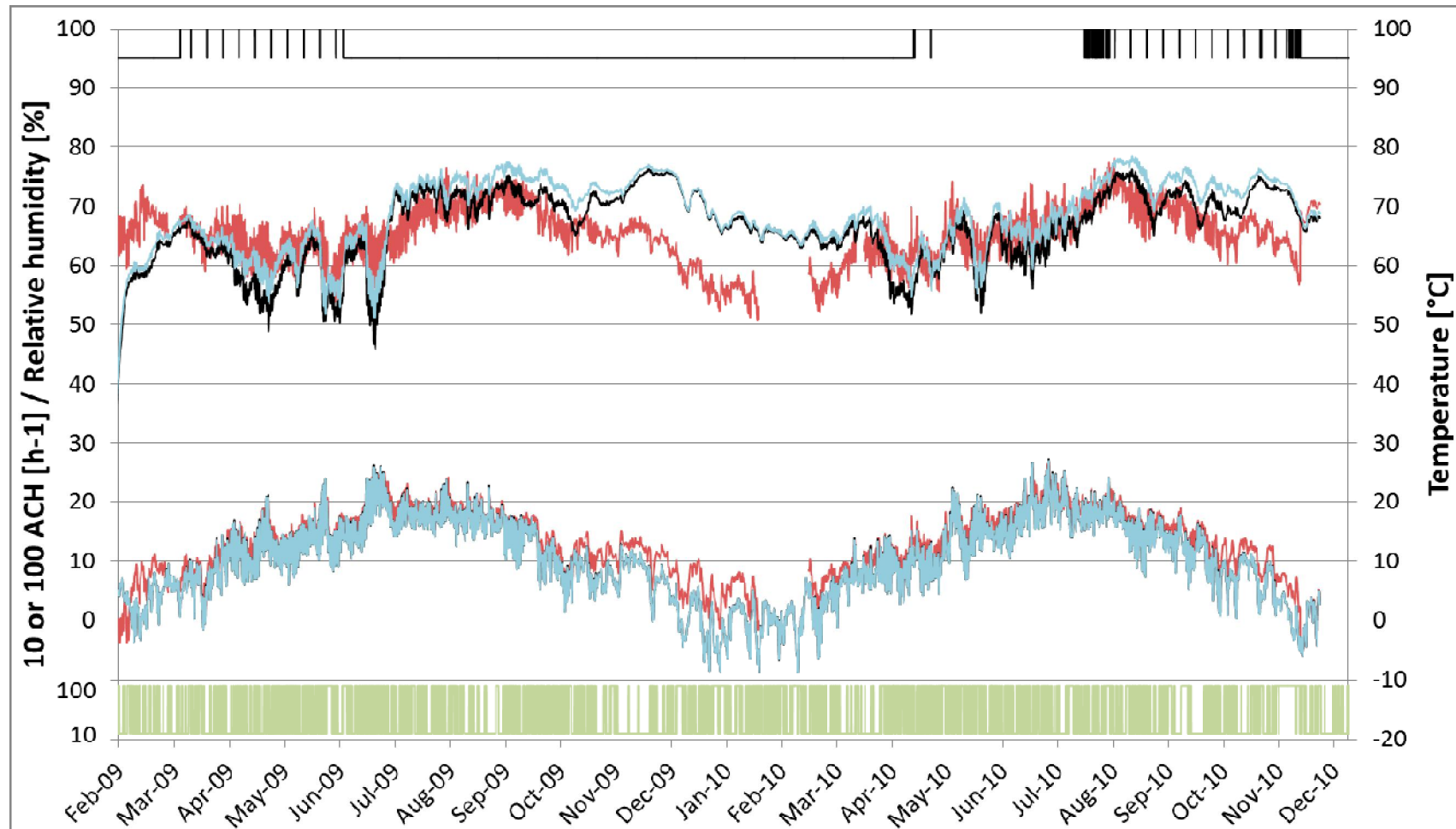


Result

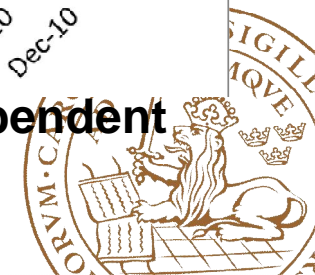
Measuring positions



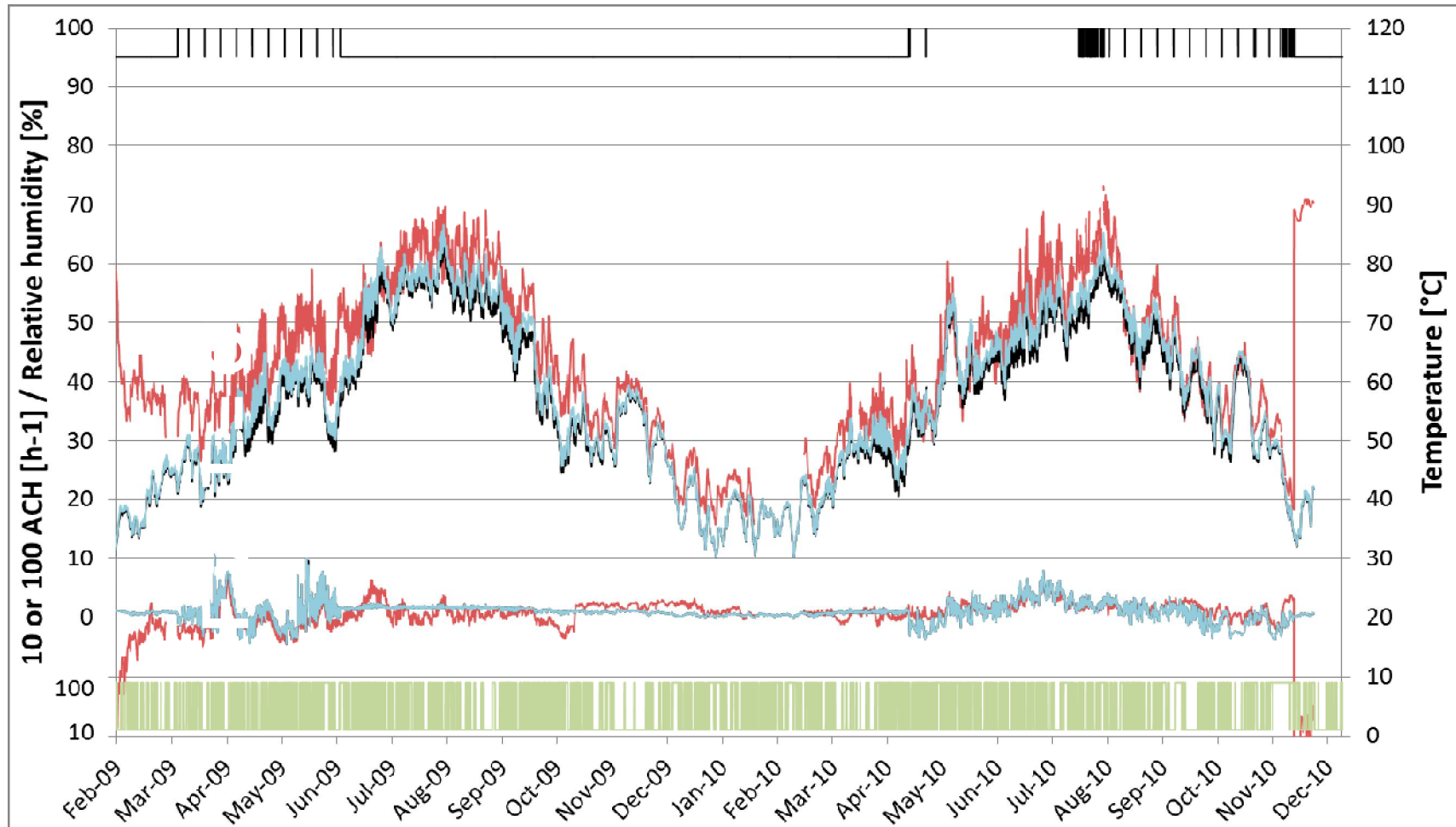
Result – Position B.3 – Comparison RH and T



Blue – Calculated constant 30 ACH, Black – Calculated wind dependent ACH, Red – measured, Green – ACH if wind dependent



Result – Position C – Comparison RH and T

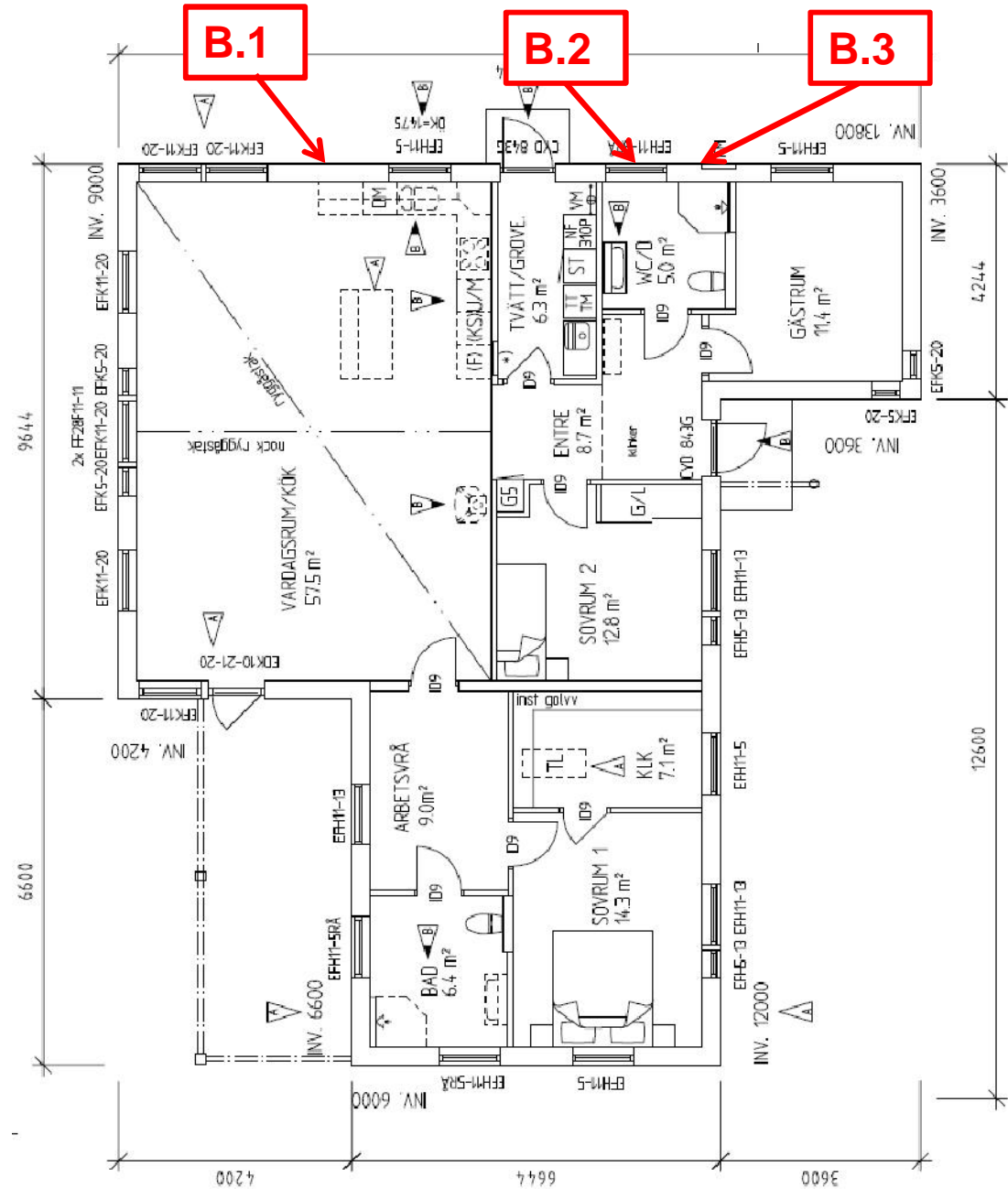
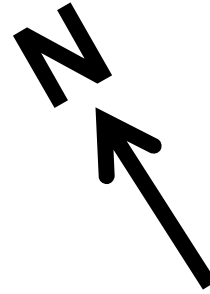


Blue – Calculated constant 30 ACH, Black – Calculated wind dependent ACH, Red – measured, Green – ACH if wind dependent

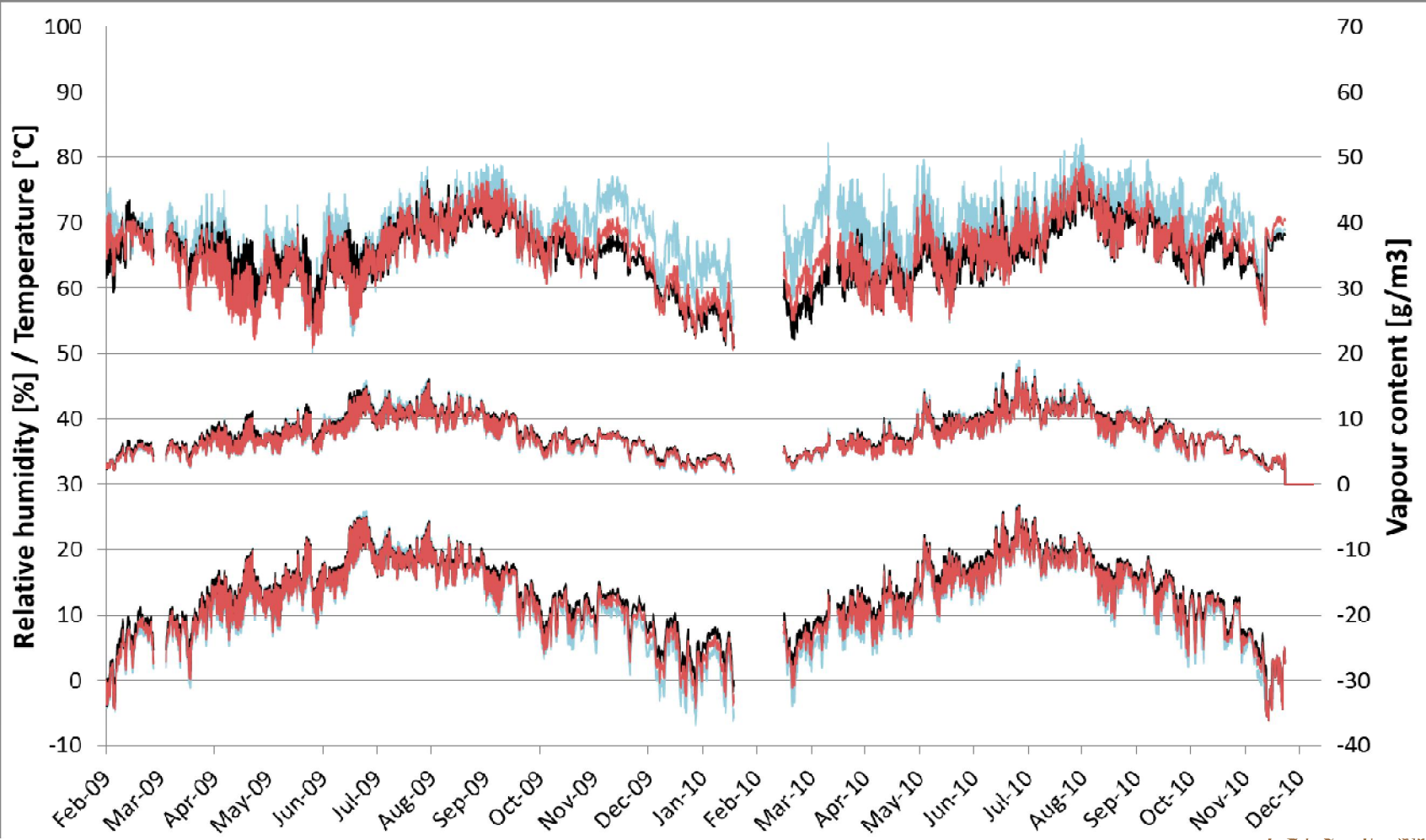


Result

Measuring positions



Δ Position B.1, B.2, B.3 RH, T, vapour content



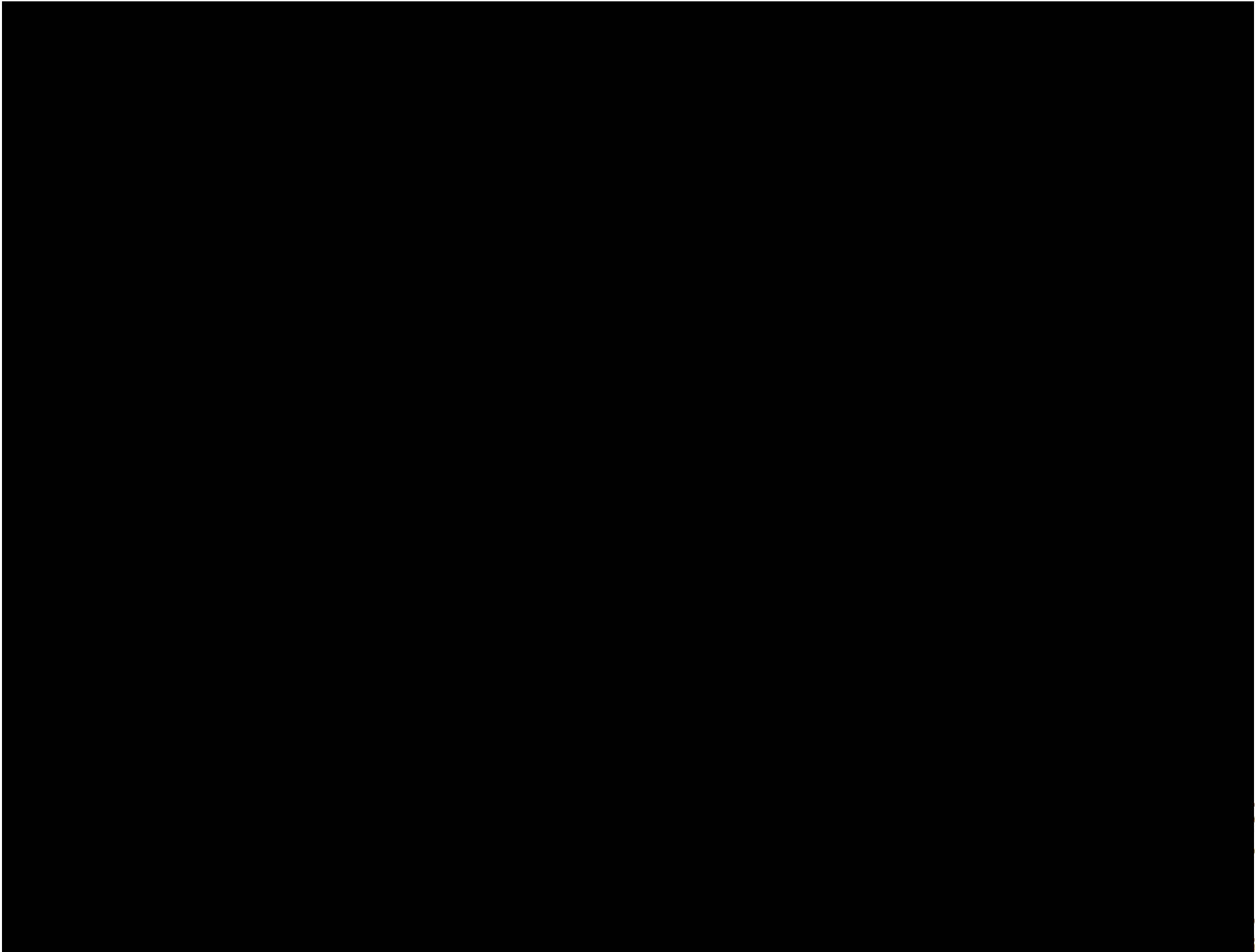
Blue – measured B.1, Black – measured B.2, Red – measured B.3



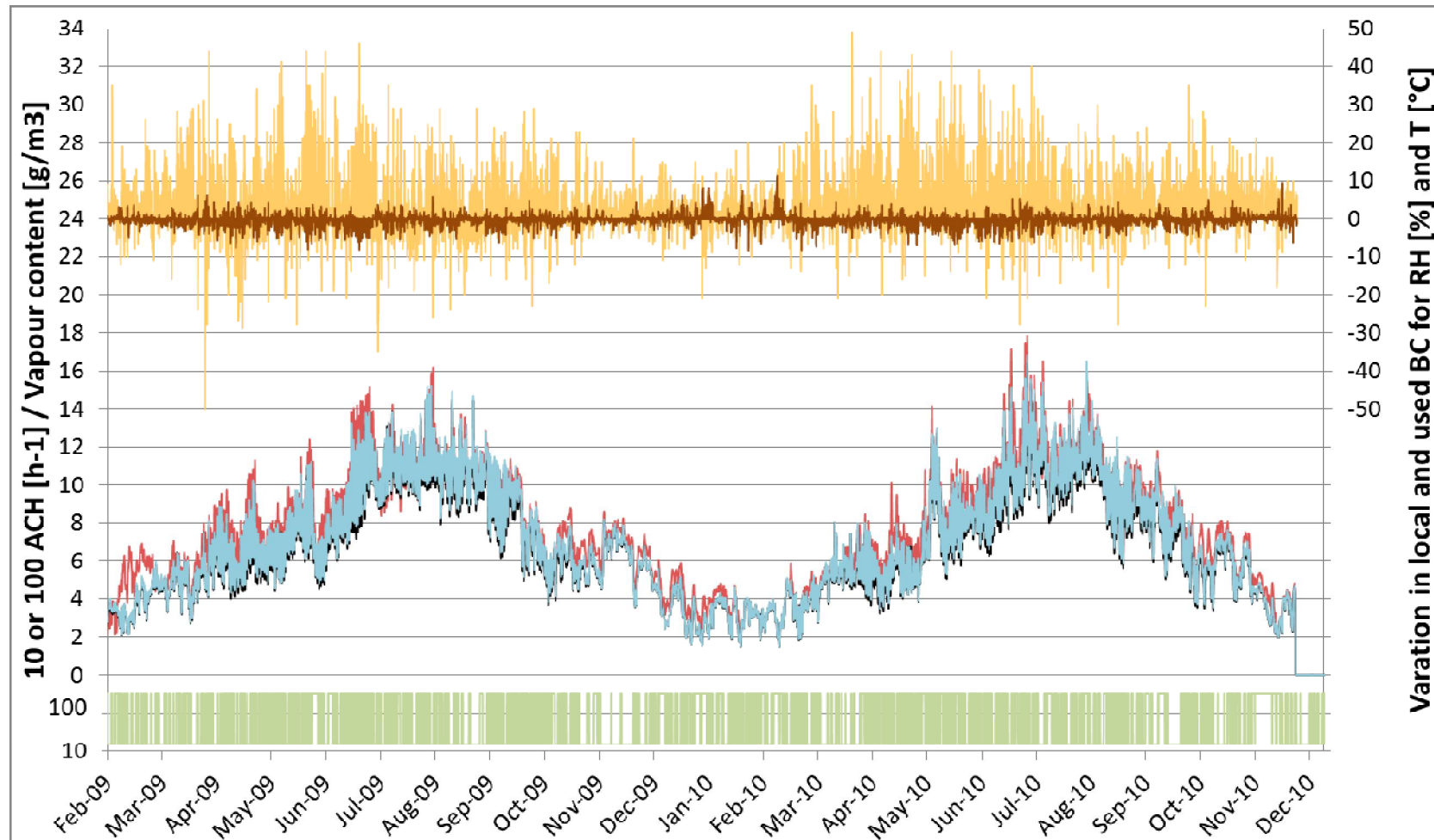
Conclusions

- A wind dependent ACH in the air gap behind the facade dose not necessary give better correlations between measrued and calculated values
 - As long as the ACH is high enough (Hägerstedt 2010)
- Climate conditions on the same depth, near the facade, in different places can vary (B.1, B.2, B.3)
- Blind comparison between measurements and calculations in WUFI 5.0 shows good correlation during spring, summer and autumn but not so good correlation during the winter period.
 - The differenses during the winter depends on temperature



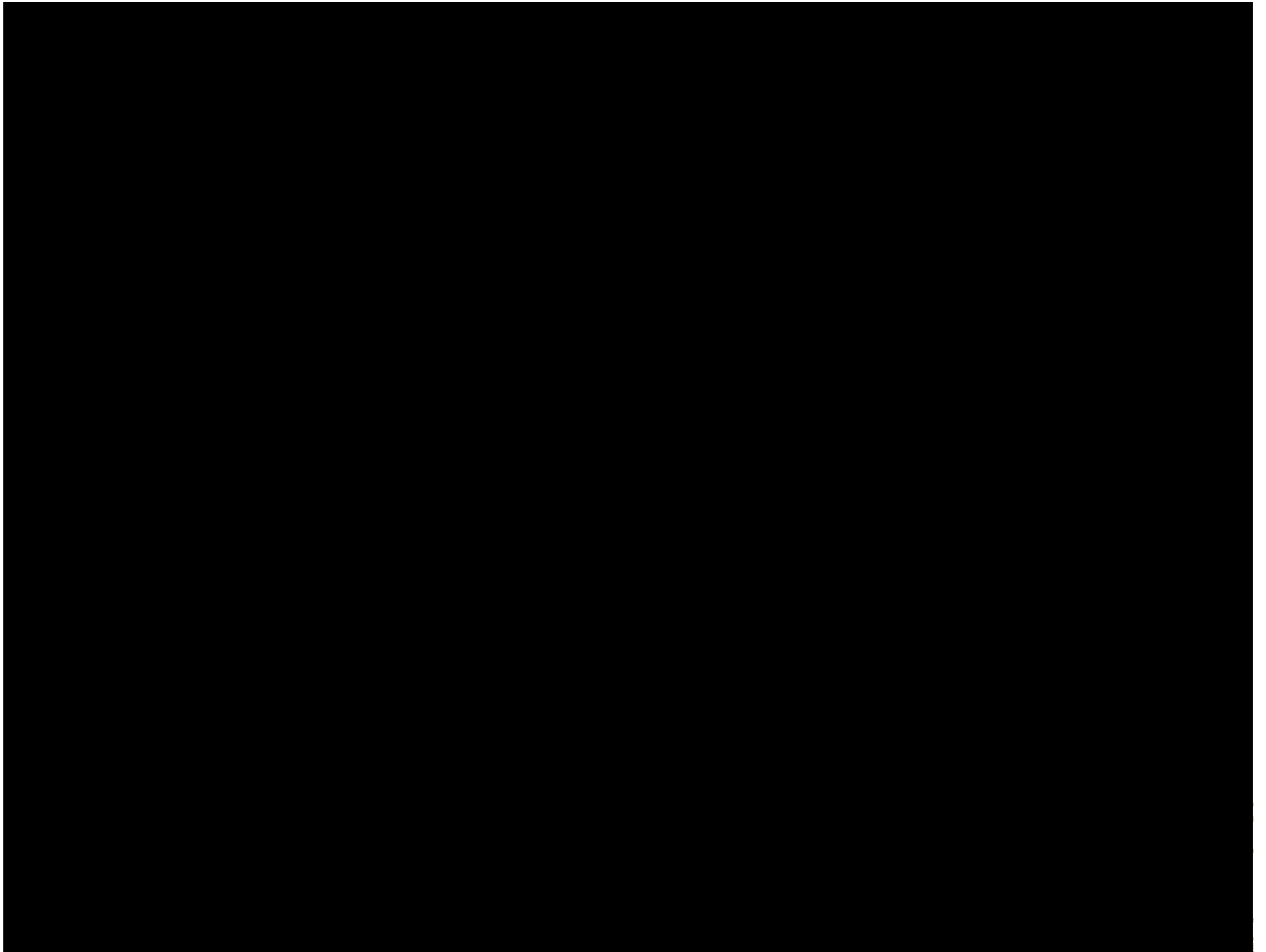


Position B. Climate control / vapour content

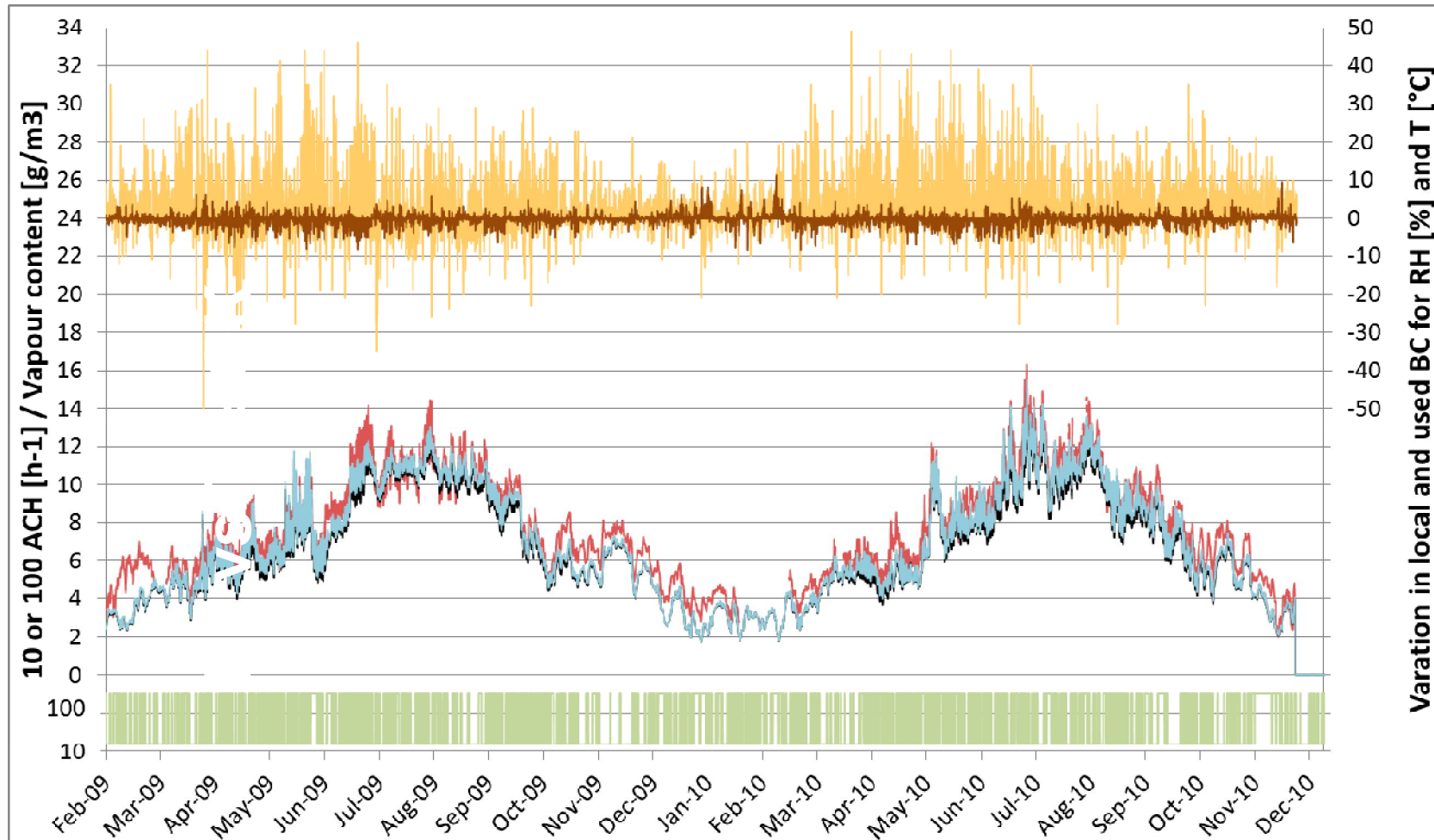


Light brown – ΔRH , Dark brown – ΔT
Blue, red and black – vapour content





Position C. Climate control / vapour content



Light brown – Δ RH, Dark brown – Δ T
Blue, red and black – vapour content



