BRANZ

An enhanced source and sink cavity ventilation model for WUFI

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New Zealand's Building Research Provider

- The Building Research Association of New Zealand
- Formed in 1969 by an act of parliament, and is owned and governed by the New Zealand Building Industry.
- 0.1% of the value of each construction project is payable to Building Research.
- Levy funding is earmarked for work of benefit to the construction industry.

New Zealand's Climate

Average winter ambient

- Kaikohe (north) 11.9ºC
- Invercargill (south) 6.2ºC

Average summer ambient

- Kaikohe (north) 18.8ºC
- Invercargill (south) 13.3ºC

Housing Timeline

20’s

40’s

70’s-80’s

30’s

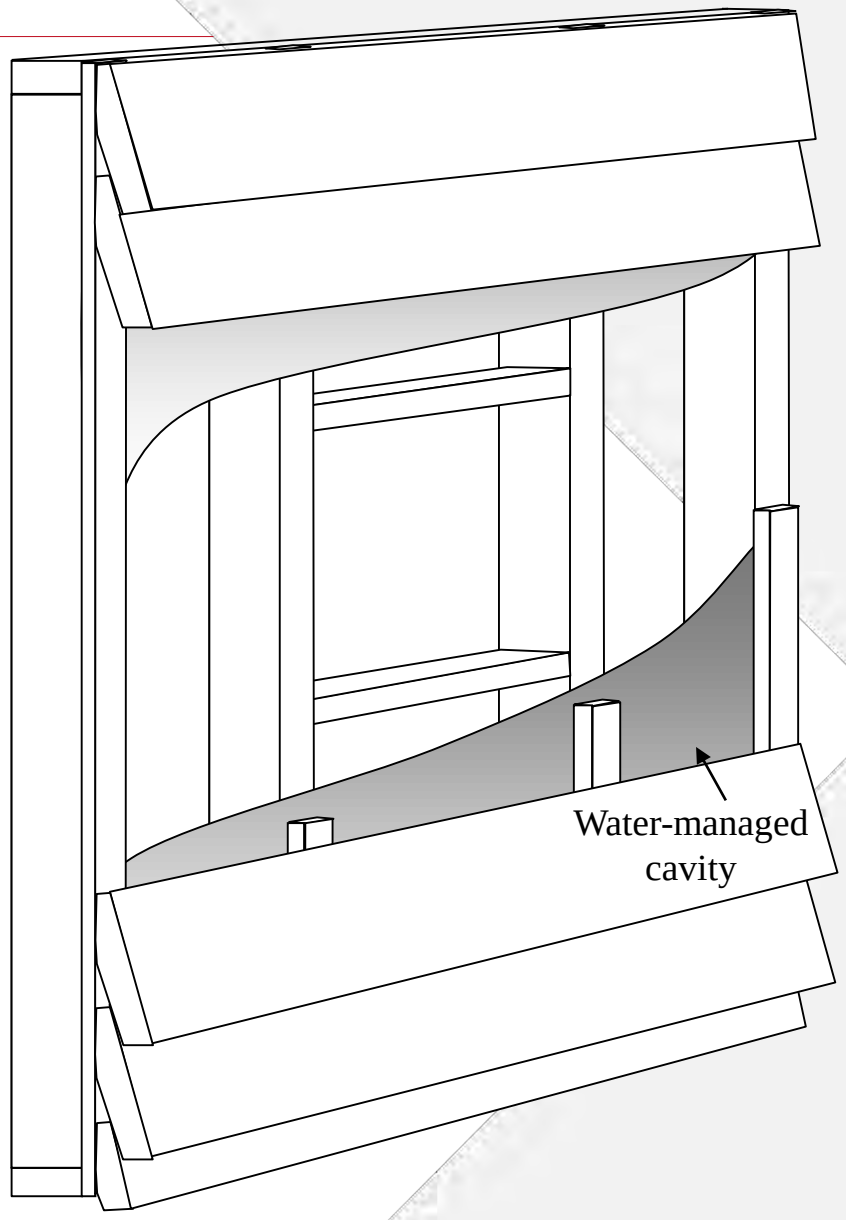
State House

90’s – 00’s

‘Classic’ Leaky Home

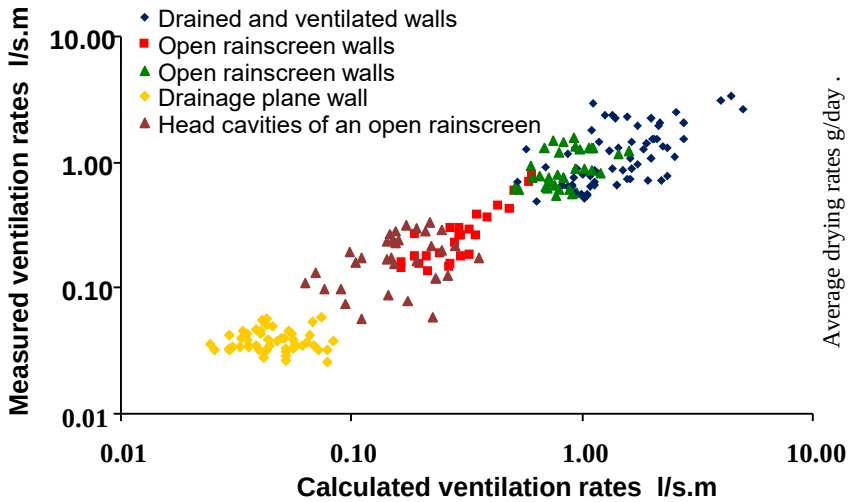
Typical construction

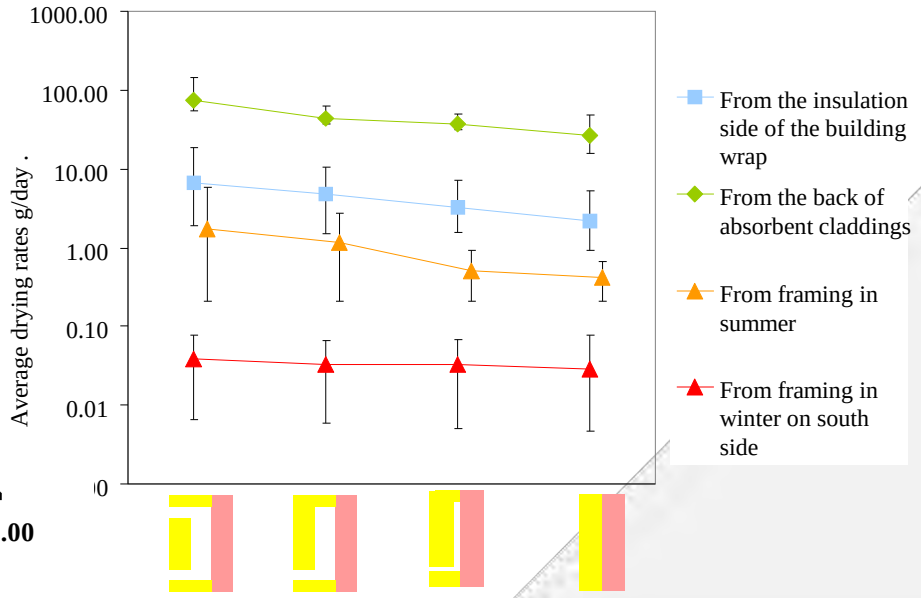
- Lightweight timber frame most common
- No requirement for airtightness
- Naturally ventilated living spaces



Previous work – 'leaky buildings'

- Tracer gas techniques to understand cavity airflow
- Experimental work establishing drying rates in walls
- Addition of a cavity vent model to WUFI2D in collaboration with FIBP
- Parametric study of drying from walls across NZ

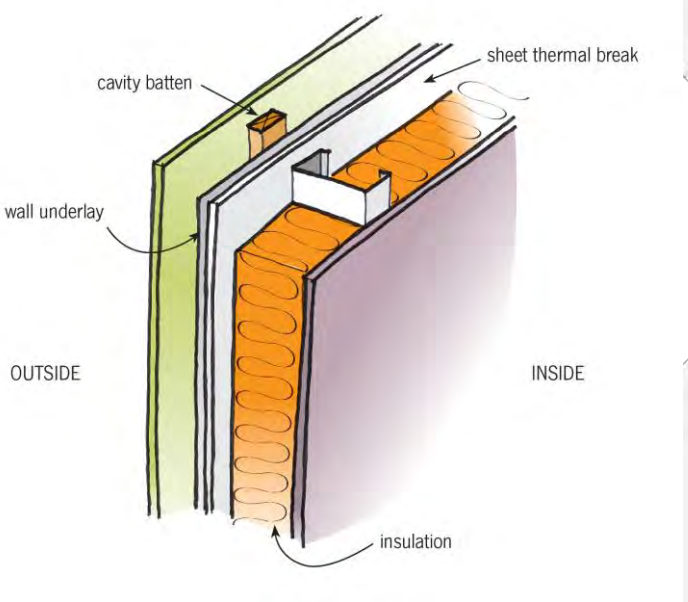




BRANZ project on vapour control

- Concerns about vapour migration in our vapour open construction.
- Verify, or otherwise, current practice around vapour control in walls.
- Controlled environment to exacerbate the issue.

- Year 1 – steel-framed walls
- Year 2 – timber-framed walls

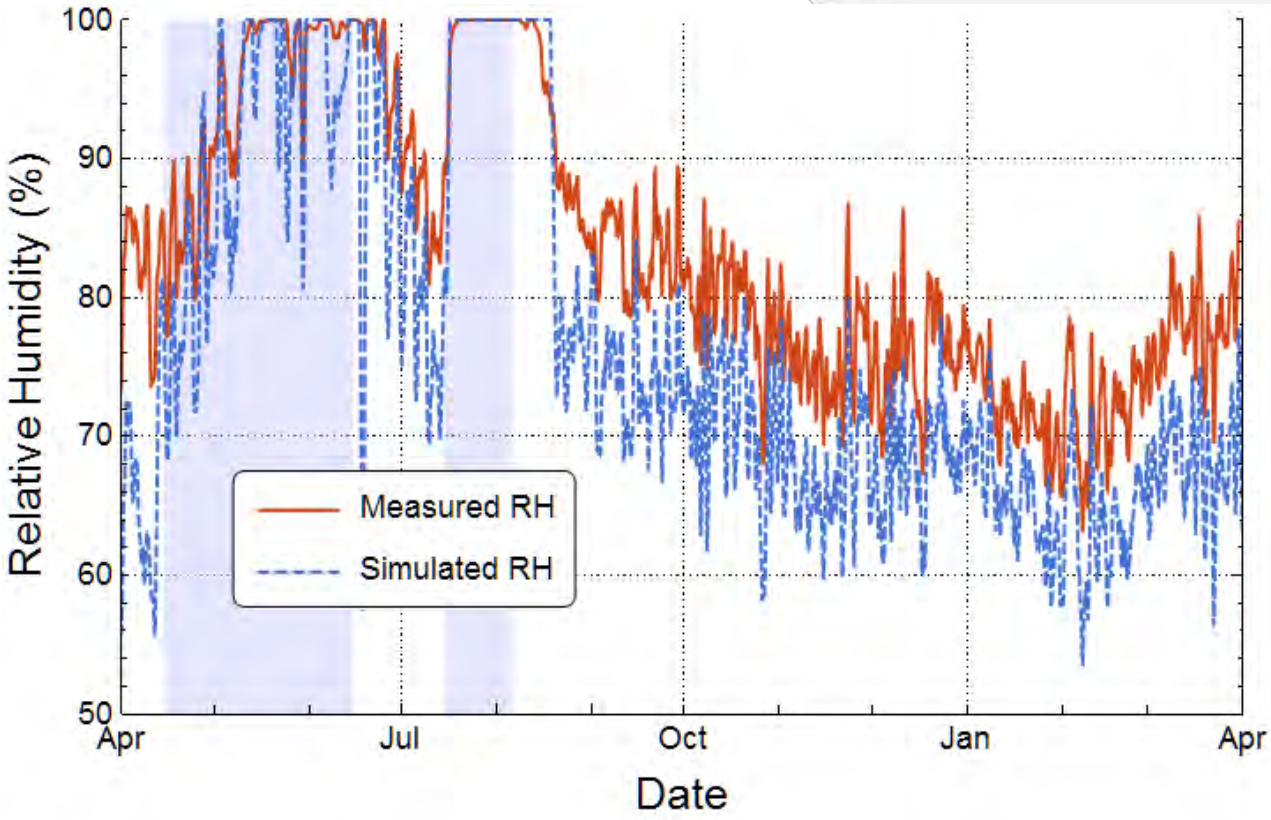


Accumulation risk?

Condensation events were short duration – matter of hours

Modelling

- WUFI used to simulate the experimental walls
- In general, our models agree well but the observed cavity RH remained unresolved



Current source and sink implementation

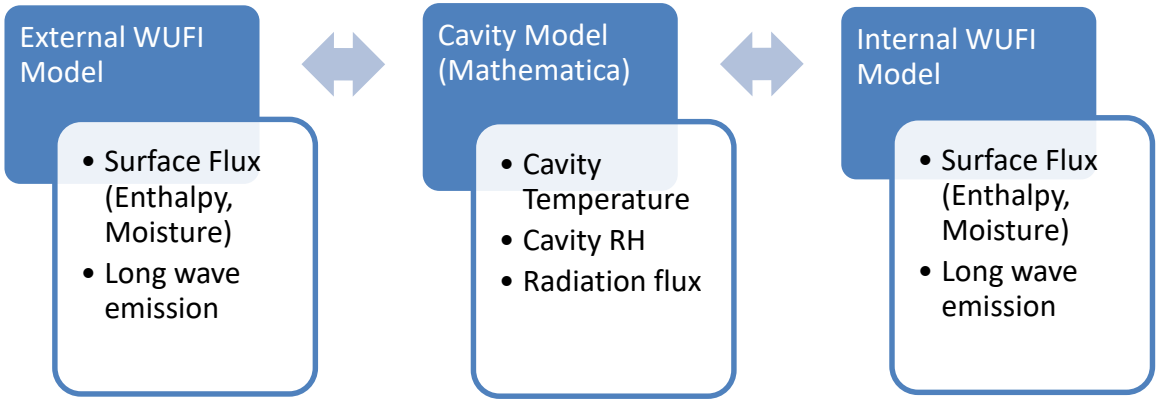
Simple perfect mixing model

Temperature difference and absolute moisture difference used to create source terms

$$Q_m = \frac{ACH}{3600} \cdot d_{cav} \cdot (X_{out} - X_{cav}) \quad [kg/m^2 s]$$

$$Q_t = \rho_{out} . \frac{ACH}{3600} . d_{cav} . C_{p,Air} . (T_{out} - T_{cav}) \quad [W/m^2]$$

Revised implementation



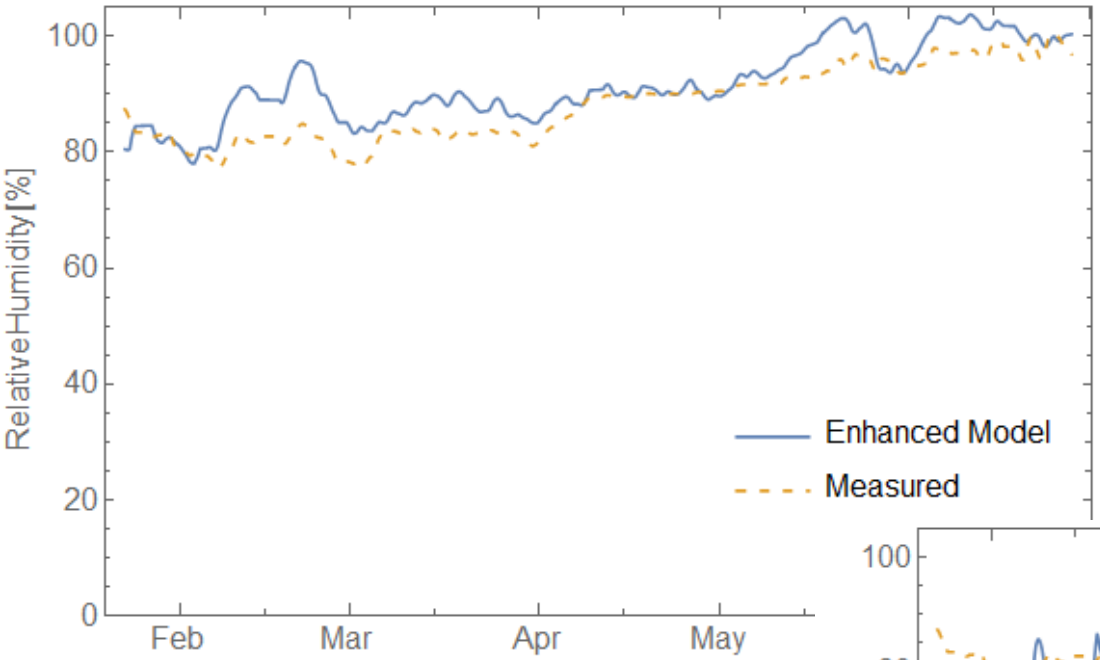
- Nodal model created in Mathematica
- Frees us from some constraints in the kernel

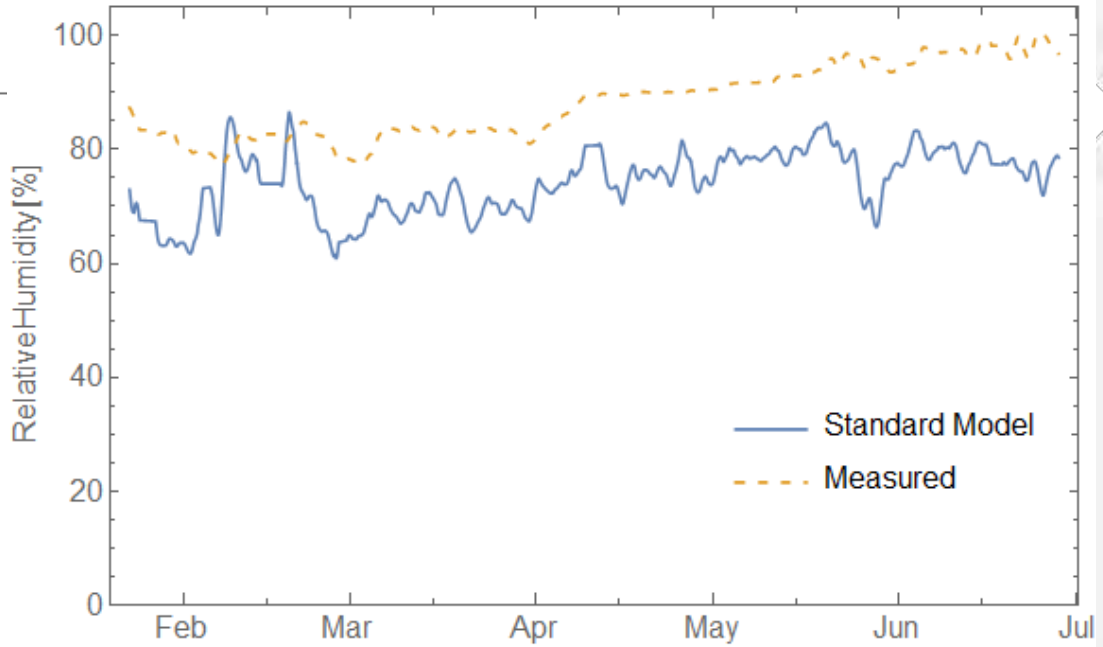
Intermediate model

- Perfect mixing assumed
- Long wave radiation decoupled from conduction
- Temperature dependence of moisture storage implemented
- Simplified radiation transport model implemented

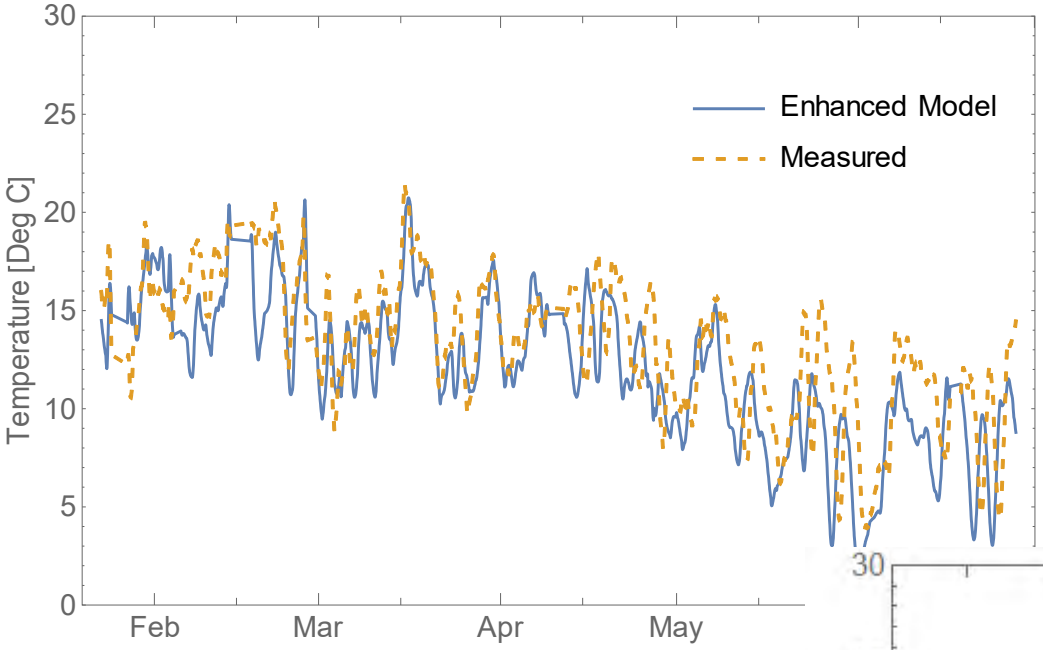
$$\boldsymbol{q_{rad}} = \boldsymbol{\sigma}(\boldsymbol{T_L^4} - \boldsymbol{T_R^4}) \frac{1}{\frac{1}{\boldsymbol{\varepsilon_L}} + \frac{1}{\boldsymbol{\varepsilon_R}} - 1}$$

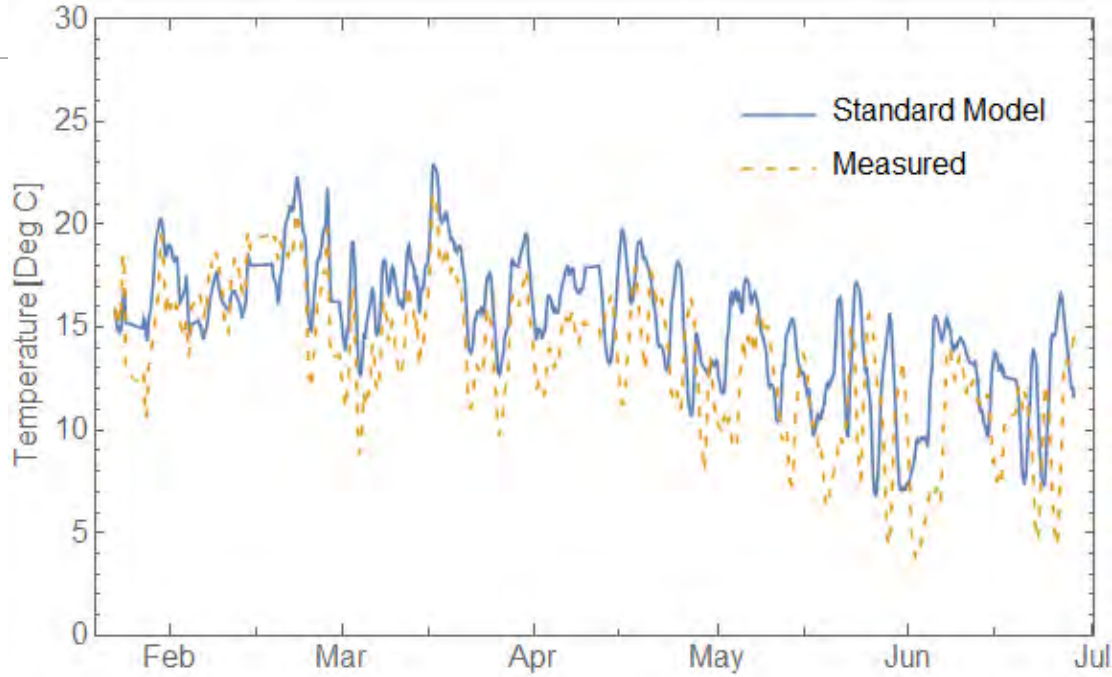
Results - moisture





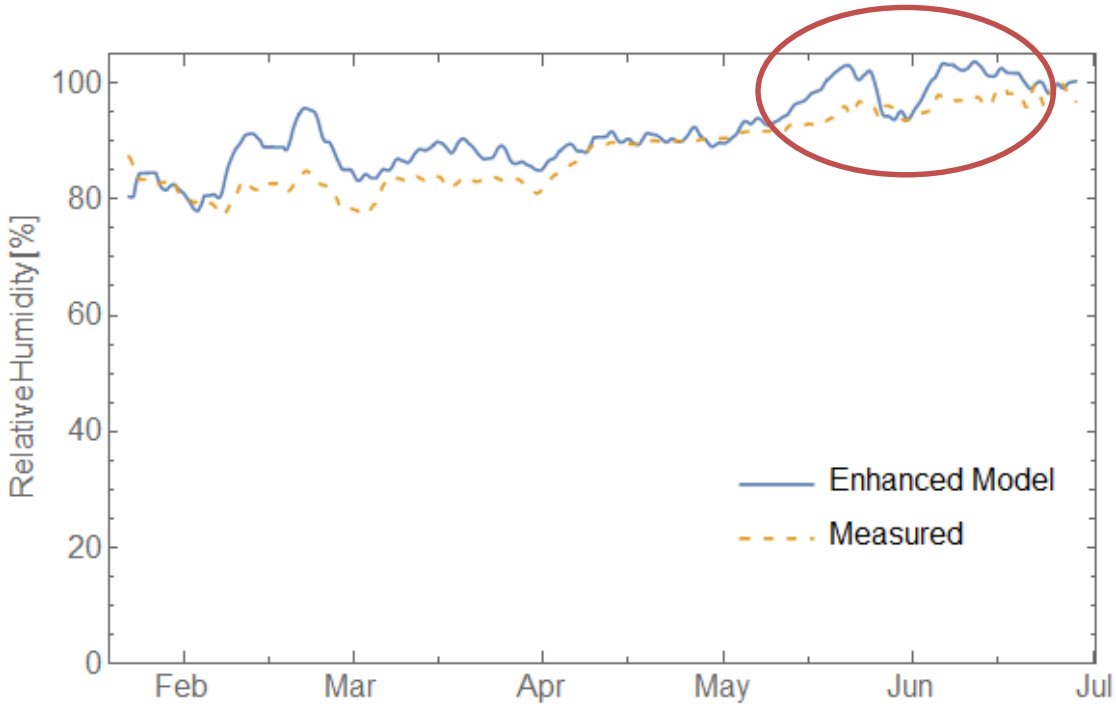
Results - Temperature





Possible Improvements

- Condensation node
- Implementation as a .dll
- Benchmarking with tracer experiments



Acknowledgements

The work reported here was funded by BRANZ from the Building Research Levy, the support in kind of the Fraunhofer institute for building physics is gratefully acknowledged

BRANZ Funded from the Building Research Levy

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