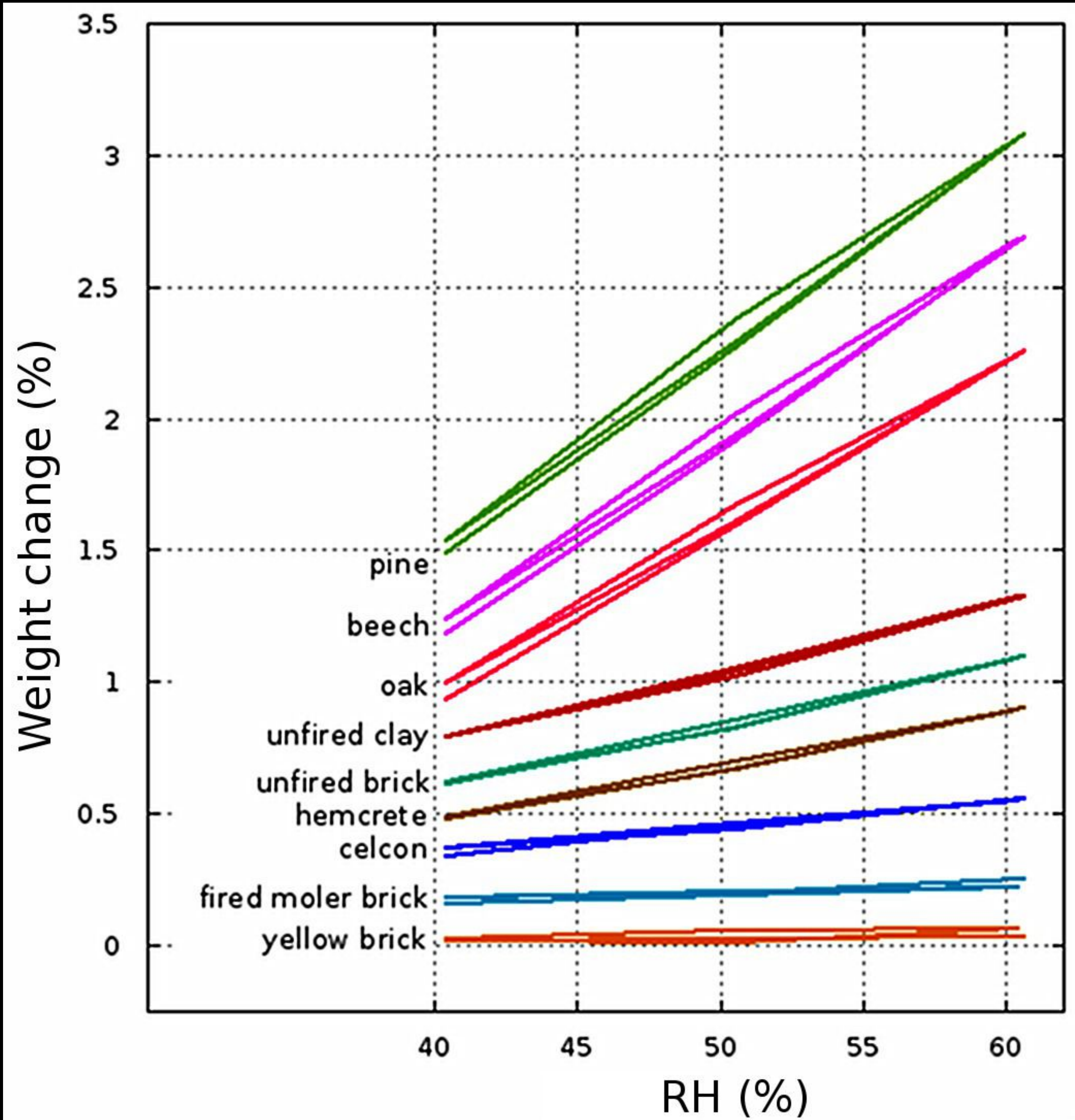
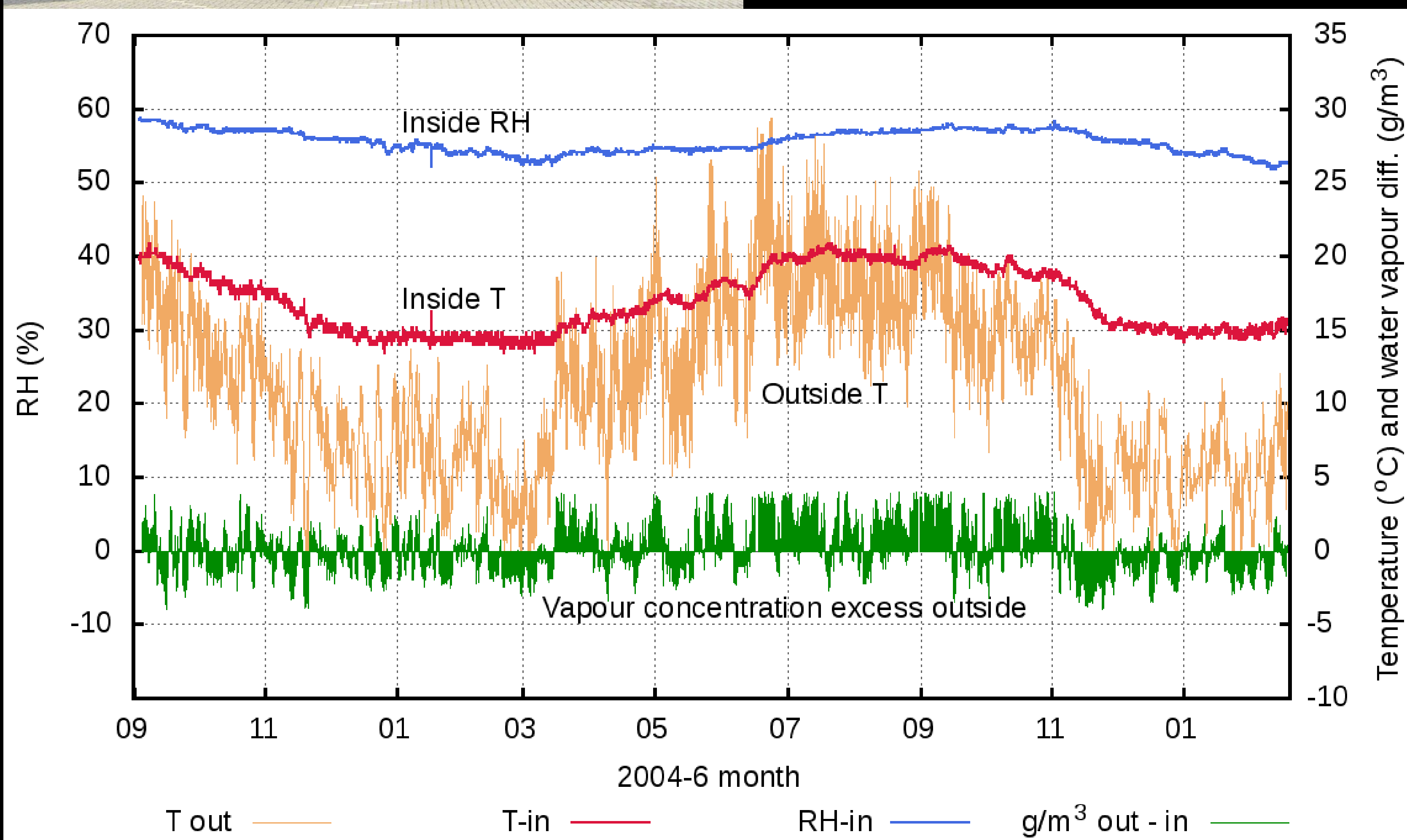
Humidity buffering of whole rooms goes back to Engineer MacIntyre in 1934.
This is Hampton Court Palace in London



Many materials absorb and desorb water as the RH changes. The process also works the other way: materials control the RH in a confined space around them according to their absorbed water content.

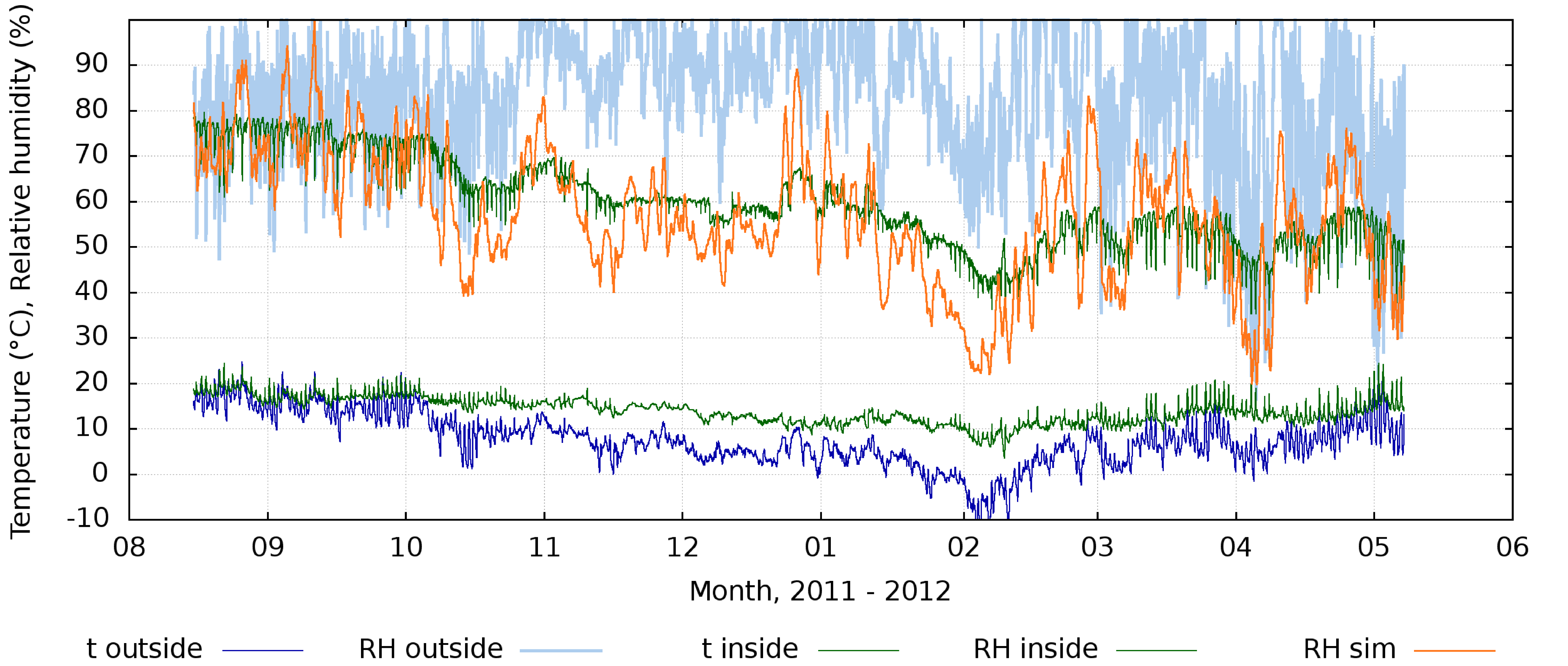
The Suffolk record office in Ipswich, UK has a nearly constant RH controlled by the archived papers, because of the immense amount of sorbed water and because of the small air exchange rate.

The green trace below shows how there is more water vapour in the air in summer outside. Within the building the paper is absorbing water vapour to maintain a moderate RH.



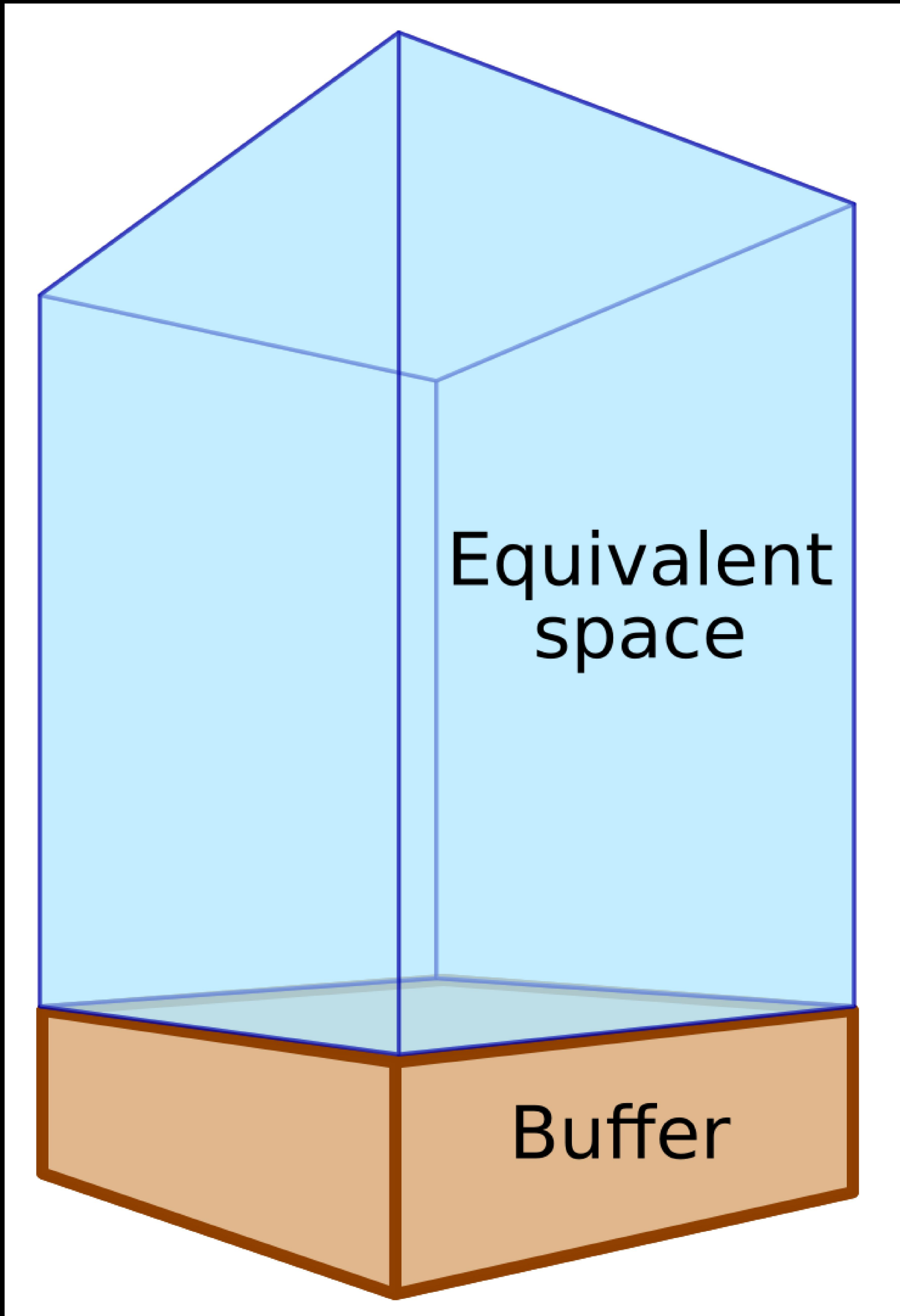
Is it possible to stabilise the RH in a museum with hard, non-absorbent surfaces and artifacts and people?

Perforated unfired clay bricks are the best cheap water absorbent wall surface. In this room they cover only 15% of the total surface area.

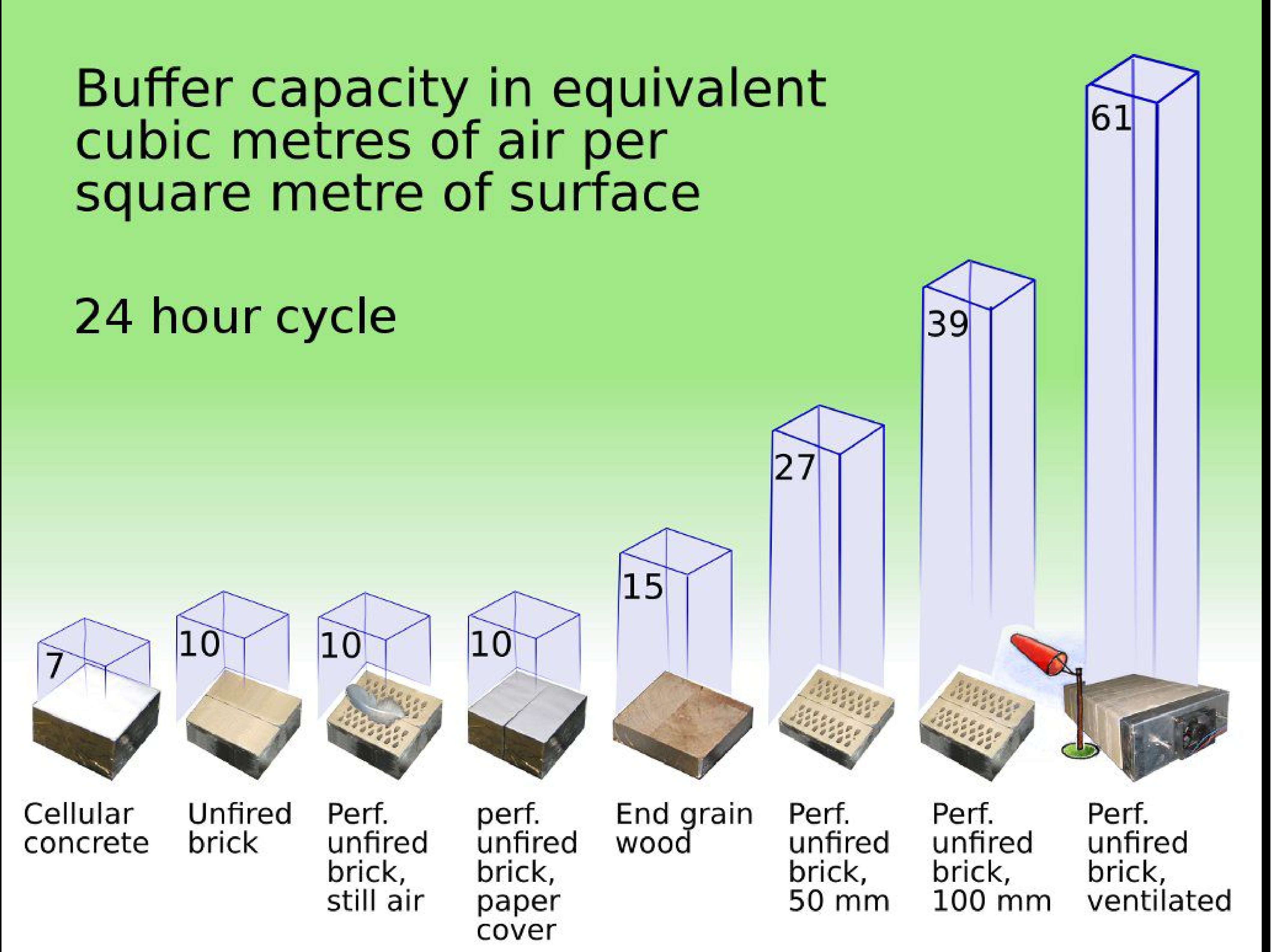


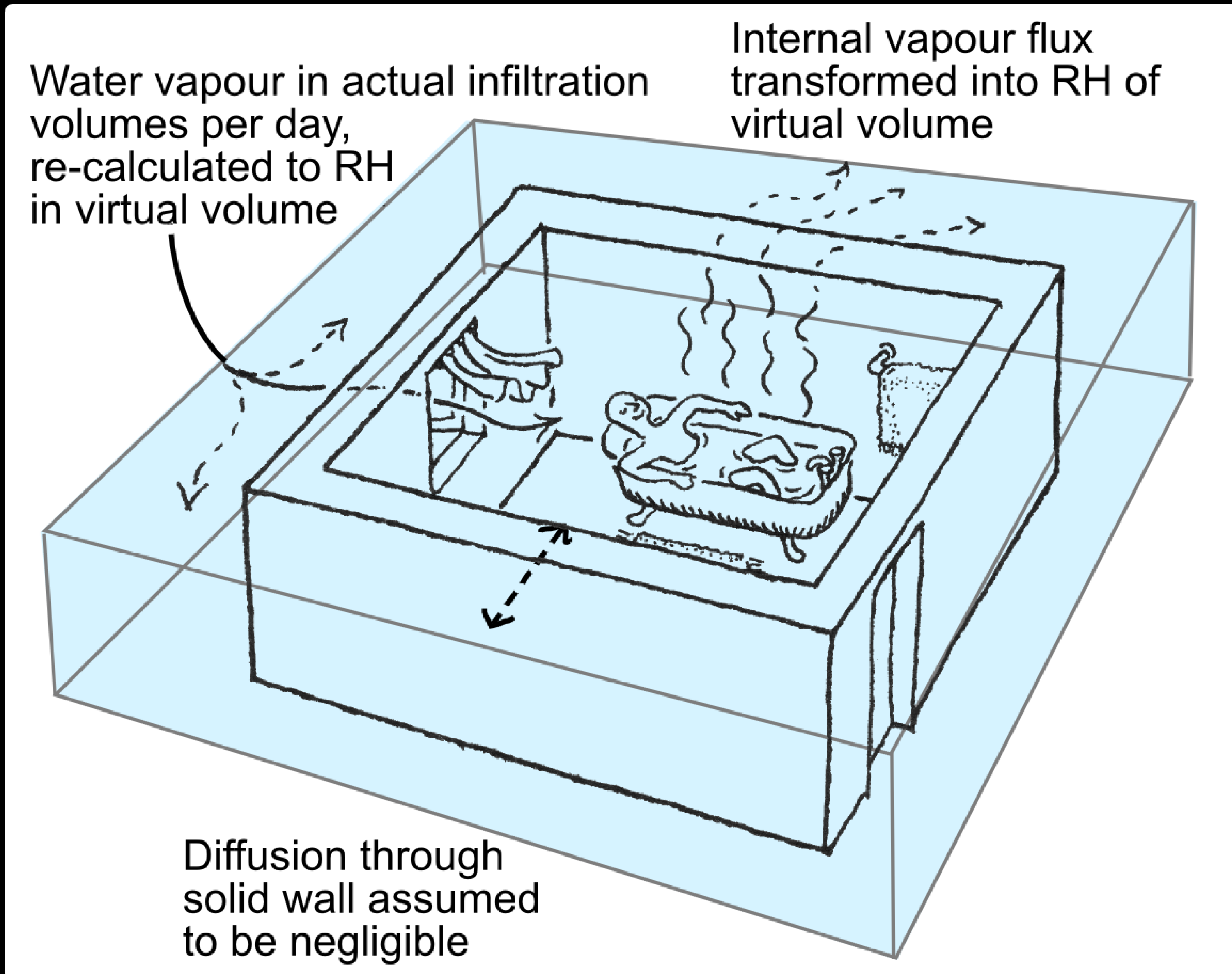
The upper green trace shows the measured RH over nearly a year. The orange trace shows the calculated RH if the room were totally non absorbent.

It would be useful to provide a way of predicting the performance of rooms before they are built.

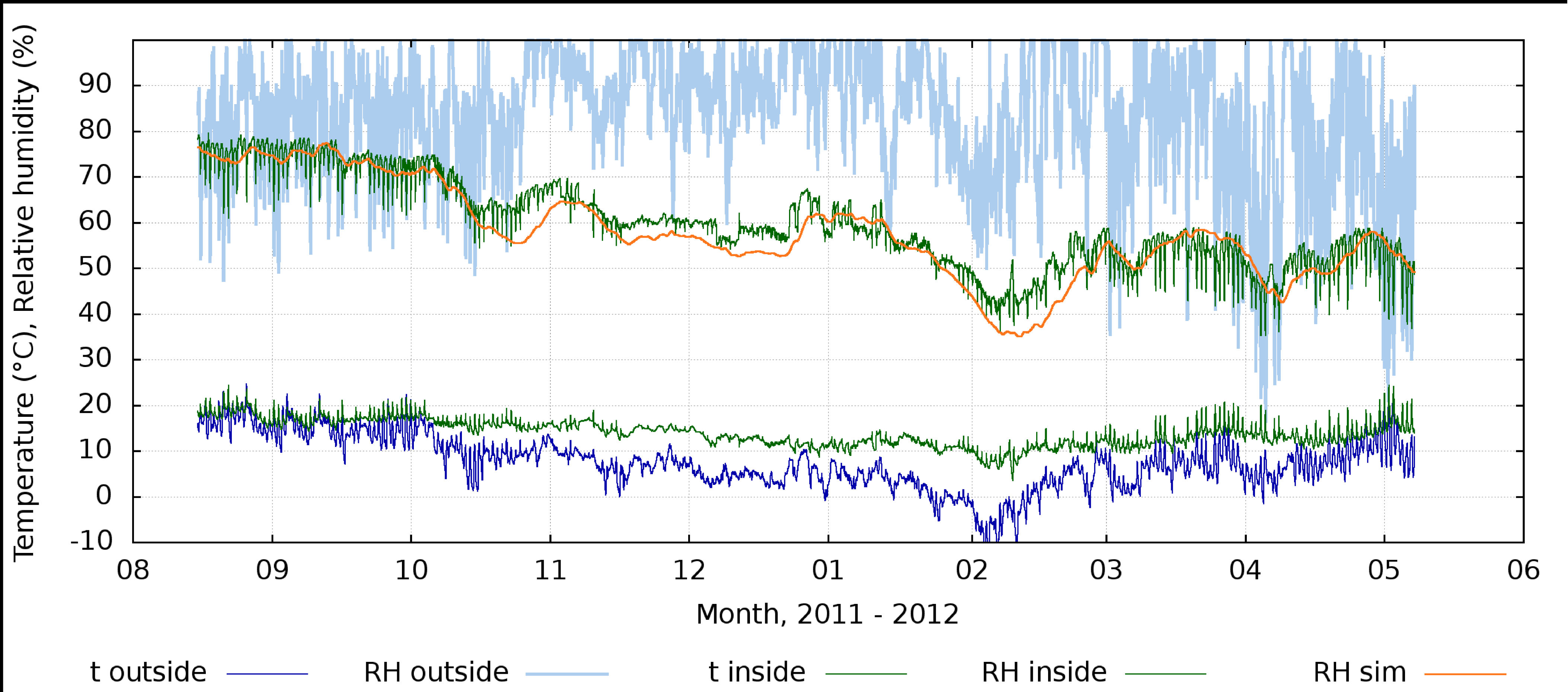


For any absorbent material we can define an equivalent volume of air (strictly speaking a volume of space) which will experience the same change in RH when water is added, as the pores within the material will experience when an equal amount of water is added to the material.


Buffer capacity in equivalent cubic metres of air per square metre of surface
24 hour cycle
7
10
10
10
15
27
39
61
Cellular concrete
Unfired brick
Perf. unfired brick, still air
perf. unfired brick, paper cover
End grain wood
Perf. unfired brick, 50 mm
Perf. unfired brick, 100 mm
Perf. unfired brick, ventilated

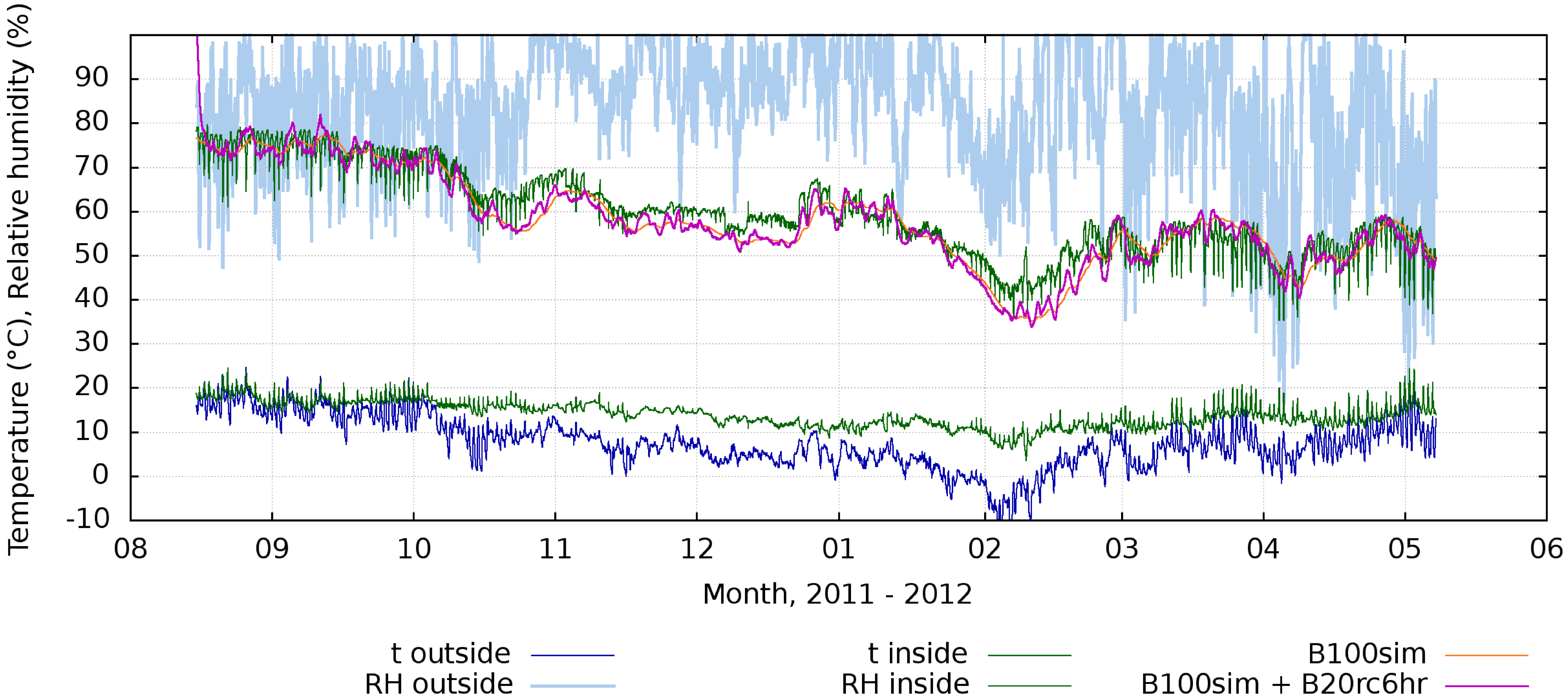


We can now calculate for a whole room the "virtual volume", which will be larger than the actual room, so infiltrating air and people's breath will not change the RH so quickly as in a room with inert surfaces.



The orange trace is the backwards-modelled performance of the room, which matches quite well the measured property of the perforated unfired brick.

The orange line misses the sharp spikes of the measured trace, due to sunlight causing rapid changes of RH which the buffer cannot compensate for.



The purple trace is a better match to the measured climate. It is produced by combining the previous calculation with a reduced quick buffer capacity suitable for rapid change of ambient RH. This will seem rather complicated, but it explains why computer models have been slow to deal with water vapour movement in buildings.

Before computer modelling there were already buildings that provided good RH buffering. End-grain wood is the best.