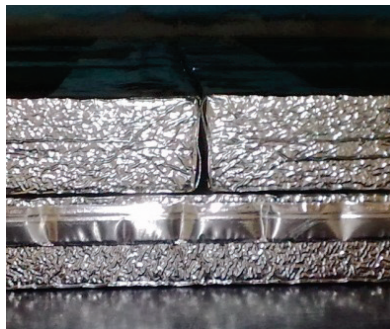
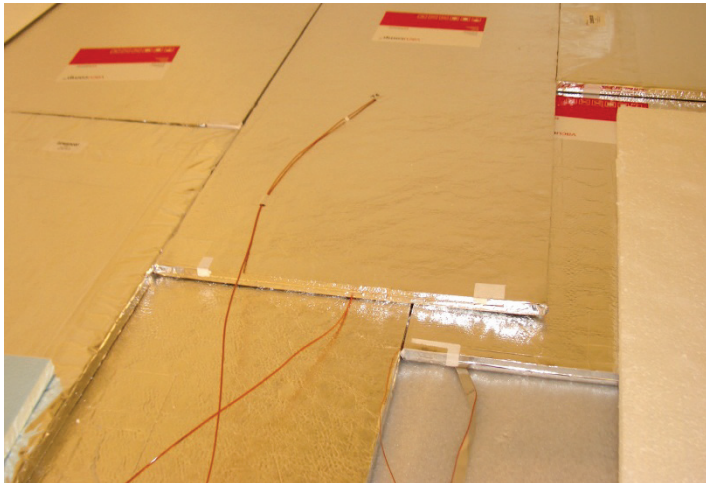


Vacuum insulation panels (VIP) in refrigerator room, freezing room & fridge

Samuel Brunner, Empa

Laboratory for Building Science and Technology

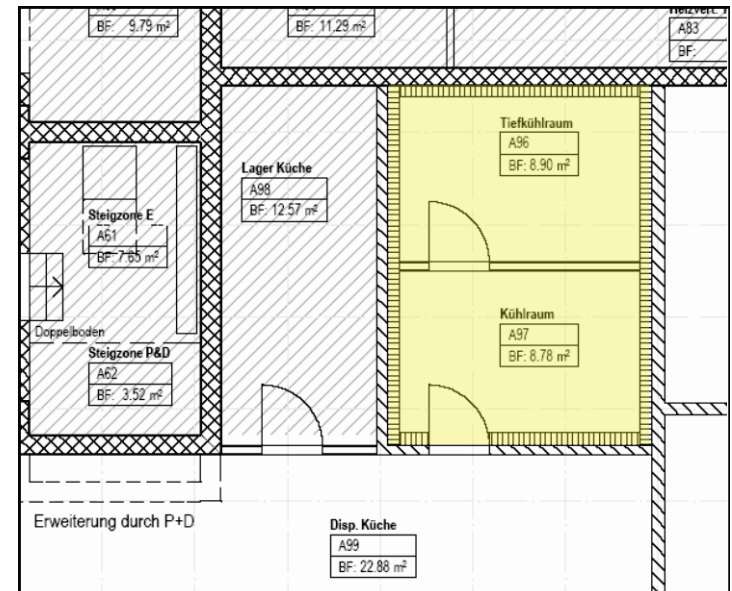


Freezer Room: location



Eawag, Dübendorf, Switzerland
Energy demand: about Passivhaus level

FREEZER Room (FR)



REFRIGERATOR or Cooling Room(CR)

Freezer Room (FR)

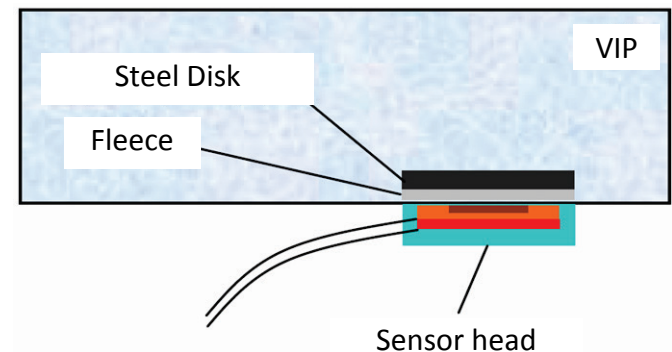
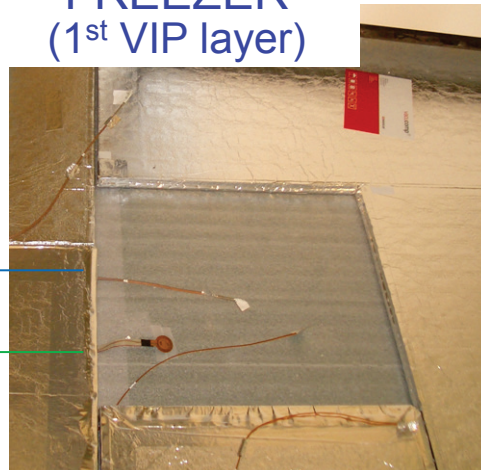
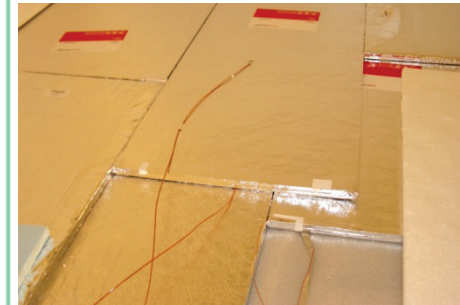
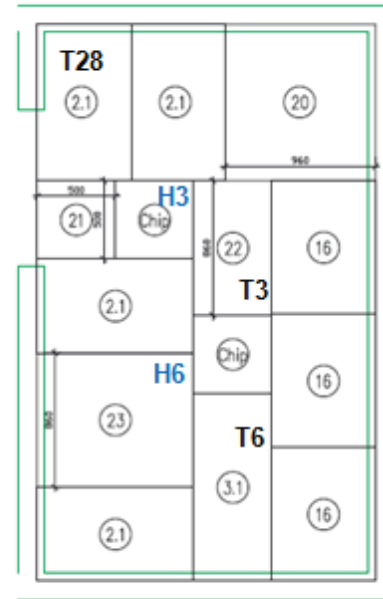


REFRIGERATOR
or Cold Room(CR)

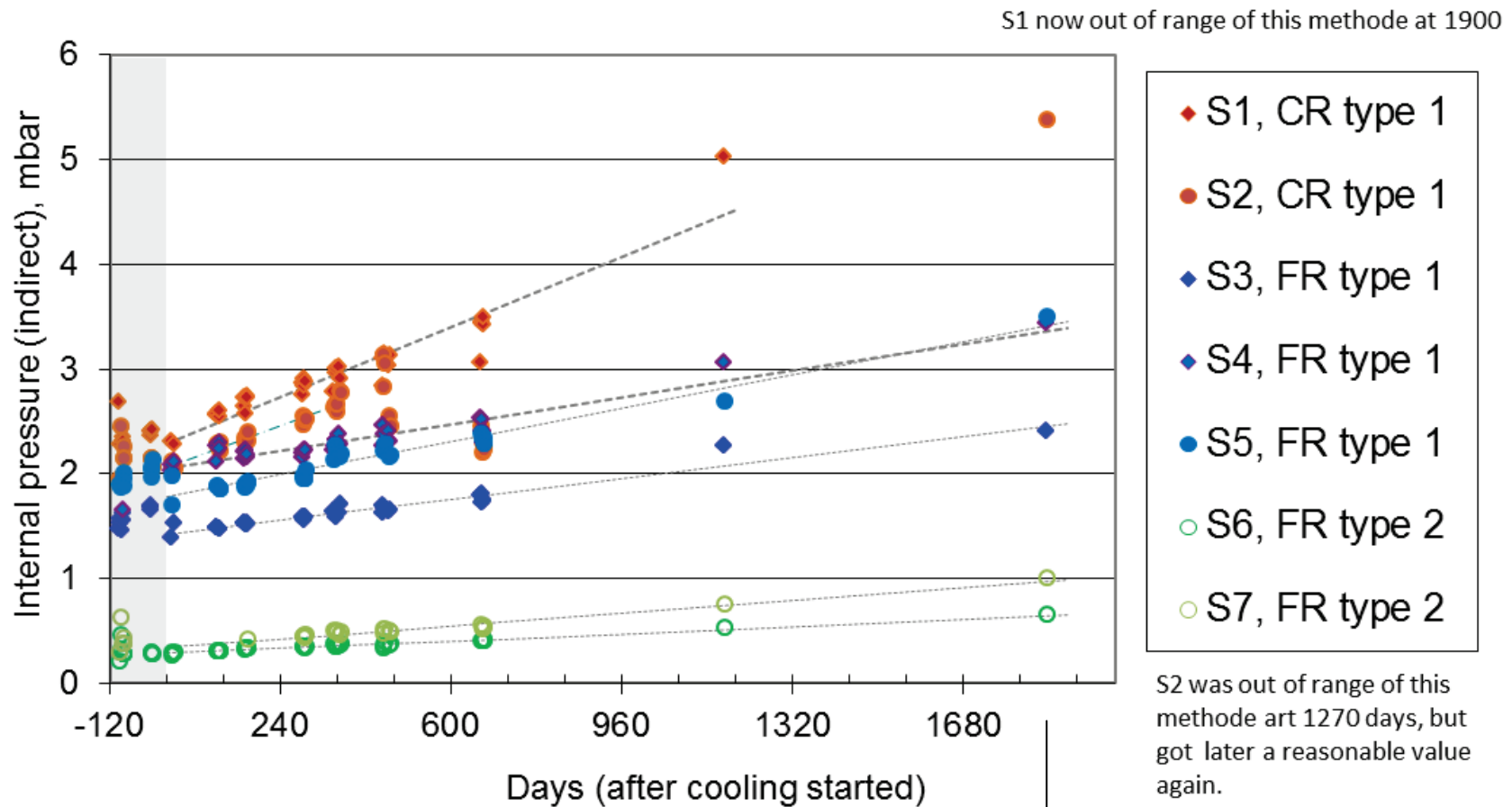
FREEZER
(1st VIP layer)

VIP layout (in grey) with
T Temperature sensor
H humidity sensor
S indirect pressure sensor

FREEZER
(2nd VIP layer)

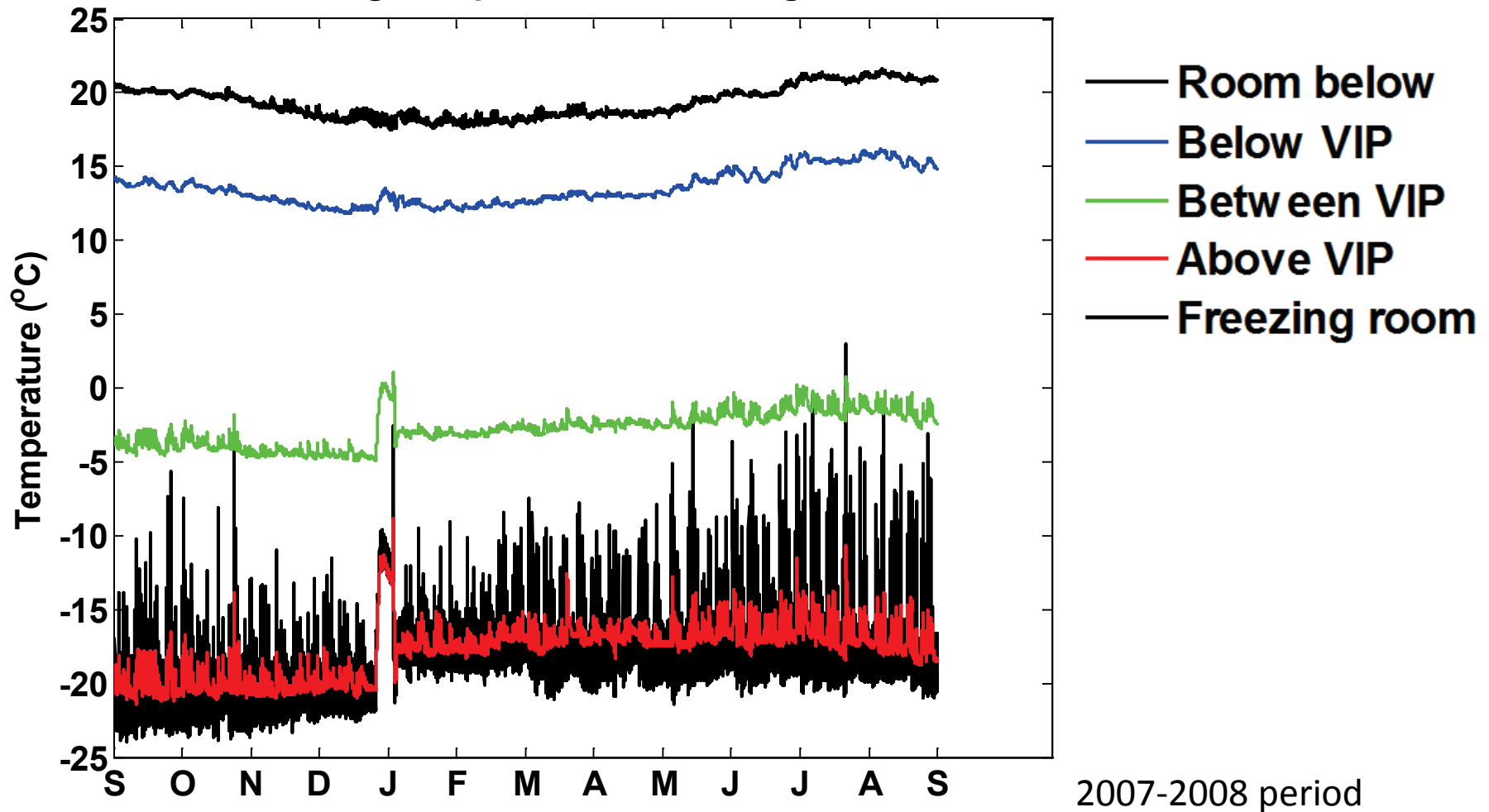


COOLING (CR) AND FREEZING ROOM (FR)

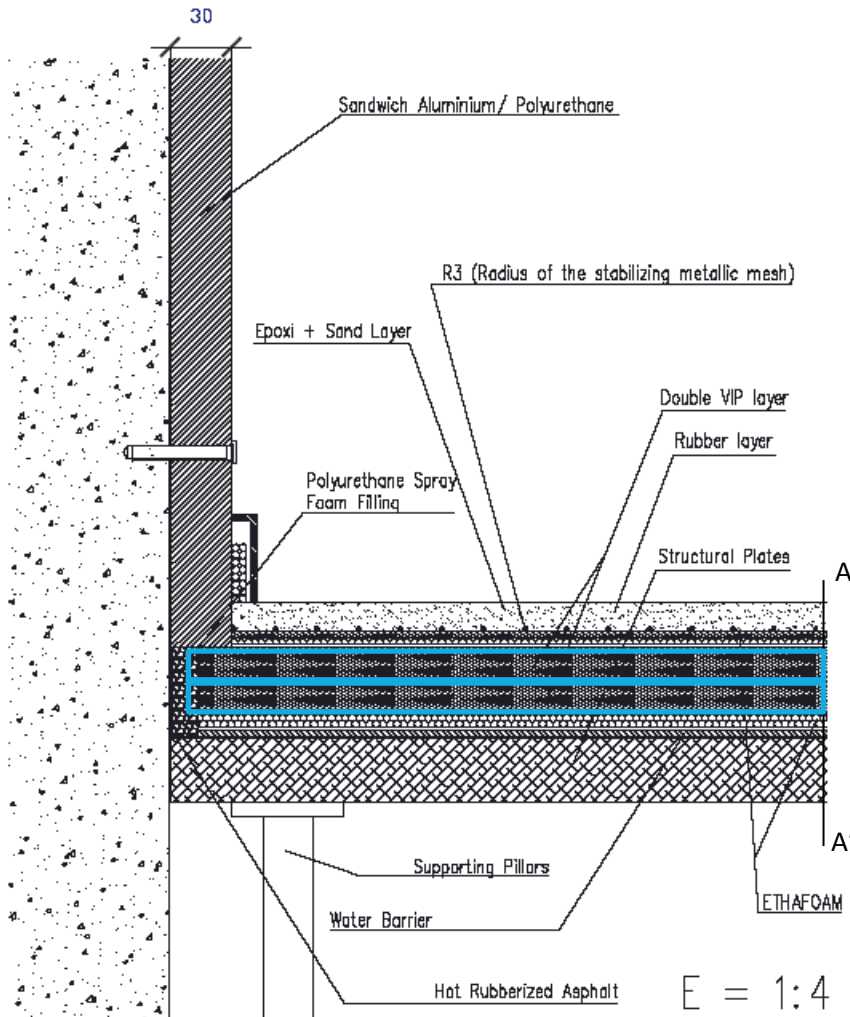


FREEZER ROOM (FR)

Average temperatures in freezing room



VIP freezer floor insulation



Layer (AA' from top to bottom)	d (mm)	λ (W/mK)	ρ (kg/m ³)	c_p (J/kgK)
Epoxy mixed with sand	23	0,3	1650	750
Stabilizing metallic mesh, radius 2 mm	-	-	-	-
Bituminous layer	2	4	-	-
Rubber mat	5,6	0,25	920	1000
VIP	25	0,0039	175	850
VIP	25	0,0039	175	850
Polyethylene foam	4	0,033	80	1550
Water barrier (PE- film)	0,2	2,3	130	2300
Structural plates	50	3	-	-

With supporting
pillars, as build
for monitoring
purpose

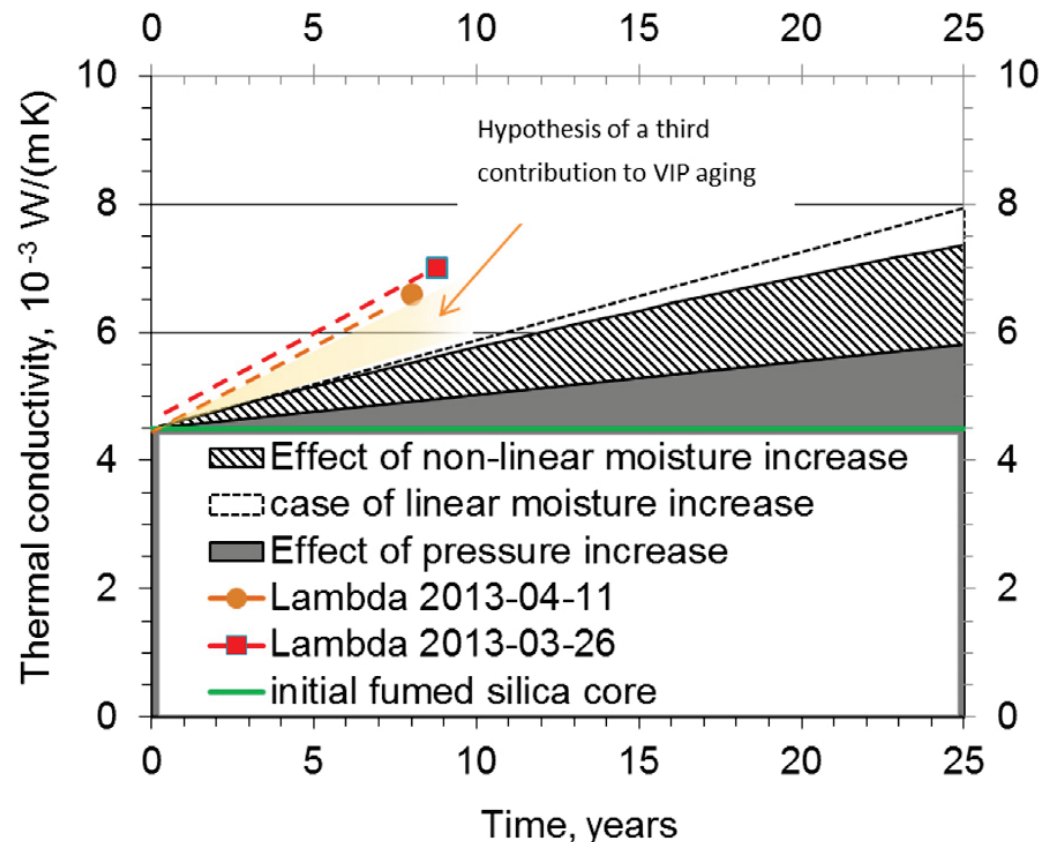
Normal application is on concrete
floor in supermarkets
second most common application
of VIP in Switzerland

CONCLUSIONS- FROM FORMER IVIS2007

25-year-extrapolation (from 2007):

- Cold and dry environment: $\Delta\lambda < 0.5 \cdot 10^{-3} \text{ W}/(\text{m K})$
- Roof (Façade?) applications: $\Delta\lambda \rightarrow 3 \cdot 10^{-3} \text{ W}/(\text{m K})$

2013 roof data:



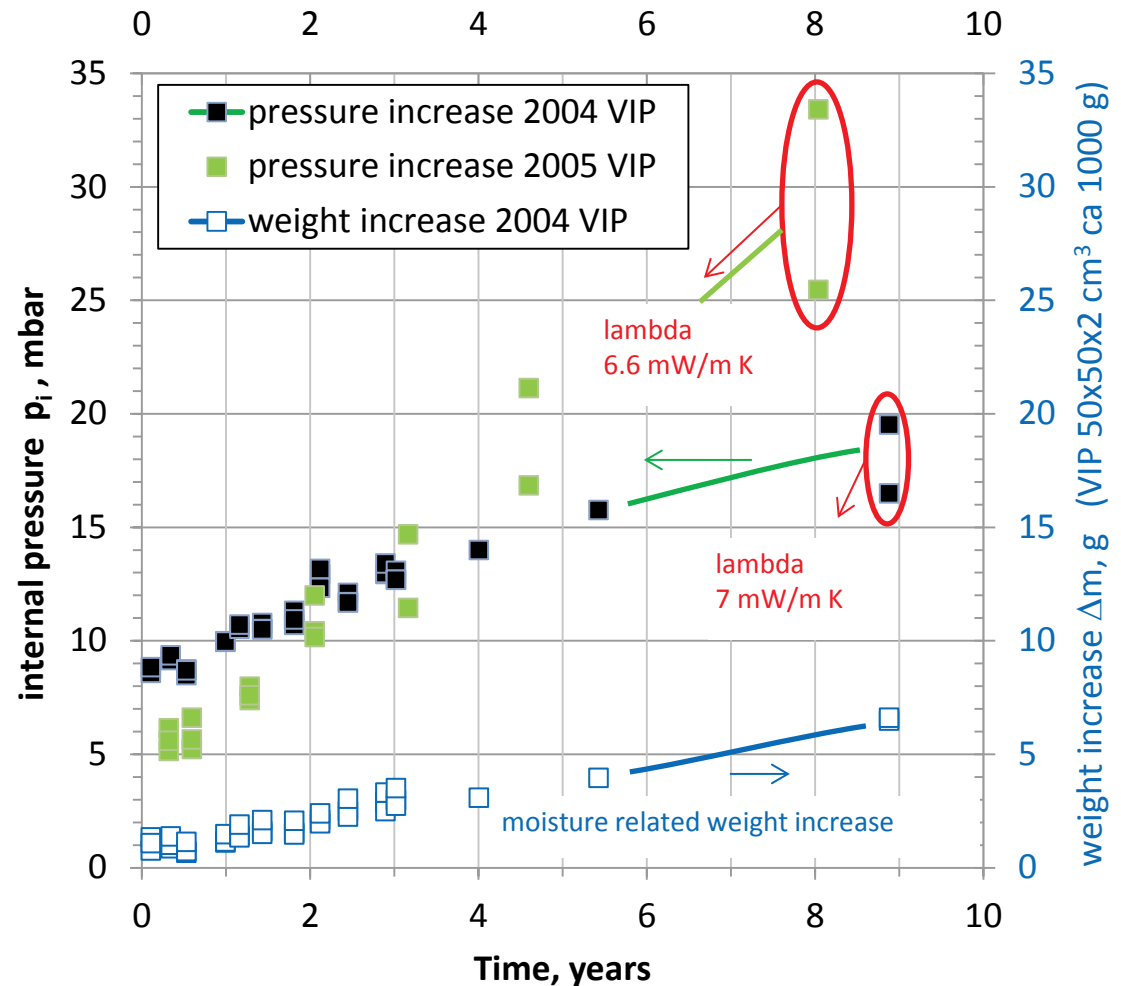
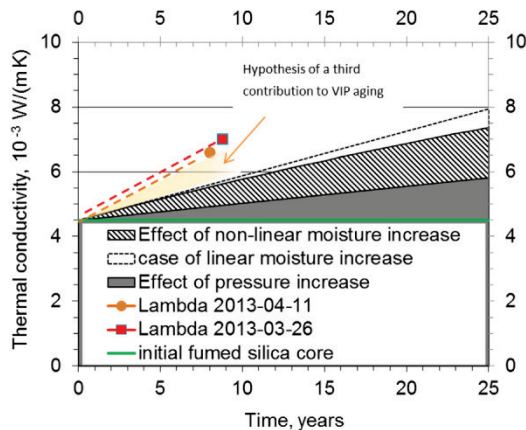
2013 PAPER IN VACUUM

100TH VOLUME

SPECIAL EDITION



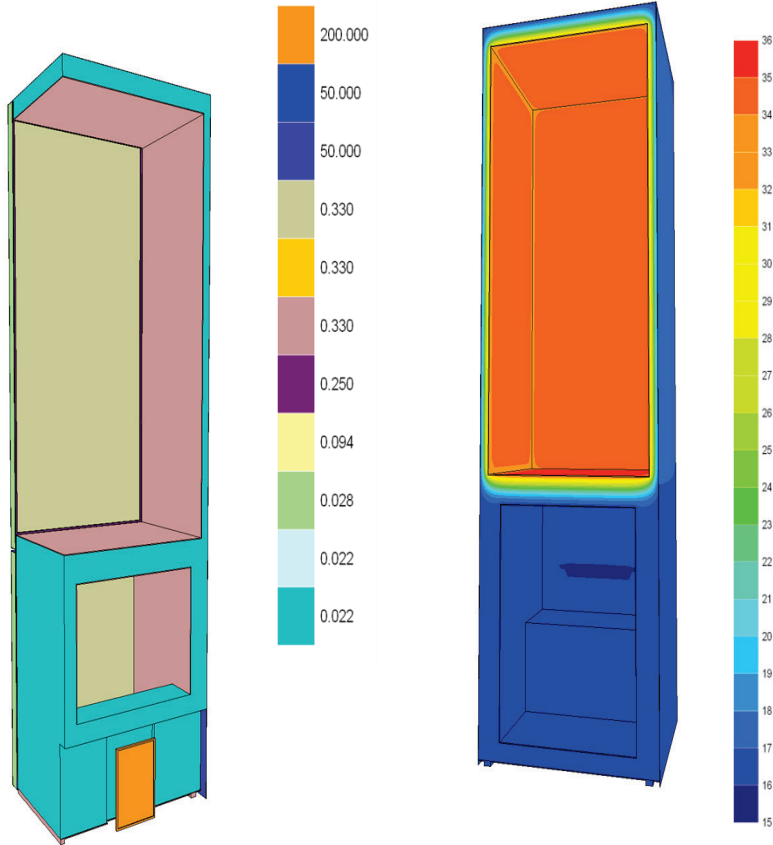
2013 roof opening data:



Paper: Brunner&GhaziWakili,
Vacuum, 2014:100:4-6

FRIDGE

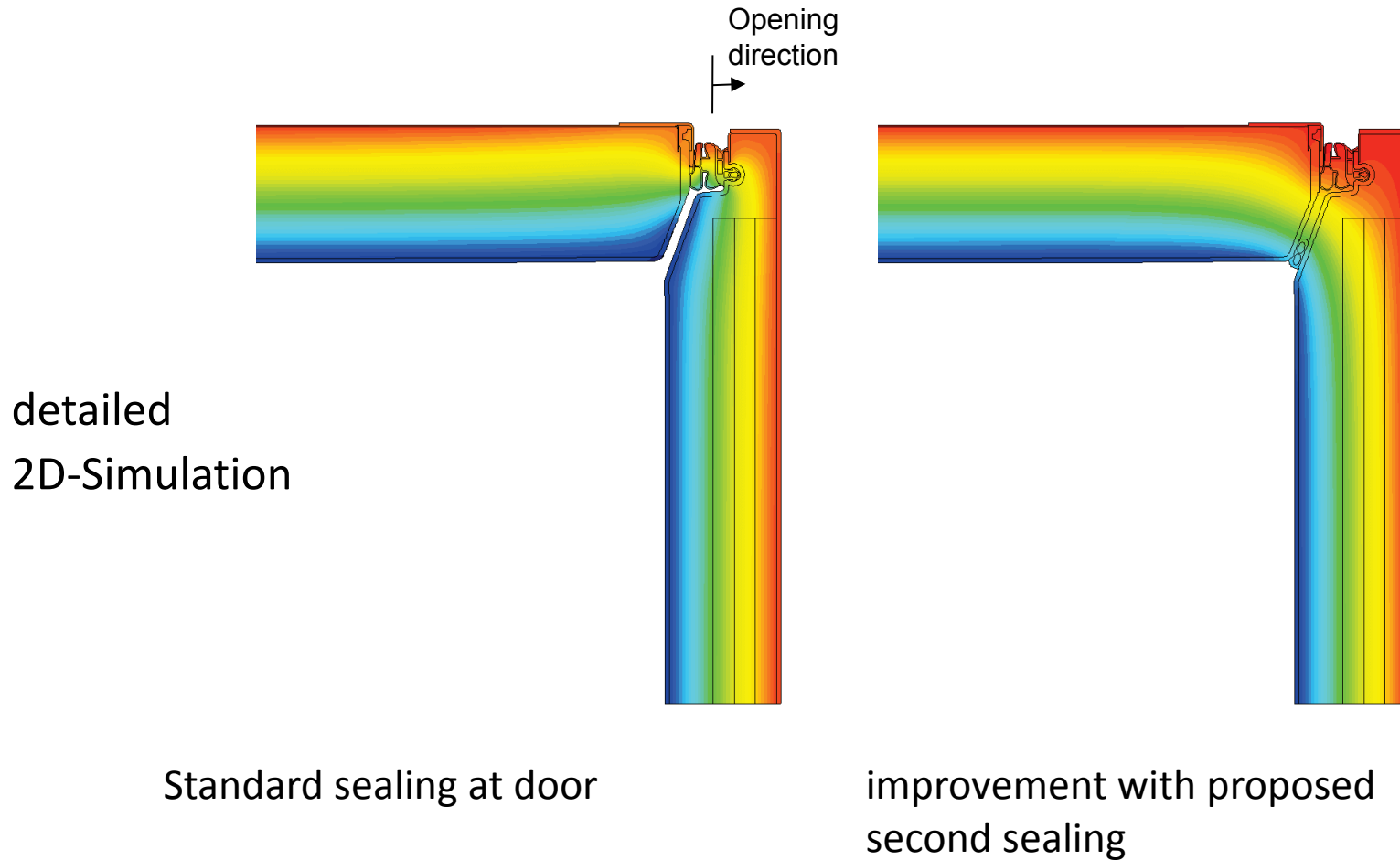
3D-Simulation of test conditions



a household fridge
(with build small freezer)



SMALL FREEZER within a household fridge



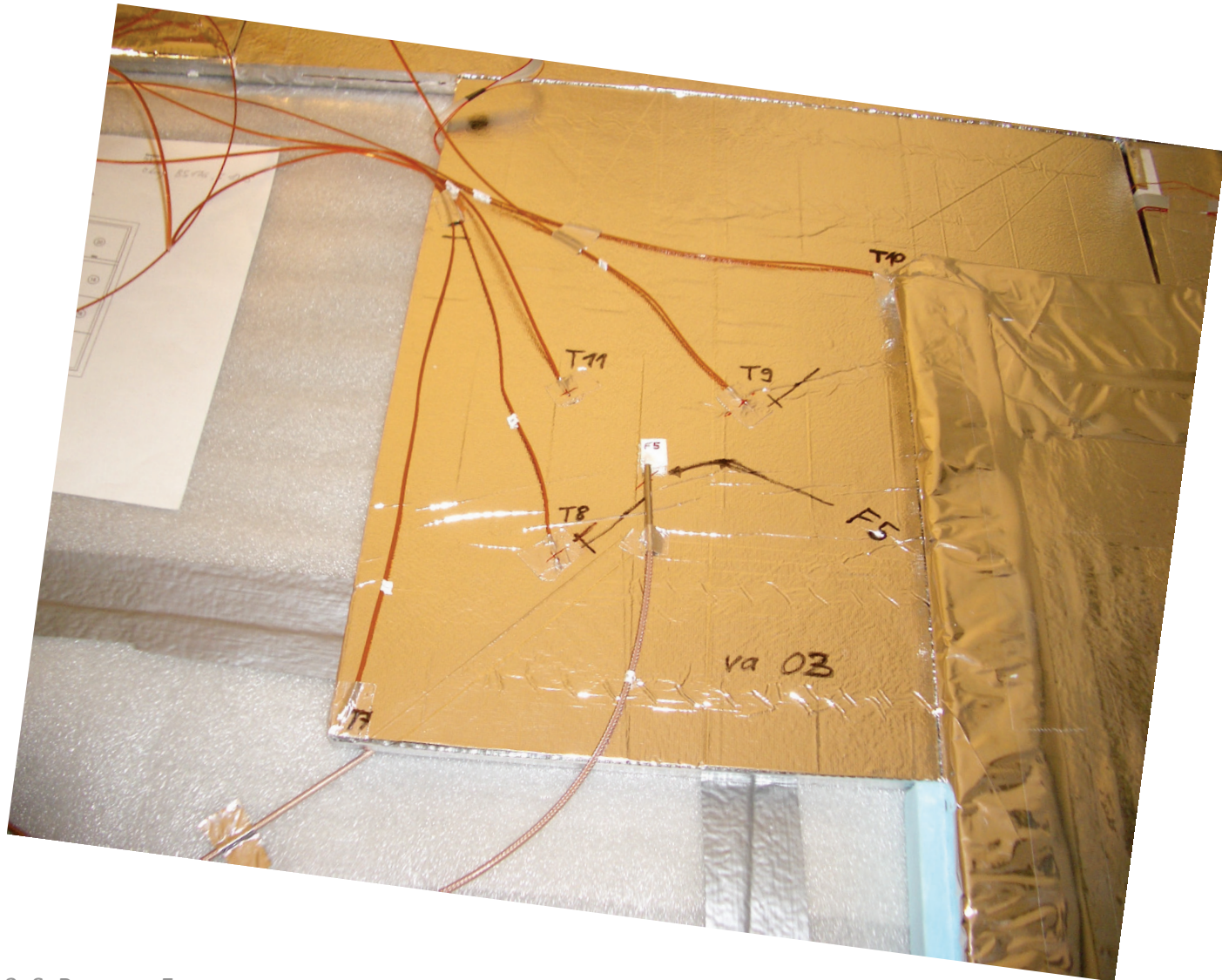
SMALL FREEZER

within a household
fridge

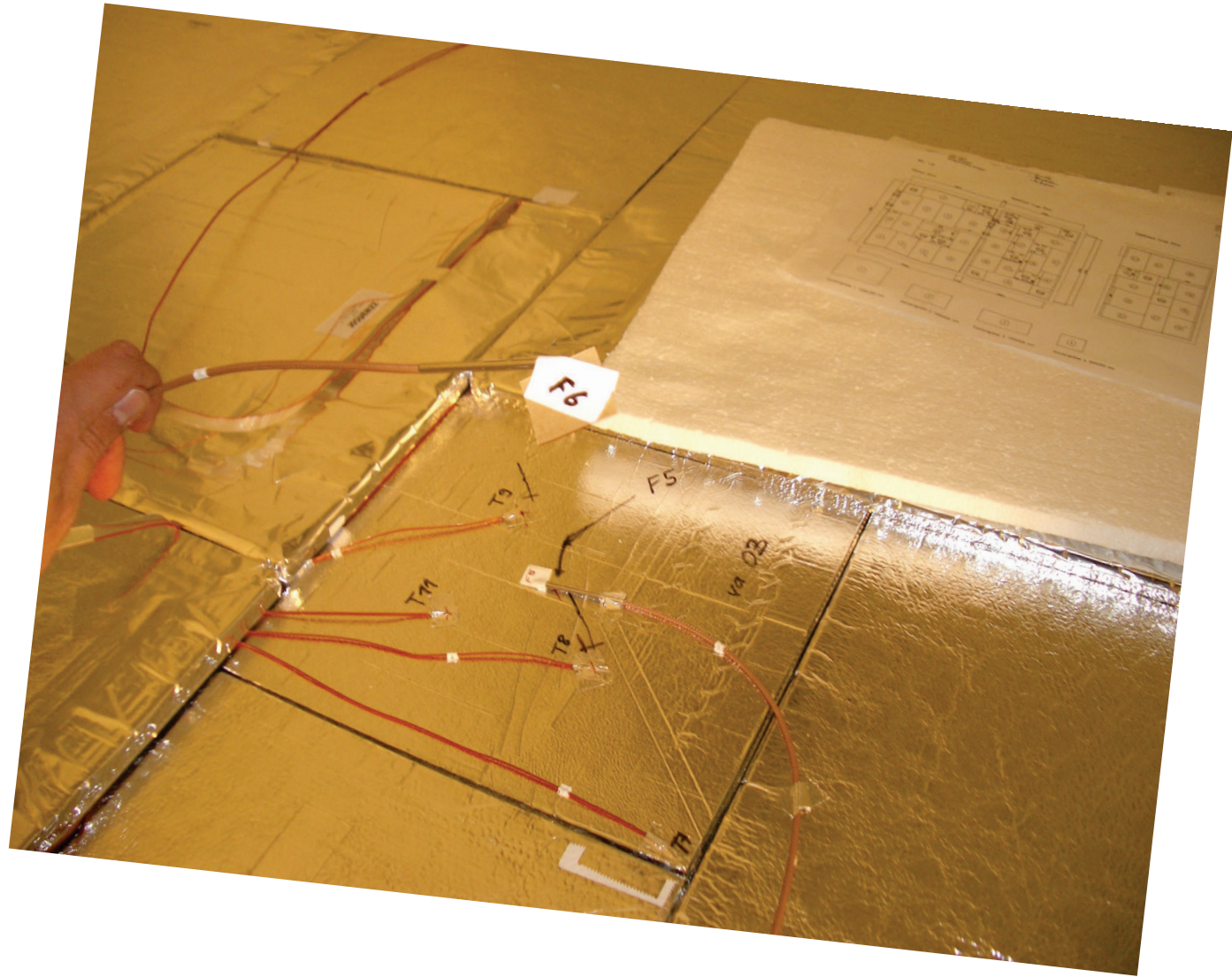
- Second Sealing



FREEZER ROOM – thermal bridge topic



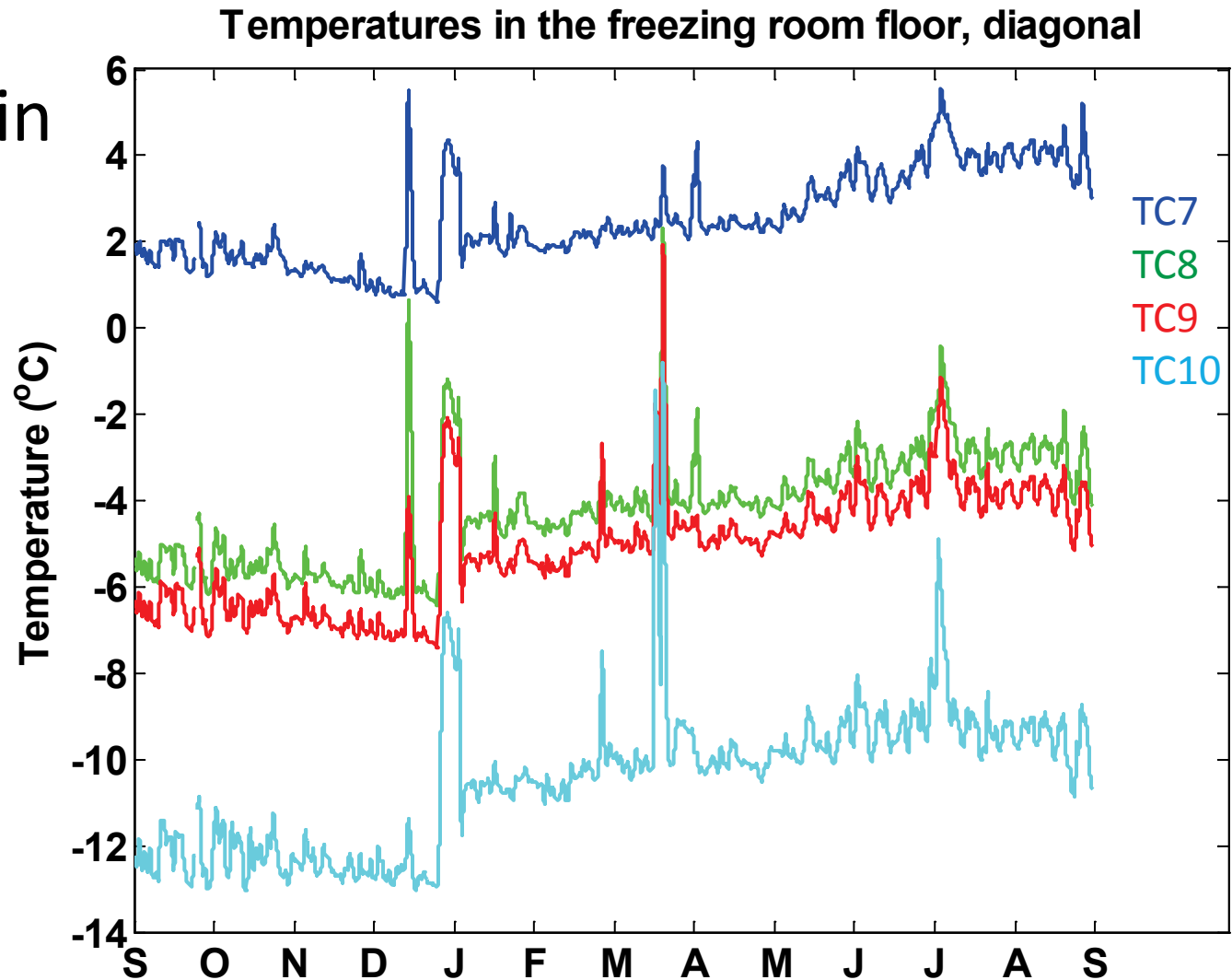
FREEZER ROOM – thermal bridge topic



FREEZER ROOM

Diagonal in
middle
layer

Temperature
20070901 to
20080831

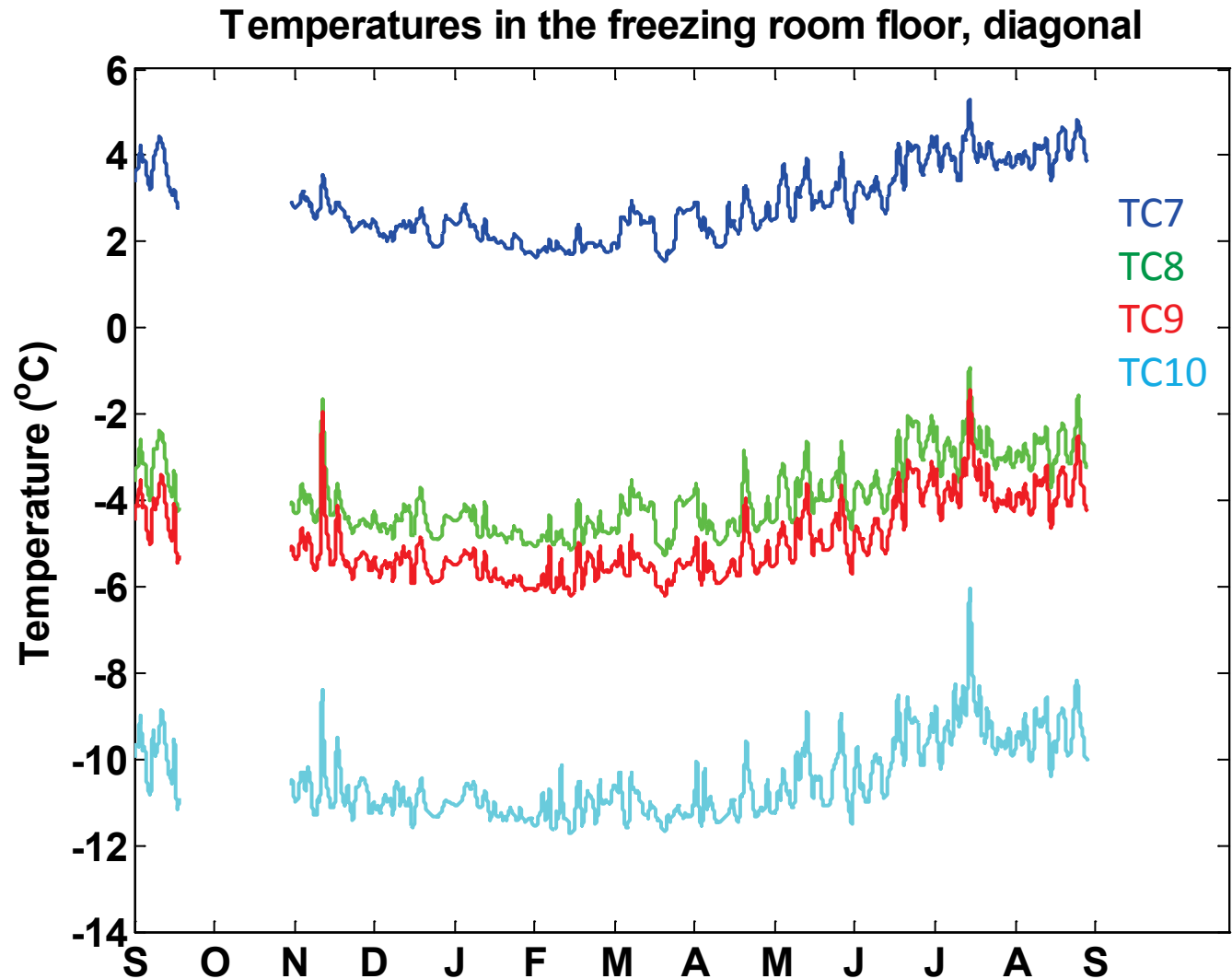


FREEZER ROOM

Diagonal in
middle
layer

Temperature
080901 to
090831
Sliding daily
average

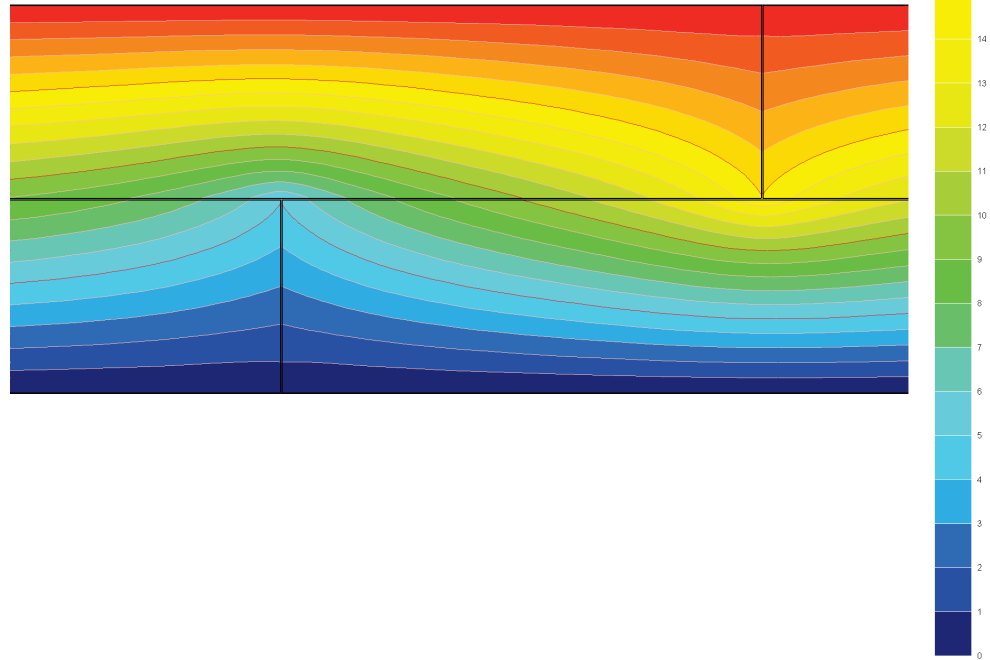
- Temperature
in the freezing
room floor
diagonal



FREEZER ROOM

Why we monitored
the diagonal?

There had been
calculations by
Reto Bundi ca. 2004



Calculated temperature distribution in a cross-section of a VIP double layer. The isothermal increment is 1°C. and the staggering length is 50mm. (file x=50.png , calculated by Reto Bundi ca. 2004)

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Thomas Stahl – double layer project

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Hans Simmler, now at Swisspor AG

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