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EN ARCHITECTUUR

VAKGROEP ARCHITECTUUR EN STEDENBOUW
ONDERZOEKSGROEP BOUWFYSICA, CONSTRUCTIE EN KLIMAATBEHEERSING

BIG DATA IN DEMAND CONTROLLED VENTILATION:

COMPARISON OF MEASURED DATA WITH LITERATURE

Loes Lokere

30/09/2019

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CONTENT

- INTRODUCTION
- HEALTHBOX 3
- DATA PROCESSING: PYTHON
- DATA-ANALYSIS: RESULTS + DISCUSSION
- GLOBAL CONCLUSION

INTRODUCTION

HEALTHBOX 3

HEALTHBOX 3

Room type	Measured parameters
Laundry room/ Shower/ Bathroom without toilet	T&RH
Bathroom/ Toilet/ Storage	T&RH + VOC
Kitchen (open/closed), Bedroom, Living room, Office	T&RH + CO_2

Source : Renson, “BE_NL_Tech_fiche_Healthbox_3”. [online].
Available: https://www.renson.eu/nl-be/producten-zoeken/ventilatie/mechanische-ventilatie/units/healthbox-3-0

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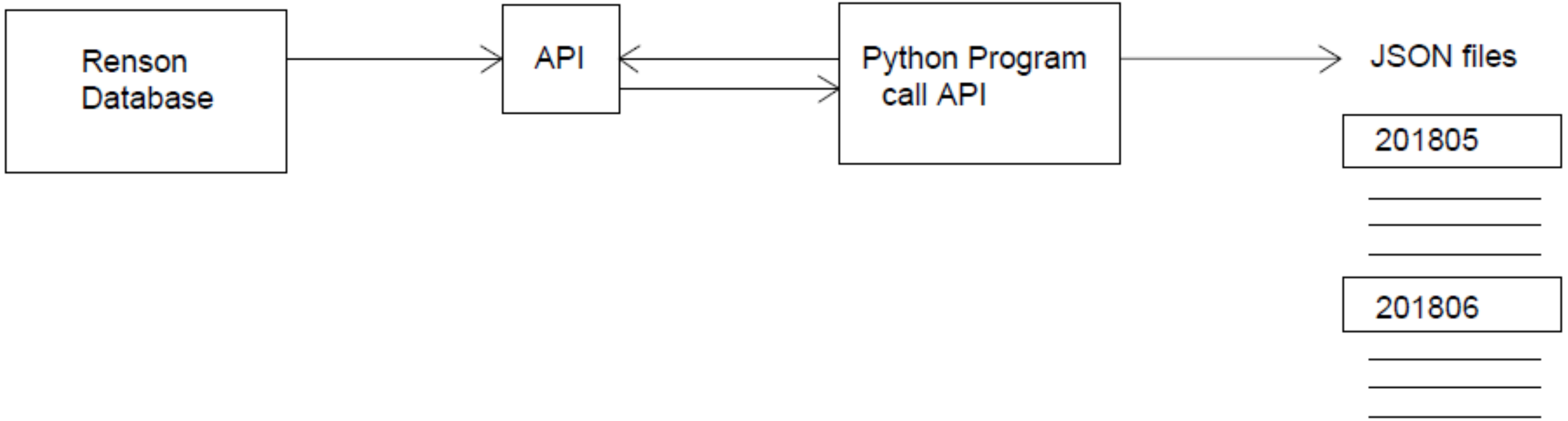
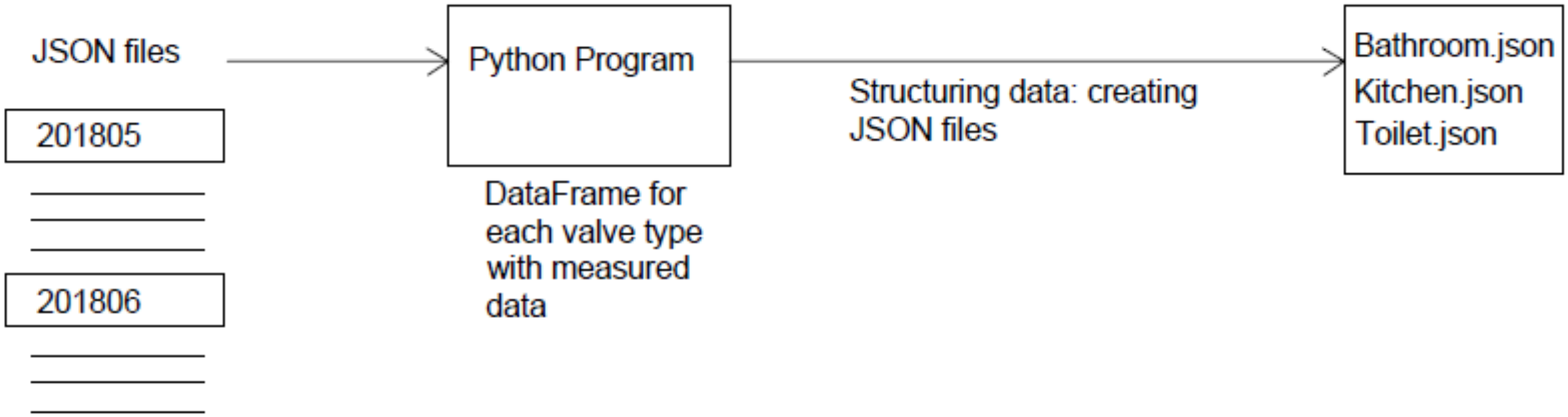
DATA-PROCESSING: PYTHON

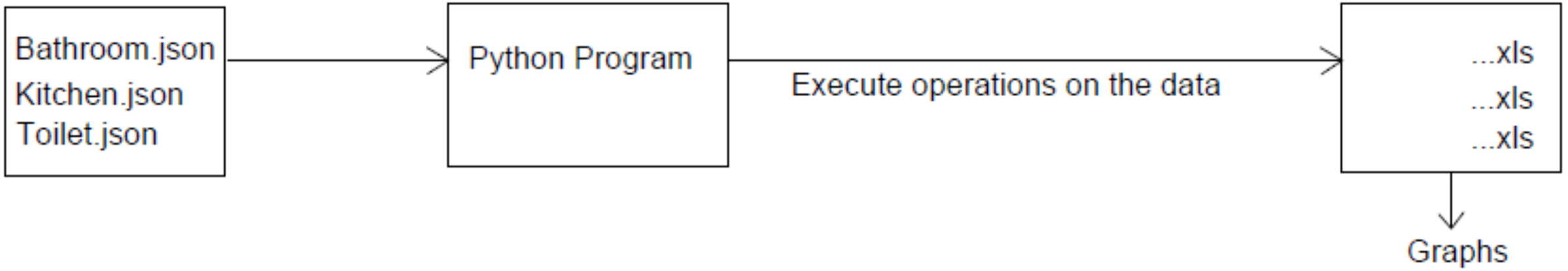
PYTHON
RETRIEVING THE DATA



PYTHON
STRUCTURING THE DATA



PYTHON PERFORMING OPERATIONS

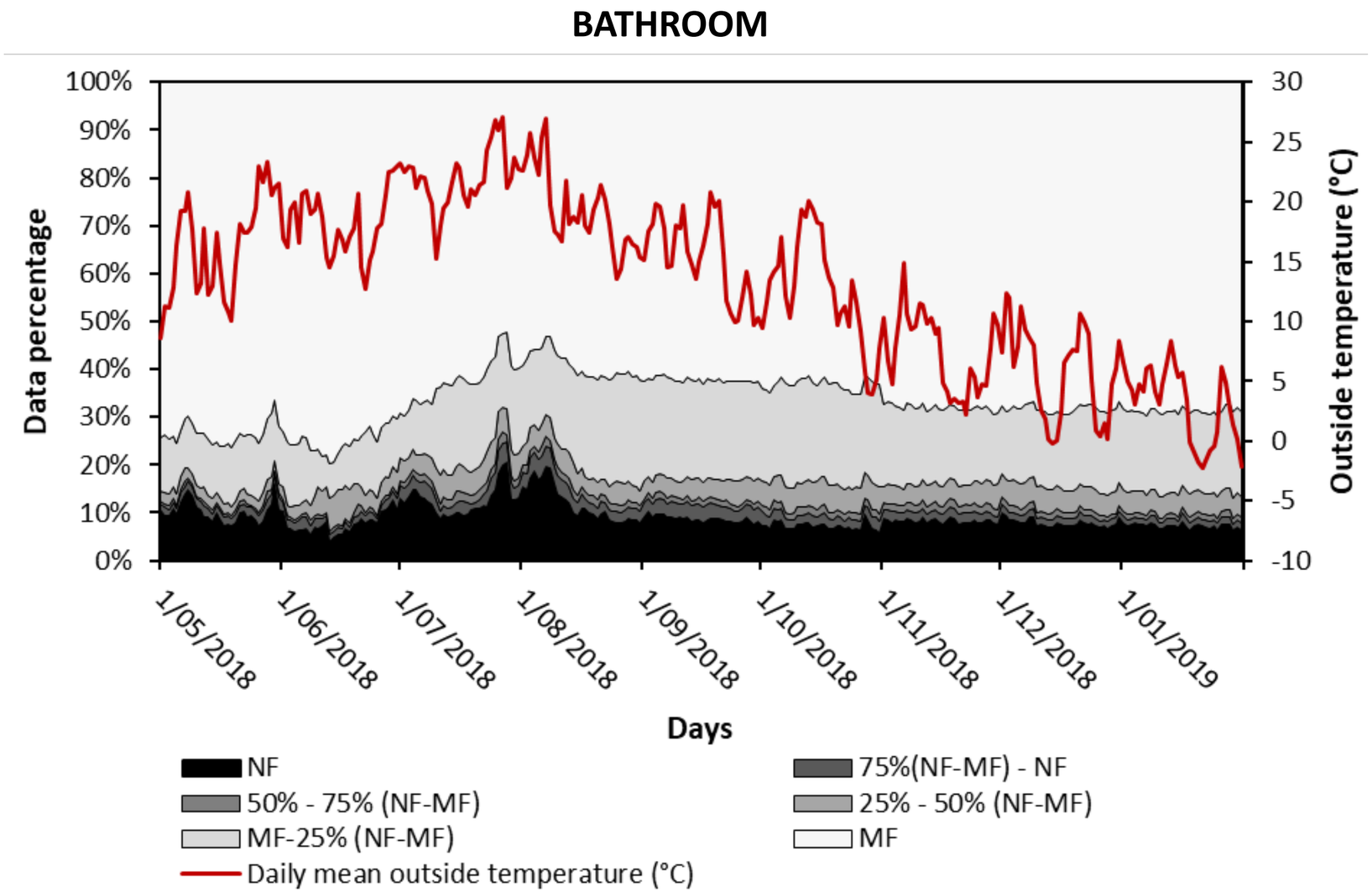


DATA-ANALYSIS

DATA-ANALYSIS

- USE OF VENTILATION
- TYPICAL INDOOR CLIMATE
- POSSIBLE OPTIMISATIONS OF THE SYSTEM

USE OF VENTILATION



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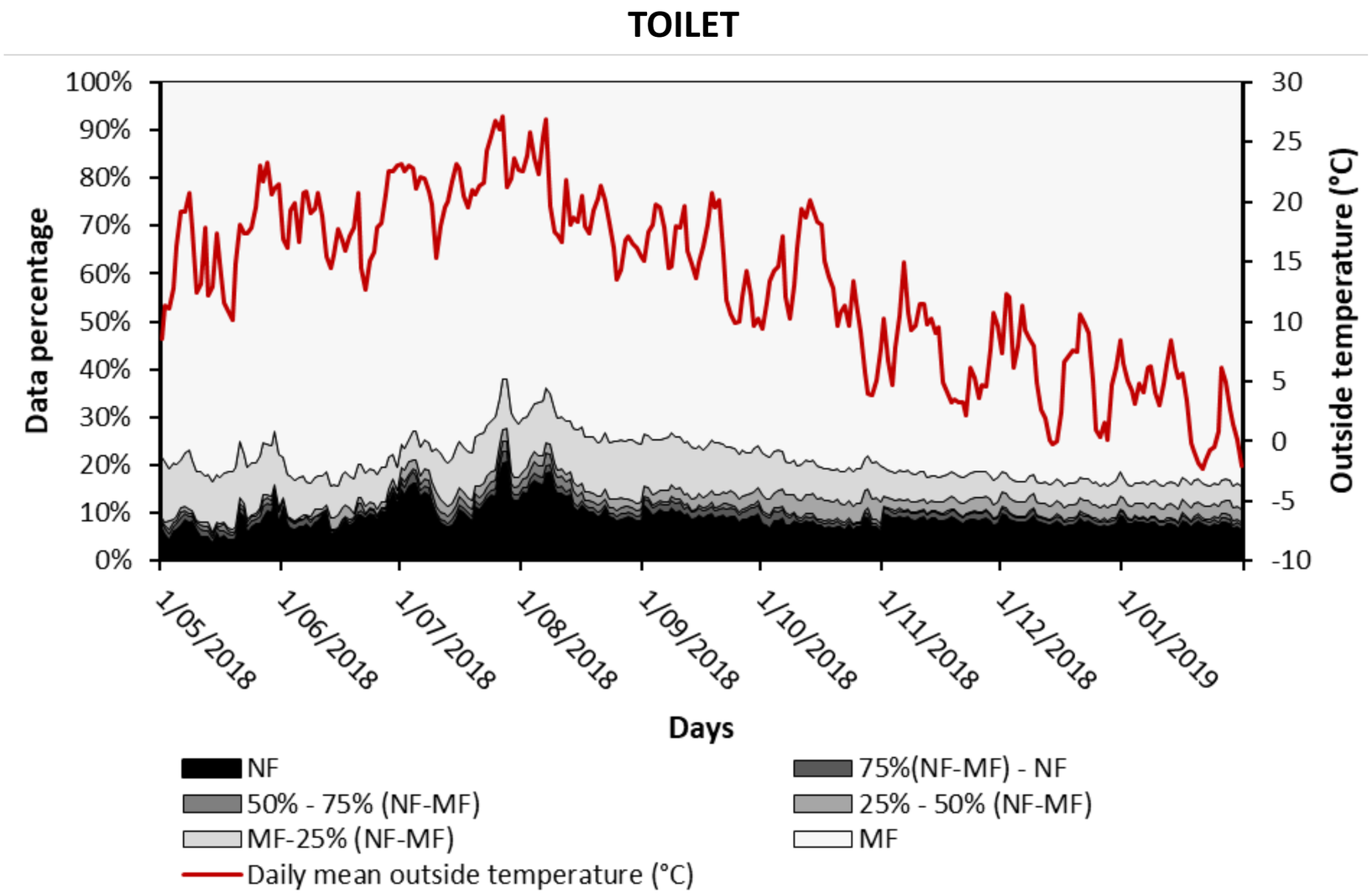
USE OF VENTILATION



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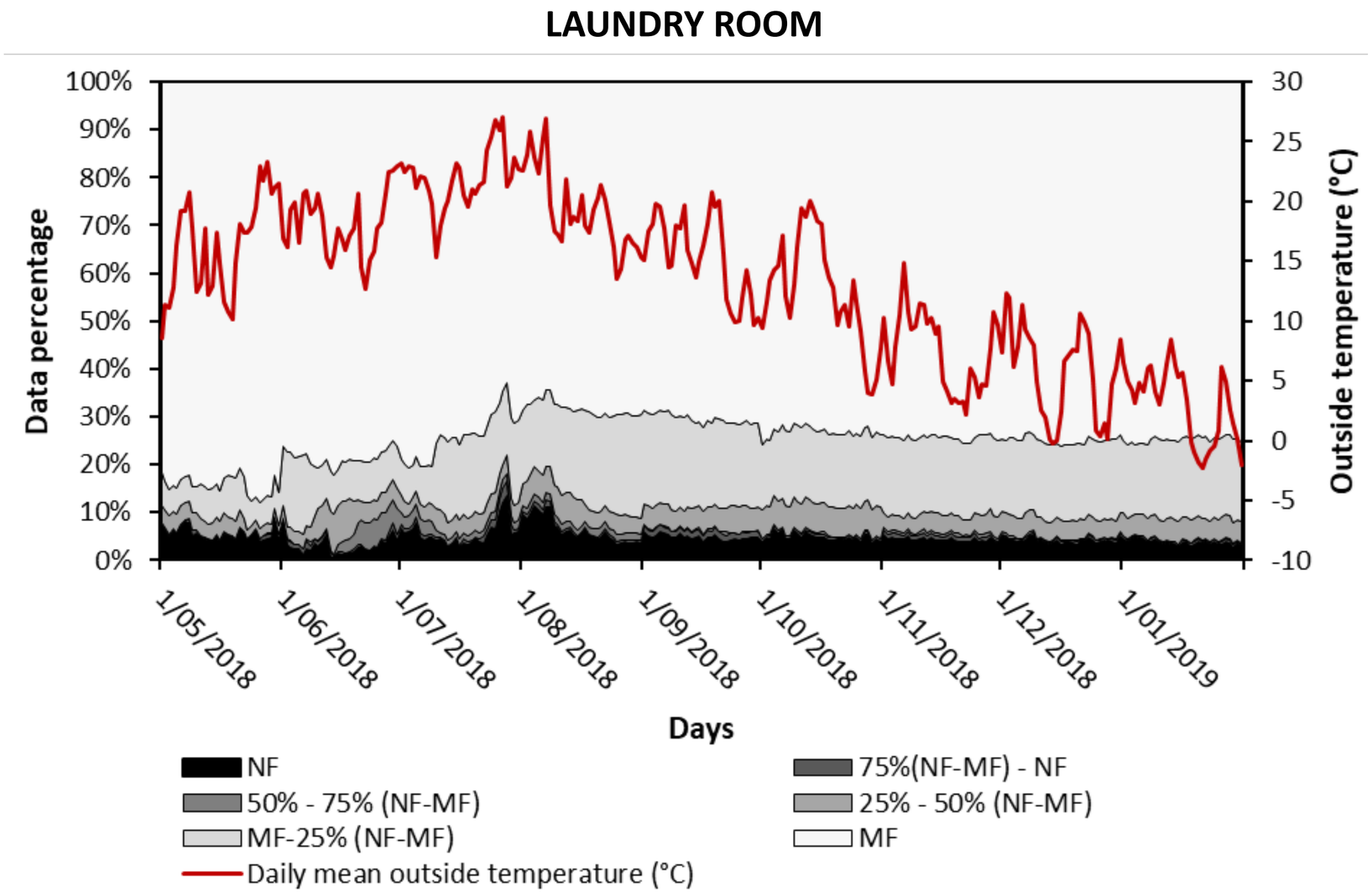

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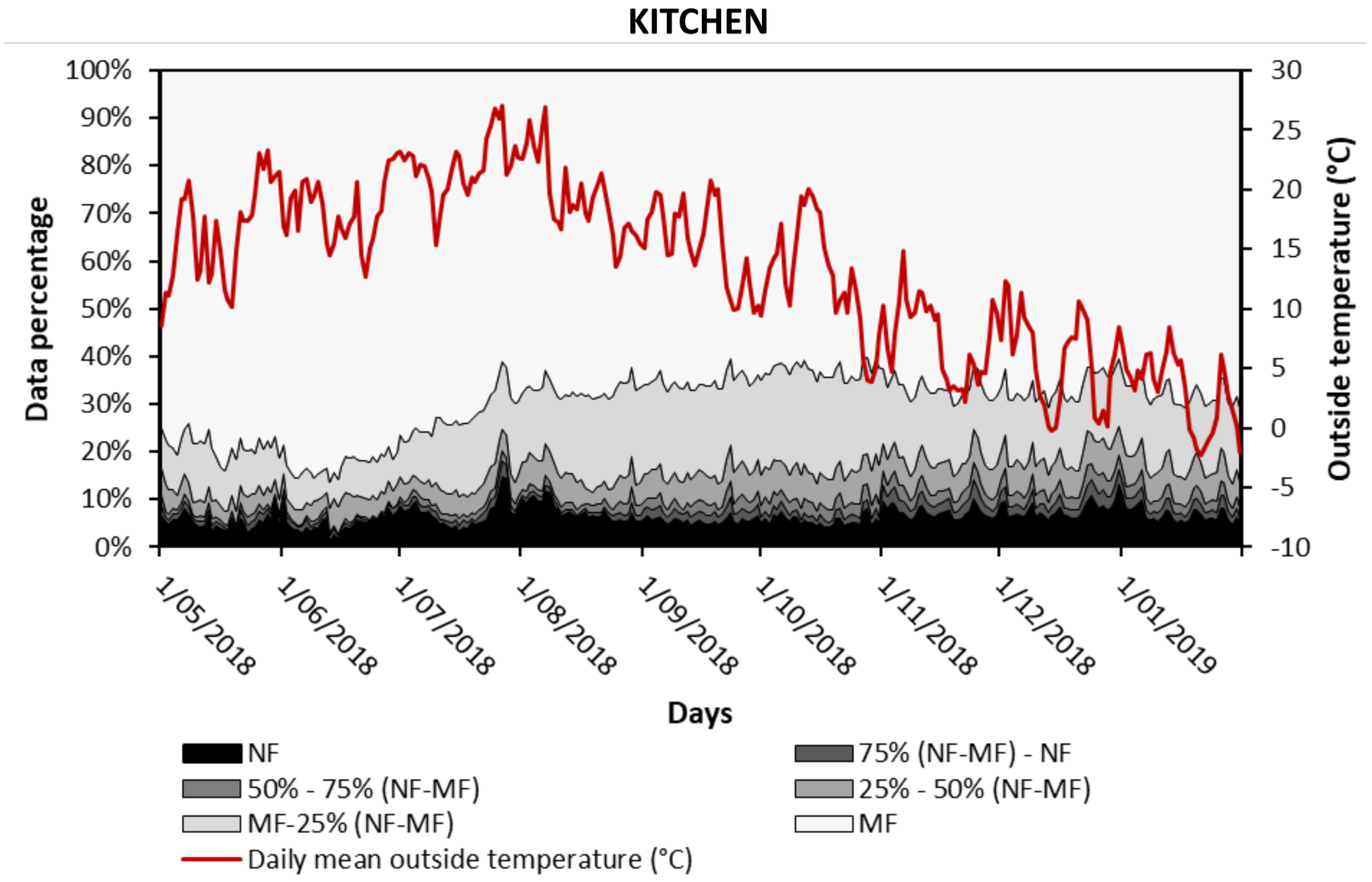

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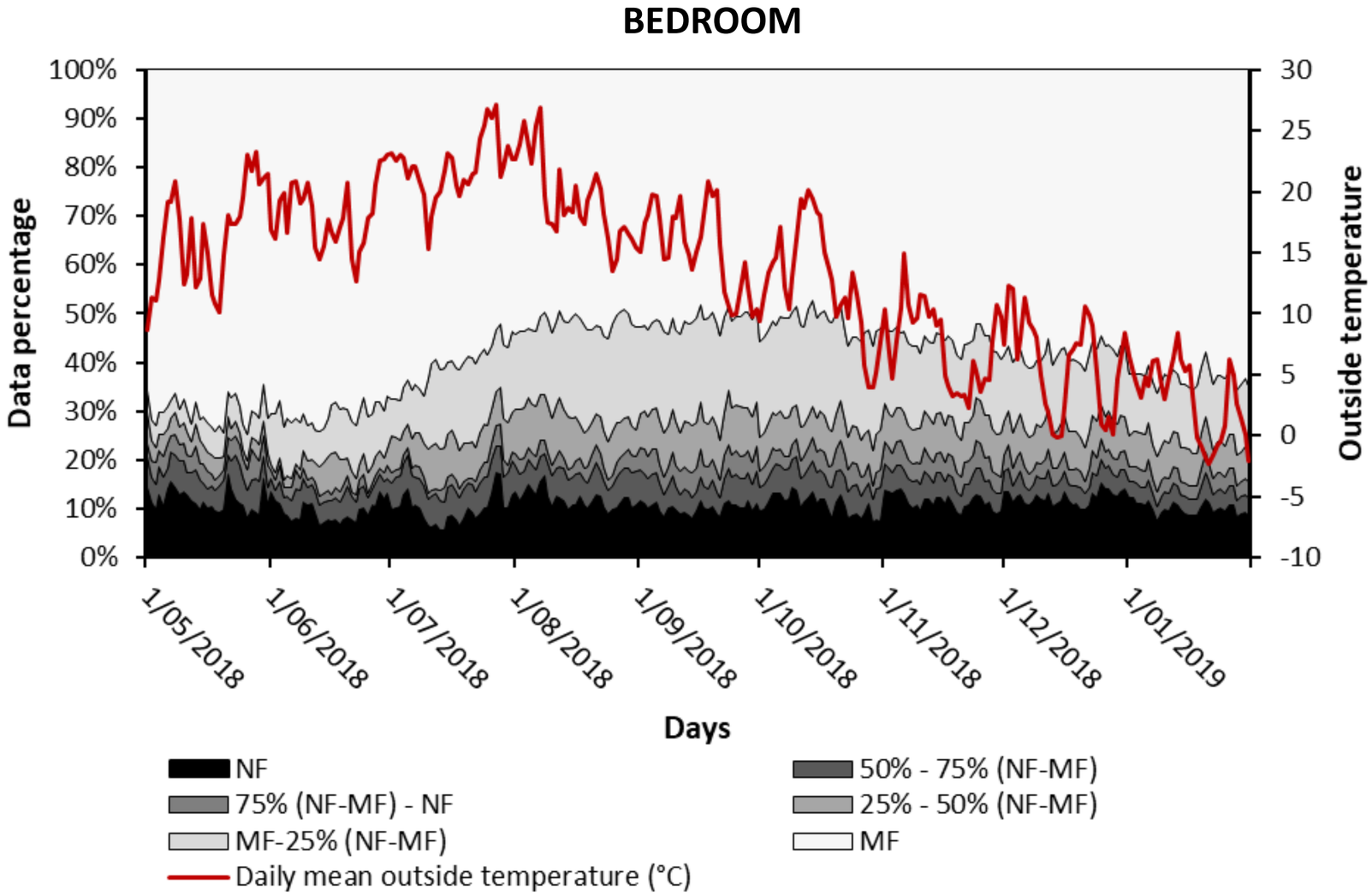

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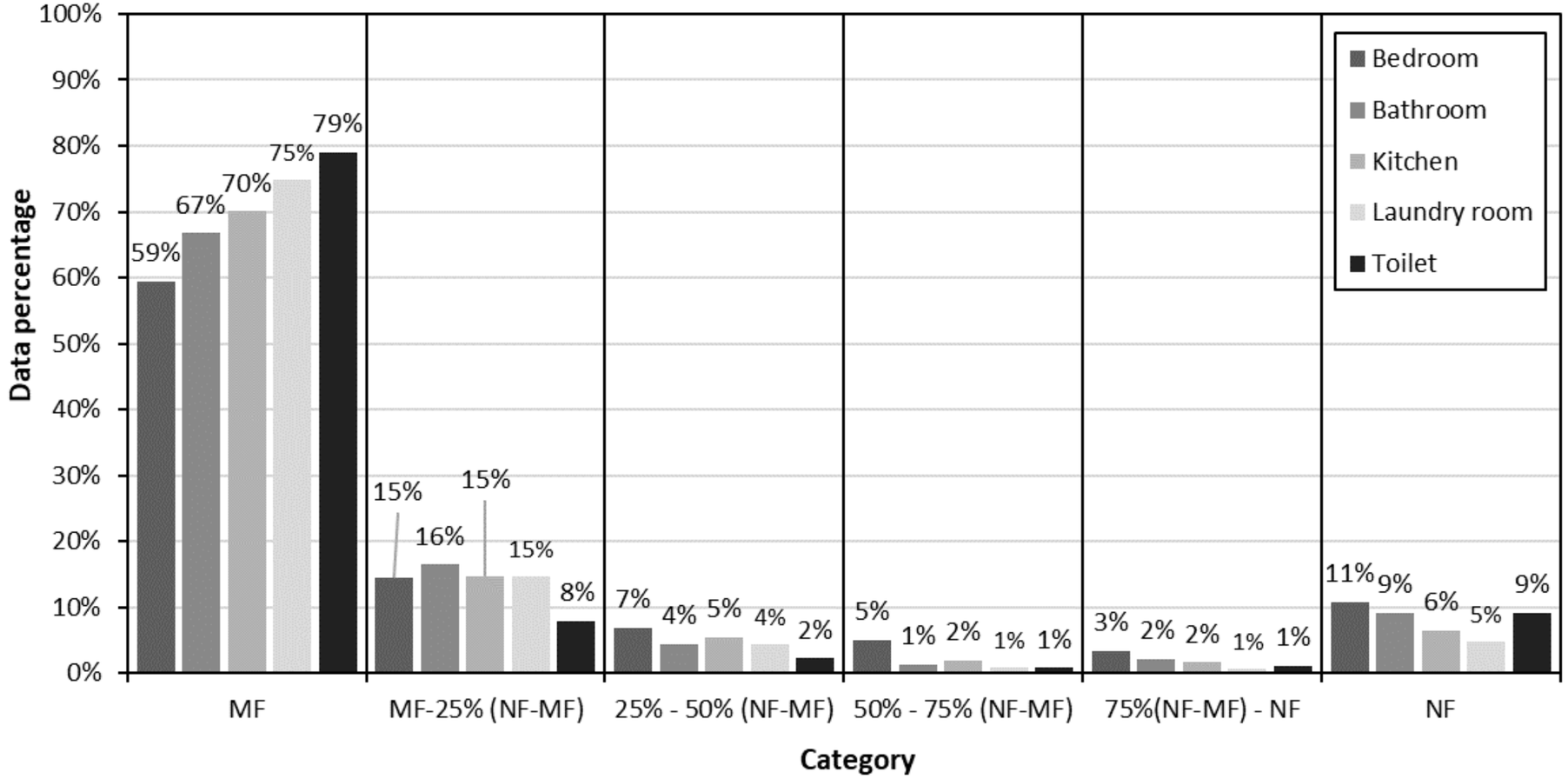
USE OF VENTILATION



	MF	MF-25%(NF-MF)	25% -50% (NF-MF)	50% - 75% (NF-MF)	75%(NF-MF) - NF	NF
Bedroom	59%	15%	7%	5%	3%	11%
Bathroom	67%	16%	4%	1%	2%	9%
Kitchen	70%	15%	5%	2%	2%	6%
Laundry room	75%	15%	4%	1%	1%	5%
Toilet	79%	8%	2%	1%	1%	9%

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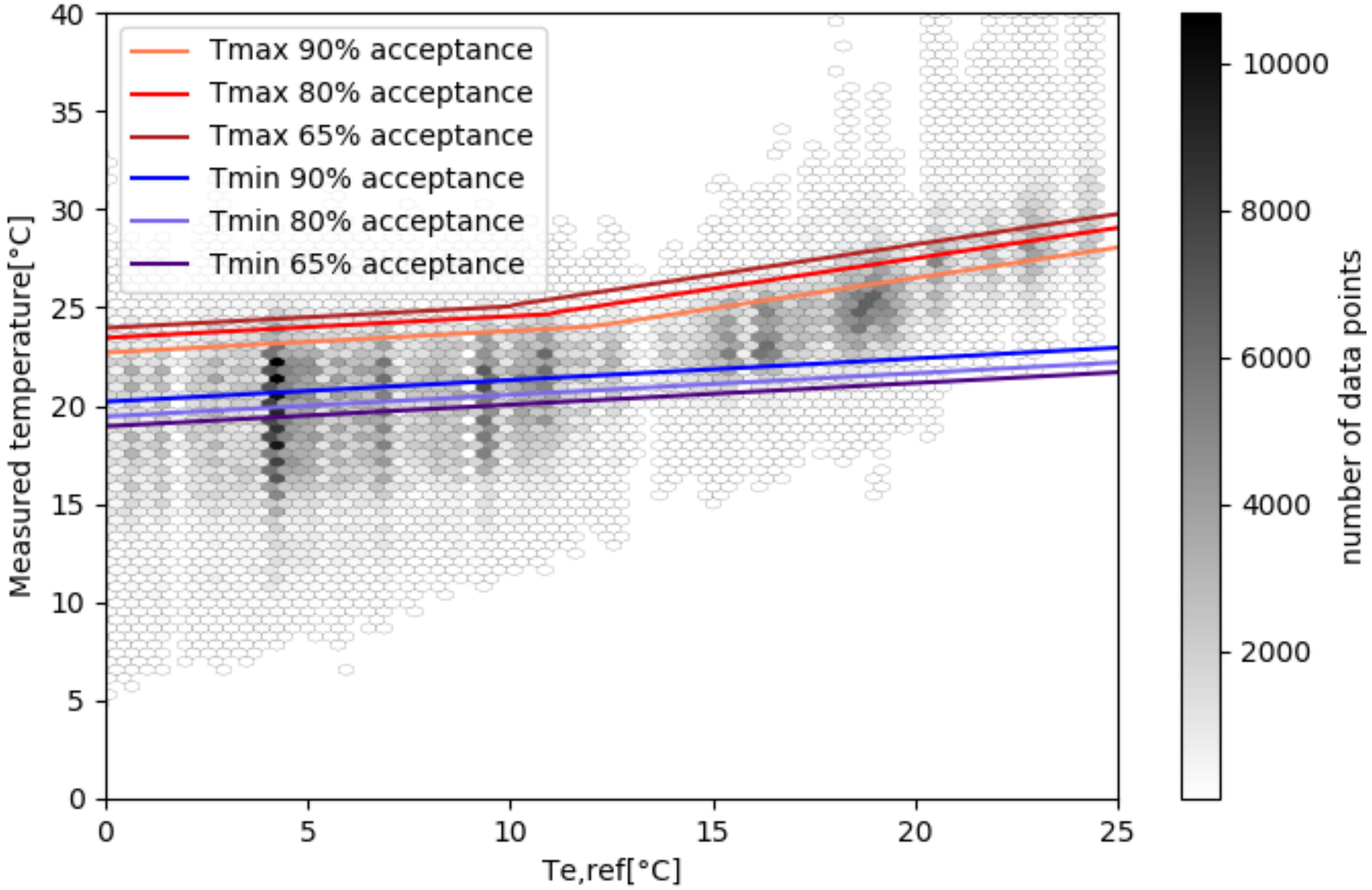
TYPICAL INDOOR CLIMATE

- Thermal comfort
- Risk of mould growth
- Indoor climate classes (ICC)
- Indoor air classes (IDA)

TYPICAL INDOOR CLIMATE: THERMAL COMFORT

BEDROOM



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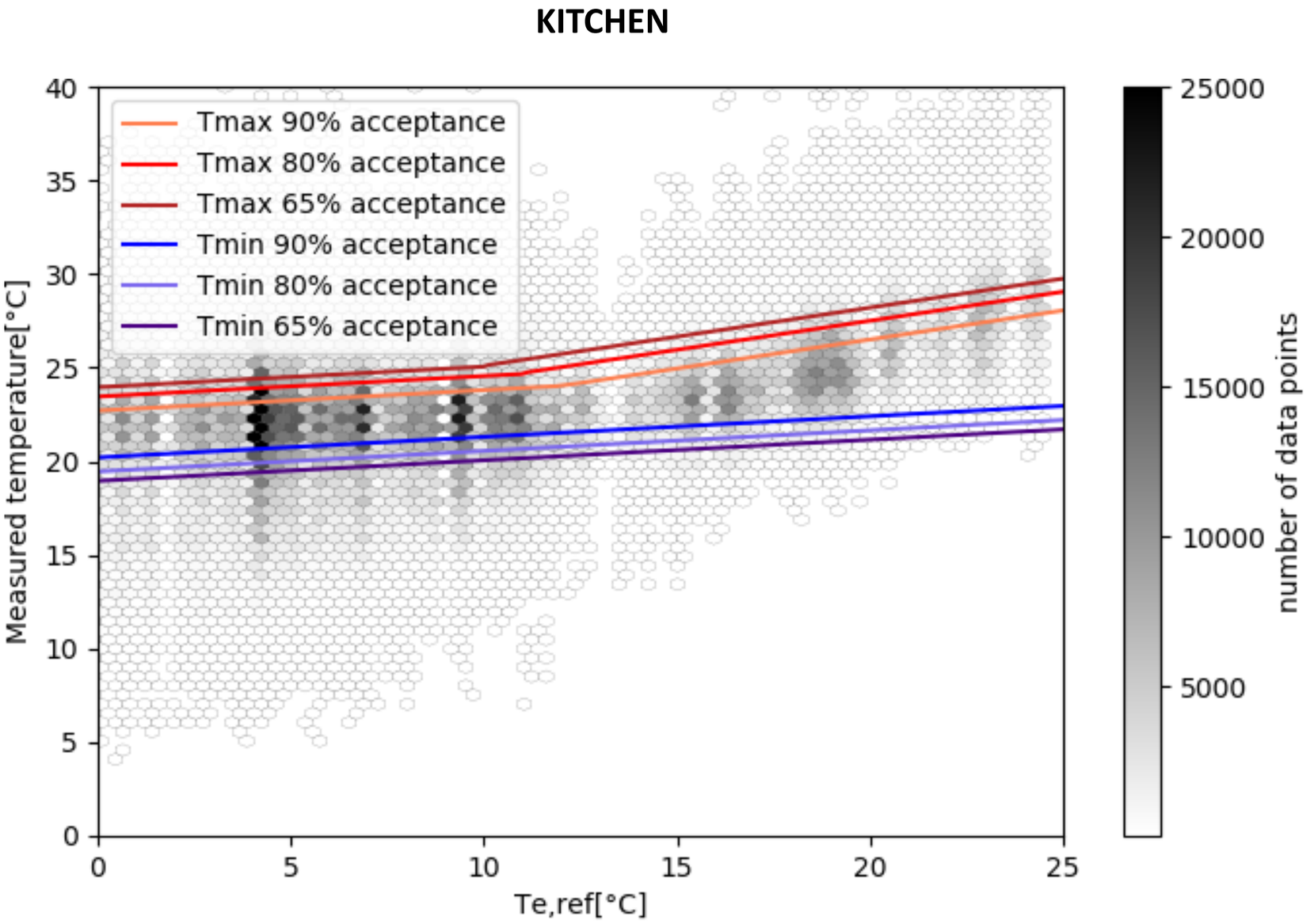
TYPICAL INDOOR CLIMATE: THERMAL COMFORT



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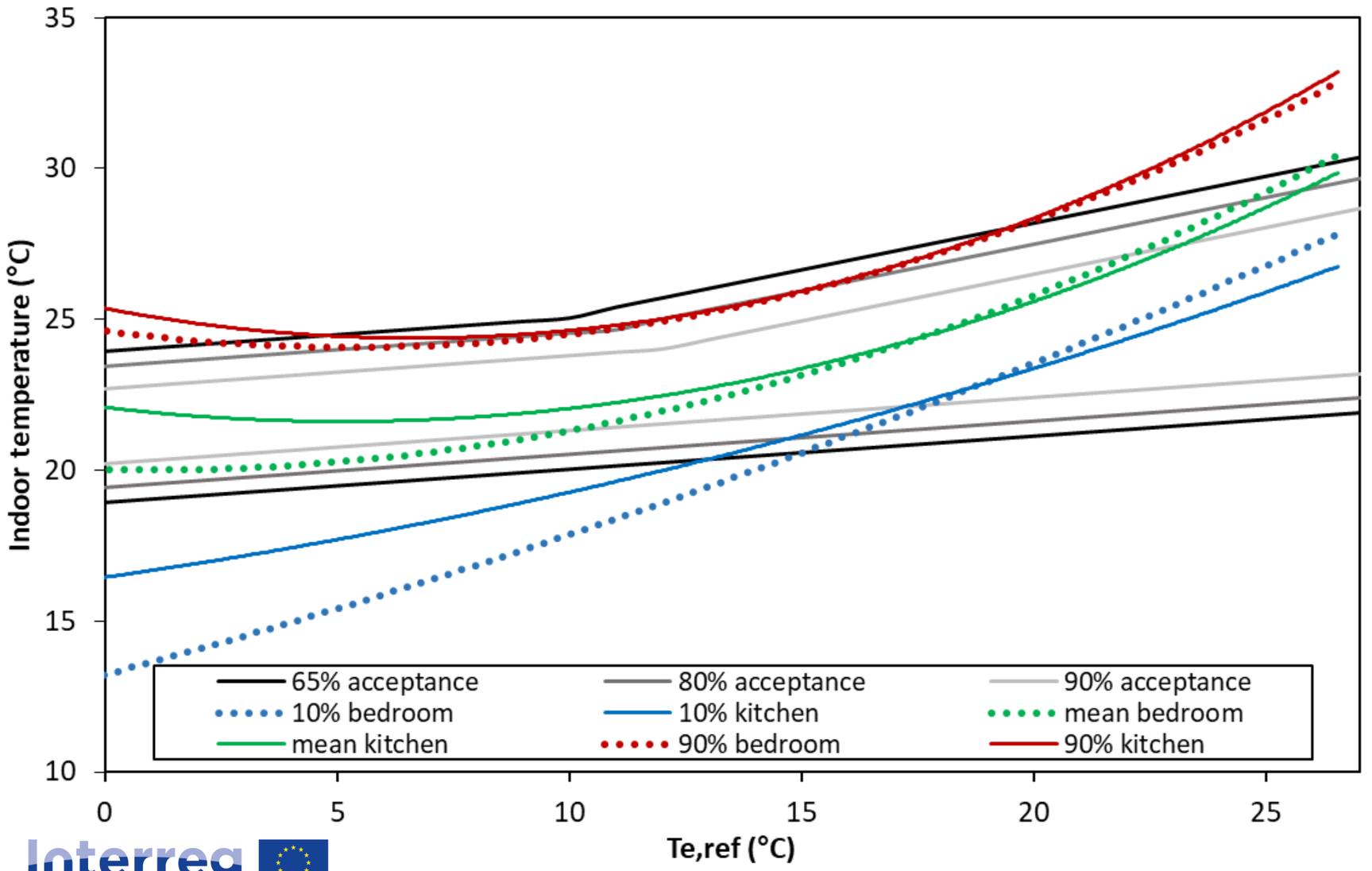
TYPICAL INDOOR CLIMATE: THERMAL COMFORT

ATL	Class 90%	Class 80%	Class 65%
Kitchen	48,35%	66,10%	74,16%
Bedroom	38,15%	53,98%	61,65%
Bedroom (without lower limit)	83,14%	91,01%	95,20%



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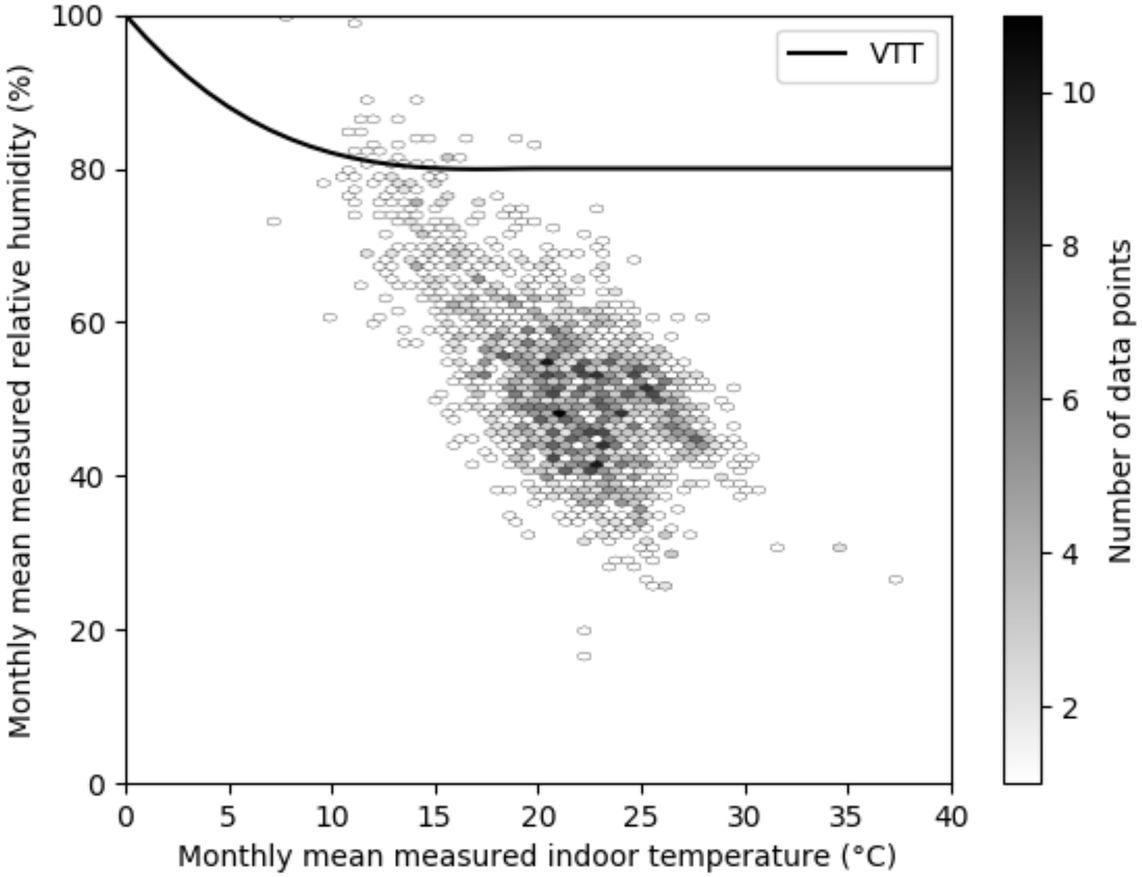
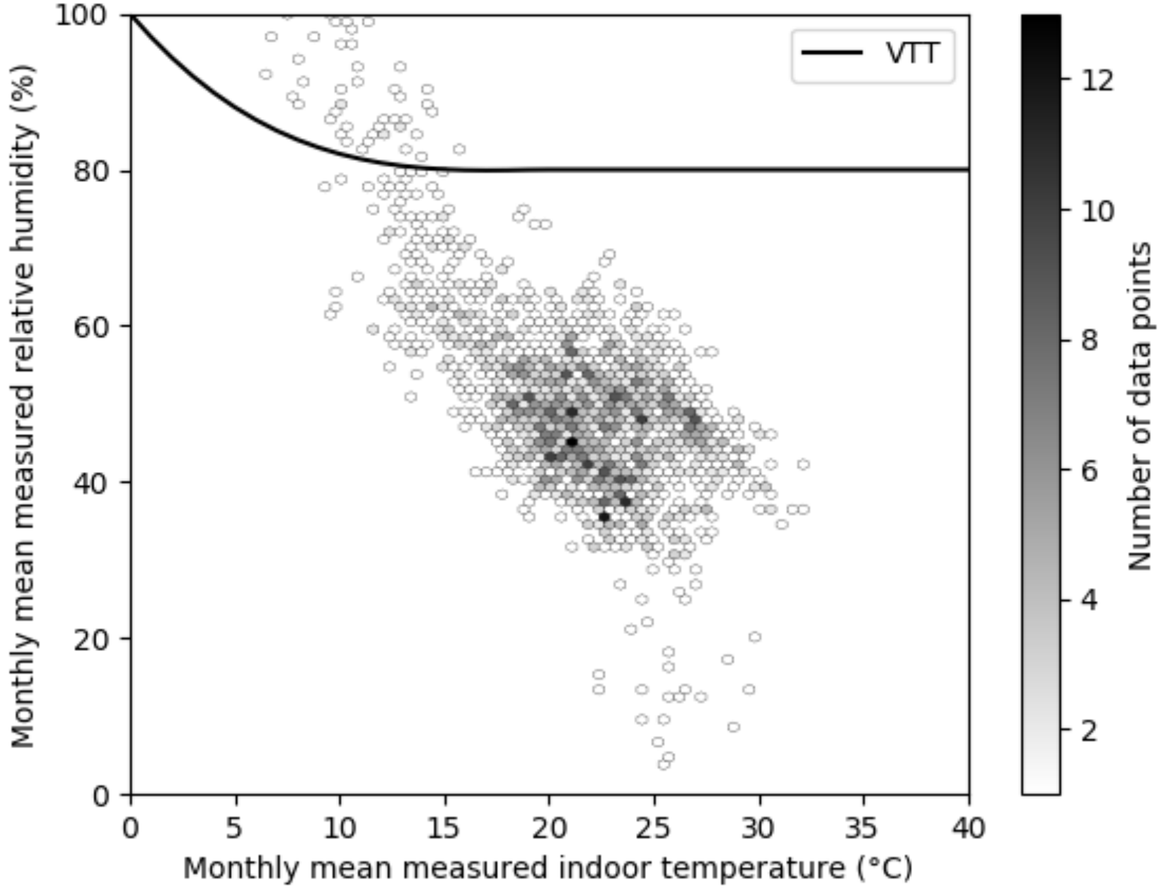
TYPICAL INDOOR CLIMATE: RISK OF MOULD

BATHROOM



TOILET



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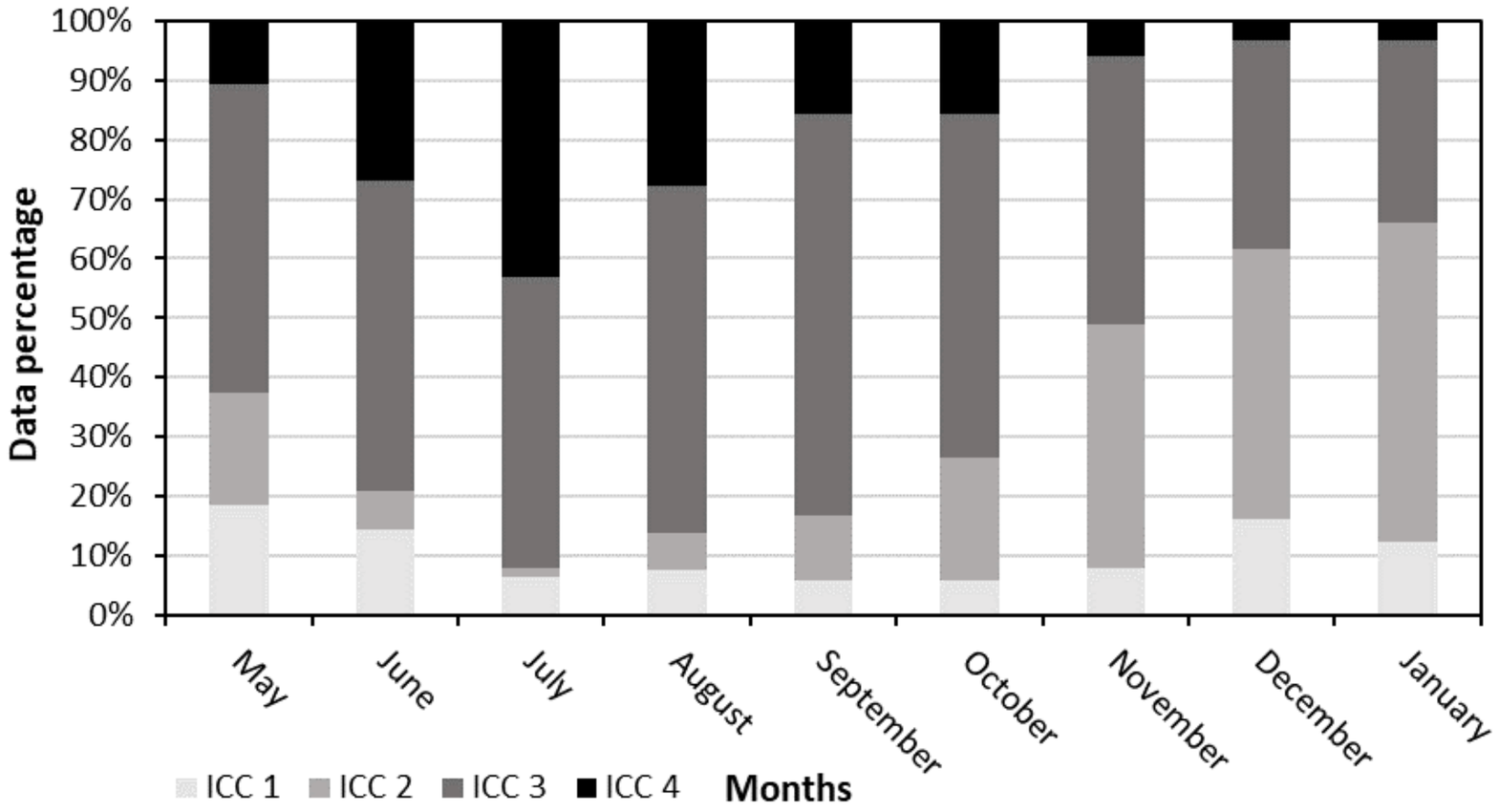
	Bedroom	Kitchen	Bathroom	Laundry room	Toilet
Risk of mould growth	1.15%	0.63%	1.14%	0.52%	2.39%

TYPICAL INDOOR CLIMATE: ICC

ICC	Model of Hens with short-term measurements	
	$P_i - P_e$ (Pa)	Description
1	<159 - 10 θ_e	Buildings with a low moist production
2	<436 -22 θ_e	Buildings with a small moist production or sufficient ventilation system
3	<713 - 22 θ_e	Buildings with a considerable moist production or moderate ventilation
4	>713 -22 θ_e	Buildings with a high moist production or poor ventilation



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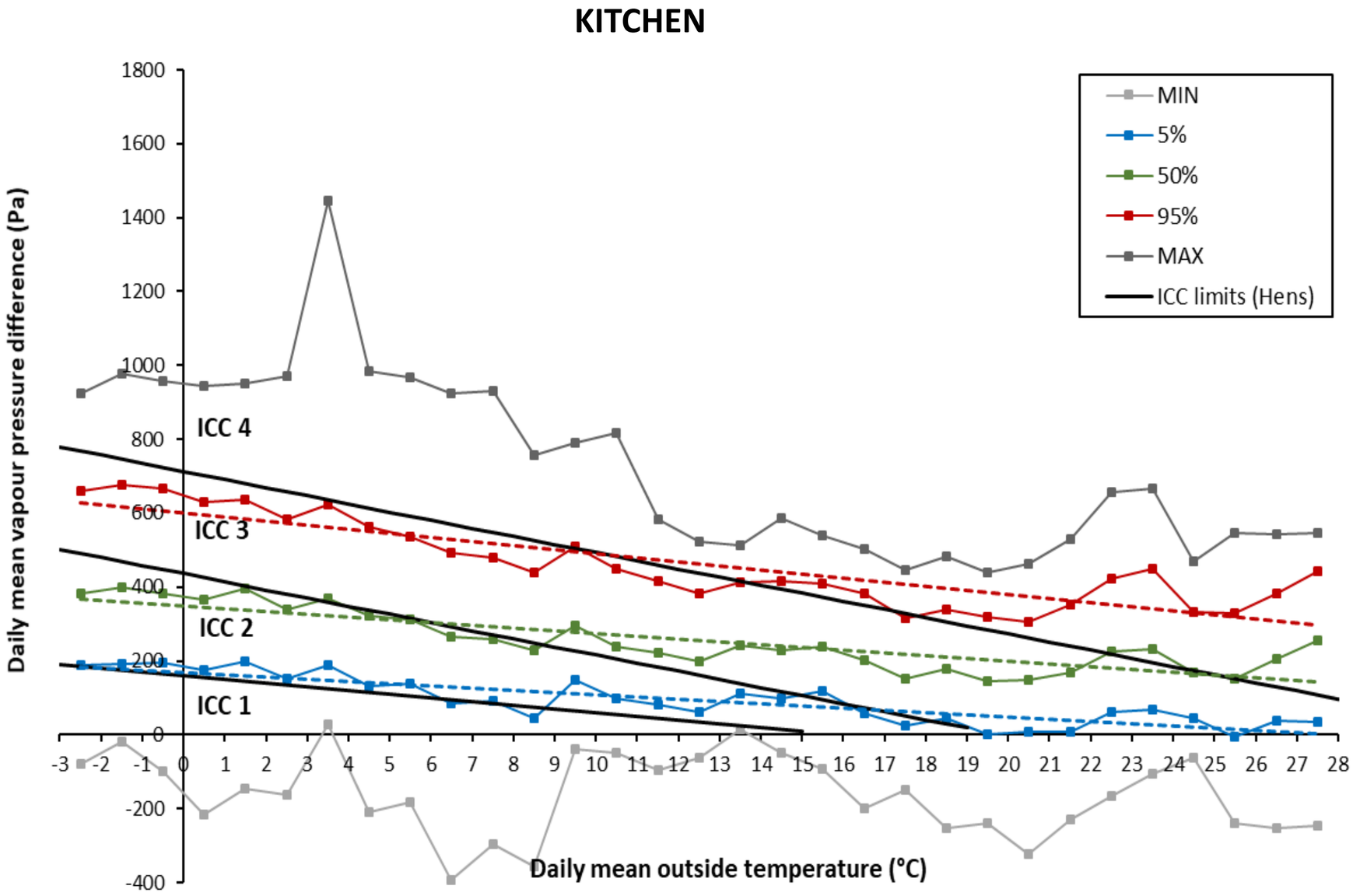
TYPICAL INDOOR CLIMATE: ICC



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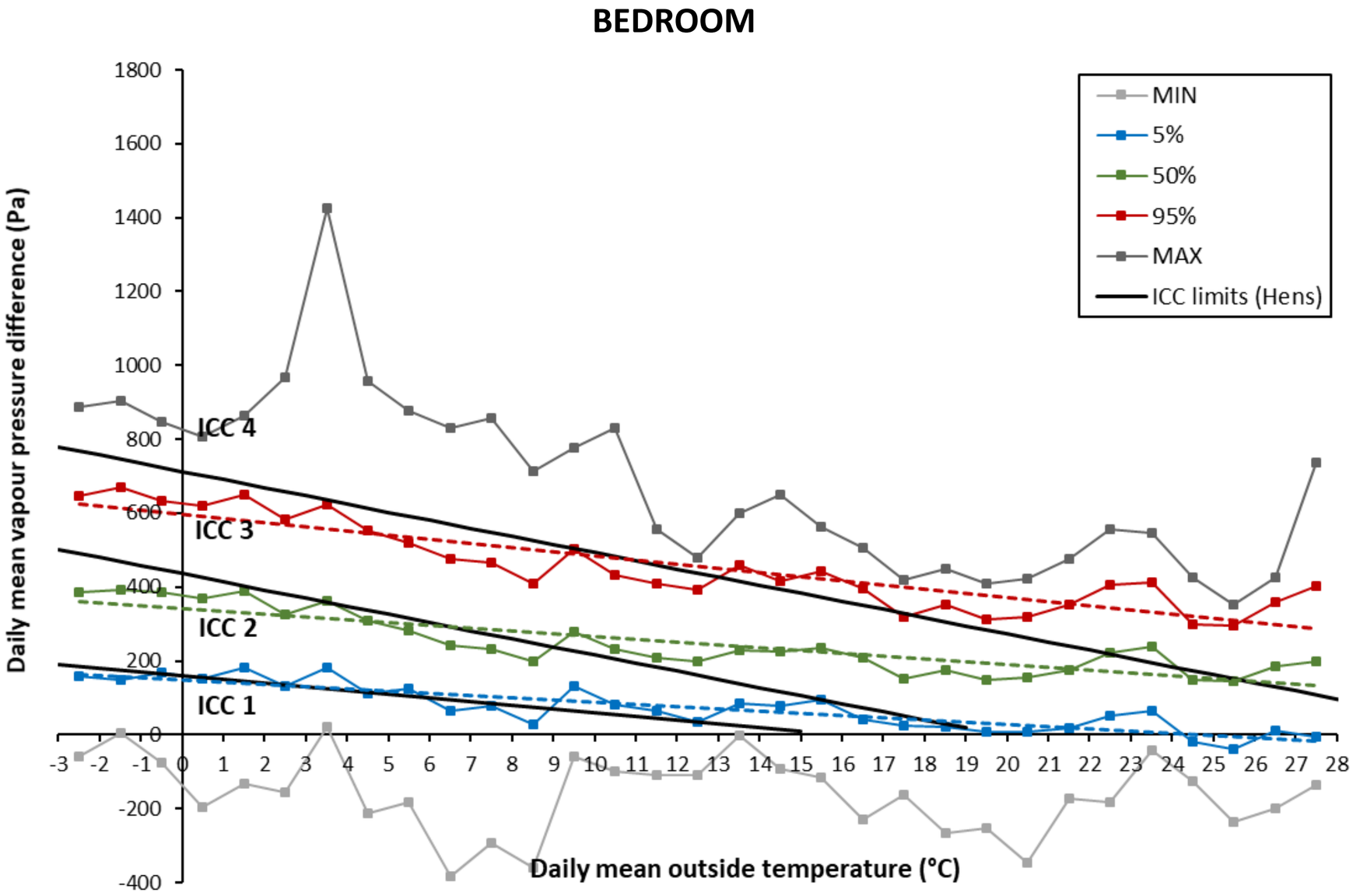
TYPICAL INDOOR CLIMATE: ICC



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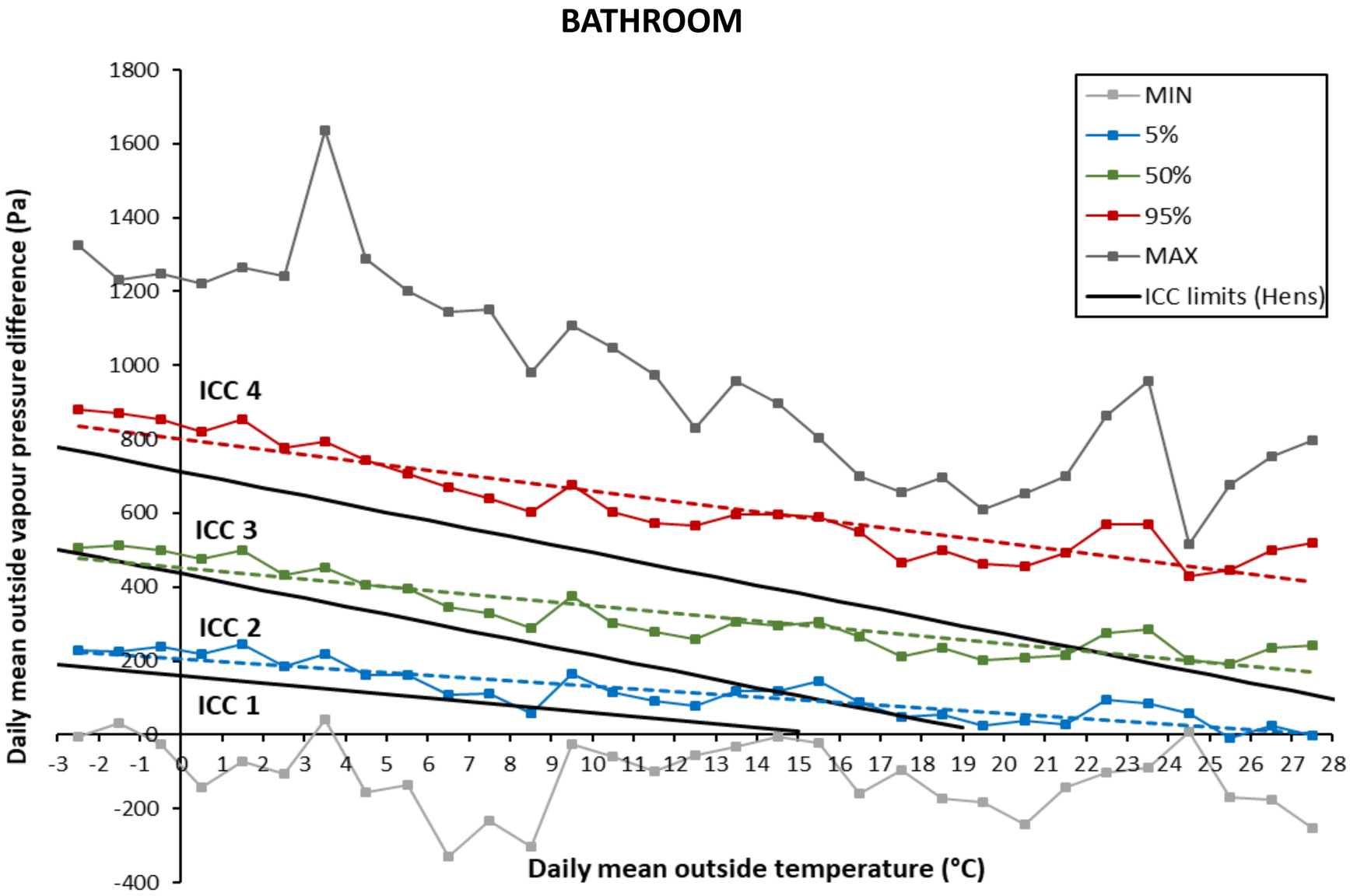
TYPICAL INDOOR CLIMATE: ICC



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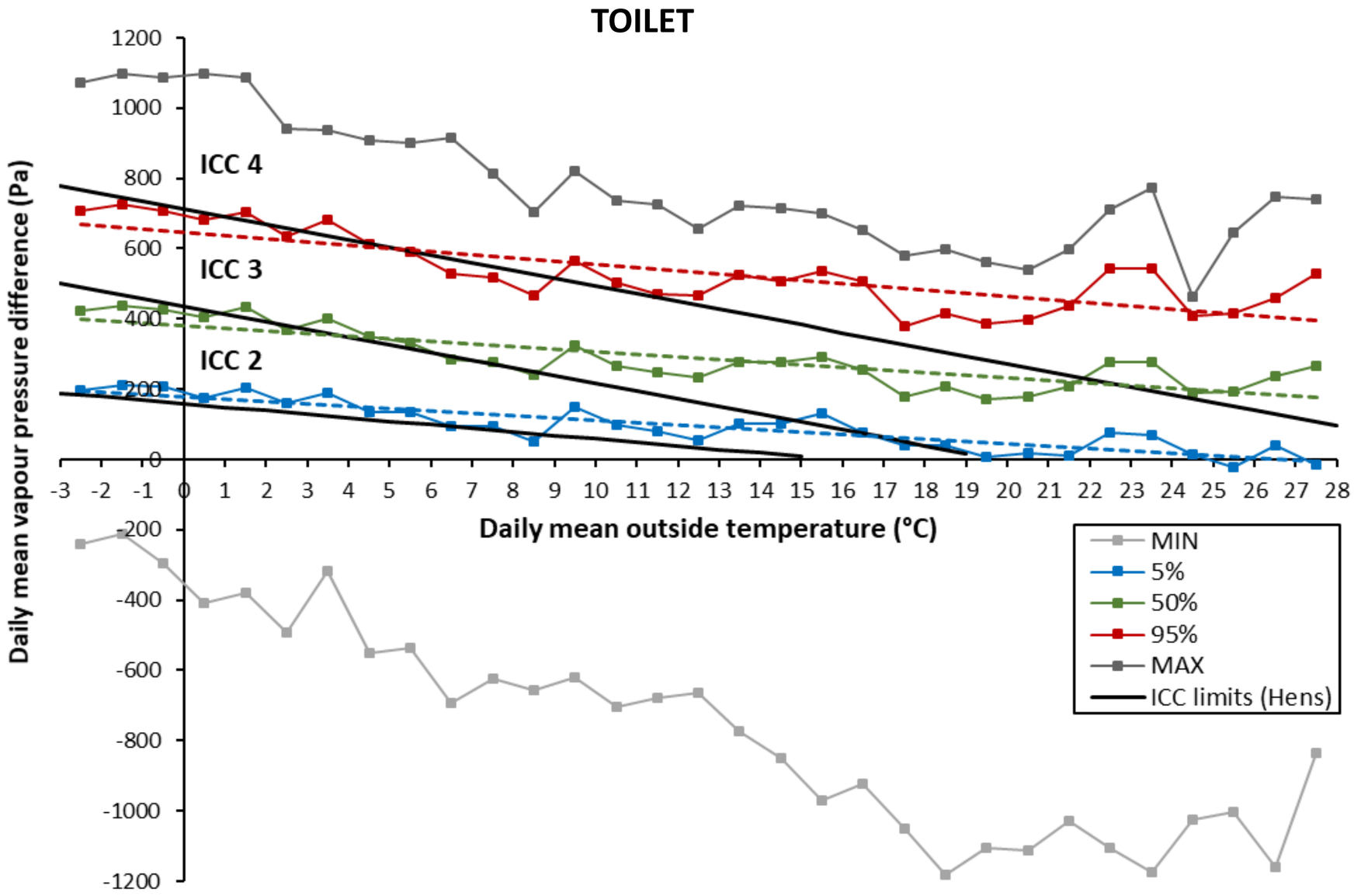
TYPICAL INDOOR CLIMATE: ICC



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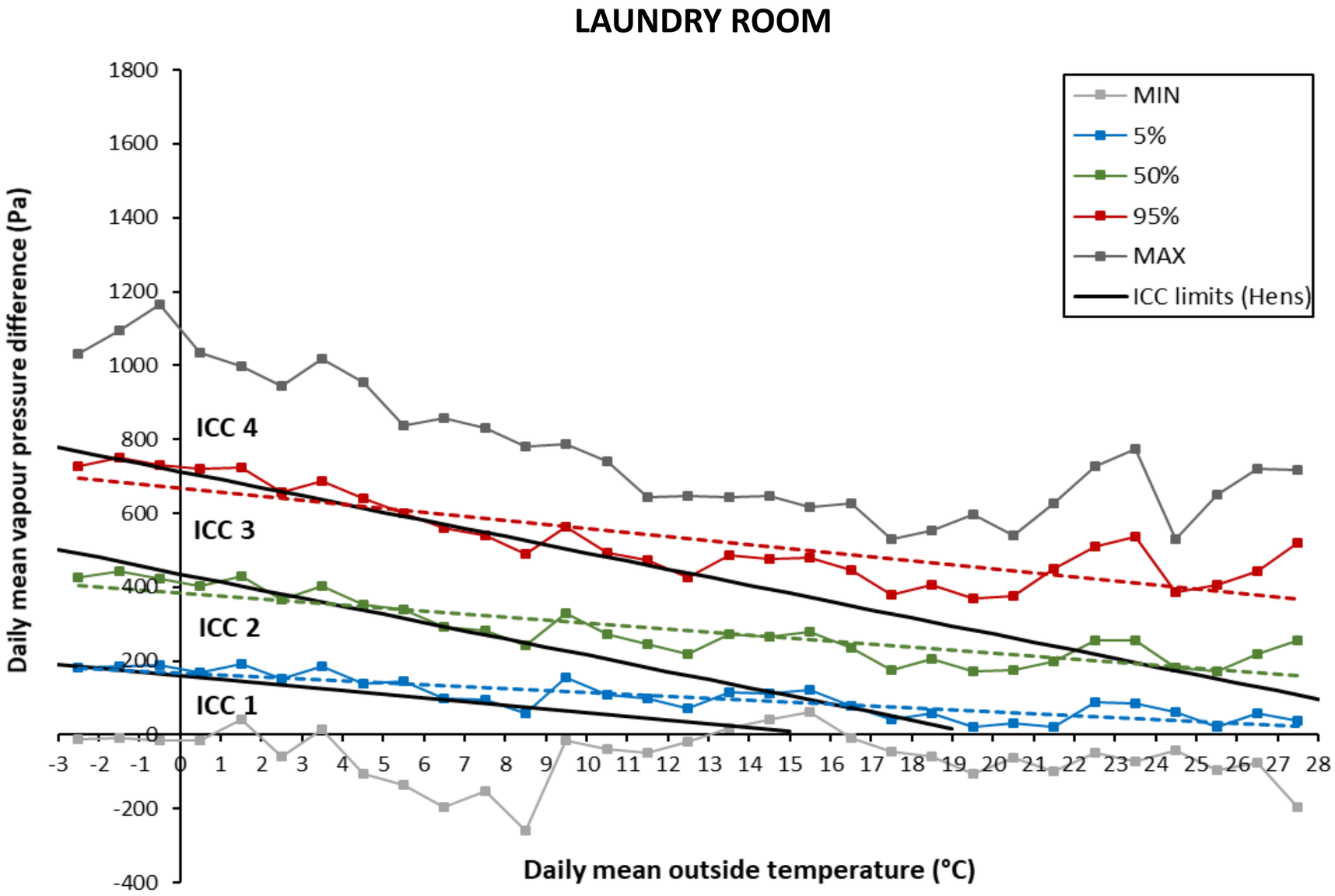
TYPICAL INDOOR CLIMATE: ICC



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TYPICAL INDOOR CLIMATE: ICC

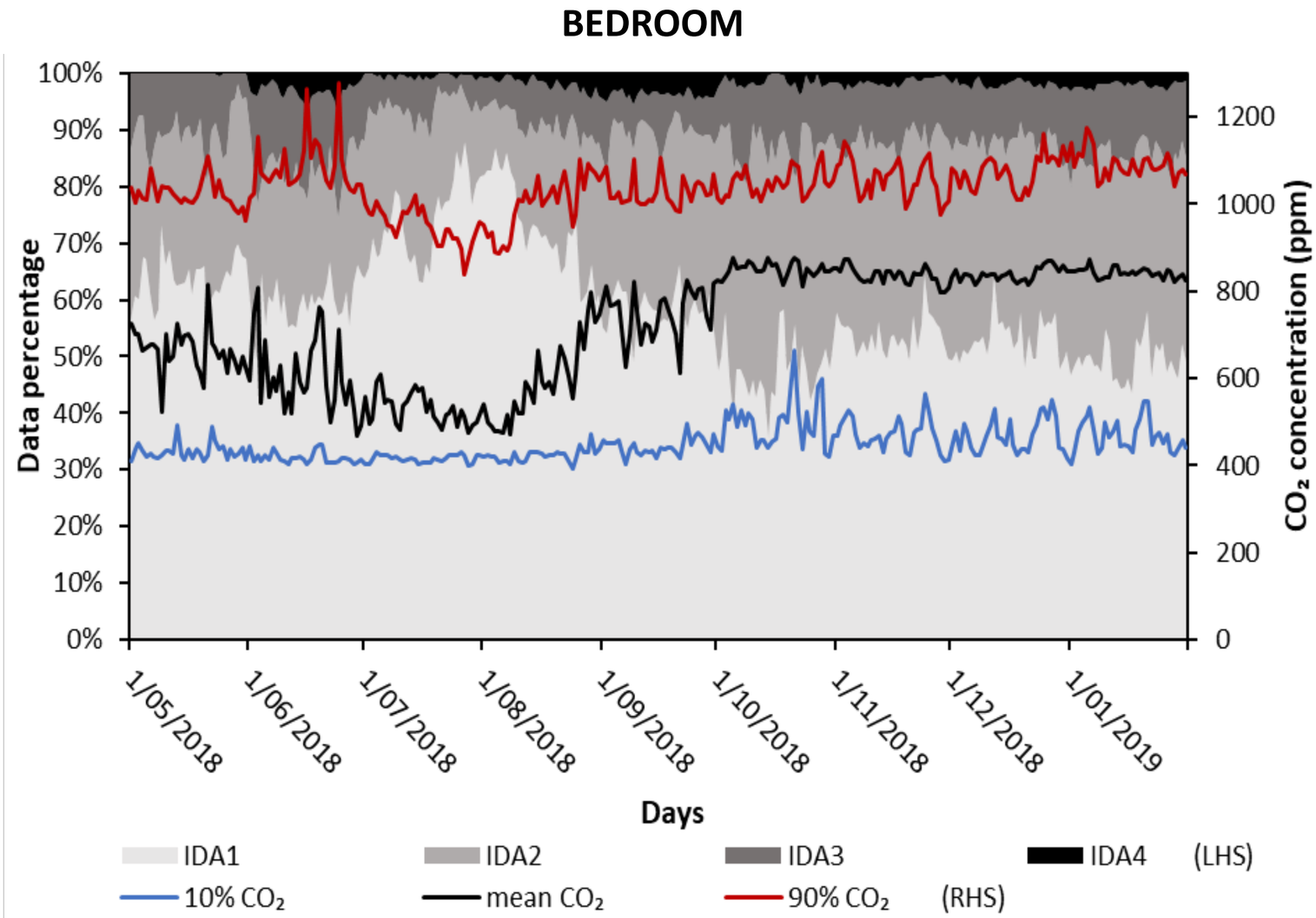
ICC	Hens 1992 (355 weekly mean data, r² = 0,25)	
	Limit $P_i - P_e$ (Pa)	Description
1	$<159 - 10\theta_e$	5% of dwellings less humid
2	$<436 - 22\theta_e$	50% of dwellings less humid
3	$<713 - 22\theta_e$	95% of dwellings less humid
4	$>713 - 22\theta_e$	5% of dwellings more humid

ICC limits according to Hens (1992)

ICC	Bedroom		Kitchen		Bathroom		Toilet		Laundry room	
	Limit $P_i - P_e$ (Pa)	R^2	$P_i - P_e$ (Pa)	R^2	Limit $P_i - P_e$ (Pa)	R^2	Limit $P_i - P_e$ (Pa)	R^2	Limit $P_i - P_e$ (Pa)	R^2
1	$<148,73 - 6,02\theta_e$	0,77	$<168,76 - 6,08\theta_e$	0,77	$<205,85 - 7,38\theta_e$	0,80	$<178,37 - 6,74\theta_e$	0,80	$<167,69 - 5,21\theta_e$	0,74
2	$<341,65 - 7,63\theta_e$	0,75	$<349,07 - 7,50\theta_e$	0,73	<452,80 - 10,34x	0,83	$<382,11 - 7,48\theta_e$	0,69	$<385,35 - 8,16\theta_e$	0,75
3	$<597,42 - 11,33\theta_e$	0,80	$<600,87 - 11,03\theta_e$	0,74	$<800,30 - 14,04\theta_e$	0,85	$<648,15 - 9,13\theta_e$	0,63	$<667,72 - 10,94\theta_e$	0,69
4	$>597,42 - 11,33\theta_e$	0,80	$>600,87 - 11,03\theta_e$	0,74	$>800,30 - 14,04\theta_e$	0,85	$>648,15 - 9,13\theta_e$	0,63	$>667,72 - 10,94\theta_e$	0,69

ICC limits according to the data of Healthbox 3.0 by Renson (2018-2019)

TYPICAL INDOOR CLIMATE: IDA CLASSES



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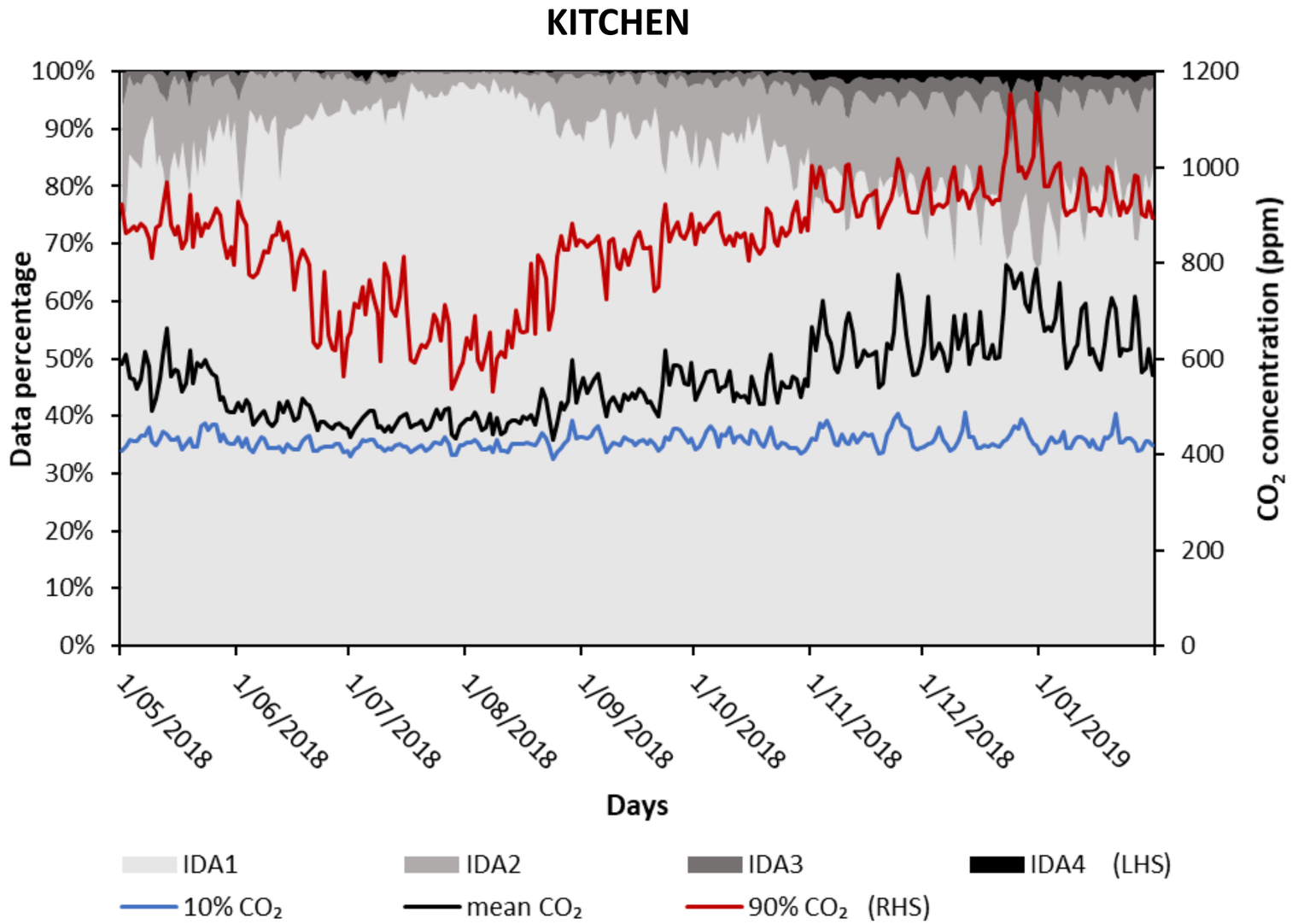
TYPICAL INDOOR CLIMATE: IDA CLASSES



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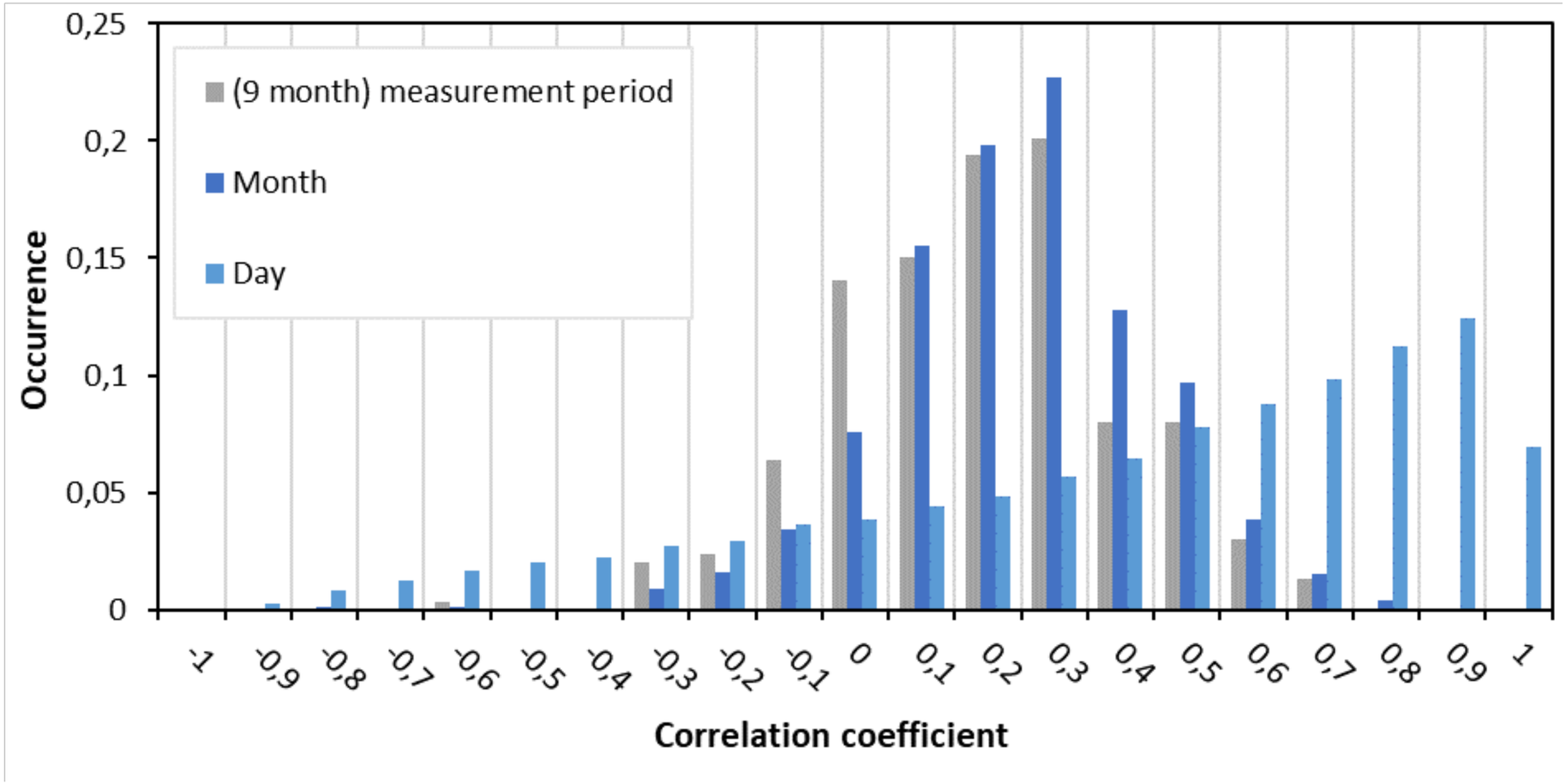
POSSIBLE OPTIMISATIONS

- Correlation CO2 and humidity
- Correlation humidity in dry and wet rooms

CORRELATION CO2 – HUMIDITY



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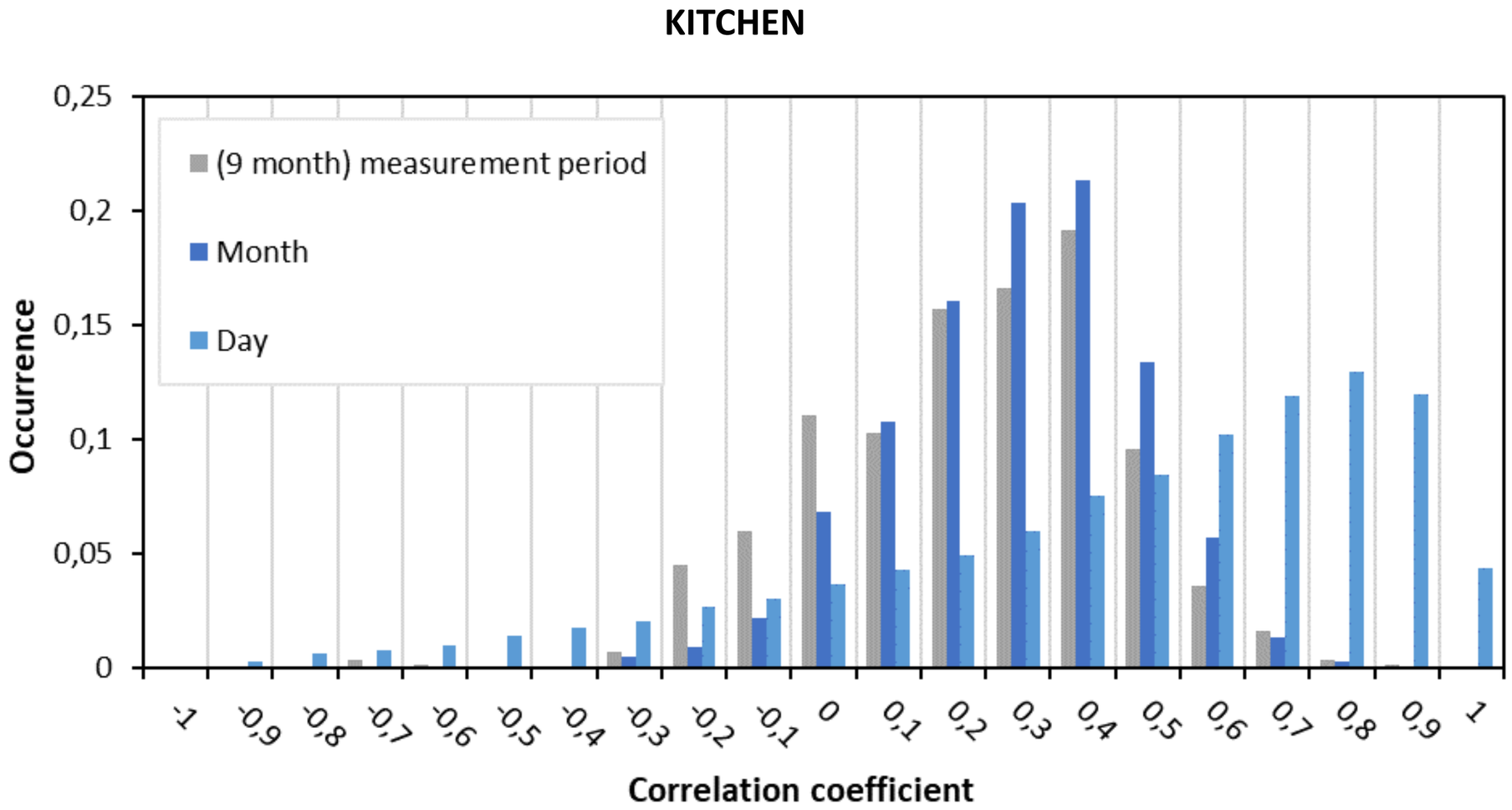
CORRELATION CO2 – HUMIDITY



CORRELATION HUMIDITY IN DRY & WET ROOMS

- Not a compatible analysis for Healthbox 3

- Healthbox 3: humidity sensors in both dry and wet rooms are relevant

CONCLUSION

GLOBAL CONCLUSION

- Usage patterns of the ventilation and the indoor climate characteristics show the **effectiveness** of demand controlled ventilation
- **Good air quality and comfort** with a limited time of active ventilation
- **ICC boundaries updated**, applicable for recent dwellings
- Limited correlation, **humidity** controlled ventilation **not** an **equivalent** alternative for **CO2** controlled ventilation in dry rooms
- System can **detect risks** and allows **proactive remediation**

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