OVERZICHT VAN INDOOR AIR 2022 KUOPIO - FINLAND

ISIAQ.NL SYMPOSIUM 2022 – GEZONDHEID & COMFORT |

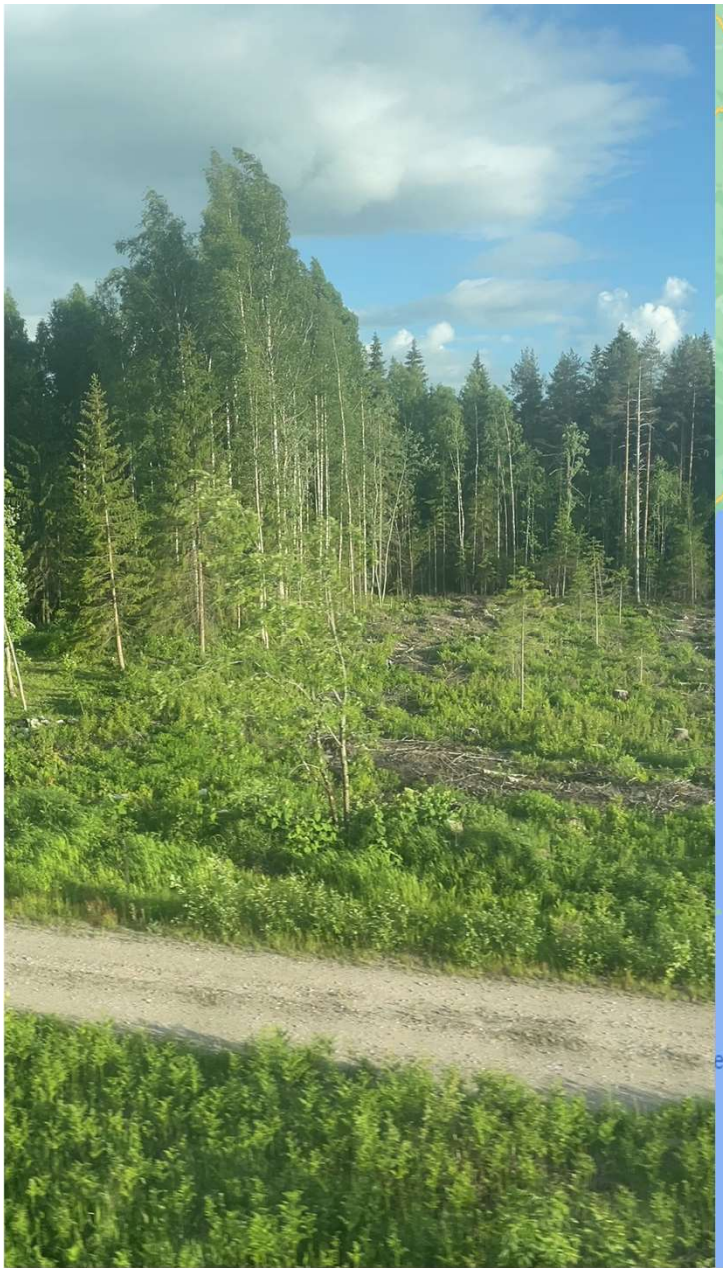
PIET JACOBS

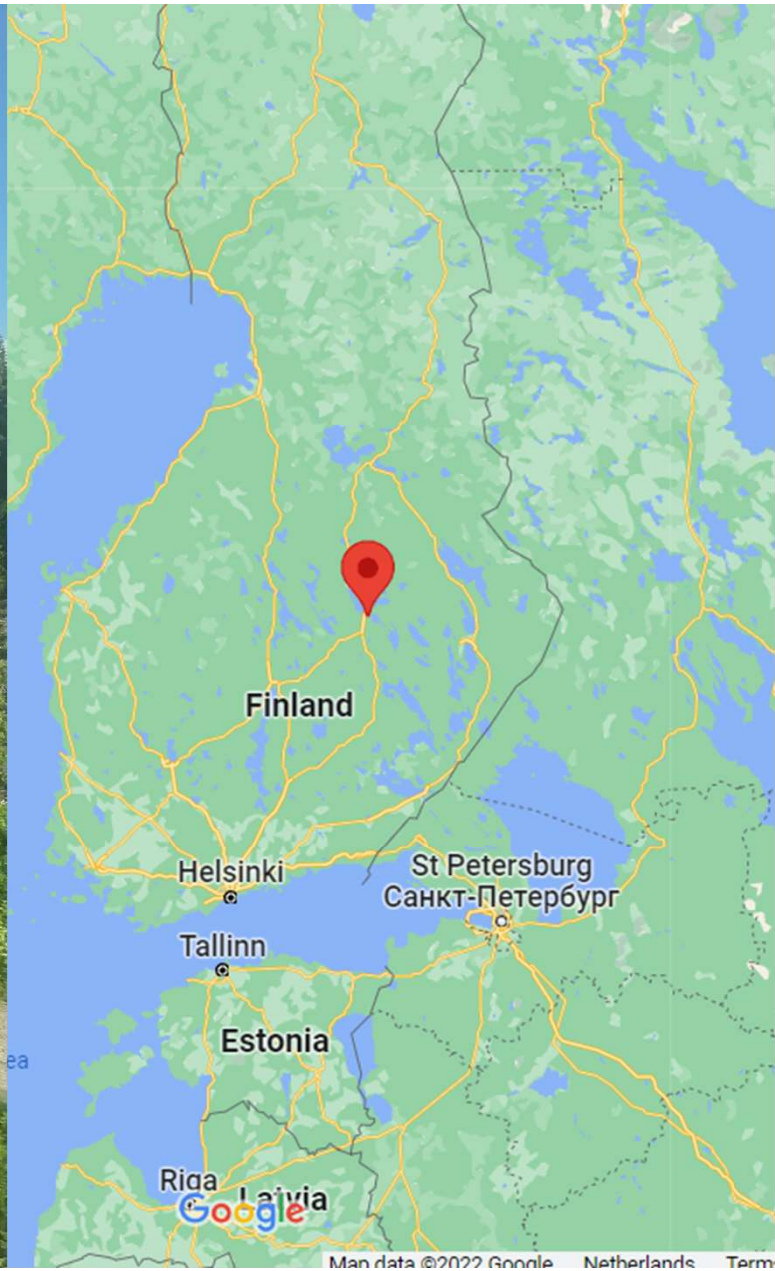
Healthy People in Healthy Indoor Environments
INDOOR AIR 2022
June 12th to 16th
Kuopio FINLAND

KUOPIO

Twee maal vliegen!

Of 1 x vliegen + 400 km trein





EERSTE GROTE CONFERENTIE NA COVID: 602 DEELNEMERS

NL delegatie:

Philomena Bluijssen	TUD
Piet Jacobs	TNO
Twan van Hooff	TUE
Tim de Graaff	Philips
?	

Country	n	Country	n	Country	N
Finland	138	Netherlands	8	Iran	2
United States	73	Luxembourg	7	Latvia	2
Japan	46	Hong Kong	6	Poland	2
France	41	Norway	6	Slovakia	2
China	38	Australia	5	Austria	1
Germany	37	Italy	5	Czech Repuplic	1
United Kingdom	33	Ireland	4	Estonia	1
Denmark	31	Singapore	4	Etiopia	1
Sweden	19	Slovenia	4	Greece	1
South Korea	18	Thaiwan	4	Iceland	1
Canada	17	Cyprus	3	Indonesia	1
Portugal	13	India	3	New Zealand	1
Belgium	11	Lithuania	3	Thailand	1
Switzerland	9	Spain	3		

ONDERWERPEN

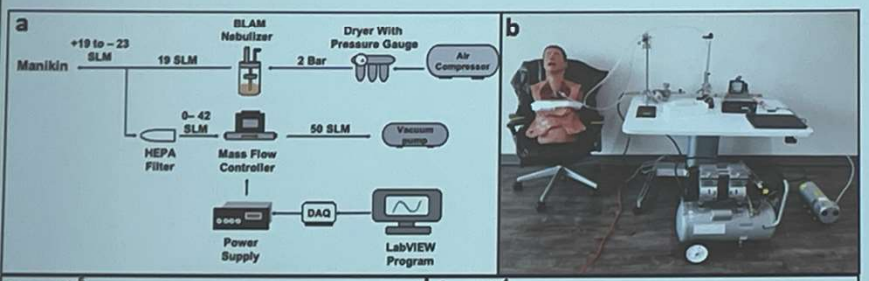
1. Effect van ventilatie en luchtreiniging in klaslokalen
2. Nationaal onderzoek naar ventilatie en aerolsol verspreiding in openbaar vervoer, vliegtuigen
3. Bijproducten bij gebruik van luchtreinigers
4. How I was infected during clima 2022 conference in Rotterdam

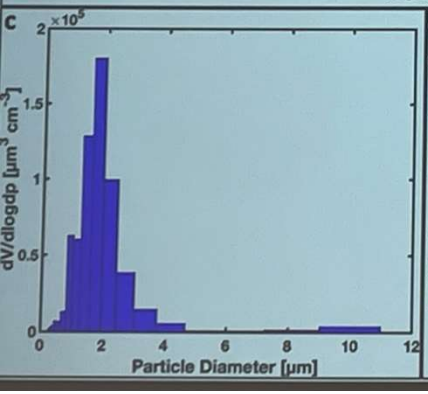
WELL LIVING LAB

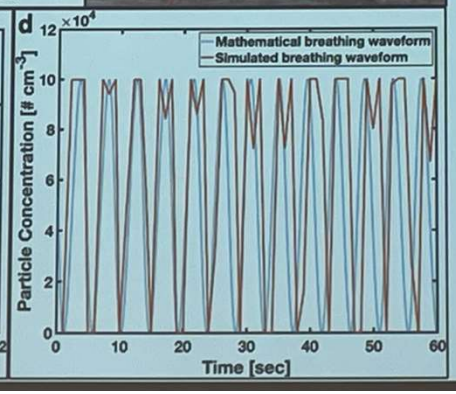
Localized and Whole-Room Effects of Portable Air Filtration Units on Aerosol Particle Deposition and Concentration in a Classroom Environment

Meng Kong, Ph.D., Linhao Li, M.S., Stephanie M. Eilts, M.S., Li Li, Ph.D.
Christopher J. Hogan, Ph.D., Zachary C. Pope, Ph.D.

Methods







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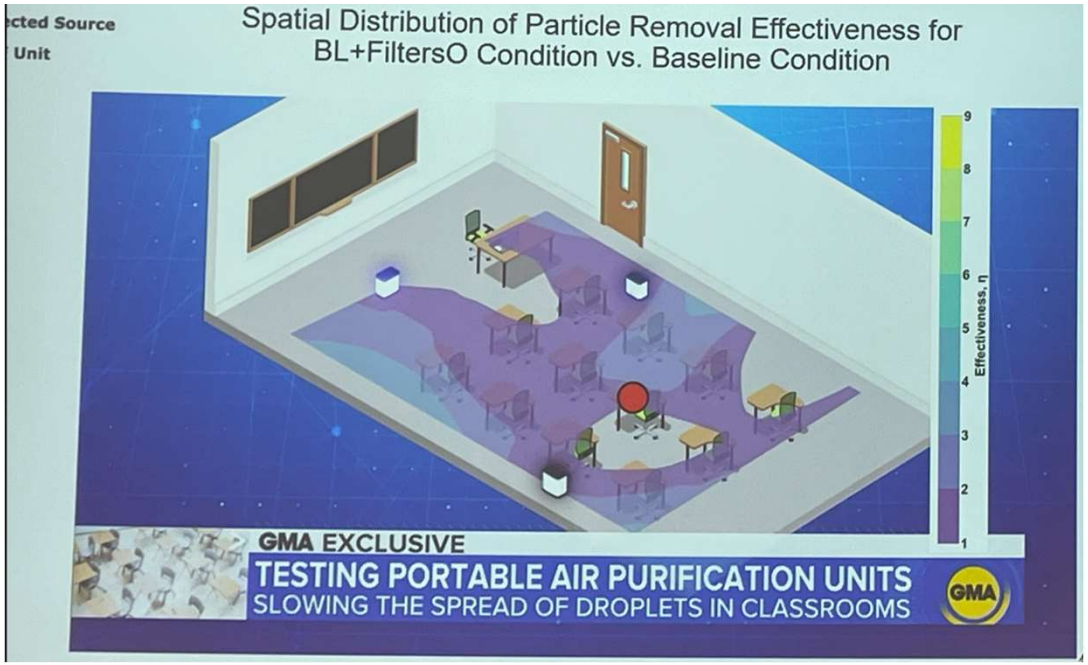


Conclusions and Limitations

Conclusion:

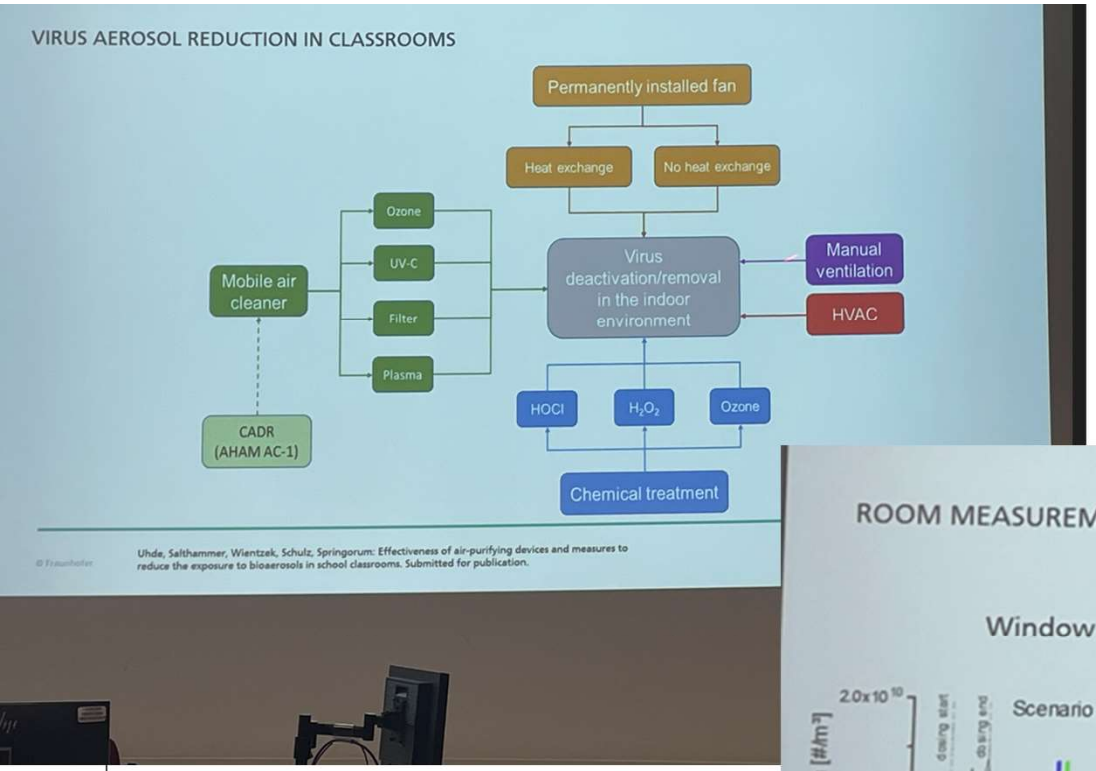
- PAF units can supplement the HVAC system and assist in reducing particle concentration and deposition if properly placed and sized for the room
- Particle exposure risk within ~2 m of infectious source is minimally influenced by the HVAC or PAF units

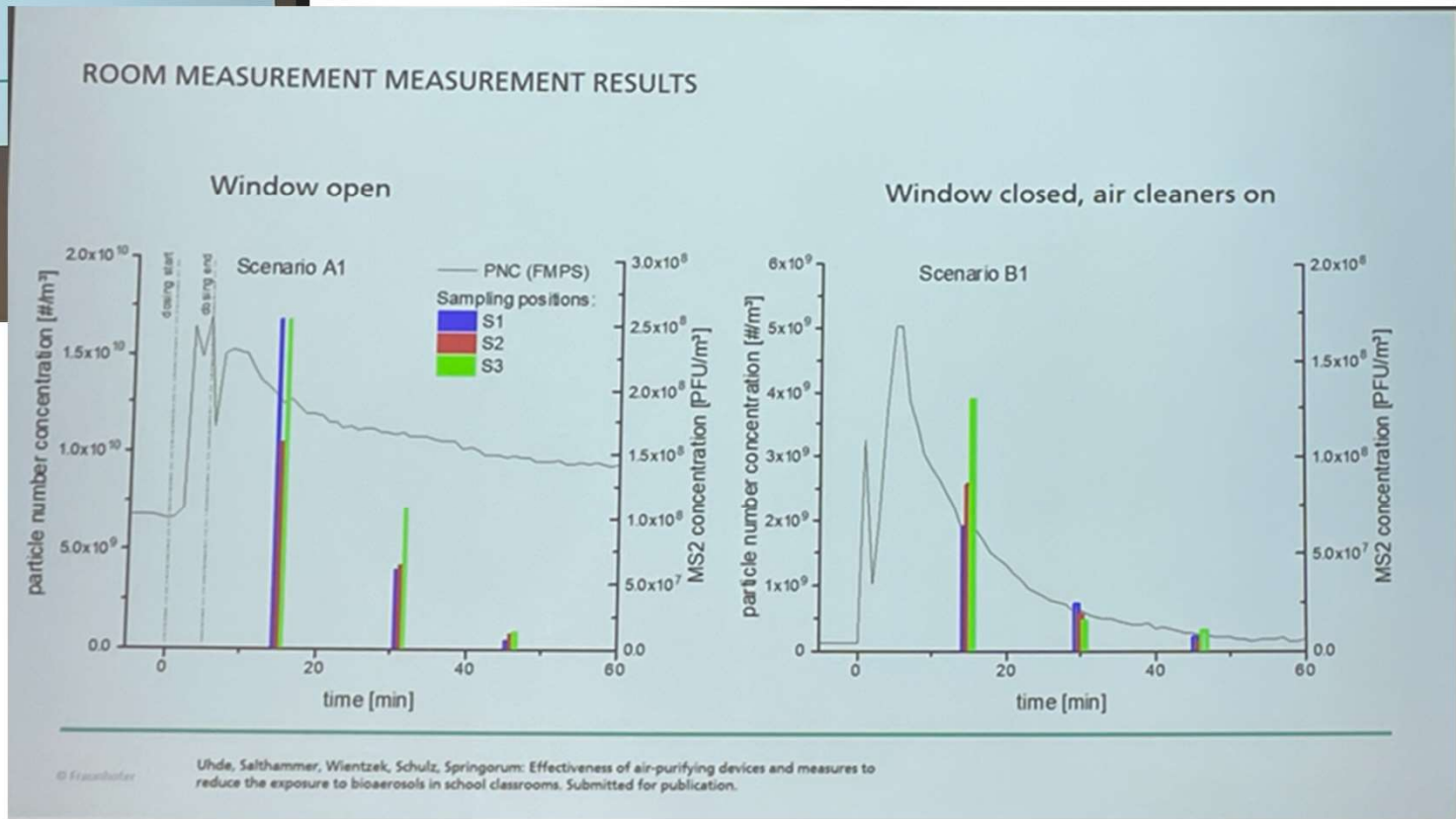
Limitations:

- Thermal effects of the human body not investigated (e.g., thermal plume, higher temperature of exhaled air)
- Excluded other occupants (only one manikin in this study; no other movement in room)
- HVAC operational mode varied (heating vs. cooling)

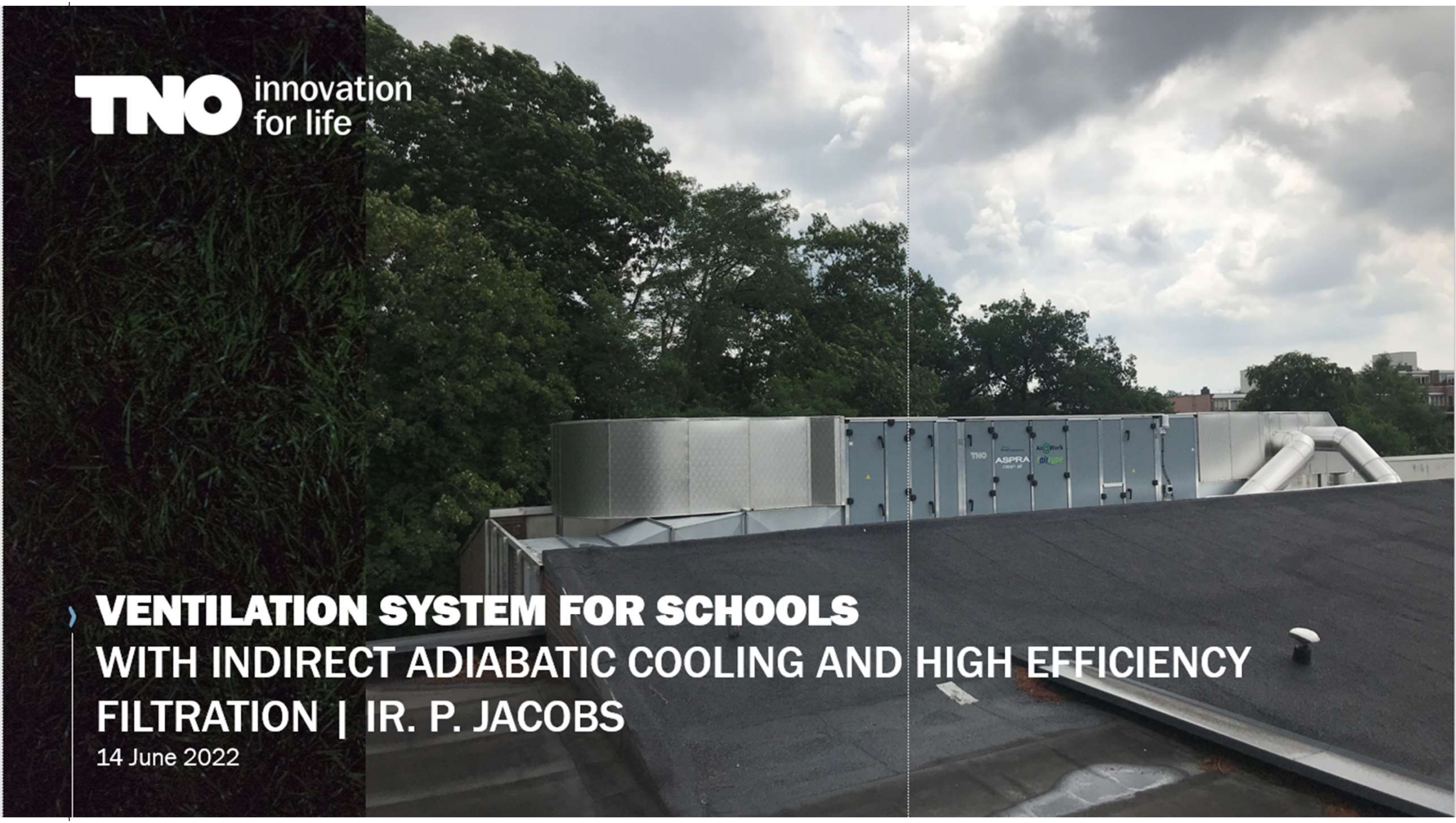
AIR-CLEANERS FOR VIRUS REMOVAL IN CLASSROOMS: TEST CHAMBER VS. REAL-WORLD ROOM, ERIK UHDE (1432/1637) FRAUNHOFER

Effect of ozon from outdoor air on deactivation of MS2 virus?





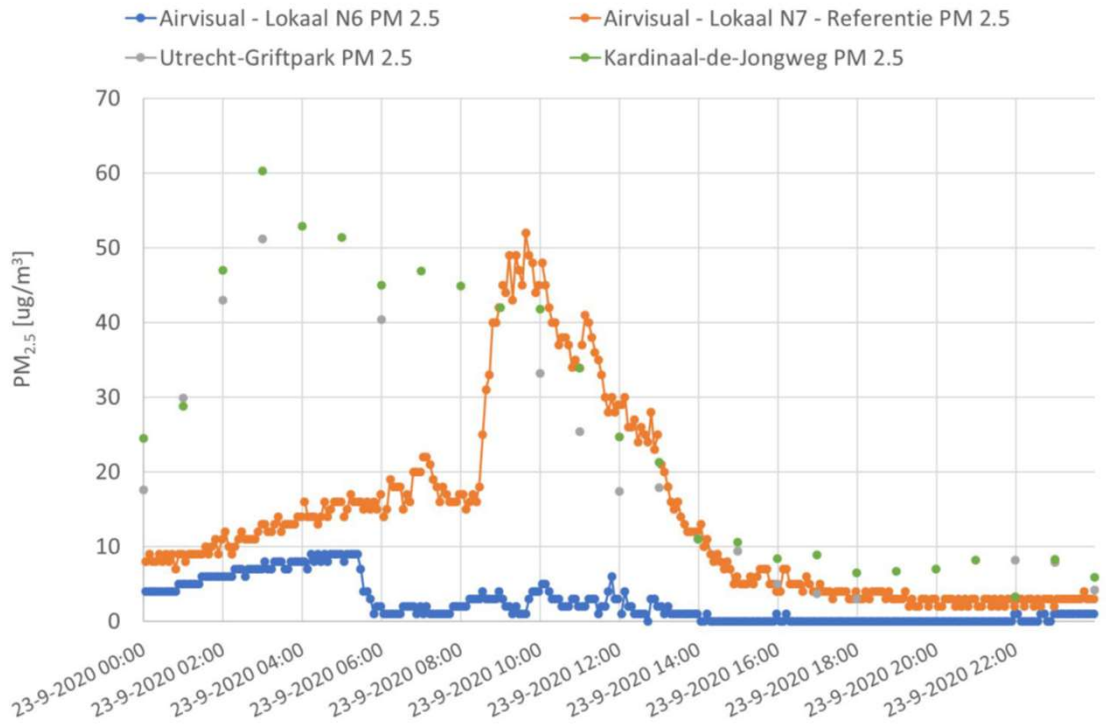
TNO innovation for life



VENTILATION SYSTEM FOR SCHOOLS WITH INDIRECT ADIABATIC COOLING AND HIGH EFFICIENCY FILTRATION | IR. P. JACOBS

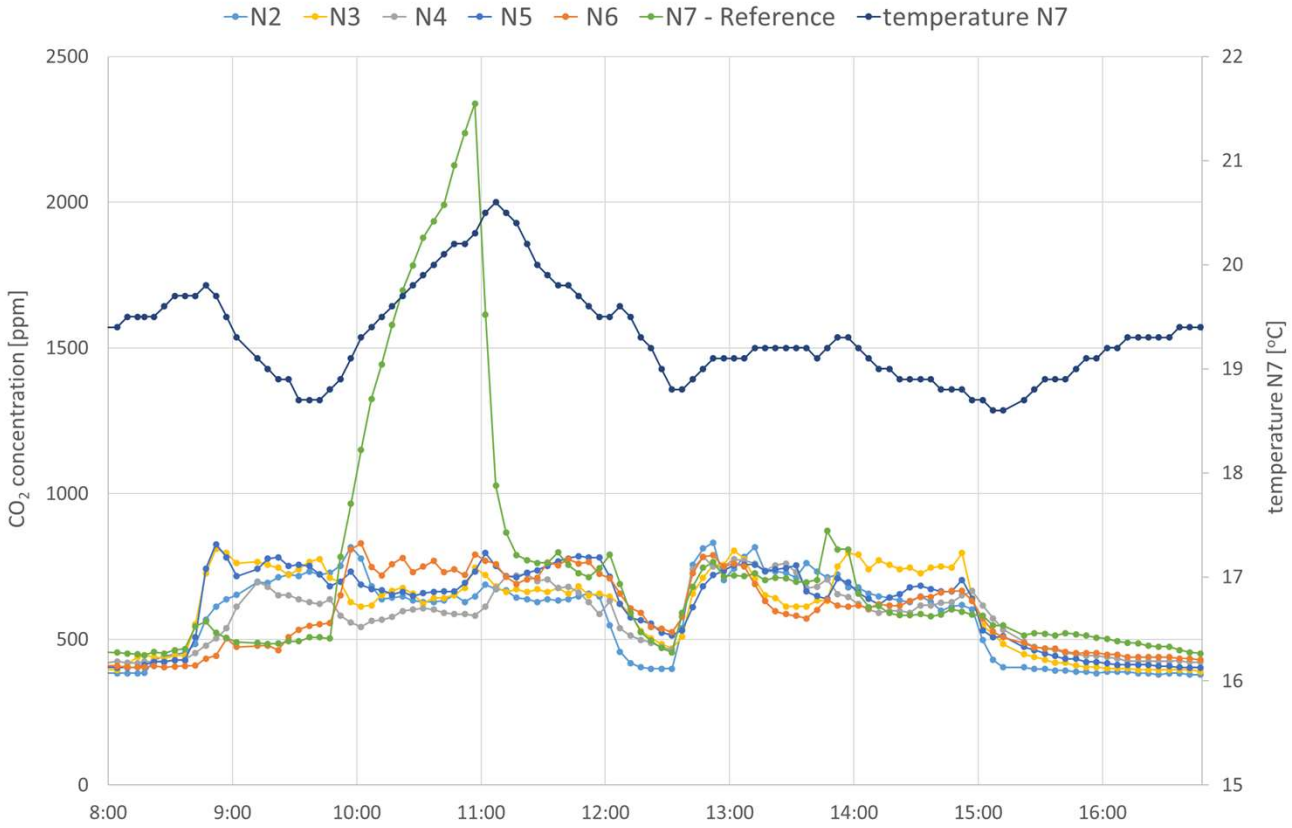
14 June 2022

$PM_{2.5}$ IN REFERENCE ROOM = OUTSIDE



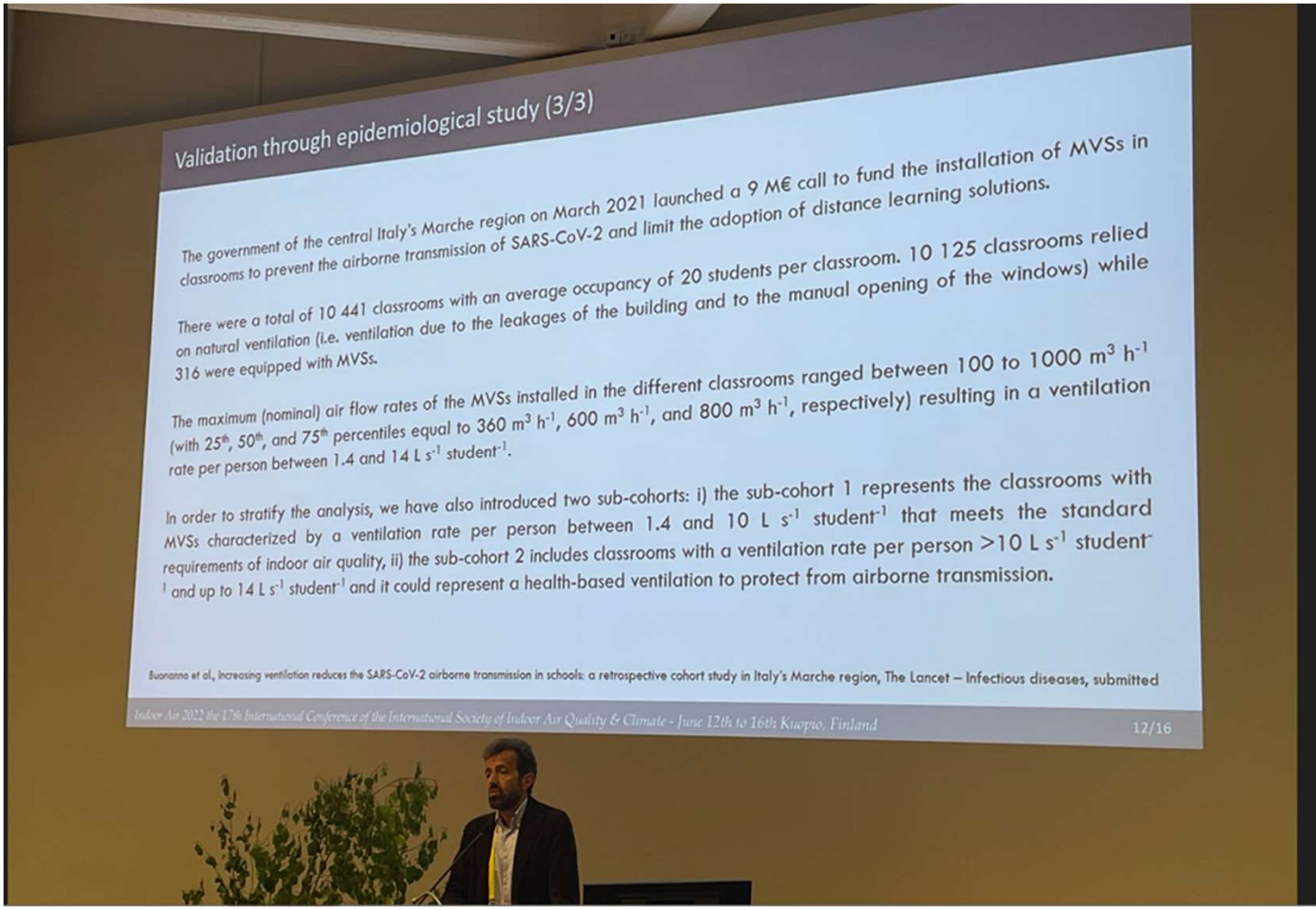
70 - 96% lower $PM_{2.5}$ concentration in SchoolVent class room compared to reference class room

DILEMMA BIJ NATUURLIJK VENTILEREN: GOED VENTILEREN EN KOUD OF RAAM DICHT EN COMFORTABEL?



VENTILEREN IS BELANGRIJK, MAAR HET THERMISCH COMFORT OP DE BOOTTOCHT OOK...

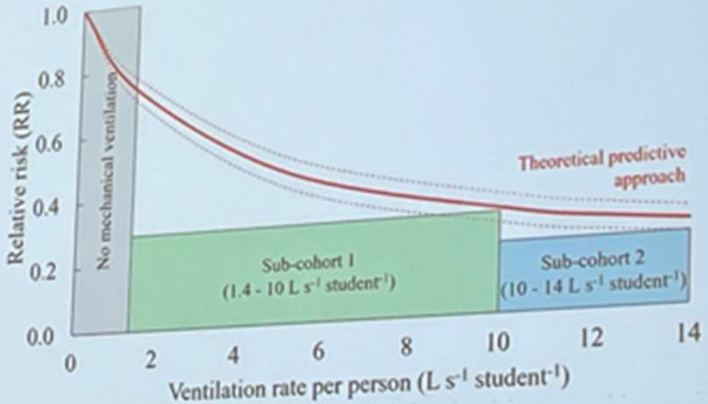
BUONANNO, KEYNOTE



NB: IN ITALIË DRAGEN KINDEREN OP SCHOOL ALTIJD MONDKAPJES

Validation through epidemiological study (3/3)

Parameter	Period of investigation	Classrooms without MVS	Classrooms with MVS
Incidence cases	Sept. 13th - Dec. 23rd, 2021	1272	18
	Jan. 7th - 31st, 2022	1818	13
	Entire period	3090	31
Incidence proportion (per 1 000 students)	Sept. 13th - Dec. 23rd, 2021	6.3	2.8
	Jan. 7th - 31st, 2022	9.0	2.1
	Entire period	15.3	4.9
Incidence proportion ratio	Sept. 13th - Dec. 23rd, 2021	0.45	
	Jan. 7th - 31st, 2022	0.23	
	Entire period	**0.32**	

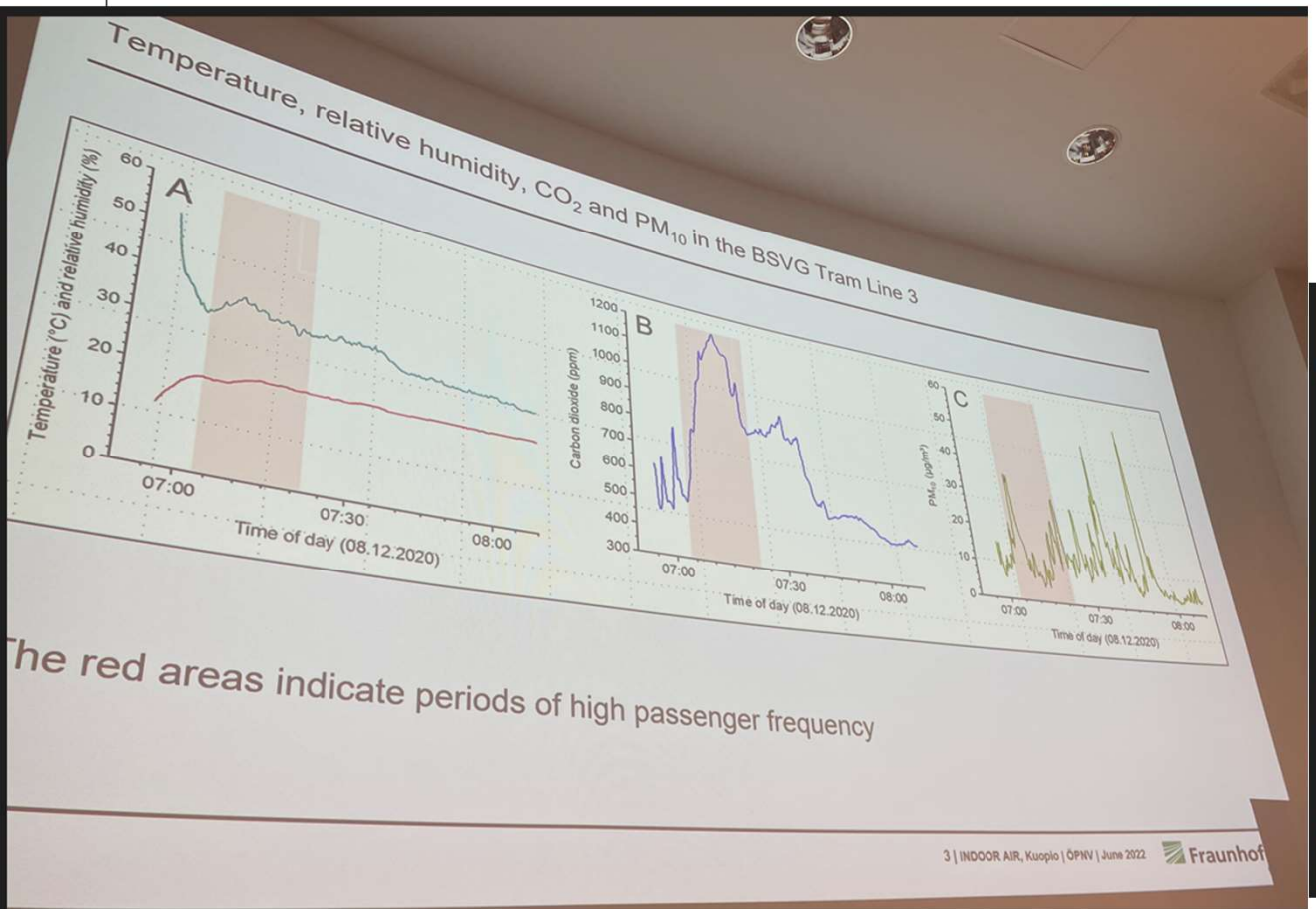


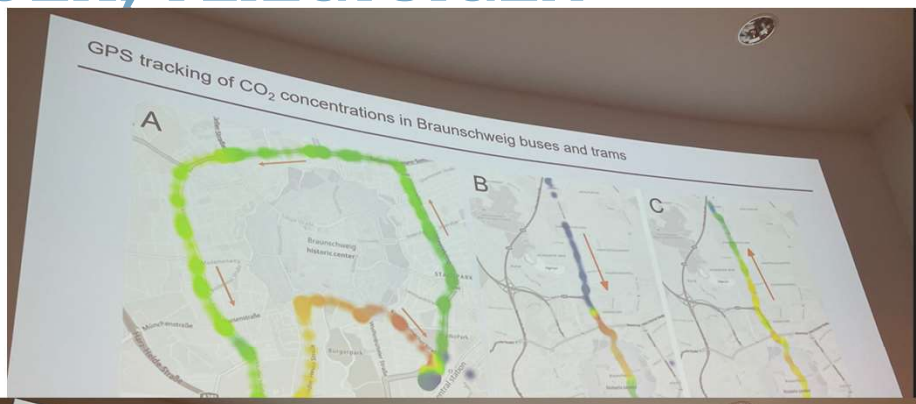
The agreement between the results obtained from the retrospective cohort study and values calculated through the predictive represents a validation of the approach through a retrospective cohort study.

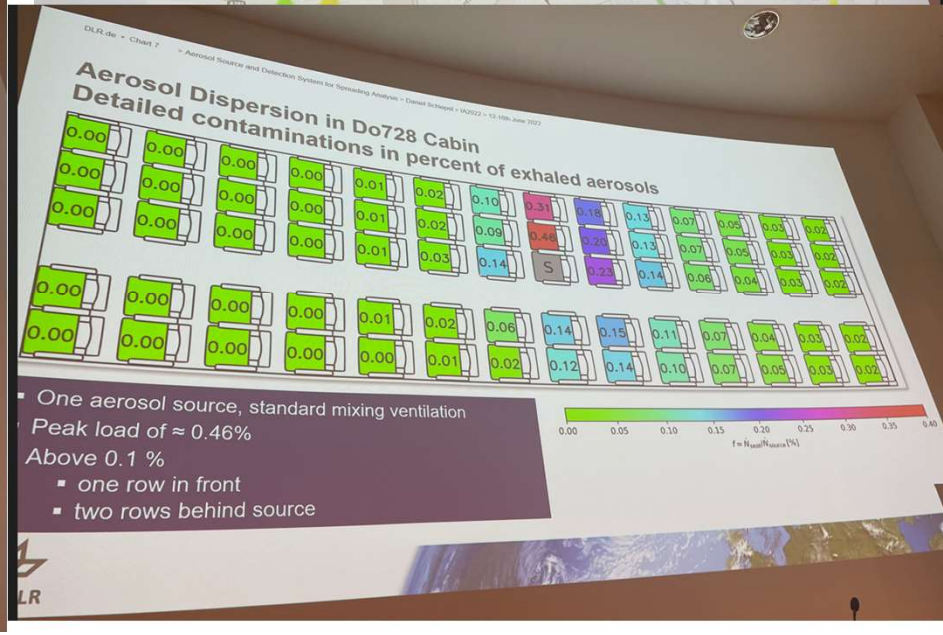
Such validations confirm the possibility of extending the use of the approach, once the scenario has been defined, to any indoor environment of interest in addition to school classrooms and providing predictive estimates of the effectiveness of the ventilation for different exposure scenarios and variants of concern.

Buonanno et al., Increasing ventilation reduces the SARS-CoV-2 airborne transmission in schools: a retrospective cohort study in Italy's Marche region, The Lancet – Infectious diseases, submitted

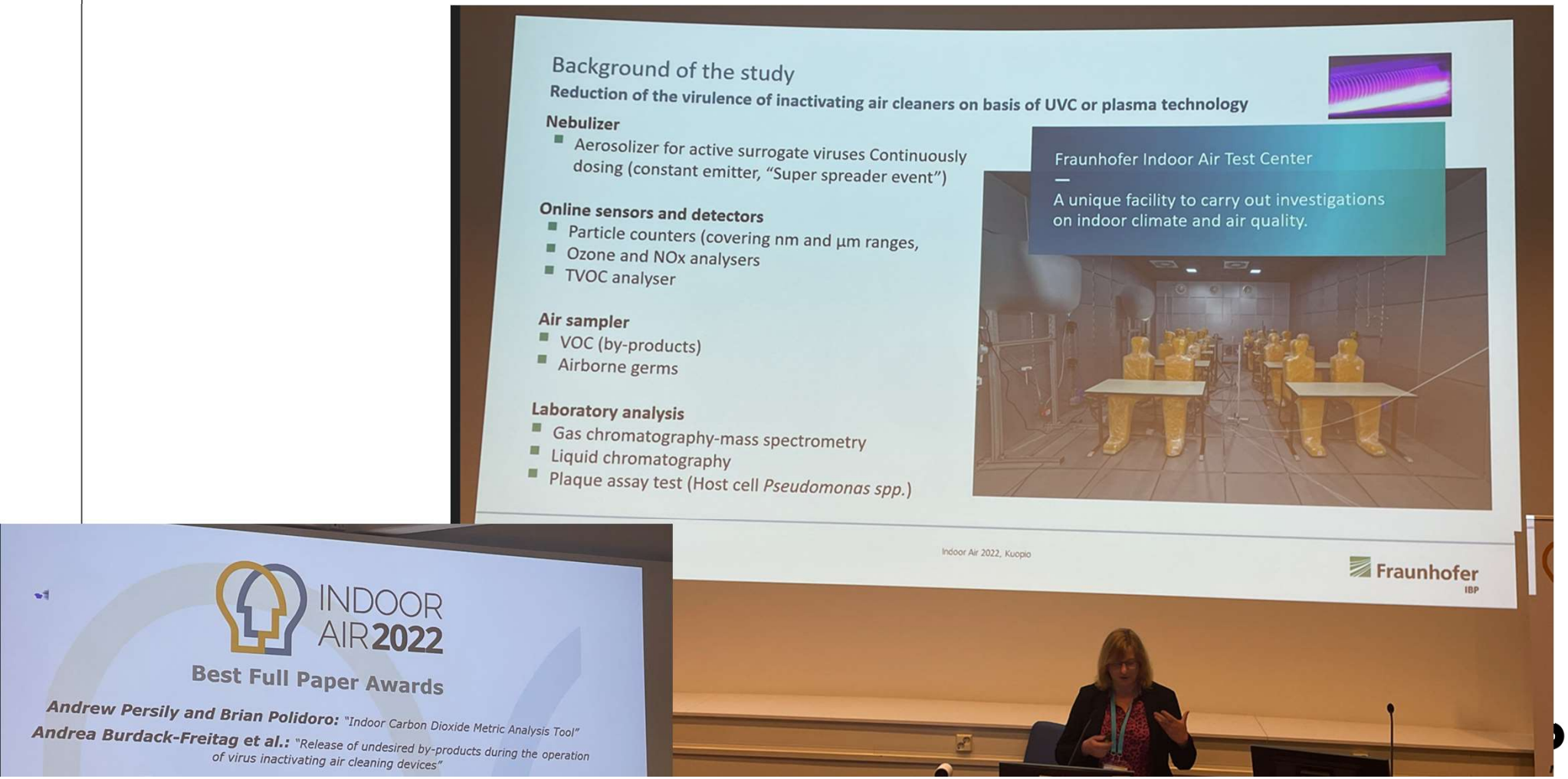
NATIONAAL ONDERZOEK NAAR VENTILATIE EN AEROLSOL VERSPREIDING IN OPENBAAR VERVOER, VLIEGTUIGEN







ANDREA BURDACK-FREITAG (1195): RELEASE OF UNDESIRED BY-PRODUCTS DURING THE OPERATION OF VIRUS INACTIVATING AIR CLEANING DEVICES



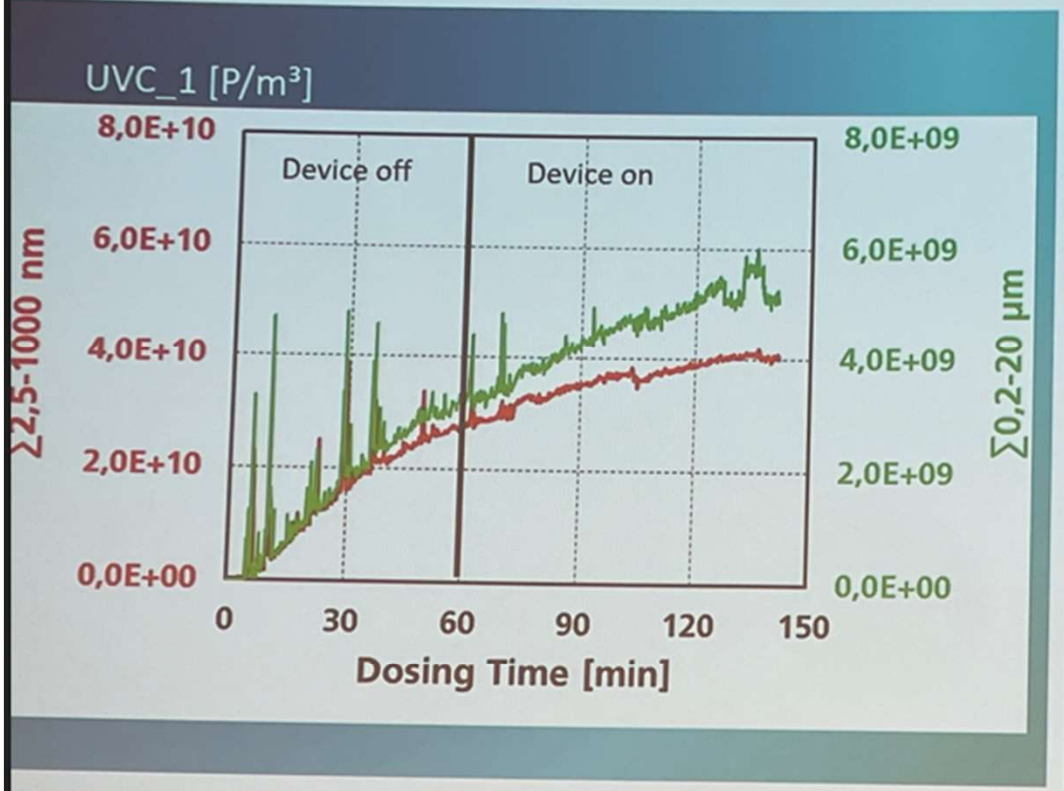
innovation for life

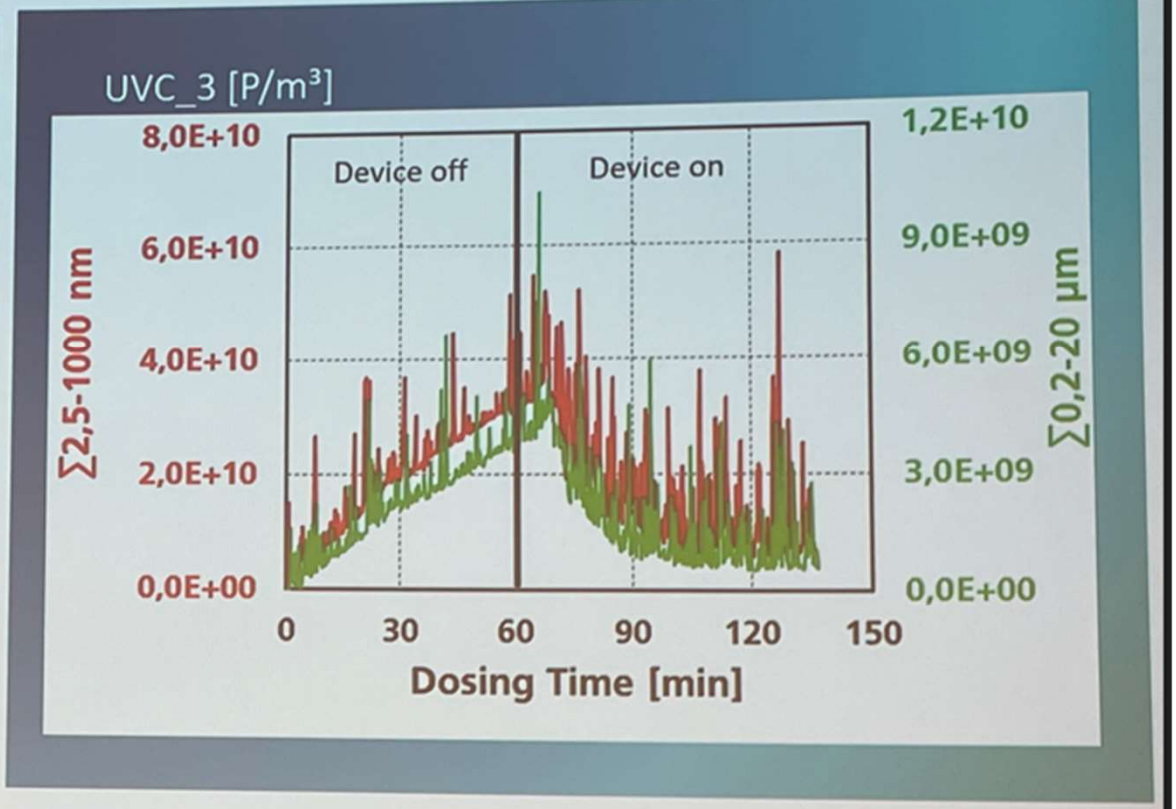
Particle distribution

UVC

Zonder deeltjes filter

Met HEPA filter

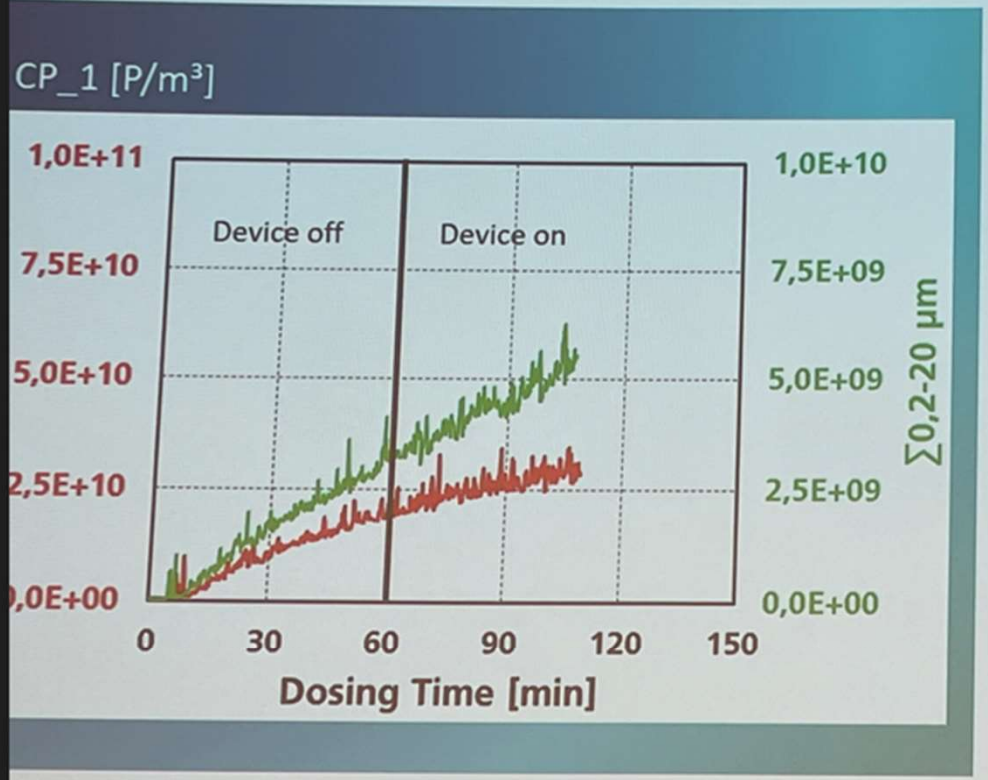


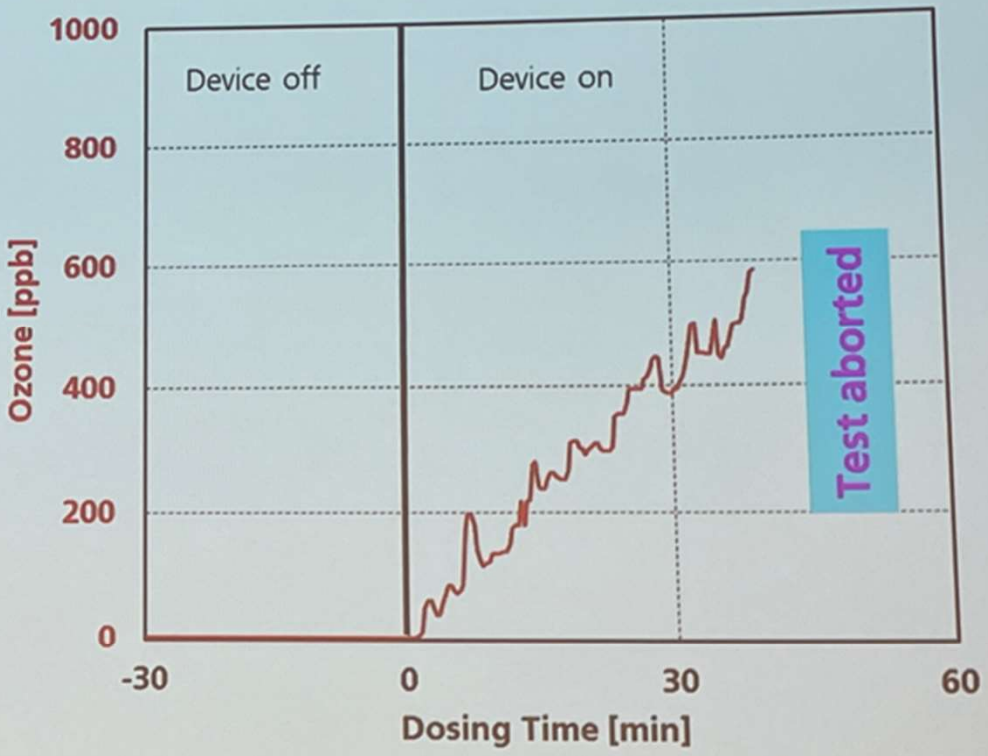


Plasma device CP_1

Device out of control!!!

No EU-OEL for ozone, 100 ppb (by end of 2005)
Odor threshold about 20 ppb





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GROTE VERSCHILLEN IN EFFECTIVITEIT

Table 1. Investigated air cleaner.

Device No [1]	Inactivating unit (additional filter technology)	Sound pressure level [db] [2]	Max. Power consumption [W] [2]	Measured flow rate [m³/h] [3]
	UVC-Technology:			
UVC_1	➢ UVC (without filter)	50	170	800
UVC_2	➢ UVC (coarse filter in front of the unit)	30 – 55	240	450
UVC_3	➢ UVC (coarse filter in front of and HEPA filter behind the unit)	25 – 45	110	1000
	Plasma Technology:			
CP_1	➢ Ionization (dialectical discharge without filter)	n. s.	25	400
CP_2	➢ Cold plasma (coarse filter in front of and behind the unit, activated carbon filter behind)	n. s.	n. s.	120
CP_3	➢ Cold plasma (coarse and HEPA filter in front of and activated carbon filter behind the unit)	30 – 50	75	400

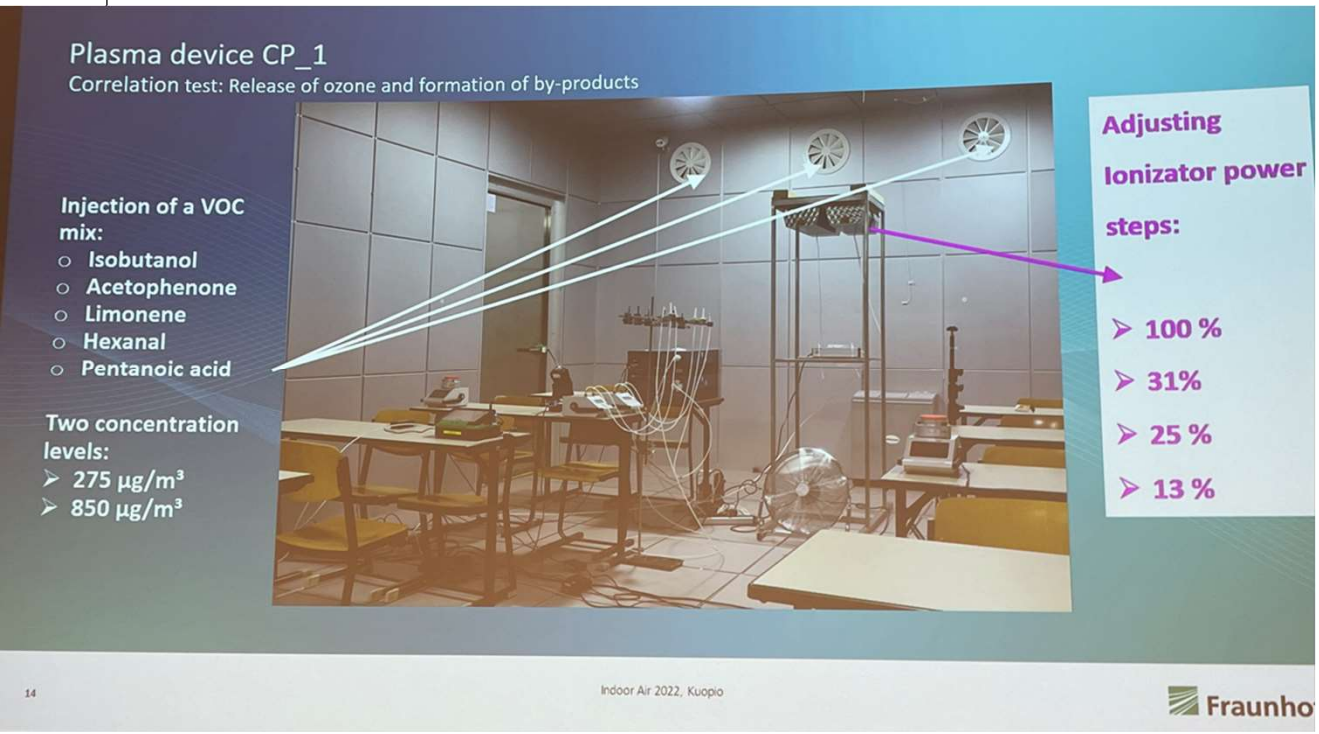
[1] Anonymized in order not to draw any conclusions about specific manufacturers
[2] Manufacturers specifications (if available), rounded values, n. s. – not specified
[3] Adjusted and measured at the air outlet during measurements, rounded values

Table 2. Virulence (constant injection).

Sampling time	Virulence [%] [1] of P1 (pfu/m³) [2]					
	UVC_1	UVC_2	UVC_3	CP_1	CP_2	CP_3
P1 maximum virus load	100 % ($3 * 10^5$)	100 % ($1*10^4$)	100 % ($1 * 10^6$)	100 % ($2 * 10^4$)	100 % ($1.5 * 10^6$)	100 % ($3 * 10^3$)
P2 30 min after device on	25 %	30 %	< 1 %	15 %	20 %	20 %
P3 1 h after device on	30 %	35 %	< 1 %	- [3]	50 %	< 5 %

[1] Results from fivefold determination, Rounded values: (P2)/(P1)*100; resp. (P3)/(P1)*100
[2] Rounded values of plaque forming unit's pfu related to 1 m³ sampling volume
[3] Test aborted for safety reasons

BIJ PLASMA VORMING VAN BIJPRODUCTEN O.A. FORMALDEHYDE



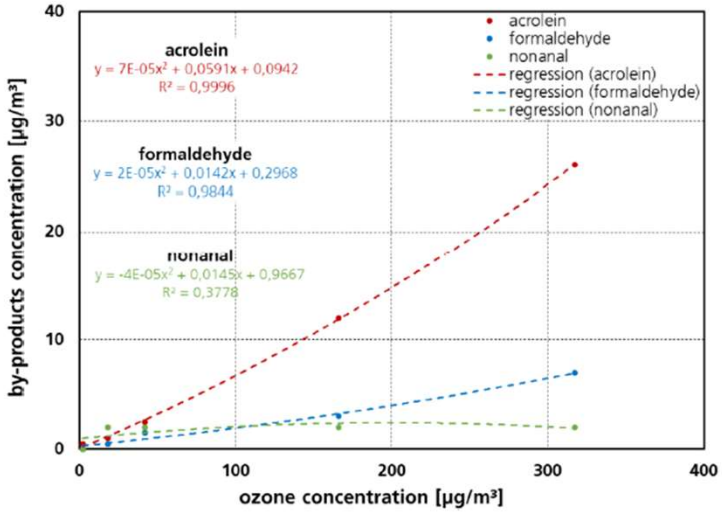
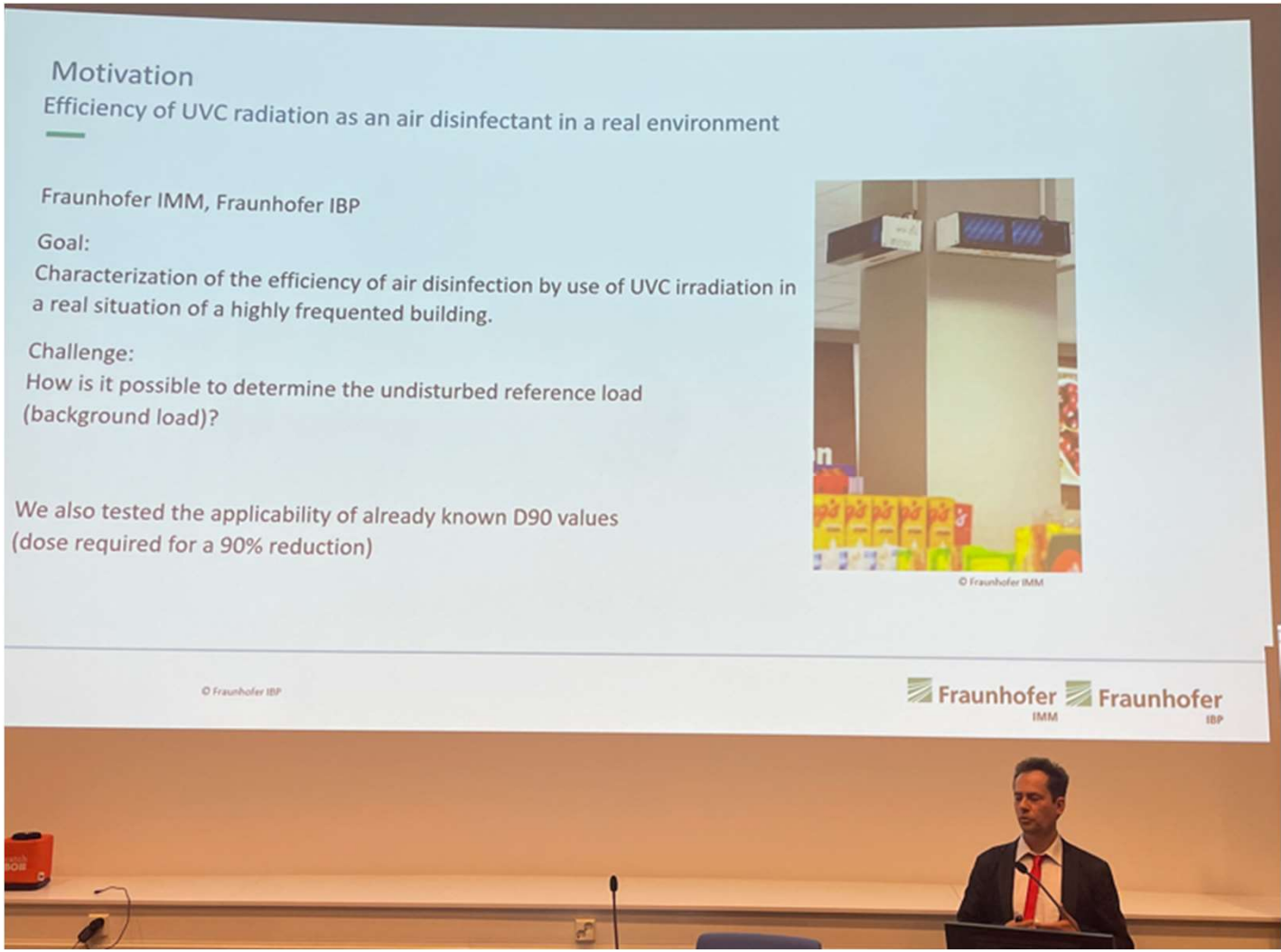


Figure 2. Correlation of ozone concentrations and formation of by-products for CP_1.

TNO innovation for life

WOLFGANG KARL HOFBAUER, FRAUNHOFER (1795)



GEBRUIK MAKEN VAN DE IN DE SUPERMARKT AANWEZIGE SCHIMMELS EN BACTERIËN

Model

UVC disinfection process and deduced decay

$N_{UV} / N_0 = e^{-kD}$

N_0: figure of active microbes before UV-C exposition

N_{UV}: figure of active microbes after UVC exposition

D: UVC dose in J/m²

k UVC rate constant, m²/J

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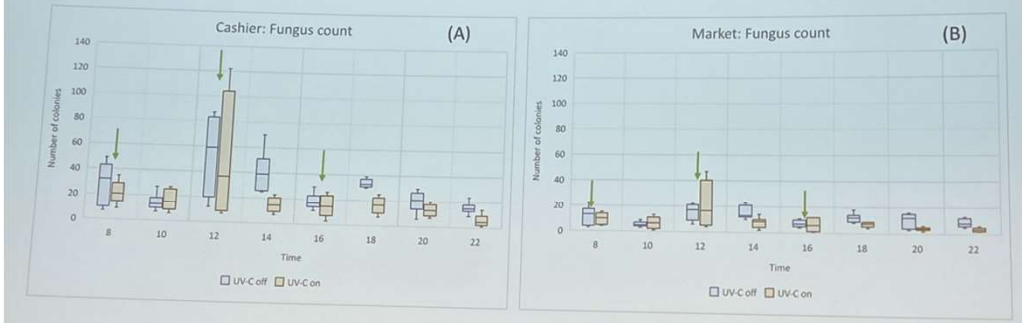
Measuring campaign1: Daily counts of fungal spores in super market

Efficiency of UVC radiation as an air disinfectant in a real environment; 1st trial



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Fungal counts at cashier (A) and in the market (B), respectively, Monday to Friday. CFU's were counted after ten days. Green arrows indicate time points with temporary events (8: daily cleaning and restocking of fruits and vegetables; 12: increase purchase of open food stuff; 16: change of shifts.

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Measuring campaign1: Assessment of UV-C effect

Efficiency of UVC radiation as an air disinfectant in a real environment, 2nd trial

Calculation:

$N_{UV} / N_0 = e^{-kD}$

59% reduction in bacteria: $N_{UV} / N_0 = 0.41$

$0.41 = e^{-kD}$

$-Ln(0.41)/k = D$

D = 0.892/0.0377= **23.7 J/m²**

applied to corona viruses this corresponds to

4-log reduction in corona viruses = **disinfection!**

2nd trial Bacteria count

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Scenario:
10fold higher k-value

Assumptions:

D90*: 60J/m2 (bacteria) → k = 0.038 m2/J

D90**: 6 J/m2 (Corona viruses) → k= 0.377 m2/J

* Measured average for typical airborne bacteria

** measured for airborne Corona viruses

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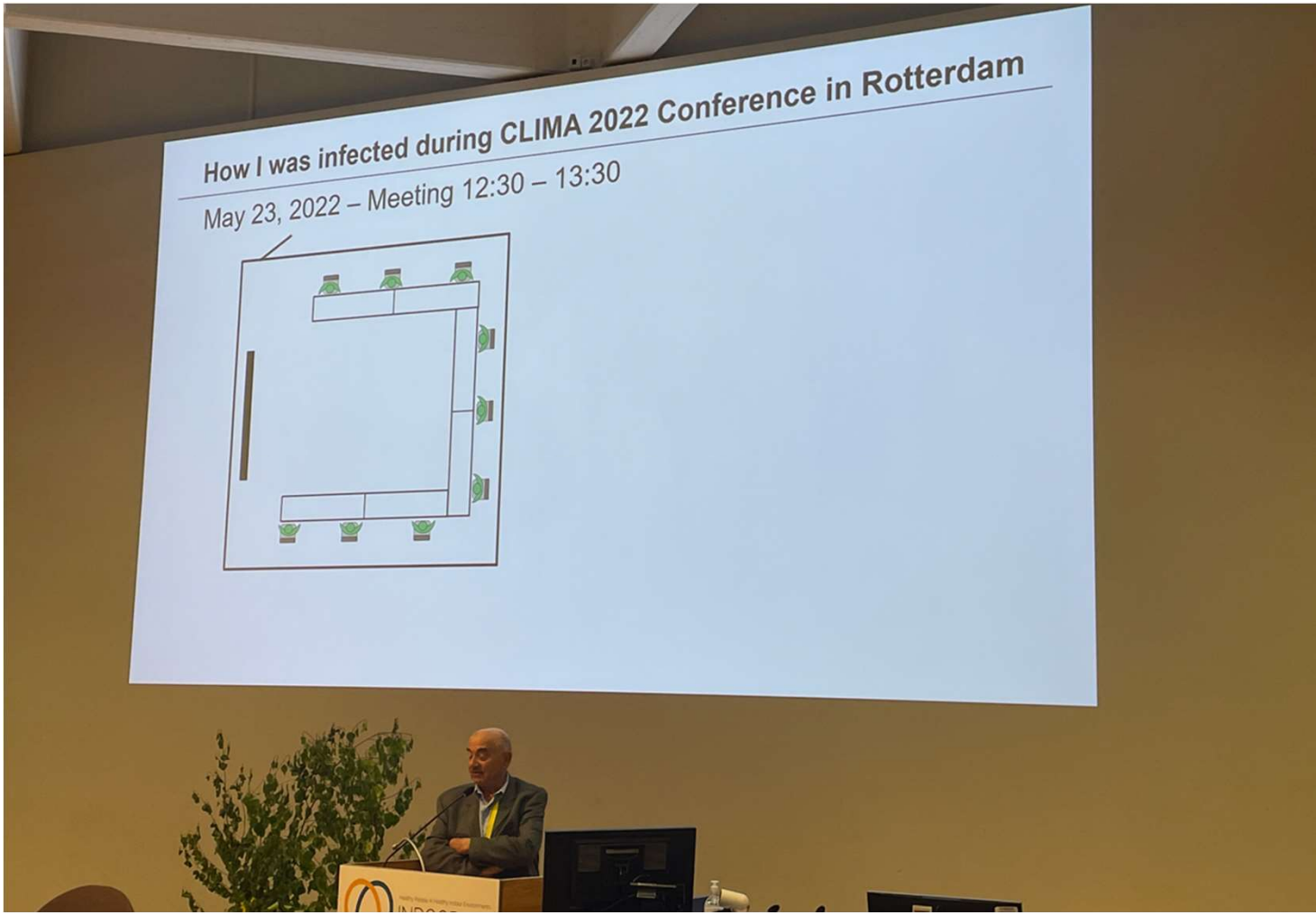
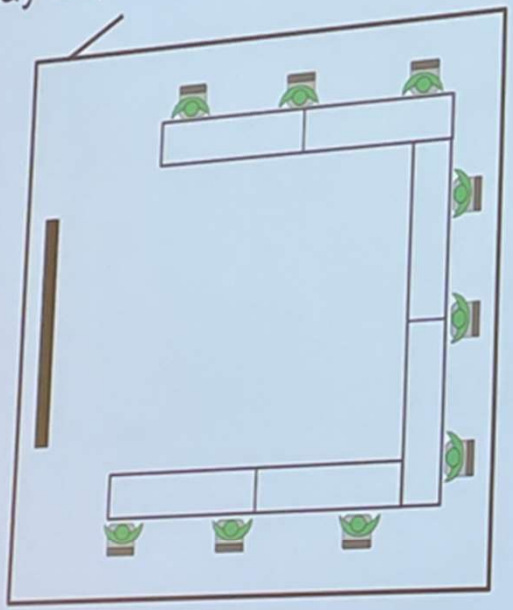
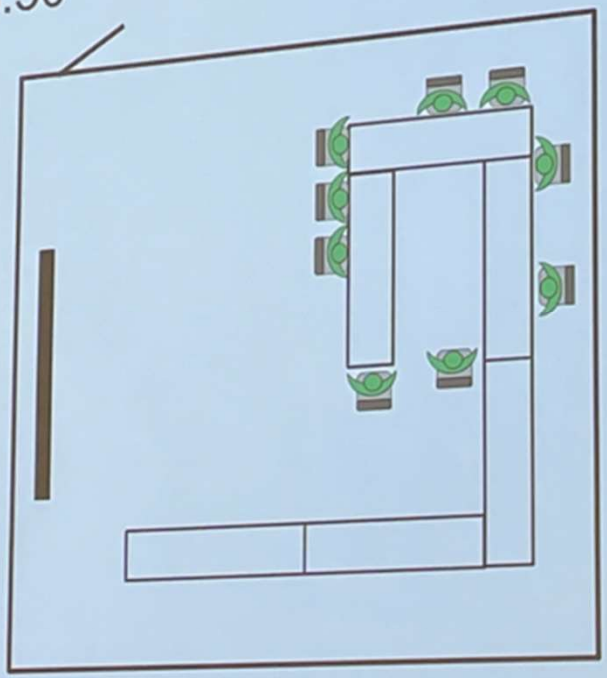
ARSEN MELIKOV – SPECIALIST ON LOCAL VENTILATION

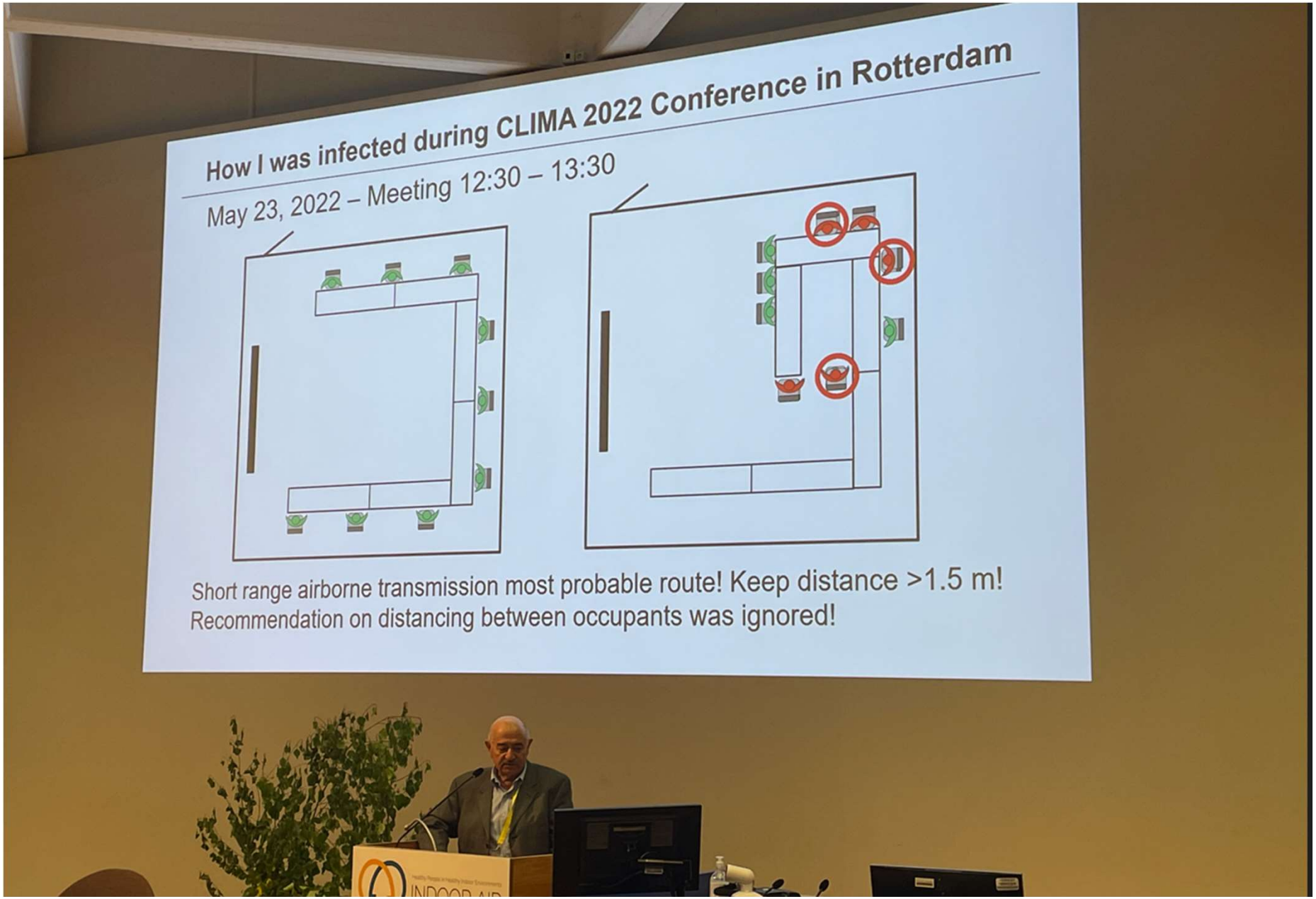


How I was infected during CLIMA 2022 Conference in Rotterdam

May 23, 2022 – Meeting 12:30 – 13:30






How I was infected during CLIMA 2022 Conference in Rotterdam
May 23, 2022 – Meeting 12:30 – 13:30
Short range airborne transmission most probable route! Keep distance >1.5 m!
Recommendation on distancing between occupants was ignored!


BEDANKT VOOR
UW AANDACHT
TNO innovation for life