INDOOR AIR 2016

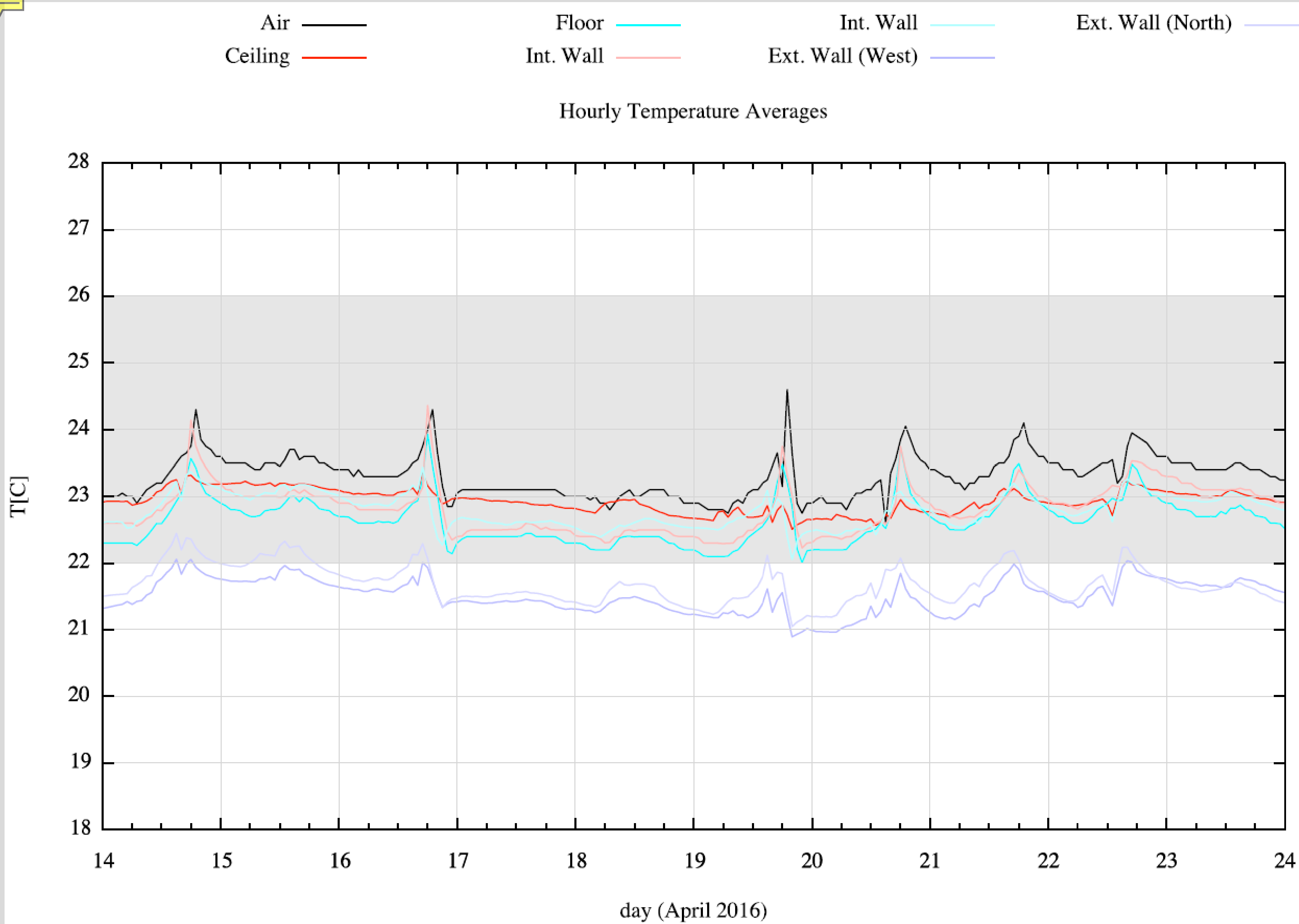
DO HEALTHY BUILDINGS NEED TECHNOLOGY ?

Indoor Climate
Comfort and Health Aspects
of
Building 2226

Walter Hugentobler, physician, family doctor

Is indoor climate in building «2226» healthy ?

doctor’s opinion


Air
Ceiling
Floor
Int. Wall
Int. Wall
Ext. Wall (West)
Ext. Wall (North)
Hourly Temperature Averages
T[C]
28
27
26
25
24
23
22
21
20
19
18
14
15
16
17
18
19
20
21
22
23
24
day (April 2016)

Permitted limits for radiant temperature asymmetries, DIN EN ISO 7730

Radiant temperature asymmetry

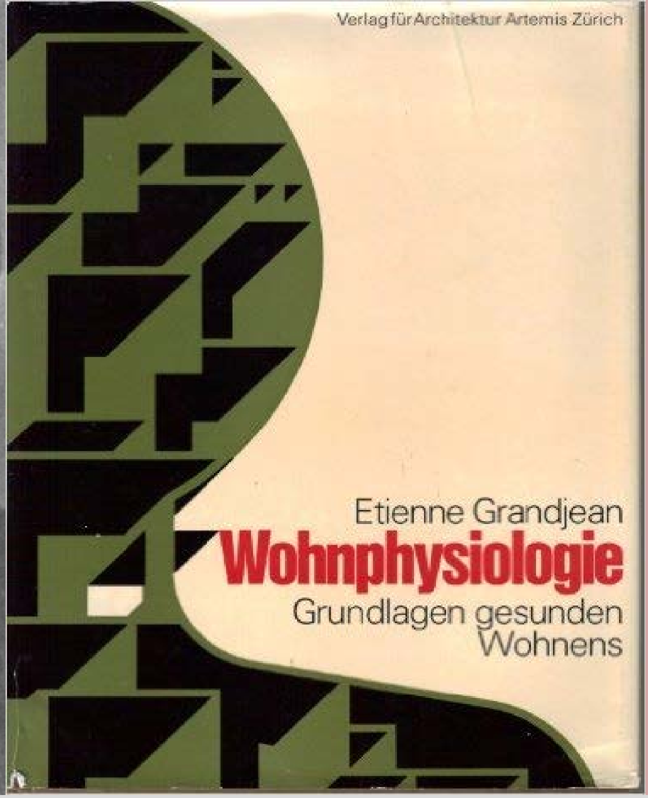
Category	Radiant temperature asymmetry °C			
	Warm ceiling	Cool wall	Cool ceiling	Warm wall
A	< 5	< 10	< 14	< 23
B	< 5	< 10	< 14	< 23
C	< 7	< 13	< 18	< 35

	Warm ceiling	Cool wall
Lustenau be «2226»	**< 0.3**	**< 2**

Few other buildings have a similarly low radiant asymmetry

Consequence:

Combined with the outstanding temperature stability this results in excellent thermal comfort



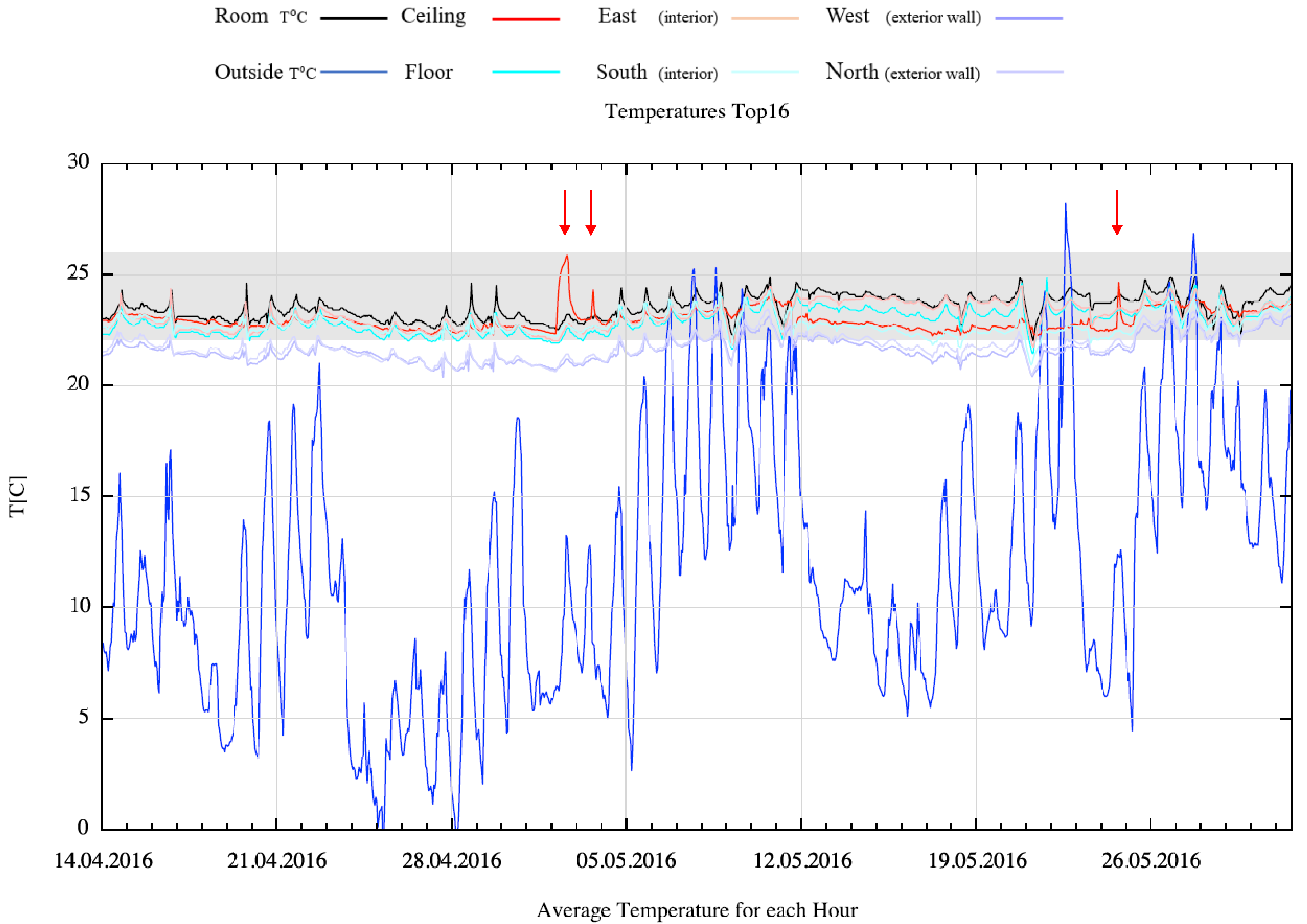
Prof. Etienne Grandjean

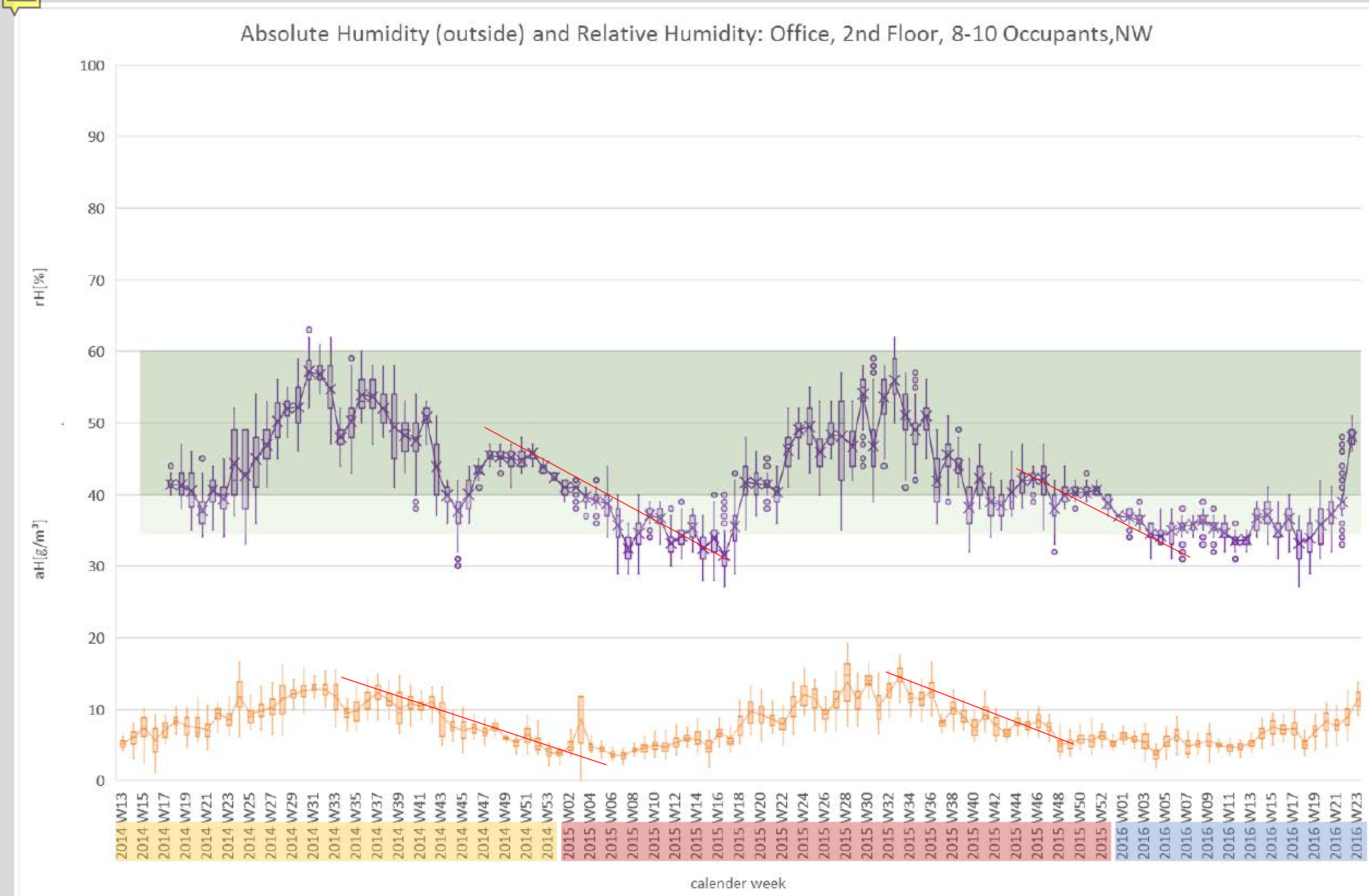
Chair of the Institute for Hygiene and Occupational Physiology
Swiss Federal Inst. of Technology, Zurich

Physician and engineer
1950-1983

Physiology in Dwellings
Basics of Health in the Built Environment, published **1972**

Quote, page 202:
«The temperature differences between air and the enclosed surfaces should by no means exceed 2 to 3 degree centigrade»


Room T°C
Ceiling
East (interior)
West (exterior wall)
Outside T°C
Floor
South (interior)
North (exterior wall)
Temperatures Top16
30
25
20
15
10
5
0
T[C]
14.04.2016
21.04.2016
28.04.2016
05.05.2016
12.05.2016
19.05.2016
26.05.2016
Average Temperature for each Hour


Absolute Humidity (outside) and Relative Humidity: Office, 2nd Floor, 8-10 Occupants,NW
rH [%]
aH [g/m³]
calender week
2014
2015
2016

Building - Protection

Health - Protection

? where is the optimum ?

Buildings don’t care about low humidity!

«the dryer - the better»

Occupants need optimal humidity of 40 to 60%!

«minimum 40 to 45 %»

progressive side effects «too dry»

progressive side effects «too humid»

0 10 20% 30% 40% 50% 60% 70% 80 90 100

THE PHYSIOLOGICAL BASIS OF HEALTH STANDARDS FOR DWELLINGS

The modern home should not only provide protection from unfavourable atmospheric conditions, but also prevent the spread of contagious disease and ensure physical and mental comfort, rest or ativity and the maintenance of human health in the wider sense.

WORLD HEALTH ORGANIZATION

GENEVA

1968

Representative survey among occupants of energy efficient buildings

conducted by an independent market research institute in behalf of

Swiss Federal Office of Energy, published March 2016[1]

Question: «how to you perceive indoor humidity in winter?»

Structured interviews			
Answers	**Building type**		
	Single family house (n= 615)	Apartment house (n= 223)	Office building (n= 92)
Far to dry	9 %	16 %	18 %
slightly to dry	44 %	49 %	32 %

Telephone survey	
Building type	
Minergie® (n=738)	MuKEn[2] (n=302)
12 %	3 %
44 %	33 %

[1] Source: Erfolgskontrolle Gebäudeenergiestandards 2014-2015, Schlussbericht, 9.3.2016

[2] in accordance to the energy efficiency rules of the different cantonal authorities

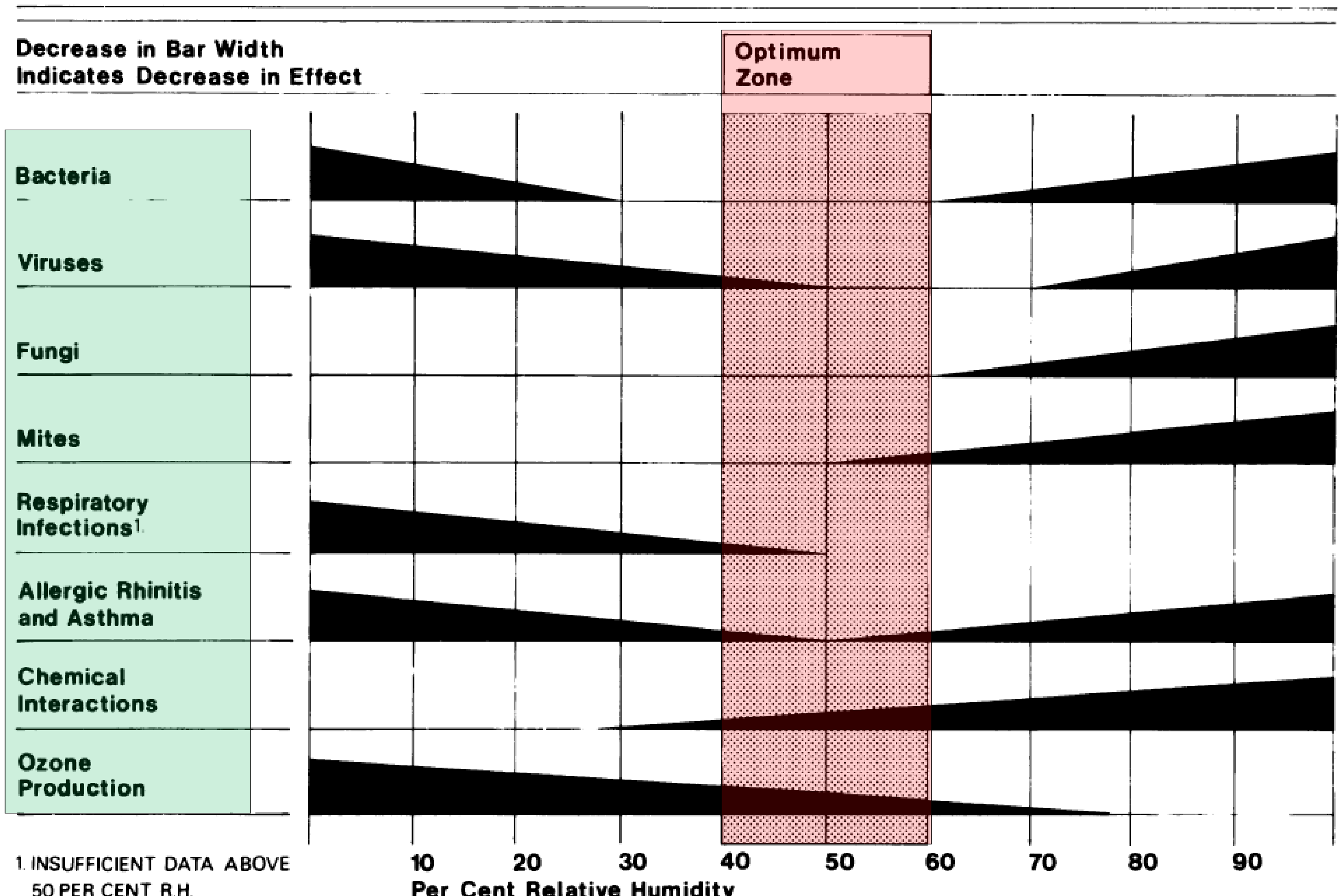


FIGURE 1. Optimum relative humidity range for minimizing adverse health effects.

Arundel AV, Sterling EM et al, Indirect Health Effects of Relative Humidity in Indoor Environment, Environmental Health Perspectives Vol. 65, 351-61, **1986**

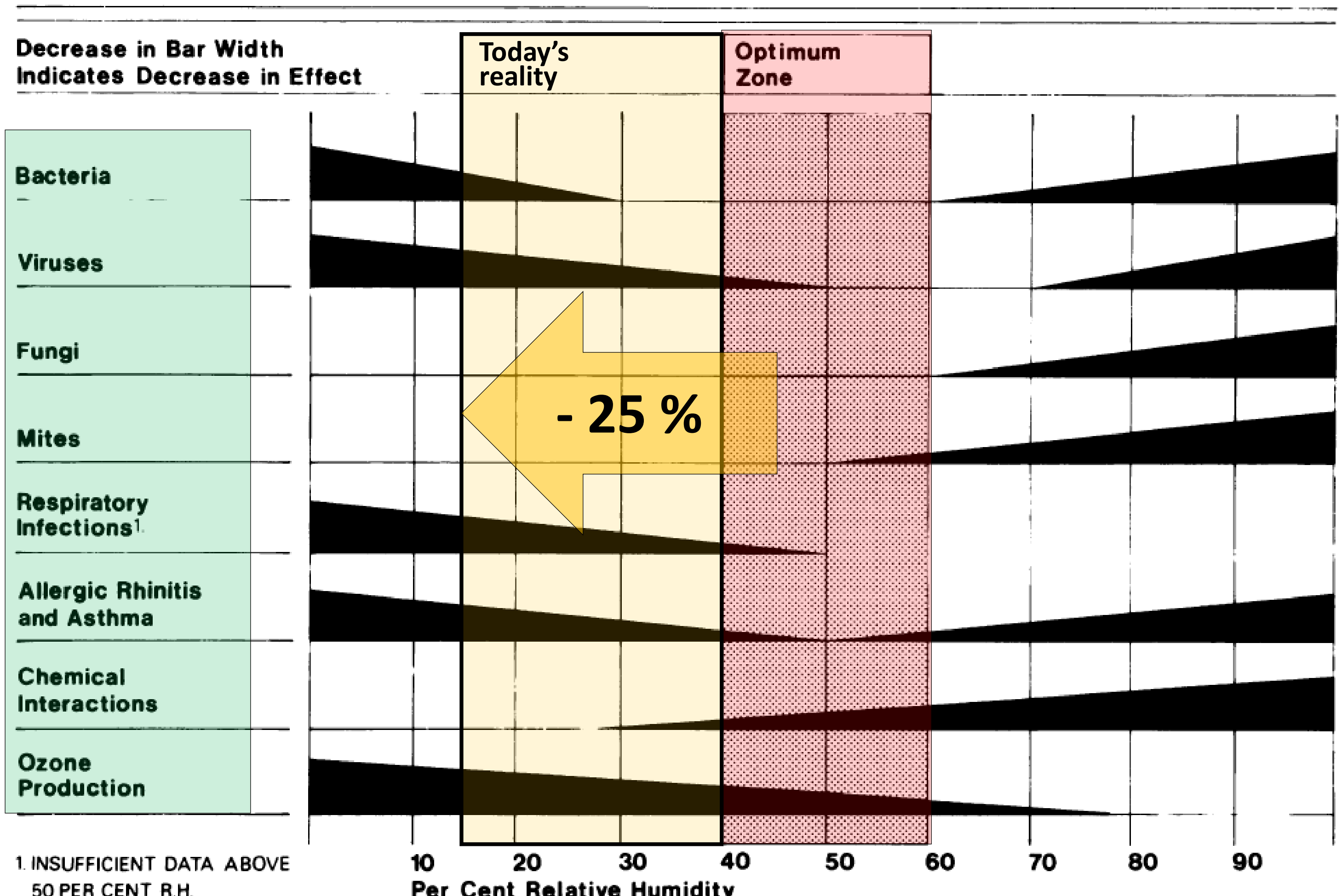


FIGURE 1. Optimum relative humidity range for minimizing adverse health effects.

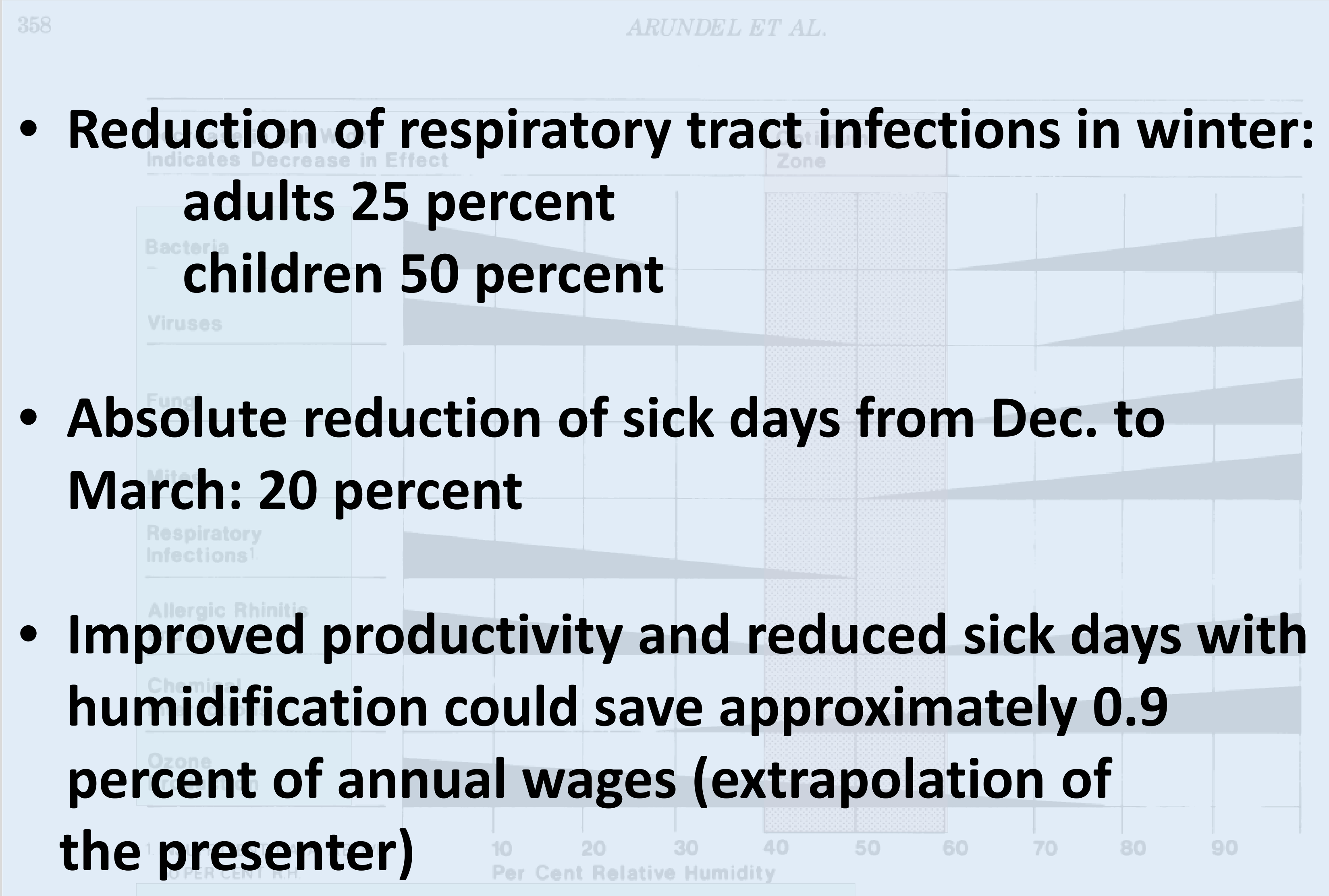
We reduced indoor relative humidity in winter by 20 percent, without evidence that this is not harmful - a blind flight (with the whole population on board) towards desert climate

1. **Ritzel G**, Sozialmedizinische Erhebung zur Pathogenese und Prophylaxe von Erkältungskrankheiten, Zeitschrift für Präventivmedizin 1966, 11. 9-16
2. **Sale Ch**, Humidification to Reduce Respiratory Illnesses in Nursery School Children, Southern Medical Journal, July 1972, Vol. 65, No 7
3. **Serati A**, **Wüthrich M,** Luftfeuchtigkeit und Saisonkrankheiten, Schweizerische Medizinische Wochenschrift, 99, 48-50, 1969
4. **Gubéran E**, **Dang VB., Sweetnam PM,** L'humidification de l'air des locaux préventielle les maladies respiratoires pendant l'hiver? Schweizerische Medizinische Wochenschrift, 108, Nr. 22, 1978
5. **Gelperin A**, Humidification and Upper Respiratory Infection Incidence. Heating, Piping and Air Conditioning, 45:3, 1973
6. **Green G**, The Effect of Indoor Relative Humidity on Absenteeism and Colds in Schools, ASRAE JOURNAL, January 1975
7. **Green G**, Winter Humidities and Related Absenteeism in Canadian Hospitals. Digest of the 3rd CMBES Clinical Engineering Conference, 1981
8. **Green G**, The Effect of Indoor Relative Humidity on Absenteeism and Colds in Schools, ASHRAE Trans. 1975, Vol. 80,Part. II.
9. **Green G**, Indoor Relative Humidities in Winter and Related Absenteeism, ASHRAE Trans. 1985, Vol.91, Part I

- **Reduction of respiratory tract infections in winter:**
  adults 25 percent
  children 50 percent

- **Absolute reduction of sick days from Dec. to March: 20 percent**

- **Improved productivity and reduced sick days with humidification could save approximately 0.9 percent of annual wages (extrapolation of the presenter)**



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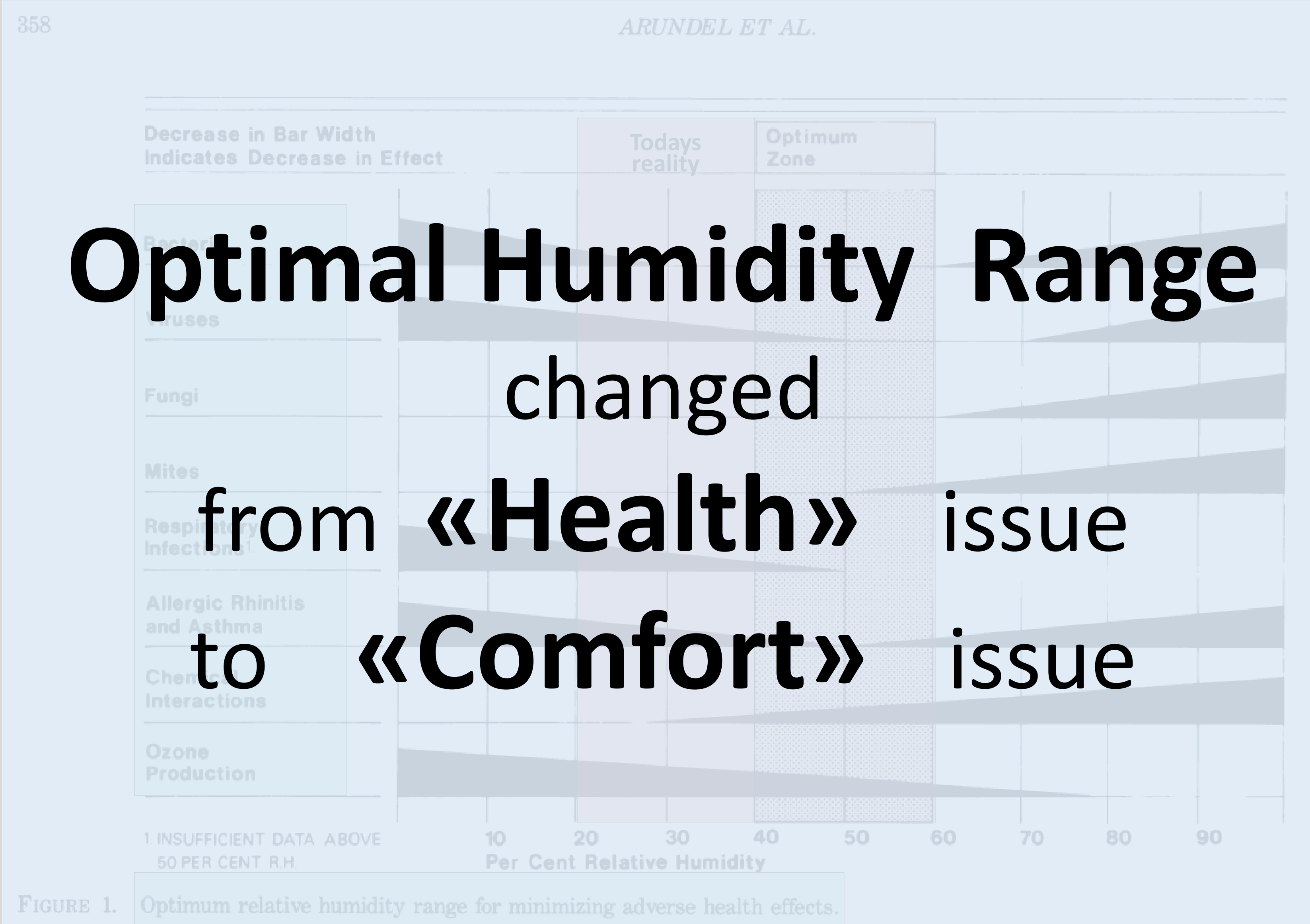
Optimal Humidity Range

changed

from **«Health»** issue

to **«Comfort»** issue



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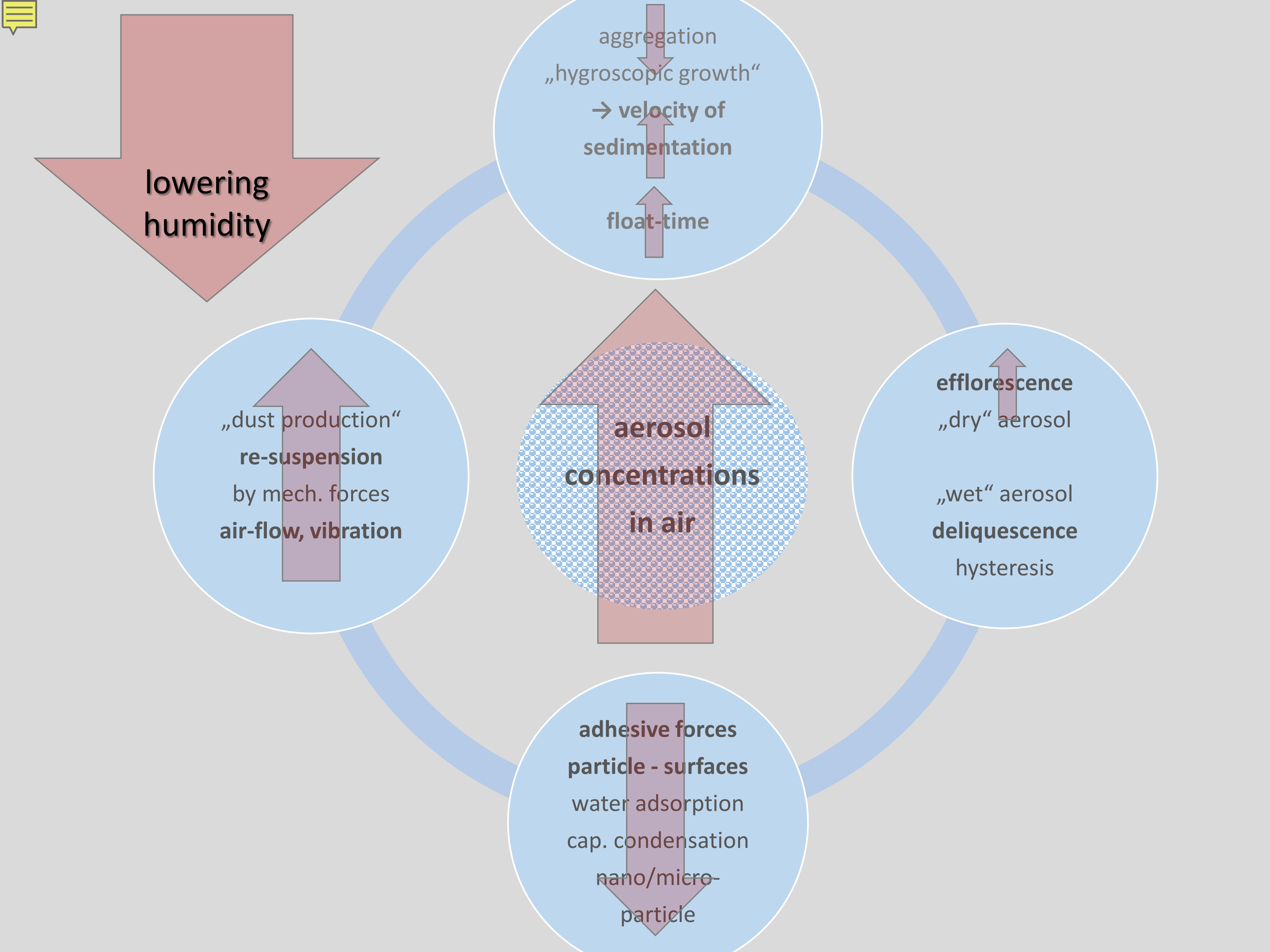
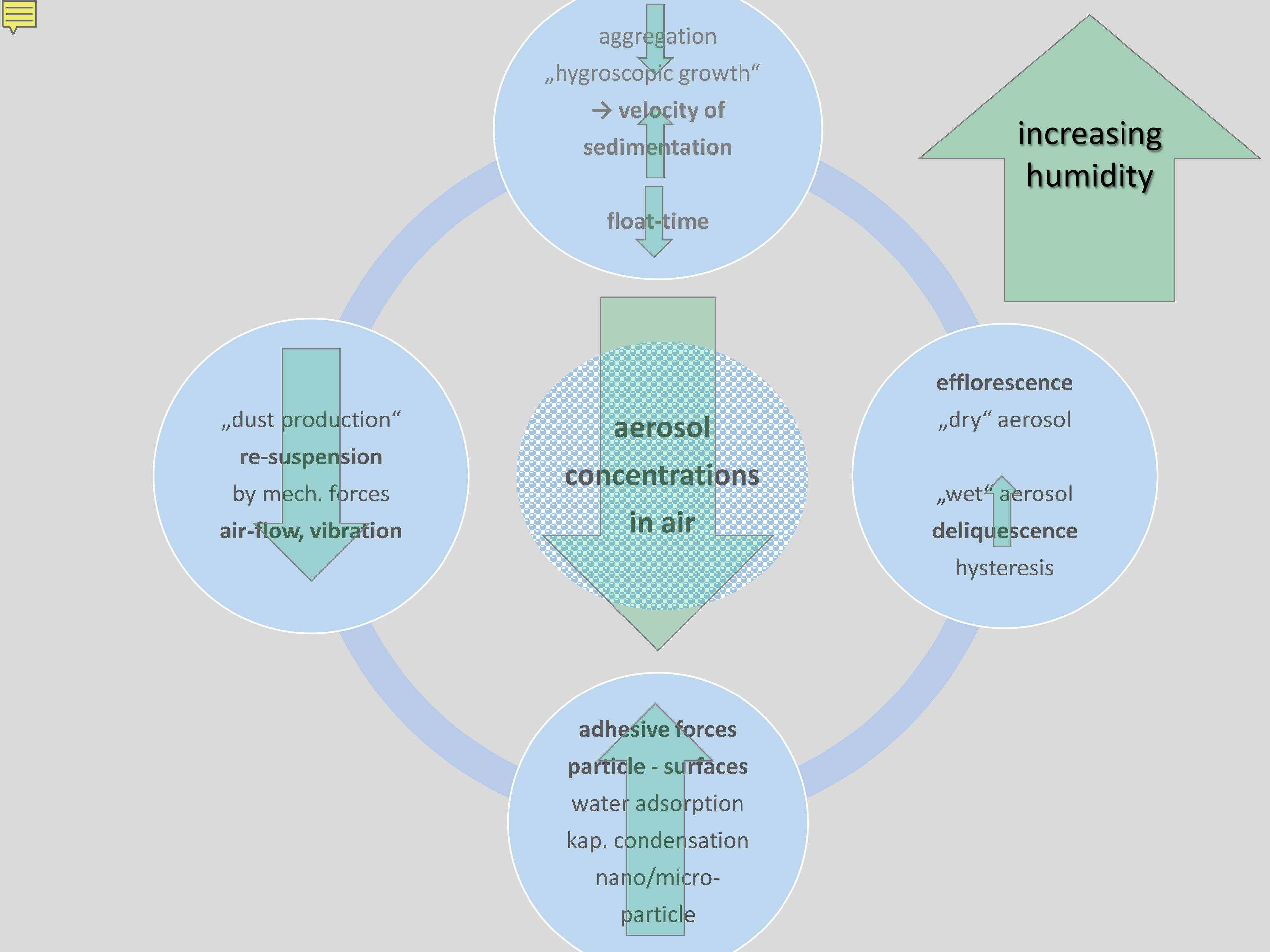

lowering
humidity
aggregation
„hygroscopic growth“
→ velocity of
sedimentation
float-time
„dust production“
re-suspension
by mech. forces
air-flow, vibration
aerosol
concentrations
in air
efflorescence
„dry“ aerosol
„wet“ aerosol
deliquescence
hysteresis
adhesive forces
particle - surfaces
water adsorption
cap. condensation
nano/micro-
particle


aggregation
„hygroscopic growth“
→ velocity of sedimentation
float-time
increasing humidity
„dust production“
re-suspension
by mech. forces
air-flow, vibration
aerosol concentrations in air
efflorescence
„dry“ aerosol
„wet“ aerosol
deliquescence
hysteresis
adhesive forces
particle - surfaces
water adsorption
kap. condensation
nano/micro-particle

Buildings without
HVAC-Technology
can be
Comfortable
Energy-Saving
and
Healthy

doctor’s opinion