UCaHS - Urban Climate and Heat Stress in mid-latitude cities in view of climate change

Research questions

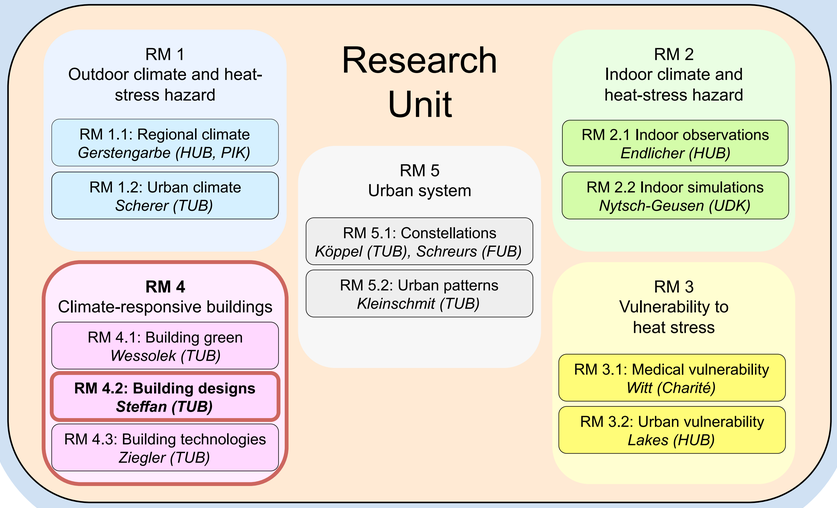
MAJOR QUESTIONS

- Regarding to climate change, in which extent is it possible to reduce morbidity and mortality according to the heat stress with passive architectural measures?

RESULTING QUESTIONS

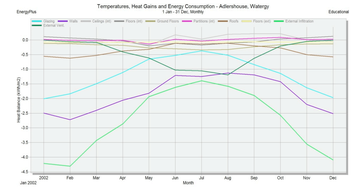
- What are the effects of standard, measured, and projected weather data on the outputs of deployed simulation tools?
- Are current passive architectural measures accurate considering +2° scenario?
- What are the two-way interactions of the urban climate directly around the building and the building itself?
- Are passive architectural measures solely sufficient to reduce the heat stress effects in buildings?
- What is the contribution of each architectural component on the reduction of heat stress effects?
- What should be considered by hospital design in the future regarding architectural measures reducing heat stress effects?

Sub-project 4.2
Building designs



Methodology

Thermal Energy Simulations

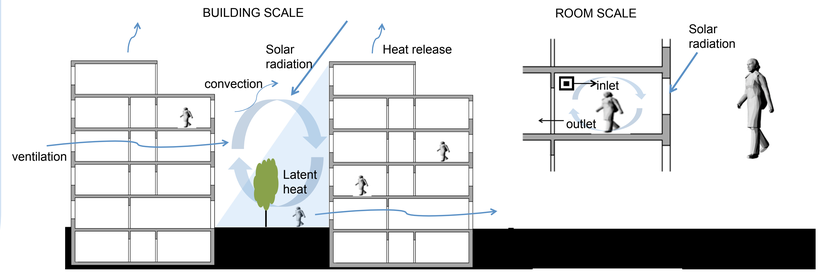


Hazard, Risk and Vulnerability Analysis

$$\frac{E_{cooling}}{\text{year}} = \frac{M_{cooling}}{\text{year}} \cdot \frac{E_{cooling}}{M_{cooling}} = \frac{\sum_{year} cdd_{day}}{\text{year}} \cdot c_{cdd}$$

$$cdd_{day} = \begin{cases} \left(T_{air,out,day} - T_{threshold,cooling}\right) \text{day} & : T_{air,out,day} > T_{threshold,cooling} \\ 0 & : T_{air,out,day} \le T_{threshold,cooling} \end{cases}$$

CFD Simulations at Different Scales



Research approach

ACTUAL SITUATION
- Modelling of analysing objects with measured and standard weather data
- Simulating the current situation
- Defining the needs

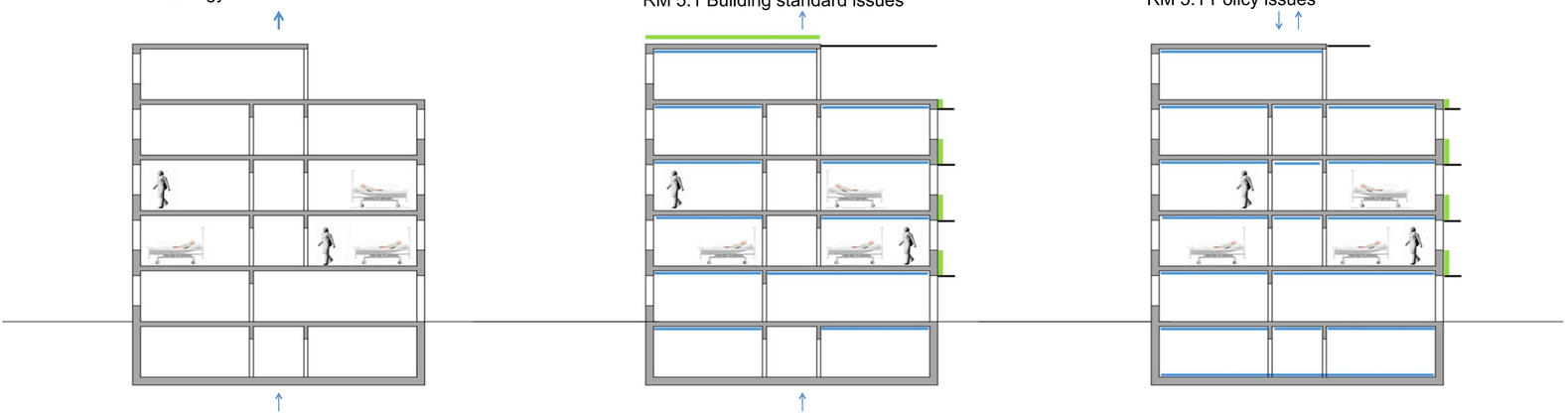
OPTIMIZATION
- Simulating the measures with measured and projected weather data (+2° scenario)
- Efficiency and effectiveness of the measures
- Interactive optimizations

DEVELOPMENT AND OUTCOME
- Effective methods regarding UCaHS

RM 2.2 Physical&time frame for CFD
RM 4.3 Energy values

RM 2.1 Interactions
RM 3.1 Design alternatives
RM 4.1-4.3 Albedo comparison
RM 5.1 Building standard issues

RM 3.1 Design feedback
RM 5.1 Policy issues



RM 1.2 Outdoor climatic data
RM 2.2 Software choice&adaptation
RM 3.1 Physical data of hospitals

RM 1.1 Projected weather data
RM 2.1 Measured indoor air data
RM 4.1 CFD calibration

Work schedule

WP	Description	Schedule
100	**Project management**	
110	Reporting	
120	Logistics and organisation	
200	**Individual research**	
210	Building data capture and simulation software choice	
220	Simulations of passive architectural adaptation measures	
230	First design for hotter summer climate conditions	
240	Simulation proofs and feedback to design	
250	Improvement of design solutions	
300	**Collaboration within the Research Module**	
310	"Effects of greening on indoor climate" (RM 4.1)	
320	"White-Green-Blue concept" (RM 4.1, 4.3)	
400	**Collaboration within Research Links**	
420	RL "Urban climate and building energy demands" (RM 1.2)	
430	RL "Simulation based design for rooms and buildings with a sustainably reduced heat-stress risk" (RM 2.2)	
440	RL "Prospective active A/C solutions" (RM 4.1, RM 2.2)	
450	RL "Options for hospital architecture for reducing heat stress" (RM 3.1)	
460	RL "Requirements and efficiency of modified building designs" (RM 5.1)	
500	**Collaboration within Research Clusters**	
510	From regional weather and climate to indoor climate	
520	Present-day heat-stress hazards, vulnerabilities and risks	
530	Effectiveness of actions for reducing heat-stress risks	
540	Efficiency of actions for reducing heat-stress risks	
600	**Collaboration within Research Unit**	
610	Projected heat-stress hazards, vulnerabilities and risks	
620	Transferability of the methodology to other mid-latitude cities	
630	Identification of future research and development activities	
640	Preparation of the follow-up proposal	

Prof. Claus Steffan, Chair of Building Technology and Architectural Design, Department of Architecture, School VI Planning–Building–Environment, TU-Berlin (claus.steffan@tu-berlin.de)
Dr. Arda Karasu, Chair of Building Technology and Architectural Design, Department of Architecture, School VI Planning–Building–Environment, TU-Berlin (karasu@tu-berlin.de)