## Overview ZURES Session

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<th>Session Title</th>
<th>Presenters</th>
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<td>13:30 – 13:40</td>
<td>Introduction and Statement BMBF</td>
<td>Birkmann (ireus) and Mr. Frank (BMBF)</td>
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<td>13:40 – 13:52</td>
<td>Urban climate and vulnerability: innovative assessment and scenario approaches – the ZURES project</td>
<td>Birkmann, Puntub, Burmeister, Garschagen</td>
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<td>13:53 – 14:05</td>
<td>Bridging science, policy and planning: Bonn and Ludwigsburg – the ZURES project</td>
<td>Löffler, Helbig, Burkhardt, Sandholz, Göttsche, Laranjeira</td>
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<td>14:06 – 14:18</td>
<td>Innovative measuring and microscale modelling – the iSCAPE project</td>
<td>Fuchs, Christian</td>
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<td>14:19 – 14:31</td>
<td>Air quality, heat stress and human vulnerability in cities: an international perspective</td>
<td>Martayan (Global Urban Air Pollution Observatory GUAPo)</td>
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<td>14:32 – 14:45</td>
<td>Discussion</td>
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Statement BMBF and BMBF/DLR (4 min)
Vulnerability and risk analysis as a tool for enhancing the resilience of cities and urban infrastructures

Key questions

- How to assess present and future heat stress in growing medium-sized cities?
- How do future climate change and urbanization interact?
- How do different population groups perceive heat stress?
- What methods and indicators can be used to develop scenarios for human vulnerability at the local scale?
- How to link local scenarios of human vulnerability and climate?
- What is the added value of the information for decision making?
Introduction

- Growing medium-sized cities have to conserve open green space, but also provide new space for housing.
- Challenges: present climate and vulnerability scenarios often focus on national and international scales.
- Urban growth and/or densification are inherent characteristics of growing medium-sized cities — is that an entry point for local scenarios?
- Which data is available at the local level for assessing climatic and societal change?

Source: IPCC 2014
Urban Climate and Human Vulnerability

Presenters:

Ms. C. Burmeister (Geo-Net)
Prof. Garschagen (UNU; now: LMU)
Ms. W. Puntub (IRPUD, Technical University Dortmund)
Prof. Birkmann (IREUS; University Stuttgart)
Urban Climate: Today and tomorrow

To quantify the heat exposure model simulations are conducted of the present and future situation. As initialisation a dry and hot weather situation with no cloud cover is used to present the „worst case“

FITNAH – 3D model
Flow over Irregular Terrain with Natural and Anthropogenic Heat Sources = FITNAH


Resolution:
Bonn - 10m □ Ludwigsburg – 25m

Climate Change
Ludwigsburg: RCP2.6 Δ +0.7 | RCP8.5 Δ +2.2
Bonn: RCP2.6 Δ +0.5 | RCP8.5 Δ +2.0
Urban Climate: results for the City of Bonn

Guidance Map – night situation 4 am (Zoom Gustav-Stresemann-Institute)
Spatial Base = real land use layer

Today — Future 2030 with climatic change and growing settlement development

- bioclimatic conditions will become severe under climate change and under compaction and sealing
- the importance of green and open spaces will grow
- present cold air tracks are the same in the future
Heat & vulnerability: Importance vs. current practice

Respondents: 89 city administrations in Germany

Expected change in vulnerability towards heat stress

Expected change in heat stress

Most cities expect both: an increase in heat stress (hazard) as well as in vulnerability!
Heat and vulnerability

Important aspects: theoretical appraisal vs. application in planning

The gap between perceived importance and actual consideration in planning practices is widest with regards to aspects of social vulnerability!
Participatory scenario development

Ludwigsburg

Bonn

- Climate-sensitive urban development
- Climate-adapted urban development
- Not prioritizing urban growth policy
- Strongly prioritizing urban growth policy
- No offensive growth policy
- Offensive growth policy
- Non-climate-sensitive urban development
- Non-climate-adapted urban development
Future socio-economic scenarios - Bonn

Core Indicators

- Ratio of inhabitants in residential areas (person/ha)
- Ratio of population age 65-year-old and above (%)
- Number of SGB2 recipients per 1,000 employable residents

Population

(0.3%)

New Living Units = Future population

Elderly

Number of people who lives in 2016 and expected to be still alive in the future

Future total population

Poverty

SGB2 recipients per 1,000 employable residents in 2035

Scenario 2  Scenario 3a-2  Scenario 3b-1  Scenario 3d

Ratio of employable residents in 2035

Scenario 3a-2  Scenario 3b-1  Scenario 3d
Coupling scenarios: core indicators - Bonn

Future climate (RCP 8.5)

Future socio-economic scenario

- Population
- Poverty (SGBII)
- Elderly (65&above)

Overall
Day-time
Night-time

e.g.

Scenario 2
Scenario 3a-2
Scenario 3b-1
Scenario 3d

RCP 8.5

Coupling scenarios: core indicators - Bonn
Lessons learned - Bonn

**Good practices**

- Double analytical models through integrated future climate and socio-economic scenarios
- Multifaceted consideration of the problem with spatio-temporal illustration
- Tool for supporting urban development policy debate and promoting risk informed planning
  - Initial hotspots’ identification of possible vulnerable area in the future
  - Support long-term investment and mitigation measures
- Simple technique & dataset and transferable

**Challenges**

**Scale does matter**

- Personal perception VS Sub-district socioeconomic VS Global climate downscaling and development pathways
- Limited access of socio-economic data in household or building block level (privacy confidentiality and disclosure)

**Uncertainty is certain**

- Social vunerable groups and social sensitive infrastructure
- Pollutions (Noise & Air)
- Social development dynamic in the future (e.g. young people mobility, immigrants, aging society)
- Interaction with neighboring cities or nodes

**Day-time & night-time social activities**

Source: https://www.freepik.com/premium-vector/day-night-sky_2589626.htm
Urban climate: results for the City of Ludwigsburg

Guidance Map Zoom to the City Center – Spatial Base = statistical ward layer

Today → Future 2030 with climatic change and growing settlement development

Heat Stress Assessment Classes

- very favourable bioclimatic situation
- favourable bioclimatic situation
- less favourable bioclimatic situation
- unfavourable bioclimatic situation
- very unfavourable bioclimatic situation
- future settlement areas

→ bioclimatic conditions will become severe under climate change
→ this process will be intensified by more compaction and sealing
→ some structures are more robust (resilient) against climate change
Methodology: assessing future vulnerability

Local specific scenarios considering development corridors and future urban development

Aging Scenarios 2031
(biregio trend and new urban development areas / housing projects)

a) Strong aging particularly also in new development areas
b) Moderate aging (trend continues)
c) Light aging (younger households move into new urban areas)

Poverty Scenarios 2031
(social welfare recipients (SGB II))
Focus on policies in new urban and housing areas:

a) priority social housing /strong increase in SGB II
b) Mixed housing (mixture of households)
c) Exclusive housing (priority on wealthy households)

Future population development corridors
(biregio and StaLa)
- biregio (future population and aging at district scale)
- StaLa (future population scenarios city scale)

Storylines (considering SSPs and qualitative research)

City scale

District and ward scale
Climate and vulnerability at ward scale 2031

Present conditions (2017)

- Trend continuation
- New housing areas contain mixed HH.

2. Scenarios

- Moderate vulnerability 2031 & RCP 8.5
- High vulnerability 2031 & RCP 8.5

• Strong aging
• Increased SGB II in new urban areas

Same Climatic Change RCP 8.5
Bridging science, policy and planning

Presenters:

Ms. J. Löffler and Mr. Helbig (City of Bonn)
Mr. A. Burkhardt (City of Ludwigsburg)
Ms. Sandholz (UNU) - Expertenbefragung
Ms. F. Göttzsche (IREUS) – HH Befragung
Mr. K. Laranjeira (IREUS) – HH Befragung
Bonn and Ludwigsburg: context situation

- urban heat stress is already a problem in both cities
- significant and measurable change of the local climate
- growing municipality – e.g. need for new housing areas
- political resolution regarding the development (activation) of new urban areas
- goal conflict: structural development vs. preservation/optimisation of important compensation functions / areas
- necessity to develop valid information for political decision-making for urban development and land-use planning
Bonn: Science – Practice Interface

- Further development of the assessment – integration of suggestions from various departments
- Intensive dialogue between practice and science moderated by ZURES project partners
Bonn: Usefulness and applicability - ZURES results

Translation of the climate analysis into specific recommendations for urban development and decision making (e.g. guidance map for planning)

- Evaluation of potential new urban areas in terms of the urban climatic situation / function (e.g. cold air generation, etc.)
- Analysis of the impact of selected measures
- Advice regarding the best implementation of measures (e.g. roof / facade greening, opening of sealed surfaces to reduce urban heat island effect)
Ludwigsburg: Science – Practice Interface

- Three science-practice workshops in the City of Ludwigsburg
- Climate analysis map, planning guidance map, integrated planning advice map
- Discussion and further development of the maps with representatives from different departments (urban planning, green areas, district commissioners, etc.)
Ludwigsburg: potential application

Potential application for integrated planning

• Land use plan and development plans at district scale

Outlook

• In the next 2 years further development of the STEPs (District Development Plans)

• Integration of climate and socio-economic indicators and scenarios - district level
Relevance of urban heatwaves – results from household surveys in Bonn and Ludwigsburg

Heatstress perceived as problem

- **Bonn:** n = 688
  - in flat/house: 44.7%, 30.7%, 24.6%
  - in district/neighborhood: 58%, 31%, 10.9%
  - in city: 67.2%, 25.2%, 7.6%
- **Ludwigsburg:** n = 666
  - in flat/house: 41.3%, 17.8%, 40.9%
  - in district/neighborhood: 42.4%, 32.3%, 25.3%
  - in city: 51.7%, 33.3%, 15%
Hotspots of urban heat stress – results from HH surveys

- **in parks/gardens**: 9.8% Not at all, 59.6% Low, 26.7% High, 3.5% Very high
- **city center (e.g. pedestrian area)**: 1.6% Not at all, 22.7% Low, 54.2% High, 21.5% Very high
- **in public transport**: 1.5% Not at all, 15.4% Low, 46.9% High, 36.1% Very high
- **at work**: 11.3% Not at all, 27.1% Low, 34.7% High, 26.9% Very high
- **in flat/house**: 7.6% Not at all, 48.4% Low, 28.8% High, 15.2% Very high
- **attic stories**: 5.5% Not at all, 25.2% Low, 33.1% High, 36.2% Very high
- **other flats/houses**: 13.8% Not at all, 48.8% Low, 27.4% High, 10.1% Very high
# Social groups at risk to urban heat stress – results from HH surveys

<table>
<thead>
<tr>
<th>Why affected?</th>
<th>How affected?</th>
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<tbody>
<tr>
<td>Elderly</td>
<td>Students</td>
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- **Why affected?**
  - **Infrequent use of parks & public recreation areas; restricted adaptation options: low coping & adaptive capacity**
  - **Often live in small flats (depending on income); high share of attic stories: high exposure**
  - **Frequently use public transport; poorly adapted flats; low income: high exposure and low adaptive capacity**

- **How affected?**
  - **15% of all above 65y indicated frequent impacts on cardiovascular system: high potential health risk**
  - **1/4 of all 30-64y indicated frequent problems to sleep during heat waves: potential effects on mental health (LOHMUS 2018)**
  - **1/4 of all under 29y indicated frequent headache during heat waves**
Policy recommendations – results from HH surveys

- Mix of “soft” and “hard” measures
  - Heat-sensitive large-scale urban planning
  - Small-scale measures, e.g. drinking fountains, trees, rooftop greening
  - Incentives for private adaptation while avoiding maladaptation -> awareness building through information transfer
Policy recommendations – results from HH surveys

- Mix of “soft” and “hard” measures
  - Heat-sensitive large-scale urban planning
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  - Incentives for private adaptation while avoiding maladaptation -> awareness building through information transfer

- Challenges
  - Achieve one thing without abandoning others

I support the use of public money for adaptation measures to projected heat stress - even if this will reduce financial means for other sectors (e.g. culture, sport, infrastructure)

Adaptation to projected heat stress should be given priority in Ludwigsburg's urban planning (e.g. construction of public drinking fountains, clouding of sidewalks, ...)

<table>
<thead>
<tr>
<th>Agree</th>
<th>Don't Agree</th>
<th>Don't Know</th>
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<tr>
<td>48.0%</td>
<td>26.4%</td>
<td>25.6%</td>
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Policy recommendations – results from HH surveys

- **Mix of “soft” and “hard” measures**
  - Heat-sensitive large-scale **urban planning**
  - **Small-scale** measures, e.g. drinking fountains, trees, rooftop greening
  - **Incentives** for private adaptation while avoiding **maladaptation** -> **awareness** building through information transfer

- **Challenges**
  - Achieve one thing without abandoning others
  - Leave no one behind

![Willingness to invest private money for adaptation measures](image-url)
I. ZURES results provide better information on how to balance the need for new space for housing areas and the need to preserve open green spaces in the context of heat stress

II. ZURES can help to identify relevant and local specific measures to optimise the thermic comfort in hotspots of urban heat

III. Challenge: there is a need to improve the data-basis of socio-economic indicators as requirement for an equal and integrated assessment of climate and vulnerability – Bonn

IV. Planning tools are needed (e.g. STEPs) that allow to represent and integrate a more comprehensive understanding of climate risks – capturing future climate and societal change
Verbundkoordination
Universität Stuttgart, Institut für Raumordnung und Entwicklungsplanung (IREUS) unter der Leitung von Prof. Dr.-Ing. Jörn Birkmann

Projektpartner
Technische Universität Dortmund, Institut für Raumplanung (IRPUD)

agl Hartz • Saad • Wendl Landschafts-, Stadt- und Raumplanung, Saarbrücken
GEO-NET Umweltconsulting GmbH, Hannover
United Nations University – Institute for Environment & Human Security, Bonn

Modellstädte
Bundesstadt Bonn, Amt für Umwelt, Verbraucherschutz und lokale Agenda, Abt. Umweltvorsorge und -planung, Leitstelle Klimaschutz

Stadt Ludwigsburg, Referat Nachhaltige Stadtentwicklung, Europa und Energie

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Bundesministerium für Bildung und Forschung (BMBF)

Eingereicht im Rahmen der Bekanntmachung Sozial-ökologische Forschung im thematischen Schwerpunkt Nachhaltige Transformation urbaner Räume

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