Urban planning and climate issues of Beirut and Hamburg: Comparison approaches, tools, and decision-making tools

Noushig Kaloustian[1] , Youssef Diab[2] , Benjamin Bechtel[3], Jürgen Ossenbrügge[3]

[1]*PhD Candidate, Université Paris-Est (France) and Institut d'Urbanisme de l'ALBA - Univerité de Balamand (Lebanon)*

[2]*Professor, Université Paris-Est , Scientific Director at Ecole des Ingènieurs de la Ville de Paris (France)*

3 Institute of Geography, University of Hamburg (Germany)

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Introduction

- One of the best known effects of urbanization on the urban climate is urban warming or urban heat island (UHI)
- UHI -> negative effects on air quality, energy consumption levels, human health, & mortality
- In addition, it has been reported that there is a lack of transfer of UHI/urban climatic knowledge to town planning (Oke, 2006)
- Urban microclimate designs can have significant impacts on urban microclimates
- => incorporation of urban climate knowledge has large potential on improving sustainability of a city
- Comparison between cities is a suitable approach to improve incorporation of urban climatic knowledge in the planning process

Beirut and Hamburg

Geographical locations and populations

Beirut: Artificial City

Figure 1. Dense artificial city of Beirut. Source: Google Image, 2015

- Beirut -> capital city of Lebanon.
- Coastal city along Mediterranean Sea.
- Surface area -> ~20km²
- Population -> ~500,000 (MOE/ECODIT/LEDO, 2001)
- Very high population density -> 21,000 inhabitants/km2
- Beirut -> predominantly artificial city (NPMPLT, 2005),
- Comprised primarily of ->concrete roofs, asphalted roads & a small fraction of urban vegetation

=>contributions to the effects on UHI are expected to be high.

Hamburg: Green City

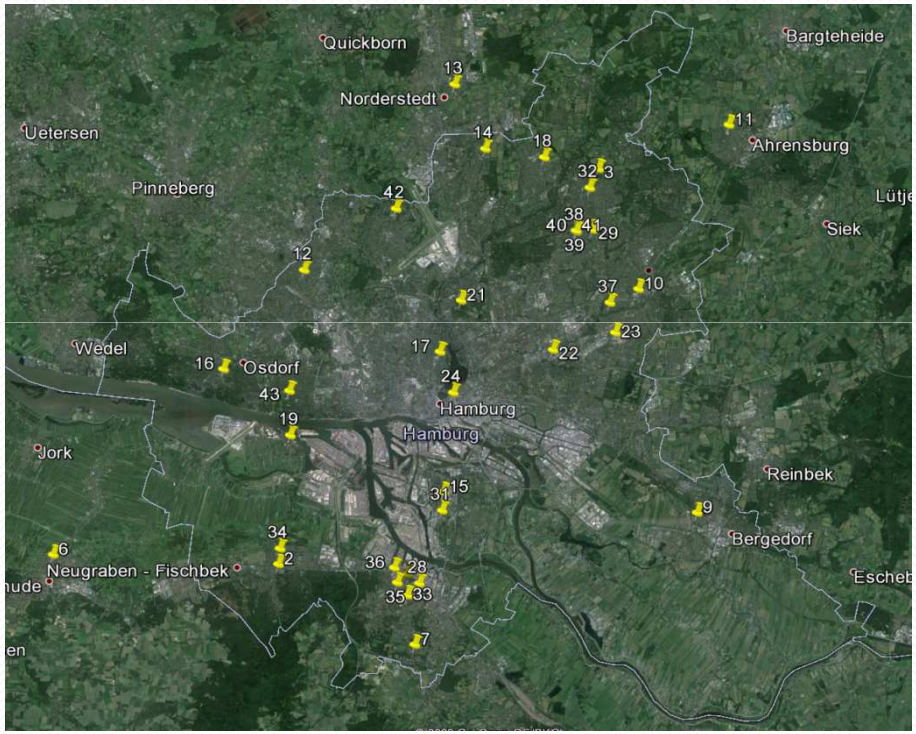
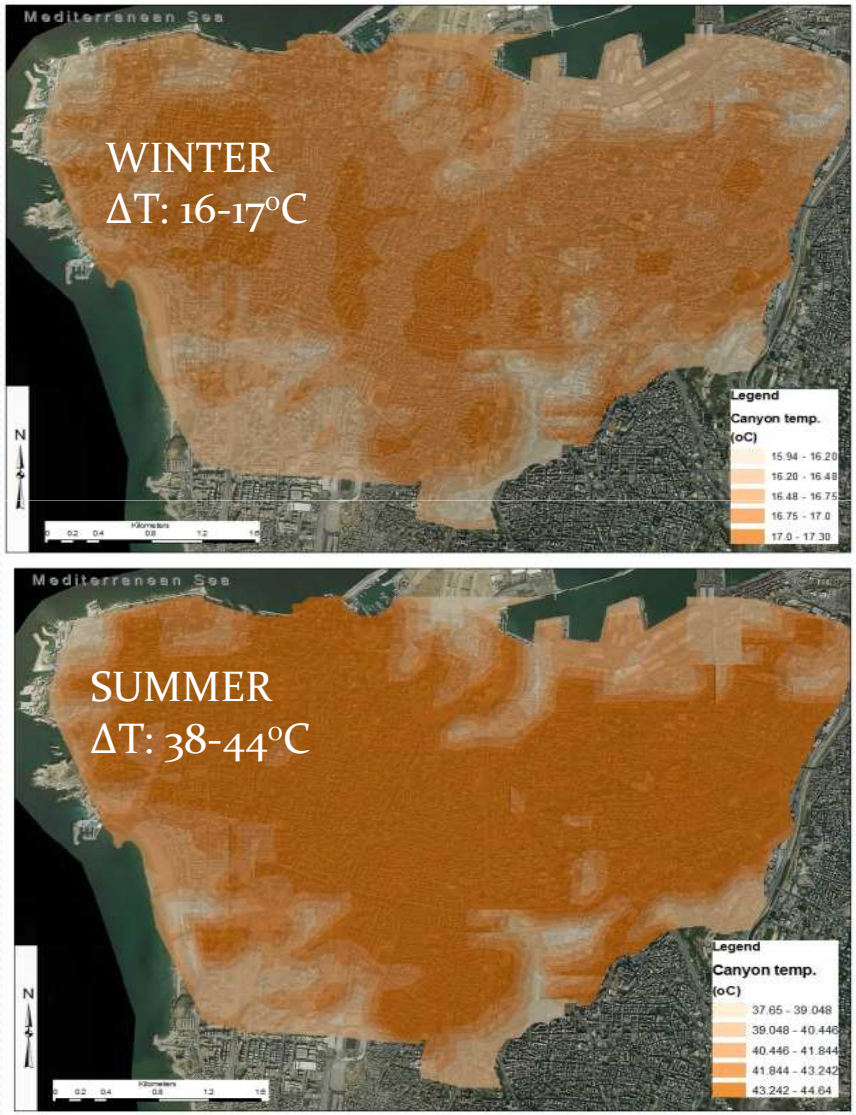


Figure 2. City of Hamburg (administrative borders) and observation networks. Imagery: Google Earth 2015

- The Free and Hanseatic City of Hamburg is also a Bundesland (= federal state) and hence has additional legislative power.
- 2nd biggest city in Germany
- ~ 1.8 Mio inhabitants (> 4 million in the metropolitan region)
- Covers a surface area of 755 km²
- Located in the Northern German lowlands, within Westerlies, ~ 80 km from North Sea & 70 km from the Baltic Sea
- It is characterized by large water bodies, numerous green spaces and street trees

Urban climatic situations

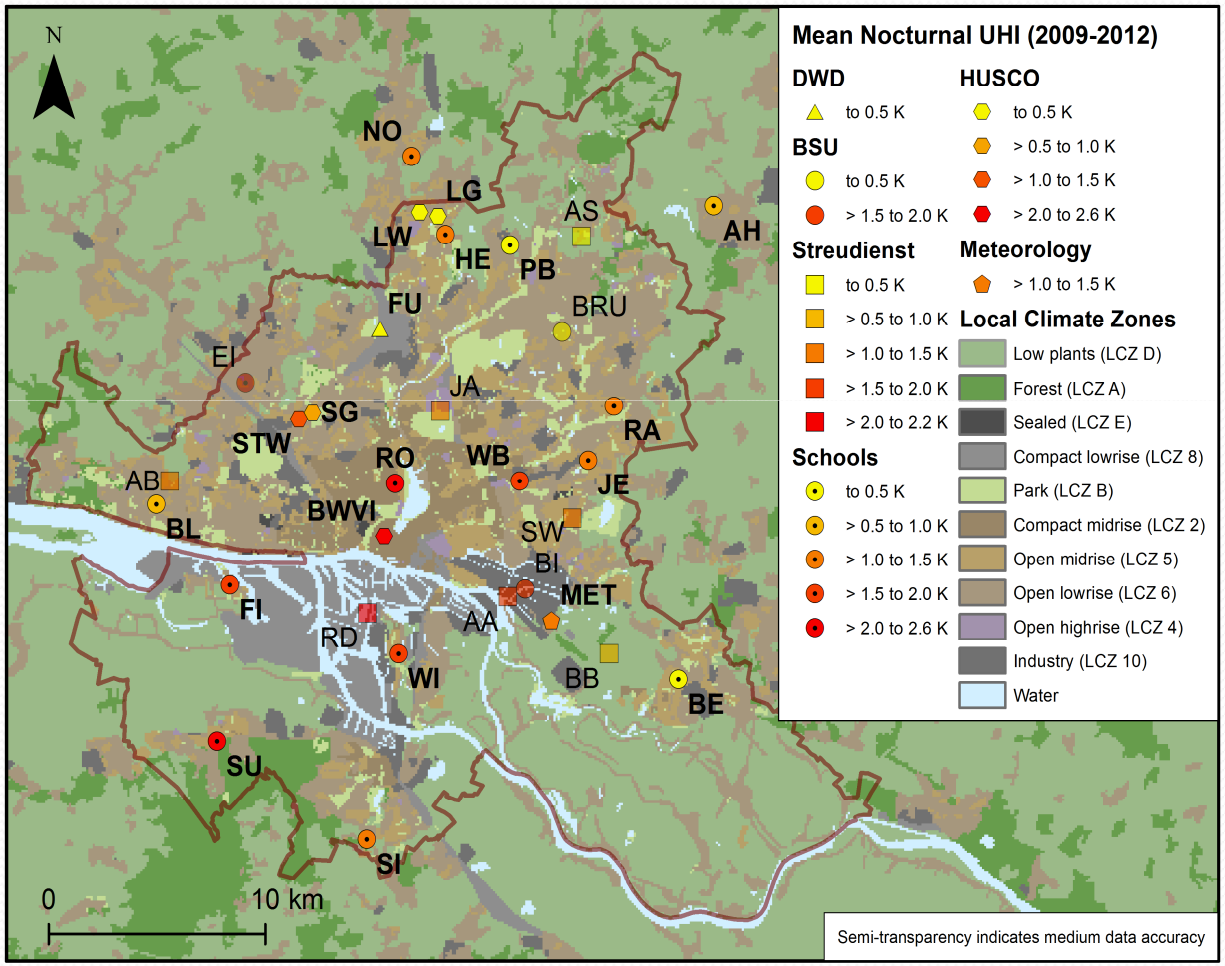
Climate in Beirut



- Mediterranean climate -> long, hot, dry summers and short, cool, rainy winters.
  - Hottest days -> July and August
  - Coldest days -> January and February
- Over the last 10 years, an intense warming of 0.12°C per decade is virtually certain to have occurred (>99% likelihood of occurrence)
- Recent modeling of the UHI of Beirut using the Town Energy Balance of Météo France (Masson, 2000) indicates ->
- areas with larger fractions of vegetation -> much cooler air temperatures
- -> difference in canyon temperatures that goes up to as high as 6° C during the summer season

Figure 3. Results of canyon temperature simulations across Beirut at 1200UTC in winter & summer (Kaloustian & Diab, 2015)

Climate in Hamburg



- Air temperature is moderate throughout the year (mean 9.0°C)
- Mean daily UHI is 1.1° C for St. Pauli characterized as dense urban morphology and 0.6° C at airport
- Average mean nocturnal UHI (differences in minimum temperatures compared to two rural reference stations) of 1.2 °C
- Considerable spatial variation; from center to outskirts UHI is decreasing which is in good agreement with the urban morphology.

Urban policies

Beirut urban planning policy and building code

- **Urban Planning Law #69 (1983)**

It is under this law that Lebanon functions today

although takes into consideration environmental discipline in 8/43 of its directives

none of these mention the need to protect the urban climate.

- **Building Code #646 (2004)**

This is the centerpiece of all construction activities in Lebanon.

this code introduced some important requirements for the protection of the environment and landscape

It includes the requirement to plant trees, to properly ventilate all areas of buildings & to encourage solar hot water systems

unfortunately, this building code is not regimentally applied due to a major deficiency in a robust implementation and reporting regime by the relevant authorities.

And again-> **there are no specific requirements that take into consideration the urban climate.**

Beirut existing institutional framework

- Weak communication amongst relevant authorities
- No robust implementation of environmental protection measures
- => protection of urban climate is not considered to be a priority
- there is no scientific evidence to show the relevance of urban heating in Beirut
- => decision-making is not effective in this regard
- => there are serious implications on environmental quality and urban climate as witnessed in the recent assessment of the state of the environment of Beirut (MOE/UNDP/ECODIT, 2010).

Relevant decision-makers must more seriously take into consideration the impacts of UHI and implement measures that can help to alleviate their impacts.

It is therefore necessary to 1)analyze the intensity UHI in Beirut, 2) modify existing legislation and building codes , 3) strengthen knowledge and institutional framework, and 4) compare to a developed city to identify more clearly weaknesses and strengths if any

Hamburg: German building code

Federal Building Code (Baugesetzbuch, BauGB)

Has been modified 2011 to include climate mitigation

The Scope, Definition and Principles of Urban Land-Use Planning are provided in this Code

Land-use plans shall safeguard **sustainable urban development** -> and provide socially equitable utilisation of land for the general good of the community -> and shall contribute to securing a more humane environment

Ensure environmental protection through the use of renewable energy sources, nature protection, protection of countryside through ecological balance in nature, and of water, air, ground and the **climate**

⇒ land-use plans should help to ensure a decent environment to protect the natural resources and to develop and **promote climate protection and adaptation to climate change, especially in the urban development**

⇒ they should also preserve the urban form and the townscape and landscape building culture

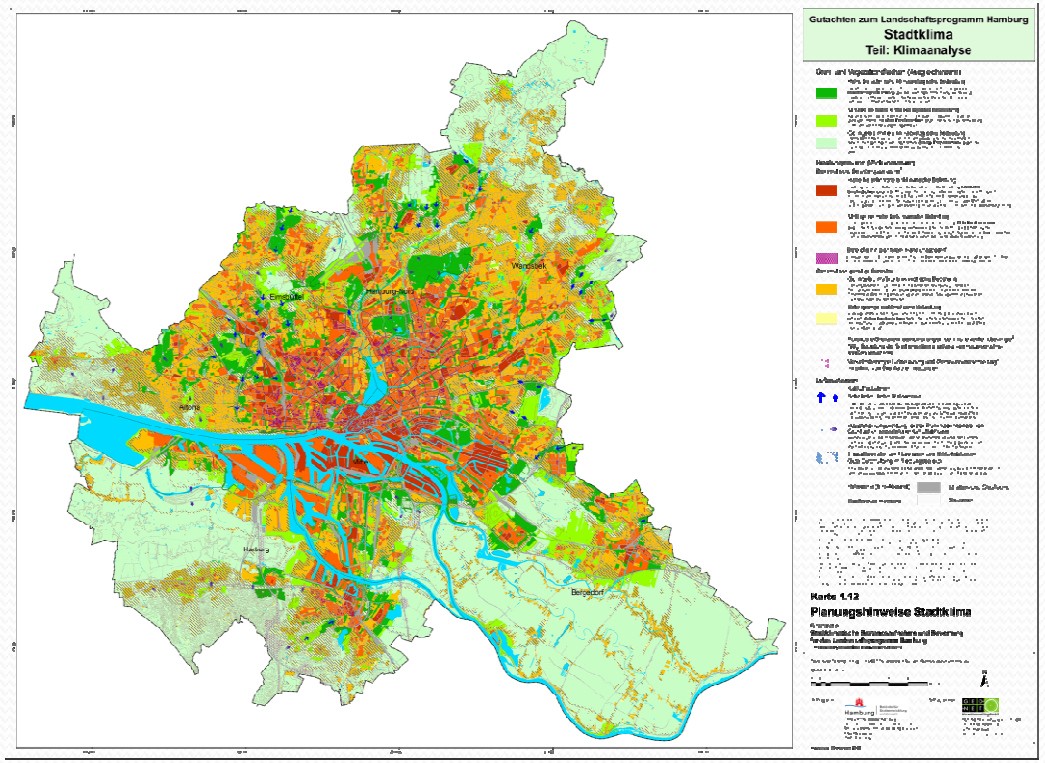
⇒ this should take place primarily through measures of internal urban development practices.

⇒ climate mitigation and adaption are now explicit goals of urban planning but amongst many other goals

⇒ **Supplementary urban planning concepts and plans must be considered but are not binding**

Adaptation measures: Hamburg Legislation

- ***Master Plan Climate Protection*** (2011): reduce CO_2 emissions about 40 % until 2020 and about 80 % to 2050 (reference 1990). The plan also outlines goals for climate change adaptation for the first time.
- ***Action plan adaption to climate change*** (2013): Provides measures against flooding, heavy precipitation and overheating (eg. Green roofing, building direction, maintaining ventilation corridors and vegetation)
- ***Landscape Programme*** (supplementary planning guideline) analysis of state of urban climate which provides guidance to for example maintain green corridors and ventilation corridors



Comparison

Approaches and tools	Beirut	Hamburg
Meteorological stations for observation/ measurement of UHI	• None	• Several networks of differing accuracy.
Decision-making tools to protect the urban climate	• None • TEB is proposed as a decision-making tool	• Urban climatic assessment and climate analysis map based on model FITNAH as basis of the landscape programme (GEO-NET, 2012). • Study of German Weather Service is currently in preparation.
Relevant urban policies and legislation	• UP Law #69 (1983) • Building Code #646 (2004) • Neither consider protection of the urban microclimate	• German Building code (BauGB) • Master plan climate protection • Action plan adaptation to climate change
Institutional framework	• No communication between relevant parties and clear lack of urban climatic knowledge amongst the decision-makers	• Increased awareness in the municipal administration. • No persistent framework but good cooperation within projects and studies.
Adaptation measures	• 2nd national communication to the United Nations Framework Convention on Climate Change -> some adaptation measures recommended for environment • none mention measures for the urban microclimate protection (MOE/GEF/UNDP, 2011).	• Green roof strategy, • Development of street trees. • Ventilation corridors

Conclusion

- When compared to Beirut, it is found that Hamburg is already quite well adapted to heat stress and much work has been carried out in this regard as outlined in the master plan climate protection, and the action plan adaptation to climate change.

- Although Hamburg is certainly privileged in some general conditions including economic, climatic and security factors, it might be concluded that Beirut can learn from the experiences of Hamburg and potentially implement similar measures to combat heat stress in the city.

Thank You

- In Beirut, no observations or data are available on the topic of the UHI.
- Beirut's Urban Planning Law #69 and Building Code #646 -> do not consider protection of the urban microclimate
- Major gap in climatic knowledge amongst urban planners and designers in Lebanon.
- In Hamburg observational data is available from several networks, which partly compensates that the German Weather service recently shut down some of its stations