An Urban Surface Scheme and Input Parameters

S. Schubert[1]*, S. Grossman-Clarke[2], A. Martilli[3], U. Böhm[1], F.-W. Gerstengarbe[1]

[1] Potsdam Institute for Climate Impact Research
[2] Arizona State University
[3] CIEMAT, Unidad de Contaminacion Atmosferice
*sebastian.schubert@pik-potsdam.de, Tel.: +49-(0)331-288-2592

The **multi-layer building energy parameterization** scheme (BEP) by Martilli et al. (2002) is currently implemented into the CCLM to enhance the application of the model to cities.

1. Description of BEP

1.1 Street Canyon Model

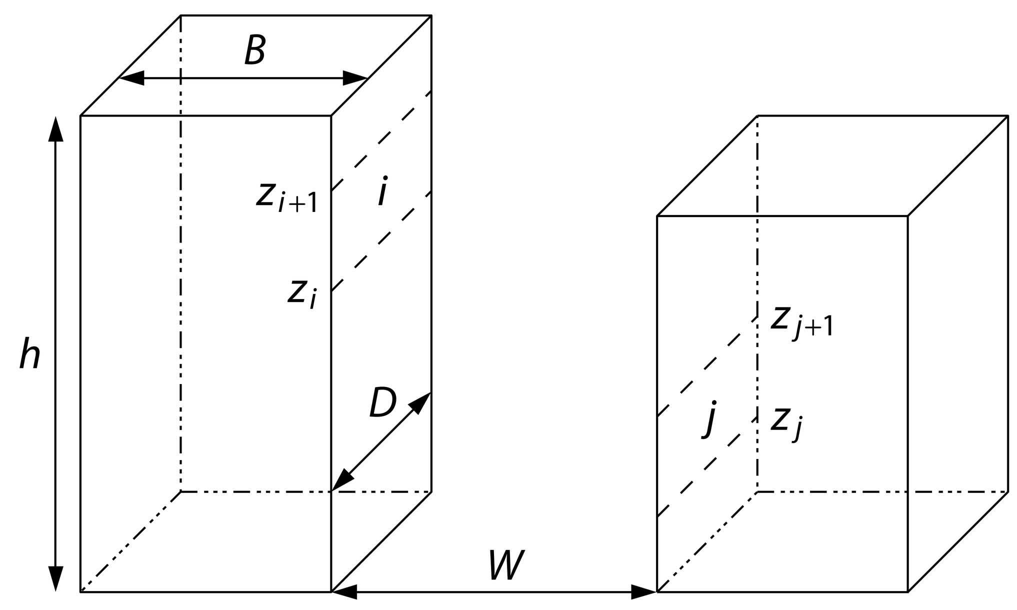
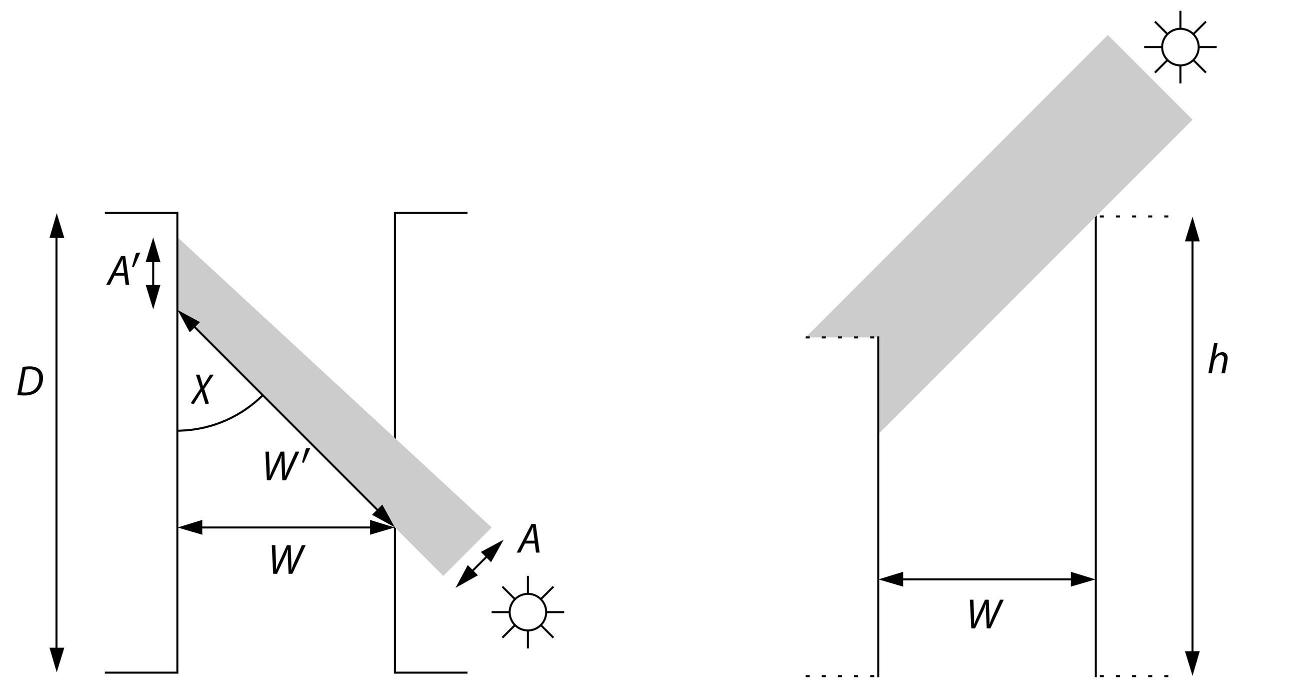


Figure 1: *Basic urban street canyon model (Martilli et al. 2002): canyon width D, building width B, street width W and canyon length D. For every grid cell, the distribution of the height h of the building is given by $\gamma(h)$. The urban layer is divided in several height levels i.*

1.2 Physical Processes

- **reduced sky visibility** (cf. fig. 2) and **reflections and emissions** from other urban surfaces (roofs, walls, roads)
- **one dimensional heat diffusion** for every urban surface
- **effects of urban surfaces on wind fields, temperature and TKE**
- **modified turbulent length scales**



(a) view from above (b) view from the side

Figure 2: *Visualization of the effective sunlit wall surface A′ and canyon width W′ in (a) and the shade effect in (b)*

1.3 Implementation and Enhancements

In the CCLM implementation, we will test potential enhancements of BEP:

- **treat roof surfaces consistently** with other urban surfaces,
- consider the **vertical distribution of buildings in the radiation transfer scheme of CCLM**,
- look for numerical techniques to **increase the calculation speed**,
- research **alternative street canyon representations** which include vegetation.

2. Derivation of urban parameters

Highly detailed urban building data (e.g. fig. 5) can be used to **derive different urban input parameters for every grid cell**. Our ansatz:

- building height probability $\gamma(h)$: area weighted heights of the buildings (cf. fig. 3),
- fraction cover of buildings: area of the building's ground surfaces (fig. 4),
- street direction: direction of wall surface,
- canyon width W: weighted average distance to other wall surfaces,
- other parameters: use the assumption that the total roof and ground surface of the buildings in every grid cell is equal to that in reality (Martilli 2009).

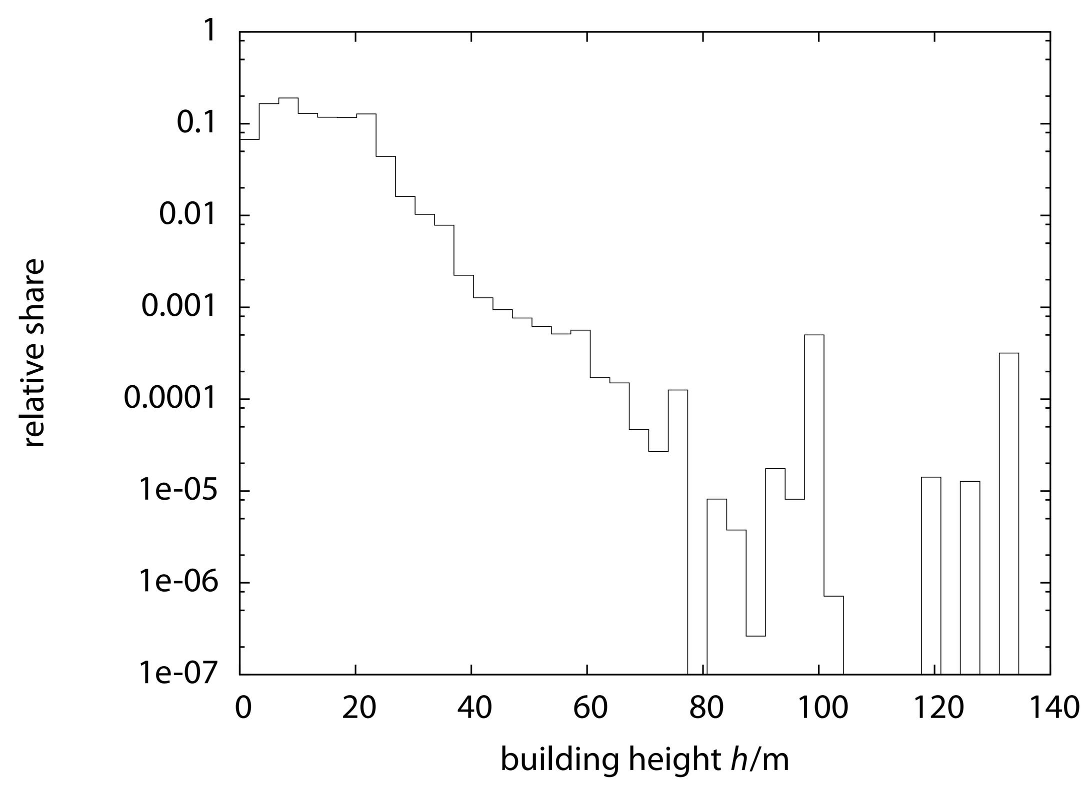


Figure 3: *Distribution of building heights in the city of Berlin (note the semi-logarithmic scale)*

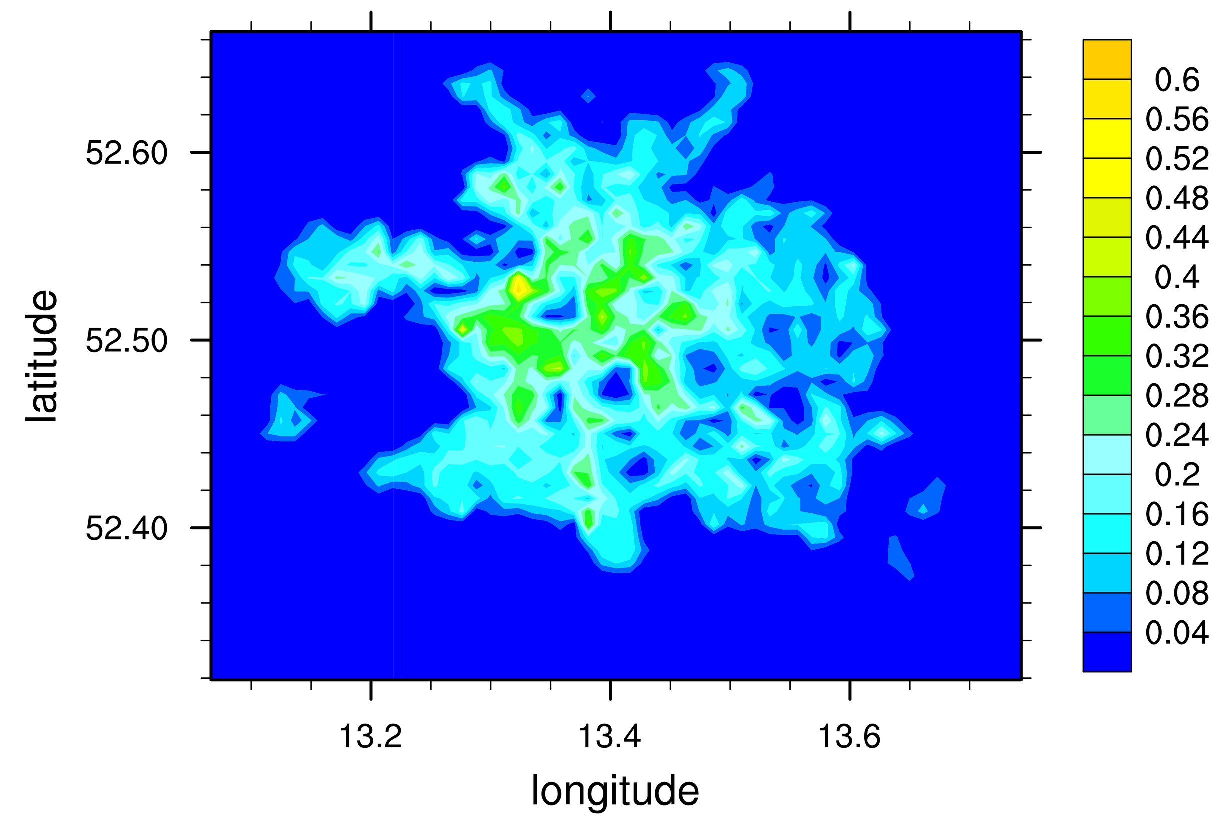


Figure 4: *Fraction of buildings in the city of Berlin (meridional grid spacing: 0.0069°, zonal grid spacing: 0.0117°)*

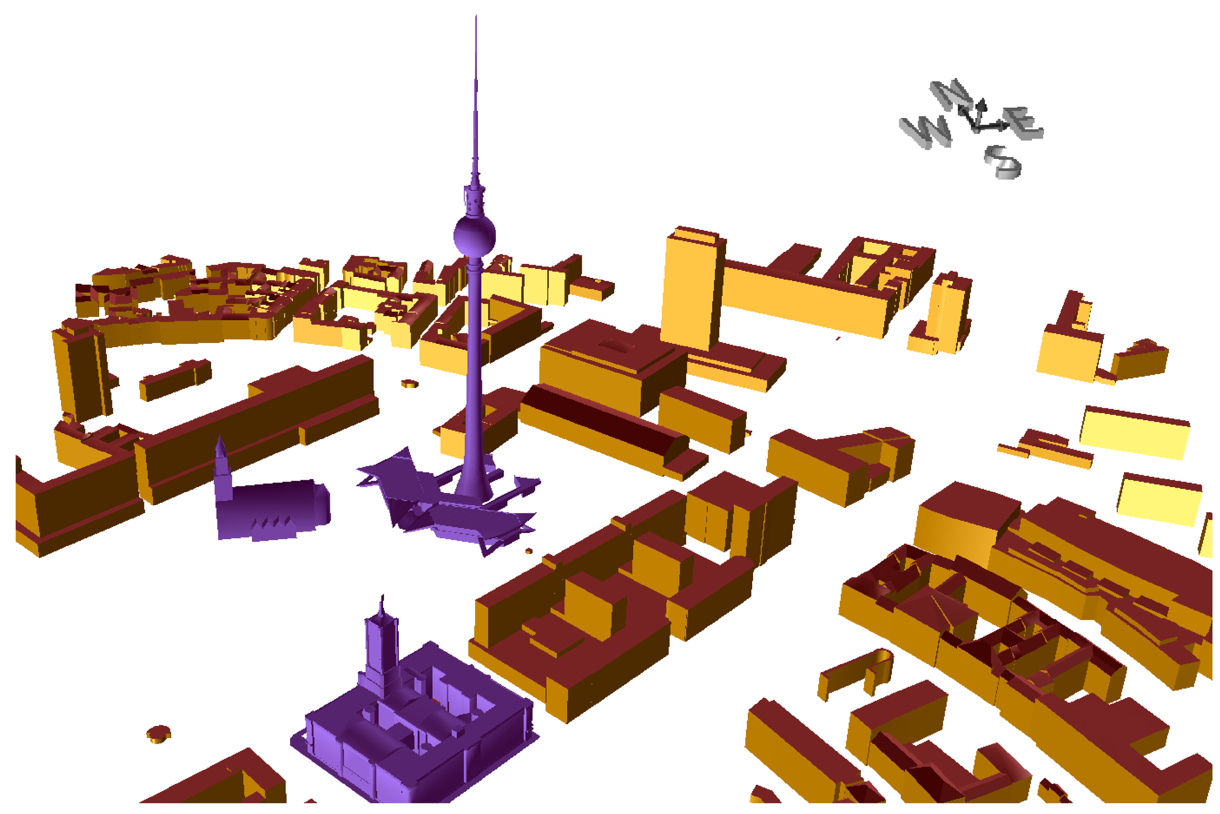


Figure 5: *Example of the 3d data used to derive the urban parameters: Berlin Alexanderplatz and the TV tower*

3. Acknowledgements

We like to thank the city of Berlin for the supply of the 3d Berlin data as well as the European Union for supporting the creation of this data through the European Regional Development Fund.

References

Martilli, A. (2009). 'On the Derivation of Input Parameters for Urban Canopy Models from Urban Morphological Datasets'. In: *Boundary-Layer Meteorology* 130.2, pp. 301–306.

Martilli, A., A. Clappier and M.W. Rotach (2002). 'An urban surface exchange parameterisation for mesoscale models'. In: *Boundary-Layer Meteorology* 104.2, pp. 261–304.