Geophysical Research Abstracts,
Vol. 11, EGU2009-7547-1, 2009
EGU General Assembly 2009

3D-modeling of the surface energy budget in an urban area

A. Brut, C. Albinet, J.-P. Gastellu-Etchegorry, E. Grau, N. Benech, and C. Suere
Universite Paul Sabatier, CESBIO, Toulouse Cedex 9, France (aurore.brut@cesbio.cnes.fr)

Cities are now at the heart of many environmental studies: energetic issues, pollution or local meteorology are topics that can affect the comfort of their inhabitants. As cities are built with a large variety of materials with heterogeneous canopies, radiative effects can strongly influence the 3D heat transfer within the canopy. For instance, the study of the urban heat island requires a good knowledge of the energy budget. Still, as some terms of this latter cannot be directly measured (e.g. the heat flux conduction), it is usually inferred from modeling which must be as accurate as possible. Therefore, it is important to correctly simulate the radiative processes and to account for the multiple reflections inside a canyon.
DART-EB (Discrete Anisotropic radiative transfer- Energy Budget) is being developed for simulating the 3D energy budget of urban and natural scenes, possibly with topography and atmosphere. Turbulent processes and heat conduction are simulated according to the TEB (Town Energy Budget) urban scheme (Masson, 2000). DARTEB uses the DART model for providing accurate simulations of radiative mechanisms: 3D radiative budget and remote sensing images (i.e. reflectances, brightness temperature values) of 3D scenes.
In this study, we will show an evaluation of the model performances. First, in the framework of the CAPITOUL experiment, DART-EB simulations of the energy balance were performed for two different streets of Toulouse and for two different IOPs. These simulations show good agreements with in-situ measurements for the surface temperatures and fluxes. Then, we will also present a sensitivity study of the model to various parameters (optical properties of urban surfaces, within building temperature, etc.) that can affect the energy budget.

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