3.6 OVERVIEW ON THE BASEL URBAN BOUNDARY LAYER EXPERIMENT – BUBBLE

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1 Introduction

BUBBLE stands for '**B**asel **U**r**B**an **B**oundary **L**ayer **E**xperiment' and is a research project directly associated to the European COST (co-operation in science and technology) initiative. Cost action 715 deals with 'Meteorology applied to urban air pollution problems'. The project, which was due to funding restrictions originally purely Swiss, has been growing rapidly since its start. By now many research groups from all over the world are participating (Table I). The philosophy of BUBBLE is based on the recognition that over complicated and essentially inhomogeneous urban surfaces both the near-surface turbulence exchange processes *and* the entire boundary layer structure have to be observed at the same time.

2 Observations

2.1 Surface observations

Two urban sites ('U' in Fig. 1) are operating since late fall 2001. Instrumentation includes:

- Turbulence profiles (6 to 7 levels) from street level up to a height larger than twice the obstacle height; Sonic anemometer at each level, fast-response hygrometers at some levels.
- Full radiation balance.
- Profiles of mean variables.
- Detailed measurements of the canyon thermal and radiative properties and turbulent fluxes of CO_2 are planned for short period (IOP).

Some more detail on the instrumentation at the urban sites and first results can be found in Christen et al. (2002a,b). At one suburban ('S') and several rural ('R') surface sites similar observations are being established. Also, turbulence statistics are measured up to a height larger than twice the local obstacle height in connection with the full radiation balance.

Over all, data from a period of almost a year will be available from the two urban sites and from a period of several months from the suburban and rural sites.

2.1 Remote Sensing

A Wind Profiler has been installed earlier in 2001 at site U2 and is continuously measuring the profile of mean wind speed since then. It is expected to be able to also retrieve profiles of some turbulence characteristics from these observations. An aerosol backscatter Lidar is also operating at site U2. Both these systems will be operated continuously until August 2002, i.e., for almost one year. Additional instrumentation to probe the urban boundary layer structure (SODAR, Profiler/RASS, tethered balloon) is foreseen for selected periods of operation (Fig.1).

Institution	**Area of interest**
ETHZ, CH	Co-ordination, near-surface turbulence, wind profiler
Univ. Basel, CH	Logistics, surface sites, near-surface turbulence
EPFL, CH	Numerical modeling
MeteoSwiss, CH	Wind profiler
Observatory Neuchatel, CH	Lidar
UBC, CA	Radiative and thermal properties of street canyon
University of W. Ontario, CA	Thermal properties of street canyon
Indiana University, USA	Urban energy balance
Ohio State University, USA	Street canyon energy budget and climate models
Natl. University of Singapore	Turbulent exchange in the urban roughness sublayer
University of Tasmania, AU	Radiative and thermal properties of street canyon
Forschungs-zentrum Karlsruhe, D	Near-surface processes; thermal structure of urban boundary layer
University of Freiburg, D	Urban boundary layer structure
TU Dresden, D	Near-surface processes
Univ. of Padova, I	Near-surface processes

Table I Institutions participating in BUBBLE together with their main field of interest.

2.3 Observational period

All the mentioned observational systems will *continuously* be operated until August 2002, i.e., for almost one year or at least several months. Additional instrumentation to probe the urban boundary layer structure (several Sodars, RASS, tethered balloon) is foreseen for a period of Intensive Operation, (IOP) in summer 2002. During this IOP, additional efforts will be undertaken to probe in detail the thermal and radiative properties of the street canyon at site U1 (Table I).

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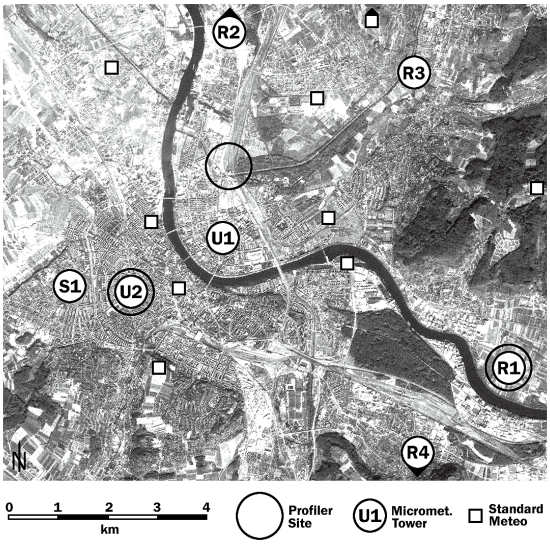

Figure 1 Satellite image of the City of Basel showing the position of the BUBBLE sites. 'Profiler site' refers to any type of remote sensing instrument (wind Profiler, sodar, or RASS).

3 Modeling

The observational activities within BUBBLE will yield a detailed data set covering the entire urban boundary layer over several months duration. This data set will be exploited in order to investigate, validate and possibly improve the surface exchange parameterization of Martilli et al. (2001a) that takes into account not only the rough character but also the modified thermodynamic and radiative properties of an urban surface. While the 'urban modification' in mesoscale numerical models is often restricted to modifying the roughness length (Craig and Bornstein, 2001) or only takes into account the thermodynamic aspect (e.g., Masson 2000), this approach allows for assessing the *relative* importance of roughness and thermodynamic properties, respectively over urban surfaces (Martilli 2002). Martilli et al. (2002a) show that this surface exchange parameterization is able to reproduce many observed near-surface turbulence characteristics and Martilli et al. (2002b) successfully apply the numerical model in a case study in the region of Athens.

Dispersion modeling in the city of Basel will be performed using the approach of Rotach (2001), in which a Lagrangian particle dispersion model has been modified in such a way that observed near-surface turbulence characteristics are reproduced. Tracer experiments over urban surfaces are successfully reproduced with this model. BUBBLE will provide more turbulence data from different types of urban surfaces in order to improve the employed empirical turbulence parameterizations. Also, a tracer experiment will be realized with a low source height in the vicinity of roof level taking advantage of the detailed meteorological measurements during the experiment. De Haan et al. (2001) have modified a Gaussian plume dispersion model in a similar manner and have obtained large improvements with respect to 'traditional' approaches when simulating yearlong NO_x surface concentrations in the city of Zürich. Similar simulations will be performed for the city of Basel using the network pollutant observations available there as a reference.

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