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EDITORIAL

Preface: The LITFASS-2003 experiment

F. Beyrich · H. A. R. De Bruin ·
D. Etling · T. Foken

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The success of weather forecasting and climate prediction essentially depends on our ability to understand and describe the energy and water cycles at various spatial and temporal scales. This has been recognised by the WMO in initiating the Global Energy and Water Cycle Project (GEWEX) as one of the major research activities within the framework of the World Climate Research Programme (WCRP). GEWEX covers measurements and modelling activities from the local up to the global scale and also provides an umbrella for a number of so-called continental-scale experiments (CSEs) that focus on the investigation of various aspects of the energy and water cycles in different geographic and climate regions of the earth. Recently, the efforts from the different CSEs have been brought together during a two-year Coordinated Enhanced Observation Period (CEOP) by combining long-term observations at a number of globally distributed reference sites, the analysis of global satellite data products and global climate model simulations in a number of the leading climate research centres of the world (Lawford et al. 2004).

The international Baltic Sea Experiment (BALTEX) as the European contribution to GEWEX is intended to describe and quantify the energy and water budget over the Baltic Sea Drainage Basin, an area of about $2 \times 10^6\ \mathrm{km}^2$ covering large parts of

F. Beyrich
German Meteorological Service, Meteorological Observatory Lindenberg,
Tauche, Germany

H. A. R. De Bruin
Meteorology and Air Quality Section, Wageningen University and Research Centre
Wageningen, The Netherlands

D. Etling
Institute of Meteorology and Climatology, University of Hannover,
Hannover, Germany

T. Foken (✉)
Department of Micrometeorology, University of Bayreuth,
Bayreuth, Germany
e-mail: Thomas.Foken@uni-bayreuth.de

northern and central Europe (Raschke et al. 2001). Within BALTEX a strong focus has been set from the beginning on the investigation of interaction processes between the atmosphere and the vegetated land surface, with a special emphasis on the proper consideration of the land-surface heterogeneity. The adequate description of land-surface—atmosphere interaction processes is essential for the success of numerical weather prediction (NWP) and climate models in simulating near-surface weather and climate conditions. Recognising existing deficits in this field, the GEWEX Atmospheric Boundary Layer Study (GABLS) programme has been established recently and is especially devoted to the representation of the atmospheric boundary layer in climate models (Holtslag and Randall 2001).

Moreover, since the interplay between the atmosphere, biosphere, pedosphere and cryosphere occurs at the land surface, this is the field where the actual requirements of climate research meet the needs of ecological studies. Land-surface atmosphere interaction studies have therefore been a part of the International Geosphere-Biosphere Programme (IGBP) as well. Recently, the main results from the BAHC project (Biospheric Aspects of the Hydrological Cycle) have been published by Kabat et al. (2004), and a new project iLEAPS (integrated Land-Ecosystem-Atmosphere Process Study) of the IGBP has just been initiated in order to proceed along this line of important studies. The reason for this long list of research activities lies in the topic itself: the complexity of the climate system with all of its non-linear interaction processes at a variety of temporal and spatial scales. Moreover, new sophisticated experimental methods and a better understanding of the processes and their parameterisation in high-resolution models make new phenomena visible and give a more comprehensive picture of our natural environment. Only the better understanding of these processes creates the opportunity to predict these also for a changing environment.

The LITFASS-programme (Lindenberg Inhomogeneous Terrain Fluxes between Atmosphere and Surface: a long-term Study, Beyrich et al. 2002) of the German Meteorological Service (Deutscher Wetterdienst, DWD) was initiated in the 1990 s in order to contribute to these efforts. LITFASS was aimed at studying the momentum and energy exchanges between a heterogeneous land surface and the atmosphere over an area of a typical grid element of a NWP model. The programme covers both long-term monitoring activities and process studies within the framework of field experiments. It focuses on a 20×20 km^2 area around the Meteorological Observatory Lindenberg (Richard-Aßmann-Observatory) of the DWD. Networks of energy balance stations, radiometers and raingauges have been set into permanent operation in this area supplemented by a complex array of remote sensing systems at the observatory site. A first field experiment (LITFASS-98) was organised in 1998 in order to collect a dataset suited for model verification with respect to the surface fluxes over this heterogeneous area (Beyrich et al. 2002). The main results from this campaign were published in a special issue of ‘Theoretical and Applied Climatology’ (73: 1–2, 2002). LITFASS-98 also was the start of a long-term collaboration between DWD and the Meteorology and Air Quality Group of the Wageningen University on the applicability of scintillometry over heterogeneous terrain. Based on the experiences from LITFASS-98, a second field experiment (LITFASS-2003) had been planned and organised with a special focus on the area-averaging of evaporation at the scale of a grid box of a regional atmospheric model or the pixel of a satellite image. LITFASS-2003 was the experimental component of the research project EVA-GRIPS (Regional Evaporation at Grid/Pixel Scale) which integrated experimental and modelling activities. This special issue of Boundary-Layer Meteorology gives an overview about the experiment and presents selected results of the data analysis and modelling activities.

The first contribution (Beyrich and Mengelkamp) gives an introduction to the EVA-GRIPS project and the study area, and also provides the background information about the measurement systems and weather conditions during LITFASS-2003. The measurement program during LITFASS-2003 comprised flux measurements from the local up to the regional scale by the use of micrometeorological stations, ground-based remote sensing and airborne measurement systems. Results from these measurements are discussed in the following papers: a network of 14 energy balance stations over different agricultural fields, grassland, forest and lakes was used to derive area-averaged fluxes using the tile approach for grid elements (Beyrich et al.). To form these so-called flux composites the single-site data were selected according to their internal quality and taking into account footprint and fetch considerations (Mauder et al.). Long-path scintillometers were operated over distances of between 3 km and 10 km during LITFASS-2003 in order to derive area-averaged surface fluxes. A large-aperture and a millimetre-wave scintillometer were used together to determine sensible and latent heat fluxes simultaneously over a path of 4.7 km length (Meijninger et al.). For the 10 km path saturation became a relevant issue, and this problem is discussed in a technical study (Kohsiek et al.). Independent area-averaged flux estimates were obtained from the Helipod, a turbulence probe carried by a helicopter (Bange et al.).

The modelling work included the use of two non-hydrostatic mesoscale models, namely the ‘Lokalmodell’ (LM, Steppeler et al. 2003), the current operational NWP model at DWD, and the FOOT3DK of the University of Cologne. The influence of the treatment of surface heterogeneity and of the use of improved external surface parameters derived from in-situ measurements and remote sensing on the fluxes simulated with LM is investigated in the two following papers (Ament and Simmer, Heret et al.). The final contribution (Heinemann and Kerschgens) deals with the comparison of measured and modelled area-averaged fluxes using different model grid resolutions.

The present collection of papers presents important results from the LITFASS-2003 experiment and from the modelling activities within EVA_GRIPS, even through it may not cover all aspects of the analysis performed so far. Ongoing activities include, e.g., large-eddy simulations of the atmospheric boundary-layer structure over the LITFASS area and studies on the energy balance closure. The dataset collected during LITFASS-2003 and comprising quality-controlled flux data at different scales is a valuable data source for further research activities. This should include the improvement of the flux parameterisations for numerical models at different scales, which was one of the central issues formulated at the beginning of the LITFASS-project (Müller et al. 1995). This can only be achieved by a close cooperation of modellers and experimentalists.

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