The Prologue

Micrometeorology refers to the branch of meteorology that is concerned with atmospheric phenomena and processes at the lower end of the spectrum of atmospheric scales, i.e. microscale, small-scale or local-scale processes (see e.g. Arya, 2001). In this context, studies on micrometeorology are centred on that part of the lower troposphere directly influenced by the underlying surface, i.e. the atmospheric or planetary boundary layer (ABL, PBL). Stull's definition of the ABL was based on a consideration of the depth over which responses to surface forcings take place over a timescale of one hour or less (Stull, 1988). Although the ABL depth comprises just a small fraction of the troposphere, knowledge of its dynamics and characteristics is important as this is the region that supports life, human activities and vegetation.

One of the main characteristics of the ABL is its degree of turbulence, and much research into the ABL is devoted to studying exchanges of heat, mass, momentum, humidity and other scalars (e.g. pollutants) that occur throughout the earth's atmosphere, and which are particularly important near the earth's surface. In fact, turbulent mixing is responsible for the efficient transmission of surface friction, heating, etc., to the whole of the ABL. If turbulence were not present, transfer processes between the surface and the atmosphere would occur only at molecular scales, and would be very small in magnitude. Furthermore, large-scale weather systems and general circulations would not be driven throughout the ABL.

Research in micrometeorology can be done through different approaches, which can be classified into two broad groups *viz.*, experimental and modelling studies. In this special issue of *Física de la Tierra*, fifteen papers are presented where different aspects of micrometeorology are featured: applied studies, theoretical developments, experimental field campaigns, data analyses, laboratory experiments, different modelling approaches, etc.

The stable boundary layer (SBL) has featured as one of the key areas for research in recent years. Several papers pertaining to the SBL are included in this issue. Maguire et al. present a study of the depth of the stably-stratified boundary layer overlying a shallow uniform slope using large-eddy simulations (LES), pointing out the importance of performing fully 3-D simulations for studies of the SBL overlying sloping terrain. In another paper focussing on the SBL, Martínez & Cuxart analyse a katabatic flow in the isle of Majorca (western Mediterranean Sea) using a high resolution mesoscale model. Their study highlights the importance of buoyancy forces and changes in the slope angle. Recent results from the experimental field campaign SABLES2006 centred on SBL are presented in Yagüe et al. Mean micrometeorological variables, stability and turbulent parameters from ten consecutive nights were analysed. Viana et al. used the SABLES2006 data set to explore surface pressure fluctuations obtained from high accuracy microbarometers. Such pressure fluctuations are generated by waves and turbulence. Wavelet transforms were used to analyse their properties.

Important aspects of micrometeorological studies include applications related to air quality, and to turbulent exchanges with the surface. In this context, San José et al. introduce OPANA (OPerational Atmospheric Numerical model for urban and regional Areas) which provides information about the pollution in areas surrounding industrial plants and which can also be used to forecast the air quality in a whole city or region. Ozone can be a dangerous component in the lower atmosphere and Beneito et al. show an operational model system that incorporates meteorological, emission and photochemical modules, to forecast surface ozone concentrations. They also perform a sensitivity analysis for the different areas simulated. With regards to CO_2 exchanges, María Luisa Sánchez et al. present experimental results to identify the main driving factors governing the Net Ecosystem Exchange (NEE) in an agricultural area, looking for the influence of the NDVI vegetation index on gross primary production in the growing season.

Several papers on the modelling of the atmospheric boundary layer from different perspectives (mesoscale, CFD, or climatic models) are presented in this issue. Vilà-Guerau de Arellano & Casso-Torralba simulate, using MM5, three consecutive days with a weak synoptic forcing in order to analyse the radiation and energy budget. They study the sensitivity of these budgets to surface properties such as albedo and the soil moisture content. The sensitivity of boundary layer characteristics to variations in surface turbulent fluxes is also explored. Their results are compared with observations from the instrumented meteorological tower at Cabauw. Martilli et al. apply CFD models to urban micrometeorology, analysing 3-D flow structures created by the urban geometry and validating the simulations with wind tunnel measurements. Soares et al. propose an eddy diffusivity/mass flux parameterization based on the turbulent kinetic energy equation, which is a unified approach to convective boundary layer modelling. This scheme is implemented in a one-dimensional version of the MesoNH model and tested for the case of a dry convective boundary layer. Enrique Sánchez et al. simulate, with a regional climate model, present and future climatic conditions, analysing the turbulent kinetic energy, as well as surface fluxes, which provides additional information about climatic change compared to that available from standard analysis. The study is focused over the Iberian Peninsula, where a higher temperature increase is expected compared to the rest of Europe, especially in summer.

Another important topic in micrometeorological studies is the cloudy boundary layer. Two papers deal with this subject. A theoretical approach to the thermodynamics of cumulus clouds can be found in the work of Stephan de Rode, where mixing diagrams are used to explore the development of buoyancy reversal from the mixing of undiluted cumulus cloud air with clear air from the clear environment. Terradellas and Bergot explore the forecasting of short-term fog and low-clouds by comparing simulations from two one-dimensional models. The importance of the initialization and the consideration of horizontal heterogeneities are highlighted.

Geophysical fluid dynamics laboratories are often used to simulate experiments applied to boundary layer meteorology. López González-Nieto et al. present laboratory experiments on mixing efficiency, which is an alternative way to study turbulent mixing in the ABL. They use an experimental model with two miscible fluids of different density under an unstable stratification.

Statistical models are an important tool for obtaining a more detailed description of smaller scales processes in the atmosphere. Dmitriev et al. consider, from numerical simulations, the problem of the temporal error estimate for statistical downscaling models, showing that it is possible to recognize *a priori* such cases when these models reconstruct the small-scale field with a high error.

Finally, we wish to inform the reader that the goal of this special issue on micrometeorology is to present a showcase of the main research lines in this field carried out by Spanish scientists, as well as by a number of authors from the wider international community.

REFERENCES

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