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978-1-107-09094-1 - Atmospheric Boundary Layer: Integrating Air Chemistry and Land Interactions

Jordi Vilà-guerau De Arellano, Chiel C. Van Heerwaarden, Bart J. H. Van Stratum and Kees Van Den Dries

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ATMOSPHERIC BOUNDARY LAYER Integrating Air Chemistry and Land Interactions

Based on more than 20 years of research and lecturing, Jordi Vilà-Guerau de Arellano and his team's textbook provides an excellent introduction to the interactions between the atmosphere and the land for advanced undergraduate and graduate students and a reference text for researchers in atmospheric physics and chemistry, hydrology, and plant physiology. The combination of the book, which provides the essential theoretical concepts, and the associated interactive Chemistry Land-surface Atmosphere Soil Slab (CLASS) software, which provides hands-on practical exercises and allows students to design their own numerical experiments, will prove invaluable for learning about many aspects of the soil-vegetation-atmosphere system. This book has a modular and flexible structure, allowing instructors to accommodate it to their own learning-outcome needs.

JORDI VILÀ-GUERAU DE ARELLANO, CHIEL C. VAN HEERWAARDEN, BART J. H. VAN STRATUM, AND KEES VAN DEN DRIES were all members of the Meteorology and Air Quality Section at Wageningen University in the Netherlands at the time of the major development of this book and software. The level of integration achieved in this book and software has only been possible because of the complementary backgrounds and expertise of the authors. Jordi Vilà-Guerau de Arellano has more than 20 years of research and teaching experience in the fields of atmospheric modeling and the atmospheric boundary layer. He has written more than 80 papers, placing special emphasis on cross-disciplinary activities in land and atmospheric science. Chiel van Heerwaarden has made fundamental contributions to integrating our understanding of land and atmospheric processes, with special emphasis on the development of conceptual and numerical models. Bart van Stratum is currently researching several aspects of shallow convection. Kees van den Dries is a specialist in atmospheric chemistry and computer systems.

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Integrating Air Chemistry and Land Interactions

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CLASS Software

The open-source Chemistry Land-surface Atmosphere Soil Slab (CLASS) model can be downloaded free of charge from [www.cambridge.org/vila]. The software runs on default installations of Microsoft Windows (XP, 7 and 8) and Mac OS X (10.6–10.10), and can be compiled on Linux distributions supporting Qt (versions 4 and 5). The source code is hosted by GitHub (<http://classmodel.github.io/>), where incremental updates to the code can be found. Major bug fixes and updates will always be made available through updates on the Cambridge website.

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Preface

Buffering the free atmospheric conditions from the soil-vegetation properties, the atmospheric boundary layer (ABL) is the region in which the wind, temperature, moisture, and atmospheric constituents change from the large atmospheric scales to the biosphere conditions. Over land, the ABL is characterized by a strong diurnal variability (daylight hours) that presents a challenge to modelling studies and observational interpretation. The first purpose of this book is to introduce the reader systematically to the most important biogeochemical and physical processes that take place in the ABL. A flexible user-friendly model of these processes called Chemistry Land-surface Atmosphere Soil Slab (CLASS) was developed to enable the reader interactively and independently to investigate the behaviour of the diurnal ABL over land. Our second aim is to enable the reader to discover freely the interactions and couplings that occur between the atmosphere and land, and to determine their impact on cloud formation, changes in greenhouse gas concentrations, and atmospheric chemistry. To this end, we decided to represent the main fundamental processes in the atmosphere-biosphere system, while retaining the essential components of the physical and biogeochemical processes involved. We have therefore attempted to move beyond individual disciplines to investigate their mutual interrelationships and feedback, laying special emphasis on the conceptualization of the problem. Finally, the interactivity and modular character of the book will make it very useful as a means of interpreting measurements made during experimental campaigns and deepening our understanding of more complex large-scale biogeochemical atmospheric models.

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