Book review

Chemistry of the climate system

DOI 10.1515/gps-2015-0002

Detlev Möller
2nd, fully revised and extended edition
De Gruyter, 2014
Hardcover, XX+786 pp.
Price: €179.95
ISBN: 978-3-11-033080-9
e-ISBN (EPUB): 978-3-11-038230-3
e-ISBN (PDF): 978-3-11-033194-3

The book gives a very detailed overview on chemical processes related to the conversion, storage and transport of climate-related substances. The role of the most climate-relevant chemical elements and their most important compounds is discussed in the framework of the geological and biological evolution on Earth and with respect to the recent global situation and the impacts of human activities on the composition of the atmosphere and their effect on climate changes. The explanation of the role of different substances and their interaction with each other and with water, soil and ecosystems is supported by the key chemical reaction equations and reaction networks as well as by a lot of measurement data from stations all over the world, among them examples from the author's own research. The presented data reflect both the recent global situation and historical developments. They emphasize the enormous importance of the biosphere for ancient and recent atmosphere and climates on Earth. And they prove the clear evidence for the massive influence of mankind on the climate system by consumption, conversion and release of many chemical elements and substances.

The author shows, very impressively, the complex network of interactions and makes clear, at the same time, that important factors and processes of climate chemistry are now well understood. The explanation of complexity is complemented by a lot of facts and suggestions for conversion of the recent non-sustainable economy into a sustainable global energy supply and use of resources.

The importance of chemical processes for the recent climate, the climate history and probable future is treated from different points of view including: atmosphere chemistry, carbon and hydrocarbon use, chemistry of energy supply, biogeochemical cycles, hydrosphere processes and human activities. Details of emission and conversion of substances and transport in the air, soil and oceans are described in all these fields and illustrated by impressive examples of data. A chapter with textbook basics of physical chemistry is included in order to support the quantitative understanding of the treated processes, particular in the atmosphere.

The book is subdivided into an introduction, four main chapters and a short chapter with final remarks. The introduction reflects on the most important historical steps in the understanding of the nature of air from ancient to recent times. The second, large chapter deals with the most important groups of effectors on climate. Under the title "Chemical evolution" eight subchapters shed light on the pre-biological evolution of the Earth and of the atmosphere, the energy sources on Earth, the biosphere and biogecochemical cycles, the role of water and the hydrosphere, the sources of atmospheric components and emission processes of nitrogen, sulfur and carbon compounds into the atmosphere as well as the influence of mankind on the air and climate by the release of CO_2 and other climate-relevant substances. The following chapter entitled "Climate, climate change and the climate system" is much shorter. It deals with some general aspects of climate research and climate variability and illustrates the impact of human activities on the composition of the atmosphere and precipitation by showing many measurement examples. The next chapter presents the physical and physicochemical fundamentals for understanding gases, chemical reactions and multiphase systems and includes aspects of thermodynamics, chemical kinetics, interfaces and dispersal systems. Finally, the last of the main chapters describes the climate-effecting particular bio-relevant compounds of hydrogen, oxygen, nitrogen, sulfur, phosphorus and halogens and their reactions in the atmosphere in separate sub-chapters.

The main topics of the book are introduced by nice overviews on the history of the related scientific areas. The progress on thinking on climate, evolution and chemistry of atmosphere is described both from the point of view of empirical research and philosophical reflection. Thus, the author brings the historical development of recognition in

most important branches of climate-relevant science and the recent insights into the chemical and physical mechanisms into a very general scientific framework. Sometimes the reader may miss, at the end of single chapters, the completion of this frame by some conclusion or assessments after the presentation of the details.

In addition to the book chapters, the reader profits from the extended appendix. It includes not only a list of abbreviations and acronyms and a subject index but also tables of units and natural constants, a very large list of references and short biographies of many important researchers. For a future edition, it is suggested to enhance the power of many data-presenting figures by more distinguishable symbols. It might be helpful to give some other or additional units beside the used units [e.g., Megatons (Mt) in case of Tg].

The reader expecting an "easy-to-read" compact monograph or a pure chemistry textbook on climate-relevant processes may be disappointed perhaps by the high number of special problems that are explained and the demanding mixture of specific measurement data and research results, scientific fundamentals, historical excurses and philosophical remarks. But the student or researcher who likes to get a sound overview on the complex world of climate-relevant environmental chemistry and on the recent state of the art of research and the resulting inter-disciplinary challenges will get enormous benefits besides learning about the chemistry of the atmosphere from the stimulating synoptic presentation of climate-related aspects of atmosphere physics and geology, biology and evolution, industrial production and material use, energy supply and exploitation of resources, economy and ecology, science history and global climate development.

J. Michael Koehler
Institute of Micro- und Nanotechnology/Institute for Chemistry and Biotechnology
Department of Physical Chemistry and Microreaction Technology
University of Technology Ilmenau
PO Box 10 05 65
98684 Ilmenau
Germany
E-mail: michael.koehler@tu-ilmenau.de