Authors preface to the second edition

Now, 4 years after the publication of the first edition of *Chemistry of the Climate System*, we see continued growth in the scientific literature and in particular new insights in the field of atmospheric aerosol (fine PM and especially the role of biological material) but also in HNO_2 and OH chemistry; however, it is not my aim to consider them all in the second edition, giving an actual review. My intention is, rather, to provide the reader a monograph textbook for a deeper understanding of physicochemical processes in a very complex system composed of different states of matter (gas, liquid, and solid) within different reservoirs, specifically the atmosphere, hydrosphere, lithosphere, and biosphere (the *climate system*). Scientific progress is measured in large strides in the fundamental sciences – laboratory and theoretical studies. Nevertheless, studying complex environmental processes by "outdoor" studies (field experiments) – and even extending one reservoir or phase – became extremely complicated and was carried out in the decade or two only in large projects that included many institutes and scientists. Our knowledge also increased and feedback for detailed laboratory work was produced. Better understanding of the climate system acquired by a deeper consideration and coupling of subsystems, most of the entire atmosphere with the oceans (e.g., explaining the discrepancy between a further rise in atmospheric CO_2 and stagnant air temperature). In addition, the biosphere was revealed to be much more complex in its feedbacks to atmospheric changes (the still unanswered question of where all the CO_2 remains). Unfortunately, controlling our climate system is much more far off compared to our understanding 4 years ago. Economics largely disregards results from climate research. Visible, human-caused catastrophes, such as the Fukushima Daiichi nuclear disaster, did result in any forward-looking changes to the energy mix or a transition to solar technologies but led backward to coal combustion, exacerbating the CO_2 problem. Climate change is likely not a catastrophe in a traditional way; rather, it is a slow process with winners and losers (humans, animals, and plants). I hope that this new edition of *Chemistry of the Climate System* will find new readers who want to learn more about our climate system. Knowledge is the key to sustainable development and to realizing that the benefits accruing to winners will pale by comparison to the penalty the losers will pay. Needless to say, (I hope) all errors have been corrected, information (especially monitoring and emission data) has been updated, many figures have been improved, several paragraphs were rewritten for clarity, and new key knowledge has been added in this edition. Moreover, two new sections on "chemical climatology" have been added: precipitation and cloud chemistry monitoring. The chapter on atmospheric trace species was enlarged to include a discussion of hydrochloric acid, nitrous acid, and nitric acid with its salty PM.

Last but not the least, I would like to express my profound gratitude to my coworkers who accompanied me over many years, even decades, in atmospheric chemistry; without them this book would have been impossible [*I corrected the*

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periods with this 3rd edition]: Karin Acker (1988–2014), Wolfgang Wieprecht (1982–2019), Günther Mauersberger (1983–2006), Renate Auel (1987–2008), Gisela Hager (1987–1997), Jürgen Hofmeister (1988–2017), and Dieter Kalass (1992–2018). Many others, not named here, were part of my group for "only" a few years. We had a great time, with many highlights in atmospheric chemistry in the 1980s and 1990s.

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