

Series Preface

With remarkable vision, Prof. Otto Hutzinger initiated *The Handbook of Environmental Chemistry* in 1980 and became the founding Editor-in-Chief. At that time, environmental chemistry was an emerging field, aiming at a complete description of the Earth's environment, encompassing the physical, chemical, biological, and geological transformations of chemical substances occurring on a local as well as a global scale. Environmental chemistry was intended to provide an account of the impact of man's activities on the natural environment by describing observed changes.

While a considerable amount of knowledge has been accumulated over the last three decades, as reflected in the more than 70 volumes of *The Handbook of Environmental Chemistry*, there are still many scientific and policy challenges ahead due to the complexity and interdisciplinary nature of the field. The series will therefore continue to provide compilations of current knowledge. Contributions are written by leading experts with practical experience in their fields. *The Handbook of Environmental Chemistry* grows with the increases in our scientific understanding, and provides a valuable source not only for scientists but also for environmental managers and decision-makers. Today, the series covers a broad range of environmental topics from a chemical perspective, including methodological advances in environmental analytical chemistry.

In recent years, there has been a growing tendency to include subject matter of societal relevance in the broad view of environmental chemistry. Topics include life cycle analysis, environmental management, sustainable development, and socio-economic, legal and even political problems, among others. While these topics are of great importance for the development and acceptance of *The Handbook of Environmental Chemistry*, the publisher and Editors-in-Chief have decided to keep the handbook essentially a source of information on "hard sciences" with a particular emphasis on chemistry, but also covering biology, geology, hydrology and engineering as applied to environmental sciences.

The volumes of the series are written at an advanced level, addressing the needs of both researchers and graduate students, as well as of people outside the field of

“pure” chemistry, including those in industry, business, government, research establishments, and public interest groups. It would be very satisfying to see these volumes used as a basis for graduate courses in environmental chemistry. With its high standards of scientific quality and clarity, *The Handbook of Environmental Chemistry* provides a solid basis from which scientists can share their knowledge on the different aspects of environmental problems, presenting a wide spectrum of viewpoints and approaches.

The Handbook of Environmental Chemistry is available both in print and online via www.springerlink.com/content/110354/. Articles are published online as soon as they have been approved for publication. Authors, Volume Editors and Editors-in-Chief are rewarded by the broad acceptance of *The Handbook of Environmental Chemistry* by the scientific community, from whom suggestions for new topics to the Editors-in-Chief are always very welcome.

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Editors-in-Chief

Volume Preface

This book presents the Pantanal wetland in a singular perspective where the reader can envisage changes in the Pantanal landscape under variable lenses of time and space, since its early formation to the actual and likely future states. The book reveals that today's Pantanal is an evolutionary sequence of geologic, ecologic, and more recently manmade events taking place at distinct space-time frequencies. Under this perspective, the notion of preserving the Pantanal wetland "as today" in the long term is somehow idealistic, as much stronger planetary forces are involved in its dynamics and configuration.

Geotectonics and Sun–Earth interaction largely dictate the rate of drastic environmental changes that eventually disrupt the ecological stability, radically rebuilding the regional landscape as already occurred in the past. Warren et al. (chapter "Underneath the Pantanal Wetland: A Deep-Time History of Gondwana Assembly, Climate Change, and the Dawn of Metazoan Life") show that Precambrian rocks that form the hills, locally known as "morrarias," register the supercontinent assembling, the origin of metazoans like *Cloudina* and *Corumbella*, and past climate changes. On the other hand, at intermediate timescales, the biota-climate system is a major driver reshaping the ecohydrology functioning in the landscape. Assine et al. (chapter "Geology and Geomorphology of the Pantanal Basin") provide evidences that the Pantanal is an active sedimentary basin with faults and associated earthquakes that delimit the most flood-prone areas and point that geomorphology is the product of climatic fluctuations and environmental changes that have been occurring since the Late Pleistocene. McGlue et al. (chapter "Paleolimnology in the Pantanal: Using Lake Sediment Archives to Track Late Quaternary Environmental Change in the World's Largest Neotropical Wetland") suggest that severe widespread drought is the response of the Pantanal to high-latitude glaciation, perhaps due to linkages among effective precipitation, ITCZ position, and North Atlantic sea surface temperatures. Assine et al. (chapter "Avulsive Rivers in the Hydrology of the Pantanal Wetland") illustrate that avulsions and bottlenecks dictate geomorphology, hydrodynamics, and the ecohydrology of the Pantanal wetland. The models and evidences presented in chapter

“Avulsive Rivers in the Hydrology of the Pantanal Wetland” is a step further in the comprehension of the Pantanal hydrodynamics.

Very recently, in the Anthropocene, short-term timescale changes in ecohydrology and biodiversity are due to both land-use and in course climate change. Chapter “Terrestrial and Aquatic Vegetation Diversity of the Pantanal Wetland” by Pott and Silva is a comprehensive review of aquatic and terrestrial vegetation diversity in the Pantanal, demonstrating how manmade land-use has been altering the vegetation landscape. Pott and Silva conclude that vegetation is very resilient and flexible and adapts to wet-and-dry seasonal and decadal cycles, including fire, and shall remain diverse as long as the hydrological balance is not disrupted by homogenization toward either an entirely dry or a fully wet system. Bergier et al. (chapter “Metabolic Scaling Applied to Native Woody Savanna Species in the Pantanal of Nhecolândia”) show for the Nhecolândia subregion how forest biomass allocation, independently of the species, follows the metabolic scaling theory, though close-to-soil groundwater makes the ratio below/above biomass lower than unit probably to cope with evapotranspiration. Still in the Nhecolândia, Bergier et al. (chapter “Alkaline Lakes Dynamics in the Nhecolândia Landscape”) show that alkaline lakes can be segregated into three ecological functional groups accordingly to their biogeochemistry and greenhouse gas exchanges and that these singular lakes are steadily reducing in area and number likely due to land-use changes in highlands that affect the ecohydrology of the whole Upper Paraguay River Basin. Bergier et al. (chapter “Methane and Carbon Dioxide Emissions from the Paraguay River floodplain (Pantanal) during Episodic Anoxia Events”) bring lacking data on methane and carbon dioxide dynamics in the Paraguay River floodplain during the natural and very anoxic “dequada” or “decoada” event that develops in variable intensity and magnitude at every annual flood.

Regarding human interferences, Dorez (chapter “Pesticides in the Pantanal”) provides a discussion highlighting that agricultural activities occur mainly in the highlands and represent the main source of pesticides to the Pantanal. Nevertheless, although detected with low frequency and relatively low concentrations, pesticides may interfere in the Pantanal ecosystem, and little is known about potential effects, indicating that more research is needed. Buller et al. (chapter “Historical Land-use Changes in São Gabriel do Oeste at the Upper Taquari River Basin”) illustrate that human appropriation of the net primary production in highlands has been improving human development index and economic concentration, although the agribusiness development has diminished ecosystem services and resilience. Buller et al. emphasize that new sustainable design of agroecosystems (integrated crop-livestock and forestry) in the Upper Taquari River Basin can maximize and optimize both the sharing of rural productivity and carbon/water regulations that positively reflect to the lowlands of the Pantanal. Cavazanna et al. (chapter “Natural and Environmental Vulnerability along the Touristic “Estradas Parque Pantanal” by GIS Algebraic Mapping”) traced the vulnerability of tourism activities in the lowlands (*Estradas Parque Pantanal*), which is a major economic activity in the region. The *Estradas Parque Pantanal* is undergoing ecological pressure, which means that further changes applied to the landscape can alter its “status” to

vulnerable. Finally, Marengo et al. (chapter “Climate Change Scenarios in the Pantanal”) show future scenarios of climate change indicating that by the end of the century temperatures can increase upon to 7°C and rainfall can decrease in austral summer and particularly in austral winter seasons. Marengo et al. highlight the relevance of restoring the natural interannual flood pulse dynamics and to improve the resilience of the wetland ecosystems with regard to future climate change risk.

In summary, the ability to recognize how those variable processes occurring at different temporal scales and strength dynamically affect the Pantanal wetland opens new opportunities to adaptation strategies for increasing ecosystem’s resilience by means of the sustainable development in low- and highlands. The Pantanal is a place of changing rivers and public policies must consider this intrinsic dynamism.

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