

The utilization of remote sensing and modeling: savannas from a distance [book review]

M. J. Hill and N. P. Hanan (eds.): Ecosystem function in savannas: measurement and modeling at landscape to global scales. CRC Press, Boca Raton, USA, 2011, 559 pp., illus., maps; 24 3 16 3 3 cm. Hardcover, ISBN 978-4398-0470-4, US\$137.00

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Koerner, S. (2011). The utilization of remote sensing and modeling: Savannas from a distance. *Landscape Ecology*, 26(8), 1199-1200. doi:<https://doi.org/10.1007/s10980-011-9634-y>

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Abstract:

With the ongoing uncertainty of climate change, there is a need to better understand long-term vegetation dynamics. The greater availability of spatial data from remote sensing presents a perfect opportunity to improve spatial process-based models which will provide the information needed to assist stake holders in making land management decisions in the face of global change. Savanna systems cover approximately 40% of Earth's terrestrial land surface, and how they respond to climate changes will have a large effect on global carbon, nitrogen, and energy fluxes. *Ecosystem Function in Savannas: Measurement and Modeling at Landscape to Global Scales* serves as key reference work on the remote sensing data currently available, how it's being used presently, and how it could be used to further improve spatial process-based models in the future. Savannas are complex ecosystems which exhibit enormous spatiotemporal variability in woody and herbaceous biomass, structure, and plant functional forms, and this complexity and heterogeneity has made studying them difficult. This book addresses many of discontinuities in the treatment of savannas by the scientific community as well as meticulously documents a range of measurements, methods, technologies, applications, and modeling approaches and how these different techniques might be unified.

Keywords: book review | climate change | savannas

Article:

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This book is a comprehensive review of the current state of knowledge and methodology associated with measuring and modeling ecosystem function in savanna systems. The first section addresses the extraordinary diversity and complexity of savanna systems. The authors discuss definitions of savannas and provide a detailed geographic description of the major tropical and subtropical regions within the savanna biome. They stress the enormous amount of area involved as well as the heterogeneity of the system, the diversity of tree cover, and the variability in climate and seasonality of growth found throughout savannas. This section is concluded by a review of the current state of understanding of the tree-grass system and what controls the dynamic balance between the two functional types.

Section two focuses on carbon, water, and trace gas fluxes and how these factors respond to disturbance. Northern Australia, the Brazilian cerrado, Southern Africa, and Texas and California oak savannas are used as examples. Few conclusions are drawn from the multiple studies, but it is apparent that all savannas contain substantial stocks of carbon in biomass and soil and, in general, are weak carbon sinks.

Section three identifies the vegetation properties that are available from remote sensing data and catalogs the methods used. The limitations of remote sensing data such as calibration and validation or lack of needed spatial or temporal coverage are also exposed, and the authors encourage users to exploit multiple sources of data to improve the effectiveness of spatial process-based models.

Section four reviews current patch-landscape scale modeling approaches in savannas. Several explanations for the coexistence of trees and grasses in savannas are covered including niche separations, disturbances, root-shoot partitioning, and facilitation. The importance of space in savannas is addressed looking at conceptual models, GIS, spatial statistics, spatial matrix models, and grid-based models. The Flames Model which examines fire and Australian savanna vegetation dynamics is used as a case study. Lastly, the issues of upscaling from patch to

landscape levels are addressed within the context of the effects of rainfall patterns and grazing on arid savannas.

Sections five and six address regional, continental, and global modeling. These sections serve as an inventory of what models are available from site models like Savanna-CENTURY to a range of global models like Carnegie Ames Stanford Approach (CASA). A major theme in these chapters is on carbon dynamics, and all models presented use climate as a major driver of carbon cycling. Key issues and deficiencies in current modeling efforts are addressed and possible methods of improvement are suggested such as the use of advanced products, multi-scale approaches, and combinations of multiple types of remote sensing data.

Section seven addresses the difficult challenge of how to model a coupled human–environment savanna system. These chapters focus on the conceptualization of the relationships between social and biophysical factors rather than modeling as there are strong limitations to the degree to which social change can be adequately modeled. Major paradigm differences exist between biophysical and social scientists, and the authors stress the importance of overcoming these obstacles, as the future of savannas and human populations are linked.

The eighth and final section summarizes the book nicely. The authors acknowledge the lack of coherence between the many components needed to make spatial process-based models and impress upon the reader the need to build new model frameworks which more easily incorporate remote sensing data from current and proposed sensing systems as well as approaches from multiple scales. The book ends with a call to scientists pleading for the establishment of a standardized approach to field data collection, longterm open access to data, and collaborations across disciplines.

Ecosystem Function in Savannas provides a comprehensive reference on the measurement and modeling of global savanna dynamics. With contributions from leading scientists in the savanna modeling world, this book clearly presents the current knowledge of modeling in savannas as well as addresses the key issues and deficiencies found in modeling these complex systems. In addition, the authors make an attempt to unify ecology and society in modeling the system, which is something very rarely done.

Even though there is a center section of selected figures reprinted in color, the general lack of color figures was a bit frustrating. Although the book gives a comprehensive list of the remote sensing data available and how it can be used, I felt that ecological conclusions were not drawn often enough or could have been expanded. This is not a book about savannas but instead a book about modeling and methods; however, it is a worthwhile read for anyone interested in remote sensing and its applications for understanding ecosystem dynamics at a landscape scale.