

WARING, R. H., RUNNING, S. W. (2007). FOREST ECOSYSTEMS – ANALYSIS AT MULTIPLE SCALES, 3RD EDITION. ELSEVIER ACADEMIC PRESS, USA

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Keywords: forest ecosystems, biodiversity, climatic limitations

PREFACE TO THE THIRD EDITION

The modeling of forest ecosystems responses has increased significantly in the last decade to include biodiversity and climatic limitations. At the same time, the network of sites that continuously monitor seasonal and interannual variation in CO₂ and water vapor exchange has grown. The authors emphasize that forest disturbance and recovery can be more accurately documented than was previously possible. On the international plane there are many studies about climatic changes and the authors want to provide background material to policy makers charged with designing policies that reduce carbon emissions and perpetuate healthy forests in an unstable climate with new mixtures of species.

This is the edition where the authors updated color plates and they added Chapter 10 that focuses on new information. In this chapter they documented how climatic changes has already affected forests, offer insights gained from an expanded network of eddy – flux sites, and provide evidence of improvements in remote sensing technology.

1. **Chapter 1. Forest Ecosystem Analyses at Multiple Time and Space Scales.** It offers a framework for analyses and introduces a set of tools that together provide a quantitative basis for judging the implications of a wide variety of management decisions. Also, it gives the analysis of forest ecosystems at the level of individual stands and gradually expand the time and space scales.
2. **Chapter 2. Water Cycles.** In this chapter the discussion is limited to the hydrologic balance of forest stands over a period of 1 year. The authors examined the rates of water loss by evaporation or transpiration from forests compared with other types of vegetation. A major part concerns the uptake of water from soil and its flow through stems and branches to leaves.
3. **Chapter 3. Carbon Cycle.** In this chapter it was identified general principles governing the way the environment affects carbon allocation seasonally and over the course of a year. In this way, an important role it has autotrophic and heterotrophic respiration. Also, the simplified models and indices presented are the

foundation for further extrapolations in time and space.

4. **Chapter 4. Mineral Cycles.** This chapter started with a discussion of plant processes by identifying the essential elements for growth and then explains how these are acquired, stored and internally recycled within vegetation before being returned through detritus production. Here, the authors talk about the importance of atmospheric inputs, biological fixation and geologic weathering for supplying nutrients to forest ecosystems, about litter processes, detritus and soil profile.
5. **Chapter 5. Temporal Changes in Forest Structure and Function.** This chapter analyses how forest ecosystems change in the course of undisturbed stand development and how those changes may be measured.
6. **Chapter 6. Susceptibility and Response of Forests to Disturbance.** This chapter identifies structural and chemical indices that reflect changes in the susceptibility and response of individual trees and forests to various kinds of disturbances. To test the reliability of these indices, it was observed that they change under experimental conditions and across biotic, physical and chemical stress gradients.
7. **Chapter 7. Spatial Scaling Methods for Landscape and Regional Ecosystem Analysis.** This chapter introduces a number of methods borrowed from other disciplines that have proved valuable, essential to conduct broader scale ecosystem analysis. These methods include application of geographic information system techniques, database management, climatological extrapolations and remote sensing.
8. **Chapter 8. Regional and Landscape Ecological Analysis.** The first part of this chapter covers ecological processes where the horizontal connections are strong and vertical links are weak. In the second part, the emphasis shifts to subjects where the vertical and temporal processes are strongly coupled, such as interactions between vegetation and atmosphere. The last part talks about problems where horizontal and vertical connections are required and where systems are also temporally dynamic.
9. **Chapter 9. The Role of Forests in Global Ecology.** This chapter summarizes current analyses of the distribution of global forests and their interactions with biosphere. Here it is emphasized the role of forests in global biogeochemistry and

climate dynamics, the importance of forests in protecting global biodiversity and in sustaining a natural resource base for supporting cultural and economic goals.

- 10. Chapter 10. Advances in Eddy – Flux Analyses, Remote Sensing and Evidence of Climate Change.** The last chapter illustrates the extent that a network of flux-measurements sites has helped to improve ecosystems models.

MATERIAL AND METHODS

These are represented by models made on the computer which simulate various processes. The models used often in this book are:

- **The model FOREST-Bio-Geo-Chemical (FOREST – BGC).** This model explore the ecosystem interactions and it quantifies the mechanistic processes of energy and mass fluxes in the stand/season space/time domain. Also, it can calculate the cycling of carbon, water and nitrogen through forest ecosystems (Running and Coughlan, 1988; Running and Gower, 1991). This model was designed to offer only standard meteorological data, namely, daily maximum - minimum temperature and precipitation.
- **The model LUE** (Landsberg and Waring, 1997). This model estimates the forest productivity.

Other models used in this book:

- **H2OTRANS** (Waring and Running, 1976);
- **DAYTRANS** (Running, 1984);
- **HYBRID** (Friend et al., 1993);
- **MT-CLIM** (Running et al., 1987);
- **GESys** (Hunt et al., 1996) etc.

These models, together, provide a means of extrapolating climate, hydrology, net primary production and ecosystem gas change across the entire surface of Earth. Many other models presented in this book make different assumptions of model structure that are valid for other objectives but do impede spatial applications.

The Chapter 10. which is a new chapter, it concentrates on new technologies applied to current conditions. Since 1998, three major advances have increased the power of multi – scale ecosystem analysis:

1. The establishment of regional and global networks of eddy – covariance flux towers. This provides continuous measures of carbon, water and energy fluxes from forest ecosystems and other types of ecosystems.
2. The launch of a new generation of earth observation satellites. This thing has lead to a new generation of regional scale modeling of carbon and water cycles, biogeochemistry, biodiversity and habitat – change analyses.
3. Clear detection of the effects of global climatic change. This thing provides

evidence that climate change has affected not only forest growth but also the frequency and extent of disturbance in the forests.

NEW MODELS

- **The NASA's moderate Resolution Imaging Spectroradiometer (MODIS).** This is used since 2000 to calculate the gross primary production (GPP), the net primary production (NPP), evapotranspiration. The MODIS production efficiency model is simplified. It does not require information about soil water holding capacity, soil fertility or daily precipitation.
- **SPOT – VGT satellite.** It was used by many scientists. For example, Delbart et al. (2005) compared three spectral indices using this satellite to define the growing seasons of *Larix* and *Populus* forests in Siberia from 1999 to 2002.

So, since 1998 many new models were used to preview the changes in future concerning the climatic changes and there effects to the forests ecosystems from all the biogeographic regions.

CONCLUSIONS

The forests were always important for the humans. Toley et al. (2005) estimated “7 to 11 million square kilometers of forested land have been converted in the last 300 years, mostly to agriculture”. To keep up with such rapid changes, continued monitoring of global resources will be essential.

This book adds important information on temporal and spatial scaling through modeling.

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