

Modeling Carbon Fluxes, Net Primary Production, and Light Utilization in Boreal Forest Stands

Scott J. Goetz

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Yowhan Son



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Modeling Carbon Fluxes, Net Primary Production and Light Utilization in Boreal Forest Stands Scott J. Goetz, 1997-08

The use of satellite remote sensing for modeling net primary production NPP was evaluated in sixty boreal forest stands spanning a range of site conditions The work included i estimating annual phenological dynamics and photosynthetically active radiation PAR interception with remotely sensed spectral measurements ii linking annually absorbed PAR APAR to measured NPP and quantifying variability in light use efficiency En iii evaluating sources of variability in En via mechanistic modeling of ecophysiology and associated carbon fluxes particularly through analyses of respiratory carbon costs in relation to assimilation gains the R A ratio iv assessing generalization of the results through an investigation of the evidence for evolutionary convergence in En the R A ratio and assimilation per unit APAR Eg The analyses showed that observed variability in En reflects a decoupling of PAR harvesting and utilization primarily as a result of differences in the R A ratio Links between En the R A ratio and standing above ground biomass were related to differences the carbon energy costs associated with synthesis and maintenance of plant constituents and longevity i e the payback period on investment in carbon gain Estimating the R A ratio from above ground biomass in order to compensate for variability in En was found to be problematic owing primarily to covariation of R and A with the amount of respiring biomass i e sapwood and foliage The analyses also showed that the differences in carbon costs between functional types plants with related life history traits resulted in convergence on Eg rather than en Variability in Eg was however introduced by stomatal control at some stressed sites These findings were supported by the remote sensing and simulation modeling results and the synthesis of work related to evolutionary ecology The primary conclusions are that variability in light utilization in these boreal forest stands was determined largely by respiratory carbon costs and that NPP models based on light harvesting require augmentation with terms that reflect PAR utilization Possible methods to address these issues and their implications for NPP modeling over large areas are discussed *Statistical Analysis and Modelling of Phytoplankton Dynamics* Jacob Carstensen, 2002

Harnessing net primary productivity data for monitoring sustainable development of agriculture Robinson, Nathaniel P., Cox, Cindy M., Koo, Jawoo, 2016-12-16 This study was undertaken to assess the utility of remotely sensed net primary productivity NPP data to measure agricultural sustainability by applying a new methodology that captures spatial variability and trends in total NPP and in NPP removed at harvest The sustainable intensification of agriculture is widely promoted as a means for achieving the Sustainable Development Goals SDGs and transitioning toward a more productive sustainable and inclusive agriculture particularly in fragile environments Yet critics claim that the 17 SDGs and 169 targets are immeasurable and unmanageable We propose adoption of satellite estimated time series NPP data to monitor agricultural intensification and sustainability as it is one indicator potentially valuable across several SDGs To illustrate we present a unique monitoring framework and a novel indicator the agricultural appropriation of net primary productivity AANPP and

analyze spatial trends in NPP and AANPP across the continent of Africa AANPP focuses on the proportion of total crop NPP removed at harvest We estimate AANPP by overlaying remotely sensed satellite imagery with rasterized crop production data at 10 by 10 kilometer spatial resolution we explore variation in NPP and AANPP in terms of food and ecological security The spatial distribution of NPP and AANPP illustrates the dominance of cropping systems as spatial drivers of NPP across many regions in West and East Africa as well as in the fertile river valleys across North Africa and the Sahel where access to irrigation and other technological inputs are inflating AANPP relative to NPP A comparison of 2000 and 2005 datasets showed increasing AANPP in African countries south of the Sahara particularly in Mozambique Angola and Zambia whereas NPP either held stable or decreased considerably This pattern was especially evident subnationally in Ethiopia Such trends highlight increasing vulnerability of populations to food and ecological insecurity When combined with other indicators and time series data the significance of NPP and the capacity of spatially explicit datasets have far reaching implications for monitoring the progress of sustainable development in a post 2015 world

Biophysical Applications of Satellite Remote Sensing Jonathan Hanes, 2013-12-26 A variety of biophysical applications e g leaf area index and gross primary productivity have been derived from measurements of the Earth system obtained remotely by NASA s MODIS sensors and other satellite platforms In *Biophysical Applications of Satellite Remote Sensing* the authors describe major applications of satellite remote sensing for studying Earth s biophysical phenomena The focus of the book lies on the broad palette of specific applications metrics of biophysical activity derived using satellite remote sensing With in depth discussions of satellite derived biophysical metrics that focus specifically on theory methodology validation major findings and directions of future research this book provides an excellent resource for remote sensing specialists ecologists geographers biologists climatologists and environmental scientists

Carbon and Nitrogen in Forest Ecosystems—Series I Yowhan Son, 2021-01-20 Understanding the differences in carbon and nitrogen distribution and cycling both spatially and temporally using various approaches is essential in forest ecosystems In addition the influence of biotic and abiotic factors as well as natural and artificial disturbances on carbon and nitrogen cycling need to first be understood before drawing their implications to forest management practices This Special Issue aims to understand carbon and nitrogen distribution and cycling in forest ecosystems for ecosystem based forest management under different natural and artificial disturbances

Land Resources Monitoring, Modeling, and Mapping with Remote Sensing Ph.D., Prasad S. Thenkabail, 2015-10-02 A volume in the three volume Remote Sensing Handbook series *Land Resources Monitoring Modeling and Mapping with Remote Sensing* documents the scientific and methodological advances that have taken place during the last 50 years The other two volumes in the series are *Remotely Sensed Data Characterization Classification and Accuracies* and *Remote Sensing of Water Resources Disasters and Urban Studies* In true handbook style the chapters in the volume have been carefully selected organized and designed to be self contained so that you can focus on a chapter and read it through without having to be

overly dependent on other chapters This volume provides comprehensive theoretical and practical coverage of remote sensing of land resources that include vegetation and biomass agricultural croplands rangelands phenology and food security forests biodiversity ecology land use land cover carbon and soils Highlights include Global terrestrial carbon and carbon budgets Precision farming Agricultural systems studies and soil studies Global croplands agricultural croplands and rangelands Food security analysis Biodiversity Land use and land cover mapping Measuring photosynthesis from space Vegetation characterization and above ground biomass measurements and modeling Hyperspectral remote sensing Ecological studies Tropical forest characterization Habitat mapping and monitoring In a very practical way the book demonstrates the experience utility methods and models used in studying a wide array of land applications With more than 100 leading global contributors this book is the most comprehensive documentation of the scientific and methodological advances that have taken place in understanding remote sensing data methods and applications over last 50 years In a very practical way the book demonstrates the experience utility methods and models used in studying a wide array of Land applications

Carbon and Nutrient Fluxes in Continental Margins Kon-Kee Liu, Larry Atkinson, Renato Quiñones, Liana Talaue-McManus, 2010-02-11 This book is a product of the joint JGOFS Joint Global Ocean Flux Study LOICZ Land Ocean Interactions in the Coastal Zone Continental Margins Task Team which was established to facilitate continental margins research in the two projects It contains significant information on the physical biogeochemical and ecosystems of continental margins nationally and regionally and provides a very valuable synthesis of this information and the physical biogeochemical and ecosystem processes which occur on continental margins The publication of this book is timely as it provides a very strong foundation for the development of the joint IMBER Integrated Marine Biogeochemistry and Ecosystems Research LOICZ Science Plan and Implementation Strategy for biogeochemical and ecosystems research in the continental margins and the impacts of global change on these systems This initiative will move forward integrated biogeochemical and ecosystems research in the continental margins We thank all the contributors to this volume and especially Kon Kee Liu who has dedicated a great deal of time to ensuring a high quality book is published IMBER Scientific Steering Committee Julie Hall LOICZ Scientific Steering Committee Jozef Pacyna v 1 Preface In general interfaces between the Earth's larger material reservoirs i e the land atmosphere ocean and sediments are important in the control of the biogeochemical dynamics and cycling of the major bioessential elements including carbon C nitrogen N phosphorus P sulfur S and silicon Si found in organic matter and the inorganic skeletons shells and tests of benthic and marine organisms

Land Carbon Cycle Modeling Yiqi Luo, Benjamin Smith, 2024-06-14 Carbon moves through the atmosphere through the oceans onto land and into ecosystems This cycling has a large effect on climate changing geographic patterns of rainfall and the frequency of extreme weather and is altered as the use of fossil fuels adds carbon to the cycle The dynamics of this global carbon cycling are largely predicted over broad spatial scales and long periods of time by Earth system models This book addresses the

crucial question of how to assess evaluate and estimate the potential impact of the additional carbon to the land carbon cycle The contributors describe a set of new approaches to land carbon cycle modeling for better exploring ecological questions regarding changes in carbon cycling employing data assimilation techniques for model improvement doing real or near time ecological forecasting for decision support and combining newly available machine learning techniques with process based models to improve prediction of the land carbon cycle under climate change This new edition includes seven new chapters machine learning and its applications to carbon cycle research five chapters principles underlying carbon dioxide removal from the atmosphere contemporary active research and management issues one chapter and community infrastructure for ecological forecasting one chapter Key Features Helps readers understand implement and criticize land carbon cycle models Offers a new theoretical framework to understand transient dynamics of the land carbon cycle Describes a suite of modeling skills matrix approach to represent land carbon nitrogen and phosphorus cycles data assimilation and machine learning to improve parameterization and workflow systems to facilitate ecological forecasting Introduces a new set of techniques such as semi analytic spin up SASU unified diagnostic system with a 1 3 5 scheme traceability analysis and benchmark analysis and PROcess guided machine learning and DATA driven modeling PRODA for model evaluation and improvement Reorganized from the first edition with seven new chapters added Strives to balance theoretical considerations technical details and applications of ecosystem modeling for research assessment and crucial decision making

Tropical Forests Padmini Sudarshana, Madhugiri Nageswara-Rao, Jaya Soneji, 2018-08-01 Tropical forests occupy only one tenth of the world s land area but are home to more than half of the world s flora and fauna They comprise extremely complex labyrinth of ecological interactions The astounding richness and biodiversity of tropical forests are rapidly dwindling There is a fear that the burgeoning human population and industrialization where a majority of these tropical forests are found may lead to the clearing or modification or may be a complete disappearance of the remaining tropical forests within few decades This has severely altered the vital biogeochemical cycles of carbon phosphorus nitrogen and so on and has led to the change in global climate and pristine natural ecosystems Hence there is an urgent need to protect restore conserve and improve the forest resources before they are irrevocably lost In this second edition of the book Tropical Forests the chapters share the above issues and help in understanding educating and creating awareness on the role of tropical forests for the very survival of mankind climate change and the diversity of biota across the globe This book will be of great use and could be useful to students scientists ecologists population and conservation biologists and forest managers across the globe

Comprehensive Remote Sensing Shunlin Liang, 2017-11-08 Comprehensive Remote Sensing Nine Volume Set covers all aspects of the topic with each volume edited by well known scientists and contributed to by frontier researchers It is a comprehensive resource that will benefit both students and researchers who want to further their understanding in this discipline The field of remote sensing has quadrupled in size in the past two decades and increasingly draws in individuals

working in a diverse set of disciplines ranging from geographers oceanographers and meteorologists to physicists and computer scientists Researchers from a variety of backgrounds are now accessing remote sensing data creating an urgent need for a one stop reference work that can comprehensively document the development of remote sensing from the basic principles modeling and practical algorithms to various applications Fully comprehensive coverage of this rapidly growing discipline giving readers a detailed overview of all aspects of Remote Sensing principles and applications Contains Layered content with each article beginning with the basics and then moving on to more complex concepts Ideal for advanced undergraduates and academic researchers Includes case studies that illustrate the practical application of remote sensing principles further enhancing understanding

Fluxes of Carbon, Water and Energy of European Forests Riccardo Valentini,2013-06-29 After years of technological development and its important achievements to make our life easier and more comfortable human society is going to face one of the most difficult challenges of the last century to stabilize the concentration levels of greenhouse gases in the atmosphere to prevent harmful effects on the climate system Through a delicate balance between photosynthesis and respiration terrestrial ecosystems and in particular forests are today thought to take up a significant part of the carbon dioxide emissions in the atmosphere sometimes called the terrestrial carbon sink However the location magnitude and vulnerability of the carbon dioxide sink of the terrestrial biota are still uncertain The suite of traditional tools in an ecologist's toolbox for studying ecosystem productivity and carbon balance include leaf cuvettes whole plant and soil chambers for gas exchange and biomass and soil carbon inventories While each of the cited methods has distinct advantages they are limited with regards to their ability to measure net carbon dioxide exchange of the whole ecosystem across a variety of time scales This book presents a compendium of results of a European project EURO FLUX funded by the European Commission through its fourth framework program aiming to elucidate the role of forests in continental carbon balance

Sustainable Forest Management Julio J. Diez,Jorge Martín García,2012-05-23 Sustainable forest management SFM is not a new concept However its popularity has increased in the last few decades because of public concern about the dramatic decrease in forest resources The implementation of SFM is generally achieved using criteria and indicators C

Tropical Ecology John C. Kricher,2011-02-28 A comprehensive introduction to tropical ecology This full color illustrated textbook offers the first comprehensive introduction to all major aspects of tropical ecology It explains why the world's tropical rain forests are so universally rich in species what factors may contribute to high species richness how nutrient cycles affect rain forest ecology and how ecologists investigate the complex interrelationships among flora and fauna It covers tropical montane ecology riverine ecosystems savanna dry forest and more Tropical Ecology begins with a historical overview followed by a sweeping discussion of biogeography and evolution and then introduces students to the unique and complex structure of tropical rain forests Other topics include the processes that influence everything from species richness to rates of photosynthesis how global climate change may affect rain forest characteristics and function how fragmentation of

ecosystems affects species richness and ecological processes human ecology in the tropics biodiversity and conservation of tropical ecosystems and species Drawing on real world examples taken from actual research Tropical Ecology is the best textbook on the subject for advanced undergraduates and graduate students Offers the first comprehensive introduction to tropical ecology Describes all the major kinds of tropical terrestrial ecosystems Explains species diversity evolutionary processes and coevolutionary interactions Features numerous color illustrations and examples from actual research Covers global warming deforestation reforestation fragmentation and conservation The essential textbook for advanced undergraduates and graduate students Suitable for courses with a field component Leading universities that have adopted this book include Biola University Bucknell University California State University Fullerton Colorado State University Fort Collins Francis Marion University Michigan State University Middlebury College Northern Kentucky University Ohio Wesleyan University St Mary's College of Maryland Syracuse University Tulane University University of California Santa Cruz University of Central Florida University of Cincinnati University of Florida University of Missouri University of New Mexico University of North Carolina at Chapel Hill University of the West Indies

Atmospheric Carbon Dioxide and the Global Carbon Cycle John R. Trabalka, 1986 Soils and Global Change John M. Kimble, Elissa R. Levine, Bobby A. Stewart, 1995-03-23

The pedosphere the thin mantle of soil on the earth's surface plays a potentially crucial role in climate and climate change The carbon storage of soils is the second largest in the biosphere making the dynamics of soil organic carbon an important issue that must be understood if we are to fully comprehend global change This new book examines the importance of soils and their relationship to global change specifically to the greenhouse effect Soils and Global Change presents a state of the art compendium of our present knowledge of soils This up to date information source enables readers to delve into the literature about soils and climate change and examine soils in both natural and managed environments

Spatial Modeling in Forest Resources Management Pravat Kumar Shit, Hamid Reza Pourghasemi, Pulakesh Das, Gouri Sankar Bhunia, 2020-10-08 This book demonstrates the measurement monitoring mapping and modeling of forest resources It explores state of the art techniques based on open source software R statistical programming and modeling specifically with a focus on the recent trends in data mining machine learning techniques and robust modeling in forest resources Discusses major topics such as forest health assessment estimating forest biomass carbon stock land use forest cover LUFC dynamic vegetation modeling DVM approaches forest based rural livelihood habitat suitability analysis biodiversity and ecology and biodiversity the book presents novel advances and applications of RS GIS and R in a precise and clear manner By offering insights into various concepts and their importance for real world applications it equips researchers professionals and policy makers with the knowledge and skills to tackle a wide range of issues related to geographic data including those with scientific societal and environmental implications

Advances in Quantitative Remote Sensing in China - In Memory of Prof. Xiaowen Li Shunlin Liang, Guangjian Yan, Jiancheng Shi, 2019-03-07 Quantitative land remote sensing has recently

advanced dramatically particularly in China It has been largely driven by vast governmental investment the availability of a huge amount of Chinese satellite data geospatial information requirements for addressing pressing environmental issues and other societal benefits Many individuals have also fostered and made great contributions to its development and Prof Xiaowen Li was one of these leading figures This book is published in memory of Prof Li The papers collected in this book cover topics from surface reflectance simulation inversion algorithm and estimation of variables to applications in optical thermal Lidar and microwave remote sensing The wide range of variables include directional reflectance chlorophyll fluorescence aerosol optical depth incident solar radiation albedo surface temperature upward longwave radiation leaf area index fractional vegetation cover forest biomass precipitation evapotranspiration freeze thaw snow cover vegetation productivity phenology and biodiversity indicators They clearly reflect the current level of research in this area This book constitutes an excellent reference suitable for upper level undergraduate students graduate students and professionals in remote sensing

Air Pollution Remote Sensing and the Subsequent Interactions with Ecology on Regional Scales Honglei Wang,Lijuan Shen,Xiaobin Guan,Xinyao Xie,Junke Zhang,2022-10-14

Managing Agricultural Greenhouse Gases Mark Liebig,A.J. Franzluebbers,Ronald F Follett,2012-06-08 In 2002 the USDA Agricultural Research Service ARS developed a coordinated national research effort called GRACEnet Greenhouse gas Reduction through Agricultural Carbon Enhancement network to provide information on the soil C status and GHG emission of current agricultural practices and to develop new management practices to reduce net GHG emission and increase soil C sequestration primarily from soil management Managing Agricultural Greenhouse Gases synthesizes the wealth of information generated from the GRACEnet project in over 30 ARS locations throughout the US and in numerous peer reviewed articles Although GRACEnet is an ARS project contributors to this work include a variety of backgrounds and reported findings have important international applications For example many parts of the world possess similar ecoregions to the U S e g northern Great Plains is similar to the Argentina Pampas and Ukraine Steppe

Measuring and modelling soil carbon stocks and stock changes in livestock production systems - A scoping analysis for the LEAP work stream on soil carbon stock changes Food and Agriculture Organization of the United Nations,2019-01-14 In order to build consensus on methods to measure and model soil carbon stocks and stock changes the Steering Committee of the Livestock Environmental Assessment and Performance LEAP Partnership mandated a task force to develop this scoping analysis and pave the way towards the formation of the LEAP Technical Advisory Group on soil carbon stock changes Soil carbon sequestration and storage in grasslands offers a significant potential to compensate for GHG emissions from livestock but the lack of consensus on the appropriate methodologies to account for soil carbon stock changes hinders robust and standardized assessments In this report we reviewed several published soil organic carbon SOC models and evaluated their aptitude to combine them with life cycle assessments LCAs Among contentious issues the most relevant are a the lack of universal models b the uneven data

availability comparability and quality between countries and regions and c the difficulty to match measurable SOC fractions with those determined by the models Taking this into account a tiered approach is proposed according to the availability of original data to run the models The use of IPCC carbon C accounting system appears to be the simplest approach suitable to countries with scarcity of original C data Conversely more complex models such as Century Parton 1987 1988 or Roth C Smith 1998 are likely to perform better and give less uncertainty when original input data are easily available

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