



# Hyperspectral Remote Sensing Of Vegetation

**Johanna S. Schönecker**



## **Hyperspectral Remote Sensing Of Vegetation:**

**Hyperspectral Remote Sensing of Vegetation** Prasad S. Thenkabail, John G. Lyon, 2016-04-19 Hyperspectral narrow band or imaging spectroscopy spectral data are fast emerging as practical solutions in modeling and mapping vegetation. Recent research has demonstrated the advances in and merit of hyperspectral data in a range of applications including quantifying agricultural crops, modeling forest canopy biochemical properties, detecting crop stress and disease, mapping leaf chlorophyll content as it influences crop production, identifying plants affected by contaminants such as arsenic, demonstrating sensitivity to plant nitrogen content, classifying vegetation species and type, characterizing wetlands and mapping invasive species. The need for significant improvements in quantifying modeling and mapping plant chemical physical and water properties is more critical than ever before to reduce uncertainties in our understanding of the Earth and to better sustain it. There is also a need for a synthesis of the vast knowledge spread throughout the literature from more than 40 years of research. Hyperspectral Remote Sensing of Vegetation integrates this knowledge, guiding readers to harness the capabilities of the most recent advances in applying hyperspectral remote sensing technology to the study of terrestrial vegetation. Taking a practical approach to a complex subject, the book demonstrates the experience, utility, methods, and models used in studying vegetation using hyperspectral data. Written by leading experts including pioneers in the field, each chapter presents specific applications, reviews existing state of the art knowledge, highlights the advances made, and provides guidance for the appropriate use of hyperspectral data in the study of vegetation, as well as its numerous applications such as crop yield modeling, crop and vegetation biophysical and biochemical property characterization, and crop moisture assessment. This comprehensive book brings together the best global expertise on hyperspectral remote sensing of agriculture, crop water use, plant species detection, vegetation classification, biophysical and biochemical modeling, crop productivity, and water productivity mapping and modeling. It provides the pertinent facts, synthesizing findings so that readers can get the correct picture on issues such as the best wavebands for their practical applications, methods of analysis using whole spectra, hyperspectral vegetation indices targeted to study specific biophysical and biochemical quantities, and methods for detecting parameters such as crop moisture variability, chlorophyll content, and stress levels. A collective knowledge bank, it guides professionals to adopt the best practices for their own work. *Hyperspectral Remote Sensing of Vegetation, Second Edition, Four Volume Set* Prasad S. Thenkabail, John G. Lyon, Alfredo Huete, 2022-07-30. Written by leading global experts including pioneers in the field, the four volume set on Hyperspectral Remote Sensing of Vegetation, Second Edition, reviews existing state of the art knowledge, highlights advances made in different areas, and provides guidance for the appropriate use of hyperspectral data in the study and management of agricultural crops and natural vegetation. Volume I: Fundamentals, Sensor Systems, Spectral Libraries, and Data Mining for Vegetation introduces the fundamentals of hyperspectral or imaging spectroscopy data, including hyperspectral data processes, sensor systems, spectral

libraries and data mining and analysis covering both the strengths and limitations of these topics Volume II *Hyperspectral Indices and Image Classifications for Agriculture and Vegetation* evaluates the performance of hyperspectral narrowband or imaging spectroscopy data with specific emphasis on the uses and applications of hyperspectral narrowband vegetation indices in characterizing modeling mapping and monitoring agricultural crops and vegetation Volume III *Biophysical and Biochemical Characterization and Plant Species Studies* demonstrates the methods that are developed and used to study terrestrial vegetation using hyperspectral data This volume includes extensive discussions on hyperspectral data processing and how to implement data processing mechanisms for specific biophysical and biochemical applications such as crop yield modeling crop biophysical and biochemical property characterization and crop moisture assessments Volume IV *Advanced Applications in Remote Sensing of Agricultural Crops and Natural Vegetation* discusses the use of hyperspectral or imaging spectroscopy data in numerous specific and advanced applications such as forest management precision farming managing invasive species and local to global land cover change detection

*Hyperspectral Indices and Image Classifications for Agriculture and Vegetation* Prasad S. Thenkabail, John G. Lyon, Alfredo Huete, 2018-12-07 Written by leading global experts including pioneers in the field the four volume set on *Hyperspectral Remote Sensing of Vegetation* Second Edition reviews existing state of the art knowledge highlights advances made in different areas and provides guidance for the appropriate use of hyperspectral data in the study and management of agricultural crops and natural vegetation Volume II *Hyperspectral Indices and Image Classifications for Agriculture and Vegetation* evaluates the performance of hyperspectral narrowband or imaging spectroscopy data with specific emphasis on the uses and applications of hyperspectral narrowband vegetation indices in characterizing modeling mapping and monitoring agricultural crops and vegetation This volume presents and discusses topics such as the non invasive quantification of foliar pigments leaf nitrogen concentration of cereal crop the estimation of nitrogen content in crops and pastures and forest leaf chlorophyll content among others The concluding chapter provides readers with useful guidance on the highlights and essence of Volume II through the editors perspective

**Key Features of Volume II** Provides the fundamentals of hyperspectral narrowband vegetation indices and hyperspectral derivative vegetation indices and their applications in agriculture and vegetation studies Discusses the latest advances in hyperspectral image classification methods and their applications Explains the massively big hyperspectral sensing data processing on cloud computing architectures Highlights the state of the art methods in the field of hyperspectral narrowband vegetation indices for monitoring agriculture vegetation and their properties such as plant water content nitrogen chlorophyll and others at leaf canopy field and landscape scales Includes best global expertise on hyperspectral remote sensing of agriculture crop water use plant species detection crop productivity and water productivity mapping and modeling

**Hyperspectral Remote Sensing of Vegetation: Advanced applications in remote sensing of agricultural crops and natural vegetation** Prasad Srinivasa Thenkabail, John G. Lyon, Alfredo Huete, 2019 *Advanced Applications in Remote*

*Sensing of Agricultural Crops and Natural Vegetation* Prasad S. Thenkabail, John G. Lyon, Alfredo Huete, 2018-12-07 Written by leading global experts including pioneers in the field the four volume set on Hyperspectral Remote Sensing of Vegetation Second Edition reviews existing state of the art knowledge highlights advances made in different areas and provides guidance for the appropriate use of hyperspectral data in the study and management of agricultural crops and natural vegetation Volume IV Advanced Applications in Remote Sensing of Agricultural Crops and Natural Vegetation discusses the use of hyperspectral or imaging spectroscopy data in numerous specific and advanced applications such as forest management precision farming managing invasive species and local to global land cover change detection It emphasizes the importance of hyperspectral remote sensing tools for studying vegetation processes and functions as well as the appropriate use of hyperspectral data for vegetation management practices The concluding chapter provides readers with useful guidance on the highlights and essence of Volume IV through the editors perspective Key Features of Volume IV Guides readers to harness the capabilities of the most recent advances in applying hyperspectral remote sensing technology to the study of terrestrial vegetation Includes specific applications on agriculture crop management practices study of crop stress and diseases crop characteristics based on inputs e g nitrogen irrigation study of vegetation impacted by heavy metals gross and net primary productivity studies light use efficiency studies crop water use and actual evapotranspiration studies phenology monitoring land use and land cover studies global change studies plant species detection wetland and forest characterization and mapping crop productivity and crop water productivity mapping and modeling Encompasses hyperspectral or imaging spectroscopy data in narrow wavebands used across visible red edge near infrared far infrared shortwave infrared and thermal portions of the spectrum Explains the implementation of hyperspectral remote sensing data processing mechanisms in a standard fast and efficient manner for their applications Discusses cloud computing to overcome hyperspectral remote sensing massive big data challenges Provides hyperspectral analysis of rocky surfaces on the earth and other planetary systems

*Hyperspectral Remote Sensing of Vegetation: Hyperspectral indices and image classifications for agriculture and vegetation* Prasad Srinivasa Thenkabail, John G. Lyon, Alfredo Huete, 2019

**Hyperspectral Remote Sensing of Vegetation - a Transect Approach** Reza Amiri, 2013 Human induced global environmental changes are increasingly occurring at larger scales Terrestrial vegetation is largely affected by such anthropologic land transformations As a result the ability to monitor the status of terrestrial vegetation is essential for understanding and managing these changes The rich spectral information contained in hyperspectral data provides a promising source of information for earth observation of global change However the analytical methods for the retrieval of vegetation bioindicators from hyperspectral data are suggested to lack spatial transferability This is important because spatial transferability is the underlying assumption in employing these methods at large scales Therefore to apply these analytical approaches confidently study of their spatial transferability is required Thus the aim of this thesis is to assess the robustness of currently dominant empirical

methods in the context of a sub continental environmental gradient In the first part of the study the performance of commonly used spectral vegetation indices for the retrieval of leaf biochemical constituents was systematically assessed along a strong rainfall gradient in savannas of northern Australia The results demonstrated that in cross site situations the performance of the estimation of the foliar biochemical properties was dependent on the biochemical constituent For example estimation of leaf nitrogen content was largely consistent at the sampling sites while leaf chlorophyll and carotenoid contents were affected by fluctuations along the gradient Furthermore the study of the performance of the indices in a cross species situation revealed that except for carotenoid content the narrowband predictors were species specific These findings indicate that the observed inconsistency of the vegetation indices at the scale of this study is likely to affect the applications that utilise the prediction of leaf biochemical properties provided by these indices The second part of the study assessed the robustness of partial least square regression PLSR multivariate technique for the retrieval of leaf biochemical properties along the NATT The results showed that PLSR provided more consistent predictions across the sites along the gradient This provided evidence that multivariate methods may be a better alternative in large scale estimations of biochemical constituents Additionally the spatial transferability of the partial least square regression technique was assessed and compared to the vegetation indices It was demonstrated that no method was able to produce solutions transferable to the whole transect The final part of the study incorporated the large scale transferability as an objective in a multiobjective optimisation framework to design transferable hyperspectral predictors of foliar biochemical properties The method introduced improvements in the vegetation indices based estimations by finding an optimal waveband demonstrating both stability and performance in the predictions along the NATT In summary findings from this work contribute to the understanding of the reliability of the currently dominant information retrieval methods from narrowband hyperspectral reflectance data The multiobjective optimisation method implemented in this work is of added benefit by providing a framework for addressing the issue of transferability

Hyperspectral Remote Sensing of Vegetation Parameters Using Statistical and Physical Models Roshanak Darvishzadeh,2008      **Hyperspectral Remote Sensing of Vegetation Species Distribution in a Saltmarsh** Karin S. Schmidt,2003      **Hyperspectral Remote Sensing of Agriculture and Vegetation** Simone Pascucci,Stefano Pignatti,Raffaele Casa,Roshanak Darvishzadeh,Wenjiang Huang,2021 This book shows recent and innovative applications of the use of hyperspectral technology for optimal quantification of crop vegetation and soil biophysical variables at various spatial scales which can be an important aspect in agricultural management practices and monitoring The articles collected inside the book are intended to help researchers and farmers involved in precision agriculture techniques and practices as well as in plant nutrient prediction to a higher comprehension of strengths and limitations of the application of hyperspectral imaging to agriculture and vegetation Hyperspectral remote sensing for studying agriculture and natural vegetation is a challenging research topic that will remain of great interest for different

sciences communities in decades      **Hyperspectral Remote Sensing of Vegetation: Biophysical and biochemical characterization and plant species studies** Prasad Srinivasa Thenkabail,John G. Lyon,Alfredo Huete,2019

**Hyperspectral Remote Sensing** Ruiliang Pu,2017-08-16 Advanced imaging spectral technology and hyperspectral analysis techniques for multiple applications are the key features of the book This book will present in one volume complete solutions from concepts fundamentals and methods of acquisition of hyperspectral data to analyses and applications of the data in a very coherent manner It will help readers to fully understand basic theories of HRS how to utilize various field spectrometers and bioinstruments the importance of radiometric correction and atmospheric correction the use of analysis tools and software and determine what to do with HRS technology and data      **Fundamentals, Sensor Systems, Spectral Libraries, and Data Mining for Vegetation** Prasad S. Thenkabail,John G. Lyon,Alfredo Huete,2018-12-07 Written by leading global experts including pioneers in the field the four volume set on Hyperspectral Remote Sensing of Vegetation Second Edition reviews existing state of the art knowledge highlights advances made in different areas and provides guidance for the appropriate use of hyperspectral data in the study and management of agricultural crops and natural vegetation Volume I Fundamentals Sensor Systems Spectral Libraries and Data Mining for Vegetation introduces the fundamentals of hyperspectral or imaging spectroscopy data including hyperspectral data processes sensor systems spectral libraries and data mining and analysis covering both the strengths and limitations of these topics This book also presents and discusses hyperspectral narrowband data acquired in numerous unique spectral bands in the entire length of the spectrum from various ground based airborne and spaceborne platforms The concluding chapter provides readers with useful guidance on the highlights and essence of Volume I through the editors perspective Key Features of Volume I Provides the fundamentals of hyperspectral remote sensing used in agricultural crops and vegetation studies Discusses the latest advances in hyperspectral remote sensing of ecosystems and croplands Develops online hyperspectral libraries proximal sensing and phenotyping for understanding modeling mapping and monitoring crop and vegetation traits Implements reflectance spectroscopy of soils and vegetation Enumerates hyperspectral data mining and data processing methods approaches and machine learning algorithms Explores methods and approaches for data mining and overcoming data redundancy Highlights the advanced methods for hyperspectral data processing steps by developing or implementing appropriate algorithms and coding the same for processing on a cloud computing platform like the Google Earth Engine Integrates hyperspectral with other data such as the LiDAR data in the study of vegetation Includes best global expertise on hyperspectral remote sensing of agriculture crop water use plant species detection crop productivity and water productivity mapping and modeling      **Hyperspectral Remote Sensing Investigations of Vegetation in Northern Peatlands** Carlomagno Soto Castro,2016 Imaging sensors designed to remotely observe the Earth can be used for land cover studies of peatlands and other areas that provide carbon storage or other important ecosystem services In order to improve our

knowledge of remote sensing and peatland research this study employed multiple types of remotely sensed data for the evaluation and testing of methodologies that aimed to map different characteristics of peatland vegetation The study was conducted in two peatland ecosystems 1 near James Bay Quebec which is an important site for hydropower generation and 2 Mer Bleue an ombrotrophic bog near Ottawa Ontario For the first site and study high resolution aerial photographs and aerial hyperspectral imagery were used to generate land cover maps over an area of proximately 145 km<sup>2</sup> This study is based on a novel approach that integrates object oriented classification GEOBIA for producing a classification validation dataset as a base to classify hyperspectral imagery from two different airborne sensors This methodology demonstrated the feasibility of using such an approach to distinguish between seven vegetation classes commonly found in peatlands The maps exhibit mapping accuracies higher than 80 % and have a high level of confidence for example the map produced with the CASI sensor has an overall accuracy of 88.18 95 % CI 87.3 89.02 My findings provide a baseline for developing a more detailed research focus on topics related to land use change and the stratification of the landscape to study the individual contributions of different plant functional types to the carbon cycle For the second study a field experiment was conducted aiming to characterize and map biophysical and biochemical characteristics of vegetation at high spatial scales

**Hyperspectral Remote Sensing** Prem Chandra Pandey, Prashant K. Srivastava, Heiko Balzter, Bimal Bhattacharya, George P. Petropoulos, 2020-08-05 Hyperspectral Remote Sensing Theory and Applications offers the latest information on the techniques advances and wide ranging applications of hyperspectral remote sensing such as forestry agriculture water resources soil and geology among others The book also presents hyperspectral data integration with other sources such as LiDAR Multi spectral data and other remote sensing techniques Researchers who use this resource will be able to understand and implement the technology and data in their respective fields As such it is a valuable reference for researchers and data analysts in remote sensing and Earth Observation fields and those in ecology agriculture hydrology and geology Includes the theory of hyperspectral remote sensing along with techniques and applications across a variety of disciplines Presents the processing methods and techniques utilized for hyperspectral remote sensing and in situ data collection Provides an overview of the state of the art including algorithms techniques and case studies Contextual Classification of Hyperspectral Remote Sensing Images Guy Thoonen, 2012 *Hyperspectral Remote Sensing of Vegetation in the Arctic Tundra* Johanna S. Schönecker, 2018 Hyperspectral Remote Sensing of Tropical and Sub-Tropical Forests Margaret Kalacska, G. Arturo Sanchez-Azofeifa, 2008-02-26 While frequently used in temperate environments hyperspectral sensors and data are still a novelty in the tropics Exploring the potential of hyperspectral remote sensing for assessing ecosystem characteristics Hyperspectral Remote Sensing of Tropical and Sub Tropical Forests focuses on the complex and unique set of challenges involved in using t **Determination and Monitoring of Vegetation Stress Using Hyperspectral Remote Sensing** Yahaya Sani, 2013 *Quantification of Vegetation Stress Via Hyperspectral Remote*

*Sensing Data* Irina Becker, 2016

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