

Are you...

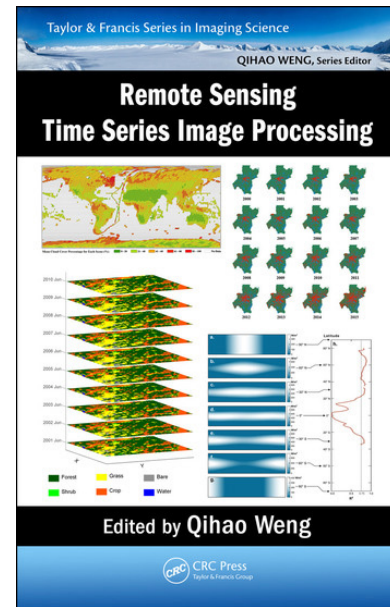
- » Engaged in Earth observation science?
- » Working on multitemporal change detection?
- » Mining data from disparate imagery archives and libraries?
- » Interested in image time series fundamentals and techniques?
- » Concerned with repairing or mitigating image artifacts and defects?
- » Reconstructing parts of images affected by contaminated pixels?
- » Seeking to create spatiotemporal data fusion products?

If you answered “yes” to any of these questions, then this book is for you!

In terms of current interest, the expression “change detection” signifies one of the premier applications of remote sensing. This book makes a momentous and substantial contribution showcasing the fundamentals of select processing techniques used with imagery time series at both coarse and fine spatiotemporal resolutions. In doing so, it also provides substantive examples of real-world applications for some of the algorithms. Often, as exemplified in this book, the existence of disparate sensor data at varying spectral, temporal, and spatial resolutions results in the creation of synthetic or fusion images and simulated time series.

This work sports a highly distinguished and recognized editor (Dr. Qihao Weng), and a list of twenty-five contributing authors and co-authors, responsible for the book’s ten chapters. On the Preface, a gem in and of itself, Dr. Weng outlines his vision for the direction in which remote sensing and imaging science are headed and provides a synopsis of the book. Written with impressive clarity, using precise and rich language, this must-read section provides an excellent opening. It paints such a clear and illustrative picture of the state-of-the-practice that it could well be used to guide the development of a course on the topic.

The book is laid out in three parts, the first part of which deals with the fundamentals of time series image and data generation and it contains three chapters: **Chapter 1**—*Cloud and Cloud Shadow Detection for Landsat Images: The Fundamental Basis for Analyzing Landsat Time Series*; **Chapter 2**—*An Automatic System for Reconstructing High-Quality Seasonal Landsat Time Series*; and **Chapter 3**—*Spatiotemporal Data Fusion to Generate Synthetic High Spatial and Temporal Resolution Satellite Images*. Chapter 1 starts out the leading thread for this section, with a categorization of algorithms to deal with specific image contamina-



Remote Sensing Time Series Image Processing. First Edition

Qihao Weng (Editor)

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tion such as clouds and cloud shadows. Chapter 2 focuses on an automated method for the reconstruction of contaminated pixels (i.e., due to clouds, cloud shadows, and SLC gaps). Chapter 3 delves into spatiotemporal data fusion for working with coarse spatial resolution/fine temporal resolution time series with fine spatial resolution/coarse temporal resolution data. Among the several different techniques contrasted, two recent algorithms are introduced in detail and evaluated, namely the NDVI Linear Mixing Growth Model (NDVI-LMGM) and Flexible Spatiotemporal DATA Fusion method (FSDAF).

The second part of the book examines topics related to feature development and information extraction; **Chapter 4**—*Phenological Inference from Times Series Remote Sensing*

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Data, **Chapter 5**—*Time Series Analysis of Moderate Resolution Land Surface Temperatures*, and **Chapter 6**—*Impervious Surface Estimation by Integrated Use of Landsat and MODIS Time Series in Wuhan, China*. Chapter 4 focuses on phenology, specifically on spectral-temporal trajectories of greenness indicators, for either single-year or multi-season, at a local or regional level. Examples of greenness analysis provided include crops in agroecosystems, forestry, and flooded landscapes. Chapter 5 exemplifies work with land surface temperature (LST) by using the data from collection-5 and collection-6 daily Aqua and Terra MODIS LST time series, with an application to surface urban heat islands (SUHI). Finally, chapter 6 shows an application of the Biophysical Composition Index (BCI) derived from a pre-processed Landsat data as a basis for mapping the annual evolution of impervious surfaces.

Finally, the third, longest and final part covers image applications of time series and contains four chapters. **Chapter 7**—*Mapping Land Cover Trajectories Using Monthly MODIS Time Series from 2001 to 2010*, **Chapter 8**—*Creating a Robust Reference Dataset for Large Area Time Series Disturbance Classification*, **Chapter 9**—*A General Workflow for Mapping Forest Disturbance History Using Pixel Based Time Series Analysis*, and **Chapter 10**—*Monitoring Annual Vegetated Land Loss to Urbanization with Landsat Archive: A Case Study in Shanghai, China*. Chapter 7 tackles the tough issues of what constitutes true land cover change and what the correct temporal interval for its determination should be, so as not to miss it – e.g., inter-annual versus intra-annual. The existence and availability of “hyper-temporal” datasets does not facilitate the task. The authors make use of the concept of “adaptive time series” to arrive at a temporal segmentation of a continuous 10-year time series. The land cover trajectories were reconstructed at 32-day intervals where most of the land cover changes that are missed or observed later than actual times in annual mapping practice can be captured.

The development of a robust reference dataset as a critical pre-requisite for meaningful spatiotemporal disturbance analysis is shown in Chapter 8. In it, trained interpreters create such dataset by using Google Earth imagery, the pixel’s trajectory as extracted from annual composites, local expert knowledge, and regional spatial datasets. To demonstrate the utility of the reference dataset, a subset is then used in a machine learning environment to produce classified disturbance maps over a 28-year period according to agent and severity categories. Chapter 9 illustrates the challenges, lessons learned and implications for future studies resulting

from quantifying temporal changes in forested lands represented by a wall-to-wall forest disturbance mapping effort at a national scale. The main factors analyzed included: automating image selection, compositing to overcome cloud-contaminated observations, achieving consistency across diverse landscapes, handling the large data volumes, and identifying and addressing quality assessment issues while under production, among others. Finally, Chapter 10 explores a workflow to quantify urban expansion at the expense of agricultural/vegetated land. Annual vegetated land conversion to urbanization information is extracted by using dense Landsat time series image stacks, creating 11 continuous years’ worth of Normalized Difference Vegetation Index (NDVI) mosaics from cloud/shadow free images. Computations were carried out on the Google Earth Engine (GEE) cloud-computing platform for large area applications.

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