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Author(s): Stephen C. Hagen, Philip Heilman, Robert Marsett, Nathan Torbick, William Salas, Jenni van Ravensway, and Jiaguo Qi

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Mapping Total Vegetation Cover Across Western Rangelands With Moderate-Resolution Imaging Spectroradiometer Data

Stephen C. Hagen,¹ Philip Heilman,² Robert Marsett,³ Nathan Torbick,¹ William Salas,⁴
Jenni van Ravensway,⁵ and Jianguo Qi^{6,7}

Authors are ¹Senior Research Scientist and ⁴President and Chief Scientist, Applied GeoSolutions, LLC, Durham, NH 03824, USA; ²Research Leader, USDA-ARS, SWRC, Tucson, AZ, 85719 USA; ³Owner, Ranges, LLC, Tucson, AZ, 85749 USA; ⁵Research Associate and ⁶Director, Center for Global Change and Earth Observations; and ⁷Professor, Department of Geography, Michigan State University, East Lansing, MI, 48824 USA.

Abstract

Remotely sensed observations of rangelands provide a synoptic view of vegetation condition unavailable from other means. Multiple satellite platforms in operation today (e.g. Landsat, moderate-resolution imaging spectroradiometer [MODIS]) offer opportunities for regional monitoring of rangelands. However, the spatial and temporal variability of rangelands pose challenges to consistent and accurate mapping of vegetation condition. For instance, soil properties can have a large impact on the reflectance registered at the satellite sensor. Additionally, senescent vegetation, which is often abundant on rangeland, is dynamic and its physical and photochemical properties can change rapidly along with moisture availability. Remote sensing has been successfully used to map local rangeland conditions. However, regional and frequently updated maps of vegetation cover in rangelands are not currently available. In this research, we compare ground measurements of total vegetation cover, including both green and senescent cover, to reflectance observed by the satellite and develop a robust method for estimating total vegetation canopy cover over diverse regions of the western United States. We test the effects of scaling from ground observations up to the Landsat 30-m scale, then to the MODIS 500-m scale, and quantify sources of noise. The soil-adjusted total vegetation index (SATVI) captures 55% of the variability in ground measured total vegetation cover from diverse sites in New Mexico, Arizona, Wyoming, and Nevada. Scaling from the Landsat to MODIS scale introduces noise and loss of spatial detail, but offers inexpensive and frequent observations and the ability to track trends in cover over large regions.

Resumen

Observaciones de pastizales con sensores remotos proporcionan una vista sinóptica de la condición de la vegetación que no está disponible usando otros medios. Múltiples plataformas satelitales en operación hoy en día (e.g. Landsat, MODIS) proporcionan oportunidades para un monitoreo regional de los pastizales. Sin embargo, la variabilidad espacial y temporal de los pastizales posee retos relacionados con el mapeo de la condición de la vegetación. Por ejemplo, las propiedades del suelo pueden tener gran impacto en la reflectancia registrada por el sensor del satélite. Adicionalmente, la vegetación senescente, la cual es a menudo abundante en los pastizales, es dinámica y sus propiedades físicas y fotoquímicas pueden cambiar rápidamente debido al contenido de humedad disponible. Los sensores remotos han sido utilizados con éxito para mapear las condiciones locales de los pastizales. Sin embargo, mapas regionales y frecuentemente actualizados de la cobertura de la vegetación en pastizales no están disponibles en la actualidad. En esta investigación, se compararon medidas del suelo del total de la cobertura, incluyendo ambas coberturas la verde y la senescente, contra la observada por el satélite para desarrollar un método robusto con la finalidad de estimar el total de la cobertura de la copa de la vegetación sobre la diversa región del Oeste de estado Unidos. Se evaluaron los efectos de escala desde observaciones al ras de suelo hasta aquellas usando Landsat a una escala de 30 m, entonces a la escala de 500 m en MODIS y se cuantificaron las fuentes de variación. El índice ajustado total de vegetación (SATVI) captura 55% de la variabilidad en la estimación del total de la cobertura vegetal de diversos sitios en Nuevo México, Arizona, Wyoming, y Nevada. La conversión de escala de Landsat a MODIS introduce cierto margen de error y pérdida de detalle espacial, pero ofrece observaciones baratas y frecuentes así como la capacidad de rastrear las tendencias en cobertura sobre extensas regiones.

Key Words: multiresolution, rangeland management, remote sensing, SATVI, scaling

INTRODUCTION

Rangelands in the lower 48 states contain over 276 million hectares of grasslands and shrublands, or about 36% of the total land area in the contiguous United States (John Heinz III Center for Science, Economics and the Environment 2002). Van Tassel et al. (2001) note that the Bureau of Land Management (BLM) and US Forest Service (USFS) are the largest land managers in the 11 western states with 42% of the land, that 85% of federal lands are grazed by domestic

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Correspondence: Stephen C. Hagen, Applied GeoSolutions, LLC, 87 Packers Falls Rd, Durham, NH, USA 03824. Email: shagen@appliedgeosolutions.com

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