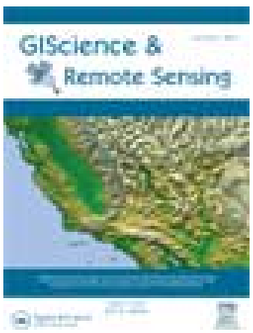

GIScience & Remote Sensing

ISSN: 1548-1603 (Print) 1943-7226 (Online) Journal homepage: http://www.tandfonline.com/loi/tgrs20

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To cite this article: Saptarshi Mondal, Chockalingam Jeganathan, Giriraj Amarnath & Peejush Pani (2017): Time-series cloud noise mapping and reduction algorithm for improved vegetation and drought monitoring, GIScience & Remote Sensing, DOI: 10.1080/15481603.2017.1286726

To link to this article: http://dx.doi.org/10.1080/15481603.2017.1286726

Published online: 09 Feb 2017.

GIScience & Remote Sensing, 2017
http://dx.doi.org/10.1080/15481603.2017.1286726

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ARTICLE

Time-series cloud noise mapping and reduction algorithm for improved vegetation and drought monitoring

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(*Received 24 July 2016; accepted 22 January 2017*)

Moderate Resolution Imaging Spectro-radiometer (MODIS) time-series Normalized Differential Vegetation Index (NDVI) products are regularly used for vegetation monitoring missions and climate change analysis. However, satellite observation is affected by the atmospheric condition, cloud state and shadows introducing noise in the data. MODIS state flag helps in understanding pixel quality but overestimates the noise and hence its usability requires further scrutiny. This study has analyzed MODIS MOD09A1 annual data set over Sri Lanka. The study presents a simple and effective noise mapping method which integrates four state flag parameters (i.e. cloud state, cloud shadow, cirrus detected, and internal cloud algorithm flag) to estimate Cloud Possibility Index (CPI). Usability of CPI is analyzed along with NDVI for noise elimination. Then the gaps generated due to noise elimination are reconstructed and performance of the reconstruction model is assessed over simulated data with five different levels of random gaps (10–50%) and four different statistical measures (i.e. Root mean square error, mean absolute error, mean bias error, and mean absolute percentage error). The sample-based analysis over homogeneous and heterogeneous pixels have revealed that CPI-based noise elimination has increased the detection accuracy of number of growing cycle from 45–60% to 85–95% in vegetated regions. The study cautions that usage of time-series NDVI data without proper cloud correction mechanism would result in wrong estimation about spatial distribution and intensity of drought, and in our study 50% of area is wrongly reported to be under drought though there was no major drought in 2014.

Keywords: MODIS NDVI; time-series noise reduction; cloud possibility index; growth cycle; drought assessment

1. Introduction

In the past two decades, usage of time-series satellite data has increased manifold due to coherent and long-term archival data being freely available at a high temporal resolution across the globe (Erasmi, Bothe, and Petta 2006; Hamandawana, Eckardt, and Chanda 2005). The time-series data is used for studying global to local-level changes in the terrestrial vegetation (Brown et al. 2008; Jakubauskas, Legates, and Kastens 2002; Jeganathan, Dash, and Atkinson 2014; Reed 2006; Tadesse et al. 2010; Tian et al. 2015; Zhang et al. 2003). Among the many time-series data, NDVI product from Advanced Very High Resolution Radiometer (AVHRR) (Eastman et al. 2013; Heumann

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