Journal of the Georgian Geophysical Society,
Issue A. Physics of Solid Earth, v.20A, 2017, pp. 32-36

Application of MODIS Data for Vegetation Cover Analysis in Georgia

[1]Genadi A. Tvauri., [2]Tatiana D. Jinjolia, [1]Ketevan J. Koridze

[1]M. Nodia Institute of Geophysics of Iv. Javakhishvili Tbilisi State University, 1, Alexidze st. Tbilisi, Georgia
[2]V. Batonishvili Institute of Geography of Iv. Javakhishvili Tbilisi State University,
6, Tamarashvili st. Tbilisi, Georgia

ABSTRACT

The MODIS Surface reflectance Daily L2G Global 250m, 500 and 1km data were used for analysis of vegetation cover of Georgia. NDVI and EVI daily values were calculated on the basis for 2008-2016 period. Mean decadal and monthly maps of NDVI and EVI were compiled with an object of future analysis of vegetation change dynamics.

Keywords: MODIS Surface reflectance, vegetation cover

Introduction

Vegetation indices are widely applied to monitor terrestrial landscapes via satellite sensors. These parameters proved to be highly successful in assessing of vegetation condition, foliage, cover, processes like primary productivity, evapotranspiration. [1-3]. Vegetation indices may be easily cross-calibrated, across different sensor systems, providing continuity of long-term monitoring of climate related land processes. The global records of Normalized Differential Vegetation Index NDVI, derifed from NOAA Advanced Very High Resolution Radiometer (AVHRR) data cover period since 1981. The Moderate Resolution Imaging Spectrometer (MODIS) on the Terra satellite provides nearly daily coverage of Earth surface since 2001 with 250 m pixel resolution and are cross-calibrated with AVHRR data. This data made great contribution in global climate, ecosystem, and agricultural studies [3].

Calculation of vegetation indices

The most used vegetation index, NDVI, is calculated as:

$$NDVI = (NIR – Red)/ (NIR – Red)$$

where NIR are Red are reflectance values of Red and Near Infrared light detected at sensors. As a ratio, NDVI has the advantage to minimize band-correlated noise, influence attributed to cloud shadows, sun and view angles, topography, atmospheric attenuation. Rationing also reduces, to a certain extent, instrument and calibration related errors. Main disadvantage is related with asymptotic behavior, which lead to insensitivities to vegetation variations in certain conditions. The Enhanced Vegetation Index (EVI) is determined as:

$$EVI = G (NIR – Red)/ (NIR+C_1Red – C_2Blue + L)$$

where NIR, Red and Blue are atmpsheric corrected surface reflections, L is the canopy background adjustment for nonlinear differential NIR and Red radiant transfer through canopy, C_1 and C_2 are coefficients of aerosol resistance term, G is a gain, scalling factor. For Modis EVI algorithm adopted values of coefficients are L = 1, C_1 = 6, C_2 = 7.5 and G = 2.5 [4]

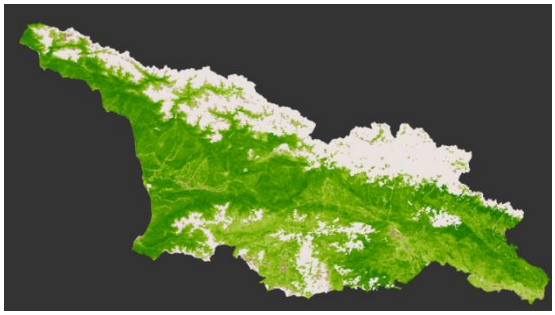
EVI gives errors over the bright objects, clouds, snow and ice due to saturation of blue band. To address this issue, standard EVI was replaced with modified 2-band EVI, calculated as:

$$EVI = 2.5\ (NIR - Red)/\ (NIR + 2.4\ Red + L);$$

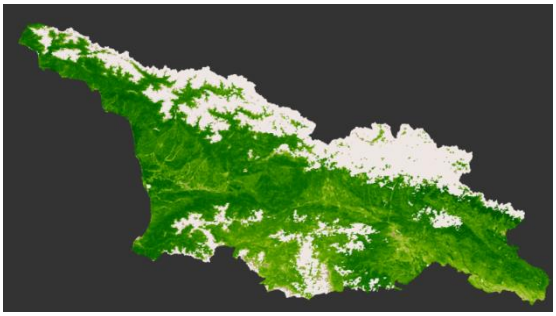
In the present work The MODIS Surface reflectance Daily L2G Global 250m, 500 (MOD09GQ) and 1km (MOD09GA) data were applied for analysis of vegetation cover of Georgia. MOD09GQ product provides MODIS band 1,2 daily surface reflectance at 250 m resolution. MOD09GQ product ought to be used in conjunction with MOD09GA, where important quality information is stored. MOD09GA provides MODIS sensor band 1-7 daily surface reflectance at 500 m resolution and 1 km observation and geolocation statistics [5]. MOD09GA also contains cloud information, necessary for NDVI and EVI cloud masking procedures.

Fig. 1 presents samples of EVI and NDVI indices of 3 decades and monthly NDVI, EVI for May 2016. Calculation of decadal EVI and NDVI gives possibility to compose monthly mean values of vegetation indices both for any particular year and for whole 2008-2016 period. Fig. 2 and 3 present EVI and NDVI mean values for 2008-2016 period. Fig. 4 shows samples of EVI NDVI color legends.

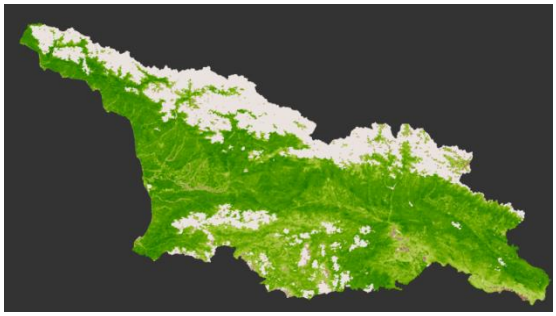
In the nearest future vegetation analysis of 2000-2007 is planned. It gives us possibility to cover whole MODIS dataset from 2000 till present days. As it was mentioned earlier, there is about 35 year NDVI global dataset from NOAA-AVHRR and in conjugation with MODIS data it provides a long term data record for use in operational monitoring studies, vegetation cover changes analysis and etc.



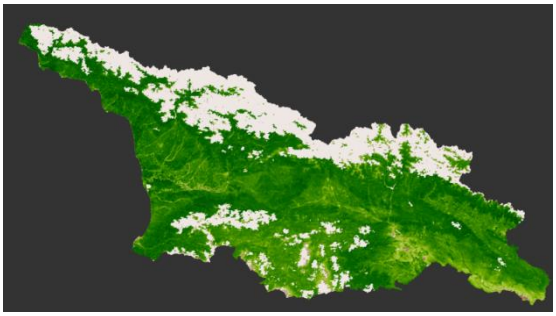
EVI, I decadem of May, 2016



NDVI, I decade of May, 2016



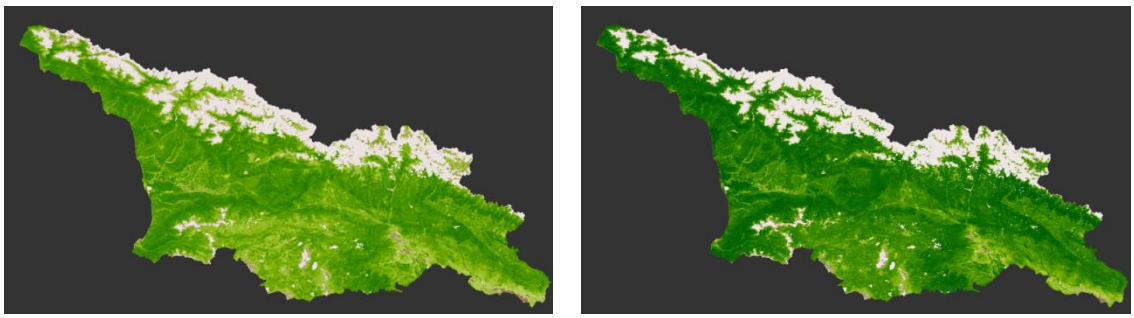
EVI, I decade of May, 2016



NDVI, II decade of May, 2016

EVI, II decade of May, 2016

NDVI, III decade of May, 2016



EVI, III decade of May, 2016 NDVI, May, 2016

Fig. 1. EVI and NDVI maps for May, 2016

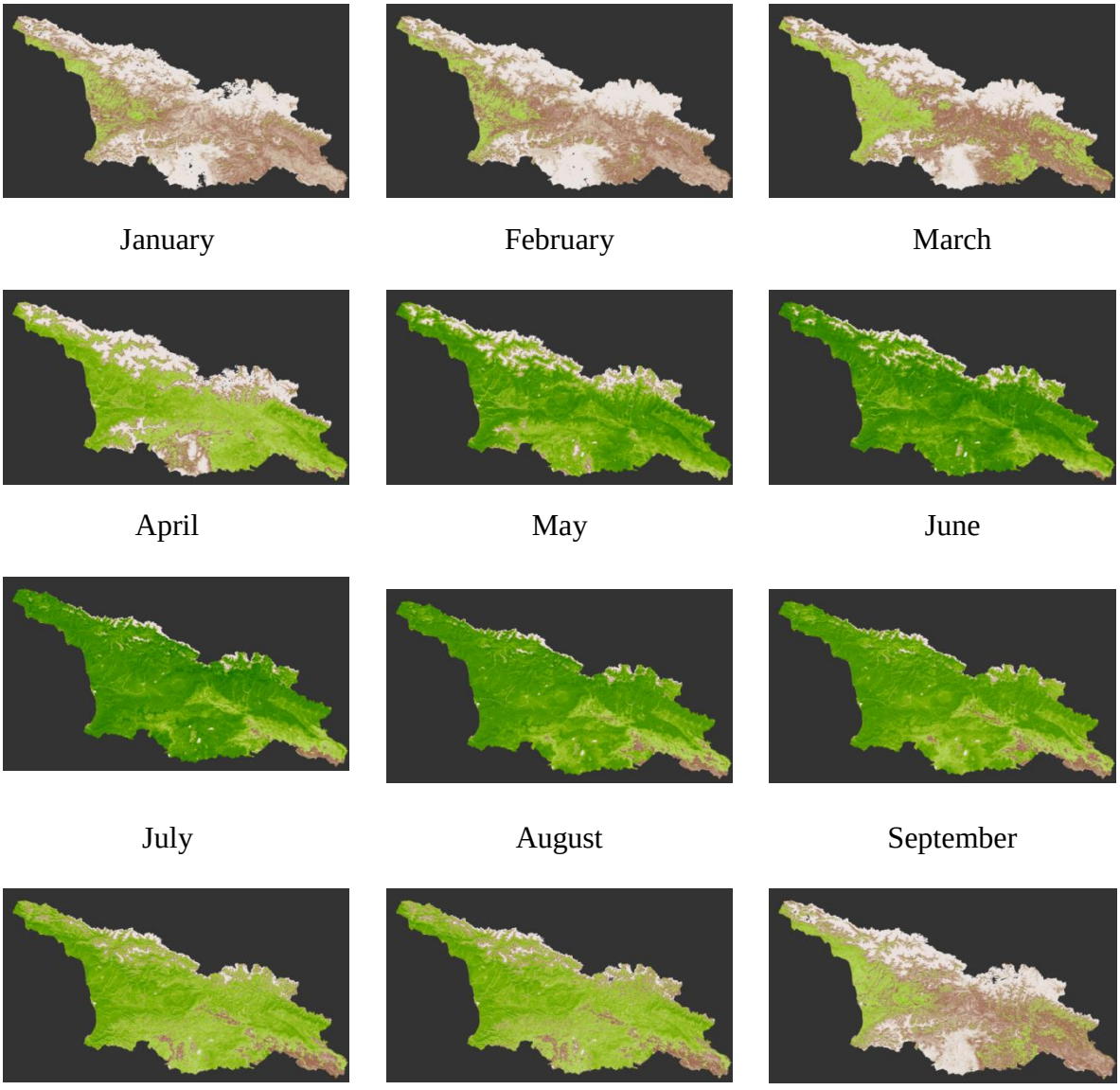


Fig.2. Monthly mean EVI for 2008-2016 period.

.

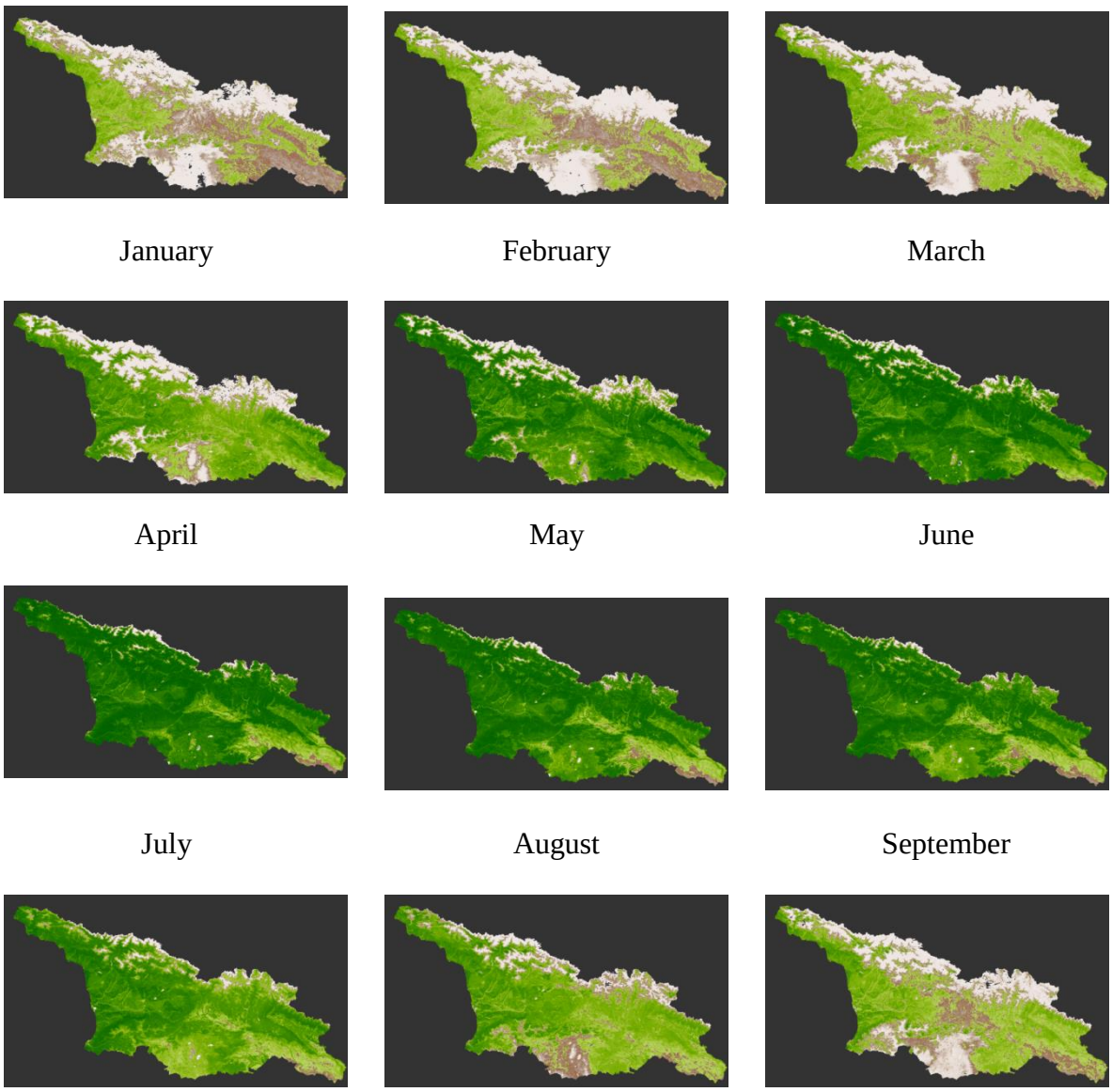
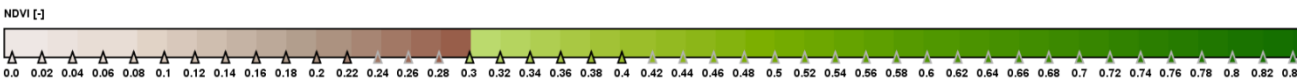


Fig. 3. Monthly mean EVI for 2008-2016 period.

a. EVI Color Legend



b. NDVI Color Legend

Fig 4. Color legends of EVI and NDVI

References

[1] Pettorelli N., Vik J., Mysterud A., Gaillard J., Tucker C., Stenseth N. Using the Satellitederived NDVI to Assess Ecological Responses to Environmental Change. Trends in Ecology and Evolution, 20, 2005, pp. 503-510.

[2] Kerr J., Ostrovsky M. From Space to Species: Ecological Applications for Remote Sensing. Trends in Ecology and Evolution, 18, 2003, pp. 299-305.

[3] Huete A., Didan K., van Leeuwen W., Miura T., Glenn E. MODIS Vegetation Indices. Land Remote Sensing and Global Environmental Change: NASA's Earth Observing System and the Science of ASTER and MODIS; Springer: New York, NY, USA, 2011, pp. 579–602.

[4] Didan K., Munoz A., Solano R., Huete A. MODIS Vegetation Index User's Guide (MOD13 Series), vol. 3, June 2015, https://vip.arizona.edu/documents/MODIS/MODIS_VI_UsersGuide_01_2012.pdf, Last accessed 02/12/2017

[5] Vermote E.F., Kotchenova S.Y., Ray J.P. MOD09 User's Guide - Modis Land Surface Reflectance, vol. 1.3, February 2011, http://modis-sr.ltdri.org/guide/MOD09_UserGuide_v1_3.pdf Last accessed Last accessed 02/12/2017

საქართველოს მცენარეული საფარის შესწავლა MODIS სენსორის მონაცემების საშუალებით

გ. თვაური, ტ. ჯინჯოლია, კ. ქორიძე

რეზიუმე

საქართველოს მცენარეული საფარის ანალიზის მიზნით გამოყენებული იქნა MODIS სენსორის ზედაპირის არეკვლადობის 250 მ, 500 მ და 1000 სივრცითი გარჩევადობის მონაცემები. მათ საფუძველზე გამოთვლილია მცენარეული საფარის მდგომარეობის შესაფასებელი NDVI და EVI ინდექსები 2008-2016 წლების თითოეული დღისთვის, შედგენილია NDVI და EVI ინდექსების სივრცითი განაწილების დეკადური და საშუალო თვიური რუკები, რაც მომავალში მცენარეული საფარის ცვალებადობის დინამიკის შესწავლის შესაძლებლობას იძლევა.

Изучение растительного покрова Грузии с помощью данных сенсора MODIS

Г.А. Тваури, Т.Д. Джинджолия, К.Дж. Коридзе

Резюме

Для анализа растительного покрова Грузии были использованы данные отражаемой способности земной поверхности сенсора MODIS с пространственным разрешением 250 м, 500 м и 1000 м. Были определены ежедневные значения вегетационных индексов NDVI и EVI для периода 2008-2016 гг. На их основе были составлены среднедекадные и среднемесячные карты распределения NDVI и EVI индексов для территории Грузии, что в будущем даст возможность изучения динамики изменения растительного покрова.