NORMALIZED DIFFERENCE VEGETATION INDEX (NDVI) PRODUCTS BY USING OCM2-GAC SENSOR DATA

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Introduction

The Normalized Difference Vegetation Index (NDVI) is a numerical indicator that uses the visible and near-infrared bands of the electromagnetic spectrum, and is adopted to analyze remote sensing measurements and assess whether the target being observed contains live green vegetation or not. NDVI has found a wide application in vegetative studies as it has been used to estimate crop yields, pasture performance, and rangeland carrying capacities among others. It is often directly related to other ground parameters such as percent of ground cover, photosynthetic activity of the plant, surface water, leaf area index and the amount of biomass. This document describes briefly monthly NDVI Products realized by using Oceansat-2 Ocean Color Monitor (OCM2) Global Area Coverage (GAC) sensor.

This is a value added product from OCM2 whose spectral bands are originally designed for ocean color retrieval applications. However, the two-day temporal resolution with a wide swath of 1420 km and high radiometric resolution of 12 bits per pixel from the OCM2 sensor can provide useful information for agricultural applications. In this document, a brief processing scheme for realizing the NDVI and albedo products at a spatial resolution of 8km is presented. Since the NDVI is an intermediate product generated for the VF products realization, this data is also provided as a product for a given month.

Products Formats Specification

- Image File Format : Geo TIFF
- Projection : Geographic coordinates (Lat., Long.)
- Datum : WGS-84
- Spatial Resolution : 8KM
- Radiometric resolution : 8 bits per pixel
- Correction Level : precision corrected
- Number of bands : 1
- DN – NDVI conversion rule : NDVI = ($0.005 \times$ DN) (in float)
- Usable range of DN : 1 – 200
- Masked Label values : 225 (clouds and VF/NDVI less than or equal to 0)
- Image background : 255 (outside country boundary)

File Naming Convention

Image file naming convention contains the following information:

- Sensor name
- Product name
- Month of reference
- Year of reference
- Version number

Examples: ocm2-GAC-_ndvi_oct2011_v01.tif

Ocean Color Monitor Sensor

The Oceansat-2 mission was envisaged as the continuity service provider to IRS-P4 data users. Oceansat-2 has onboard 3 payloads, namely, OCM2, Ku-band Scatterometer and ROSA (developed by the Italian Space Agency, ASI). Oceansat-2 was launched into a near polar sun-synchronous orbit of 720 km altitude. The local time of pass is 12 noon + 10 minutes. The OCM2 is an 8-band multi spectral camera operating in the Visible-Near IR Spectral range. This camera provides an Instantaneous Geometric Field of View of 1000 m covering a swath width of 1420 km. This wide swath enables the OCM2 to provide a temporal resolution of 2 days for any given area. For further details, please refer to webpage http://www.nrsc.gov.in and further following links >> Satellite Data/Mapping and >> Missions.

Data Processing

OCM2 Level-1B imagery has been obtained to generate a monthly product. To make genuine representation of the vegetation growth, selection of datasets was ordered and processed for every date. Cloud masking is done through automatic cloud masking algorithm for each scene. Two steps of data processing are involved: 1) Data preprocessing to prepare the base data, and 2) Generation of intermediate NDVI imagery.

The GAC processing is done for entire pass which had an advantage in compared over conventional techniques is that the number of ground control points (GCPs) required is substantially smaller. Pass processing is a method for determining geometric correction models by using GCPs from a large part of the pass (orbit) containing the desired output scene. Currently, LAC Local area coverage uses ground truth which is located a region the size of one scene. The goal of pass processing is to achieve accuracy comparable to single scene processing, using the minimum number of GCPs which ultimately require less time to complete the entire processing. The two step procedure is done to achieve subpixel level accuracy

1. Standard correction is done through localized second order polynomial affine transformation using the grid which is generated from orbit attitude information. This step brings the L1B product to the standard level product.
2. The standard product biases was removed by updating of standard grid using Ground control points .The updated grid used to generate the Rational Polynomial Coefficients, through these coefficients relief corrected global orthoimages were generated at 1KM images. The ortho-images are resampled and mosaicked at 8km resolution.

Data preprocessing for generating the NDVI products involves following steps: 1) sun and view angle effect corrections across the image swath, 2) atmospheric correction to realize surface reflectance (Image based Technique), 3) cloud masking, 4) precision correction of images, 5) generation of image mosaics, and 6) generation NDVI images.

An image based atmospheric correction was chosen, primarily to generate the required inputs from image itself, rather than from other sources and computationally intensive radiative transfer model. The OCM2 sensor being a large swath imaging system has the bi-directional effect and hence is to be corrected. Cloud screening is essential for the proper utilization of satellite data in the remote sensing of vegetative parameter. Cloud mask algorithm was based on the threshold method using radiance values of bands B1, B3 and B7 bands of the OCM2 sensor. Cloud will reflect part of the incoming solar radiation leading to an increase in the radiance as observed by the sensor in all the bands. The thresholds used to classify a pixel to be cloudy were B1 > 13.8, B3 > 8 and B7 > 14.5 respectively. The algorithm cloud easily screen thick cloud pixel but some of the very thin clouds were identified as clear sky pixels. The Normalized Difference Vegetation Index (NDVI) was computed with NIR (OCM2-B8) and Red (OCM2-B6) bands Top of Atmosphere reflectance data:

$$NDVI = \frac{\rho_{NIR} - \rho_R}{\rho_{NIR} + \rho_R} = \frac{\rho_{B8} - \rho_{B6}}{\rho_{B8} + \rho_{B6}}$$

OCM2_NDVI products are at 4-byte float value. In the NDVI product, all pixels with values less than or equal to zero were brought to zero to enhance the variation in vegetation more predominantly. An image mosaic of the NDVI products for the year 2013 is shown in Figure 1.

Products horizontal Accuracy

Geometric accuracy of the NDVI products is better than a pixel.

Thematic Mapping Accuracy

Though elaborate comparison was not made so far with ground measured vegetation indices, a comparison was made with reference to NDVI products from MODIS sensor data by visually identifying common two samples for each continent except Antarctica . Mean values of these regions are considered for analysis. A good overall correlation between these products is noticed (correlation ~ 80%). The root mean square error (RMSE) between these products is found to be 0.0475, with an overall variation of the OCM2 NDVI products with respect to MODIS NDVI data of about 8.8%.

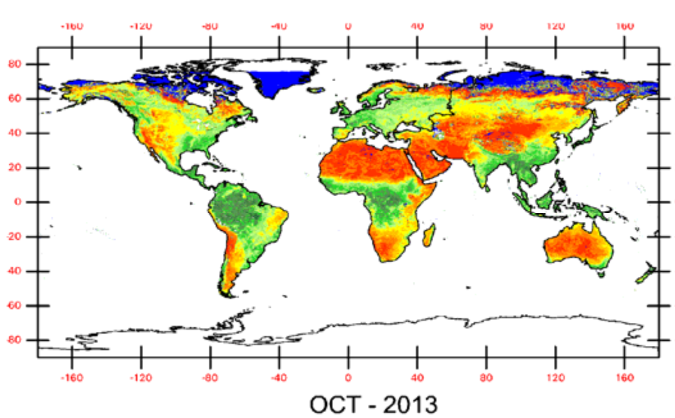

Fig. 1. NDVI global Map for Oct. 2013