Real-time daily rolling weekly green vegetation fraction derived from Suomi NPP satellite

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Introduction

Green Vegetation fraction (GVF) is defined as the fraction of a pixel covered by green vegetation if it were viewed vertically. Real-time GVF is needed in the numeric weather, climate and hydrological models. The current NOAA operational GVF product is derived from AVHRR top of atmosphere NDVI data at 16-km resolution. In the Suomi National Polar-orbiting Partnership (SNPP) era, there is a need to produce GVF as a NOAA-Unique Product (NUP) from data from the Visible Infrared Imager Radiometer Suite (VIIRS) sensor for applications in numerical weather and seasonal climate prediction models at the National Centers for Environmental Prediction (NCEP). The retrieval algorithm uses VIIRS red (I1), near-infrared (I2) and blue (M3) bands centered at 0.640 μm, 0.865 μm and 0.490 μm, respectively, to calculate the Enhanced Vegetation Index (EVI) and derive GVF from EVI. This poster describes the GVF algorithm that is used for GVF retrieval. To meet the data needs of NCEP and other potential users, GVF will be produced as a daily rolling weekly composite at 4-km resolution (global scale) and 1-km resolution (regional scale).

VIIRS GVF Algorithm

The basic retrieval strategy of the GVF processing system is to produce green vegetation fraction from VIIRS observations. Daily VIIRS surface reflectance data are composited weekly and EVI is calculated based on the composited data. GVF is then calculated by comparison of weekly EVI to the global maximum and minimum EVI values.

The GVF processing system generates weekly Green Vegetation Fraction through the following steps:

Step 1: VIIRS swath surface reflectance data in bands I1 (red), I2 (NIR), and M3 (blue) during a calendar day (0000 – 2400 UTC) are mapped to the native GVF geographic grid (0.003 degree plate carree projection) to produce a gridded daily surface reflectance map.

Step 2: At the end of a 7-day period, the daily surface reflectance maps of the 7 days are composited to produce a weekly surface reflectance map using the MVA-SAVI compositing algorithm, which selects, at each GVF grid point (pixel), the observation with maximum view-angle adjusted SAVI value in the 7-day period. The 7-day compositing is conducted daily using data in the previous 7 days as input data, which is called daily rolling weekly compositing.

Step 3: EVI is calculated from the daily rolling weekly composited VIIRS surface reflectance data in bands I1, I2 and M3.

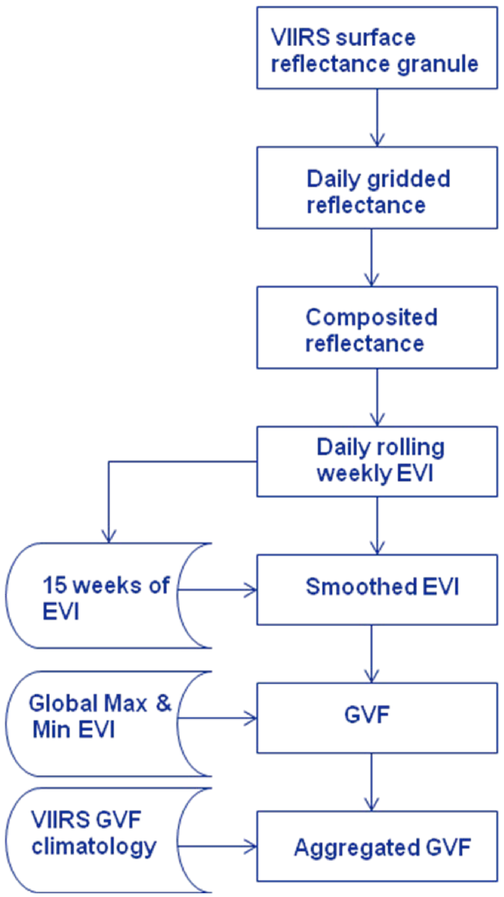
$$EVI = 2.5\frac{NIR - \mathrm{Re}\,d}{NIR + 6\,\mathrm{Re}\,d - 7.5Blue + 1}$$

Step 4: High frequency noise in EVI is reduced by applying a 15-week digital smoothing filter on EVI.

Step 5: GVF is calculated by comparing the smoothed EVI against the global maximum (EVI_∞) and minimum EVI (EVI_0) values assuming a linear relationship between EVI and GVF.

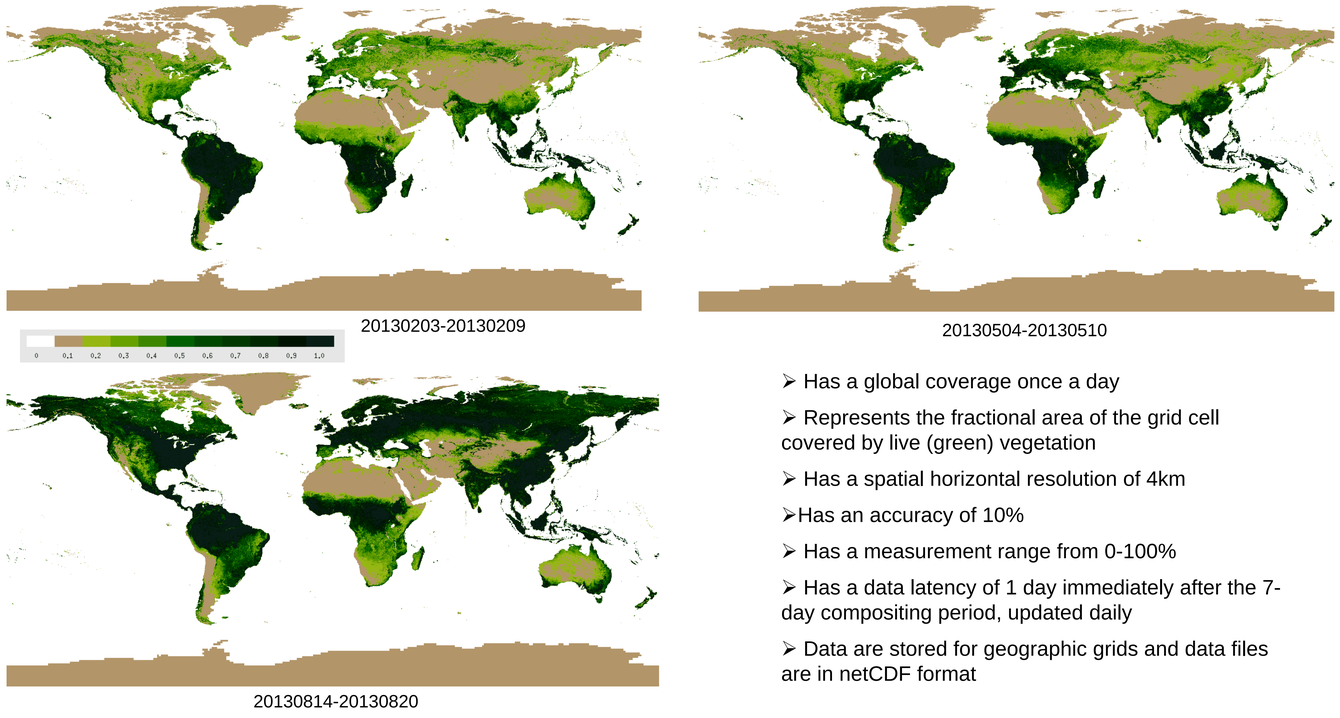
$$GVF = \frac{EVI - EVI_0}{EVI_\infty - EVI_0}$$

Step 6: GVF is aggregated to 0.009 degree (1-km) and 0.036 degree (4-km) resolution for output maps. Potential gaps on the output maps at high latitudes are filled using monthly VIIRS GVF climatology.



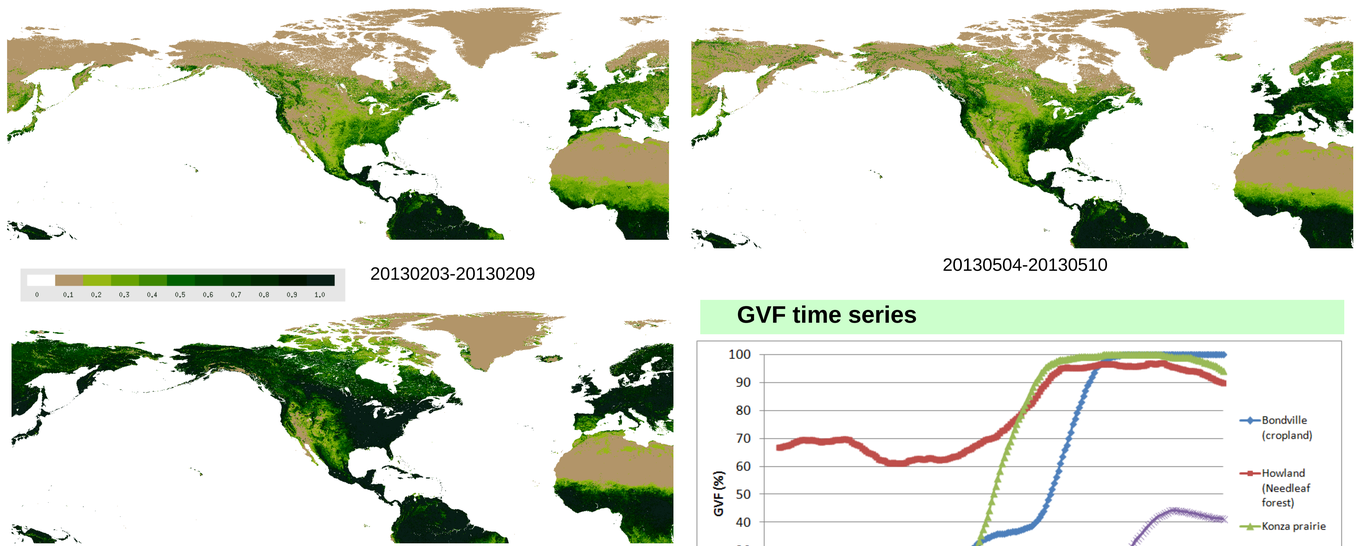
Flow chart of GVF system

Global GVF product



- Has a global coverage once a day
- Represents the fractional area of the grid cell covered by live (green) vegetation
- Has a spatial horizontal resolution of 4km
- Has an accuracy of 10%
- Has a measurement range from 0-100%
- Has a data latency of 1 day immediately after the 7-day compositing period, updated daily
- Data are stored for geographic grids and data files are in netCDF format

Regional GVF product



- Has a regional coverage once a day, covering latitude 7.5° S to 90° N degrees, longitude 130° E eastward to 30° E
- Has a spatial horizontal resolution of 1km

GVF time series

Daily rolling weekly GVF time series over different land cover types

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