Developing a compositing algorithm for retrieval of green vegetation fraction

Zhangyan Jiang1,2, Junchang Ju1, Marco Vargas3, Ivan Csiszar4

1 NOAA National Environmental Satellite, Data, and Information Service, Center for Satellite Applications and Research, College Park, MD, 20740. 2 AER inc. Lexington, MA, 02421

Introduction

Green Vegetation fraction (GVF) is defined as the fraction of a pixel covered by green vegetation if it were viewed vertically. It is used to separate vegetation and soil in energy balance processes, including temperature and evapotranspiration. Real-time weekly global GVF is needed in the numeric weather, climate and hydrological models. The current NOAA operational GVF product is derived from weekly AVHRR NDVI, which is composited using the maximum-value compositing (MVC) method. Although MVC is a widely used technique to remove cloud and atmospheric contamination by selecting the observation with the maximum NDVI value, it is well documented that the maximum NDVI is often selected from the high sensor zenith angles by MVC, which may introduce errors in GVF retrieval. To select high quality observations close to the nadir view, a Maximum View Angle Adjusted SAVI (MVA-SAVI) compositing algorithm is developed. It needs only SAVI and view zenith angle information in compositing. It is evaluated and compared with other compositing algorithms, including MVC, the MODIS vegetation index compositing algorithm and the MODIS 8-day surface reflectance compositing algorithm. The new compositing technique is being used in a new GVF product from Suomi NPP VIIRS, that is currently being transitioned from research to operation.

Method and data

MVC favors observations in the forward scatter direction. To reduce the bias in view angle directions, Jiang et al (2012, submitted to ISPRS P&RS) proposed using the soil-adjusted vegetation index (SAVI), instead of NDVI, in compositing.

\[
\text{SAVI} = \frac{(1 + L) \times \text{NIR} - \text{Red} + L}{\text{NIR} + \text{Red} + L}
\]

SAVI increases with the increase of view zenith (VZ) angles due to surface BRDF effects. VZ should be taken into account in compositing such that observations close to the nadir view are given a priority under clear sky conditions and observations at off-nadir view should be selected only if nadir view observations are cloudy. So, in compositing, SAVI should be adjusted according to its VZ angle for each observation. The View-angle Adjusted SAVI (VA-SAVI) is designed as:

\[
\text{VA-SAVI} = \text{SAVI} - \text{C} \times \text{VZ}
\]

Where C is a coefficient. The Maximum VA-SAVI (MVA-SAVI) observation in a compositing period, instead of the maximum NDVI, is selected to represent the compositing period.

Results

A. MVA-SAVI composite maps

B. Comparison with MVC, MYD13A1 and MYD09A1 data

C. Time series comparison at Walker Branch (Broadleaf Forest)

Conclusions

- MVA-SAVI compositing algorithm was designed to select high quality observations from low view zenith angles (mostly less than 20°) to ensure GVF is measured vertically.
- Compared with MVC, MVA-SAVI reduced sensor zenith angles by 65.6%.
- Increased NDVI values by 6.9%.
- Increased EVI values by 2.7%.

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