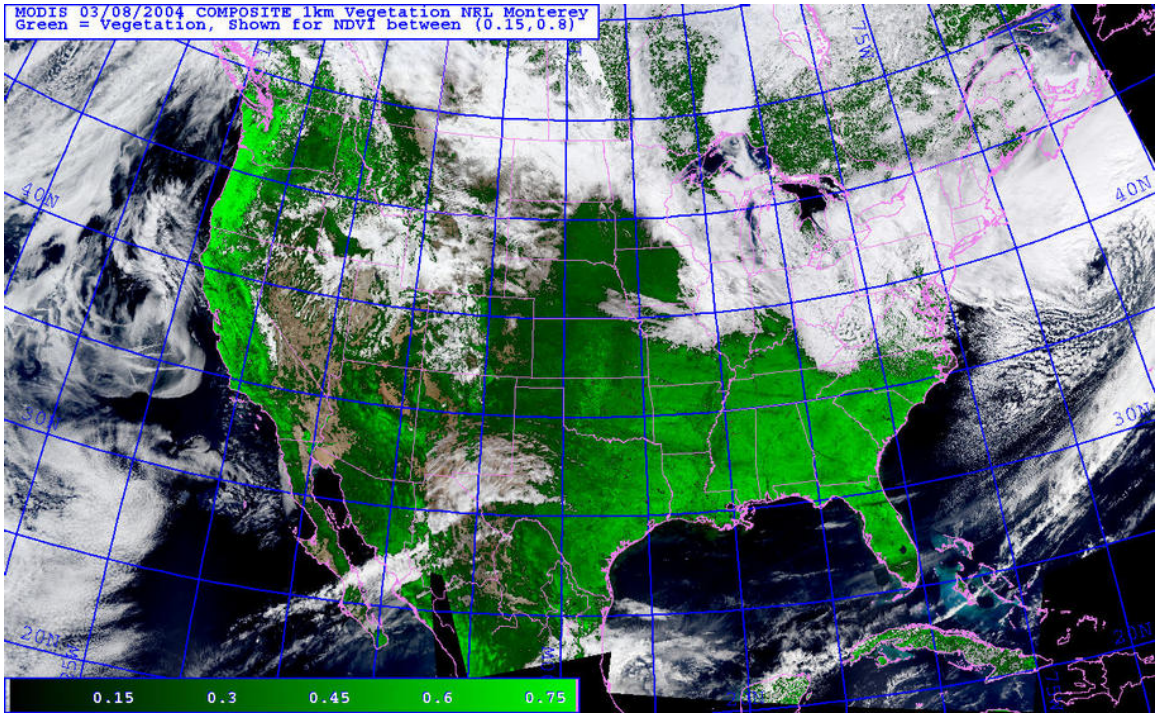
Satellite Product Tutorials:

Vegetation (Biomass) Index



Above: The so-called "normalized difference vegetation index" (NDVI) biomass product provides a measure of how much photosynthetically active vegetation is present in the scene. Areas dense in vegetation are depicted in bright green (NDVI's larger than about 0.6 on the color bar), areas with less vegetation in dark green (NDVI's less than 0.2), and vegetation sparse regions are replaced by true color imagery (see tan areas in the southwestern deserts). The strongest signals present in this example come from the thick coniferous forests of the Pacific Northwest.

Why We're Interested…

Knowledge of vegetation coverage and health has numerous applications to land management, including large-scale monitoring of croplands, forest health, and the impact of droughts. Looking at the big picture, the carbon dioxide uptake of plants is an important player in the "carbon cycle" with great implications to the current and future states of the Earth's climate.

The military is interested in surface classification from the standpoint of determining vehicle accessibility.

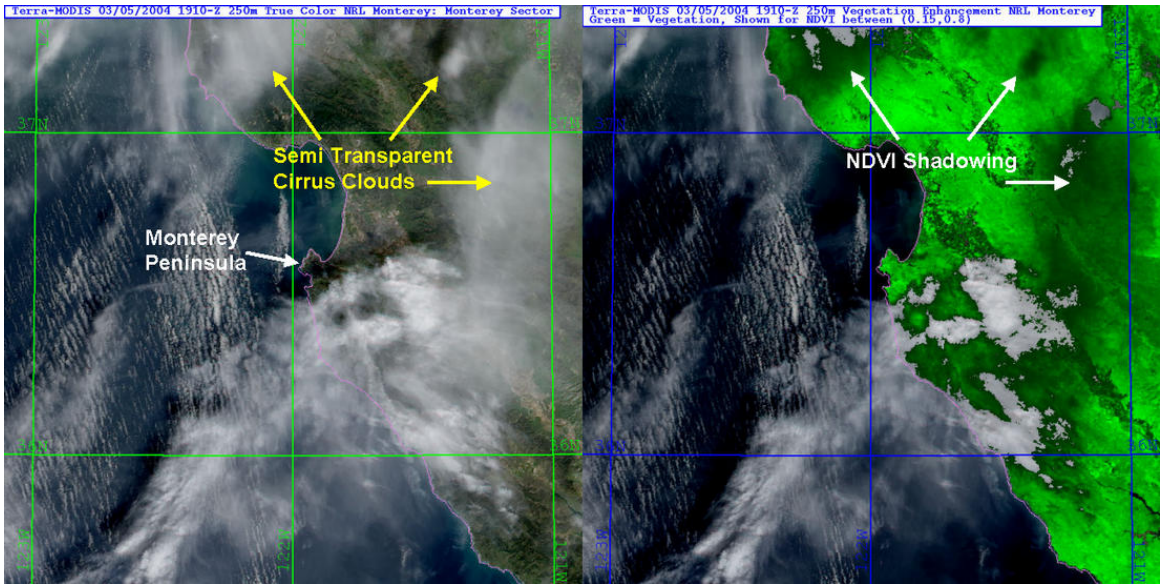
How This Product is Created…

The presence of chlorophyll in plants is key to the process of photosynthesis (whereby plants to convert sunlight energy into vital nutrients, "breathing" in carbon dioxide and "exhaling" oxygen in the process). Chlorophyll is a strong absorber of blue light (~0.45 micron) and also marginally absorbs red light (~0.65 micron), while moderately reflecting green light (~0.55 micron) and strongly reflecting near infrared (~0.86 micron). This explains why most plants appear green.

The vegetation product is based on this unique spectral behavior of chlorophyll. It is basically a visualization of the NDVI, defined as the difference between measured solar reflection from a satellite band very sensitive to chlorophyll (here, 0.86 micron) and a band in the red part of the visible spectrum (0. 65 micron). A green color palette is used to display the NDVI. Low values of NDVI (below 0.15) are not shown and instead are replaced by natural color imagery that typically reveals barren desert landscapes.

How to Interpret…

The NDVI is a quantitative product (each pixel of the image has a characteristic NDVI value) but has been displayed here as qualitative imagery for illustrative purposes. In general, bright green regions correspond to high vegetation content, while dark regions correspond to sparse vegetation. Viewing examples of the biomass product over a long time period can give indications of seasonal trends in vegetation over large domains. The enhanced contrast of high vegetation backgrounds can enhance the detection of fine-scale details (for example, cleared forest patches in Brazil, road networks) and cloud/smoke features.



Cloud cover inherently produces low NDVI and therefore is shown in true color. However, corrections have not been applied to account for sub-pixel scale cloud and thin cirrus "contamination," resulting in an occasional NDVI "shadowing" effect. Other channels on MODIS, such as the 1.38 micron channel which is sensitive to thin cirrus clouds, could be used here to mitigate these effects.

Looking Toward the NPOESS Era…

The National Polar-orbiting Operational Environmental Satellite System (NPOESS) will carry the Visible/Infrared Imager/Radiometer Suite (VIIRS) will continue the capability of POES in providing NDVI, but with improved spatial (for resolving fine-scale details) and radiometric (for quantifying NDVI values) resolution. Additional bands on VIIRS will enable more effective cloud screening techniques and overall improved characterization of the surface properties.

Did You Know…?

The vegetation enhancement can also be used to highlight burn scars from recent major fires.

Want to Learn More?

Science Papers:

Paruelo, J. M., M. F. Garbulsky, J. P. Guerschman, and E. G. Jobbagy, 2004: Two decades of normalized difference vegetation index changes in South

America: identifying the imprint of global change. *Int. J. Rem. Sensing*, **25**, No. 14, 2793-2806.

Technical P.O.C.: Steve Miller (miller@nrlmry.navy.mil)