

# The MODIS VI Product (MOD13) series: Accomplishments, Refinements, and Validation

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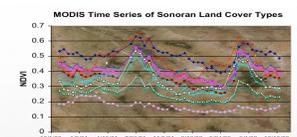


## Accomplishments:

The MODIS Vegetation Index products have been evaluated over a wide range of ecosystems on seasonal and inter-annual time scales to test their performance in providing consistent, spatial and temporal measures of vegetation conditions.

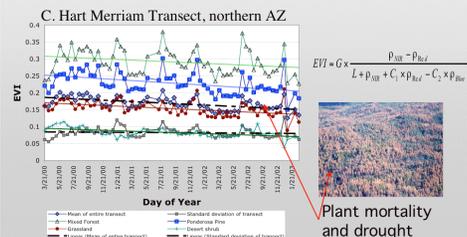
### Southwest Time Series Analyses (Arid/ Semiarid Ecosystems)

- The temporal dynamics of vegetation in the semiarid and arid Southwest, are highly sensitive to anthropogenic and climatic forcings (monsoon pulse, drought, etc.).

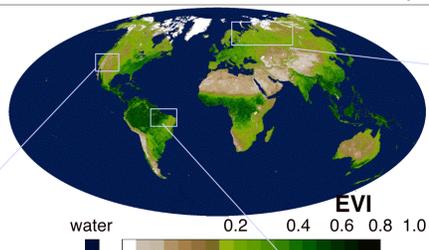
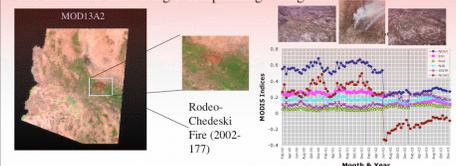


$$NDVI = \frac{P_{NIR} - P_{Red}}{P_{NIR} + P_{Red}}$$

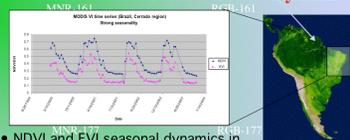
- The effects of the current 6-year drought are clearly evident in the MODIS VI Product throughout all ecosystems (desert shrub to montane forest) studied.
- The MODIS VI Product capture the spatial and temporal variability of the climatic drought signal under low biomass (semiarid ecosystems) conditions.



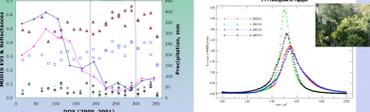
- The severe drought in the Southwest has also resulted in severe fire condition and strong corresponding VI signals:



### Brazil Amazon and Cerrado Dynamics

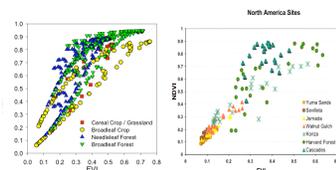


- Tapajos EOS core site shows EVI increasing during dry season ('flush' of new leaf growth in agreement with flux tower CO2 results). No saturation.



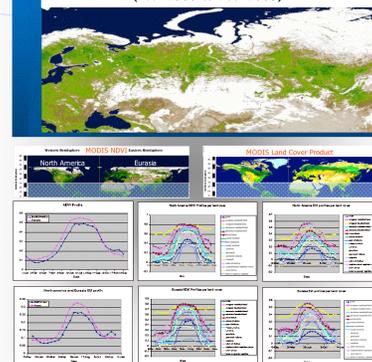
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## NDVI & EVI Relationships



NDVI-EVI relationships based on canopy radiant transfer models (left) and MODIS data (right). These relationships need to be studied more, globally and per land cover class.

## Vegetation Phenology Analysis in Eurasia (Feb. 2000-to-Dec. 2003)



## Algorithm Refinements

We aim to make algorithm refinements in order to optimize VI product performance and conduct global characterization of the error and uncertainty fields of the VI products in time and space. Some of the major issues include:

- The snow effect on the VI results in false negative values on NDVI and false positive values on EVI. Mapped snow fields provide an opportunity to quantify this effect and rectify it.
  - Saturation and soil background effects on NDVI.
  - Residual aerosols/clouds. We plan to quantify the extent to which the aerosol resistant VI's reduce this problem and the degree to which this impacts the NDVI. (Use of the Aeronet sites)
  - Cloud shadow. Assess how cloud shadows impact the VI signal.
  - Inland water body problems and false VI signals.
  - Topography influences. There is currently no correction for topographic effects on the VI values and the uncertainties over such complex areas need to be assessed.
  - Miscellaneous issues. There are a variety of issues that are related to the identification of poor input data that cause problems for the VI product, such as striping, blocky data, residual clouds, etc.. This has to be coordinated with the MODIS land team.



- Examples of unstable VI behavior over inland water bodies (left) and presence of snow (right)

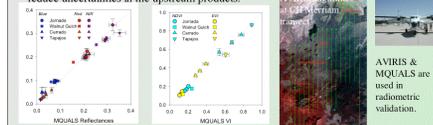
## Validation, Uncertainty modeling and error propagation analyses:

The sensitivity, accuracy, and performance of the VI products in depicting vegetation variability through space and time include the following types of analyses activities:

- assessments of the accuracy, noise, and uncertainty present in the 'upstream' inputs (cloud, atmosphere correction, instrument characteristics),
- the quality in which the computed VI values are composited over a 16-day interval,
- the accuracy with which the VI time series depict seasonal and interannual vegetation dynamics and variability over all biomes,
- performance verifications with respect to biophysical canopy parameters (e.g., fractional green cover, LAI) and ecosystem model outputs,
- performance verification with ecosystem (CASA) models.

### Radiometric comparisons of the MODIS VI products

- The radiometric validation of VI's is similar to the validation of the surface reflectance products except that in combination, multiple bands may enhance or reduce uncertainties in the upstream products.



- We are evaluating the radiometric stability and accuracy of the VI composited product through comparisons of independently derived measures of TOC: nadir VI's with MODIS-derived VI's, for a global range of spatial/ temporal conditions.

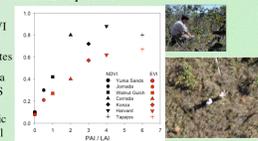
- Additional comparisons of MODIS VI's are being conducted at:

- the Aeronet sites
- a global set of ASTER and ETM+ images
- at major field campaigns (e.g., LBA, SMEX04, SAFARI, Jornada-PROVE campaigns)

### Biophysical comparisons of the MODIS VI products

- Biophysical verification of the VI products are made at major field campaigns and CEOS validation sites

- We plan to provide reference data sets summarizing expected MODIS VI response to different land cover classes, including expected dynamic range and a coupling to biophysical "control points".



## Summary

- The VI products are provisionally validated from radiometric, seasonal, interannual and biophysical perspectives,
- VI product accuracy has been assessed by a number of independent measurements, at a number of locations or times representative of conditions portrayed by the product.
- Residual cloud, cloud shadow, BRDF, topography, and snow induce the largest uncertainties in the VI's,
- Assessment of feasibility of using snow product and BRDF products.
- VI product accuracy varies with QA, enabling the user to decide on level of accuracy necessary for specific applications.

