Global Land Cover & Land Cover Dynamics (MOD12): Recent Results & Activities

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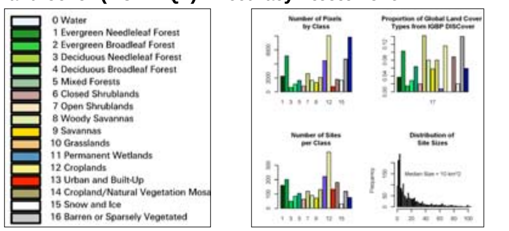
Summary

The MOD12 product provides datasets related to two distinct dimensions of terrestrial ecosystems: (1) land cover, which is defined in terms of thematic classes; and (2) land cover dynamics, which characterizes the seasonal variation in global vegetation phenology. Recent activities have focused on:

- Evaluating the quality and accuracy of the MOD12Q1 product
- Developing methods to map wetlands and seasonal flooding patterns in large wetlands complexes using MODIS
- Developing methods to improve characterization of croplands from MODIS
- Validation of the MOD12Q2 product using available datasets.
- Development of cost-effective data collection methods for calibration and validation of the MOD12Q2 product.
- Assessment of uncertainty and sources of error in the MOD12D2 product
- Preparation for collection 5 processing.

Future planned activities include continued refinement and accuracy assessment of our algorithms, and transition to C5 processing based on 8-day 500-m nadir BRDF-adjusted data

Land Cover (MOD12Q1) – Accuracy Assessment

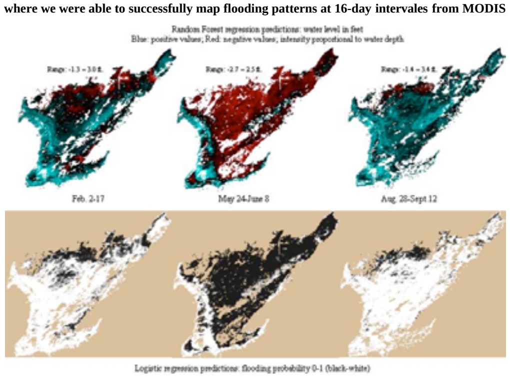


Top: global distribution of C4 training sites; Bottom left: legend for IGBP layer; Bottom right: general properties of site data

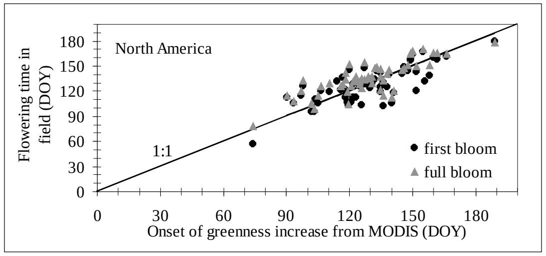
User's and producers accuracies for the MOD12 IGBP layer based on cross-validation analysis. Panels at left show assignment of class labels for all classes; panels at right show results for individual classes.

Mapping Wetlands and Seasonal Inundation Using MODIS

We have also been exploring methods to use MODIS to map wetlands extent and seasonal flooding patterns. Below we present results from an analysis for the Florida Everglades where we were able to successfully map flooding patterns at 16-day intervales from MODIS

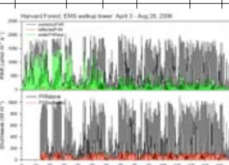


Land Cover Dynamics – Accuracy Assessment

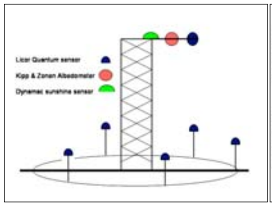


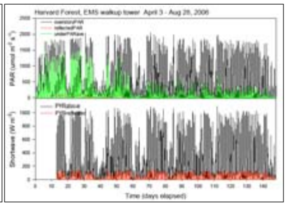
Comparison between flowing time measured in the field and the onset of greenness increase retrieved from MODIS data (data from Plantwatch;).

	G_{in}			G_{ma}			G_{de}		G_{mi}			
	MODIS	ABD	BBD	MODIS	FL1	FL2	MODIS	CL	MODIS	AGD	GL	TL
2001	120±5	123±4	20	157±7	77	81	236±4	1	317±2	297±12	0.25	3
2002	122±4	118±10	5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	315±1	304±10	1	10
2003	130±2	127±9	5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	304±3	295±9	2	15



Comparison between phen[illegible] [illegible]IS data and in-situ data collected at Harvard F[illegible] [illegible]). For the MODIS-based estimates we provide [illegible] e nearest neighbor 1-km2 cells. Gin: date of gre[illegible] [illegible]urity; Gde: date of greenness decrease; Gmi: d[illegible] [illegible]ate of first budburst observed in field ; BBD: pe[illegible] [illegible]of MODIS retrieval; FL1: percent of leaves in c[illegible] [illegible] mean MODIS Gma; FL2: percent of leaves in canopy reaching their final size at the time of maximum MODIS Gma; CL: average percentage coloring of leaves at the time of mean MODIS Gde; AGD: average date of last green leaf coloring for each individual plant: GL: the percent of green leaves in the canopy at the time of mean MODIS Gmi; TL: the percent of leaves on trees at the time of mean MODIS Gmi.





In the past several months we have initiated field measurements at Harvard Forest and at a field site in southern New Hampshire (Sargent Camp). These measurements are designed to provide high quality information regarding the phenology of forest canopies at each site. To do this, we have installed (1) arrays of optical (PAR) sensors below the canopy, (2) PAR sensors measur-ing upwelling and downwelling PAR above the canopy, and (3) pyranometers measuring upwelling and downwelling solar fluxes above the canopy at each site (Figures 9 and 10).

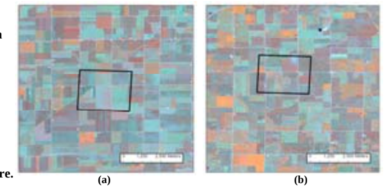
Recent Publications

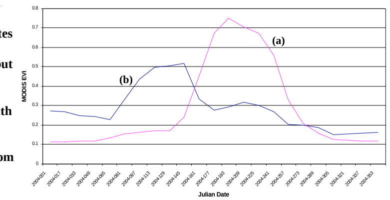
- X. Zhang, M. A. Friedl, C. B. Schaaf. Global Vegetation Phenology from MODIS: Evaluation of Global Patterns and Comparison with in-Situ Measurements. In press, *JGR-Biogeosciences*, 2006.
- X. Zhang, M. A. Friedl, C. B. Schaaf, A. H. Strahler, J. C. F. Hodges, F. Gao, B. C. Reed, and A. Huete. Monitoring vegetation phenology using MODIS. *Remote Sensing of Environment*, 84: 471-475, 2003.
- X. Zhang, M. A. Friedl, C. B. Schaaf, A. H. Strahler, and A. Schneider. The footprint of urban climates on vegetation phenology. *Geophysical Research Letters*, VOL 31, L12209, doi: 10.1029/2004GL020137, 2004.
- X. Zhang, M. A. Friedl, C. B. Schaaf, A. H. Strahler. Climate controls on vegetation phenological patterns in northern mid- and high latitudes inferred from MODIS data. *Global Change Biology*, 10:1133-1145, doi: 10.1111/j.1365-2486.2004.00784.x, 2004.
- X. Zhang, M. A. Friedl, C. B. Schaaf, A. H. Strahler, Z. Liu. Monitoring the response of vegetation phenology to precipitation in Africa by coupling MODIS and TRMM instruments. *Journal of Geophysical Research – atmospheres*, 110(D12): Art. No. D12103 JUN 17 2005.

Ongoing Activities: MOD12Q1: Land Cover

Croplands are inherently difficult to classify as a distinct land cover type. However, phenology may be a useful tool for identifying and accurately characterizing cropland training sites. We are currently employing both the MODIS Land Cover Dynamics product (MOD12Q2) and temporal trajectories of the raw MODIS EVI product (MOD13) to examine and update the five hundred cropland exemplars in the System for Terrestrial Ecosystem Parameterization (STEP) training database, which is a key element of the MOD12Q1 classification algorithm. In many cases, phenological characterization makes croplands separable from surrounding natural vegetation. It is also a promising method for discrimination between broad crop categories, such as cereal crops and broadleaf crops.

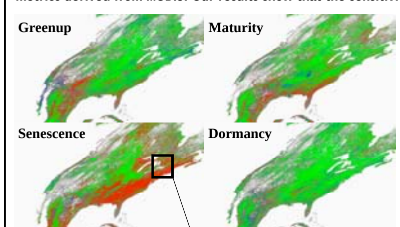
The figures at right illustrate the use of phenological trajectories in identifying and accurately characterizing cropland training sites for the MODIS land cover classification algorithm. MOD12Q1 training sites have traditionally been located by interpretation of Landsat TM images, such as the false color composites (RGB=453) shown here. Site (a) is known to contain corn and soy fields, while site (b) contains wheat. Both of these sites (shown in black outlines) can be clearly identified as croplands, but it is much more difficult to determine crop type from the image alone. The plot underneath presents the phenological trajectories of each site for the 2004 growing season, derived from the 250m MODIS EVI product.



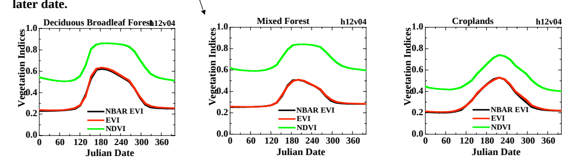


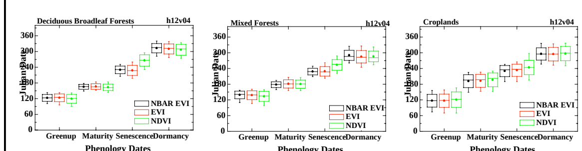
Ongoing Activities MOD12Q2: Land Cover Dynamics

Selection of the vegetation indices is a key factor that affects the quality of phenological metrics derived from MODIS. Our results show that the sensitivity of MOD12Q2 algorithm to the choice of the vegetation index depends on the biome type. Specifically, we observed distinct differences in phenology inferred from EVI versus NDVI in densely vegetated areas caused by saturation of the NDVI. The biggest difference is in estimated senescence dates. NDVI for natural dense vegetations is unchanged while the greenness of vegetation decreases (refer to the bottom figure). In semi-arid areas we observed large differences arising from weak phenology.



Differences between phenological dates derived from NBAR EVI vs NDVI. Green: dates from two VIs are similar (difference < 16 days). Red: NBAR EVI yields an earlier date. Blue: NBAR EVI yields a later date.





Top three plots show temporal changes in NBAR EVI, EVI, and NDVI in 2002. The bottom plots show the phenological dates derived from three VIs. The data are achieved by averaging all pixels in a class in tile h12v04.