Enhanced Land Cover and Land Cover Change Products from MODIS

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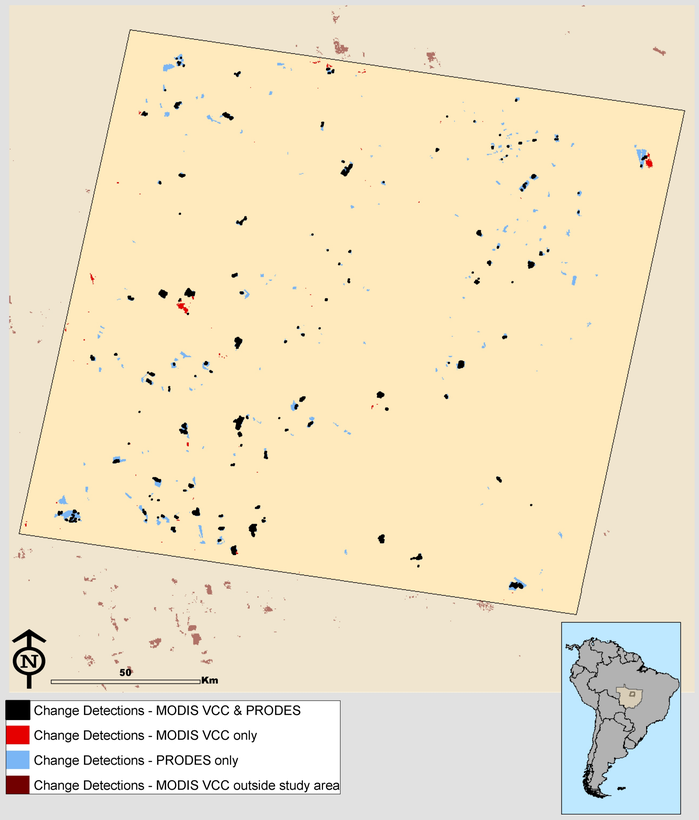
Vegetation Cover Conversion Deforestation Validation

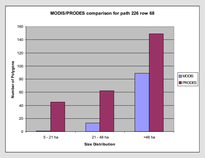
A comparison of VCC and the PRODES deforestation data set in Mato Grosso, Brazil (Landsat tile p226r68)



The MODIS Vegetative Cover Conversion product is designed to be a global alarm product for large scale land cover changes. The current version of the product is available for the humid tropics (30° N to 30° S) and shows changes due to deforestation. VCC is generated quarterly using data from the current year and comparing that to data for the same time period from the previous year. This product is available from the LP-DAAC under the title MOD44A Vegetative Cover Conversion 96-day.

Validation has been performed using the PRODES Digital 2002 data set. The Instituto Nacional de Pesquisas Espaciais (INPE) analyzes more than 220 Landsat TM scenes each year to provide annual high-resolution mapping of deforestation as part of the PRODES project (Estimativa do Desflorestamento da Amaznia, or Program for the estimation of deforestation in the Brazilian Amazon). The PRODES product is generated using the most cloud free scene from the current year and comparing to the forest cover mask for the previous year.

The validation results shown in the image to the left is for scene P226R068. The analysis identifies areas where PRODES and MODIS have identified the same occurrence of change.

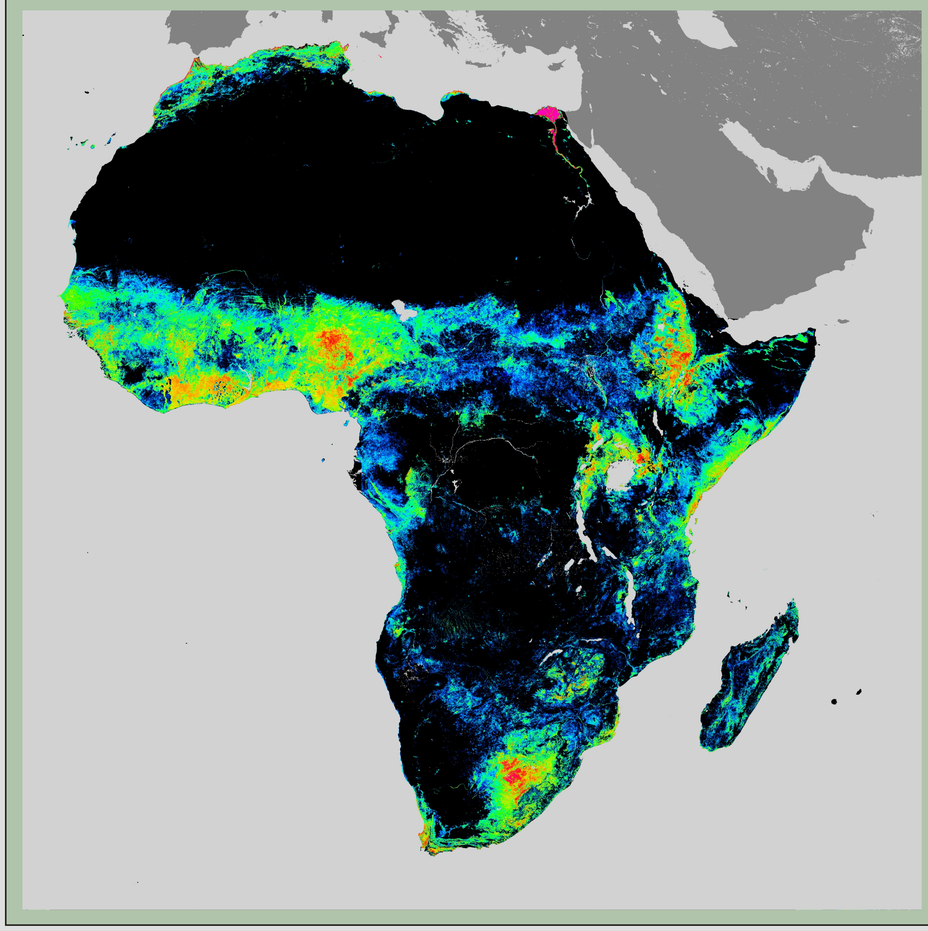


The figure above shows that as the size of the occurrence of change increases VCC from MODIS identifies more of the locations that have changed. For moderate to large sized areas of change (>48 ha), VCC correctly identifies 62% of all occurrences of deforestation in the scene that were of moderate size.

The table below shows that where VCC identifies change it is correct greater than 91% of the time. This translates to 9% commission error (incorrectly labeling something as change) and 38% omission error (not labeling change that actually occurred) for moderate sized areas of change for the scene 226/68 for 2002.

	number	% of polygons
number of polygons w/in 2001 forest mask	250	
location of MODIS polygons w/ respect to PRODES		
forested	*6*	*2.40%*
deforested 2002	*228*	*91.20%*
previously deforested	*16*	*6.40%*

Vegetation Continuous Fields - Percent Crops Layer

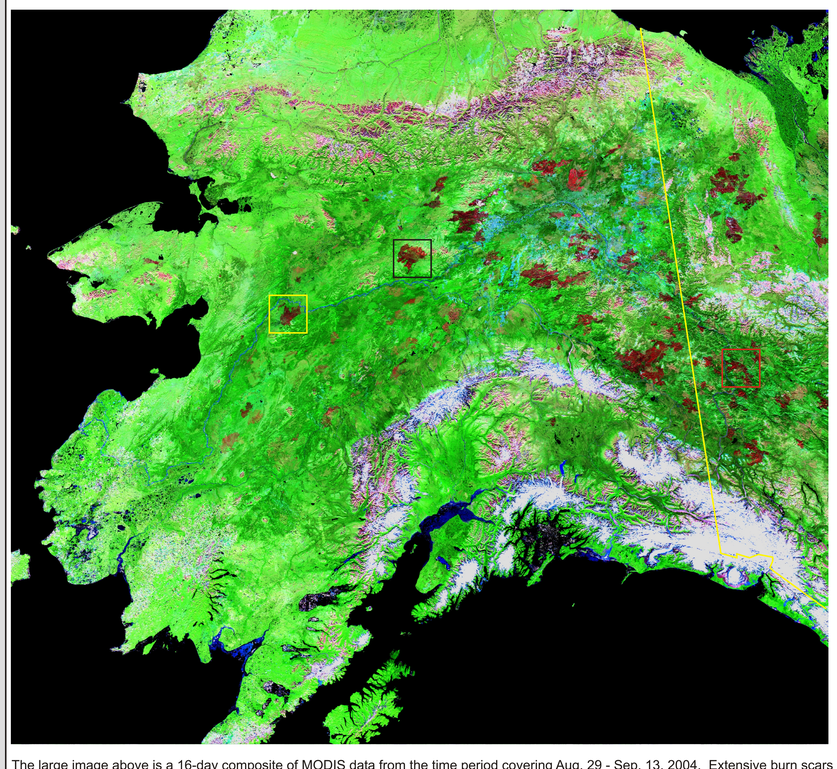


Several products in which vegetation characteristics are displayed as continuous fields have already been created, namely percent tree cover, percent herbaceous and percent bare. The MODIS Vegetation Continuous Fields (MOD44B) product is currently available as a Collection 3 product validated to Stage 1 through the LP-DAAC. This product is currently being regenerated using Collection 4 data. The Collection 4 version will be available the summer of 2005.

Mapping croplands as a continuous field is a challenge as sub-pixel calibration information is not available due to the variation in cropping patterns through time and over space. To create such a map, a two class training set is developed for regions which are typically cropped versus others which are not. These data are put into a classification tree procedure. This new approach combines bagging techniques to derive an output of likelihood of class membership per training pixel. The final training vector is then used as an input to a regression tree model. This single model retains the interpretability of the tree algorithm, allowing for iterating the product, while retaining most of the benefits gained through the bagging procedure. In this figure, red and orange represent areas of more intensively developed croplands.

Low — Cropland Intensity — High

Vegetation Cover Conversion Due to Burning



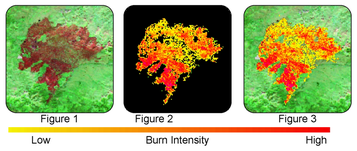


Figure 1 - MODIS 250 m resolution image of the North Dag fire burn scar in central Alaska (black square). Figure 2 - VCC conversion due to burning. Figure 3 - Overlay of 250m MODIS image with VCC Burned Area prototype. Area in red suggests a higher burn intensity.

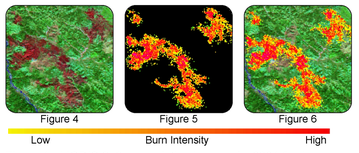


Figure 4 - MODIS 250 m resolution image of a 2004 fire burn scar in the Yukon Territory of Canada (red square). Figure 5 - VCC conversion due to burning. Figure 6 - Overlay of 250m MODIS image with VCC Burned Area prototype. Area in red suggests a higher burn intensity.

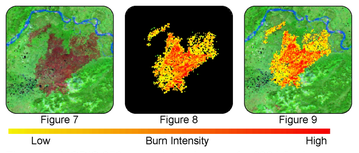
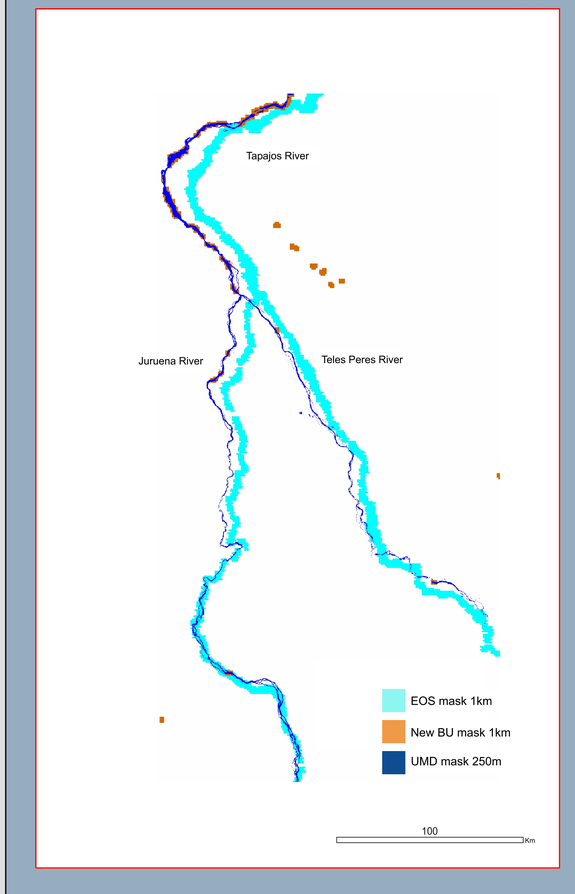
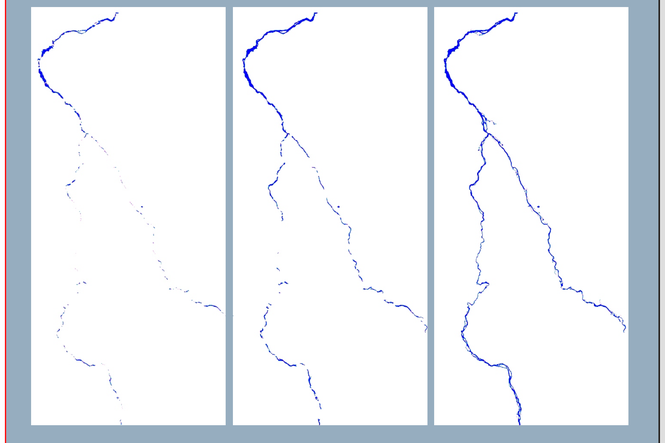


Figure 7 - MODIS 250 m resolution image of a 2004 fire burn scar in western Alaska (yellow square). Figure 8 - VCC conversion due to burning. Figure 9 - Overlay of 250m MODIS image with VCC Burned Area prototype. Area in red suggests a higher burn intensity.

The large image above is a 16-day composite of MODIS data from the time period covering Aug. 29 - Sep. 13, 2004. Extensive burn scars can be seen as dark brown features in the false color visualization (using MODIS bands 7 2 1 assigned to Red, Green, Blue respectively). The smaller images on the right show an analysis that was performed to detect burned areas in the image. The method uses the MODIS active fire location points to locate areas of consideration, then calculates the Normalized Difference Burn Ratio (NDBR) for this image and for the same time period a year earlier. By subtracting the year 1 result from the year 2 result a difference image is created where higher values show increasing difference between the 2 years. Starting from the fire location points a burned area is "grown" by following natural patterns in the difference image. The result is then refined by removing any observation where the NDBR from the current year (year 2) that was greater than 2 standard deviations from the mean. The progression can be seen in the sets of 3 images where the image on the left is a 250 meter resolution image from the scene, the center image is the burned area result, and the image on the right is an overlay of the burned area on the original image. By retaining the values from the NDBR difference one can infer burn intensity assuming that a greater difference yields a higher intensity of burn. This is illustrated in the full resolution images as a color from yellow to red.

UMD Prototype 250m Water Mask





Step 1: MODIS water mask using highest confidence pixels.

Step 2: Water mask uses additonal MODIS pixels to extend the rivers.

Step 3: Landsat data is used to enhance and fill gaps in the rivers.

The image to the left shows an overlay of the standard EOS water mask, the new improved MODIS water mask from Boston University (both at 1 km spatial resolution), and the prototype water mask from the University of Maryland (at 250m spatial resolution). The EOS water mask shows significant geolocation issues when compared to the other masks. The new MODIS BU mask is located accurately, however it often has many discontinuities and omissions.

The Prototype water mask from the University of Maryland is generated from MODIS at 250m resolution and uses Landsat data to help fill discontinuities.

The sequence of images above shows the progression of the algorithm from the original "high confidence" MODIS detections through the discontinuity filling process. Step 1 retains only those MODIS observations that were classified with the highest confidence by the decision tree classifier. Step 2 in the process is to extend the rivers using lower confidence MODIS water observations. The final step uses Landsat observations to attempt to connect existing portions of rivers.

Poster created by Karl Wurster