MODIS Collection 5 Land Cover Type and Land Cover Dynamics: Algorithm Refinements and Early Assessment

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Abstract
The Moderate Resolution Imaging Spectroradiometer (MODIS) aboard NASA’s Terra and Aqua spacecraft provides land surface data at global scales that are useful for a wide array of scientific applications related to land surface properties and processes. In the past year, land products from MODIS collection 5 reprocessing have become available. In this paper, we describe algorithm refinements and recent results from collection 5 reprocessing of the MODIS land cover type and land cover dynamics products (MOD12). Specifically, we summarize changes to the algorithm and data sets that are being used to characterize the geographic distribution and phenology of vegetation and land cover types at global scales. In collection 5, the MOD12 product is produced at 500-meter spatial resolution using 8-day inputs from the MODIS normalized difference vegetation index (NDVI) product. The increased spatial and temporal resolution of the input data used to produce the MOD12 product represents significant steps forward and result in substantial improvements relative to the MOD12 collection 4 products. This poster describes specific changes to algorithms and input data that are being used in collection 5, and will provide preliminary assessments regarding changes in product quality.

Algorithm Refinements
The collection 5 MOD12 product will include a number of significant changes and refinements. Most importantly, the CS product will be based on input data with increased spatial and temporal resolution. In the case of land cover type and error analysis based on PCA of temperature in addition to surface reflectance. These improvements increase the overall quality of the product by (1) refining and improving the representation of vegetation patterns at global scales that are useful for a wide array of scientific applications related to land surface properties and processes. In the past year, land products from MODIS collection 5 reprocessing have become available. In this paper, we describe algorithm refinements and recent results from collection 5 reprocessing of the MODIS land cover type and land cover dynamics products (MOD12). Specifically, we summarize changes to the algorithm and data sets that are being used to characterize the geographic distribution and phenology of vegetation and land cover types at global scales. In collection 5, the MOD12 product is produced at 500-meter spatial resolution using 8-day inputs from the MODIS normalized difference vegetation index (NDVI) product. The increased spatial and temporal resolution of the input data used to produce the MOD12 product represents significant steps forward and result in substantial improvements relative to the MOD12 collection 4 products. This poster describes specific changes to algorithms and input data that are being used in collection 5, and will provide preliminary assessments regarding changes in product quality.

Major Changes to the MODIS Land Cover Type and Land Cover Dynamics Products (MOD12)

- Collection 5 Refinements to the Land Cover Dynamics Product
  - Ancillary data layers are used within the MOD12Q2 algorithm to aid classification results when data from MODIS do not effectively separate classes. These data are derived from a variety of sources including the Collection 4 MOD12Q2 product, agricultural intensities data, and the MODIS land cover mask.
  - A 150 km x 150 km moving window was used to compute the approximate regional frequency of classes based on MODIS collection 4 data; this provides local likelihoods for each class at each pixel.
  - To preserve the likelihood of agriculture or agricultural mosaic, we used a new data set from Ramankutty et al. (2008, in press, GBC; see below).

Updated Ancillary Data Layers
- Auxiliary data layers are used within the MOD12Q2 algorithm to aid classification results when data from MODIS do not effectively separate classes. These data are derived from a variety of sources including the Collection 4 MOD12Q2 product, agricultural intensities data, and the MODIS land cover mask.
- A 150 km x 150 km moving window was used to compute the approximate regional frequency of classes based on MODIS collection 4 data; this provides local likelihoods for each class at each pixel.
- To preserve the likelihood of agriculture or agricultural mosaic, we used a new data set from Ramankutty et al. (2008, in press, GBC; see below).

Collection 5 Refinements to the Land Cover Dynamics Product
Refinements to the Collection 5 land cover dynamics product (MOD12Q2) include changes to the algorithm and input data. Most importantly, 500-m NBAR data at 8-day intervals are being used to model land cover dynamics on seasonal time scales (phenology). As a result, the spatial resolution of the product has increased from 1-km to 500-m, and detection of phenology transition dates should be both more accurate. In addition, the algorithm used to produce collection 5 results includes a number of new database products that affect how missing data in NBAR data are treated, and how snow in both detected and accounted for in the algorithm (see below).

Reframed to the STEP database
- The System for Terrestrial Ecosystem Parameterization (STEP) database provides training data for the MOD12Q2 land cover type product algorithm.
- In preparation for collection 5 the STEP database was analyzed and extensively revised to improve representative sampling of land cover. Specifically, we examined:
  - Geographic & ecological sampling based on collection 4 data and ancillary data related to climate and geographic distribution.
  - Geophysical data including MODIS NBAR data, agricultural intensities data, and measures of internal heterogeneity.
- The distribution and sampling of agricultural sites using crop inventory data.
- Results from these analyses lead to the following changes to the STEP database:
  - Addition of wetland and forest sites in China; deciduous-mixed forest sites in Siberia; forest sites in New Zealand; and agricultural sites in Sahel African, Mexico, India, Canada, and New Zealand.
  - Reduction in sites or removal of large sites such (e.g., large snow/ice sites in Greenland).
  - Re-labeling or removal of sites based on new sources of data including ancillary maps, high resolution imagery, or EVI temporal profiles.

Step Database Distribution in the STEP Database

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