INTRODUCTION

Land use is an essential human activity to meet demands for food, fiber, shelter, and natural resources. Additionally, biomass grown specifically to meet energy demands is an increasingly important alternative to other energy sources. But land cover change to meet human demands for resources and land use in themselves cause greenhouse gas emissions and affect the climate through biophysical interactions. Maintaining ecosystems with higher carbon stocks is an option for mitigating climate change, and major international programs such as the United Nations initiative on Reducing Emissions from Deforestation and forest Degradation (REDD) seek to implement such strategies. Thus, the variety of global Earth system models represent not only the commitments of land and terrestrial natural resources to meeting human demands, but also the corresponding changes in terrestrial carbon pools and carbon exchanges with the atmosphere, other greenhouse gas emissions due to land use, and changes in land surface characteristics that affect climate.

Objective

In terms of consistent spatial coverage and temporal stability, the standard land cover data products derived from observations by Moderate Resolution Imaging Spectroradiometer (MODIS) instruments on the NASA Terra and Aqua spacecraft provide one of the highest quality representations of global land cover over a sufficient period to investigate change. The project “Enabling Centralized Access to Land Cover Data for Climate Change Integrated Assessment Modeling” is making selected MODIS land cover data available as global mosaics at resolutions suitable for use with global models. This project is part of NASA’s Advancing Collaborative Connections for Earth System Science (ACCESS) program.

A number of factors complicate any direct use of standard MODIS land data products for representing land attributes in global models:

- Retrieving an attribute from a set of tiles or iterating over tiles in order to represent a land attribute globally is inefficient and prone to error;
- Within global models, locations typically are specified in terms of latitude and longitude making spatial reference to tiles in a sinusoidal projection incompatible with model coordinates; and
- The storage required to represent a land attribute globally at native spatial resolutions of MODIS standard data products is prohibitive in both complex and more simplified models.

Many Earth system models are computationally demanding and require efficient interfaces to land surface data at manageable resolutions. Global models that require less computational resources tend to be designed for solution efficiency with modest storage requirements and impose similar constraints on their representations of land attributes. Thus, while moderate spatial resolution land cover data are useful in studies at local to regional scales, to be manageable within Earth system models and applications, global geospatial land cover data need to be at coarser resolutions, than are nominal for standard remote sensing data products (e.g., 500 m MODIS land cover data). For example, a single byte attribute at the 500 m resolution of the standard MODIS land cover type data product requires approximately 3.07 GB of storage. As a result, within more complex Earth system models, land attributes typically are represented at resolutions of 5° latitude × 5° longitude or 2.5° × 2.5°. Simplified models may represent land attributes at even coarser resolutions such as 0.5° latitude × 0.5° longitude.
Error estimation and Validation of Global Tree Cover Continuous Fields using Lidar Remote Sensing
Anupam Anand*, Joseph O. Sexton, Xiao-Peng Song, Min Feng, Praveen Noojipady, Chengquian Huang, Do-Hyung Kim, Saurabh Channan, John R. Townshend
Global Land Cover Facility, Department of Geographical Sciences, University of Maryland. * anupam@umd.edu

INTRODUCTION
Validating tree cover estimates is limited by scale and cost. With increasing coverage potentially superior means of reference data collection. We assess the accuracy of the new global, Landsat-based tree cover dataset for circa 2000 and 2005 and the MODIS Vegetation Continuous Fields tree cover layer relative to lidar measurements in a sample of biomes.

METHODS
- Global, 30-m estimates of tree cover in 2000 and 2005 were generated by a scale-free model of cover as a function of surface reflectance. The model was fit locally to cover estimates from the 250-m Moderate-resolution Imaging Spectroradiometer (MODIS) Vegetation Continuous Fields (VCF) tree cover layer and ancillary information from the MODIS Cropland Layer and Training Data Automation-Support Vector Machines (TDA-SVM).
- Lidar measurements of tree cover were calculated by dividing the number of returns > 5 m in height by the total number of returns within a 10-m radius.

REFERENCES
The Global Land Cover Facility (GLC) is available for free download at the Global Land Cover Facility website (www.landcover.org).

RESULTS
The overall accuracy of GLS estimates is comparable to that of the MODIS VCF (RMSE= 17% for both MODIS VCF and Landsat GLS).
- GLS estimates exhibit improved accuracy in difficult agricultural regions, with an RMSE of 20% in GLS vs. 23% RMSE in MODIS VCF.
- GLS has improved potential for calibration to lidar, with post-calibration RMSE = 9% vs. 14% in the MODIS VCF.

Lidar measurements vs. Landsat- and MODIS-based estimates. MODIS-based estimates vs. lidar measurements (A), Landsat-based estimates vs. lidar measurements (B), and Landsat- vs. MODIS-based estimates (C). Points and (dashed) regression lines are identified with sites by color, the overall (across-site) regression is in dashed white, and the 1:1 line is solid white.

Resolution of tree cover by lidar, Landsat, and MODIS data. Landsat provides far superior resolution of small surface features such as forest clearings. MODIS estimates replicated lidar estimates with reasonable fidelity in large and discrete patches of forest cover. However, complex height and cover gradients (e.g., UT) pose a continuing challenge for both datasets.

B) Lidar measurements vs. Landsat and MODIS-based estimates. MODIS-based estimates vs. lidar measurements (A), Landsat-based estimates vs. lidar measurements (B), and Landsat- vs. MODIS-based estimates (C). Points and (dashed) regression lines are identified with sites by color, the overall (across-site) regression is in dashed white, and the 1:1 line is solid white.