National Annual Tree Canopy Structure and Surface Water Dynamics Products

Global Land Analysis and Discovery Lab and SERVIR-Mekong

Thailand

Summary

The primary objective of the joint project conducted by the Global Land Analysis and Discovery Lab (GLAD) from University of Maryland and SERVIR-Mekong is providing regionally consistent timely updates on land cover change at the national and regional scales. The GLAD team has developed an automated system for the Landsat archive data processing and characterization. Using temporally and spatially consistent Landsat data, the GLAD team derived a series of products depicting annual dynamics of tree canopy cover, tree height, and surface water extent for the 2000-2016 interval and is committed to performing annual product updates. The products are consistent at the regional level and provided at spatial resolution relevant for the national analysis. Presented data may be useful for annual tree cover dynamics analysis, assessing the national forest management policy effects, international forest resources reporting, and greenhouse gases emission estimation. The validation and calibration of these products are currently performed by the GLAD and SERVIR-Mekong teams. A copy of this product can be obtained at: http://glad.geog.umd.edu/dataset/servir

Technical Data Description

All data layers are provided in the geographic coordinates using WGS84 reference system. Pixel size is 0.00025 x 0.00025 degree. Annual data are provided in 8-bit GeoTiff format suitable for visualization and analysis in most GIS software. Other datasets (including annual Landsat data composites as 16-bit data) are available by request.

Suggested Citation

For all publications that use original products or derived maps and estimates, the source product should be referred to as “GLAD-UMD and SERVIR-Mekong, National annual tree canopy structure and surface water dynamics products, 2017”.

Contact information

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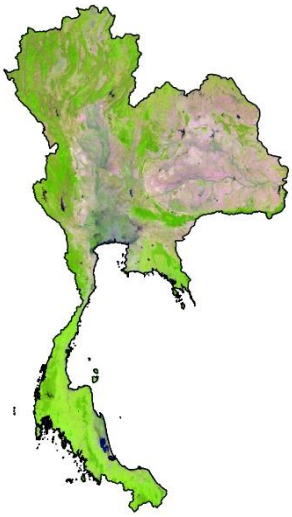
Annual Landsat cloud-free image composites

The GLAD team used the entire Landsat archive available for Mekong region to derive nationally and regionally consistent image time-series data. The Landsat archive data were provided by the United States Geological Survey National Center for Earth Resources Observation and Science (USGS EROS). Overall, the Landsat archive for Mekong region contains 44,438 terrain corrected images received from the Landsat TM, ETM+, and OLI/TIRS sensors from the year 1999 to 2016. Each image were processed using the automated system developed by the GLAD team. Processing steps include:

- **Radiometric calibration and cloud screening.** Source image data were transformed to top-of-atmosphere spectral reflectance using sensor-specific equations. To detect observations with significant atmospheric contamination we applied a set of pre-defined decision tree models that produce per-pixel likelihood of observation contamination by clouds, haze, or cloud shadows. Observations (pixels) with high likelihoods of cloud or cloud shadow contamination were excluded from the further processing. A separate set of decision tree models was used to flag surface water for the cloud-free observations.
- **Normalization using the global MODIS-derived surface reflectance.** This step was implemented to reduce the effects of atmospheric scattering and surface anisotropy, and to create spatially and temporally consistent inputs that are suitable for classification model implementation at the regional scale. We implemented a relative reflectance normalization using the global MODIS-derived surface reflectance as the normalization target.
- **Observation compositing.** For creating the cloud-free annual data composites, we used the data for each year and supplemented it with the data collected within 2 years of observation before and after the current year if no cloud-free data were available. All spectral band data were ranked by the reflectance value, and the cloud-free composites were created using the average reflectance between 25 and 75 percentile for each year.

The reflectance value of annual composite included three bands: SWIR (1,600 nm); NIR (850 nm); and red (660 nm). Reflectance is scaled to fit 8-bit data range. **Original 16-bit normalized reflectance data and data for other spectral bands are available on request** (Send data requests to Dr. Peter Potapov, potapov@umd.edu)

Landsat image composite, year 2000



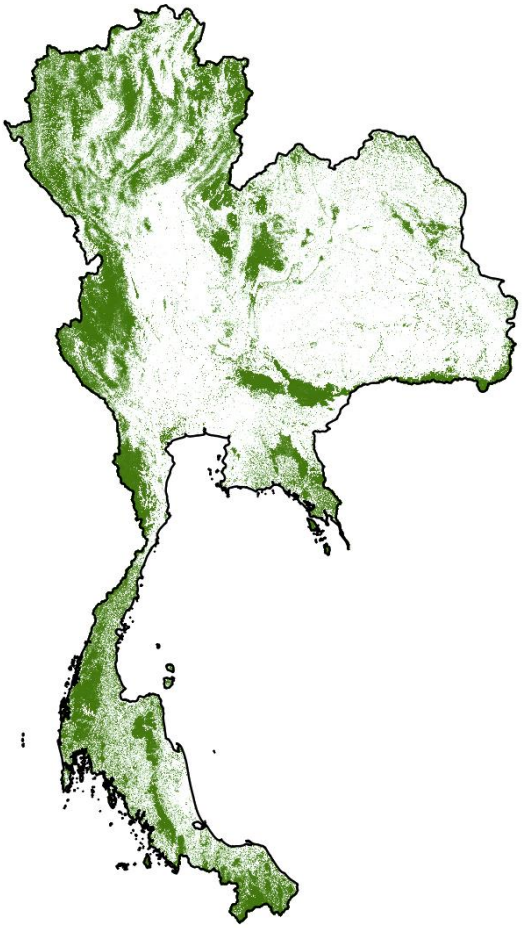
Landsat image composite, year 2016

Annual tree canopy cover (TCC)

For the purposes of this analysis, trees are defined as woody vegetation with the height of 5 m or taller. Tree canopy cover was defined as crown cover of woody vegetation above 5 m tall, including trees within natural forests, plantations, and outside forests. The tree canopy cover was mapped using a set of regression trees. The training data for the regression model were collected from the higher spatial resolution data available globally. The data can be used to map forest extent based on the national forest criteria.

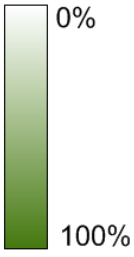
The pixel value represent percent tree canopy cover (value 0 to 100%). It was corrected for the tree cover change events detected in the time series.

Methodology reference: Hansen M.C., Egorov A., Roy D. P., Potapov P., Ju J., Turubanova S., Kommareddy I. and Loveland T. R. (2011) Continuous fields of land cover for the conterminous United States using Landsat data: first results from the Web-Enabled Landsat Data (WELD) project Remote Sens. Lett. 2 279–88
Online: http://www.tandfonline.com/doi/abs/10.1080/01431161.2010.519002#.VP3Y_4vF98E



Tree canopy cover, year 2016

Percent tree canopy cover

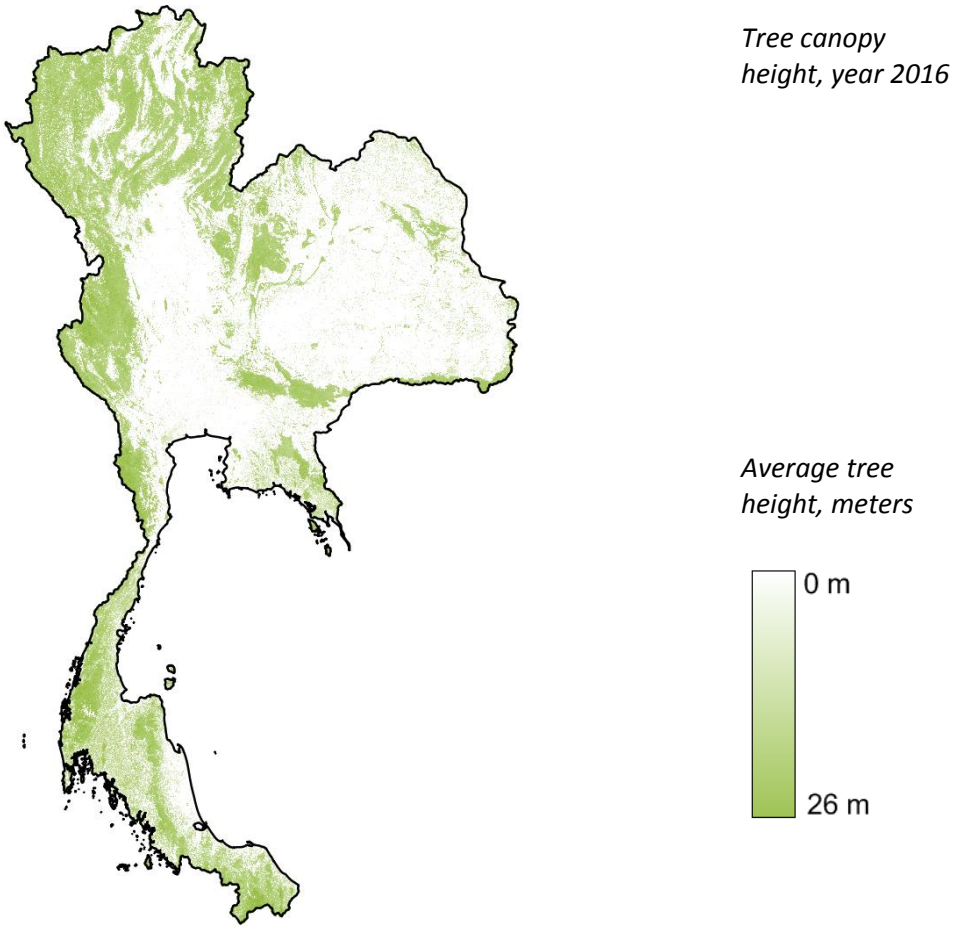


Annual tree canopy height (TCH)

Tree canopy height (TCH) is defined as average woody vegetation top of the canopy height within each 30x30m Landsat pixel. The TCH was modeled using Geoscience Laser Altimeter System (GLAS) space-borne lidar data. Vegetation height was estimated for all available GLAS data points and used as training to create a set of regional regression tree models. Due to GLAS height estimate saturation, the height has the maximal value of 26 meters. The data can be used to map forest extent based on the national forest criteria.

The pixel value represents woody vegetation height in meters (0-26 meters). It was corrected for the tree cover change events detected in the time series.

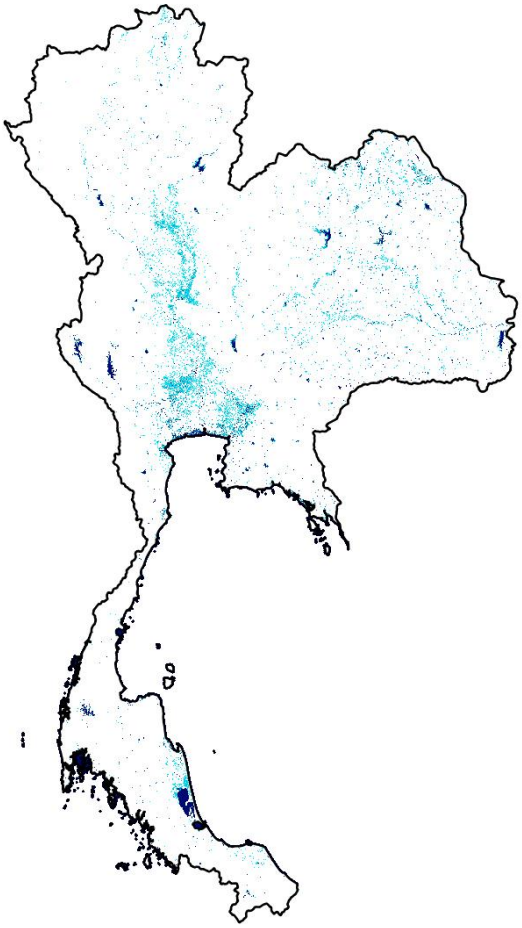
Methodology reference: Hansen M. C., Potapov P. V., Goetz S. J., Turubanova S., Tyukavina A., Krylov A., Kommareddy A. and Egorov A. (2016) Mapping tree height distributions in Sub-Saharan Africa using Landsat 7 and 8 data Remote Sens. Environ. Online: http://dx.doi.org/10.1016/j.rse.2016.02.023



Annual surface water duration

Annual water duration was derived from the full archive of Landsat cloud-free observations. For each cloud-free Landsat observation, we automatically mapped presence/absence of surface water. From these annual observations, we calculated percent of water presence from the total number of cloud-free looks. The annual surface water duration provides additional information on land cover type and can be used to map flooded forests and woody wetlands.

The pixel value is the proportion (in percent, 0-100%) of time within the year when the area is submerged.



Surface water duration, year 2016

Percent time of the year when the area was submerged