

# Remote Sensing for Forest Cover Change Detection

## Introduction

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The objective of this training is to build remote sensing capacity, focusing on image processing theory and fundamental concepts, land cover mapping, accuracy assessment, and detecting and monitoring landscape change. This training will help countries with their ongoing work, such as preparing the forestry data for the United Nations Framework Convention on Climate Change (UNFCCC) and Reducing Emissions from Deforestation and forest Degradation (REDD) reporting.

### Module 1: Project Planning and Documentation

Project planning and methods documentation play a key role in any remote sensing analysis project. This module is designed to encourage you to think through your remote sensing approach to ensure the resulting products will be relevant to your project goals and that your methods are well documented and transparent.

### Module 2: Acquiring Data with Google Earth Engine

The basic change detection workflow involves first acquiring two sets of imagery, one for an initial baseline time period (time 1) and another for a subsequent time period (time 2) to facilitate the change analysis. You will use Google's Earth Engine to compile cloud-free Landsat image composites for two time periods.

### Module 3: Land Cover Mapping (time 1)

You will create a land cover map with the time 1 cloud-free Landsat image composite by collecting training data using various imagery sources for reference and specifying a random forests modeling algorithm (Breiman 2001<sup>[1]</sup>). Finally, you will assess the accuracy of the map product and consider if a revision to the mapping process is required based on your accuracy assessment results.

### Module 4: Mapping and Classifying Areas of Change (time 2)

Using the time 1 and time 2 cloud-free Landsat image composites you will create a multi-temporal transformation to help locate areas of change. Again you will collect reference data to train a model and

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<sup>[1]</sup> Breiman, L. 2001. Random Forests. *Machine Learning*. 45: 5–32.



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use random forests to generate a change map. As in the single data mapping process in Module 3, you will assess the accuracy of the change map and consider if you need to re-iterate the analysis to improve your map.

## Course Prerequisites

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### Recommended Skills

Training participants should have a solid background in GIS concepts and data analysis. In addition, a general awareness of remote sensing technology and common workflows would be beneficial.

### Data

Download the pre and post cloud-free Landsat composites (created with Google Earth Engine). The supplied images are for a study region in southern Thailand.

### Software (required locally on all workstations)

- Google Earth Engine (GEE)
  - Google Earth Engine Beta Tester account ([register here](#)) and Google Drive ([register here](#))
  - Google Chrome browser, most recent version, ([download here](#))– this is the required interface to access GEE
- Google Earth – <https://www.google.com/earth/download/ge/agree.html>
- The QGIS Install, version 2.18.5 Las Palmas, with Orfeo Toolbox

**Note:** *There were some issues running the Orfeo Toolbox on some operating systems using this install option. If you run into problems, you can try to set up QGIS with the Virtual Machine (VM) supported by researchers and instructors at the Boston Education in Earth Observation Data Analysis at Boston University. The files to get this set up are large, so you will need access to high speed internet to complete the Virtual Machine setup.*

*Visit the following website to learn how to set up a Virtual Machine and download the necessary files here: [https://github.com/beeoda/tutorials/tree/master/1\\_Introduction](https://github.com/beeoda/tutorials/tree/master/1_Introduction)*

### Hardware (recommended specs...)

- Computer (participants will bring a GIS processing laptop from home unit)
  - Administrative rights to install software on the laptop: you will be installing QGIS and other plugins, so it is important that each participant comes with administrative rights for their laptop.
  - Storage: At least 5 Gigabytes of free disk space
  - RAM: 3 Gigabytes

# Data, Software, and Resources

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The following data and resources are available for download on the SERVIR Training website.

## A. Change Detection Data files:

[https://s3.amazonaws.com/bucket.servirglobal.net/trainingmaterials/Change\\_detection.zip](https://s3.amazonaws.com/bucket.servirglobal.net/trainingmaterials/Change_detection.zip)

### Data: Composite

- Cloud-free composites from two time periods for the study area in southern Thailand, generated from the Google Earth Engine script. These include 6 Landsat bands (blue, green, red, near infrared, shortwave infrared 1 and shortwave infrared 2). These values are the median pixel values from two different two-year seasonal periods beginning in 2008 and 2013. Bands 7-9 are the 10<sup>th</sup>, 50<sup>th</sup> (median) and 90<sup>th</sup> percentile NDVI value. Finally, band 10 in the image stack is the number of images used to calculate the median and percentile values at each pixel location. A list describing the order of the image bands is found in the table below.

<b>Data:</b>	Band [1]	Median blue
	Band [2]	Median green
	Band [3]	Median red
	Band [4]	Median nir
	Band [5]	Median swir1
	Band [6]	Median swir2
	Band [7]	10 <sup>th</sup> percentile ndvi
	Band [8]	Median ndvi
	Band [9]	90 <sup>th</sup> percentile ndvi
	Band [10]	Pixel count

### Shapefiles

- **Change\_Examples** – examples of regions of forest cover change within the study site. These files have been saved as a kmz file for Google Earth and as a shapefile for QGIS
- **Thailand**
  - **Thailand.shp** - a shapefile of the country of Thailand
  - **ThailandSubset** - the subset study region you will be working with (e.g., for the data download). Included formats include a shapefile and a kml file.
  - **Processing\_Subset.shp** - a smaller subset for running land cover classification and change detection.

## **B. Exercises and presentations**

Available here: <https://www.servirglobal.net/Global/Articles/Article/2549/forest-cover-change-detection-training>

## **C. QGIS Scripts**

A folder with supplemental QGIS tools – saved as python scripts:

[https://s3.amazonaws.com/bucket.servirglobal.net/trainingmaterials/QGIS\\_Scripts.zip](https://s3.amazonaws.com/bucket.servirglobal.net/trainingmaterials/QGIS_Scripts.zip)

## **D. QGIS and OSGeo4W64 installation files**

The set up instructions are located in Module 3,

[https://www.servirglobal.net/Portals/0/Documents/Articles/ChangeDetectionTraining/Module3\\_LC\\_Classification\\_Accuracy\\_Assessment.pdf](https://www.servirglobal.net/Portals/0/Documents/Articles/ChangeDetectionTraining/Module3_LC_Classification_Accuracy_Assessment.pdf).

The files that you will need to download are available here:

<https://s3.amazonaws.com/bucket.servirglobal.net/trainingmaterials/OSGeo4W64.zip>