National Centre of Competence in Research North-South

Assessing landscape changes in Laos using MODIS Enhanced Vegetation Index

Cornelia Hett, Kaspar Hurni, Andreas Heinimann, Centre for Development and Environment (CDE), University of Bern, Switzerland; Daniel Müller, Leibniz-Institute of Agricultural Development in Central and Eastern Europe (IAMO), Germany, JACS SEA

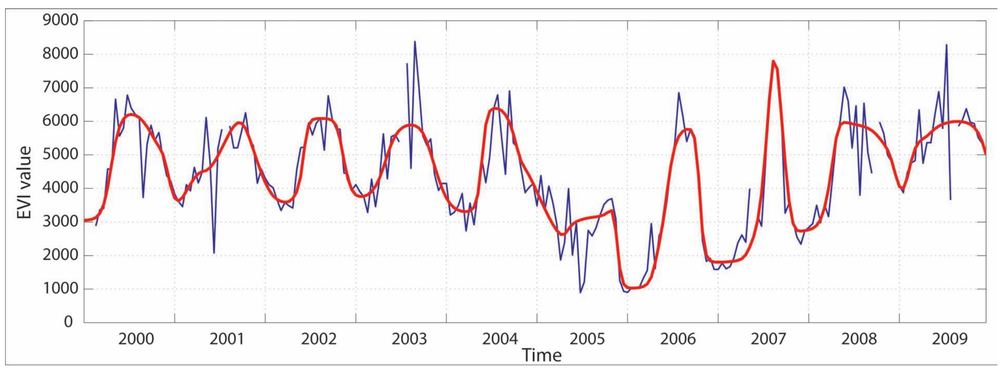
The ongoing rapid and vast land cover and land use transformations in Laos are only documented by punctual local case studies; information on national level is barely available. We explore ways to address this by using MODIS vegetation index times series data to detect medium to large scale transformation on the national level.

Rapid and large scale landscape transformations over the last decade in Laos emphasize the importance of data and information on location and extend of different landscape transformation processes for informed decision making. However, to date no regional or national level assessments are available.

To address this lack of information we exploit the Enhanced Vegetation Index (EVI) which measures vegetation density based on MODIS (Moderate Resolution Imaging Spectroradiometer) remote sensing imagery. We tap the potential of the high temporal resolution of MODIS data with an EVI image every 16 days. This allows us to work with 230 datasets as a basis for monitoring intra- and inter-annual changes of vegetation in Laos over the last 10 years (2000 – 2009). This timeseries data on biomass variation holds the potential to detect different landscape changes better than applying the traditional way of two or three images from different years and dates.

Generating a 9 years time series of MODIS EVI imagery

The EVI raw data had to undergo several processing steps. The varying climatic conditions in Monsoon Asia result in significant noisy data. Using an elaborated smoothing algorithm (Timesat), a fitting function of the EVI time series data could be produced, which lead to significant data improvement. The figure below shows the raw and the fitted EVI values of a pixel in a rubber plantation established in 2005/2006.



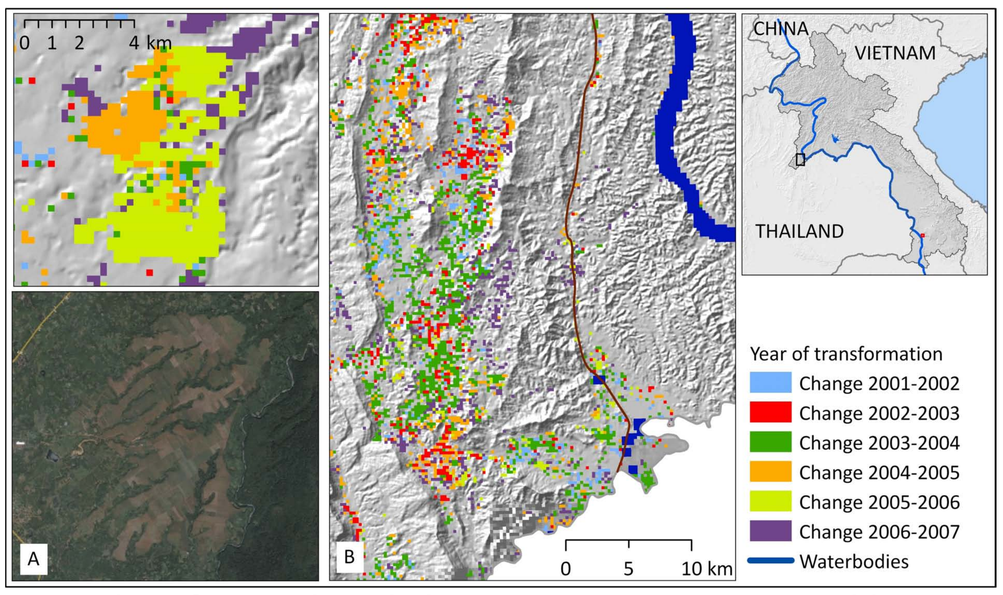
Fitting function of the Timesat software. Blue: Raw EVI values, red: fitted values of the time series

Applications

The potential of the generated MODIS EVI time series is currently investigated through studies aiming at delineation of (A) expansion of permanent agriculture and (B) swidden agricultural areas.

A) Detection of expansion of permanent agriculture

To reduce data complexity a series of aggregated statistical measures (e.g. EVI annual means) are now tested for their performance to delineate the various change processes behind different types of agricultural expansion. With pixels of permanent agriculture having lower EVI annual means than e.g. forest or swidden areas, a change process was defined as a drop below 0.3 followed by low values in the years there after. Based on this assessment the location of different known agricultural conversions could be confirmed through spatial delineation.

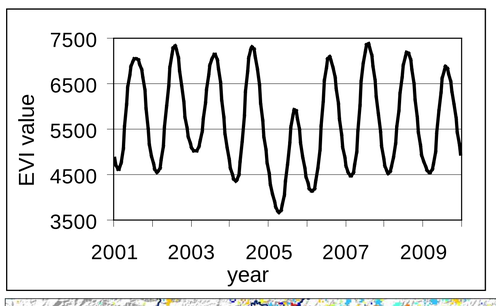


Examples of agricultural change. A: Conversion to rubber plantation; B: From swidden to premanent agriculture.

The current challenge is to distinguish these drops in biomass from other land cover changes, e.g hydrodpower dam construction or forest degradation. Therefore over 2000 ground control points are now collected using high resolution satellite imagery. Their spectral curves will serve to calibrate future models.

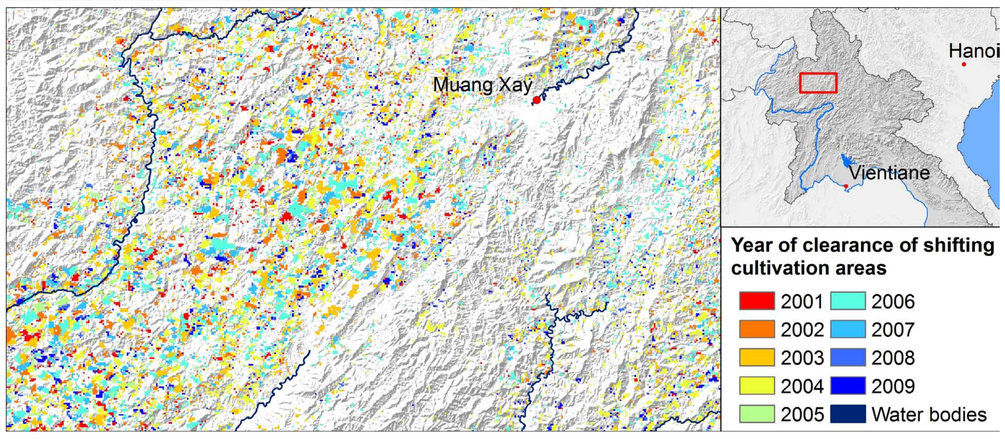
B) The detection of shifting cultivation plots

With an unsupervised classification of the MODIS imagery the data is spatially reduced to 700 classes while still keeping the full times series information. Classes representing shifting cultivation plots can be identified by looking at the evolution of the vegetation index over time, as they show a distinct pattern from other land use and land cover classes. The example below shows the class covering areas cleared in 2005.



Left: Evolution of EVI on swidden plots cleared in 2005

Below: Delineation of swidden plots using MODIS EVI time series data



Joint Areas of Case Studies:

East Africa
Horn of Africa
West Africa
South-East Asia
South Asia
Central Asia
Central America and Caribbean
South America
Switzerland