Presentation about the research project "Detecting forest degradation with multi-spectral, seasonal and multi-temporal classification trees in North Central Vietnam"

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Outline

I-REDD+ Project

- Impacts of Reducing Emissions from Deforestation and Forest Degradation and Enhancing Carbon Stocks (I-REDD+)
- I-REDD+ addresses issues at national to local level in four countries: Laos, Vietnam, China (Yunnan) and Indonesia
- An interdisciplinary team with researchers and professionals from 9 countries work together
- WP3 - Remote sensing based monitoring of change in land use and biomass

Figure: Paddy rice fields (a typical land use in the uplands of Vietnam; Source: HU Berlin 2013

Project area

- Con Cuong is a district of the Nghe An Province located in the North Central Vietnam

- Characteristics of the area: Small-scale agricultural and agro-forestry land use practice, mountainous
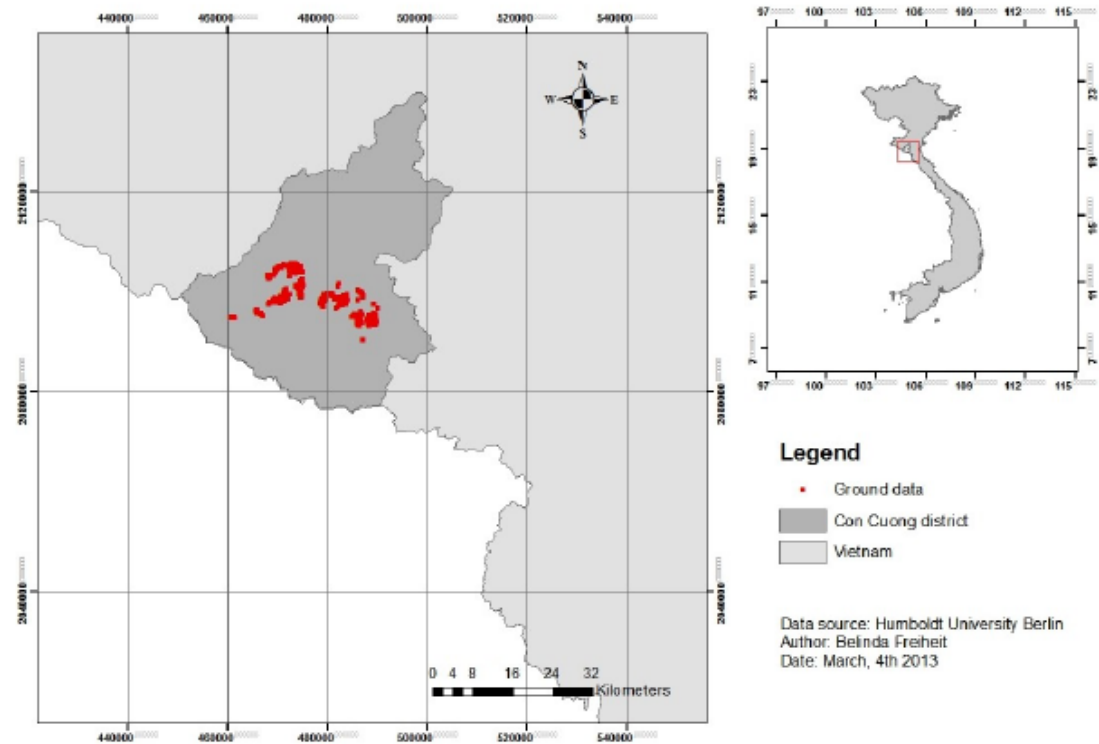

Figure: Map of the Con Cuong district with the GPS reference plots

Research Topic

Detect forest cover changes in the project area with means of temporal Landsat scenes (1989 - 2012)

Data sources: 133 multi-temporal Landsat images (TM 4/5 and ETM+), GPS points from field trip in 2011/2012
Challenge: frequent cloud cover, inaccurate reference data, spatial resolution, complex land cover!
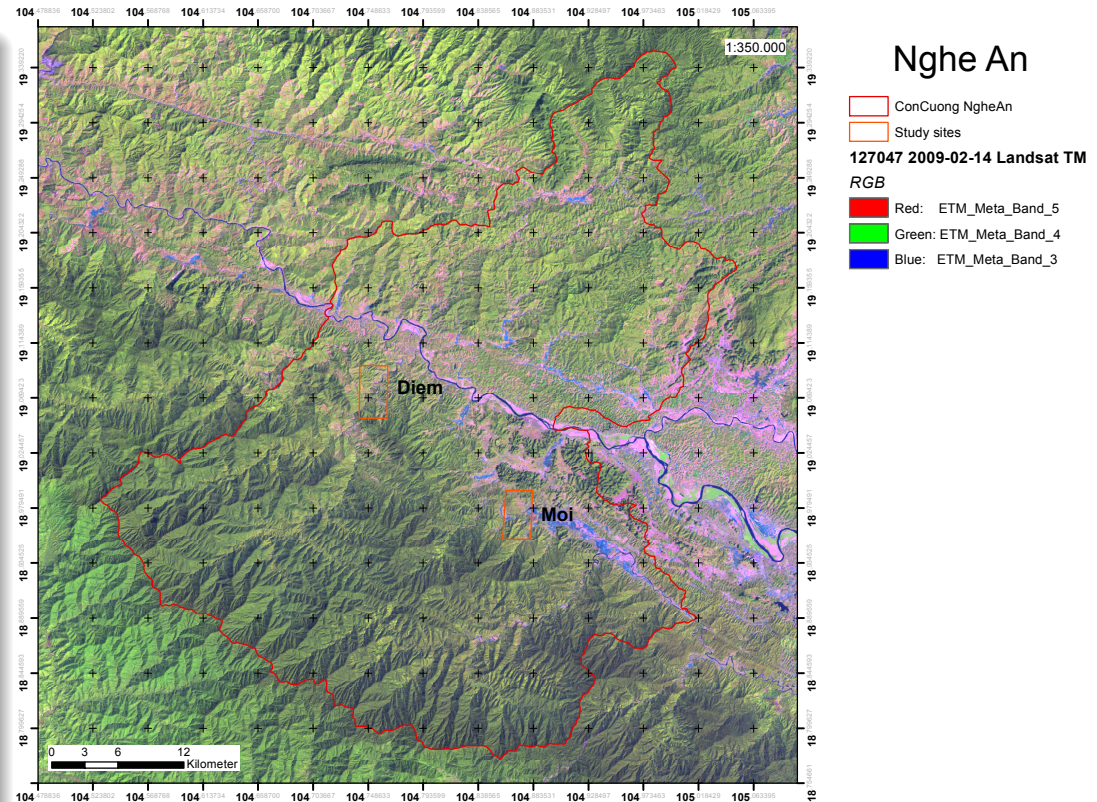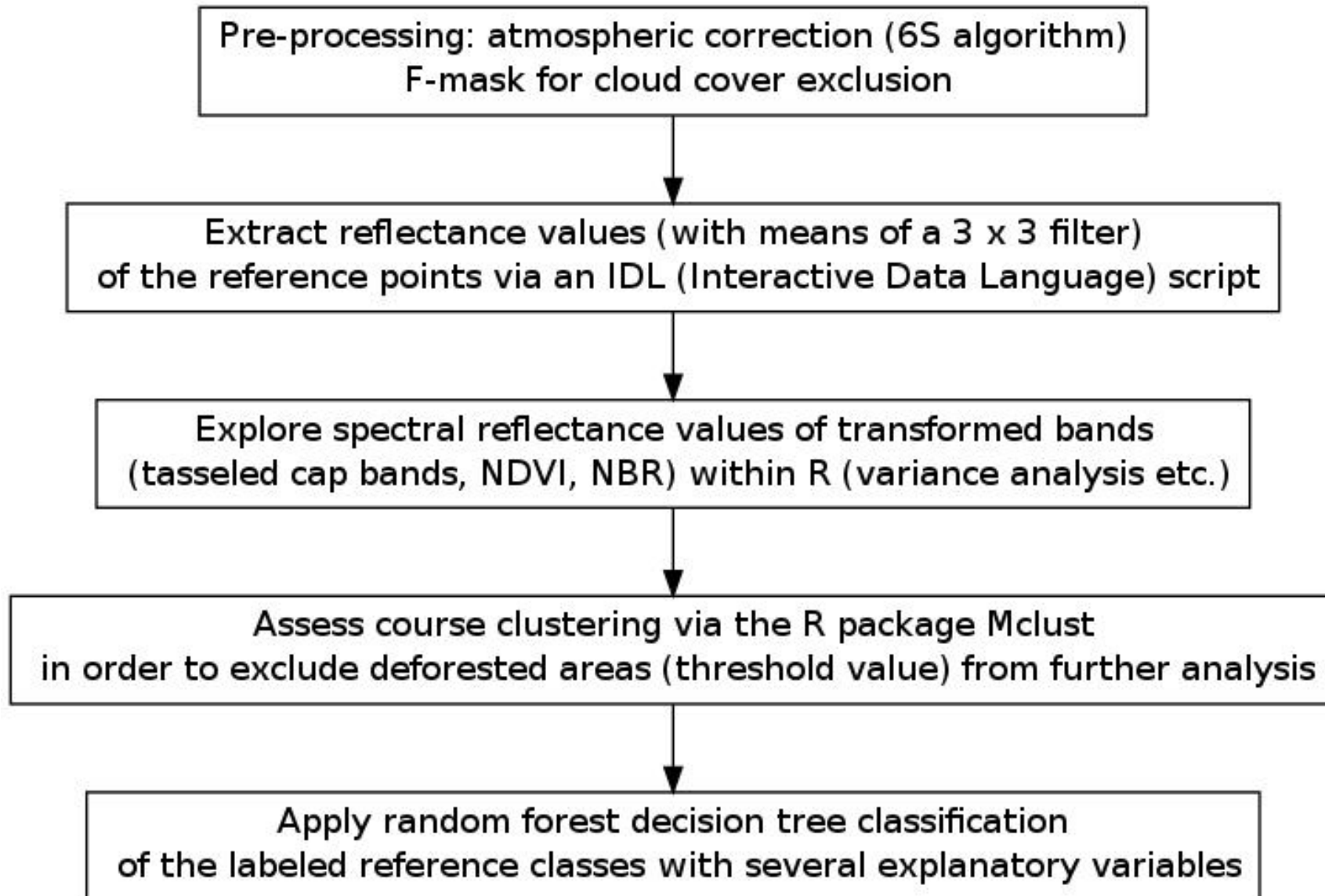

Figure: Landsat scene of the Con Cuong district in 2009 (dry season); Source: HU Berlin 2013

Methodology

Pre-processing: atmospheric correction (6S algorithm)
F-mask for cloud cover exclusion

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Extract reflectance values (with means of a 3 x 3 filter)
of the reference points via an IDL (Interactive Data Language) script

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Explore spectral reflectance values of transformed bands
(tasseled cap bands, NDVI, NBR) within R (variance analysis etc.)

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Assess course clustering via the R package Mclust
in order to exclude deforested areas (threshold value) from further analysis

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Apply random forest decision tree classification
of the labeled reference classes with several explanatory variables

Results I

- Visual interpretation of the 9 x 9 pixel image extracts of the multi-temporal TC Angle Landsat images
- Explore which reflectance values represent cleared land (comparing threshold)
- Model-based cluster analysis to discriminate between non-forested and forested areas (threshold: 0.278 degree)
- Forest resources account for 419 plots out of 748 plots with vegetation cover
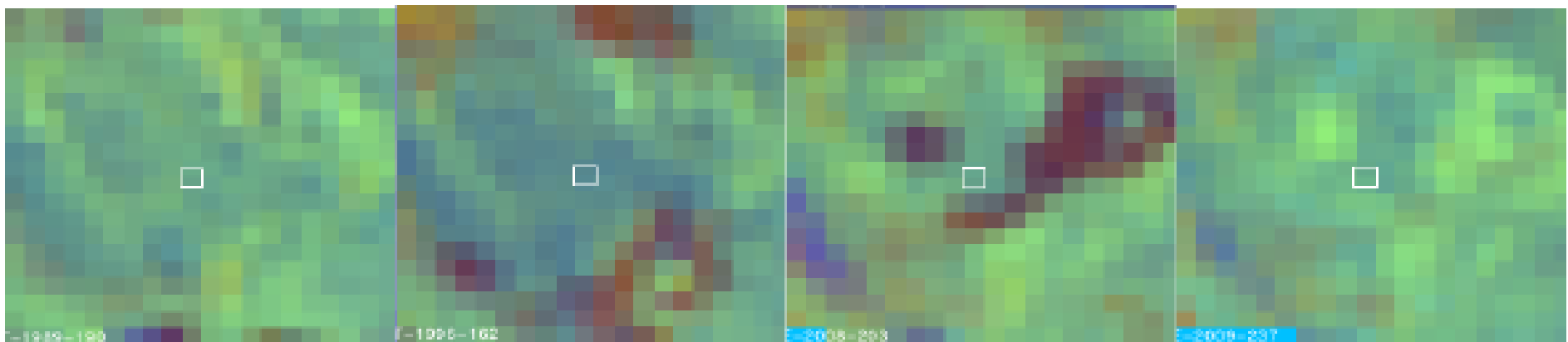

Figure: Extract of four image chips out of 133 in total for plot no. 8 for the years 1989, 1996, 2008 and 2009 (from left to right)

Results II

The four classes comprising natural vegetation (according to the LULC classification):
Closed canopy forests TEBC (more than 60% canopy cover),
Open forests TEBO (less or equal 60% canopy cover),
Bamboo trees OWB (naturally regenerated),
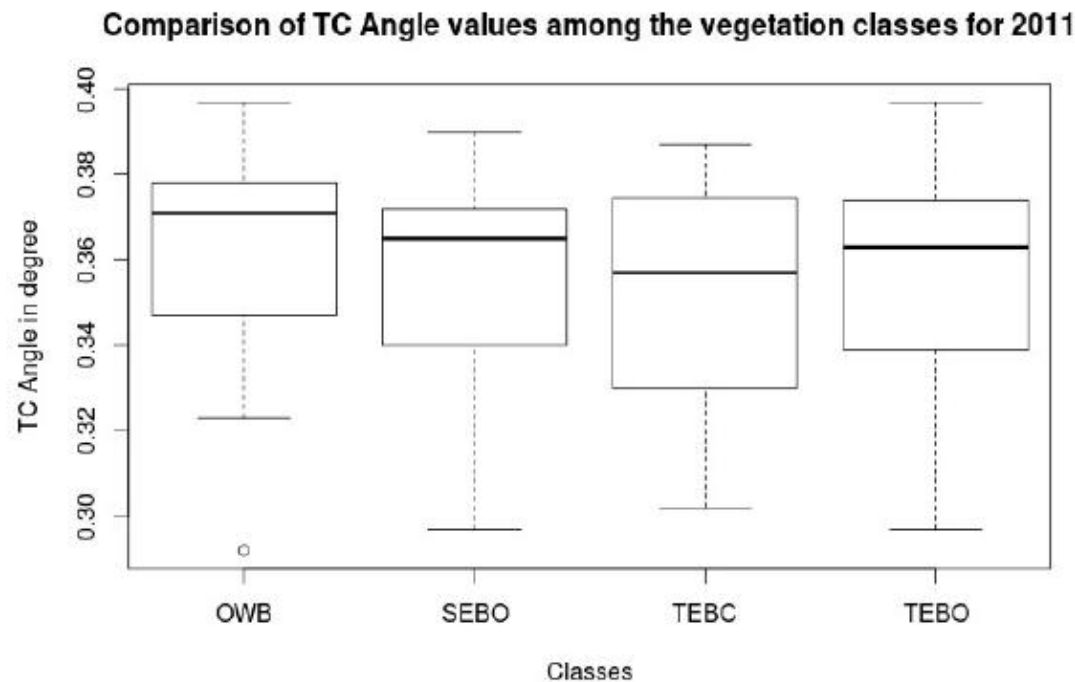Bushes SEBO (mixed with small to medium trees)

Figure: Box and whisker plot of the TC Angle value of the four vegetation classes

Results III

RF 1: with multi-spectral data from the dry season of 2012
RF 2: with multi-spectral data from the rainy season of 2011
RF 3: with multi-spectral data of both seasons
RF 4: with multi-temporal, multi-spectral data for the rainy season
RF 5: with multi-temporal, multi-spectral data with temporal information (slope, intercept) for the rainy season

Classes	Class error in percent				
	RF 1	RF 2	RF 3	RF 4	RF 5
OWB	50.88	55.17	49.12	52.27	47.27
SEBO	64.71	68.63	58.82	44.12	58.82
TEBC	89.47	76.92	83.78	55.56	58.83
TEBO	71.42	70.18	62.50	86.67	80
OOB	**67.33**	**66.83**	**61.69**	**58.33**	**59.72**

Figure: Overview of the results from the RF-CART with the vegetation classes as dependent variable

Discussion

1. Limitations when working with optical sensors in tropical climate regions
2. Differing illumination and view angles (topographic effects)
3. Difficulty of distinguishing marginal variances of reflectance values within the respective vegetation classes
4. Field data exhibit inadequate land cover classes

Outlook

- Enlarge the study area to the Nghe An Province (eventually including bordering areas in Laos)

- Literature review about accomplished research and projects in the region

- Focus on a thematic question: land cover changes and its impact on natural forests in the context of REDD+

- Study on shifting cultivation cycles to assess proper classification

- Review appropriate methods in RS: vector change analysis, post-classification etc.