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Analysing land cover and land use change in the Matobo National Park and surroundings in Zimbabwe

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Introduction

- Matobo National Park established in 1926
- Due to political compromise reduction of the National Park area in 1953
- In 1982 expansion of the National Park area to final boundaries
- Since 2003 UNESCO World Heritage Site (Fig. 2)

Research questions

- Can we detect changes in land cover in the Matobo National Park?
- Where do changes occur, in the whole park or only in its core?
- Does the land cover in the surroundings differ between common and not common land?

Research Area and Data

Figure 1 : Location of Zimbabwe in Africa.

- Research area: Matobo National Park in South-West Zimbabwe and surroundings
- Initial data: Surface reflectance of three Landsat images from 10th May 1989, 19th May 1998 and 15th May 2014
- Choice of month: End of rainy season → cloudless sky (high quality satellite images) and rich vegetation
- Choice of years: maximum time span, comparable rainfalls in previous rainy season, cloudless sky in May

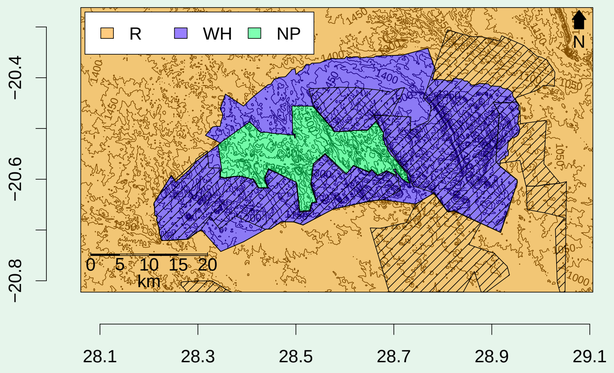

Figure 2 : Study area with elevation data in the background, NP: National Park, WH: World Heritage Site without National Park, R: Residual area, shaded area: common lands. The extension of the common lands east of 29.06°is unknown.

Methods

General approach

Aim Detect changes of land use/land cover types (LULCs) in study area with post-classification by using supervised classification

Problem Missing training data

Idea Infer training data by combining clustering and change vector (cv) analysis

- Clustering of image from 2014
- Assignment of LULC labels via ground photographs and Google Earth images
- Change vector analysis to find unchanged pixels in 1998 and 1989 for training

Change vector (cv) analysis

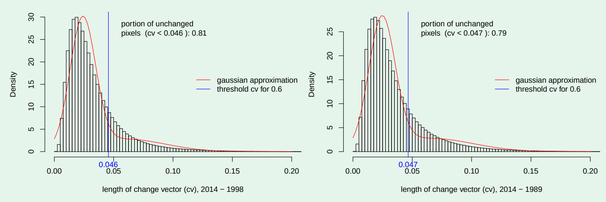

Figure 3 : Distribution of length of cv for 2014-1998 (left) and 2014-1989 (right).

- Different hue of topographically corrected (tc) data → subtraction of median [1] for all bands and dates
- Cv analysis following [1]
- Gaussian approximation of distribution of cv-length including two Gaussians
- Unchanged pixels in 2014: Belonging to first Gaussian with probability > 0.6 in both distributions (Fig. 3)

Clustering

- Clustering with clara (k-medoids for huge data sets) for k = 2, . . . , 15
- k = 4 best choice for number of clusters

Supervised classification

- Training data for all years by transferring LULCs of 2014 of unchanged pixels to 1989 and 1998; isolated pixels are avoided
- Supervised classification with random forest; cross-validation to optimize parameters of random forest; set-aside dataset for validation
- Post-classification by comparing resulting classification images of 1989, 1998 and 2014 (Fig.4)

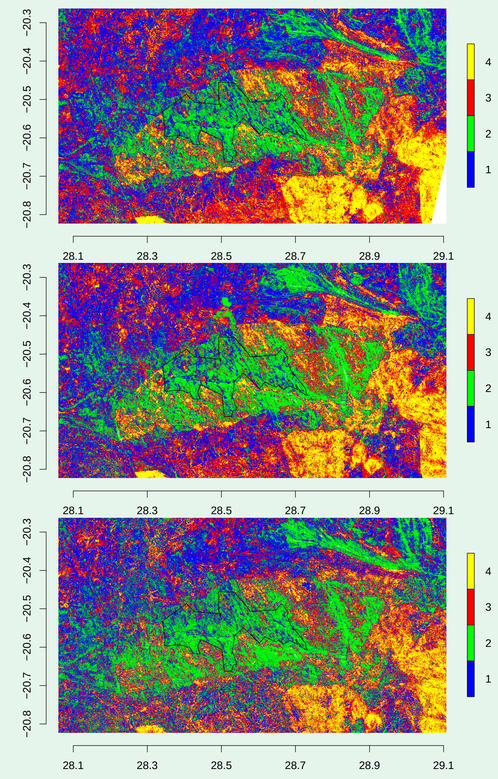

Figure 4 : Classified Landsat images, from top to bottom: 1989, 1998 and 2014 with the LULCs: 1: *shrub land*, 2: *forest*, 3: *patchy vegetation*, 4: *agricultural land*.

Results and Discussion

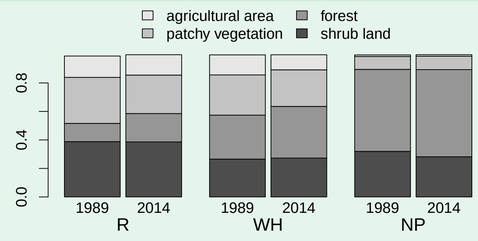

Figure 5 : Portions of LULCs of National Park (NP), World Heritage Side without NP (WH) and the residual area (R).

- NP protected from farming → LULC *forest* dominant, *agricultural land* barely exists (Fig. 5)
- WH differs from R already in 1986 → habitat types (hills vs. flat land) main reason for differing LULCs, not state of protection of WH

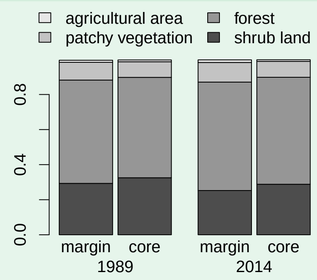

Figure 6 : Portions of LULCs of 500m margin of NP and its core.

- NP: Protection of major of NP since 1926 → marginal changes of LULCs
- Reduced *shrub land* in 500m margin (Fig. 6), maybe caused by: Occasionally destroyed fence bordering NP → livestock grazes inside

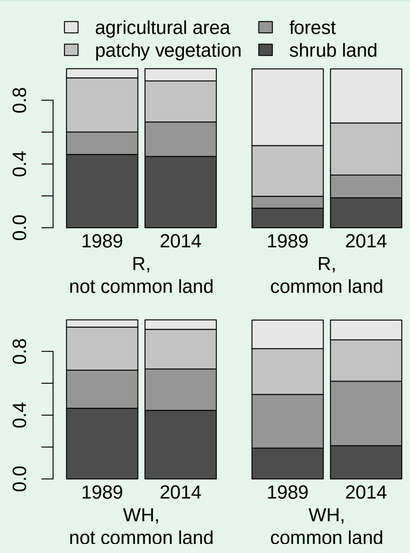

Figure 7 : Portions of LULCs of R and WH differentiating between common and not common land.

- Ownership: Important role for composition of LULCs (Fig. 7), see also Fig. 4: Yellow areas in 1986 coincide with common land).
- Common land in 1986: Many households with average size of land of five hectares ([2]) → Intensive farming, exhaustive for soil.
- Not common land in 1986: Fields of 169 hectares in average ([2]).
- Decrease of *Agricultural land* in common land maybe caused by: Fast Track Reform beginning in 2000 in Zimbabwe → resettlement of communal farmers, millions of emigrants ([3]).

References

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