Cross-Border Infrastructure in Africa

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Introduction

- USA – Canada: one border crossing every 65km

- Mozambique – Tanzania: one border crossing every 350km
Introduction

• African Borders were drawn by colonial powers, adopted by OAU in 1964

• Today, the AU aims to both demarcate and overcome borders

• Cross-Border Infrastructure (CBI) is tangible proof of good relations

• There is no large scale research on CBI available

• Why are there many CBI on some borders, and almost none on others?

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Materials, Methods - Methodology

- Logistic Regression
  - Predicts the probability of an event to happen, e.g. 70% yes / 30% no
  - Event = raster cell contains CBI
  - Non-geographical analysis

- Not used: Linear Regression
  - Only if dependent variable is quantifiable, e.g. size, costs

- Not used: Geographically Weighted Regression
  - Only for spatially continuous phenomena, e.g. geologic layers
Materials, Methods - Data

- Dependent Variables:
  - Large CBI (298)
  - OSM roads (3328)

- Airports
- Bridges
- Hydropower
- Railways
- Ferries
- Off. Crossings
Materials, Methods - Data

- Independent Variables
  - Pixel Size
  - Border length
  - Distance from coast
  - Distance to nearest capital
  - Elevation
  - Slope
  - River size
  - Population Density
  - Fraternisation
  - GDP per Capita
  - Trade
  - Shared RECs memberships
  - Differing RECs memberships

- Geometrical
- Topographical
- Sociological
- Economical
- Political
- Pixel-specific
- Boundary-specific
Materials, Methods - Data

- **Data Sources**
  - OSM
  - LSIB, US Govt
  - IOM
  - World Bank
  - FAO
  - WWF
  - VGI
  - etc.

- **Data Formats**
  - Table
  - Vector
  - Raster
Materials, Methods - Variables

- Reference Geometry: LSIB
- Rasterisation 15" (ca. 460m)
- > 230‘000 raster cells
- One raster layer per variable
- 230‘000 x 2y x 13x = 3.5Mio values

- Challenges: some data unavailable for the Sahrawi Republic (Western Sahara)
  - excluded from the analysis
Materials, Methods - Variables

- Challenges (continued)
  - Choice of raster size: one, two or three CBI? Decision: 15" (ca. 460m)

- Phantom crossings. Solution: only one CBI per intersecting feature

- Inconsistency between OSM and LSIB

- Erroneous OSM attributes

- De jure vs. de facto boundaries

- Other unexpected situations
Materials, Methods - Analysis

- Rule of 10
  - At least 10 events per variable
- Rare events
  - < 3% events vs. > 97% non-events
  - Under-prediction of events
- Variance Inflation Factor
  - Remove variables with VIF > 5
- Correlation
  - Analysis of high correlations between variables
- Stepwise regression
  - Forward / backward elimination of variables
Results

- Large list of coefficients
- Expected (green)
- Unexpected (red)
- Ambiguous (mixed)
- Pseudo-R2 between 5% – 21%
- Borders with more / less CBI than expected
- Impact per variable on overall probability
Results

- Prediction of CBI on continental and regional level
Results

- Prediction of CBI in Southern Africa, using coefficients from Eastern Africa
Discussion & Conclusion

- Large CBI as well as cross-border paved roads are most likely:
  - In areas with high population density
  - close to capitals
  - in flat terrain
  - on dry land or across small rivers
- Some challenges, such as
  - Missing Data on Sawhari Republic (Western Sahara)
  - Completeness and correctness of OSM
  - CBI are Rare Events
Discussion & Conclusion

- Pixel-specific variables are better than boundary-specific ones
- Borders of Regional Economic Communities have no impact on CBI
- Possibly better economic and sociological indicators available
- Models explain 5-21% of why a CBI is or isn‘t present in any cell
- Continental models are less accurate than regional ones
- Regional models shouldn‘t be applied to other regions