THE LEXICAL FREQUENCY OF LABIAL-VELAR STOPS IN NORTHERN SUB-SAHARAN AFRICA AND ITS HISTORICAL IMPLICATIONS

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INTRODUCTION

- Northern sub-Saharan Africa is obviously a spread zone with a marked areal distribution of various linguistic features
  - Macro-Sudan belt
  - Sudanic zone
  - …

Given that:

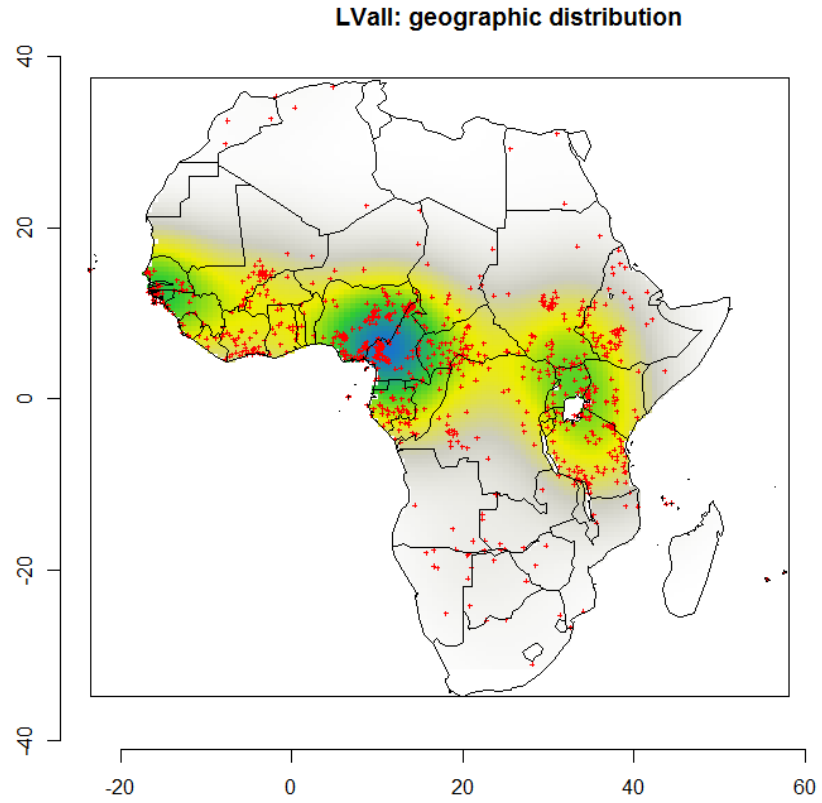
- LV are common in NSSA languages
- typologically, LV are known to be rather rare

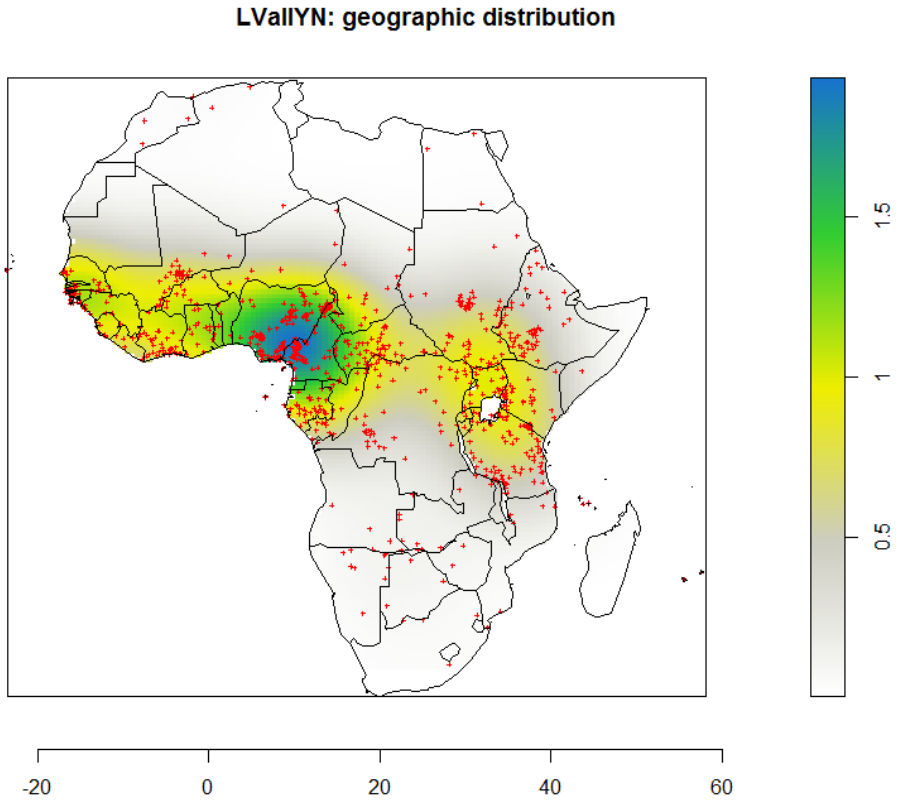
Interested in:

- Are LV "normal" phonemes in NSSA languages?
- Are there differences between languages in the frequencies of LV in their lexicons?
- Are there geographic patterns in the LV frequency distribution?
- Are the distributions of LV within the lexicons random?
- How can we explain the observed patterns?
- Why are LV common in NSSA?

LV data sources:

- **RefLex**, www.reflex.cnrs.fr, LVFreq data
- Phoible, www.phoible.org, YN data
- Additional LVFreq data for some Mande and Bantu languages





LVall

1074 languages with frequency data:

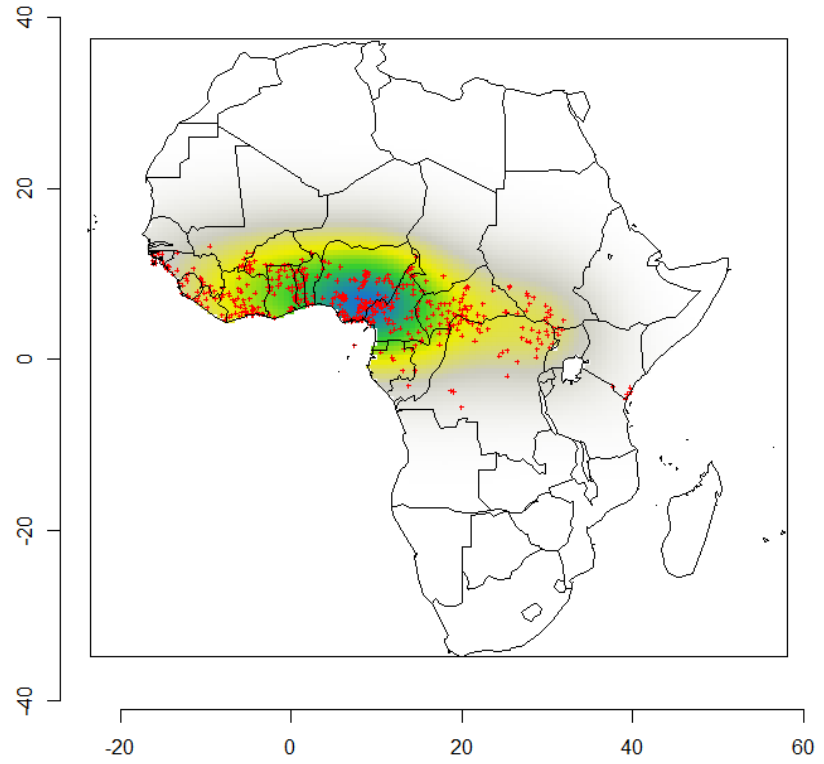
- LV & their frequency is known (336 lgs)
- No LV

LVallYN

1304 languages:

- LV & their frequency is known (336 lgs)
- LV, but no frequency data (230 lgs)
- No LV

LVall_Y languages: geographic distribution



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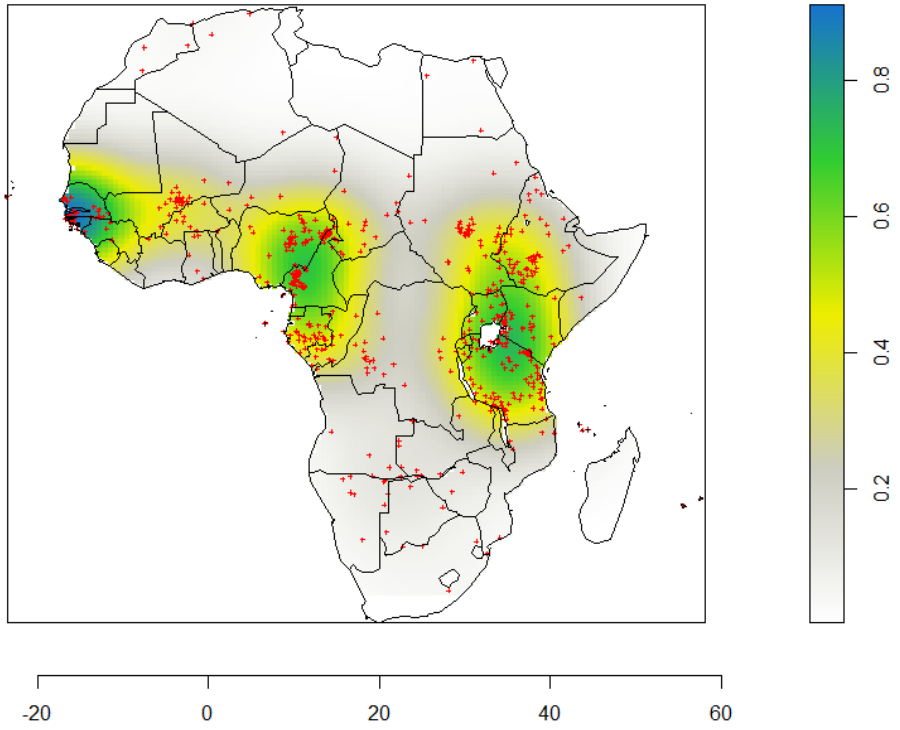


LVFreq estimation

H_0: In a lexicon, all C phonemes have equal frequency (have equal probability of occurrence)

$$\boldsymbol{LVFreq} = \frac{LV_O}{LV_E * W_{LV}} * 100\% = \frac{\sum T_{LV}}{\frac{\sum T_C}{\sum P_C} * \sum P_{LV}} * 100\%$$

LV_O - observed LV count

LV_E - expected LV count

W_{LV} - LV weighting coefficient

T_{LV} - LV token

T_C - any C token

P_{LV} - LV phoneme

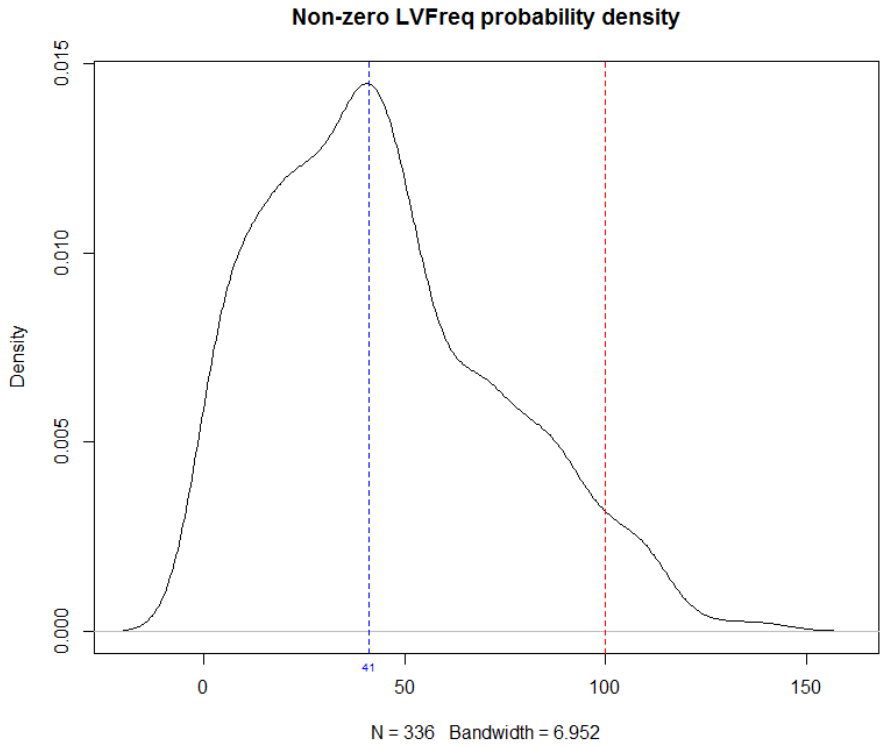
P_C - any C phoneme

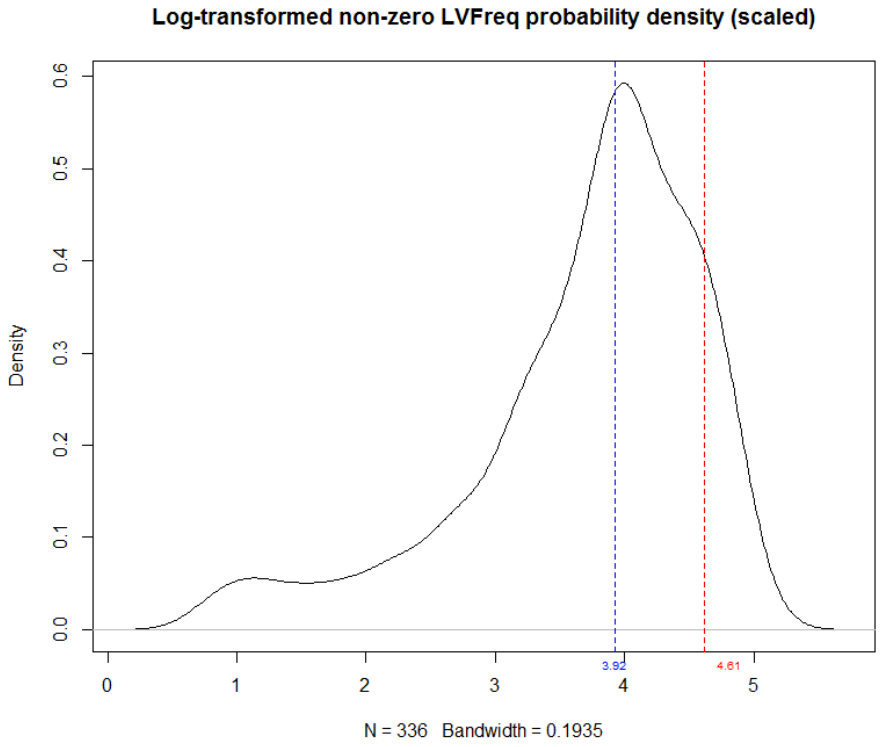
LVFreq estimation

LVFreq = **0%** no LV

LVFreq = **100%** **"reference LVFreq"** - LV are "normal" phonemes, i.e. the observed number of occurrences of LV is the same as would be expected given the H_0

LV FREQUENCY ESTIMATION





median reference LVFreq

- Log-transformation does not help to make the data more normal
- LV are relatively rare phonemes in most languages that have them, which is in accordance with their typological rarity

Are the distributions of LV within the lexicons random?

H_0: LV are distributed randomly throughout the lexicon

H_T: LV are NOT distributed randomly throughout the lexicon, but are more common outside of the "basic" vocabulary domain

(especially in the "expressive" parts of the lexicon)

DISTRIBUTION WITHIN THE LEXICON

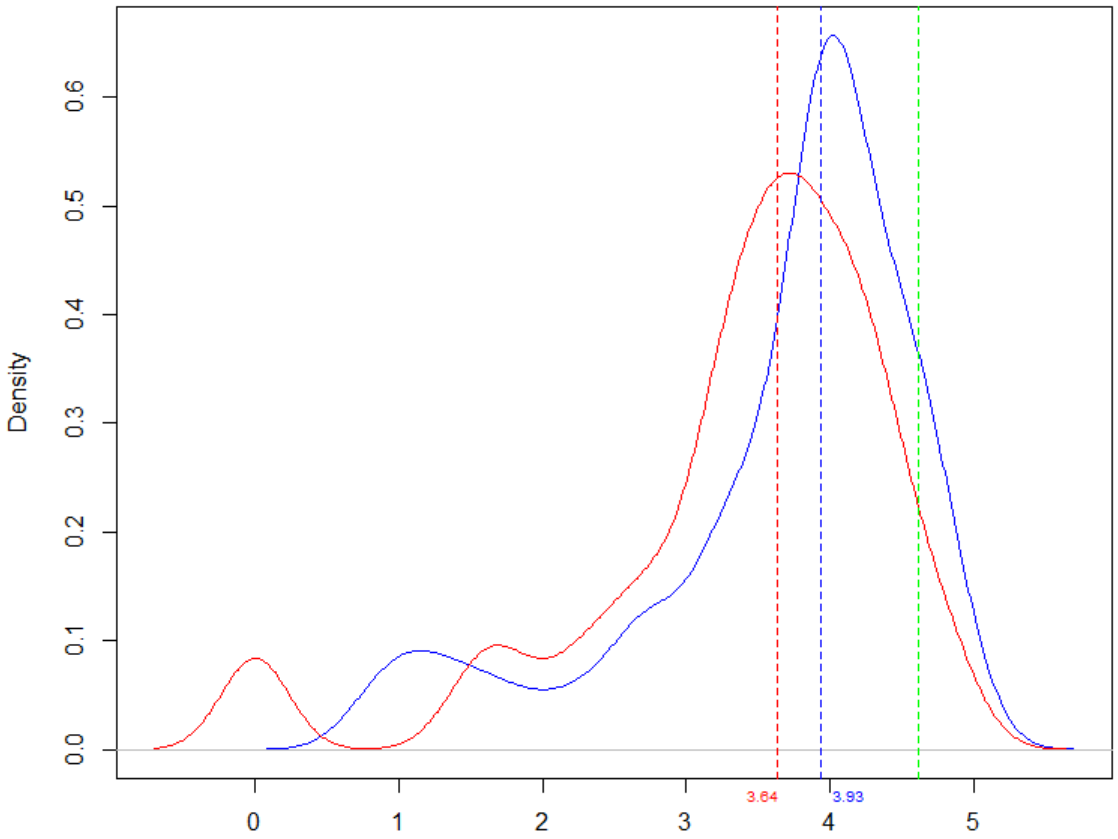
- background: LV are relatively rare, both typologically and within the lexicons
- compare Olson & Hajek (2003, 2004) on the "phonological status" of the labial flap /ⱱ/:
  - distribution across grammatical categories (ideophones, flora & fauna names, taboo words…)
  - frequency of occurrence
  - distribution within the word
  - borrowed words

  E.g., in Bena (Adamawa), /ⱱ/ only in the ideophone *pàⱱàd* 'suddenly (appear)'
- impressionistically, a similar pattern holds for (at least some) languages with a low LVFreq:
  - E.g., in Wawa (Martin 2015), LV stops are overall rare except in ideophones
  - See also Bostoen & Donzo (2013) on Bantu languages of the north of DRC

Are the distributions of LV within the lexicons random?

- A possible test: Extract a subset of entries of a "basic vocabulary" from each source of a sufficient size and compare the LVFreq pattern in the original sample with the LVFreq pattern in a "basic vocabulary" sample
- Our version of the test:
  - automatically created Swadesh-200 lists
  - the sources with $\geq$ 400 entries
  - fill the gaps with random entries
  - the result is a quasi-Swadesh-200 list

DISTRIBUTION WITHIN THE LEXICON



paired U-test (Wilcoxon signed rank test):

p-value = 5.061e-13

Bootstrap (rep = 999):

100% p-values < 0.5

50% p-values ≤ p_0

original LVFreq (≥ 400 entries)

quasi-Swadesh-200 LVFreq

original median (≥ 400 entries)

quasi-Swadesh-200 median

reference LVFreq (= 100%)

DISTRIBUTION WITHIN THE LEXICON

Are the distributions of LV within the lexicons random?

- LV tend to be less common in "basic vocabulary"
- **{H}:** LV are more common in the "expressive" parts of the lexicon, such as ideophones or property words, rather than referring expressions, such as nouns and verbs
- LV are largely restricted to the stem-initial position

LV, SIC-ACCENT & C-EMPHASIS PROSODY

- The correlation [LV ~ "expressive" vocabulary] is not independent of the correlation [LV ~ stem-initial position]
- **SIC-accent** (as a manifestation of a more general phenomenon of **C-emphasis prosody**) is a very important factor behind the emergence of LV in NSSA (as well as labial flaps, bilabial trills, and)
- In a broader perspective, **C-emphasis prosody** is a very good candidate for the role of a major driving force behind the emergence of several other types of sounds, such as labial flaps, bilabial trills, and possibly clicks

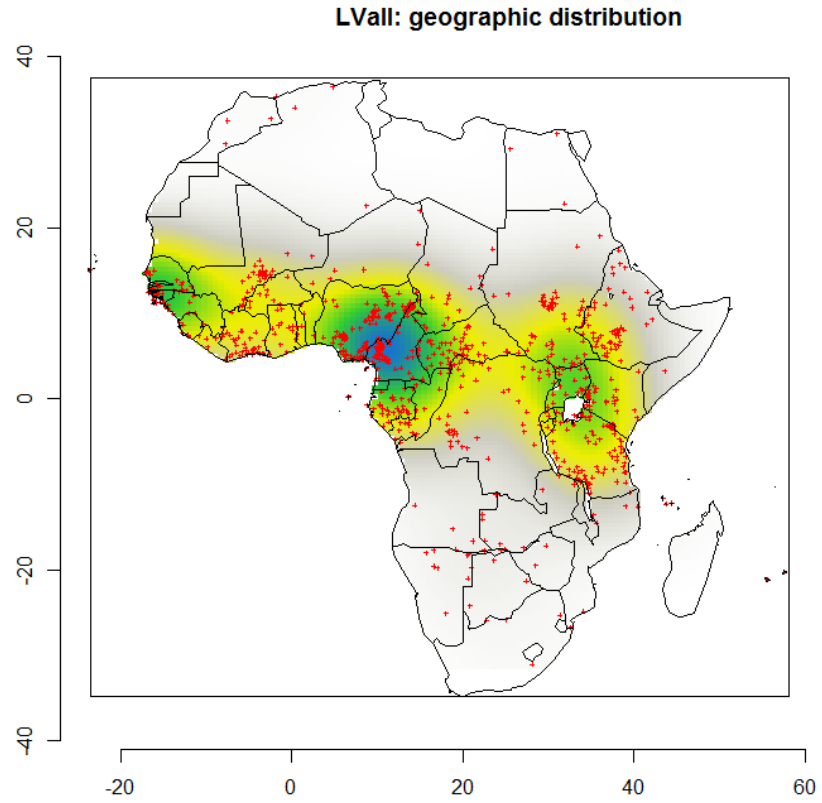
EMERGENCE OF LV & SIC-ACCENT

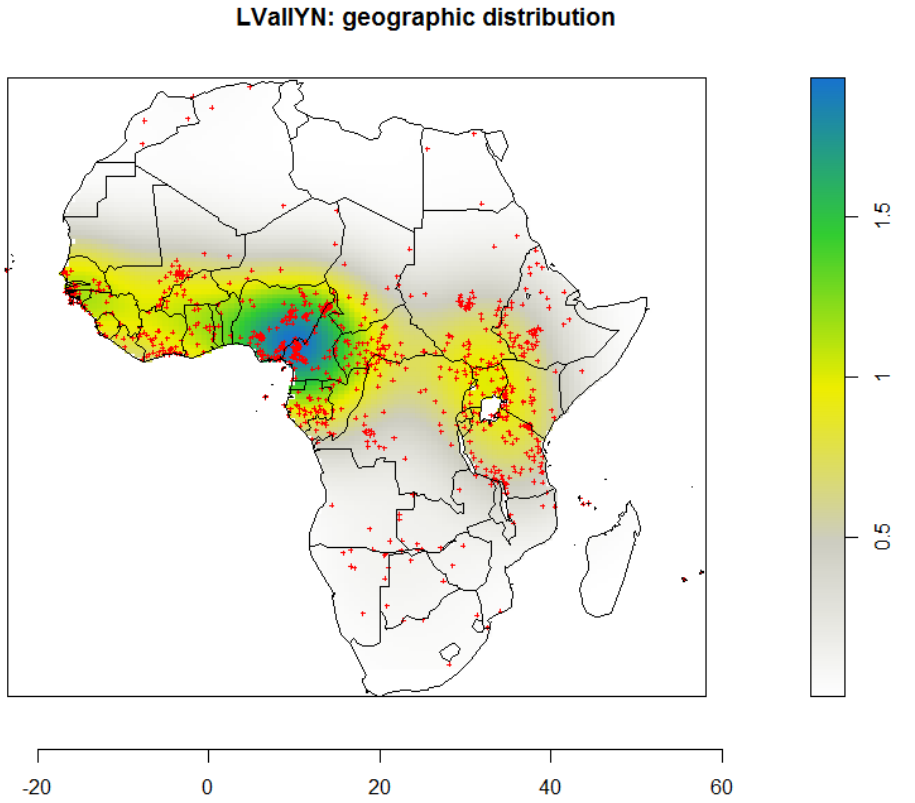
- {H}: Emergence of LV is favored by a significantly longer closer duration of the stem-initial C
- {H}: Emergence of LV is favored in the "expressive" parts of the lexicon
  - In origin, SiP is an intonational/prosodic phenomenon: emphasis by exaggerating the closure duration of a C
  - "expressive" words are more often emphasized prosodically

- The "expressive" function & the C-emphasis prosody as important vehicles of spread of LV through language contact (see Matras 2009, 2014… on borrowability)

> Functions that serve to negotiate attitudes among the participants in the interaction and which convey evaluations, assessments, the processing of presuppositions, or emotions, are particularly prone to borrowing: This includes information structuring at the level of the discourse and clause, [...], prosody in phonetics and phonology, discourse particles [...] They represent bilingual speakers' need to align the emotional and presupposition-oriented side of negotiating communicative interaction across interaction settings.
>
> (Matras 2014:5)

SPATIAL DISTRIBUTION





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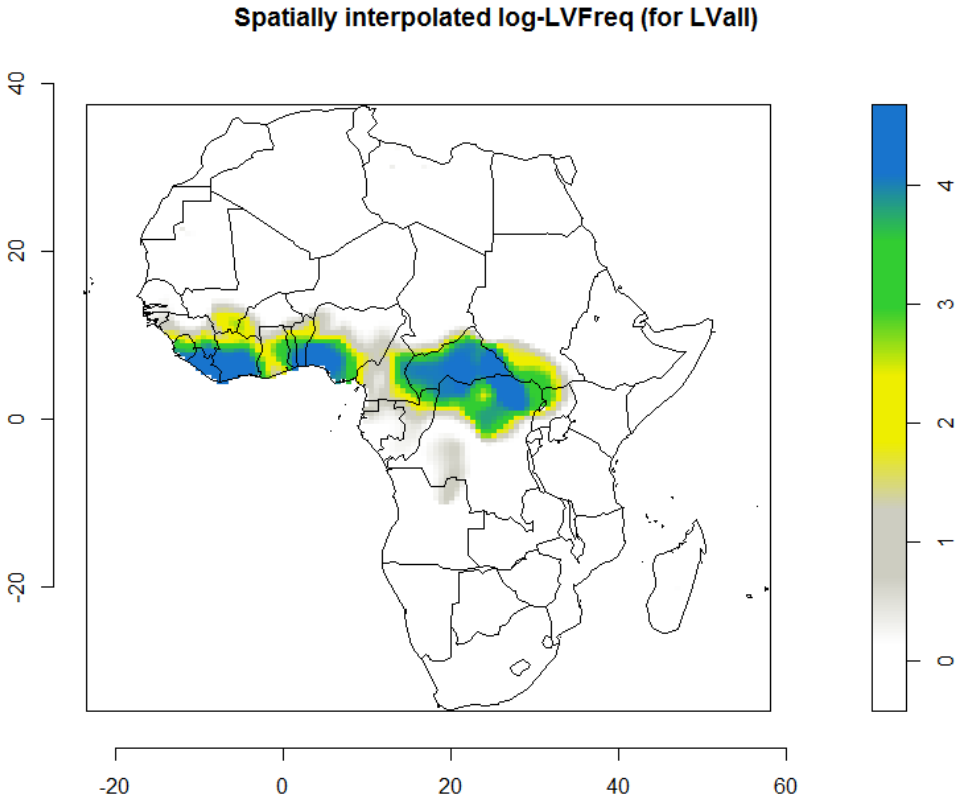
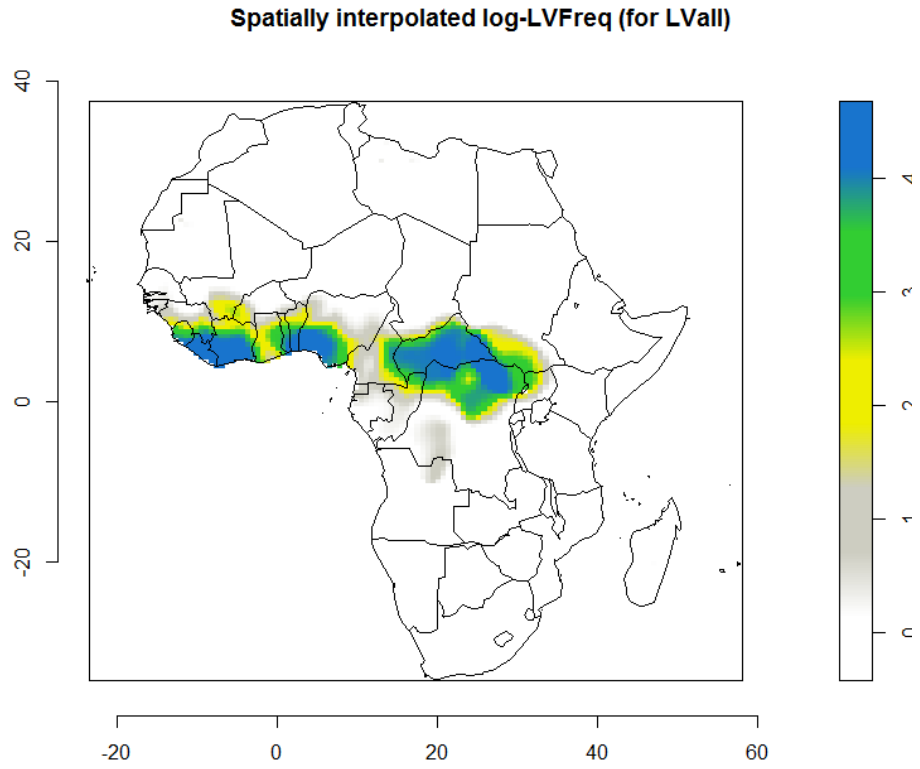
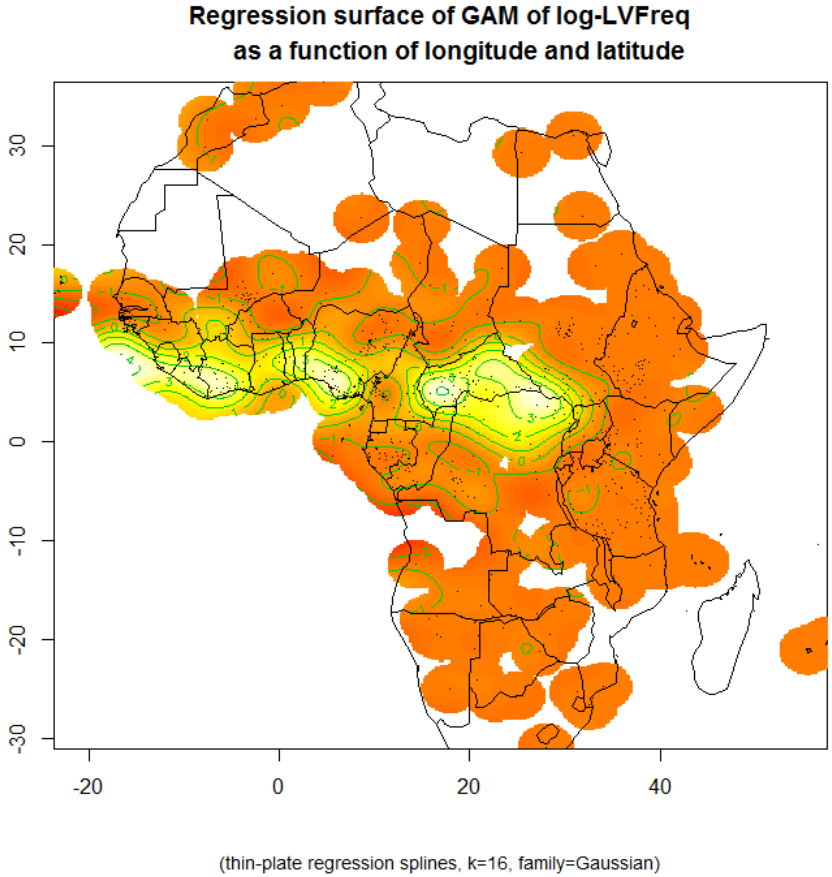


- 2 clearly separated clusters
  - Coastal West Africa (possibly itself composed of 2 sub-clusters)
  - Central Africa
- possibly, +1 less prominent cluster
  - SW Mali & SE Burkina-Faso
- 1 major spatial discontinuity
  - NE Nigeria & Cameroon
- 1 minor spatial discontinuity
  - Ghana

SPATIAL DISTRIBUTION

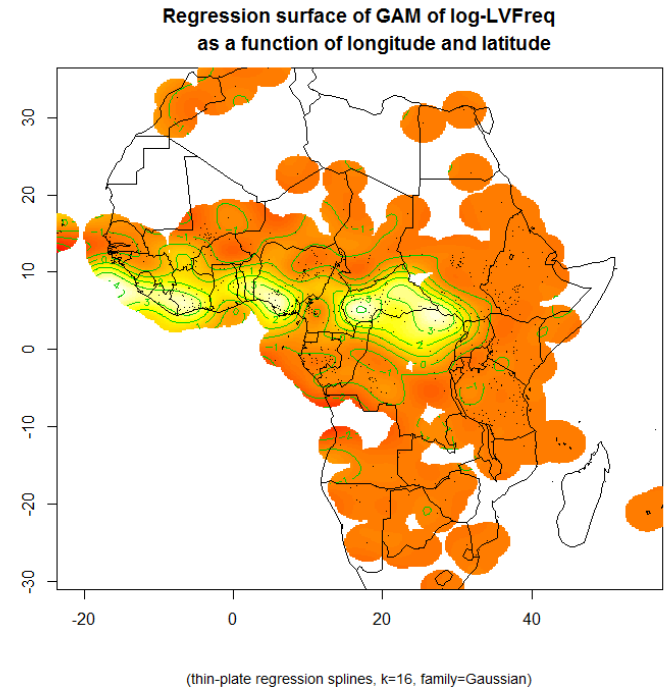


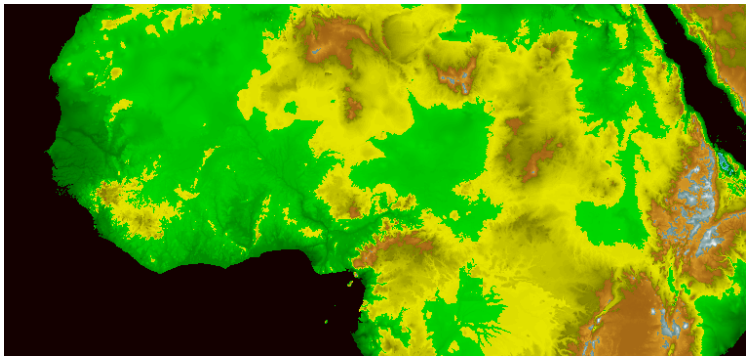


(thin-plate regression splines, k=16, family=Gaussian)

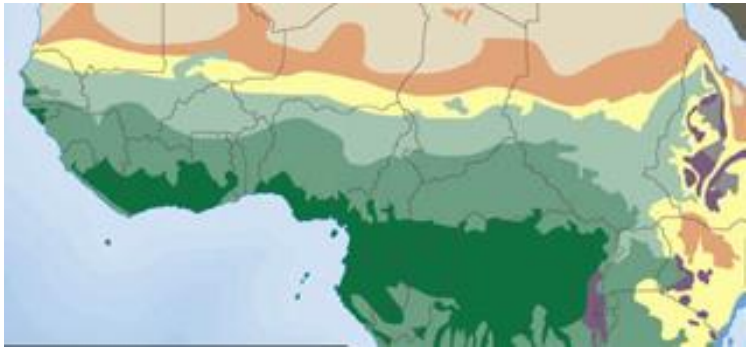
Langage, Langues et Cultures d'Afrique Noire
Llacan

SPATIAL DISTRIBUTION

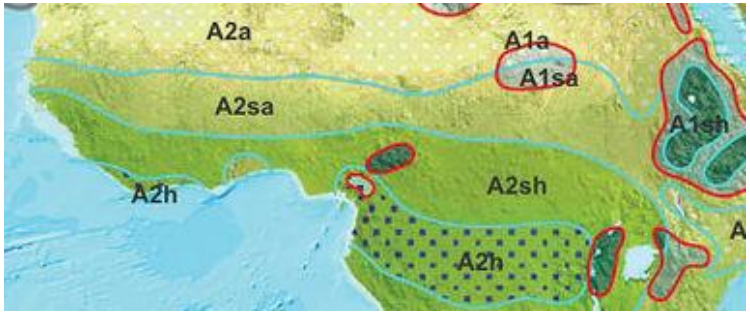




Topography

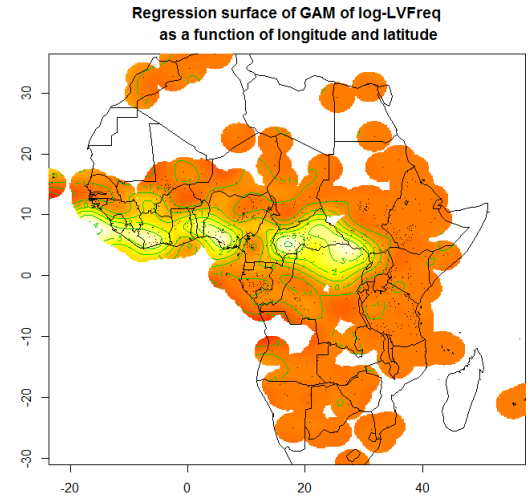


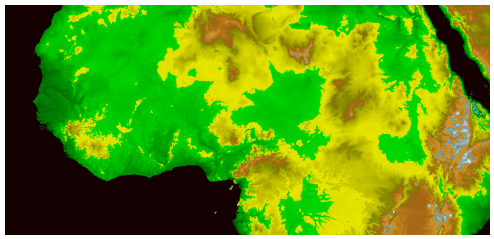
Vegetation

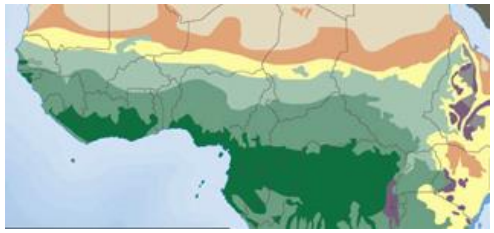


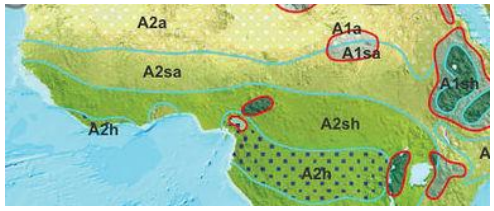
Climate zones

SPATIAL DISTRIBUTION



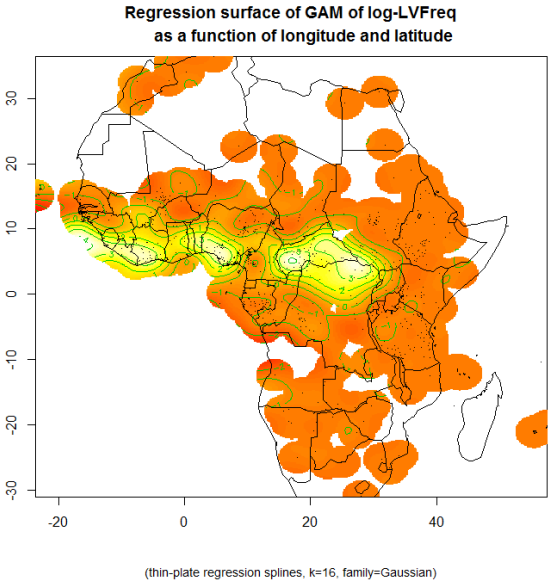






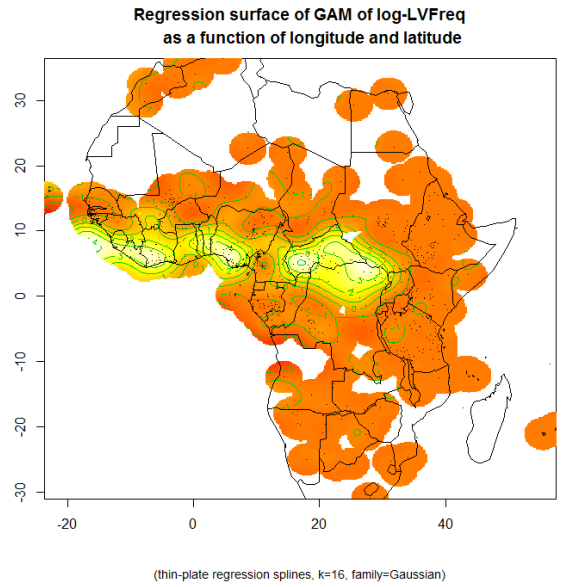
- Geographically, the 3 major zones of high LVFreq (and the possible minor zone) appear to be **refuge zones** delimited by natural barriers (sea, forest, mountain ranges)
- Ghana discontinuity ≈ Dahomey forest gap
- NE Nigeria & Cameroon discontinuity ≈ Adamawa Plateau, Cameroon mountains

SPATIAL DISTRIBUTION



- "hotbeds" → older presence of LV (and ultimately SIC-accent)
- Given the refuge zone nature of the "hotbeds", they are probably "hotbeds" not so much for spread but for **retention** of the feature LV/SIC-accent present in the original population

SPATIAL DISTRIBUTION



- Genetic build-up of hotbeds & their outskirts is diverse:
  - W: mostly Niger-Congo, except the extreme W
  - E: Gbaya, Ubangian, parts of Central Sudanic
- Linguistically, the original LV/SIC-accent-population may be almost any of these (unlikely Niger-Congo or Central Sudanic) or none
- Hotbeds as refuge zones & retention:
  - hotbeds ‖ language shift
  - outskirts ‖ change in language contact situations

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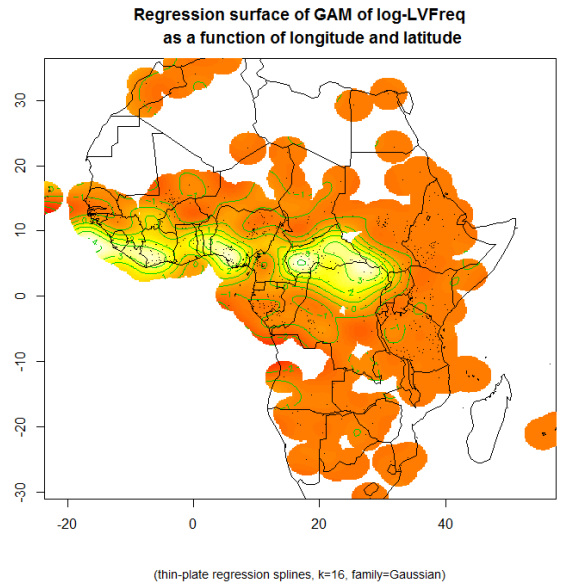


- Bantoid & Adamawa appear to have arrived in the area relatively recently
- Bantoid may have passed it & then re-entered or just entered late
- The spread of Bantoid must have been also rather quick without much language shift involved (except in the N of Congos)
- This model also supports the "East-out-of-West" hypothesis of the E Bantu emergence with the E Bantu break-off point somewhere south of the rainforest

MODEL CROSS-VALIDATION

- Our lexical frequency data coverage can be improved:
  - 566 languages with LV in LVallYN, of which we have some frequency data for ≈ 60%
  - quality and lexical coverage of the sources is uneven
  - certain areas and language families are somewhat underrepresented
- That's a lot of work… Is there a quicker way to cross-validate our model?

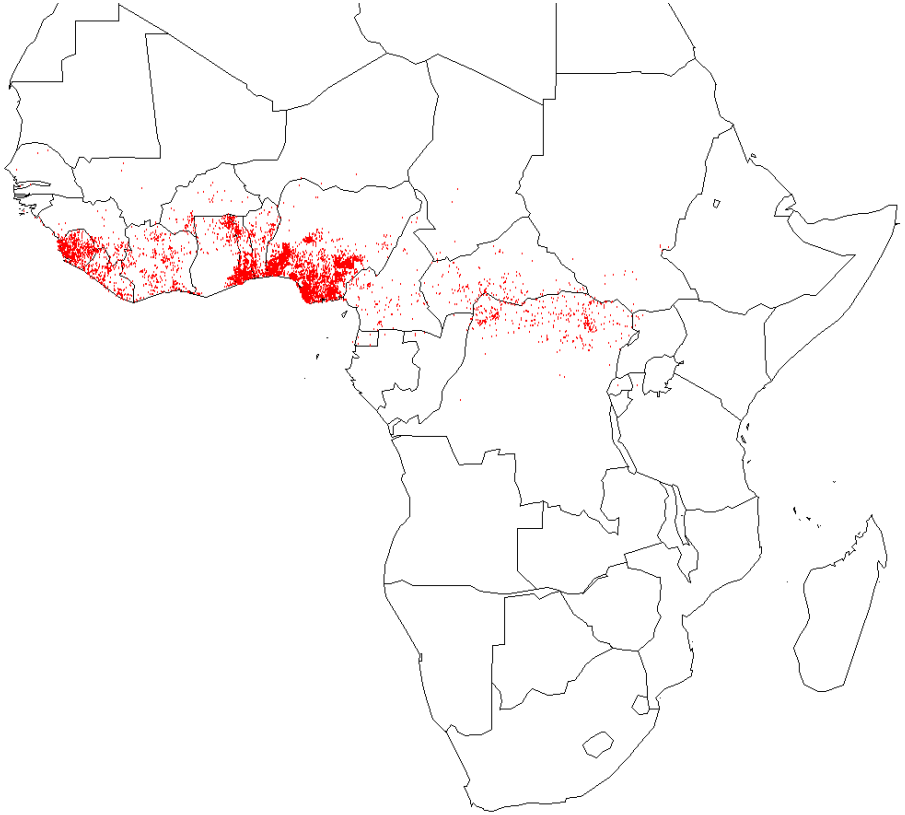
MODEL CROSS-VALIDATION

- Spatial distribution of settlement names spelled with a LV (such as “kp”, “gb”, Yoruba “p”) on the assumption that:

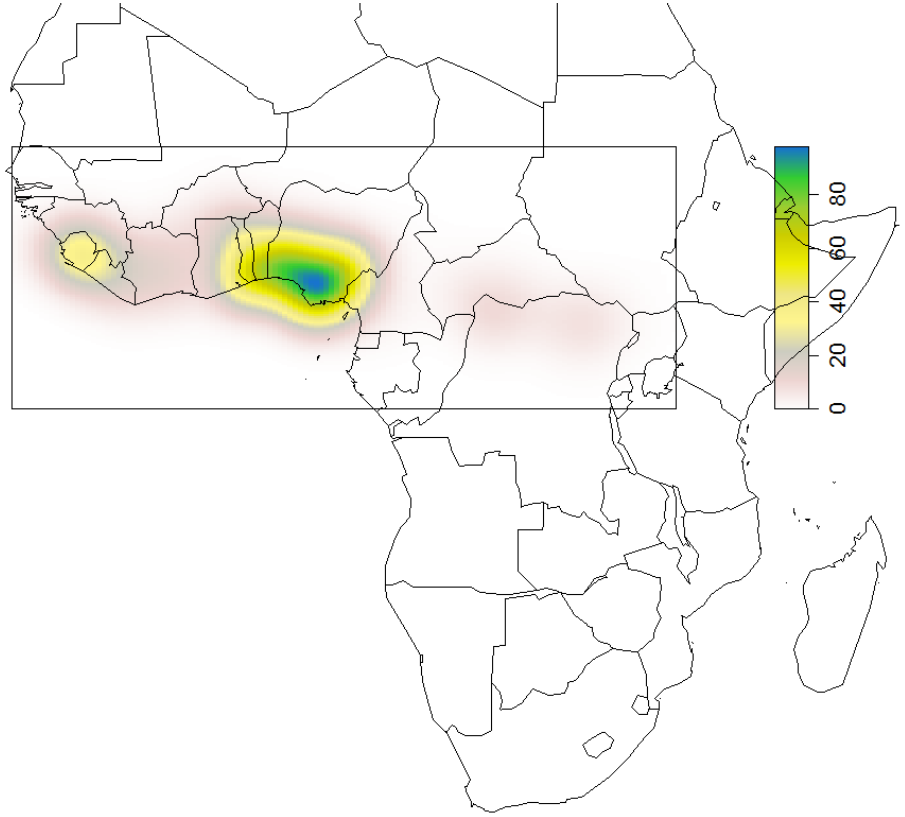
  H_0: Frequency of settlement names with LV in a given area should roughly correlate with (be representative of) lexical frequency of LV in the languages spoken in the area

- Big data approach: quantity compensates for quality
- Settlement names data source: GeoNames.org

MODEL CROSS-VALIDATION

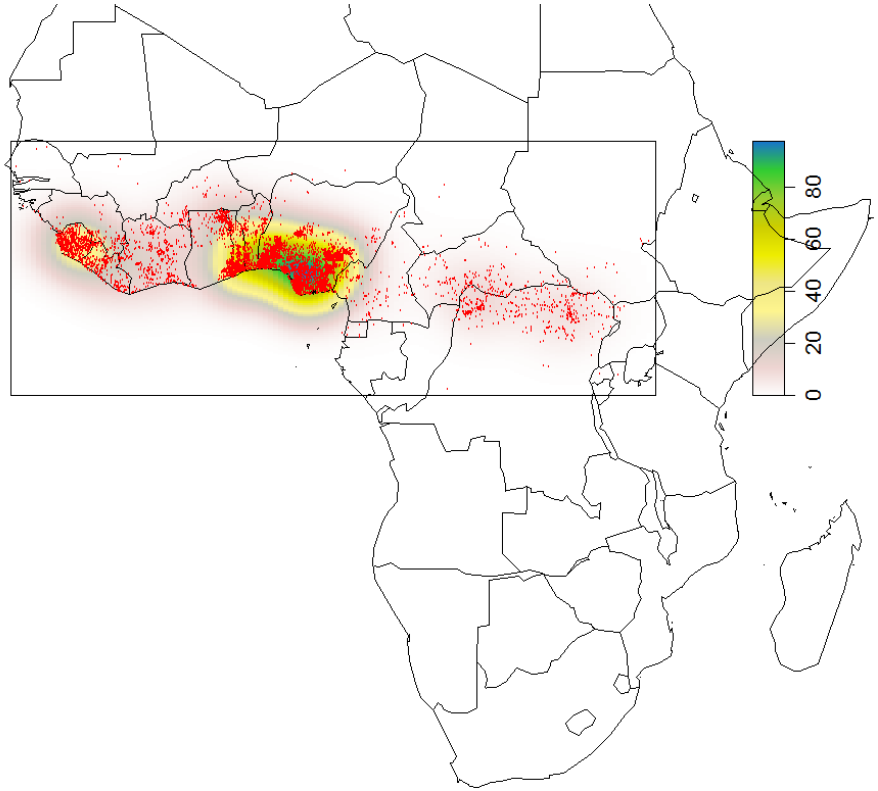


Unique settlement names with a <LV> (<kp>, <gb>, Nigerian Yoruba <p>)



Spatial intensity of unique settlement names with a <LV>

MODEL CROSS-VALIDATION



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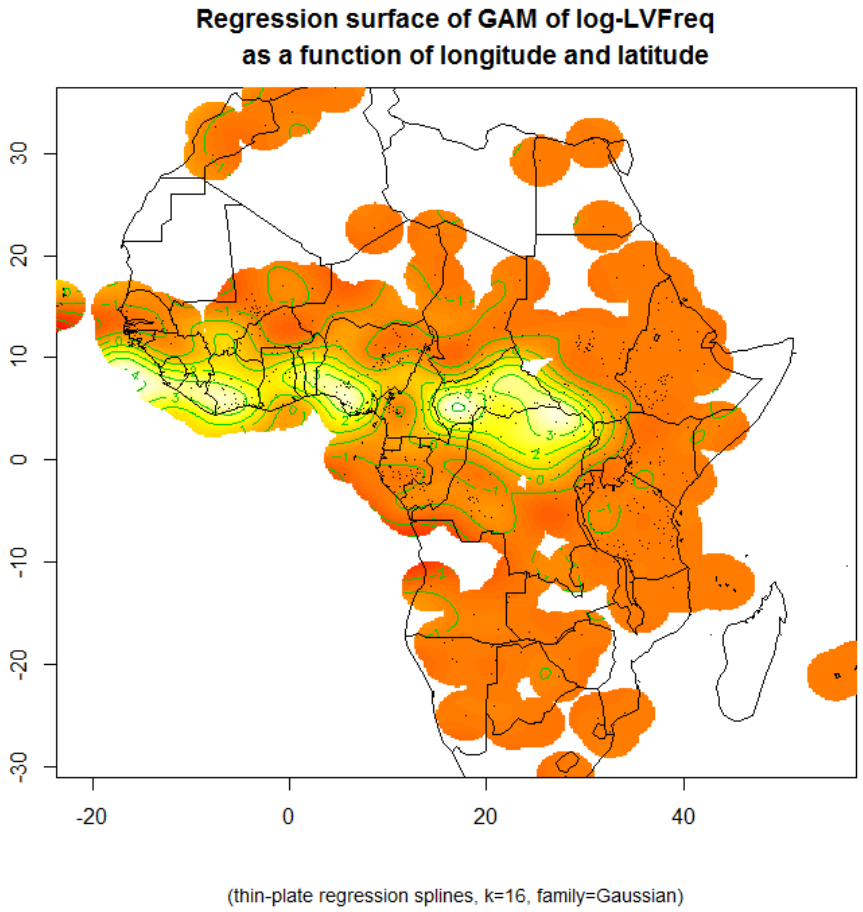

MODEL CROSS-VALIDATION

- The significance of the clusters should be evaluated against the general population density in the respective areas:
  - The seeming weakness of the E-most cluster is an artefact of the low population density in Central Africa
  - Both discontinuities are significant