Combining GIS and R for dialectal data analysis and representation

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ARCHIMEDES

Outline of the presentation

- About the project “Applying Spatial Data in Linguistics”
- The aim of the presentation
- About the Corpus of Estonian Dialects (CED)
- Digitizing dialect atlas data
- Analyzing and visualizing data with R
- Using R to combine data from different sources
- Conclusions

About the project (RuRaKe)

- http://rurake.keeleressursid.ee/
- “Ruumiandmete rakendamine keeleteaduses” (Applying Spatial Data in Linguistics)
- Initially:
  - Adding geographical information to the Corpus of Estonian Dialects
  - Digitizing dialect maps of the “Väike Eesti murdeatlas” (“Small atlas of Estonian dialects”, 1955) by Andrus Saareste
- Creating resources for combining and analyzing different data sources with a spatial dimension
- Bringing dialect data closer to people not actively working in the field

The aim of the presentation

- Show, how combining different data sources (atlas data and corpus data) and applications (GIS-systems and statistical computing software R) is beneficial for getting a more diverse picture of linguistic variation and the language phenomena
- 3 alternation phenomena:
  - *sui* / *suvi* ‘summer’ (Saareste 1955)
  - *suurem* / *suuremb* ‘bigger’ (Saareste 1955)
  - *ei ole* / *pole* ‘is not’ (Saareste 1955)

About the Corpus of Estonian Dialects

- http://www.murre.ut.ee/mkweb
- The electronic corpus contains text from all the Estonian dialects.
- The corpus mainly consists of transcribed and morphologically annotated texts of interview recordings from the 1960s and 1970s, as well as the recordings themselves and the metadata.
- Morphological annotation is done manually. Annotation includes information about lemma, part-of-speech, morphological categories, and meanings.

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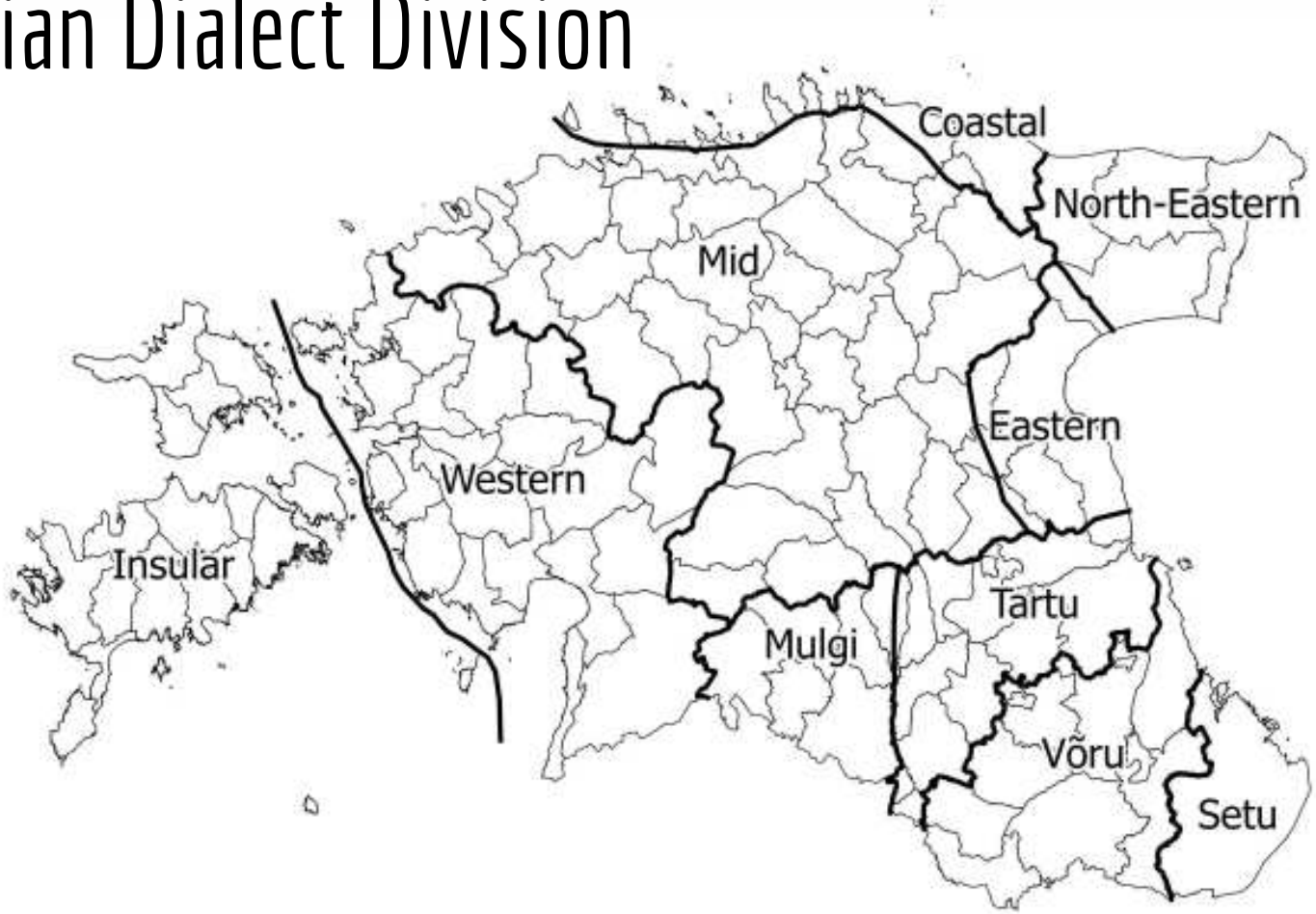
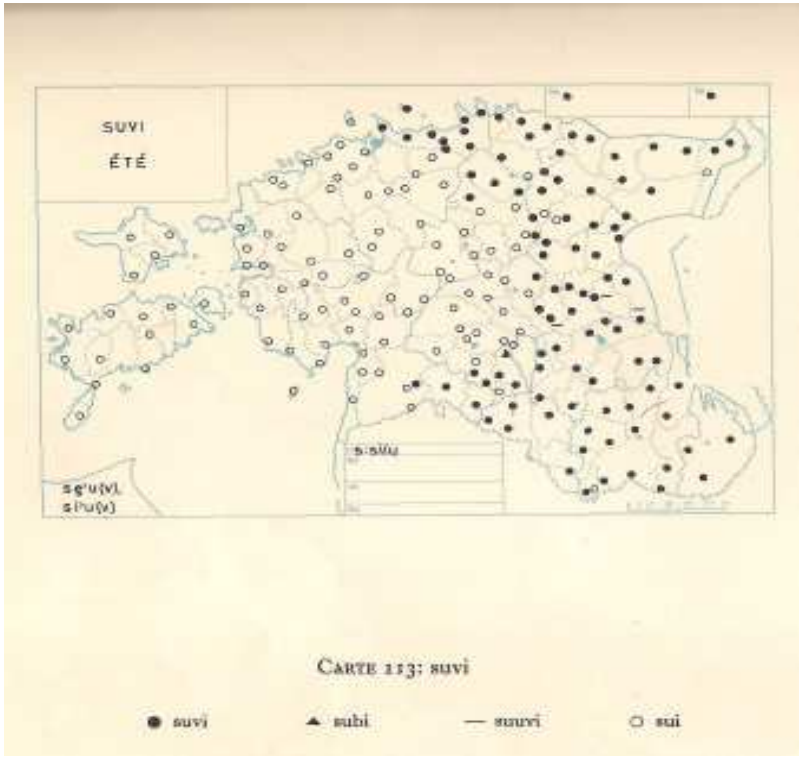
Estonian Dialect Division



Atlas data and using GIS

- A. Saareste's two atlases:
  - 1938/1941 "Eesti murdeatlas" ("Atlas of Estonian Dialects") with 66 maps
  - 1955 "Väike Eesti murdeatlas" ("Small Atlas of Estonian Dialects") with 125 maps
- "Atlas of Estonian Dialects" (AED) contains maps with text (a la Jules Gilliéron)
- In "Small Atlas of Estonian Dialects" (SAED) Saareste also used map symbols to visualize dialect data
- Mostly maps of vocabulary in AED (about 70%)
- SAED contains more morphology and phonology (57%) as well as vocabulary (41%)
- Using QGIS
  - Scanning and georeferencing
  - Assigning phonetically transcribed linguistic data (words, phrases, constructs) to the centroids of villages where the data was collected

Andrus Saareste's dialect maps



CARTE 30: ei ole < e(p)i ole-k

| ei (ãi) ole	● pole	× ei (ãi, õi) pole	▽ -p põle
— ei oole	○ põle	+ ei põle	⊥ ole ei (õi)
∧ ei õle	△ põle	▲ -p ole (õle)	⊤ ei olõ' õijõ'
S ep ole	◐ põlõ	▼ -p pole	⌒ oleki
			Y ãle

Using R

Perks of using R for dialectal data manipulation:

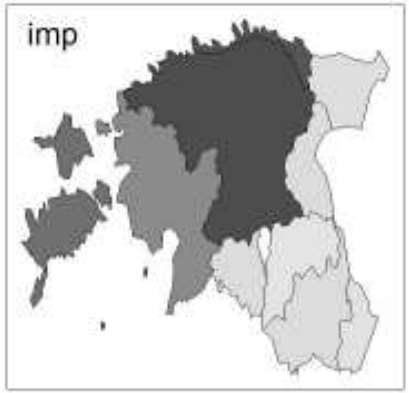
- Ready made analysis tools support limited number of statistics
- Possibility to manipulate dialect borders
- All the steps of the analysis are in the same environment
- A large number of statistical methods is supported in R (9144 packages available at http://cran.r-project.org/web/packages/available_packages_by_date.html)

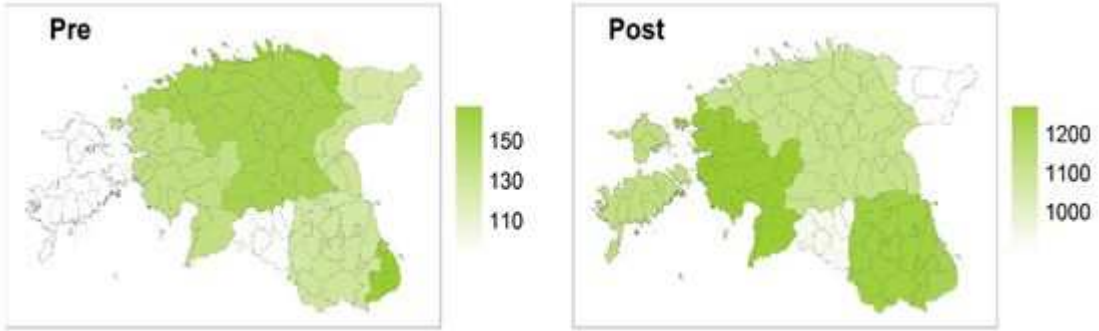
R packages

Packages for visualization:
Ggplot2 (Wickham 2009)
Ggmap (Kahle & Wickham 2013)

Packages for processing geodata:
Rgdal (Bivand et al. 2015)
Rgeos (Bivand & Rundel 2015)

Studies based on CED data

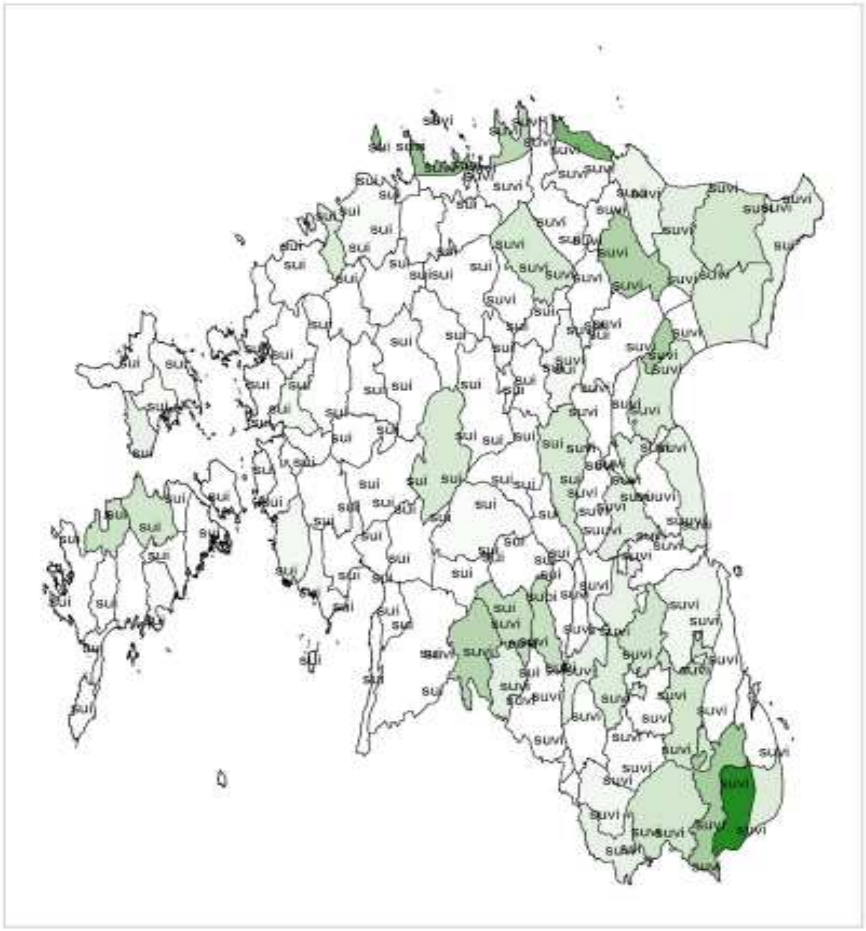


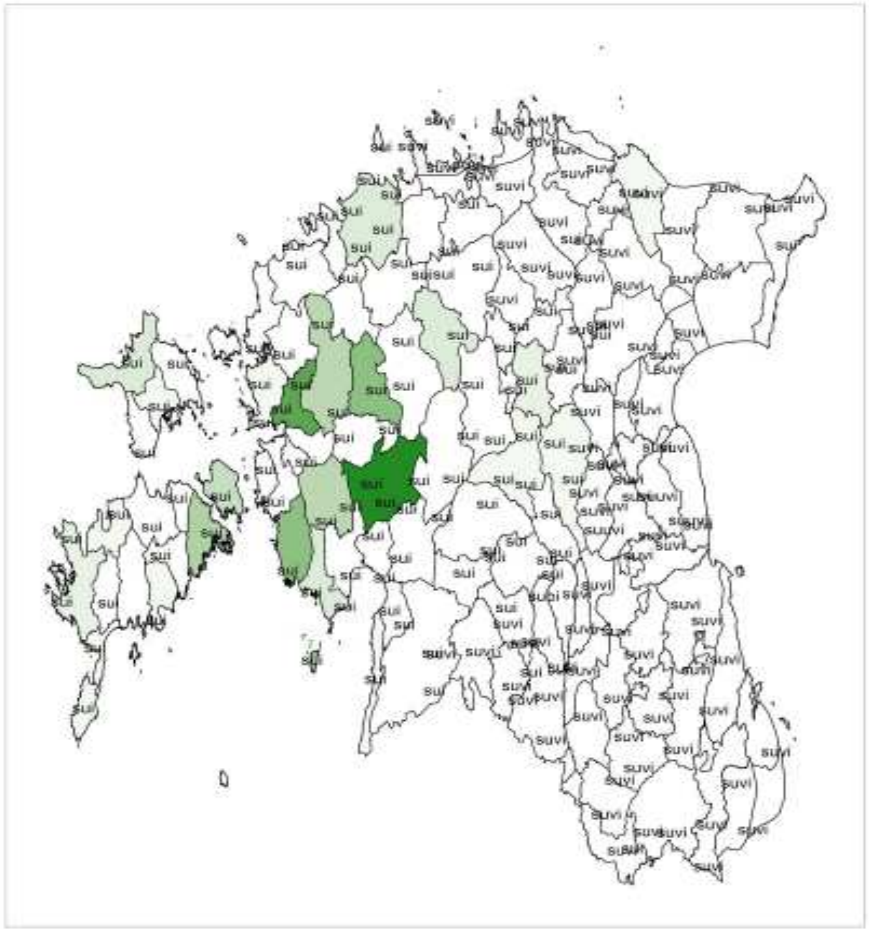


- Uiboaed, Kristel (2013): *Verbiühendid eesti murretes.* Tartu: Tartu Ülikooli Kirjastus. (= Dissertationes Philologiae Estonicae Universitatis Tartuensis).
- Vihman, Virve-Anneli, Liina Lindström, and Kristel Uiboaed (2014): "Varieerumine tarvis-/vaja-konstruktsioonides keelekontaktide valguses." *Keel ja Kirjandus* 8-9, pp. 609-630.
- Ruutma, Mirjam. *Kaassõnad eesti murretes*. Diss. Tartu Ülikool, 2016.
- Uiboaed, Kristel 2016. *Spatial Visualization with R.* spatial-visualization-with-r 1.0. http://dx.doi.org/10.5281/zenodo.51473.

Corpus data

- 973 147 morphologically annotated running words
- *suvi / sui*
  - 375 occurrences from 62 parishes
  - Frequencies normalized based on a mean corpus size
- *suurem / suuremb*
  - 218 occurrences from 62 parishes
  - Frequencies normalized based on a mean corpus size
- *ei ole / pole*
  - 2969 occurrences from 53 parishes
  - Data drawn from a balanced sample of ~40 000 words/dialect (total of 405 287 words)


suvi
sui


suvi
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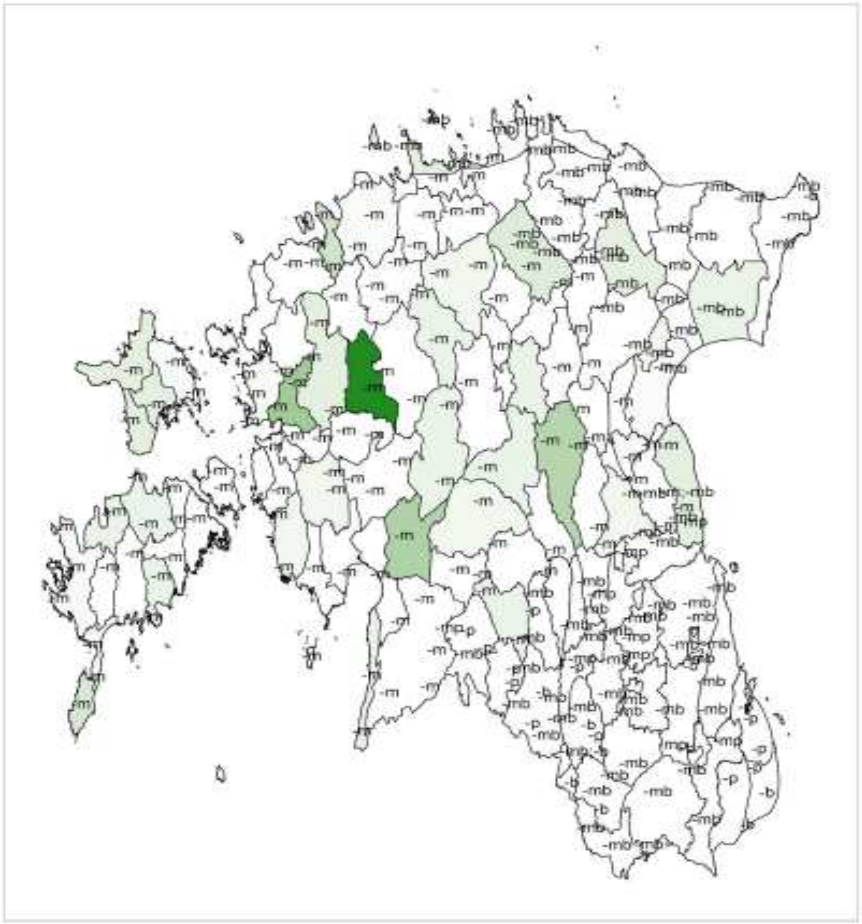

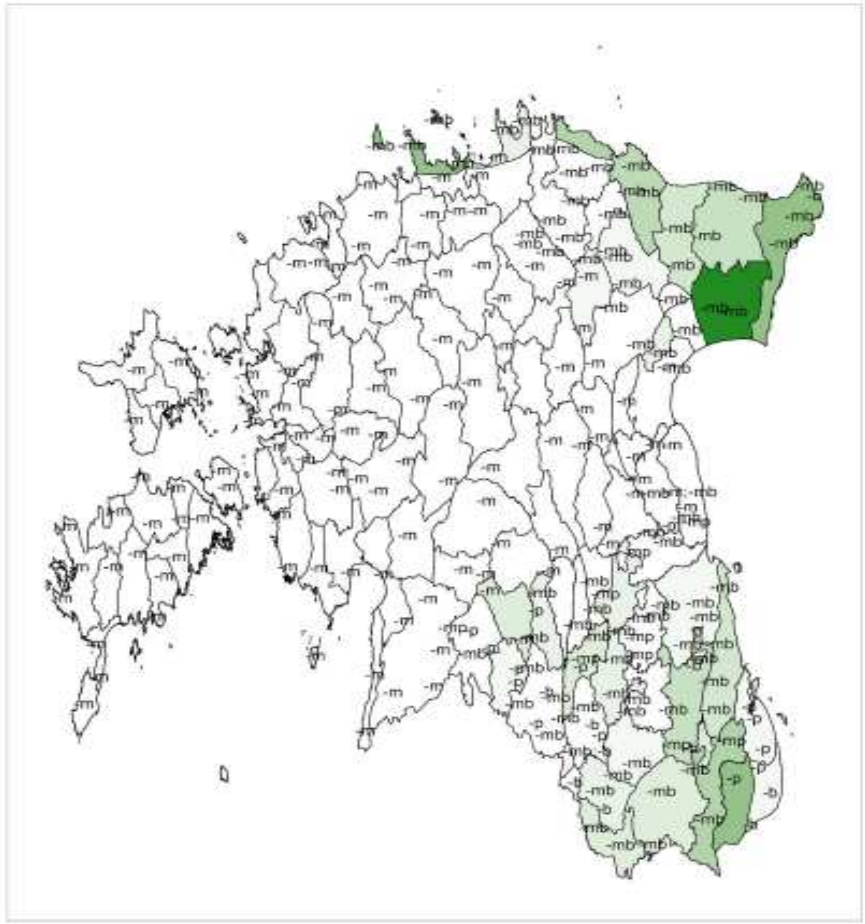

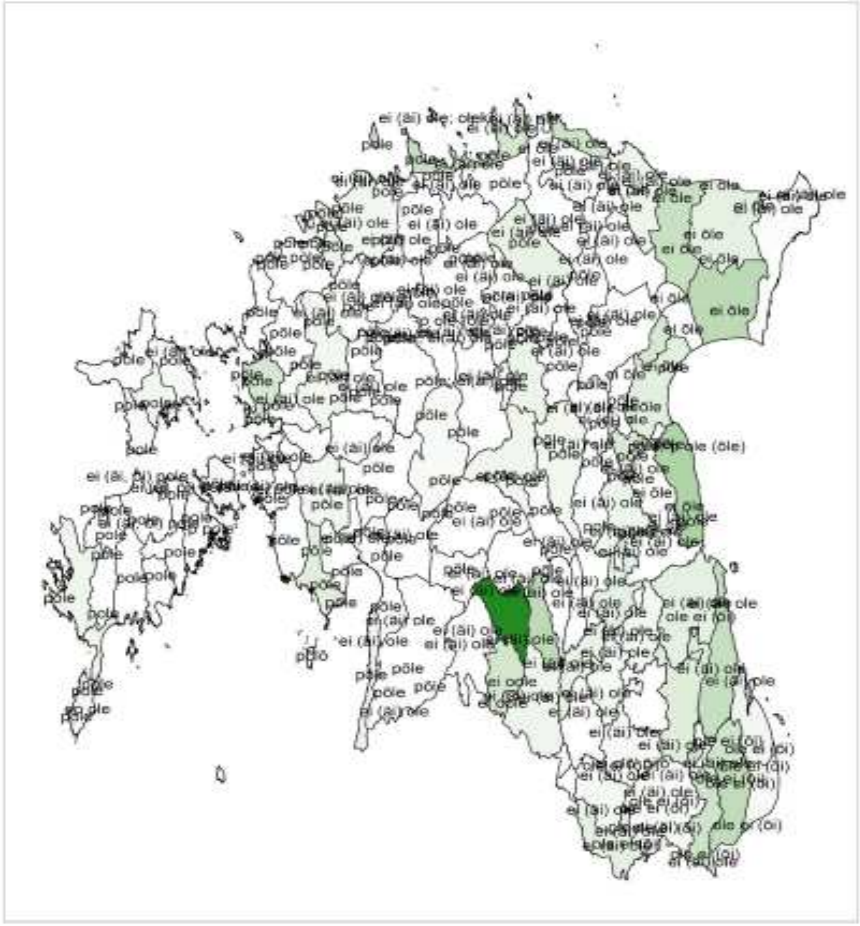
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ei (ai) ole
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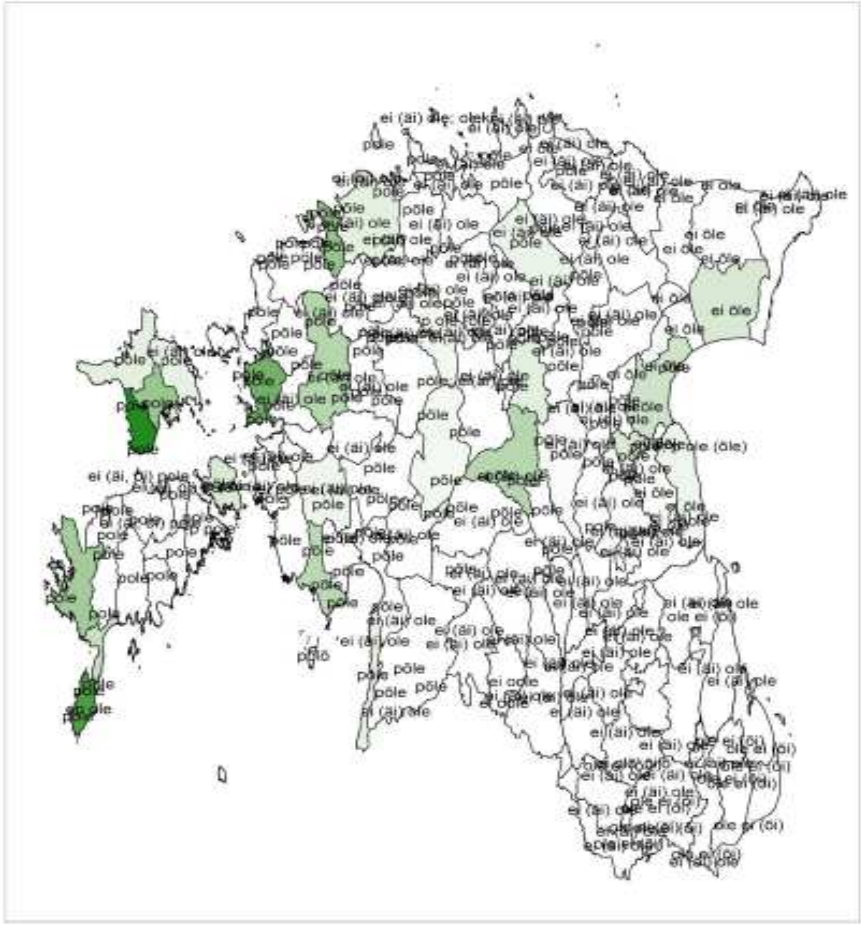
pôle
ei (ai) ole
ei ôle
ei (ai, ôi) ole
ei (ai) ole (ôle)

Shiny

- An RStudio package for creating interactive web applications
- Relatively simple syntax
- No web programming knowledge required
- Enable everything that is possible also in R, among other things, interactive mapping and statistical analysis of dialectal data
- Visualizing dialect data for the “lay person”
- Initial prototypes available at http://rurake.keeleressursid.ee/index.php/apps/

In conclusion

- Dialectal data analysis has always had an inherent spatial component
- Corpus data provides frequency information, linguistic atlases information on the spread of certain linguistic phenomena
- Combining the 2 data sources provides us with a more diverse understanding of dialectal variation
- R enables to perform a wide range of operations, starting from data extraction all the way to geographic visualization
- In addition to making dialect data more accessible, Shiny applications would also be a suitable platform for crowdsourcing