

Linguistic traits as heritable units? Spatial Bayesian clustering reveals Swiss German dialect regions

Supplementary materials

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This document provides supporting information for the main article *Linguistic traits as heritable units? Spatial Bayesian clustering reveals Swiss German dialect regions*.

In the main paper we used [TESS 2.3](#) to cluster Swiss German dialect data taken from the Syntactic Atlas of Swiss German (SADS). This document contains additional results for different setups.

- For all TESS results (15 runs), please visit: [TESS results](#)
- To explore the interactive maps choosing 6 populations, please visit: [Mapping Swiss German dialects](#)
- For full dataset (correlated features not removed), please visit: [Data including correlated features](#)

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Results with 6 populations

These results have been obtained with the Admixture model of TESS using the least correlated syntactic phenomena of the Syntactic Atlas of Swiss German (SADS). Choosing 6 populations ($K=6$), we obtain the following results.

Loading libraries

```
library(tmap)
library(sf)
library(pophelper)
library(dplyr)
library(RColorBrewer)
```

Reading data

Read combined results with CLUMPP and merge them

```
#Read clumpp results
K6 <- readQ("../.../Results/CLUMPP_output/pop_K6-combined-merged.txt")
```

```
#Merging results of 6 populations
merged_data <- mergeQ(K6)[[1]]
```

```
#Import coordinates
coord<-read.table("../.../coordinates_wgs84.txt",header = T)
```

```
#Spatialize results
k6_results<-cbind(coord,merged_data)
```

```
#Convert data to sf format
point_data<-st_as_sf(k6_results, coords = c("X_1", "Y_1"), crs = 4326)
```

```
#Read municipalities
municipalities <- st_read("../.../shapefiles/municipalities_voronoi.shp")
```

```
## Reading layer `municipalities_voronoi' from data source `~/home/noe/Desktop/Paper/Romano_PdM/shapefiles/municipalities_voronoi.shp'
## Simple feature collection with 356 features and 0 fields
## geometry type: MULTIPOLYGON
## dimension: XY
## bbox: xmin: 7.025109 ymin: 45.91675 xmax: 10.09691 ymax: 47.80846
## geographic CRS: WGS 84
```

```
#Create ID in municipalities
municipalities$id <- 1:nrow(municipalities)
```

Results

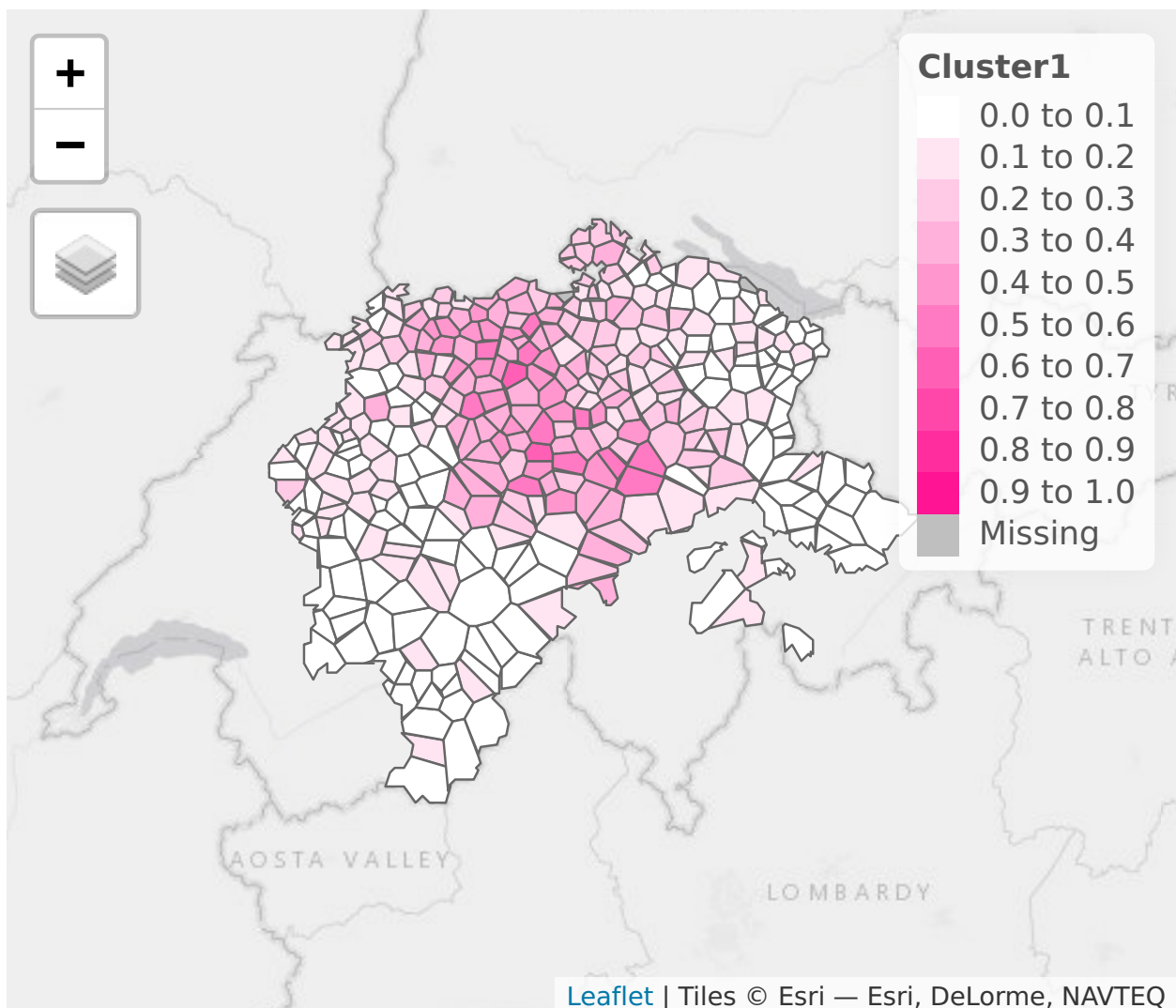
Population 1

```
#Defining my palet of colors
mypaletTESS<-c("#1F78B4", "#33A02C", "#E31A1C", "#FF7F00", "#6A3D9A", 'deeppink1')
palette <-colorRampPalette(c("white", mypaletTESS[6]))

#Defining breaks
breaks <- c(0, 0.1, 0.2,0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1)

population_1_aggregated = municipalities %>%
  st_join(point_data[,c('Cluster1', 'geometry')]) %>%
  group_by(id) %>%
  summarize(Cluster1 = mean(Cluster1, na.rm = TRUE))

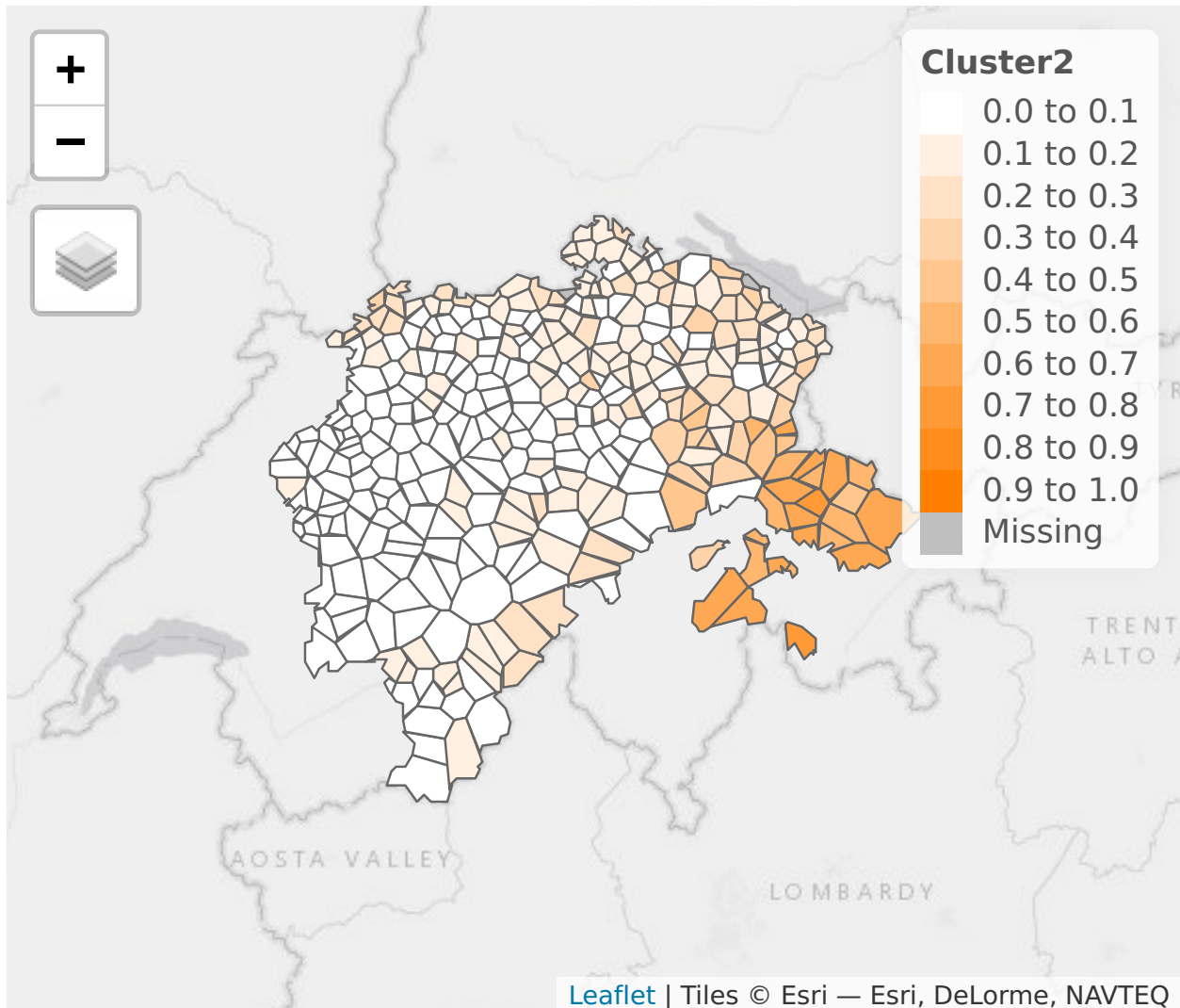
tmap_mode("view")
tm_shape(population_1_aggregated) +
tm_polygons("Cluster1", palette = palette(15), breaks = breaks)
```



Population 2

```
palette <-colorRampPalette(c("white", mypaletTESS[4]))
population_2_aggregated = municipalities %>%
  st_join(point_data[,c('Cluster2', 'geometry')]) %>%
  group_by(id) %>%
  summarize(Cluster2 = mean(Cluster2, na.rm = TRUE))

tmap_mode("view")
tm_shape(population_2_aggregated) +
tm_polygons("Cluster2", palette = palette(15), breaks = breaks)
```

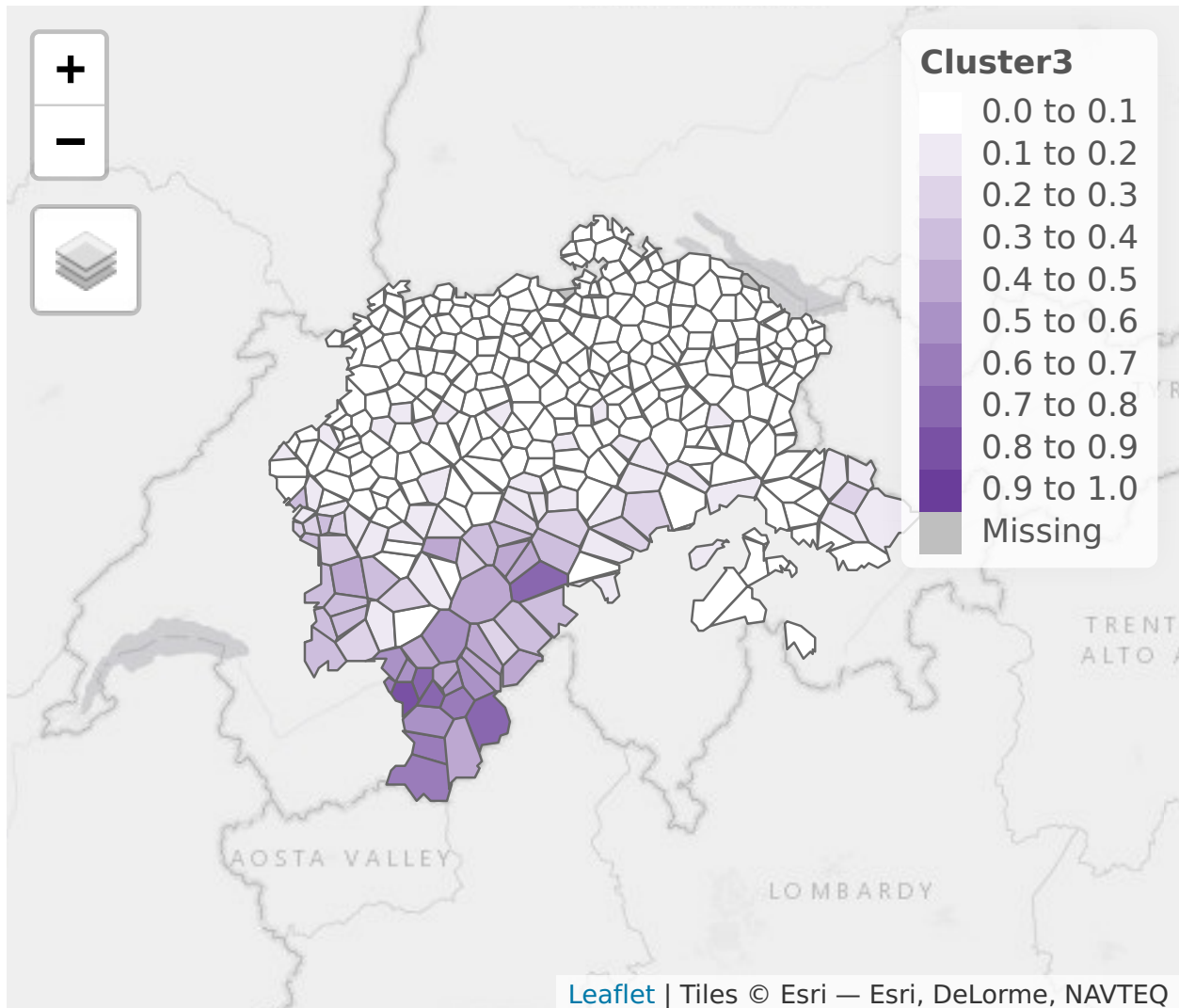


Population 3

```
palette <-colorRampPalette(c("white", mypaletTESS[5]))

population_3_aggregated = municipalities %>%
  st_join(point_data[,c('Cluster3', 'geometry')]) %>%
  group_by(id) %>%
  summarize(Cluster3 = mean(Cluster3, na.rm = TRUE))

tmap_mode("view")
tm_shape(population_3_aggregated) +
tm_polygons("Cluster3", palette = palette(15), breaks = breaks)
```

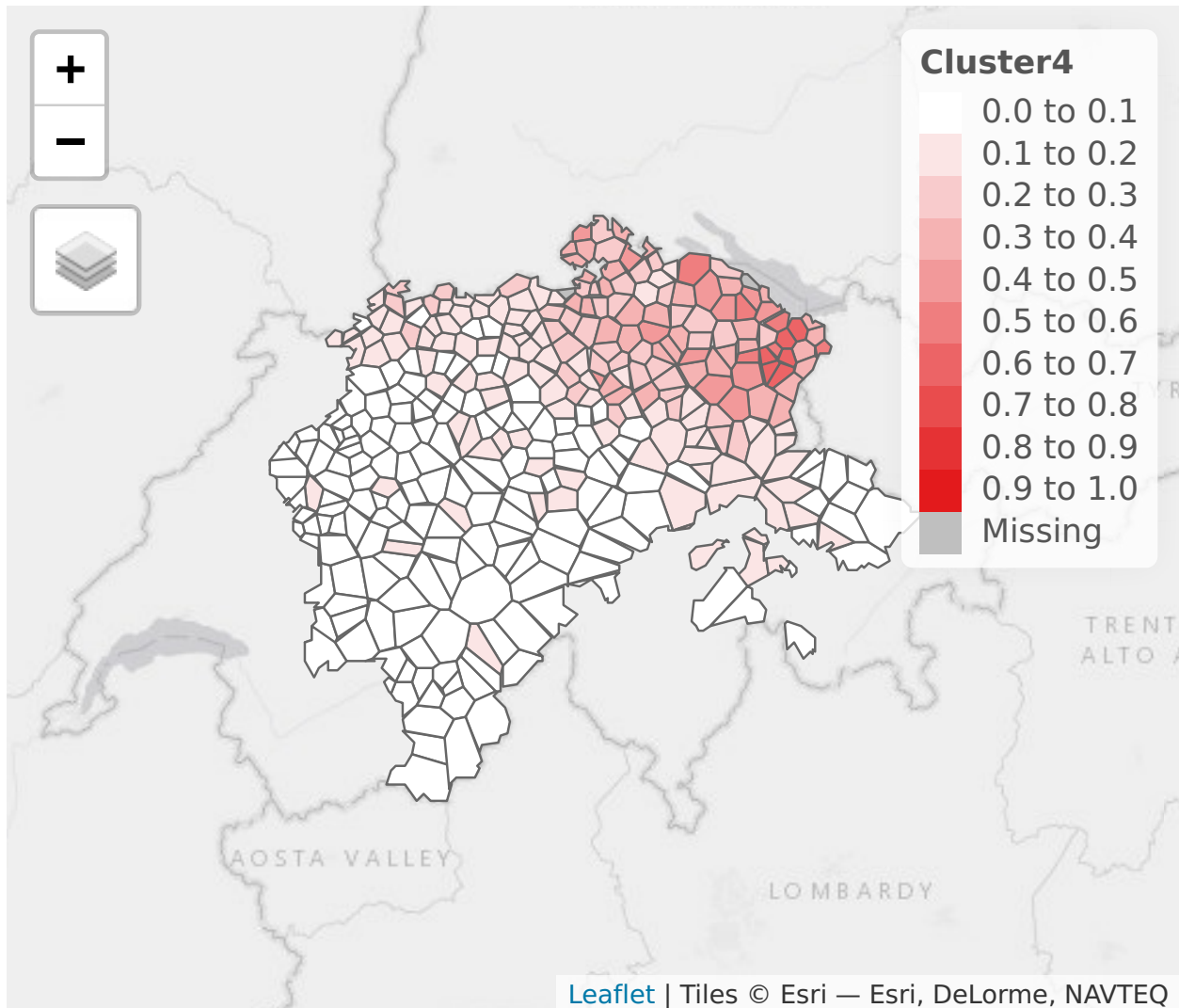


Population 4

```
palette <-colorRampPalette(c("white", mypaletTESS[3]))

population_4_aggregated = municipalities %>%
  st_join(point_data[,c('Cluster4', 'geometry')]) %>%
  group_by(id) %>%
  summarize(Cluster4 = mean(Cluster4, na.rm = TRUE))

tmap_mode("view")
tm_shape(population_4_aggregated) +
tm_polygons("Cluster4", palette = palette(15), breaks = breaks)
```

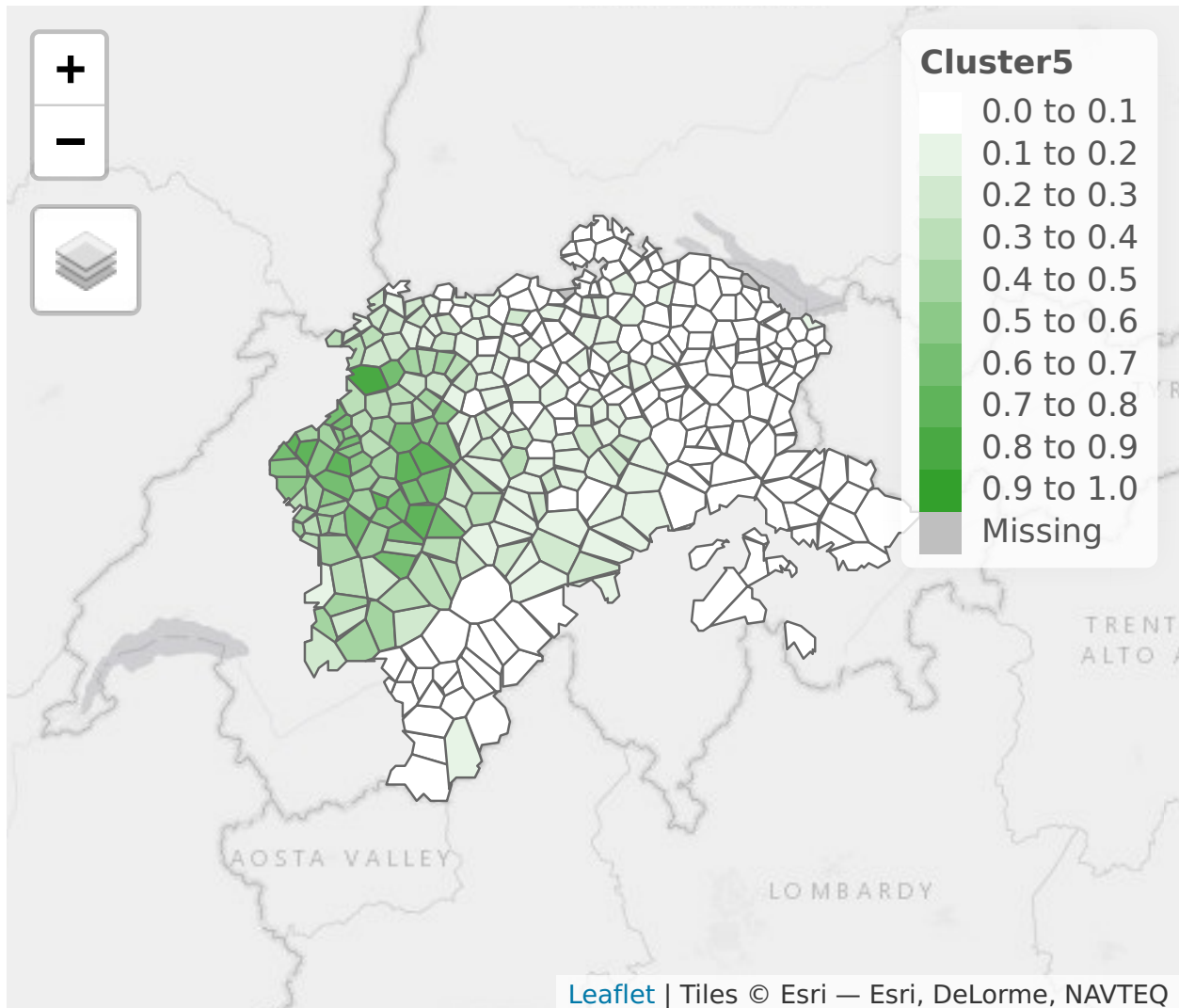


Population 5

```
palette <-colorRampPalette(c("white", mypaletTESS[2]))

population_5_aggregated = municipalities %>%
  st_join(point_data[,c('Cluster5', 'geometry')]) %>%
  group_by(id) %>%
  summarize(Cluster5 = mean(Cluster5, na.rm = TRUE))

tmap_mode("view")
tm_shape(population_5_aggregated) +
tm_polygons("Cluster5", palette = palette(15), breaks = breaks)
```

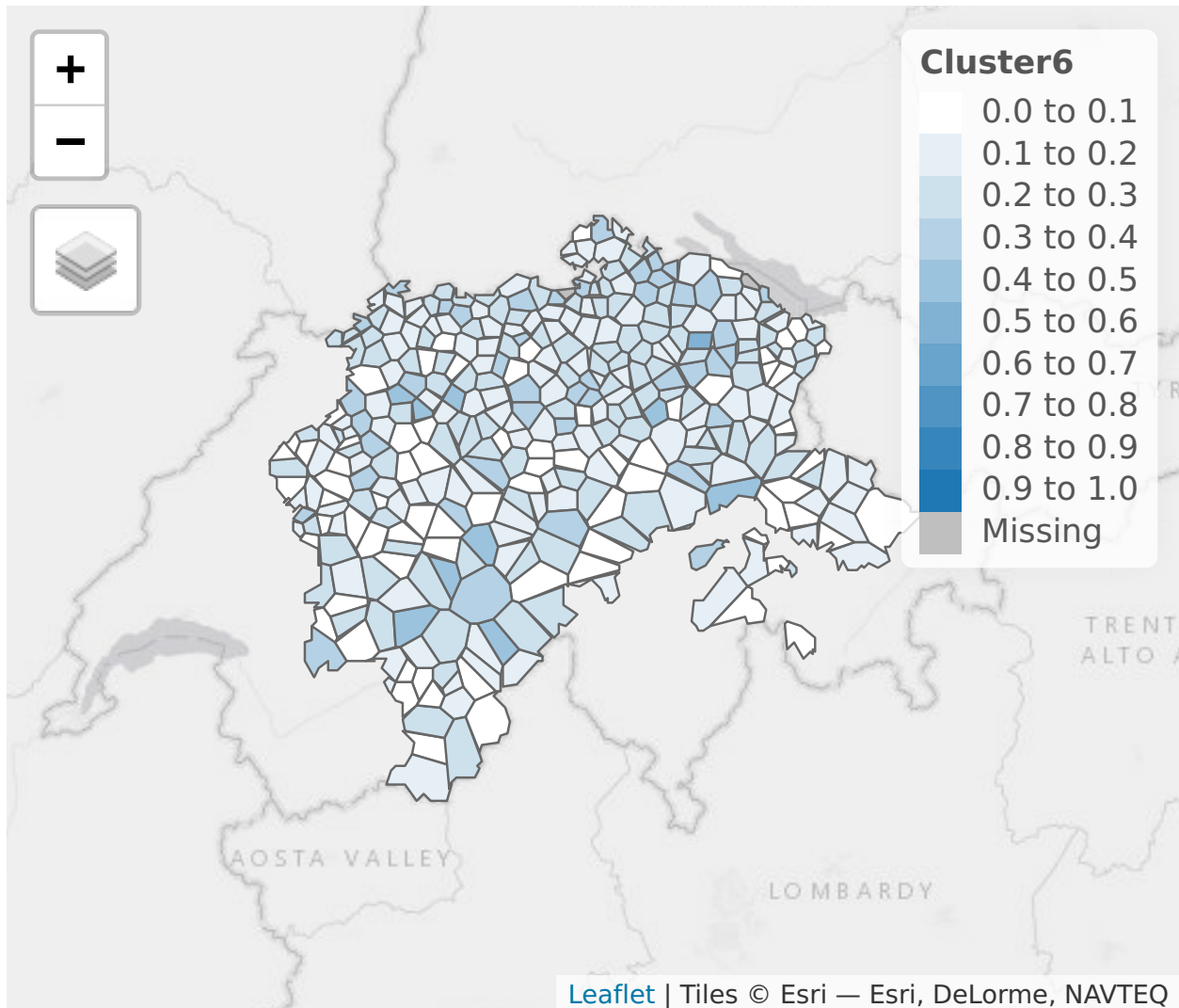


Population 6

```
palette <-colorRampPalette(c("white", mypaletTESS[1]))

population_6_aggregated = municipalities %>%
  st_join(point_data[,c('Cluster6', 'geometry')]) %>%
  group_by(id) %>%
  summarize(Cluster6 = mean(Cluster6, na.rm = TRUE))

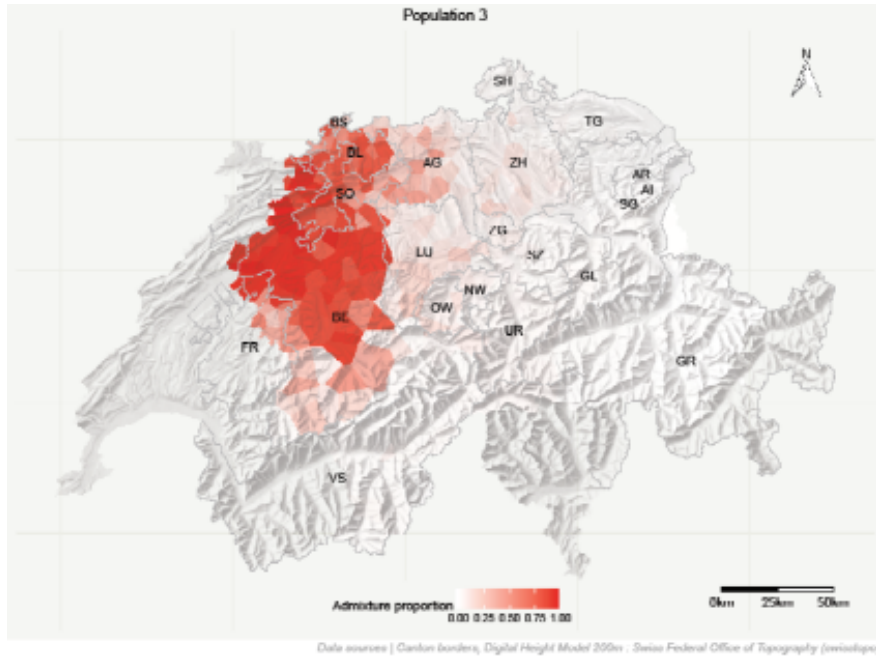
tmap_mode("view")
tm_shape(population_6_aggregated) +
tm_polygons("Cluster6", palette = palette(15), breaks = breaks)
```



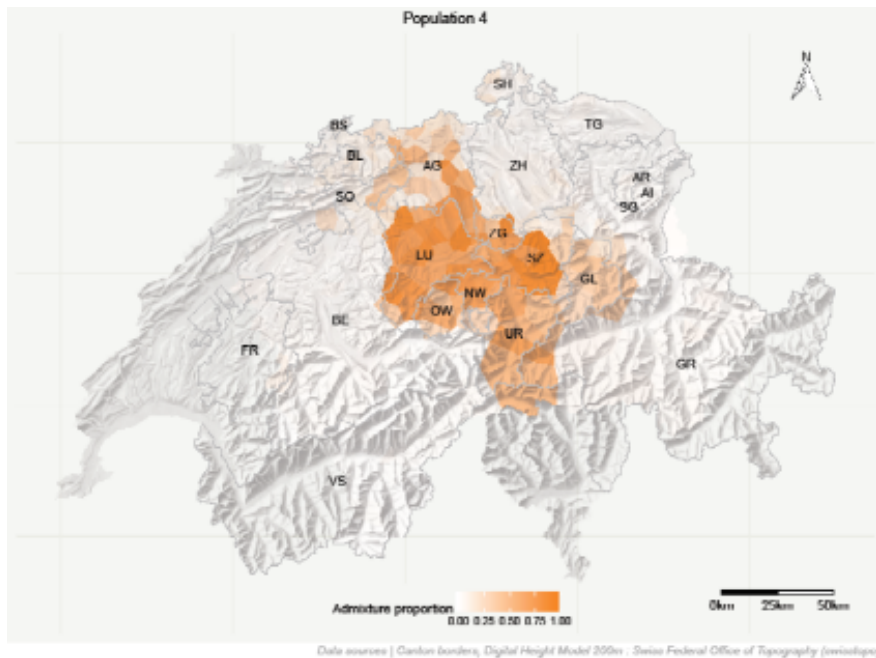
Results with full dataset

These results have been obtained with the Admixture model of TESS using the full dataset (correlated features not removed) of the Syntactic Atlas of Swiss German (SADS).

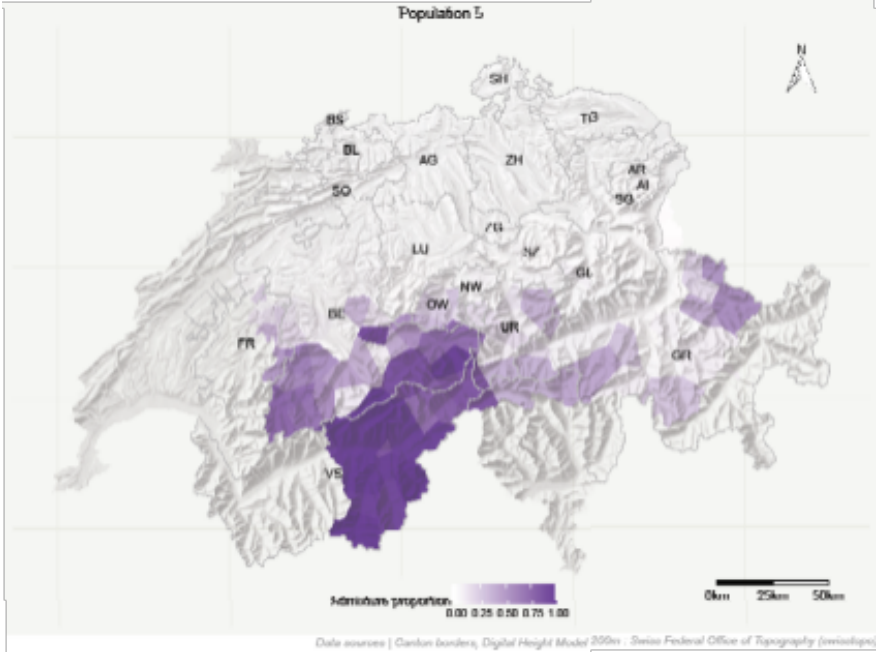
Bern population



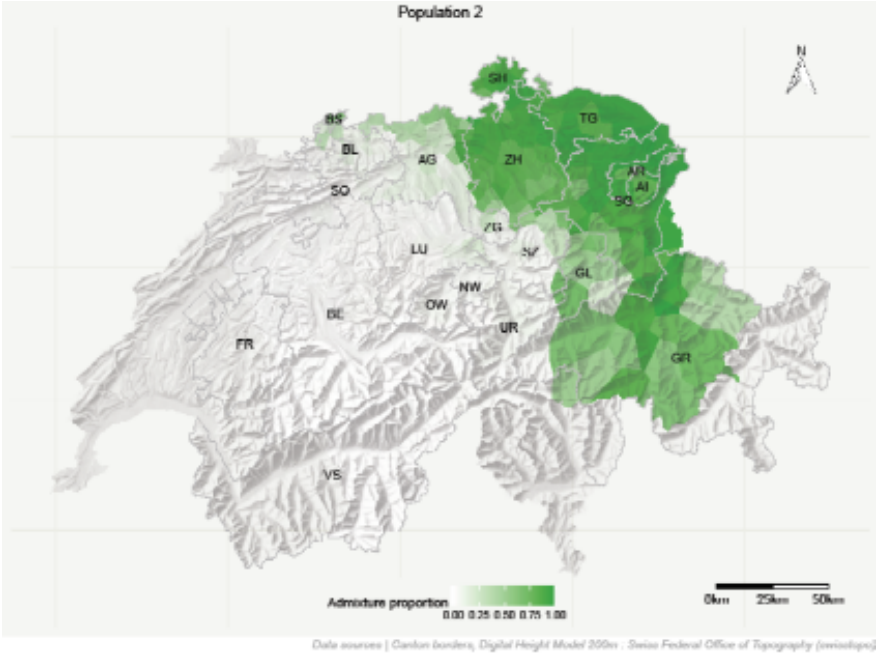
Central population



Walser population



Eastern population



Ground population

