Acoustic properties and regional variation of Saterland Frisian vowels

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Introduction

Germany

District of Cloppenburg

Introduction

- Saterland Frisian is spoken in the municipality of Saterland (Strücklingen, Ramsloh and Scharrel) by 1500 to 2000 people.
- Speakers are trilingual: they speak Saterland Frisian, Low German and High German.
- Saterland Frisian is the last East Frisian language still spoken today.
- Is one of the smallest minority languages in Europe.

Introduction

- Saterland Frisian vowel systems have been studied by: Fort (1971, 1980, 2001), Kramer (1982, 1991), Bussmann (2004), Tröster-Mutz (1997, 2002)
- Saterland Frisian has both long and short closed tense vowels.
- Large number of diphthongs.

Vowel system

Monophthongs according to Fort(1980):

	front		central	back
close	i	y		u
	iː	yː		uː
close-mid	ɪ	ʏ		ʊ
	eː	øː		oː
open-mid	ɛ	œ		ɔ
	ɛː	œː	(ə)	ɔː
open			a, aː	

Vowel system

Diphthongs according to Fort(1980, 2001):

a͡ːi	y͡ːi	ɛ͡ːu(w)	i͡ːu(w)
o͡ːi	œ͡ːi	ɛ͡u(w)	i͡u(w)
ɔ͡ːi	ɛ͡ːi	e͡ːu(w)	ɪ͡u(w)
ɔ͡y	u͡ːi	a͡ːu	o͡ːu

Research questions

1. Are all 36 Saterland Frisian vowels still distinguished? Do we find mergers?
2. Which (supplementory) acoustic variables (F1, F2, duration, vowel inherent spectral change (VISC)) distinguish the vowels within the rich inventory?
3. Do Saterland Frisian vowels exhibit regional variation?

Subjects

- Male speakers between 50 and 75 years old
- All born and raised in Saterland; lived there the larger part of their life.
- 13 Speakers from Ramsloh, 11 speakers from Scharrel, 11 speakers from Strücklingen.

Method

- Goal: to obtain all vowels in /hVt/ context.
- /hVt/ syllables were cued by reading aloud real rhyming monosyllabic Saterland Frisian words immediately preceding the production of the /hVt/ syllable.
- Each such sequence was presented twice, thus two /hVt/ samples were obtained per speaker and per vowel.
- Sequences were presented in random order.

Sweet?

‘Schweiß’

Sweet?

H_t.

Strait? ‘(er) streut’

Strait?

H_t.

Data analysis

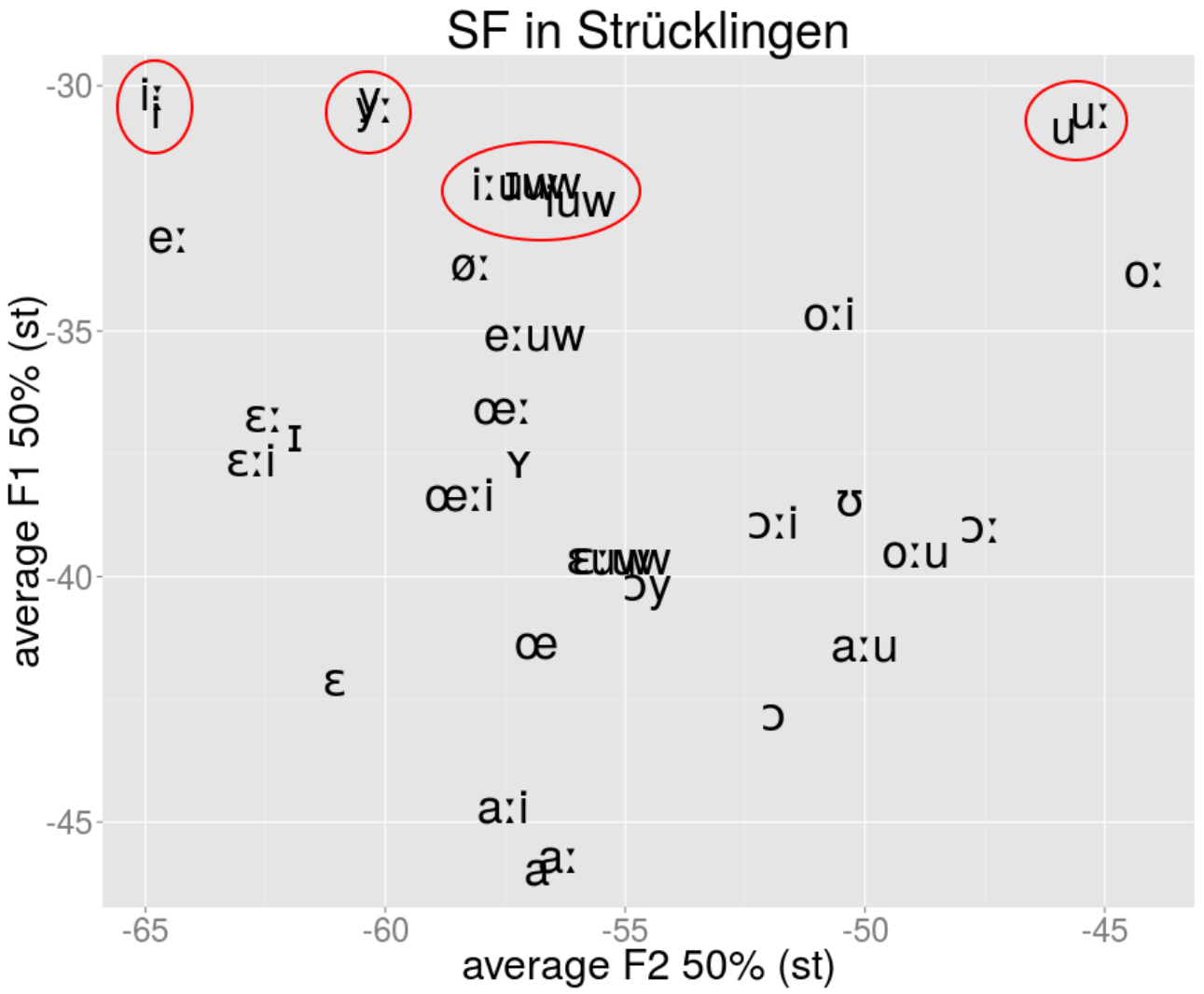
- For each /hVt/ we measured:
  - Vowel duration (milliseconds)
  - F1 and F2 at 20%, 50% and 80% (semitones)
  - VISC :

$$\sqrt{(F1_{50} - F1_{20})^2 + (F2_{50} - F2_{20})^2} + \sqrt{(F1_{80} - F1_{50})^2 + (F2_{80} - F2_{50})^2}$$

(cf. Fox & Jacewicz 2009 and Jin & Liu 2013)

First research question

- Are all 36 Saterland Frisian vowels still distinguished? Do we find mergers?
- For each Saterland Frisian location the 36 vowels were compared to each other.
- 36 vowels were pronounced twice by 11–13 speakers.
- We used mixed models with *vowel* as a fixed factor and random intercepts for *speaker*.
- The dependent variable is duration or a spectral feature.
- Two vowels were considered mergers, when no significant differences were found for duration, F1 and F2 (20%, 50%, 80%) and VISC.


SF in Strücklingen
average F1 50% (st)
-30
-35
-40
-45
-65
-60
-55
-50
-45
average F2 50% (st)
i:
y:
u:
i:uw
e:
ø:
o:
o:i
e:uw
œ:
ɛ:
ɪ
ɛ:i
ʏ
œ:i
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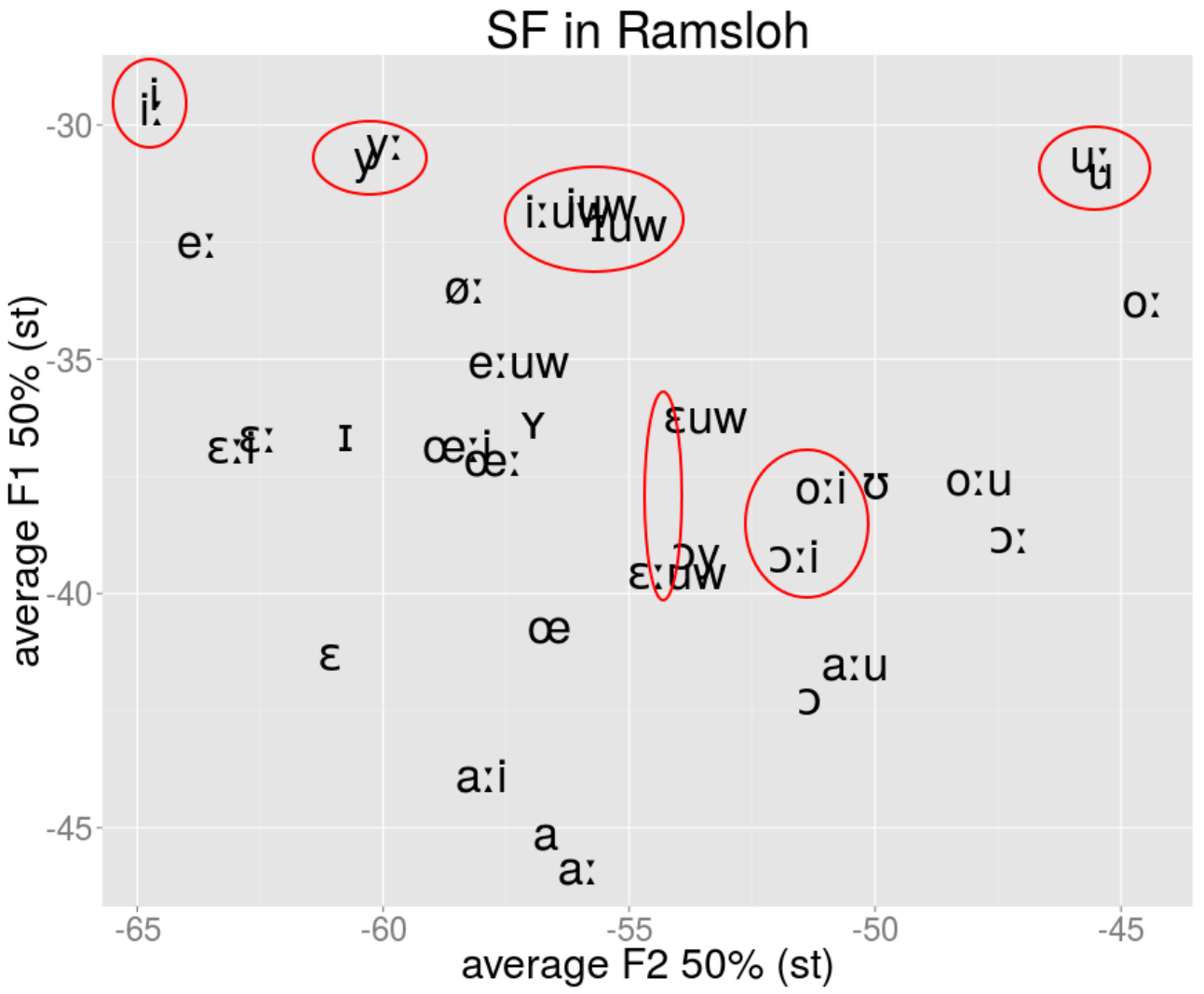
SF in Ramsloh
average F1 50% (st)
-30
-35
-40
-45
-65
-60
-55
-50
-45
average F2 50% (st)
iː
yː
uː
eː
iːuw
øː
oː
eːuw
ɛːɪ
ɪ
œːi
ʏ
œː
ɛuw
oːi
ʊ
oːu
ɔː
ɔːi
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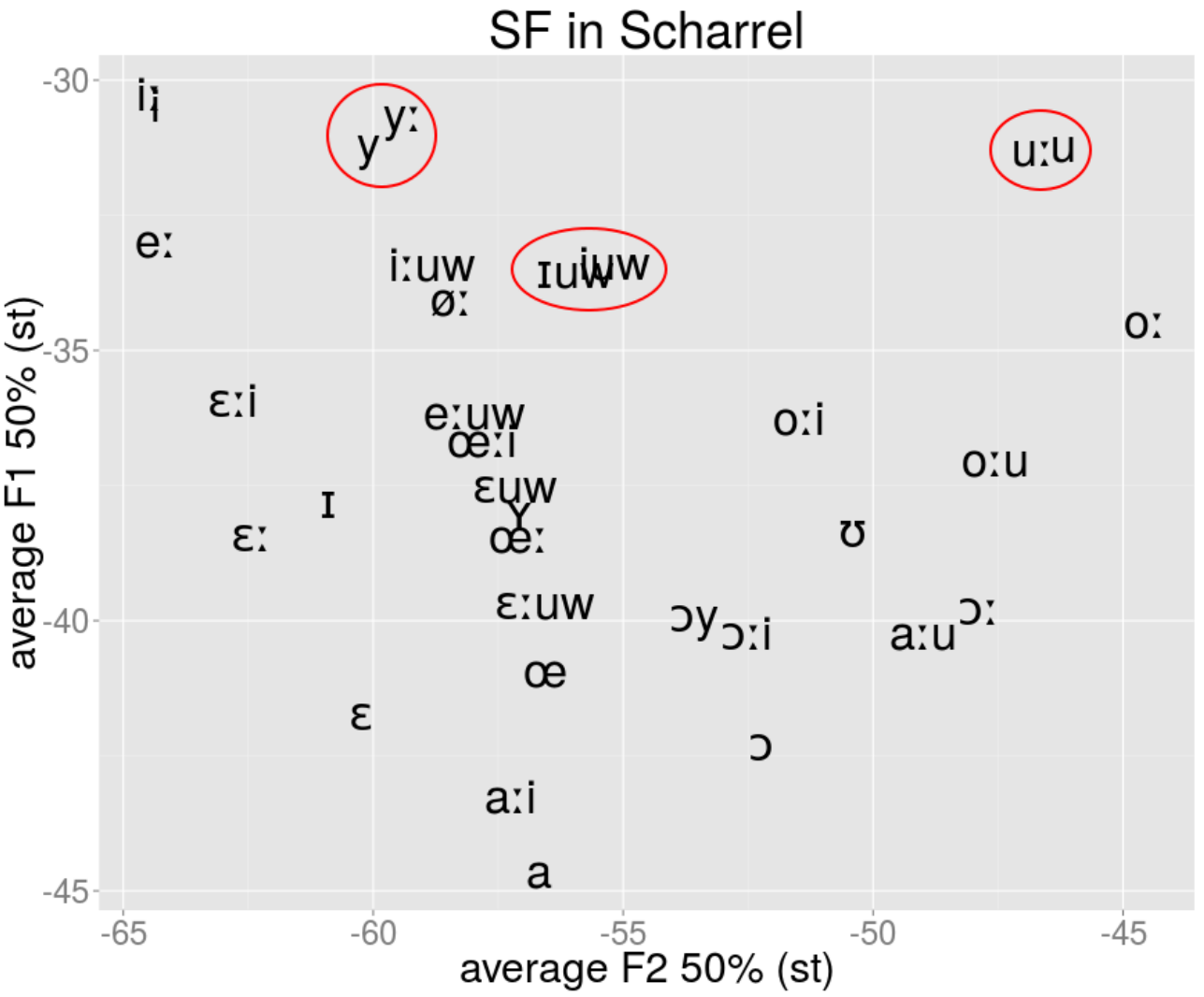
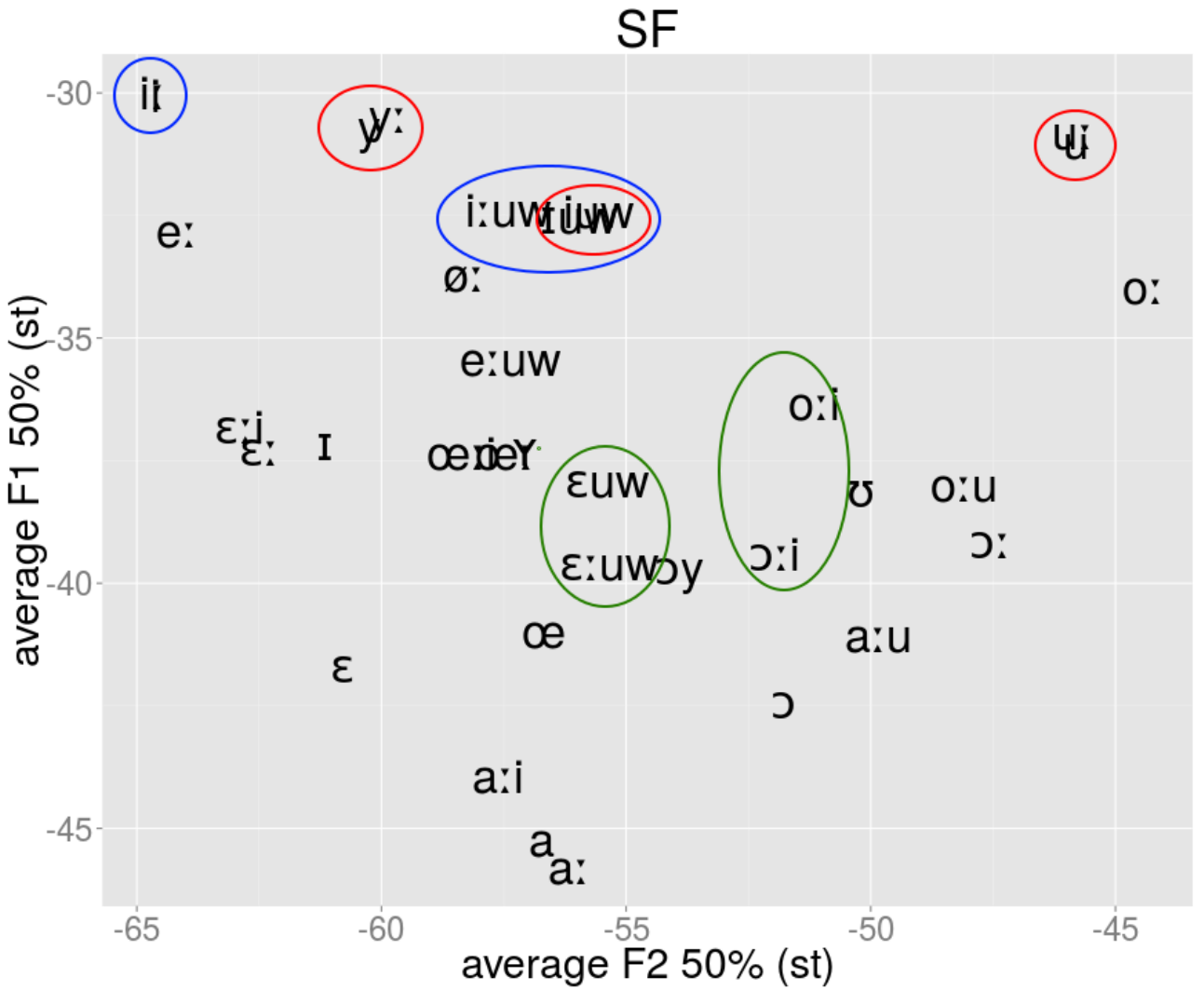
a
aː


SF in Scharrel
average F1 50% (st)
-30
-35
-40
-45
-65
-60
-55
-50
-45
average F2 50% (st)
iː
yː
y
uːu
eː
iːuw
ɪuw
øː
oː
ɛːi
eːuw
œːɪ
oːi
oːu
ɛuw
ɪ
ʏ
ɛː
œː
ʊ
ɛːuw
ɔy
ɔːi
aːu
ɔː
œ
ɛ
ɔ
aːi
a



Red: all; blue: not in Scharrel; green: only in Ramsloh

Number of vowels

	vowels not used	vowels merged	
Fort			36
Ramsloh	-2	-7	= 27
Scharrel	-3	-3	= 30
Strücklingen	-2	-5	= 29

Second research question

- Which (supplementory) acoustic variables (F1, F2, duration, VISC) distinguish the vowels within the rich inventory?
- Linear discriminant analysis was used to obtain the percentage of correctly predicted vowels per location

Monophthongs

	Ramsl.	Scharr.	Strückl.
Dur	19.4	20.2	17.8
$F1_{50} + F2_{50}$	73.7	76.8	81.1
Dur + $F1_{50} + F2_{50}$	85.0	87.7	91.4
$F1_{20} + F2_{20} + F1_{80} + F2_{80}$	75.0	79.4	81.5
Dur + $F1_{20} + F2_{20} + F1_{80} + F2_{80}$	85.2	88.4	91.9
$F1_{50} + F2_{50} + F1_{20} + F2_{20} + F1_{80} + F2_{80}$	80.5	81.9	83.1
Dur + $F1_{50} + F2_{50} + F1_{20} + F2_{20} + F1_{80} + F2_{80}$	89.3	90.0	92.7
Dur + $F1_{50} + F2_{50} + F1_{20} + F2_{20} + F1_{80} + F2_{80}$ + VISC	90.0	91.2	92.5

Diphthongs

	Ramsl.	Scharr.	Strückl.
Dur	23.2	21.2	29.7
$F1_{50} + F2_{50}$	66.5	63.3	66.5
Dur + $F1_{50} + F2_{50}$	69.4	67.1	70.9
$F1_{20} + F2_{20} + F1_{80} + F2_{80}$	84.5	78.4	81.0
Dur + $F1_{20} + F2_{20} + F1_{80} + F2_{80}$	86.8	77.0	82.9
$F1_{50} + F2_{50} + F1_{20} + F2_{20} + F1_{80} + F2_{80}$	85.2	80.6	81.6
Dur + $F1_{50} + F2_{50} + F1_{20} + F2_{20} + F1_{80} + F2_{80}$	88.4	80.6	85.1
Dur + $F1_{50} + F2_{50} + F1_{20} + F2_{20} + F1_{80} + F2_{80}$ + VISC	89.0	81.3	83.9

All vowels

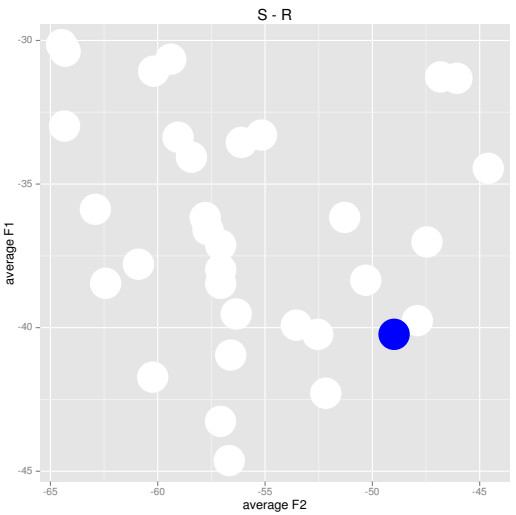
	Ramsl.	Scharr.	Strückl.
Dur	16.4	15.4	18.4
$F1_{50} + F2_{50}$	54.5	52.1	57.5
Dur + $F1_{50} + F2_{50}$	67.8	68.9	74.3
$F1_{20} + F2_{20} + F1_{80} + F2_{80}$	74.6	75.4	79.0
Dur + $F1_{20} + F2_{20} + F1_{80} + F2_{80}$	83.6	82.1	86.4
$F1_{50} + F2_{50} + F1_{20} + F2_{20} + F1_{80} + F2_{80}$	79.0	77.5	80.5
Dur + $F1_{50} + F2_{50} + F1_{20} + F2_{20} + F1_{80} + F2_{80}$	85.0	82.5	88.3
Dur + $F1_{50} + F2_{50} + F1_{20} + F2_{20} + F1_{80} + F2_{80}$ + VISC	86.1	83.2	87.5

Third research question

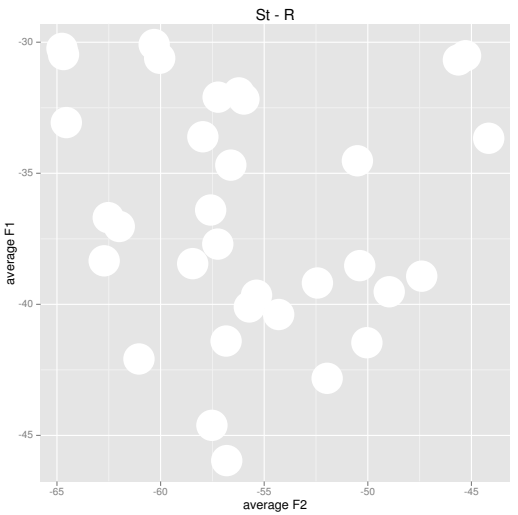
- Do Saterland Frisian vowels exhibit regional variation?
- Is there regional variation across the three villages in terms of
  - duration
  - location in F1-F2-plane
  - amount of VISC

Duration

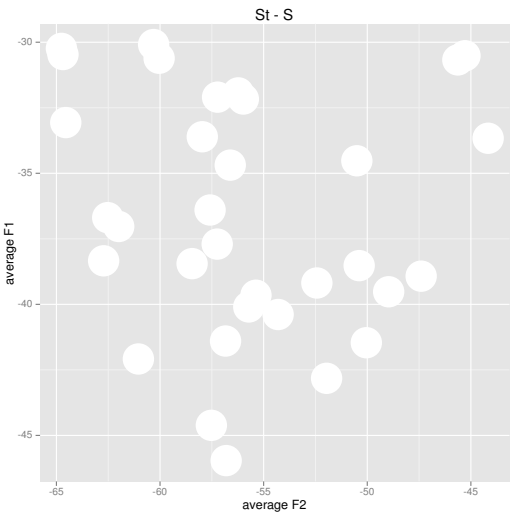
Scharrel
vs.
Ramsloh



Strücklingen
vs.
Ramsloh



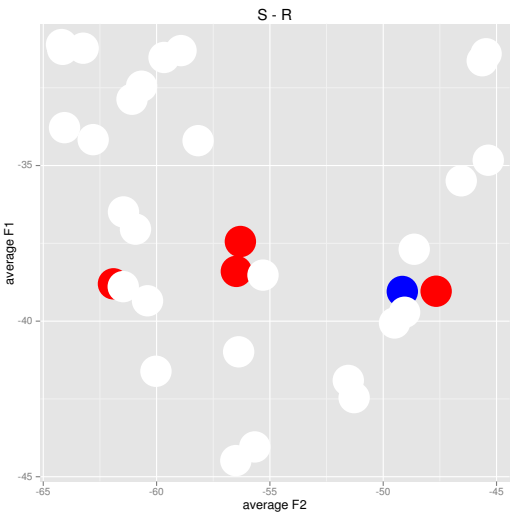
Strücklingen
vs.
Scharrel



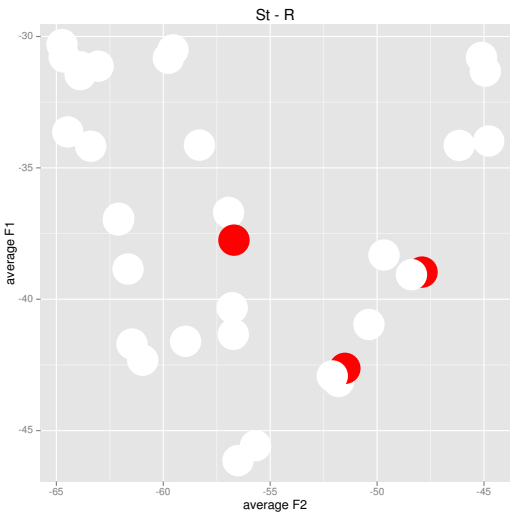
Red: first village $>$ second village at $\alpha = 0.05$ level.
Blue: first village $<$ second village at $\alpha = 0.05$ level.

F1 20%

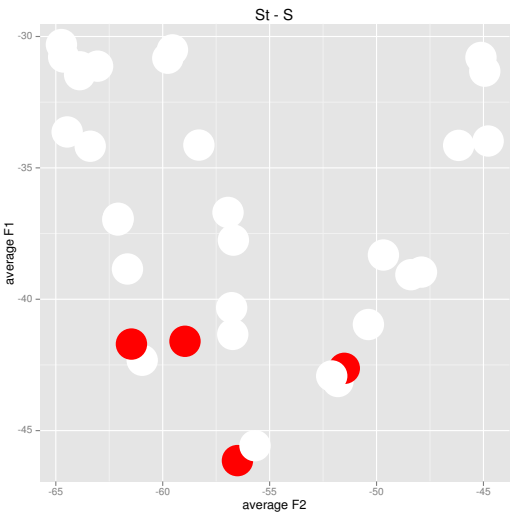
Scharrel
vs.
Ramsloh



Strücklingen
vs.
Ramsloh



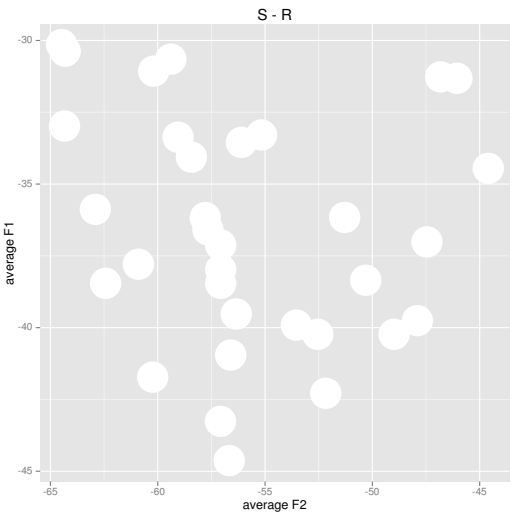
Strücklingen
vs.
Scharrel



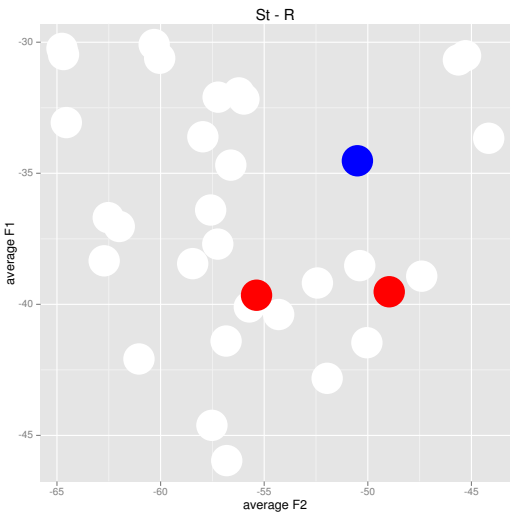
Red: first village $>$ second village at $\alpha = 0.05$ level.
Blue: first village $<$ second village at $\alpha = 0.05$ level.

F1 50%

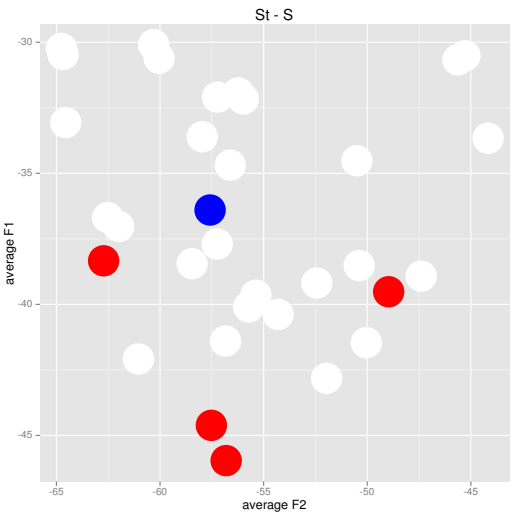
Scharrel
vs.
Ramsloh



Strücklingen
vs.
Ramsloh



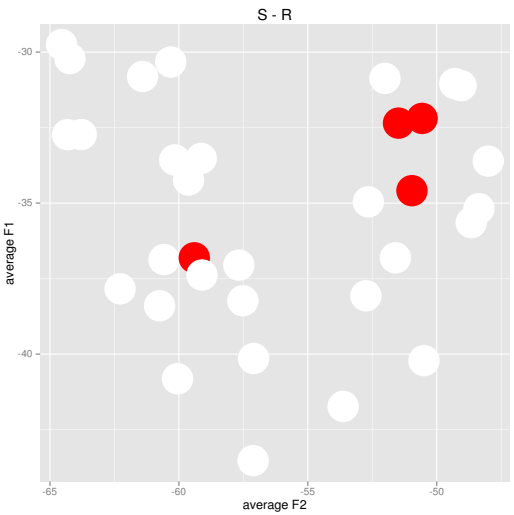
Strücklingen
vs.
Scharrel



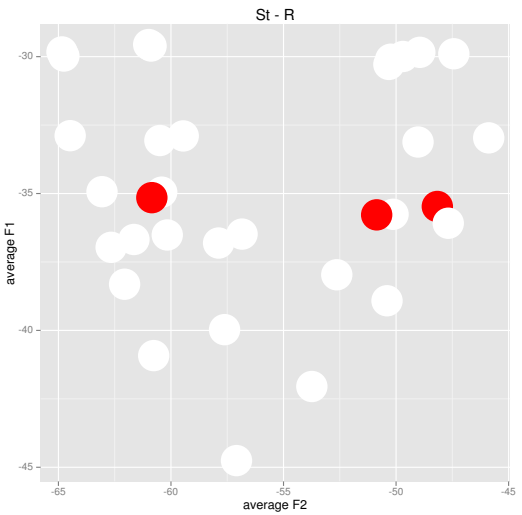
Red: first village $>$ second village at $\alpha = 0.05$ level.
Blue: first village $<$ second village at $\alpha = 0.05$ level.

F1 80%

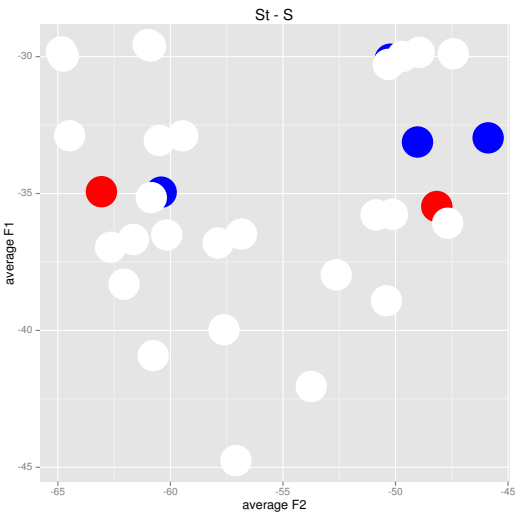
Scharrel
vs.
Ramsloh



Strücklingen
vs.
Ramsloh



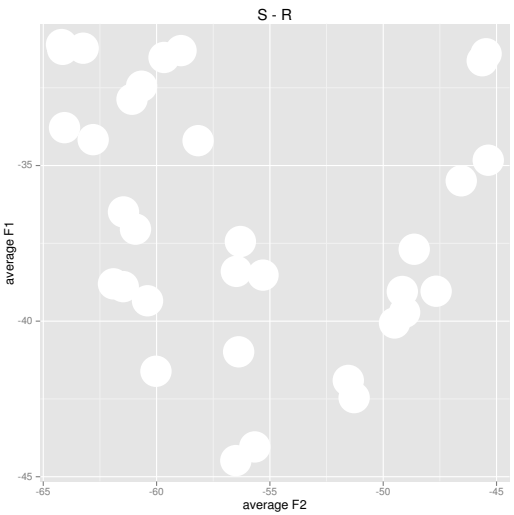
Strücklingen
vs.
Scharrel



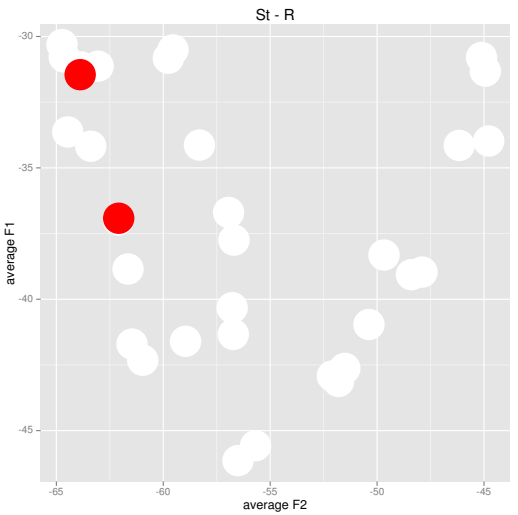
Red: first village $>$ second village at $\alpha = 0.05$ level.
Blue: first village $<$ second village at $\alpha = 0.05$ level.

F2 20%

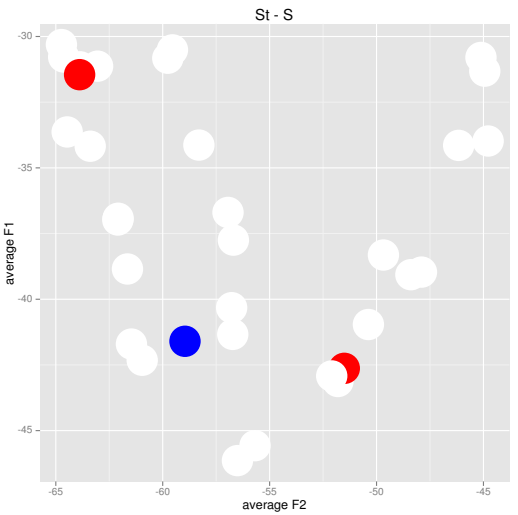
Scharrel
vs.
Ramsloh



Strücklingen
vs.
Ramsloh



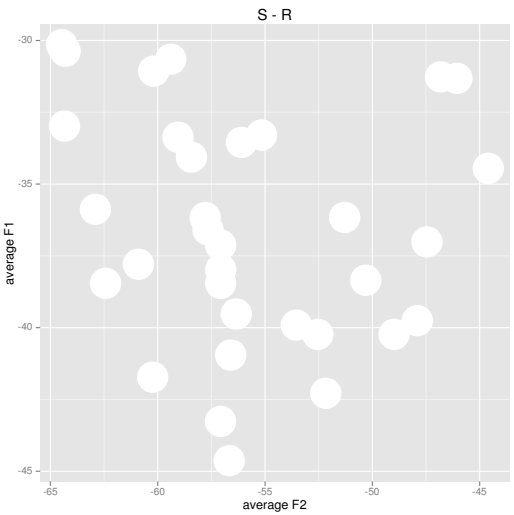
Strücklingen
vs.
Scharrel



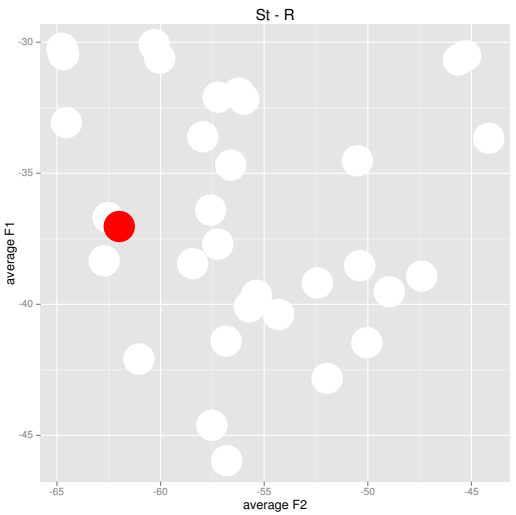
Red: first village $>$ second village at $\alpha = 0.05$ level.
Blue: first village $<$ second village at $\alpha = 0.05$ level.

F2 50%

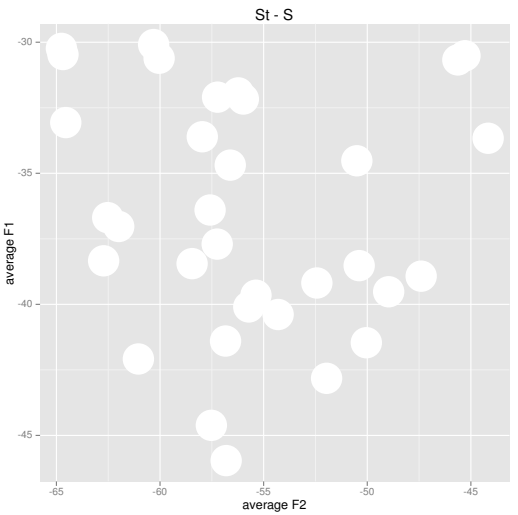
Scharrel
vs.
Ramsloh



Strücklingen
vs.
Ramsloh



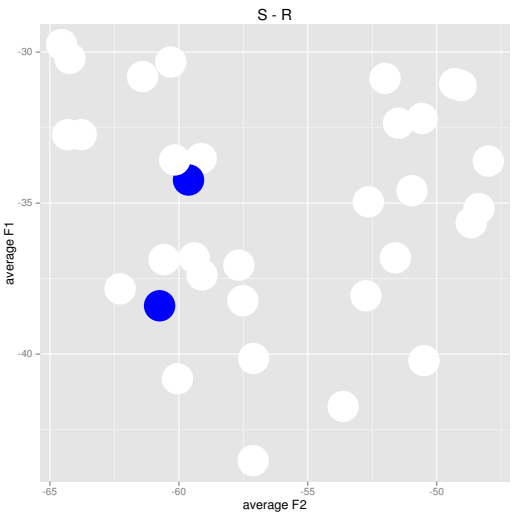
Strücklingen
vs.
Scharrel



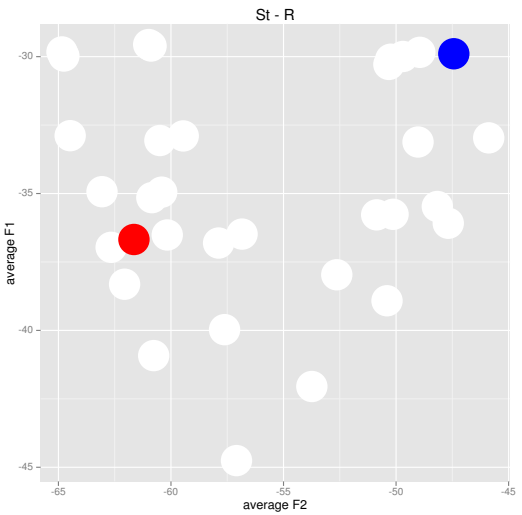
Red: first village $>$ second village at $\alpha = 0.05$ level.
Blue: first village $<$ second village at $\alpha = 0.05$ level.

F2 80%

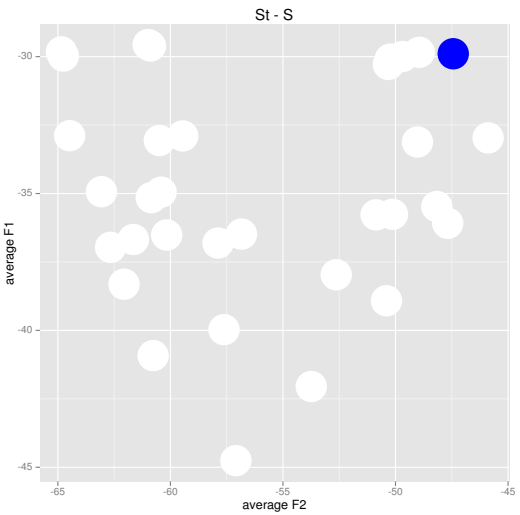
Scharrel
vs.
Ramsloh



Strücklingen
vs.
Ramsloh



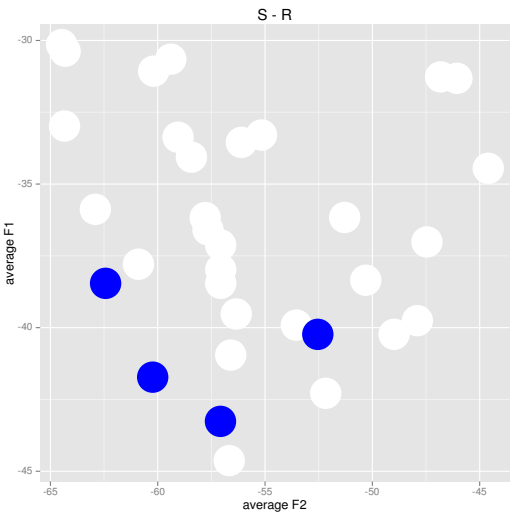
Strücklingen
vs.
Scharrel



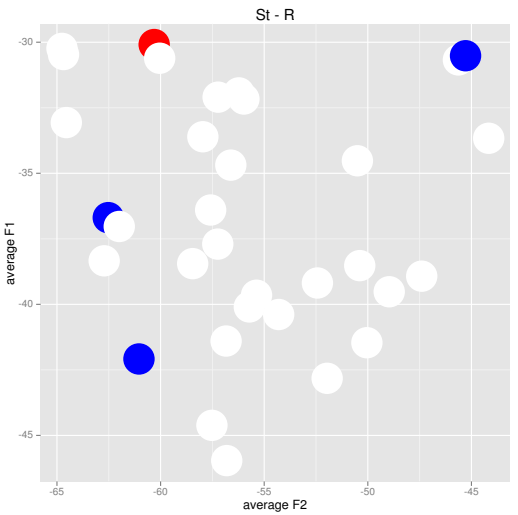
Red: first village $>$ second village at $\alpha = 0.05$ level.
Blue: first village $<$ second village at $\alpha = 0.05$ level.

VISC

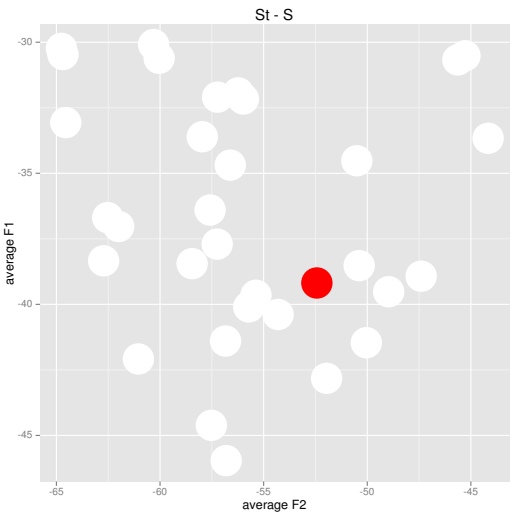
Scharrel
vs.
Ramsloh



Strücklingen
vs.
Ramsloh



Strücklingen
vs.
Scharrel



Red: first village $>$ second village at $\alpha = 0.05$ level.
Blue: first village $<$ second village at $\alpha = 0.05$ level.

Conclusions

- High short tense vowels have merged with high long tense vowels, except for the short tense [i] in Scharrel which is still distinguished from long tense [iː].
- Vowel variation is better predicted by spectral features than by duration; VISC is not a good predictor.
- In general the three varieties are not significantly distinguished by duration, F1, F2 or VISC.

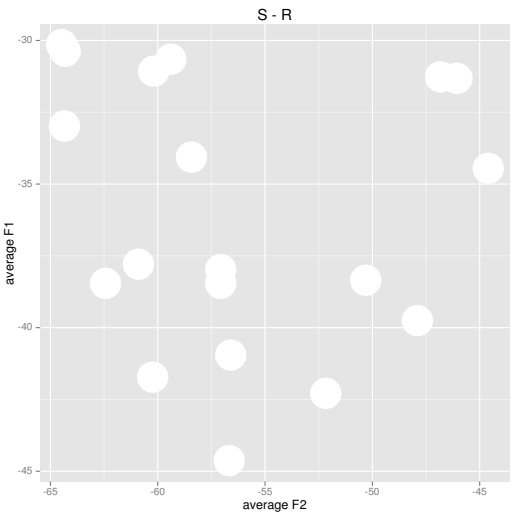
Conclusions

- There are significant differences between individual vowels.
- Differences in F1 (20%) are found in the open(-mid) vowels, differences in F1 (80%) are found in the close(-mid-) vowels.

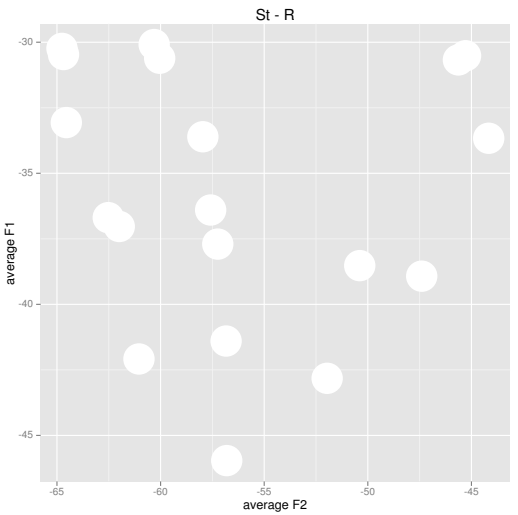
Extra slides

Duration mono

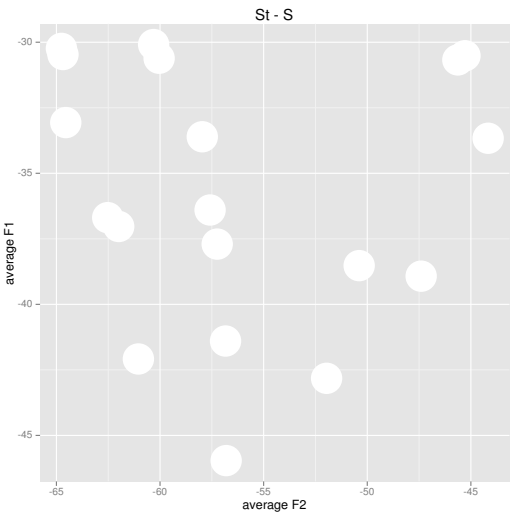
Scharrel
vs.
Ramsloh



Strücklingen
vs.
Ramsloh



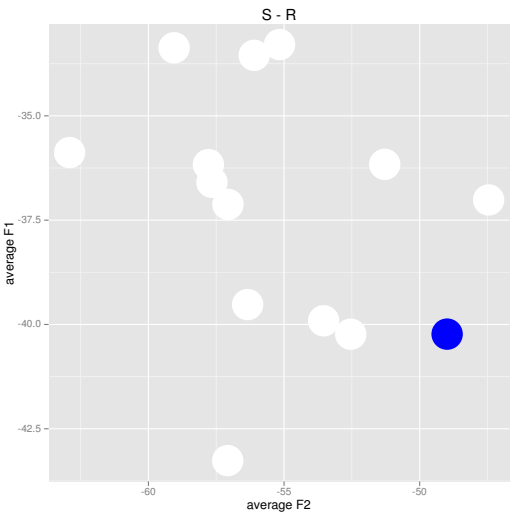
Strücklingen
vs.
Scharrel



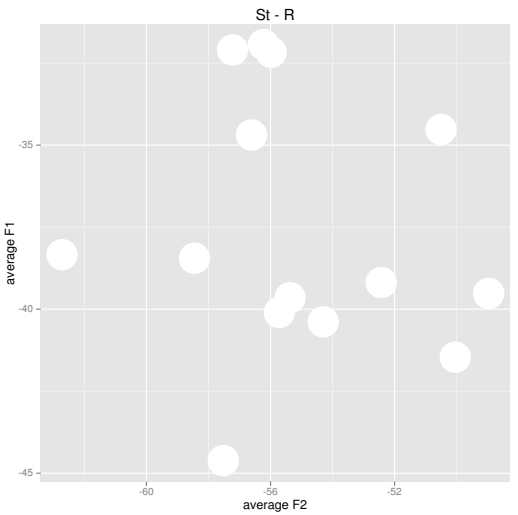
Red: first village $>$ second village at $\alpha = 0.05$ level.
Blue: first village $<$ second village at $\alpha = 0.05$ level.

Duration diph

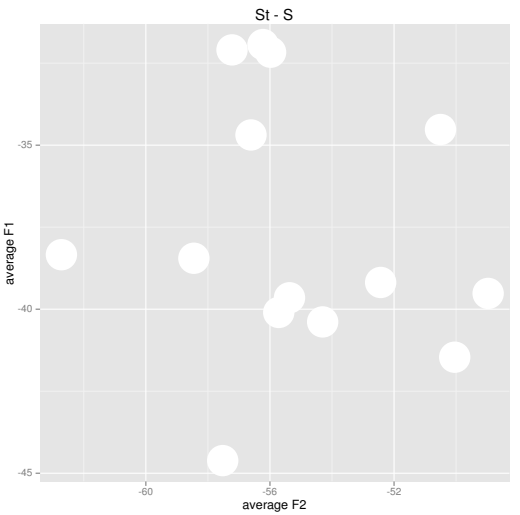
Scharrel
vs.
Ramsloh



Strücklingen
vs.
Ramsloh



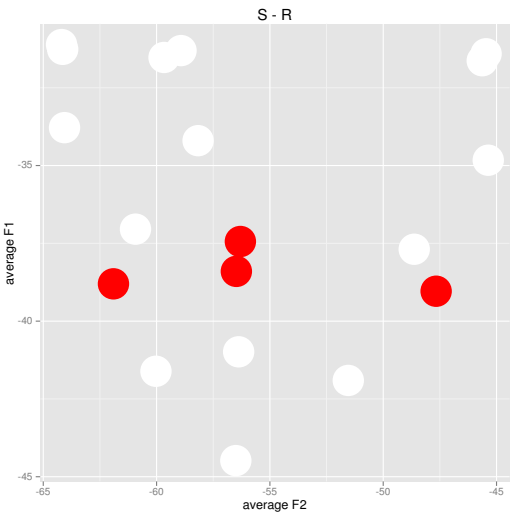
Strücklingen
vs.
Scharrel



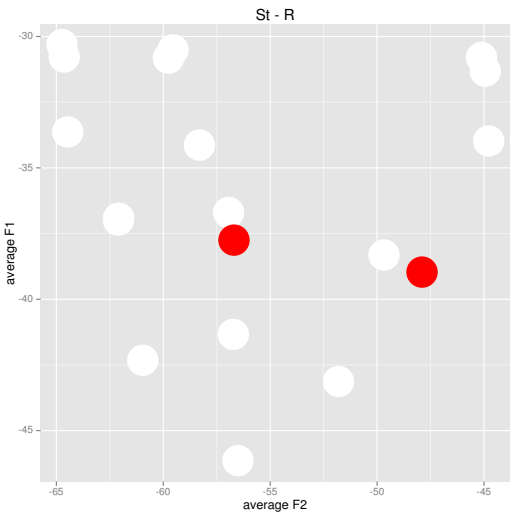
Red: first village $>$ second village at $\alpha = 0.05$ level.
Blue: first village $<$ second village at $\alpha = 0.05$ level.

F1 20% mono

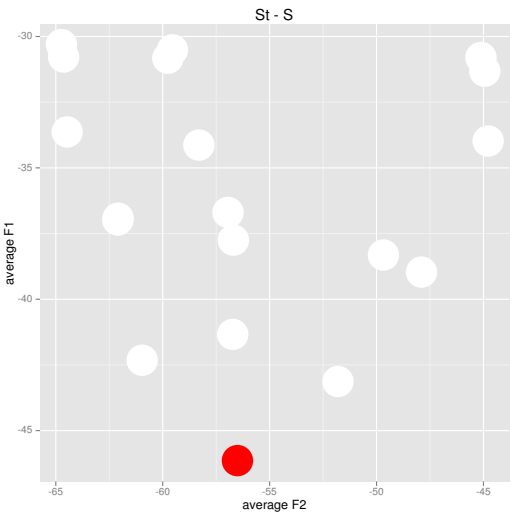
Scharrel
vs.
Ramsloh



Strücklingen
vs.
Ramsloh



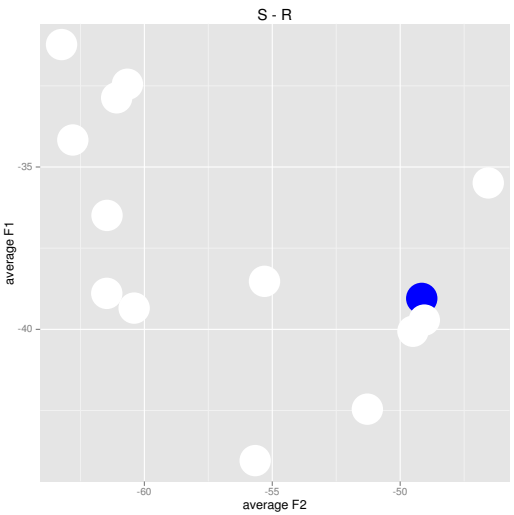
Strücklingen
vs.
Scharrel



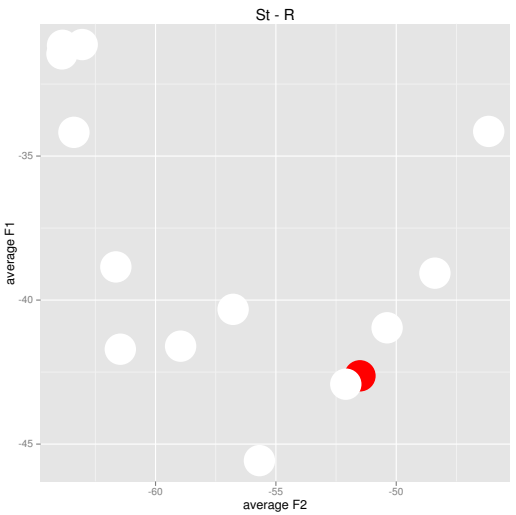
Red: first village $>$ second village at $\alpha = 0.05$ level.
Blue: first village $<$ second village at $\alpha = 0.05$ level.

F1 20% diph

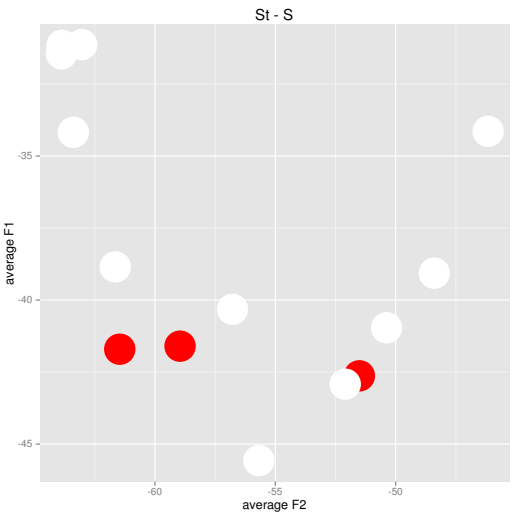
Scharrel
vs.
Ramsloh



Strücklingen
vs.
Ramsloh



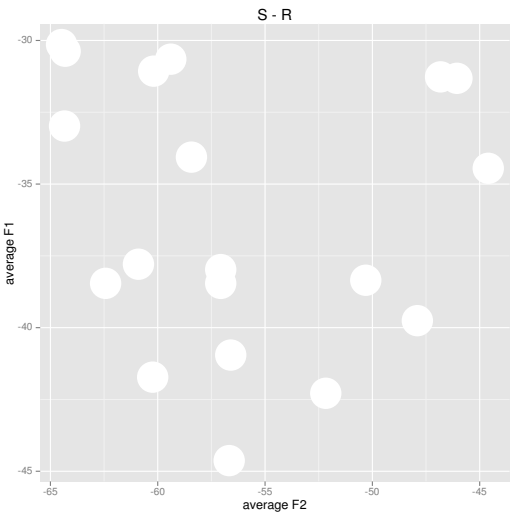
Strücklingen
vs.
Scharrel



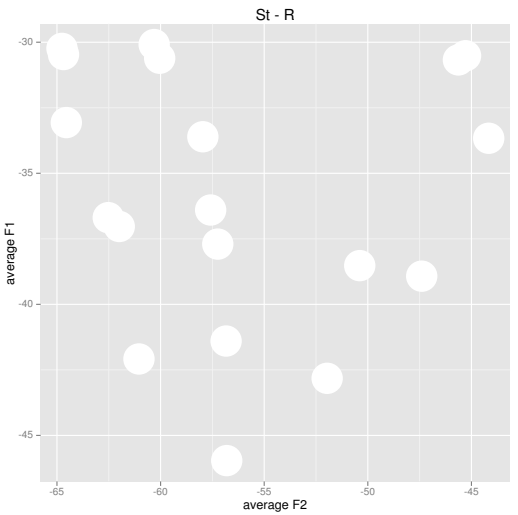
Red: first village $>$ second village at $\alpha = 0.05$ level.
Blue: first village $<$ second village at $\alpha = 0.05$ level.

F1 50% mono

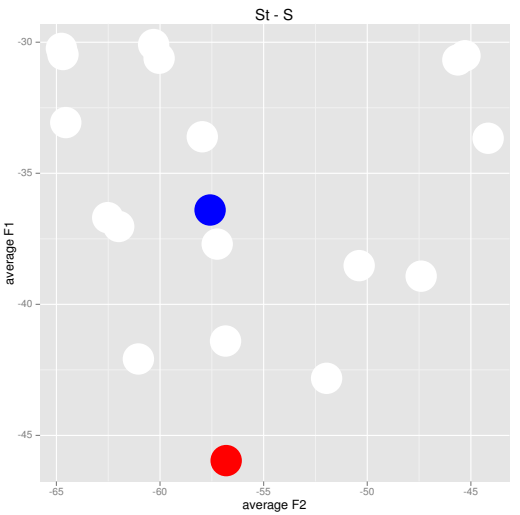
Scharrel
vs.
Ramsloh



Strücklingen
vs.
Ramsloh



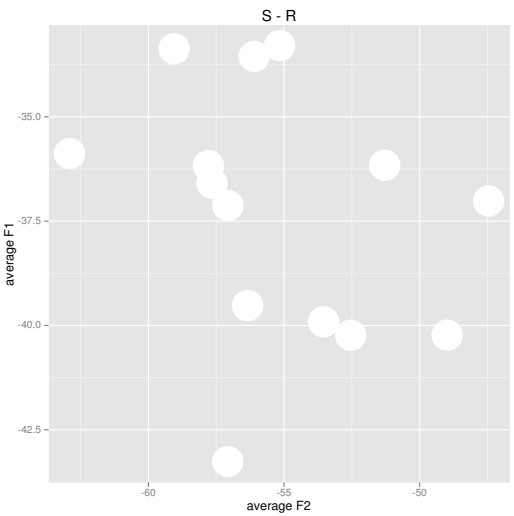
Strücklingen
vs.
Scharrel



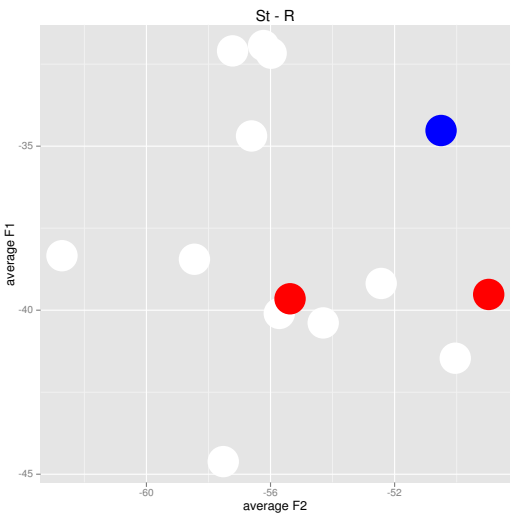
Red: first village $>$ second village at $\alpha = 0.05$ level.
Blue: first village $<$ second village at $\alpha = 0.05$ level.

F1 50% diph

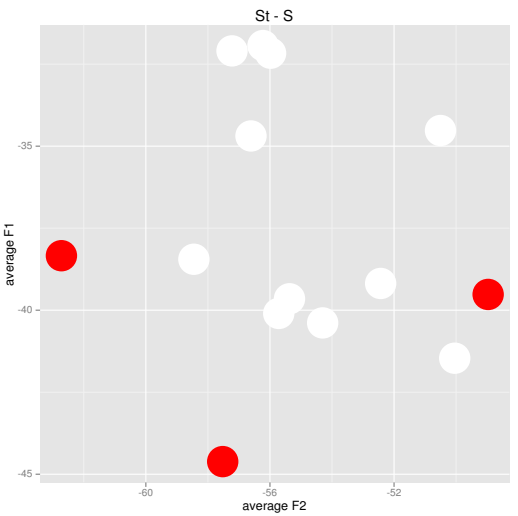
Scharrel
vs.
Ramsloh



Strücklingen
vs.
Ramsloh



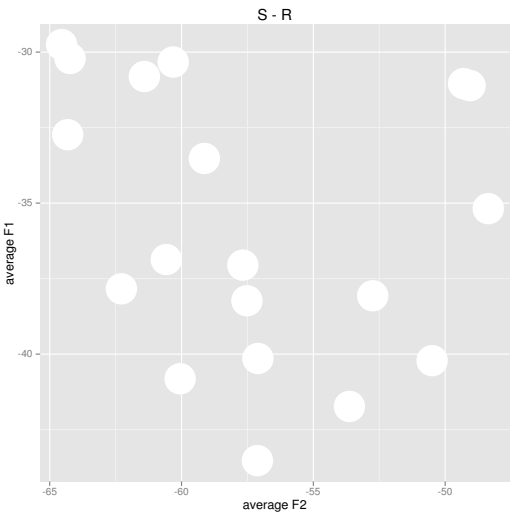
Strücklingen
vs.
Scharrel



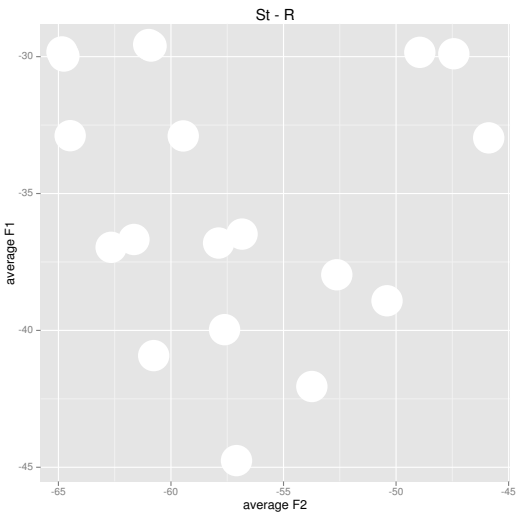
Red: first village $>$ second village at $\alpha = 0.05$ level.
Blue: first village $<$ second village at $\alpha = 0.05$ level.

F1 80% mono

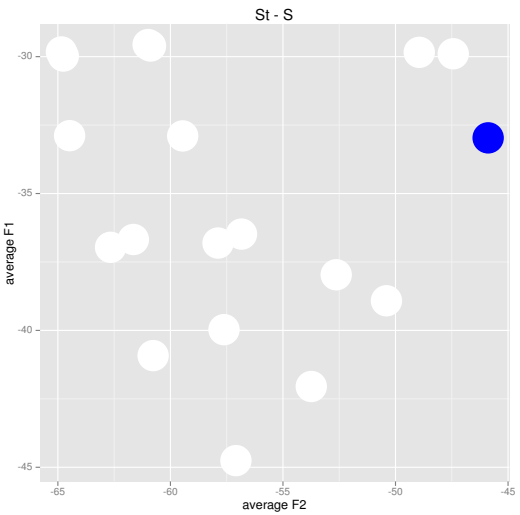
Scharrel
vs.
Ramsloh



Strücklingen
vs.
Ramsloh



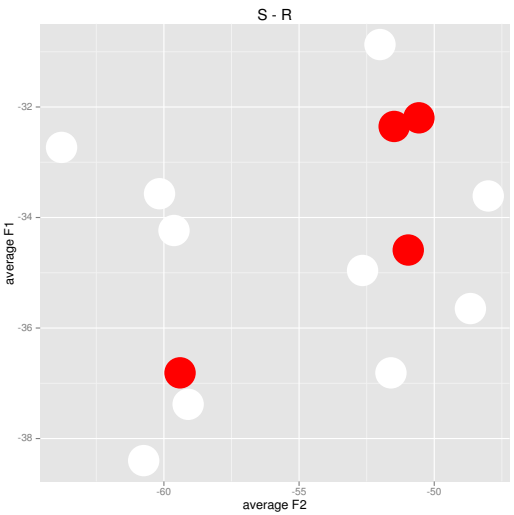
Strücklingen
vs.
Scharrel



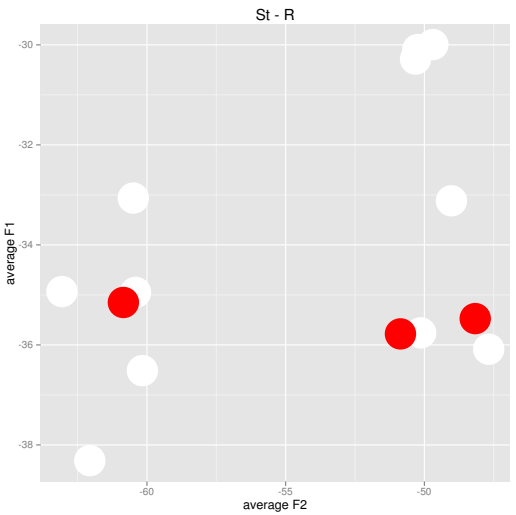
Red: first village $>$ second village at $\alpha = 0.05$ level.
Blue: first village $<$ second village at $\alpha = 0.05$ level.

F1 80% diph

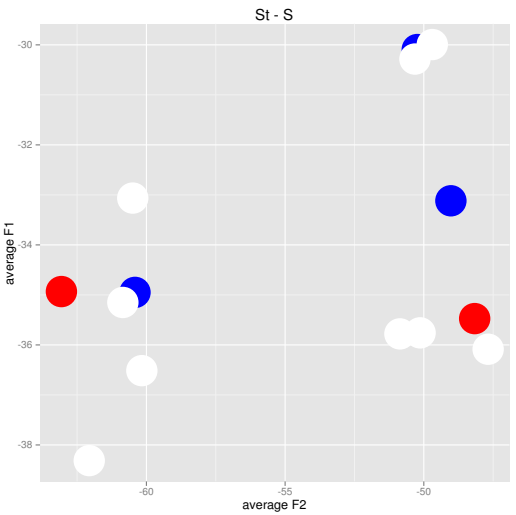
Scharrel
vs.
Ramsloh



Strücklingen
vs.
Ramsloh



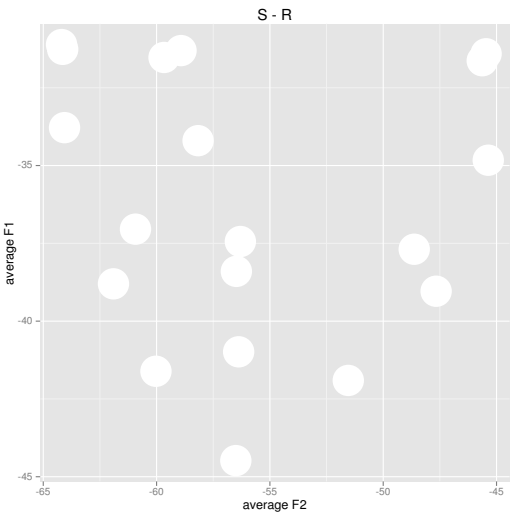
Strücklingen
vs.
Scharrel



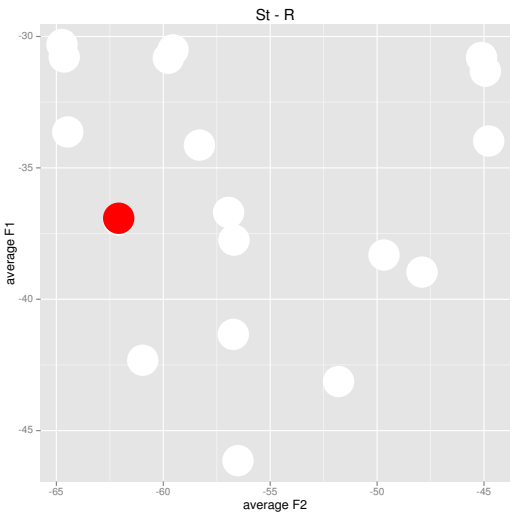
Red: first village $>$ second village at $\alpha = 0.05$ level.
Blue: first village $<$ second village at $\alpha = 0.05$ level.

F2 20% mono

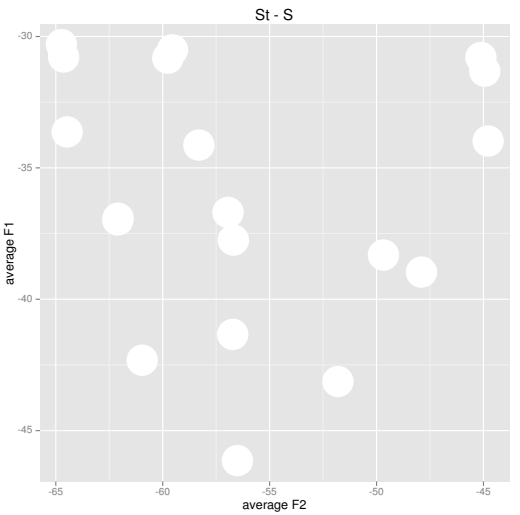
Scharrel
vs.
Ramsloh



Strücklingen
vs.
Ramsloh



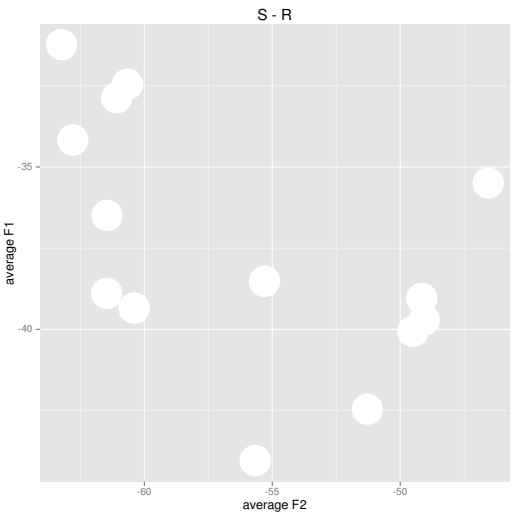
Strücklingen
vs.
Scharrel



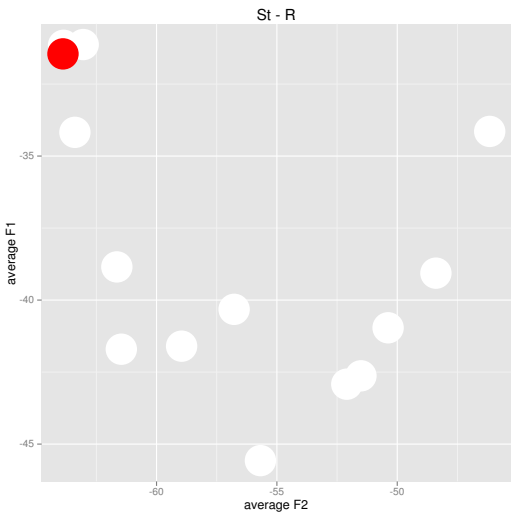
Red: first village $>$ second village at $\alpha = 0.05$ level.
Blue: first village $<$ second village at $\alpha = 0.05$ level.

F2 20% diph

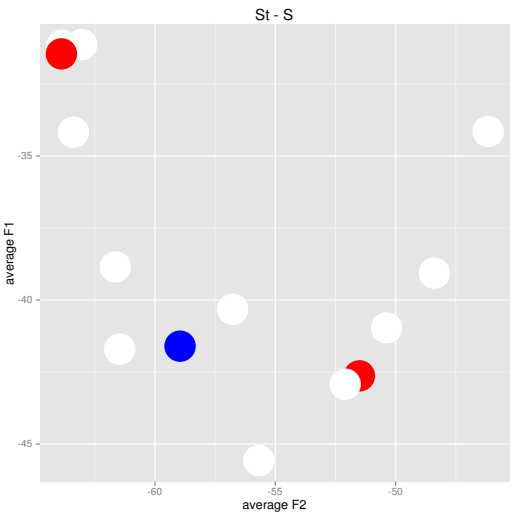
Scharrel
vs.
Ramsloh



Strücklingen
vs.
Ramsloh



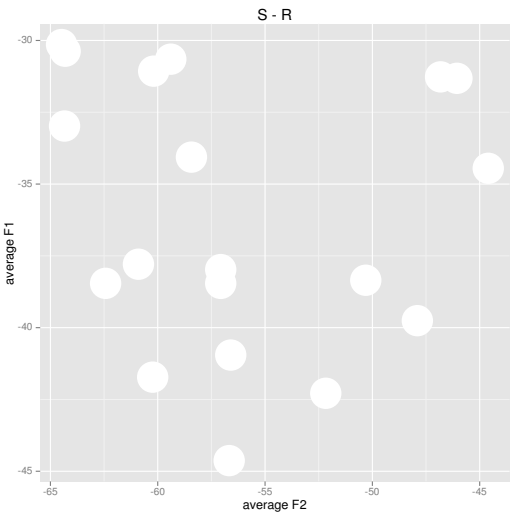
Strücklingen
vs.
Scharrel



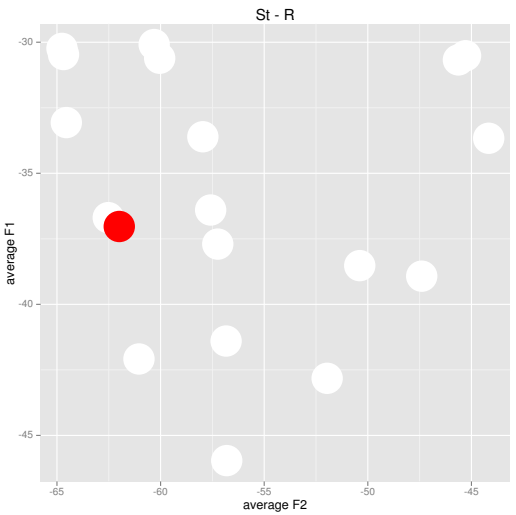
Red: first village $>$ second village at $\alpha = 0.05$ level.
Blue: first village $<$ second village at $\alpha = 0.05$ level.

F2 50% mono

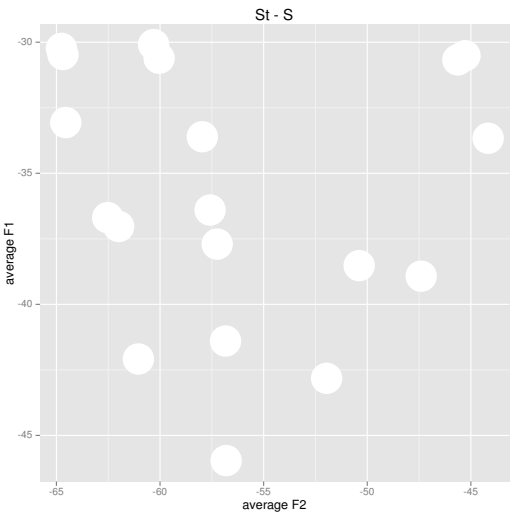
Scharrel
vs.
Ramsloh



Strücklingen
vs.
Ramsloh



Strücklingen
vs.
Scharrel



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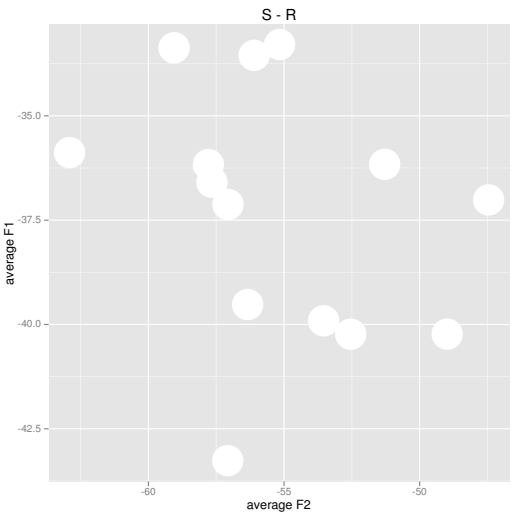
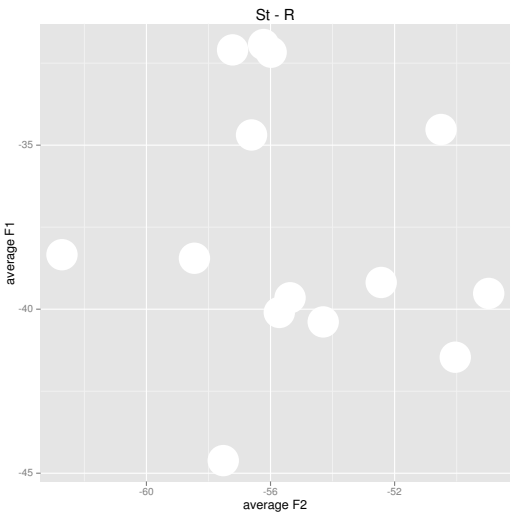
F2 50% diph

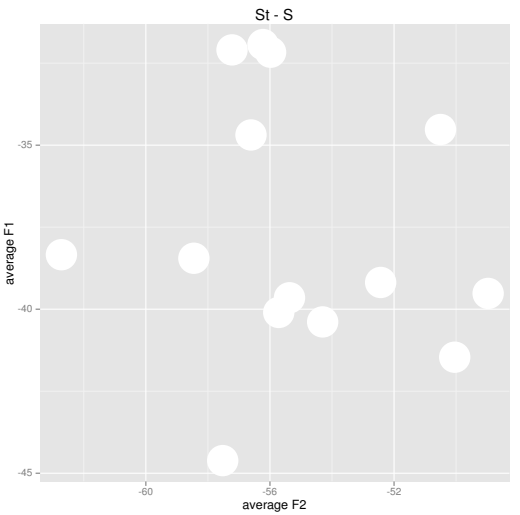
Scharrel
vs.
Ramsloh



Strücklingen
vs.
Ramsloh



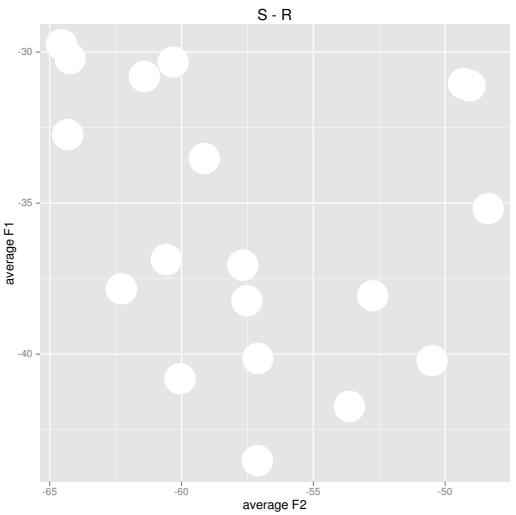
Strücklingen
vs.
Scharrel



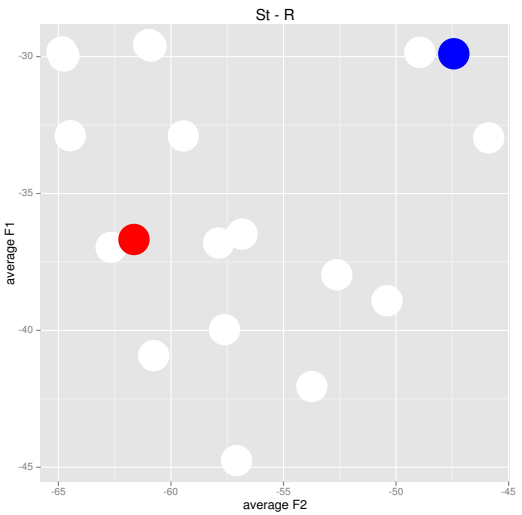
Red: first village $>$ second village at $\alpha = 0.05$ level.
Blue: first village $<$ second village at $\alpha = 0.05$ level.

F2 80% mono

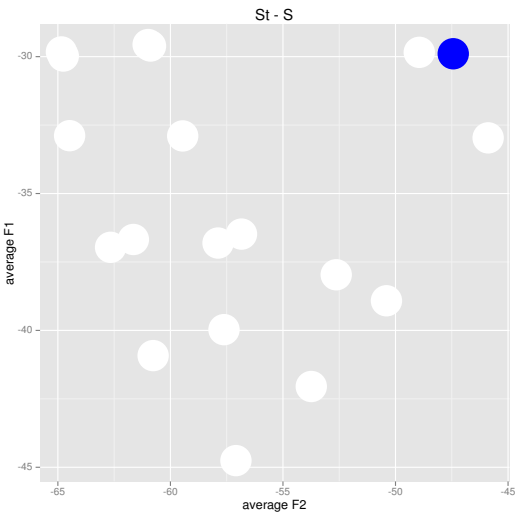
Scharrel
vs.
Ramsloh



Strücklingen
vs.
Ramsloh



Strücklingen
vs.
Scharrel



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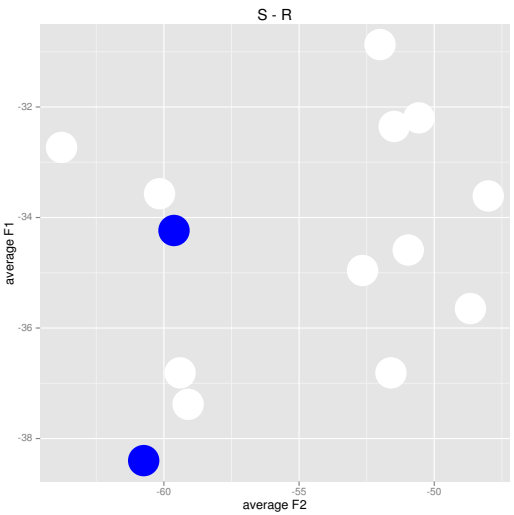
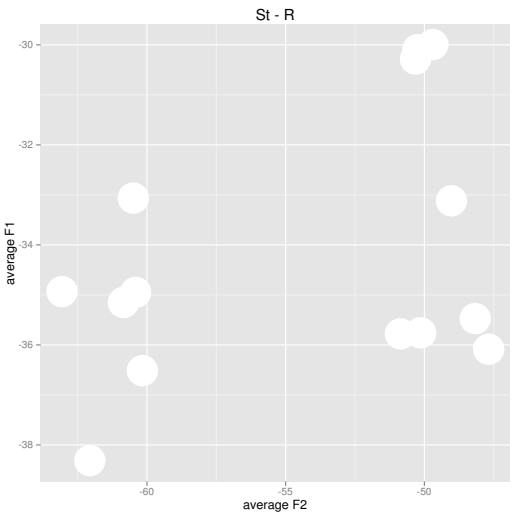
F2 80% diph

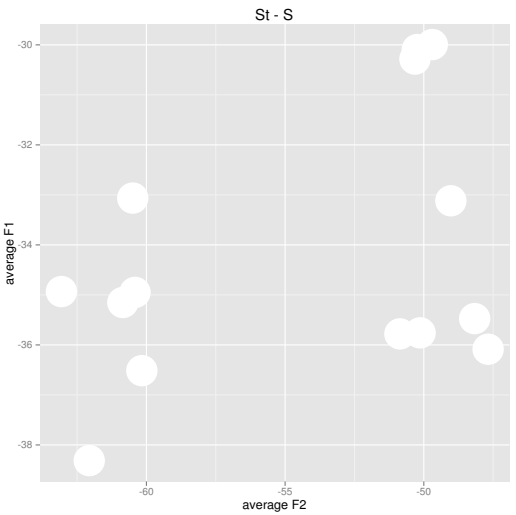
Scharrel
vs.
Ramsloh



Strücklingen
vs.
Ramsloh



Strücklingen
vs.
Scharrel



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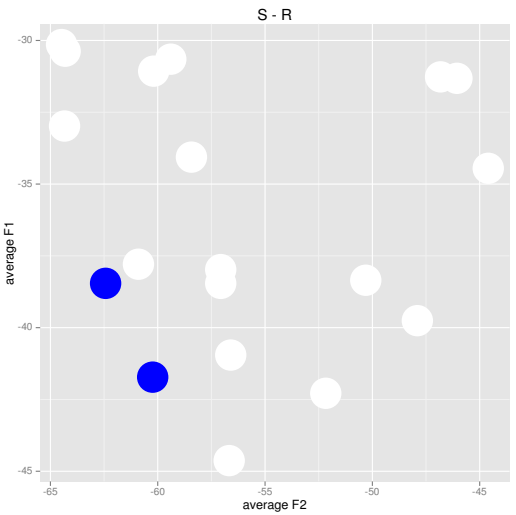
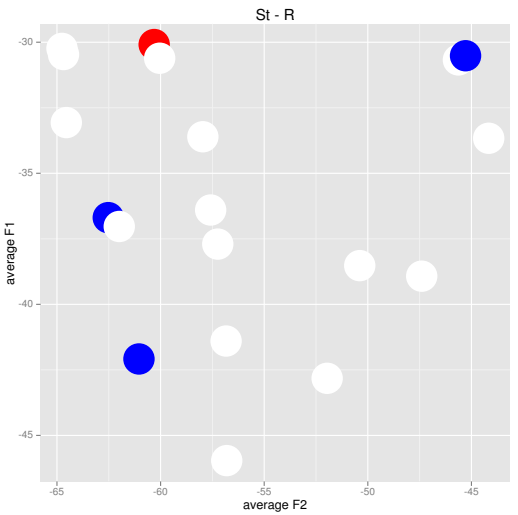
Blue: first village $<$ second village at $\alpha = 0.05$ level.

VISC mono

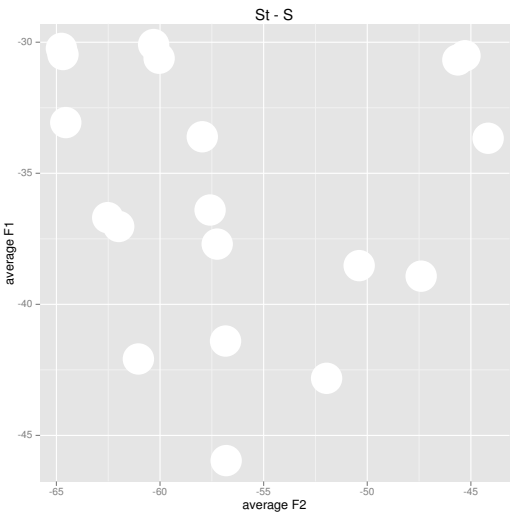
Scharrel
vs.
Ramsloh



Strücklingen
vs.
Ramsloh



Strücklingen
vs.
Scharrel



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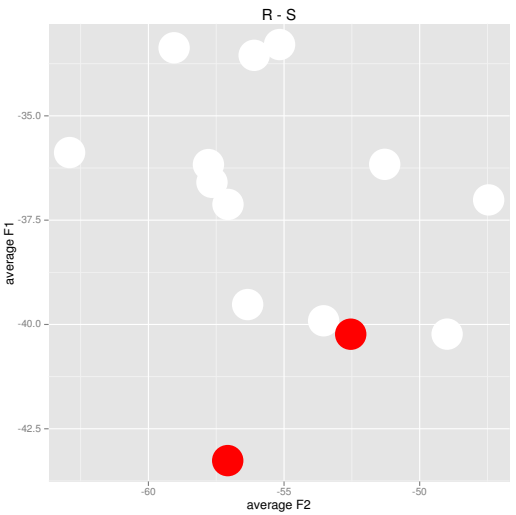
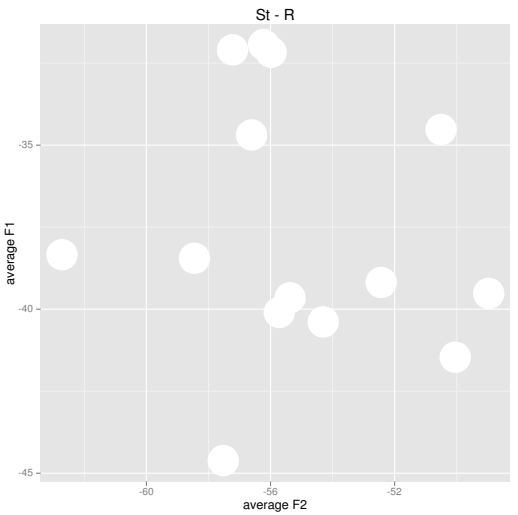
VISC diph

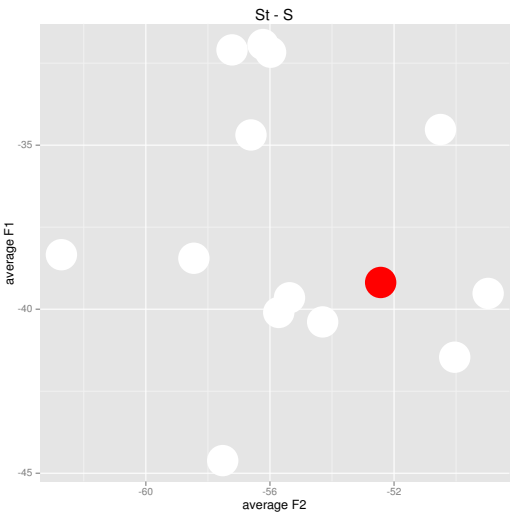
Ramsloh
vs.
Scharrel



Strücklingen
vs.
Ramsloh



Strücklingen
vs.
Scharrel



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