# Aggregate Analysis of Vowel Pronunciation in Swedish Dialects

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# The Goal

- Swedish dialects haven gone through massive **leveling** in the latter half of the 20th century.
- The aggregating methods are used for **identifying geographic dialect areas** and studying **ongoing changes** in Swedish dialects.



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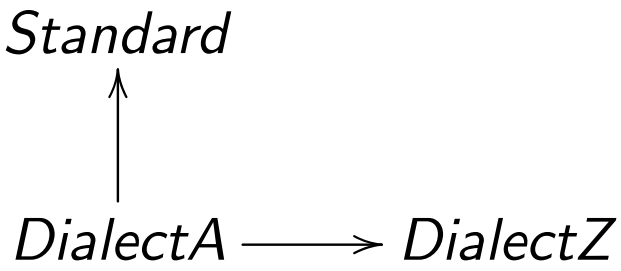
# Language leveling

- Dialect levelling is defined as the reduction of structural variation
- Dialect levelling makes $(a)$ individual dialects more homogeneous, and $(b)$ different dialects more similar and ,consequently, diasystems more homogeneous



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# The aggregating methods

- Feature-Based Variation Studies analyze variation in one element. While Aggregating methods consider **more than single feature**.
- Both rural Swedish dialects and regional varieties of Standard Swedish vary a lot when it comes to vowel pronunciation, and **vowels** have been **important for characterizing varieties of Swedish and classifying dialects**.
- are used for identifying **geographic dialect areas** and studying **ongoing change**.



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# Swedish Dialects

- South Swedish dialects
- Gotaland dialects
- Svealand dialects
- Norrland dialects
- Gotland dialects
- Finland-Swedish dialects

Figure: The traditional Swedish dialect area according to Wessn




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# Phonology data resource

- 98 rural sites
- from 1998 to 2001
- 1170 speakers
- 12 people for each location
- older group from 55 to 75 years
- younger group from 20 to 35 years
- 48 kHz sample rate and 16-bit amplitude resolution (recording)
- downsampled to 16 kHz/16 bit for analysis
- swedia.ling.gu.se

**Title of Project**
Swedia 2000 - Phonetics and phonology of Swedish dialects around the year 2000.

**Project Period**
01/01/1998 - 12/31/2008

**Subject areas**
Linguistics, Phonetics

**Head of research**
Eva Strangert, Department of language studies

# Phonology data resource-2

- Vowel segments were elicited with mono- or bi-syllabic words
- target vowels were surrounded by coronal consonants
- vowel recruitment criteria : long vowels, allophonic variants of /ɛː/, /øː/, vowels reflect the Historical development
- 19 words were used : dis[iː], disk[ɪ], dör[œː], dörr[œ], flytta[ʏ], lass[a], lat[aː], leta[eː], lett[e̞], lott[ɔ], lus[(ʉ)], lås/låt[oː], lär[æː], lös[ø], nät[ɛː], sot[uː], särk[æ], söt[øː], typ [yː]

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# Acoustic analysis

- All vowel segments were filtered with Bark filters.
- **principal component analysis(PCA)** : PC1 is related to **vowel height** and PC2 is related to **tongue advancement**
- males and females vocal tracts were normalized for by applying PCA separately to data from male and females speakers.



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# Analysis of dialectal variation

- multidimensional scaling (MDS) is a method for reducing complex distance data. Gap statistic is used for estimating the number of significant clusters.
- MDS is suitable for visualizing dialect continua.And cluster analysis detects dialect groups.
- This paper used Kruskal's non-metric MDS
- Euclidean distance represents the vowel quality.
- x, y are either two different sites or two different speaker groups.

$$distance(x,y) = \sqrt{\sum_{i=1}^{9}((PC1_{xi} - PC1_{yi})^2 + (PC2_{xi} - PC2_{yi})^2)}$$

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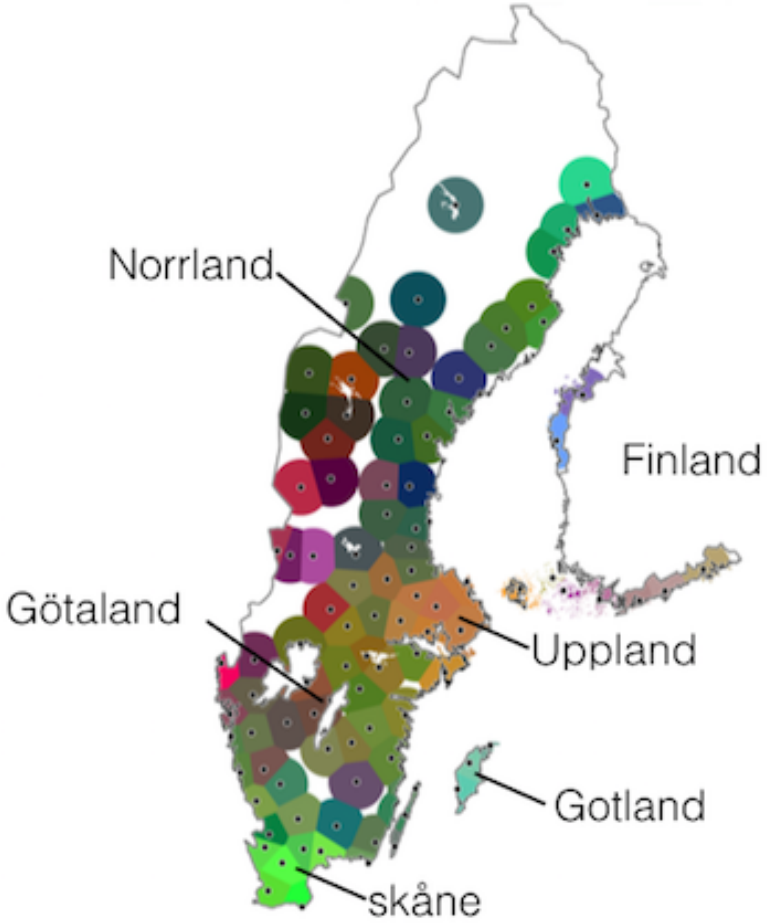
# Geographic dialect continuum

- one dimension explains 81.4%, two dimension explains 93.6% and three dimension explains 96.3%
- the dimension cannot be interpreted as PC1 and PC2 fully.

# Geographic dialect continuum-2




- coherent area : Skåne, Gotland, Uppland
- incoherent area : Norrland, Götaland

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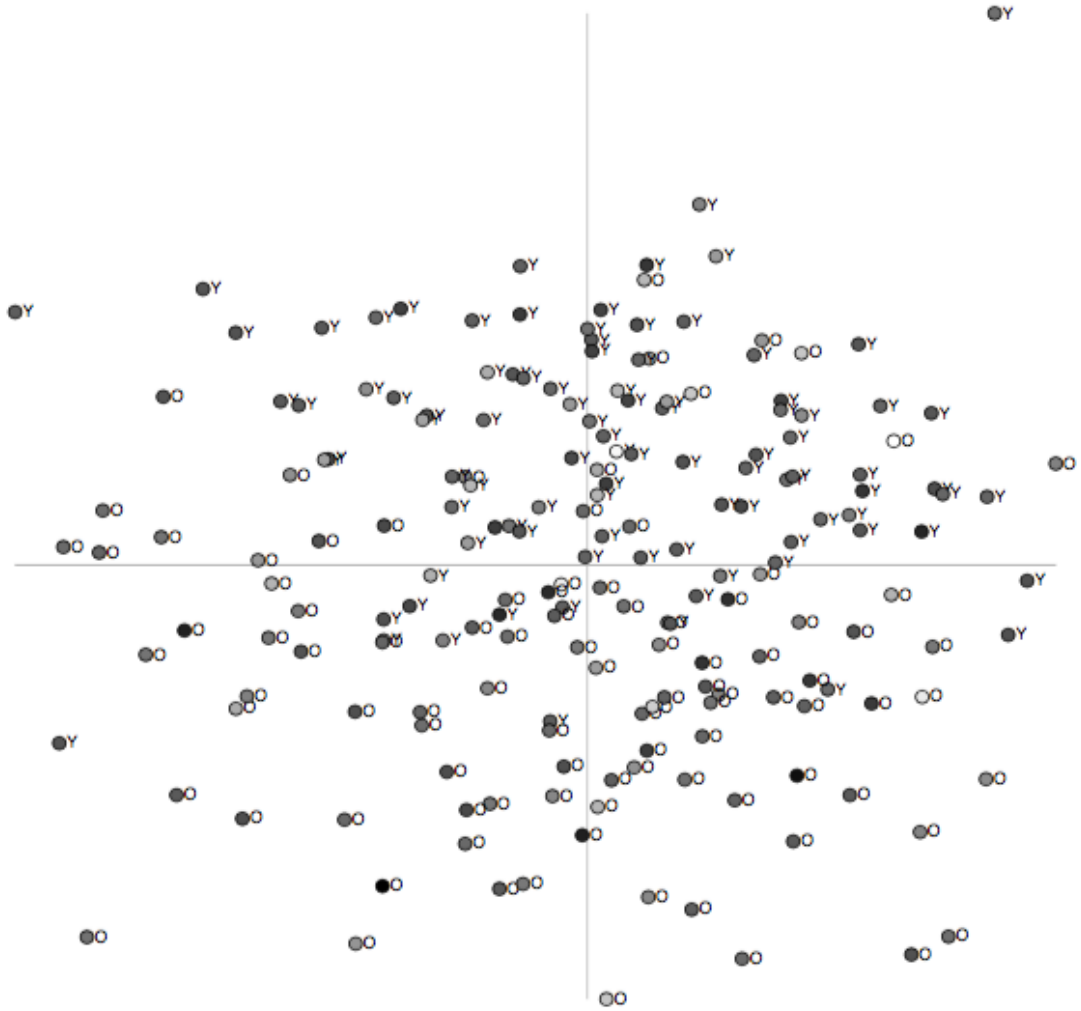
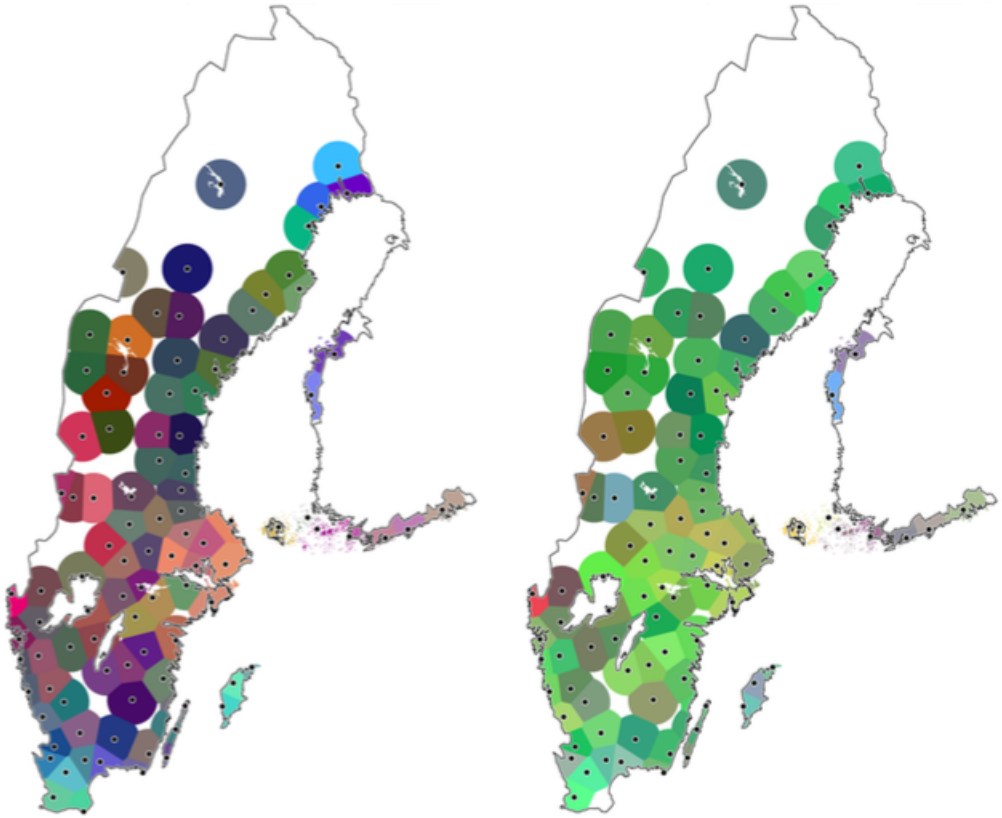
# Dialect leveling



- The extreme outlier is younger speakers of Löderup

# Dialect leveling-2




- A broad spectrum of colors is found in older group. While the younger group shows mainly green color
- A large scale of dialect leveling can be confirmed.
- The difference between younger speakers do exist! But the difference is so much smaller than between older speakers. Therefore, the color cannot reflect the differences precisely



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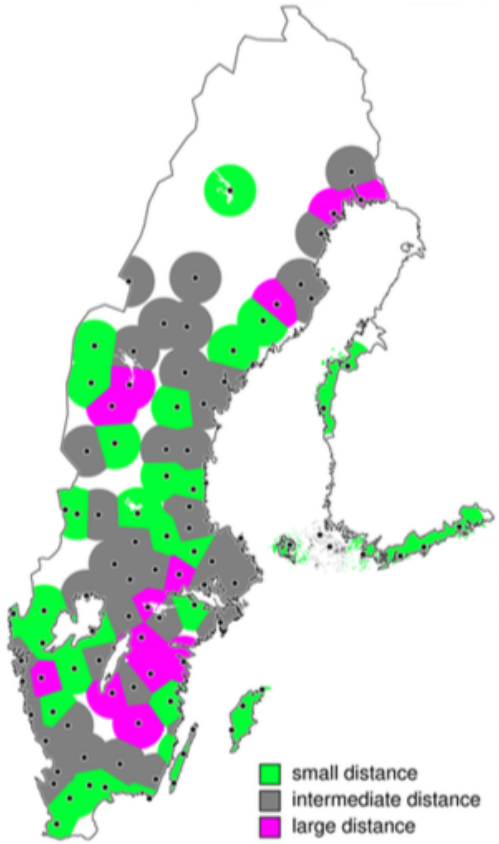
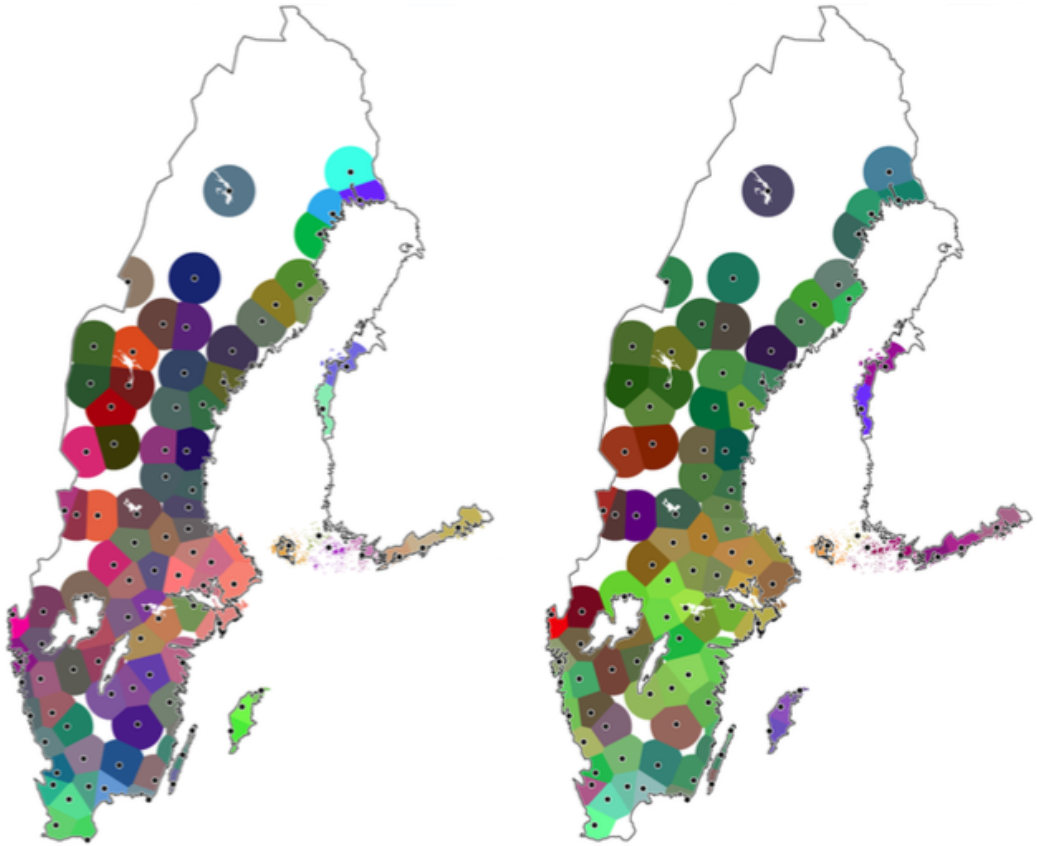
# Dialect leveling-3




- the map shows the similarity distance.
- the sites close to biggest cities, such as Stockhom and Göteborg shows a large ongoing changes

# Dialect leveling-4




- In order to present the difference between younger groups, MDS were applied to two age groups seperatly.
- Two maps are independent.
- A more uniform spoken variety of Norrland is emerging

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# The observation

- The paper showed that the variation in vowel pronunciation across Swedish dialects is **continuous** and **abrupt dialect borders exist**. And MDS result **agree** with the traditional division of Swedish dialects by Wessén.
- The **dialect leveling** has been **confirmed statistically** by the aggregate analysis.



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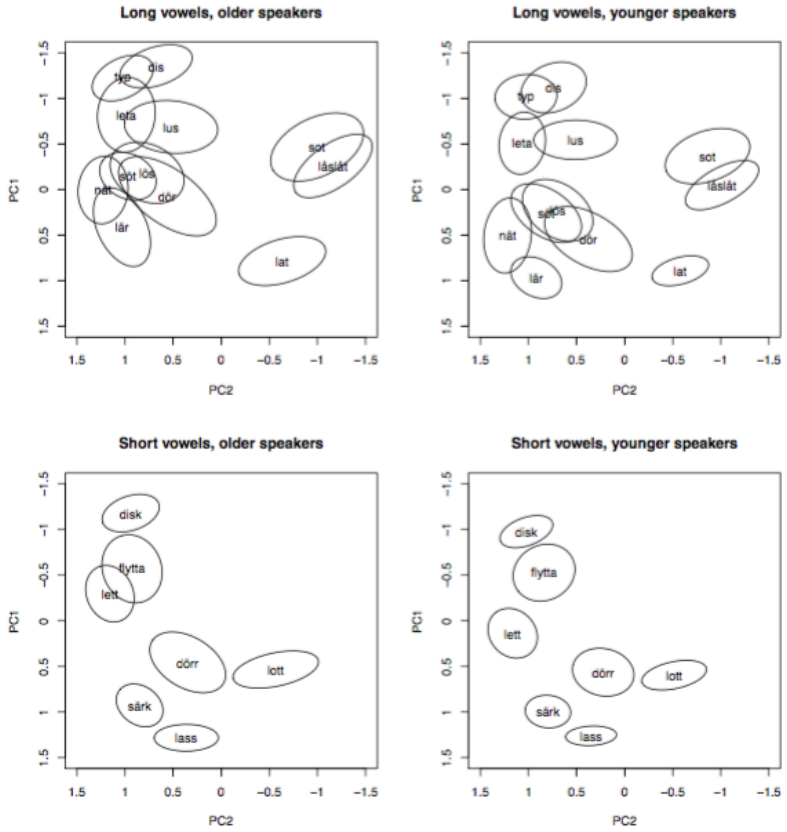
# The observation-2

- A general lowering of front vowels going on
- The areas where the vowel shift is strongest are areas close to south-west of Stockholm and Göteborg
- The chain shift can be regarded as simplification of the vowel system : the vowel inventory becomes smaller.



# The observation-3

Figure: http://goo.gl/hbRDxa

- Not much change in vowel pronounciation : South Sweden (province Skåne), Gotland and the Swedish dialect area in Finland.
- Aggregation of linguistic data reveals global tendencies and overall relationships between varieties.

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# The pros and cons of aggregation analysis

The advantage

- Aggregation gives a more reliable signal of provenance than single features do.
- It allows us to examine the question whether dialectal variation can best be described in terms of areas of continua.

The limitation

- The linguist structure of the variation is not revealed
- The aggregate analysis does not reveal which linguistic features characterize the dialect areas.



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