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Review of nordic classifications of acidification

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Background

- Water Framework Directory (WFD):
  - All waterbodies should achieve at least ”good status”
  - Ecological status (ES) defined by Ecological Quality Ratio (EQR)

$$EQR = V_{ref} / V_{meas.}$$

- Norway, Sweden and Finland has different systems for setting reference values and thresholds for god status for acidification

Differences in calculation of Critical load was pointed up earlier in a study by Kari Austnes

Why different systems?

- Different natural conditions
  - E.g. Norway clear waters and thin soils
- Different implementation strategies
  - E.g. Type specific or site specific reference values
- Different management demands
  - E.g. Sweden’s extensive liming program
- Or just a lack of cooperation…..

Comparison and harmonisation of Nordic systems for classification of physicochemical acidification status of lakes and rivers

Nordic cooperation project funded by Norwegian and Swedish authorities

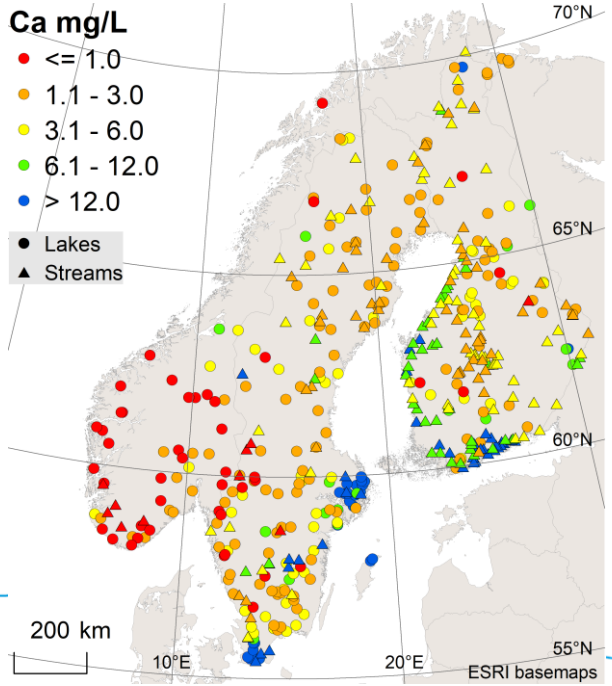
- WP1. Review of current national approaches for assessing acidification.
- WP2. Analysis of biological responses to selected predictors of water acidity

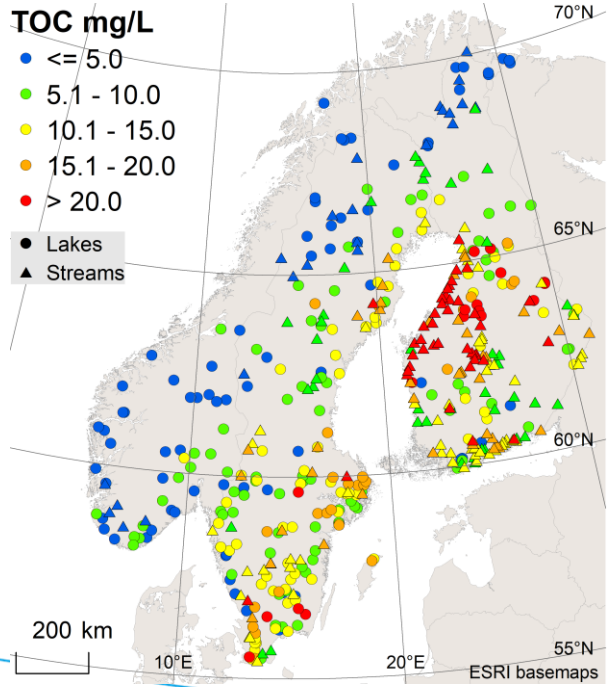
- *WP3. Time-series analysis of organism response to acidification.*
- *WP4-6. Develop suggestions to new classification systems*

WP1: Differences in assessment of (chemical) acidification of surface waters

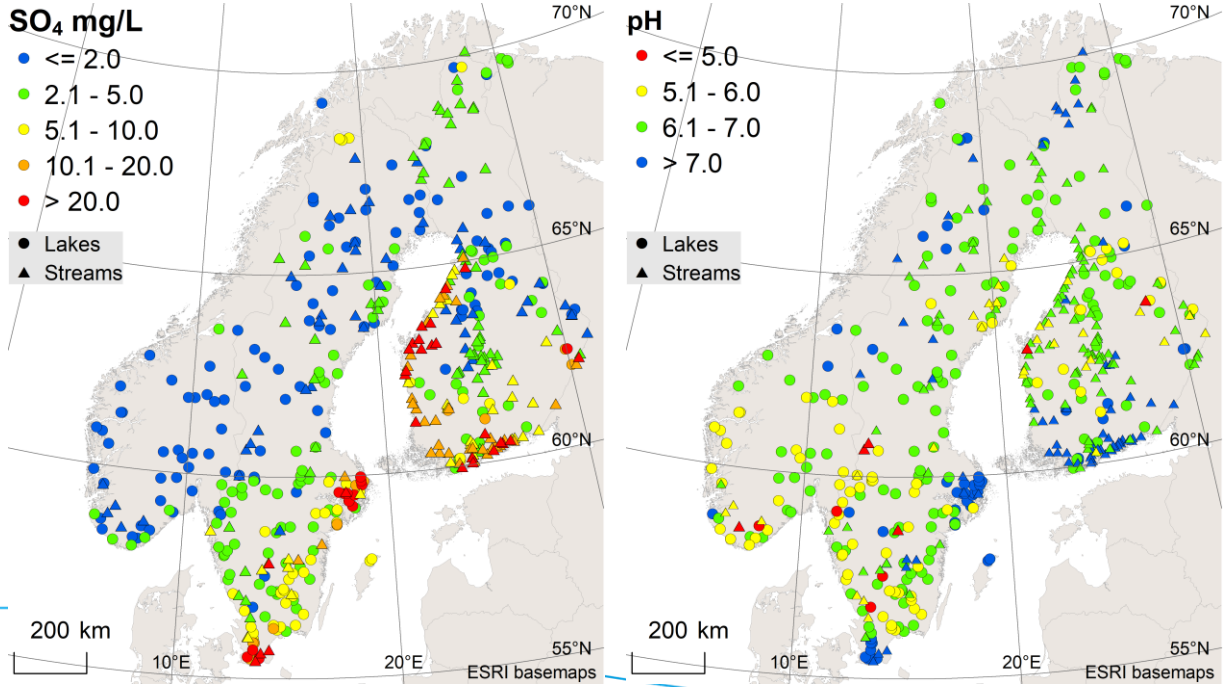
Norway – Sweden - Finland

Spatial variability in water chemistry



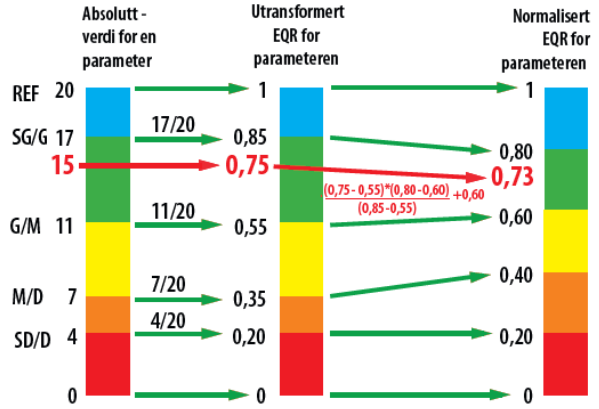


Spatial variability (cont.)



Different approaches

Norway: 15 different water types differentiated by calcium and TOC levels (8 different types for water bodies with calcium < 1 mg/l and TOC < 5 mg/l). **ANC, pH and Ali reference values and classes** are define for each type



Different approaches (cont.)

Sweden: Water body specific classes. Dynamic model (MAGIC) is used to estimate ANC in 1860. **Change in pH is derived**.

Tabell 6.1. Klassgränser för klassificering av försurningspåverkan i vattendrag.

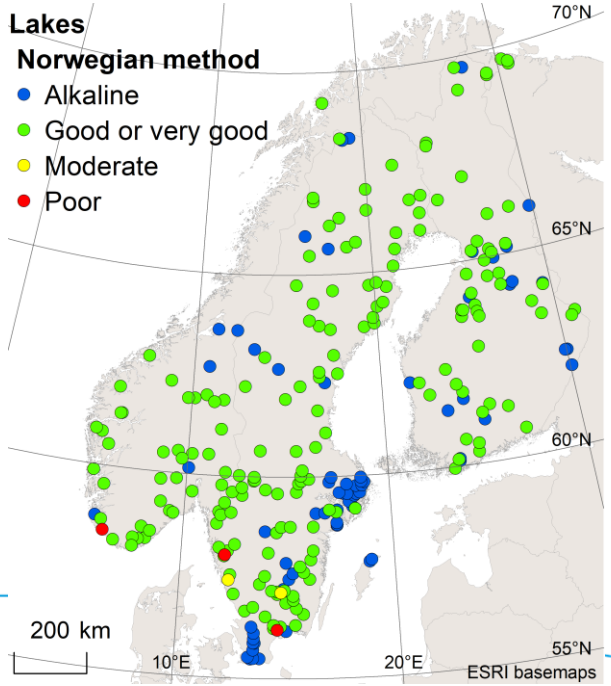
Klass	pH-förändring	Status
1	<0,2	Hög status
2	0,2-0,4	God status
3	0,4-0,6	Måttlig status
4	0,6-0,8	Otillfredsställande status
5	>0,8	Dålig status

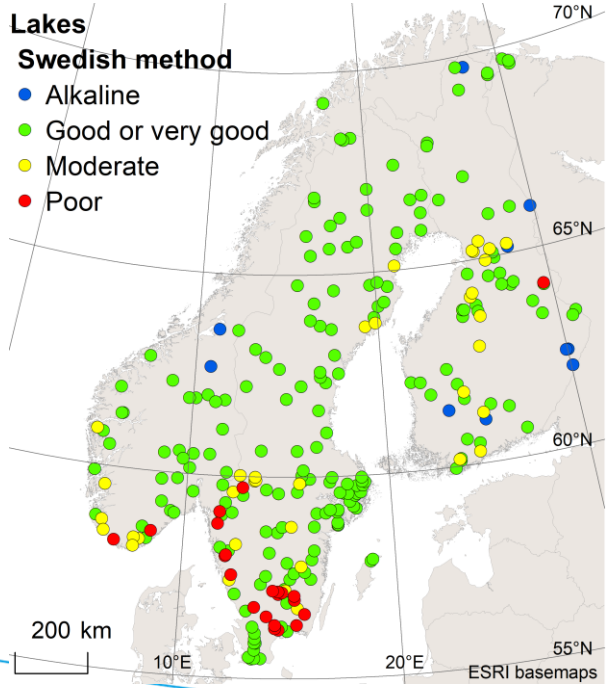
Different approaches (cont.)

Finland:

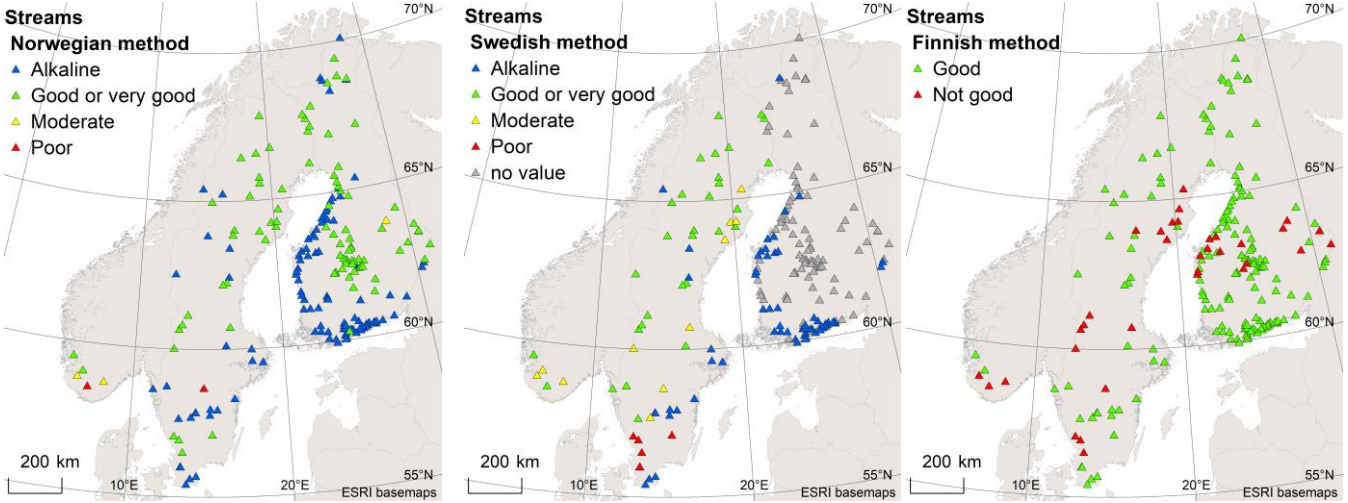
- Finland has physicochemical criteria for pH in rivers. Mainly because acid sulphate soils are affecting river water quality in e.g. Ostrobothnia
- Computational pH-class is determined by mean annual **pH-minimum values for the period 2006-2012**

Differences in assessments for lakes





Differences in assessments for rivers



WP2. Analysis of biological responses to selected predictors of water acidity

- Lakes and streams
- Bentic fauna and fish

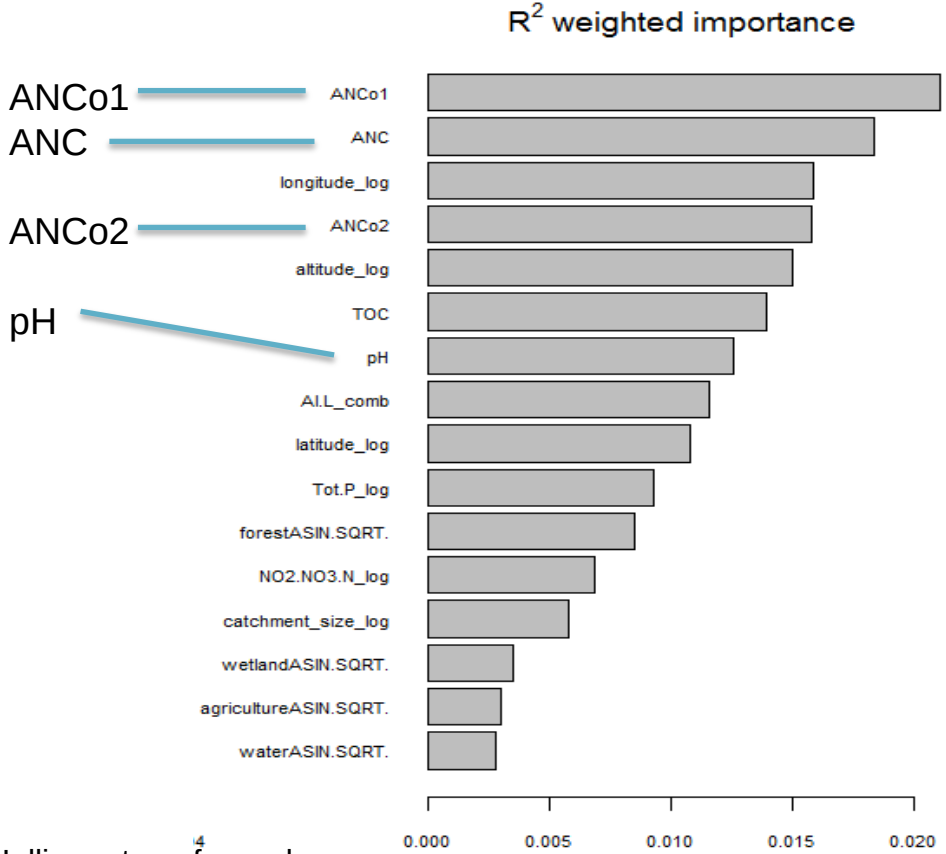
- What parameter are best related to biota?
  - pH,
  - ANC = BC - SAA
  - ANCo1 = ANC – TOC * 10,2 * 1/3 (Assuming 1/3 of org. Acids as strong) (Lydersen)
  - ANCo2, = ANC – TOC * 10,2 * 2/3 (Assuming 2/3 of org. Acids as strong)
  - (Ali (measured or modelled))
- Are there any clear thresholds of effect or a more continuous relation?

Data and method

- Data
  - Benthic fauna in 218 lakes (and 126 streams)
  - Water chemistry
  - Geographic data

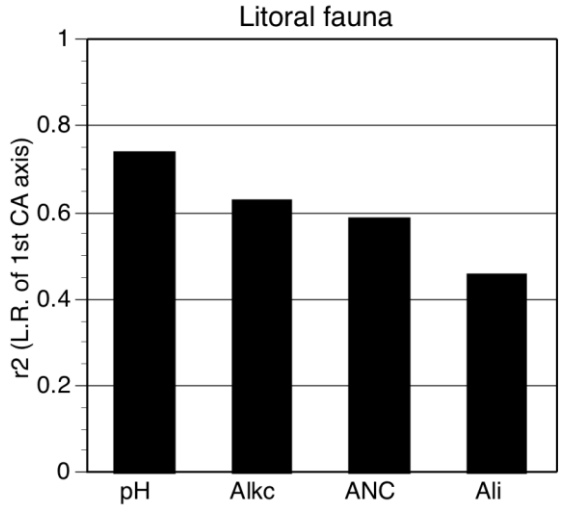
- Statistical method - gradient forest
  - Ordination of the whole species community in relation to predictive variables
  - Decision tree based approach
  - Randomized repeated analysis on subsets to avoid overfitting

Results from Benthic fauna i lakes



Hellinger transformed

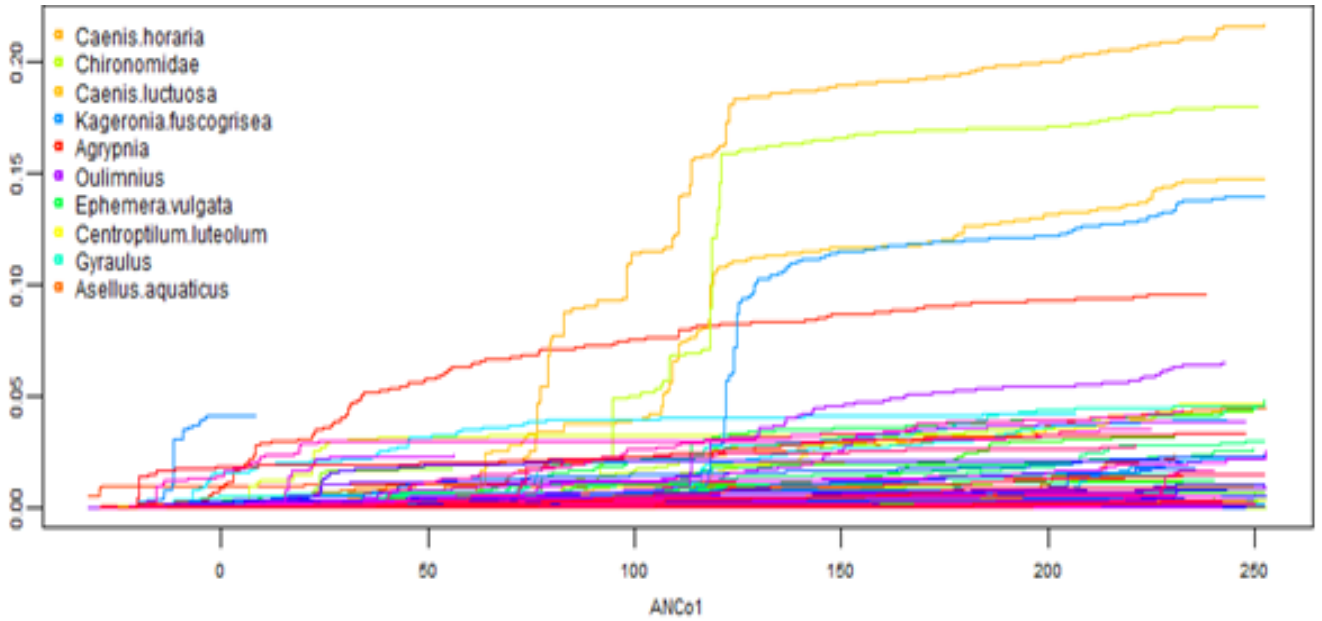
Swedish study 2007



Less data
Data from 1990ies
Simpler statistics

Tendency of a threshold at ANCo1 120 µeq/l

Hellinger transformed



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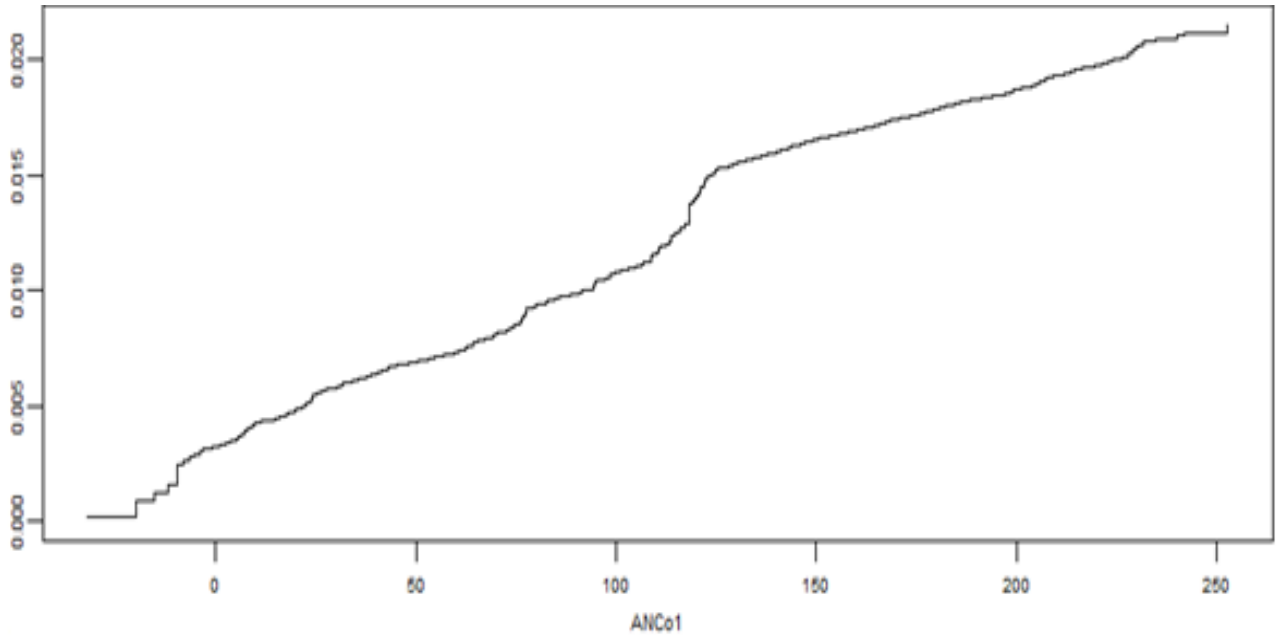


Hellinger transformed data

Further analysis

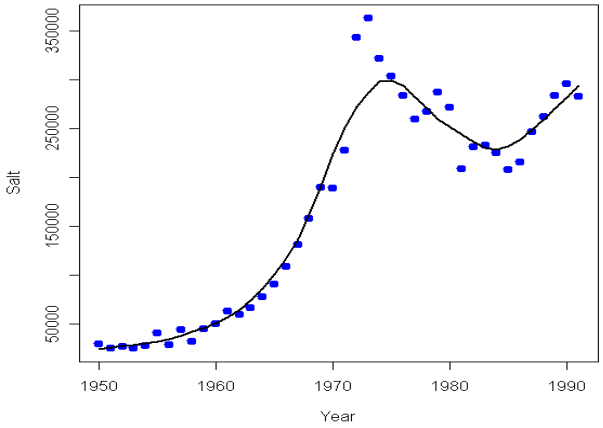
- Finalise benthic fauna in streams
- Similar analysis for fish in lakes and streams
- WP3. Time-series analysis of organism response to acidification.

Conclusions

- Norwegian system gives less acidification
- Largest differences in brown lakes (TOC > 5 mg/l)
- ANCo1 best predictor for BF in lakes
- No pronounced thresholds for relations BF to chemistry
- Similar preliminary results for streams

GAM-models

- Non-parametric model using a smooth fit instead of a linear or other function
- Degree of smoothing from a cross validation
- Can be combined with e.g. linear models for other explanatory variables (similar to multiple regression)
- We analysed:
  - response pattern of 1st ordination axix to chem. parameter
  - interaction between variables



GAM-models

First ordination axis as dependant variable

- No interactions for ANCo1
- (Several interactions for pH)
- No thresholds for ANCo1
- Circumlinear respons up to ANCo1 = 170µeq/l