Schweizerische Eidgenossenschaft
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Swiss Confederation

Federal Department of Economic Affairs,
Education and Research EAER
Agroscope

FNSNF
Swiss National Science Foundation

University of Zurich[UZH]

ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

The Swiss feed database

a GIS-based analysis platform

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EAAP Annual Meeting, August 26th – 30th 2013 Nantes, France
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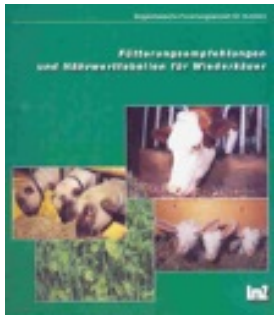
Milestones

1979

1991 - 2004

Print versions of the Feeding Recommendations and Feed Tables for Ruminants and Pigs



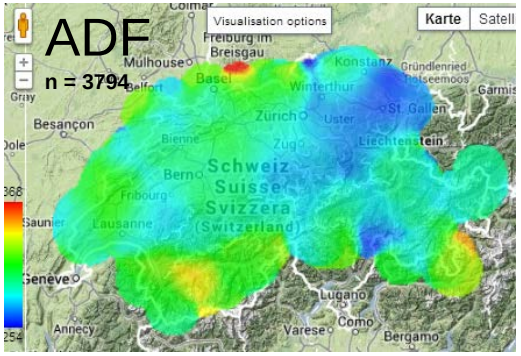
2007

Online version of the Swiss Feed Database: Reference mean values of nutrients for more than 600 raw materials and roughage for ruminants, pigs, horses and poultry

Aliment	MA [g/kg MS]	MG [g/kg MS]	CB [g/kg MS]	NDF [g/kg MS]	ADF [g/kg MS]	sucres [g/kg MS]
G prairie riche en graminées, autres que ray-grass, stade 4, sec	123.0	35.0	278.0	514.0	312.0	86.0
G prairie riche en graminées, autres que ray-grass, stade 5, sec	101.0	35.0	315.0	578.0	346.0	83.0
GR prairie riche en graminées, surtout en ray-grass, stade 3, sec	134.0	35.0	239.0	441.0	269.0	128.0
GR prairie riche en graminées, surtout en ray-grass, stade 4, sec	118.0	35.0	253.0	466.0	285.0	124.0
E prairie équilibrée, stade 3, sec	146.0	35.0	238.0	430.0	276.0	89.0

2010 - 2014

Thesis: Managing Time-Varying Measurement Sets in Databases



2013

Launch of the temporal data warehouse: interactive web interface enriched with visual tools

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Data sources

- Research and Surveys: Agroscope, ETH, HAFL
  - Feeding trials
  - Conservation
  - Plant breeding







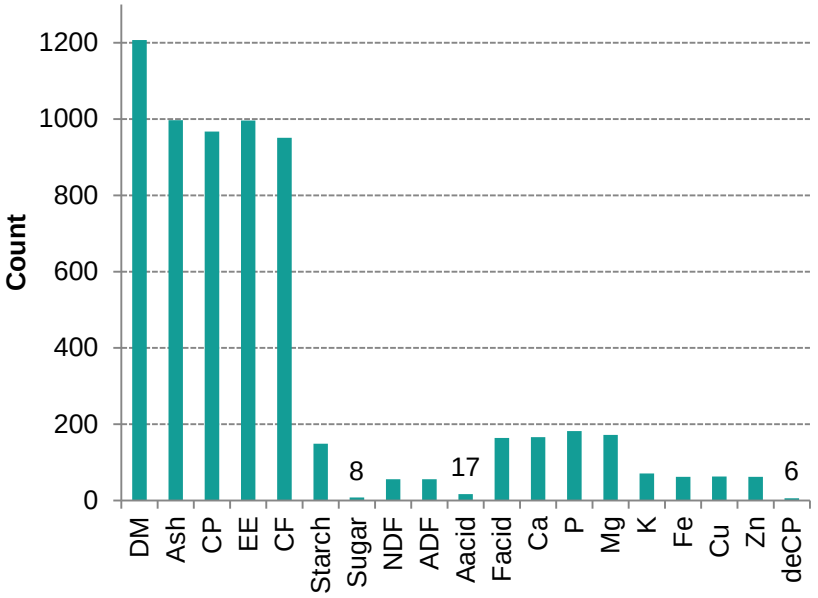


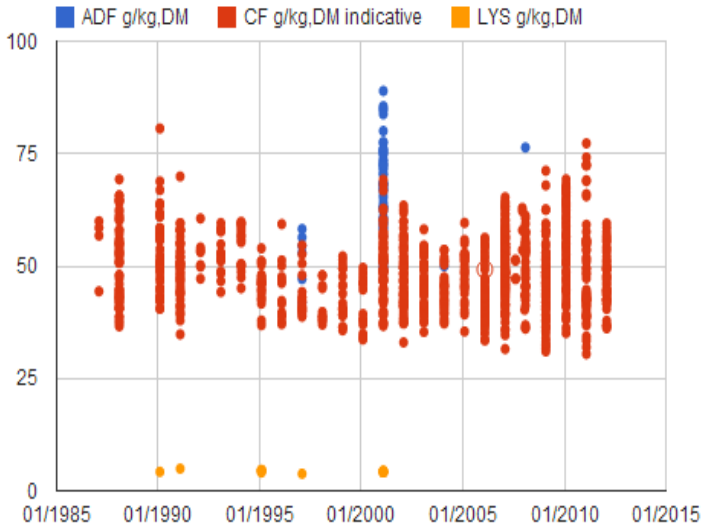
- Farms, Feed industry: yearly hay survey, raw materials
- Nutritional coefficients from literature and institutions (INRA, CVB, DLG, ARC, NRC)

Data curation

Main challenge: Data incomplete and irregular in time, origin and analyzed nutrients

Count and temporal pattern of chemical analyses in barley samples





Abundant proximate analysis, sparse fiber fractions, amino acids, trace elements
Aggregated nutrients need to be balanced for coherence and representativeness

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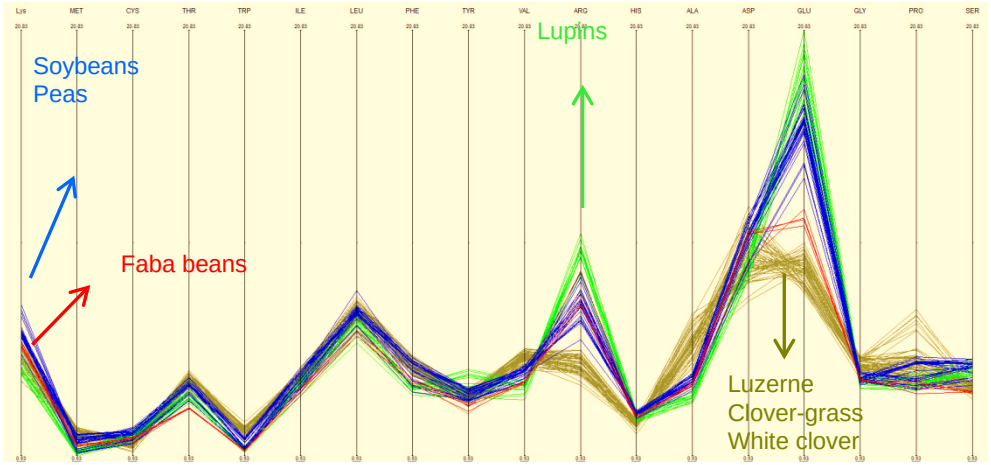
Imputation of aggregated nutrients

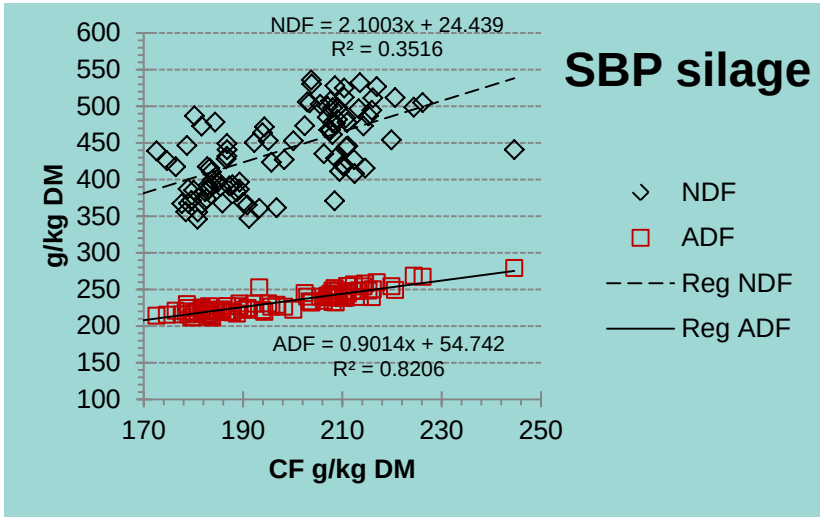
Amino acid profiles of legume seeds



Pre-condition:
characteristic, multivariate pattern (profile) → fingerprint

Example:
Quantification of amino acids based on the **amino acid profile** (g AA/g CP)

Lys g/kg = [avg g Lys/g CP] * CP



Pre-condition:
Correlated nutrients → regression

Example:
Regression technique to adjust mostly fiber fractions to the mean crude fiber content. High and rather low correlations co-exist.

ADF g/kg DM = 0.9014 * CF + 54.742
(SBP silage)

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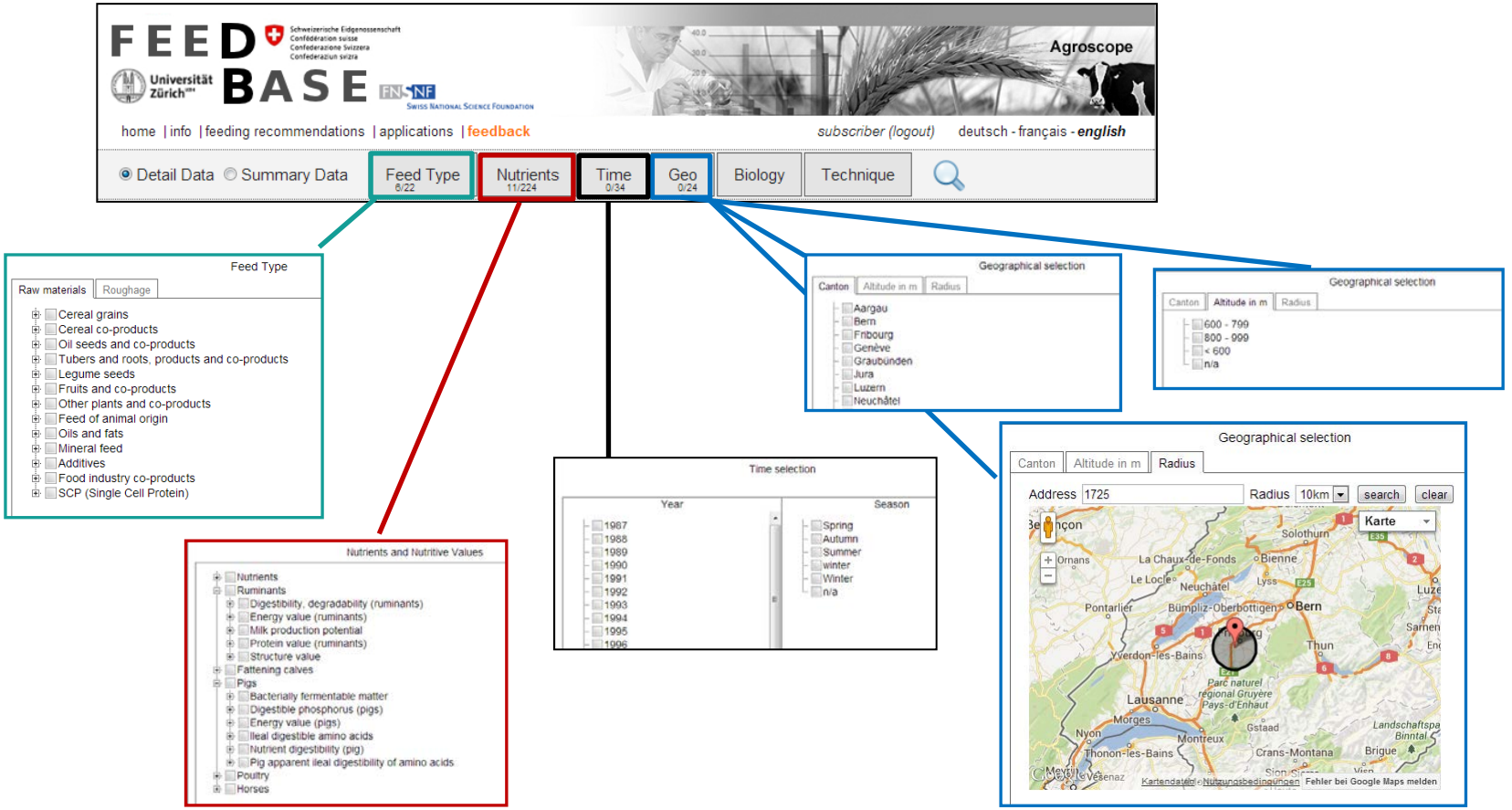
Interactive web application: query concept

Search parameters for summary data or detail data

- organized into a row of buttons, each button one search category
- an overlay window displays search options by a list, tree or map
- are loaded dynamically based on the already chosen options



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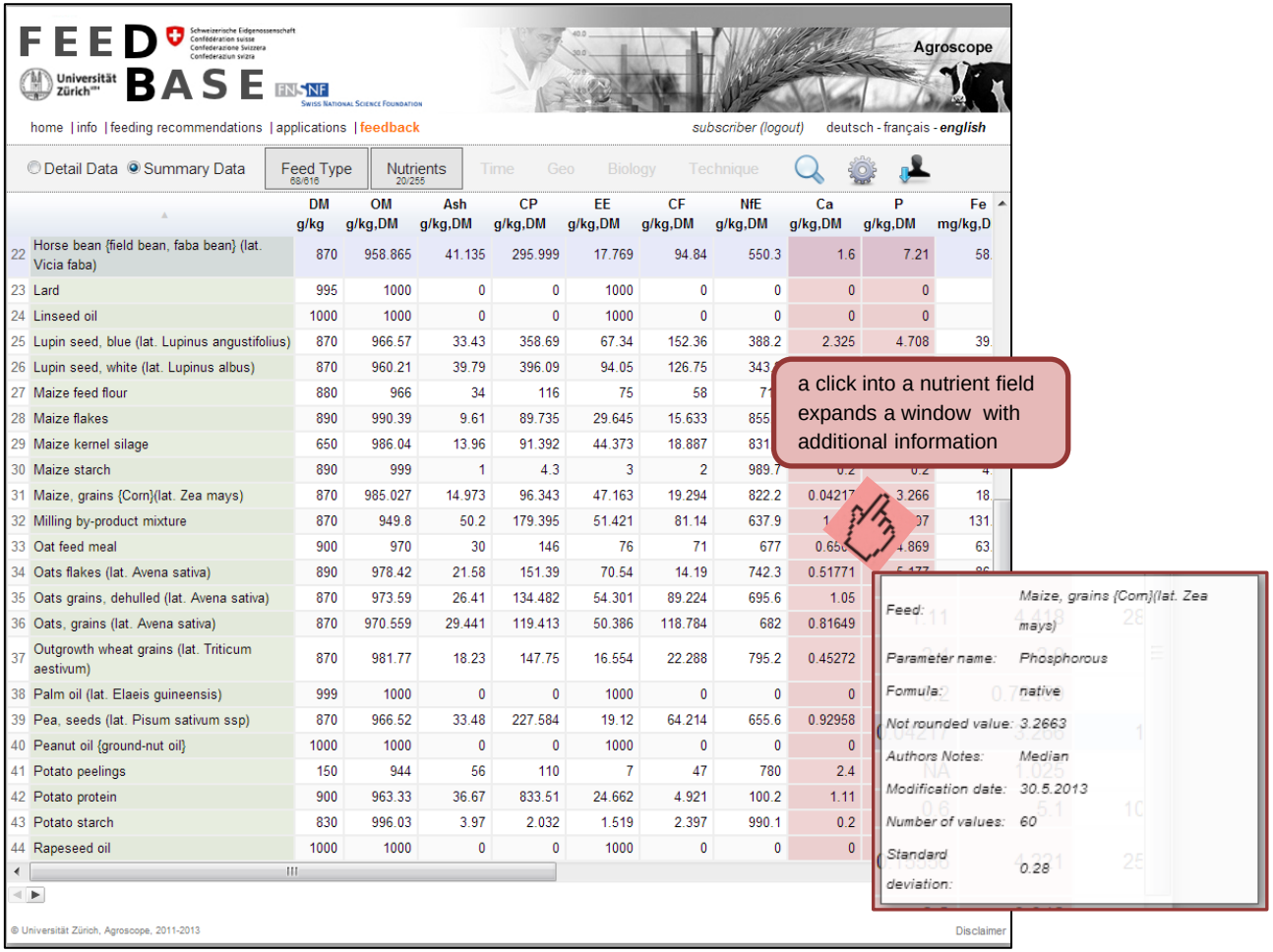
Result views: Summary Data

Curated, aggregated nutrients on a dry matter or as fed basis, with export function



		DM g/kg	OM g/kg,DM	Ash g/kg,DM	CP g/kg,DM	EE g/kg,DM	CF g/kg,DM	NfE g/kg,DM	Ca g/kg,DM	P g/kg,DM	Fe mg/kg,D
22	Horse bean {field bean, faba bean} (lat. Vicia faba)	870	958.865	41.135	295.999	17.769	94.84	550.3	1.6	7.21	58
23	Lard	995	1000	0	0	1000	0	0	0	0	
24	Linseed oil	1000	1000	0	0	1000	0	0	0	0	
25	Lupin seed, blue (lat. Lupinus angustifolius)	870	966.57	33.43	358.69	67.34	152.36	388.2	2.325	4.708	39
26	Lupin seed, white (lat. Lupinus albus)	870	960.21	39.79	396.09	94.05	126.75	343			
27	Maize feed flour	880	966	34	116	75	58	7			
28	Maize flakes	890	990.39	9.61	89.735	29.645	15.633	855			
29	Maize kernel silage	650	986.04	13.96	91.392	44.373	18.887	831			
30	Maize starch	890	999	1	4.3	3	2	989.7	0.2	0.2	4
31	Maize, grains {Corn}(lat. Zea mays)	870	985.027	14.973	96.343	47.163	19.294	822.2	0.04217	3.266	18
32	Milling by-product mixture	870	949.8	50.2	179.395	51.421	81.14	637.9	1	07	131
33	Oat feed meal	900	970	30	146	76	71	677	0.650	4.869	63
34	Oats flakes (lat. Avena sativa)	890	978.42	21.58	151.39	70.54	14.19	742.3	0.51771		
35	Oats grains, dehulled (lat. Avena sativa)	870	973.59	26.41	134.482	54.301	89.224	695.6	1.05		
36	Oats, grains (lat. Avena sativa)	870	970.559	29.441	119.413	50.386	118.784	682	0.81649		
37	Outgrowth wheat grains (lat. Triticum aestivum)	870	981.77	18.23	147.75	16.554	22.288	795.2	0.45272		
38	Palm oil (lat. Elaeis guineensis)	999	1000	0	0	1000	0	0	0		
39	Pea, seeds (lat. Pisum sativum ssp)	870	966.52	33.48	227.584	19.12	64.214	655.6	0.92958		
40	Peanut oil {ground-nut oil}	1000	1000	0	0	1000	0	0	0		
41	Potato peelings	150	944	56	110	7	47	780	2.4		
42	Potato protein	900	963.33	36.67	833.51	24.662	4.921	100.2	1.11		
43	Potato starch	830	996.03	3.97	2.032	1.519	2.397	990.1	0.2		
44	Rapeseed oil	1000	1000	0	0	1000	0	0	0		

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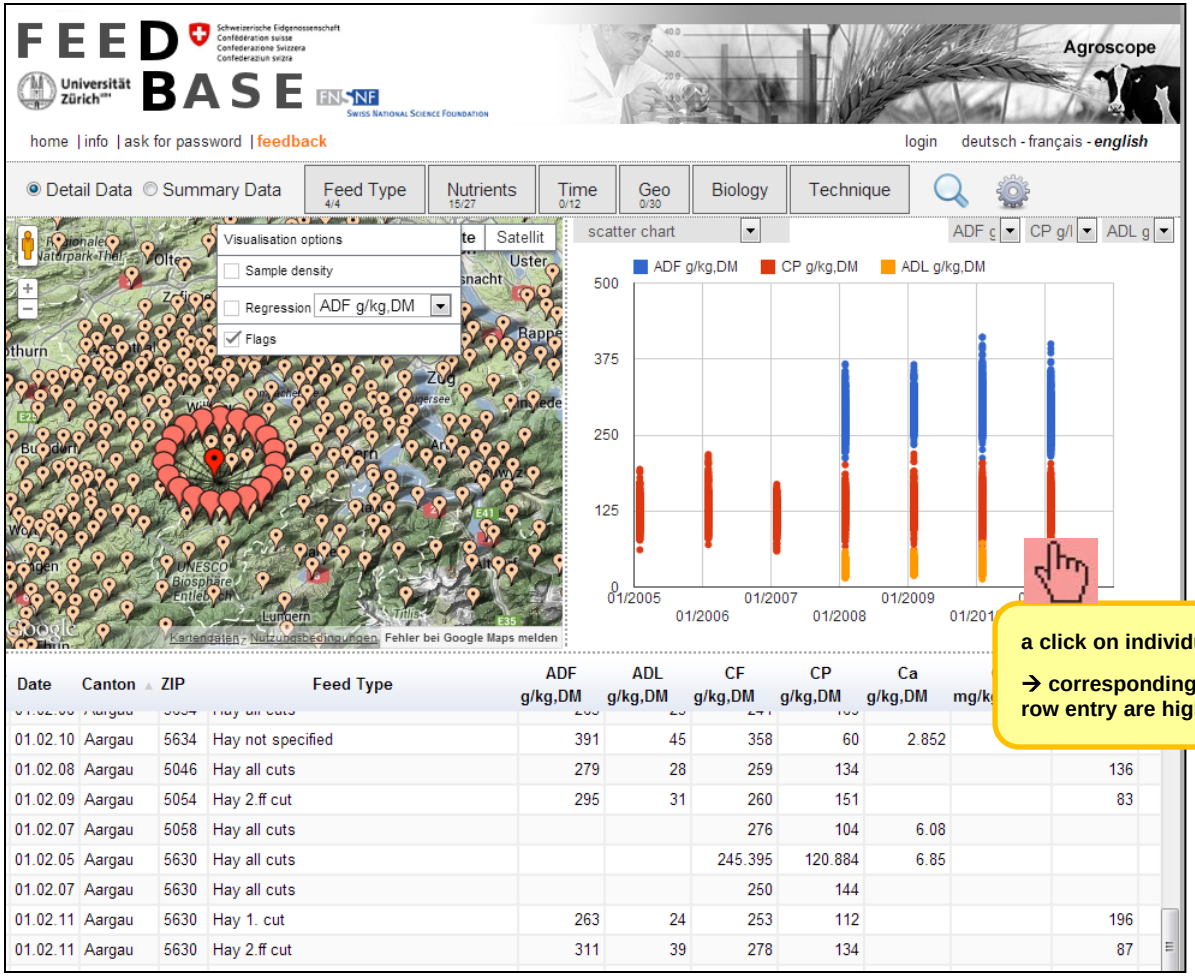
Result views: geo-referenced Detail Data

Query results displayed in 3 interacting windows: map, chart (+statistic), sortable list

Query result based on the hay survey



Date	Canton	ZIP	Feed Type	ADF g/kg,DM	ADL g/kg,DM	CF g/kg,DM	CP g/kg,DM	Ca g/kg,DM		
01.02.10	Aargau	5634	Hay not specified	391	45	358	60	2.852		
01.02.08	Aargau	5046	Hay all cuts	279	28	259	134			136
01.02.09	Aargau	5054	Hay 2.ff cut	295	31	260	151			83
01.02.07	Aargau	5058	Hay all cuts			276	104	6.08		
01.02.05	Aargau	5630	Hay all cuts			245.395	120.884	6.85		
01.02.07	Aargau	5630	Hay all cuts			250	144			
01.02.11	Aargau	5630	Hay 1. cut	263	24	253	112			196
01.02.11	Aargau	5630	Hay 2.ff cut	311	39	278	134			87

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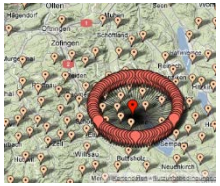
Visualization options: Google Maps, Kernel density function

Latitude and longitude of individual samples based on zip code

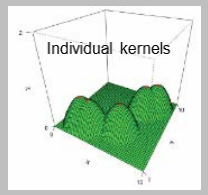


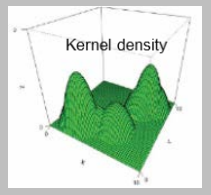
Limited visual possibilities with markers

Computation of the two-dimensional **density estimation** using bivariate Kernel function. Conversion of the density value into color values ranging from blue=low to red=high density.

$$\hat{f}_h(x,y) = \frac{1}{nh^2}\sum_{i=1}^{n} K\left(\frac{x-X_i}{h}, \frac{y-Y_i}{h}\right)$$

$$h_{opt} = \sigma * A(K) * n^{-\frac{1}{6}}$$





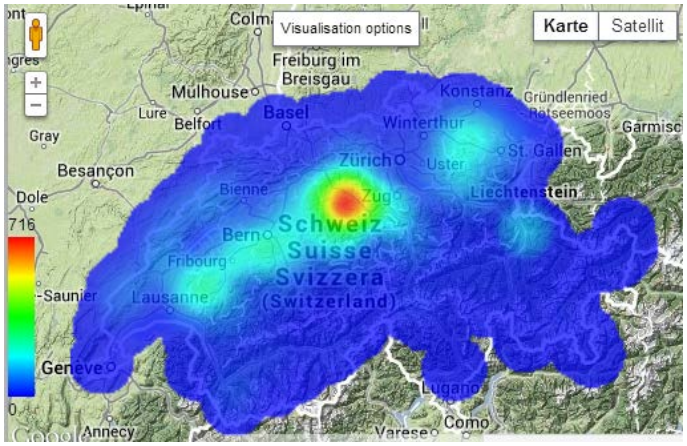
Where K = Bivariate Epanechnikov Kernel

$$K(x,y) = \begin{cases} \frac{2}{\pi}(1-x^2-y^2), & if\ x^2+y^2<1 \\ 0, & otherwise. \end{cases}$$

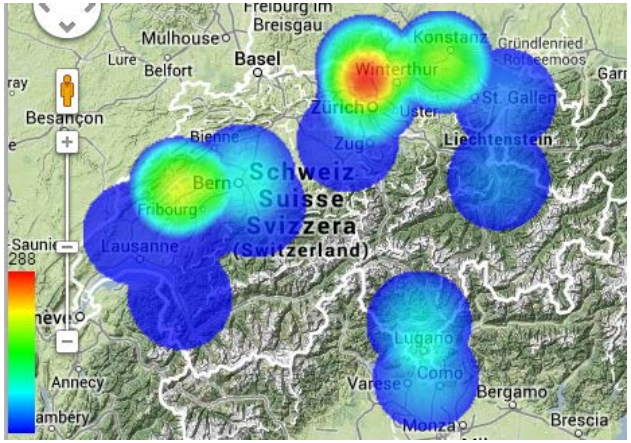
h = bandwidth (smoothing factor)
x, y = coordinates

Sample density: color scale dynamically generated for each selected data set

Hay survey: countrywide sample distribution



Maize grains: regional sample distribution



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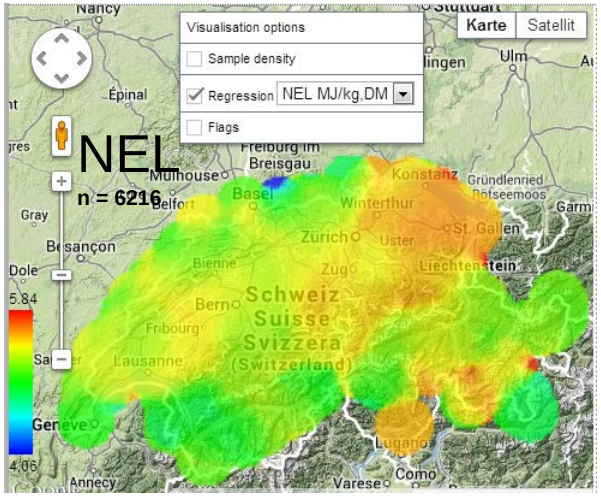
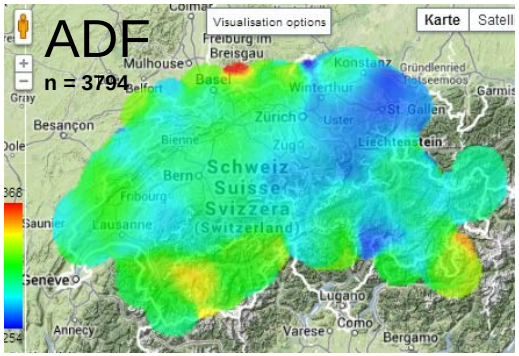
Spatial patterns in hay quality (Kernel regression)

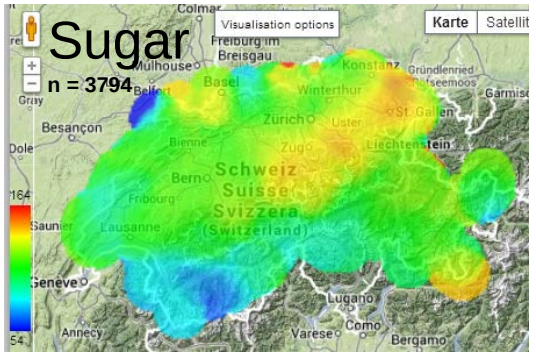
The nutrient density at the location (x,y) is:

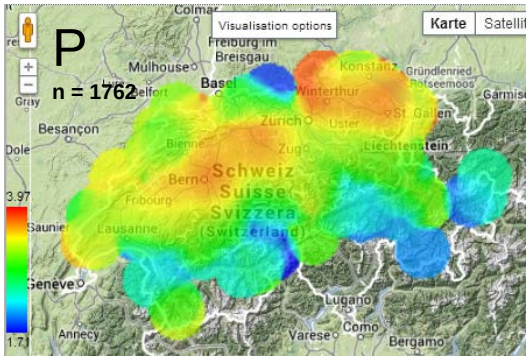
$$\hat{g}_h(x,y) = \frac{\sum_{i=1}^{n} K\left(\frac{x - X_i}{h}, \frac{y - Y_i}{h}\right) Q_i}{\sum_{i=1}^{n} K\left(\frac{x - X_i}{h}, \frac{y - Y_i}{h}\right)}$$

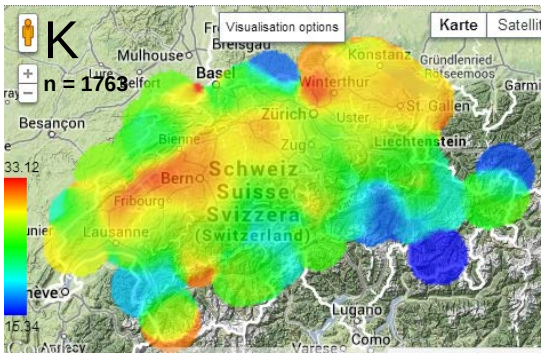
Reliable interpretation with >1000 locations











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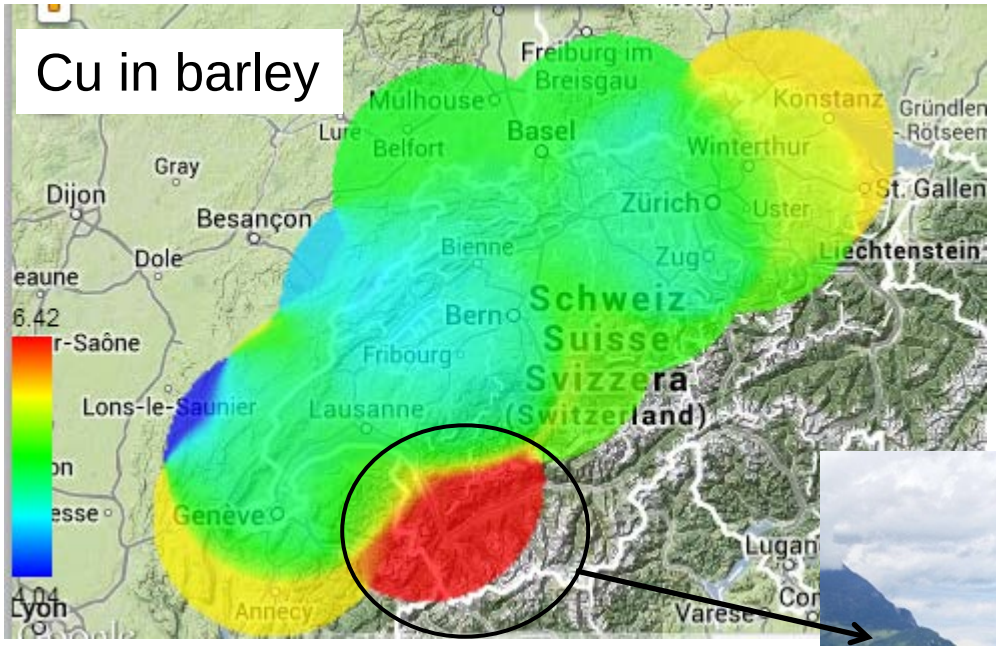
Spatial pattern in barley: local effects on Cu



Wind drift from vinyards?

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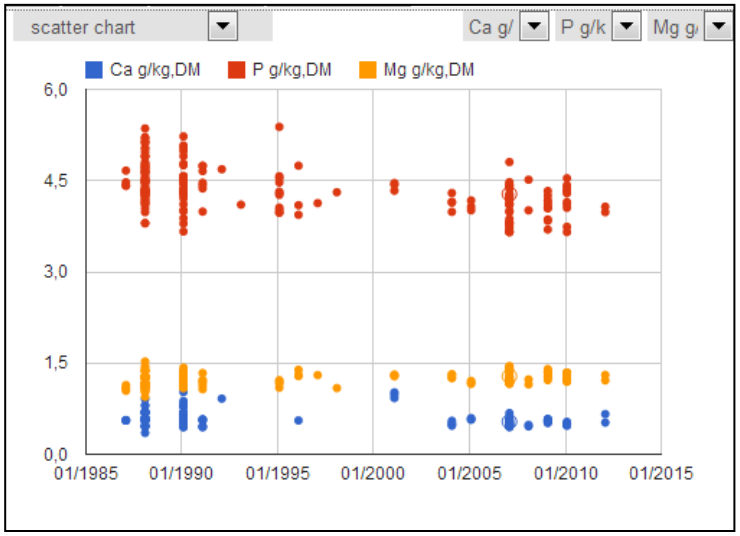
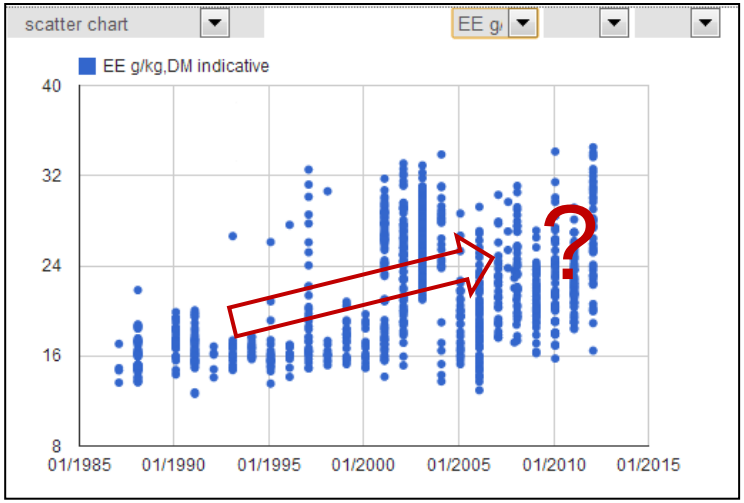
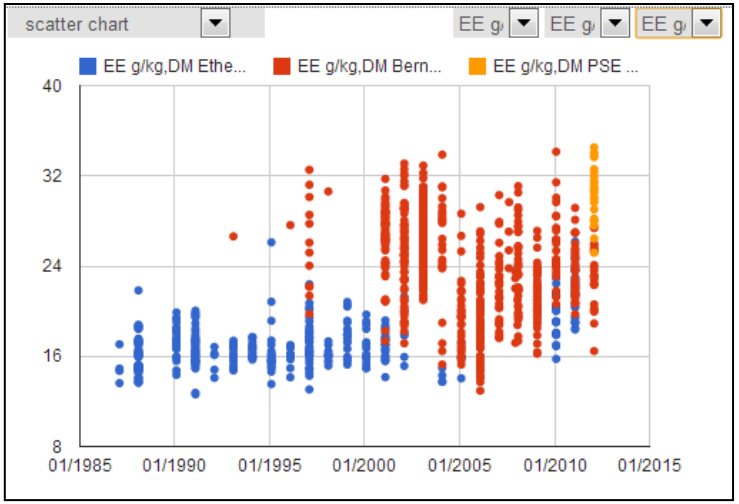
Temporal analysis in barley: minerals, fat



Decreasing P content in barley
1988/1990: 4.5 g P/kg DM
>2000: 4.1 g P/kg DM

Change in chemical analysis





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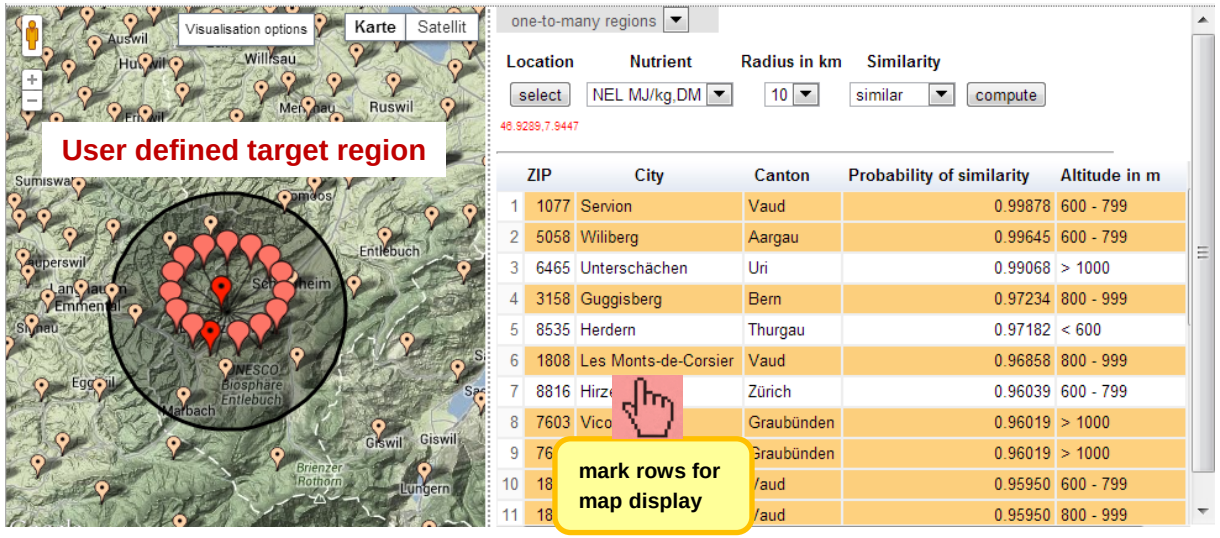
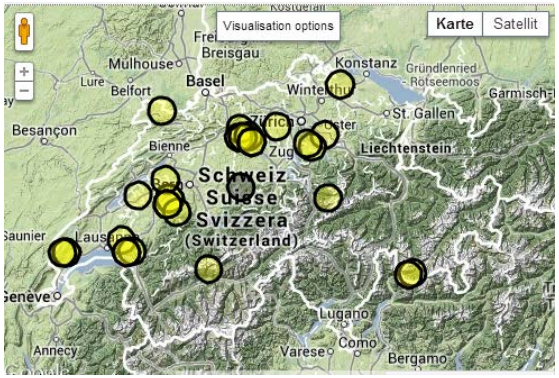
Advanced data analysis: region comparison



Top 30 most similar regions



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Conclusions

- Recent developments of the online Swiss feed database support intuitive and advanced data analysis down to individual samples with the use of visual tools.
- Scatter plots visualize temporal patterns or trends and show the full extent of variation.
- As a novel approach, spatial patterns are generated for large, geo-referenced data sets using the Kernel regression technique.
- Now two complementary approaches for forages:
  1) Reference nutritive values dependent from botanical composition, growth stage, cut number and type of conservation (from 2007) however, not dependent from year and geographical region.
  2) Detailed spatio-temporal data (from 2013), however without information on botanical composition nor growth stage.

- For further discovery: **www.feedbase.ch**