Preliminary results on the EE-LV transboundary spring monitoring activities

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Joint actions for more efficient management of common groundwater resources

Aims of the activity

- **Spring monitoring optimization and watershed modeling**
  - Propose representative springs for transboundary GWB monitoring

Approach

- Sample a lot of springs
- Gather all the available data about the GWB
- Sample some wells to define aquifer end-members
- Try to guess from which aquifer the springs get water from

What has been done so far

- Three sampling campaigns
  - April 2021
  - August 2021
  - March 2022
- 89 water samples have been collected from 64 locations
  - EE – 55 samples
  - LV – 34 samples


ĢRĒSU
BRŪZA
GRAUZDĒTAIS
GAIŠAIS ALUS


SPECTRO PHOTO -
METER

Sampling

- **Solinst 410 peristaltic pump or a syringe** and a 0,45 um RC filter
- Bottles and preservation:
  - Cations (15 ml HDPE) – HNO_3
  - Anions (15 ml HDPE)
  - Trace elements (15 ml HDPE) – HNO_3
  - $^{18}O/^{2}H$ (15 ml HDPE)
  - DOC/N_{tot} (60 ml HDPE)
  - P_{tot} (175 ml HDPE) – H_2SO_4
- *In-situ* field parameters and hardness and HCO_3^- titration.

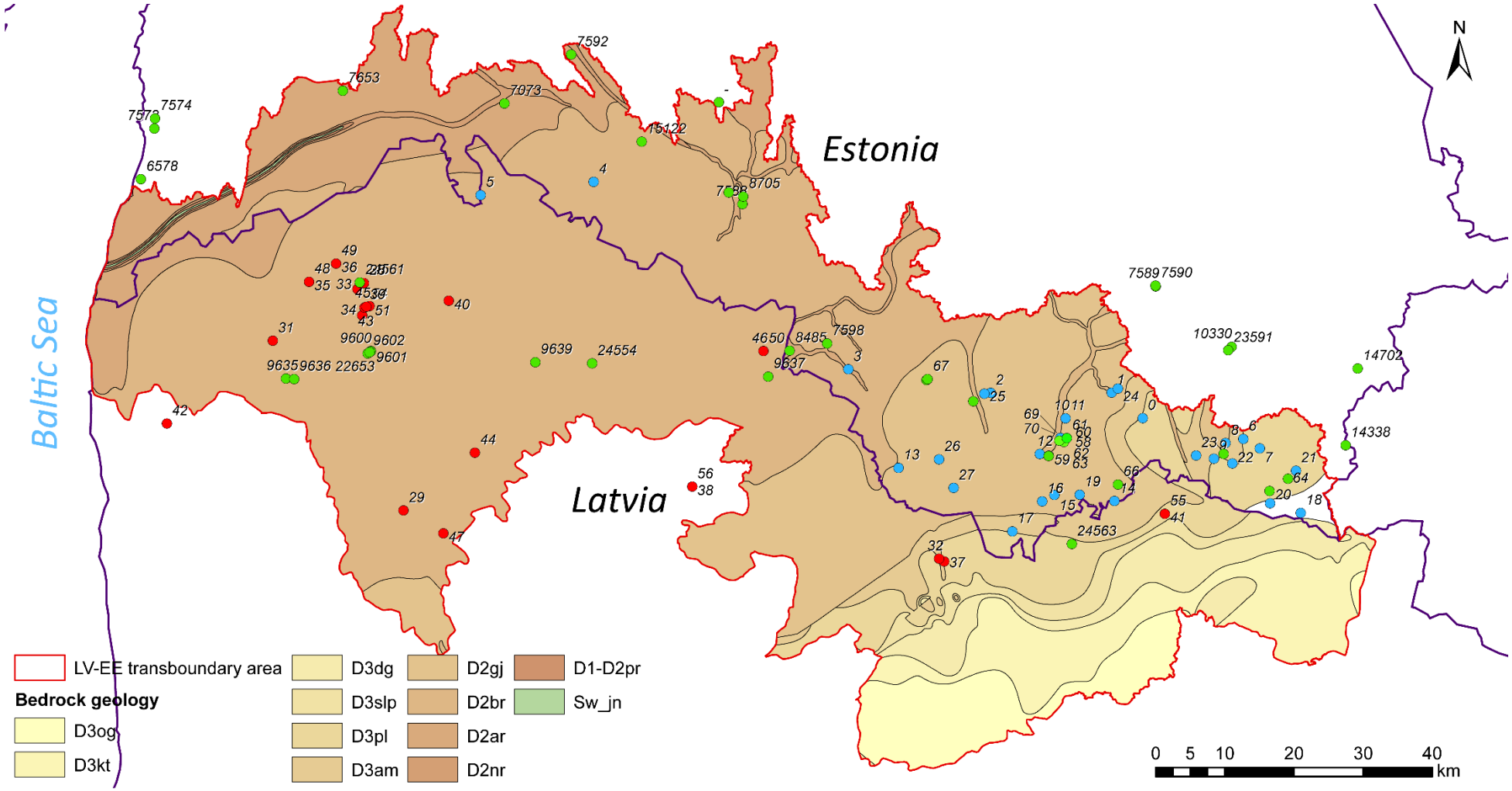
Lab analysis

- TLÜ lab:
  - **Major ions** (Na+; NH4+; K+; Mg2+;Ca2+; F-; Cl-; NO2-; Br-; NO3-; PO43-; SO42-) – HPLC - SHIMADZU® RID-10A või CDD-10A ;Shodex IC YS-50 ja Shodex IC SI-50.
  - **Nutrients** (DOC; IC; TC; Ntot; Ptot; PO4-P; OP) – Analytik Jena multi N/C 3100 TOC/TNb analyzer and spectrophotometry
- University of Latvia lab:
  - **Trace elements** (Al; As; B; B; Ba; Be; Ca; Cd; Co; Cr; Cu; Fe; K; Li; Mg; Mn; Mo; Na; Ni; P; Pb; S; Sb; Se; Si; Sr; Ti; Tl; V; Zn) – Thermo Scientific Inc. iCAP7000 ICP-OES
  - **Stable isotopes** (^{18}O; ^{2}H) - Picarro Isotopic Water Analyzer L2130-I (Cavity Ring-Down Spectroscopy)

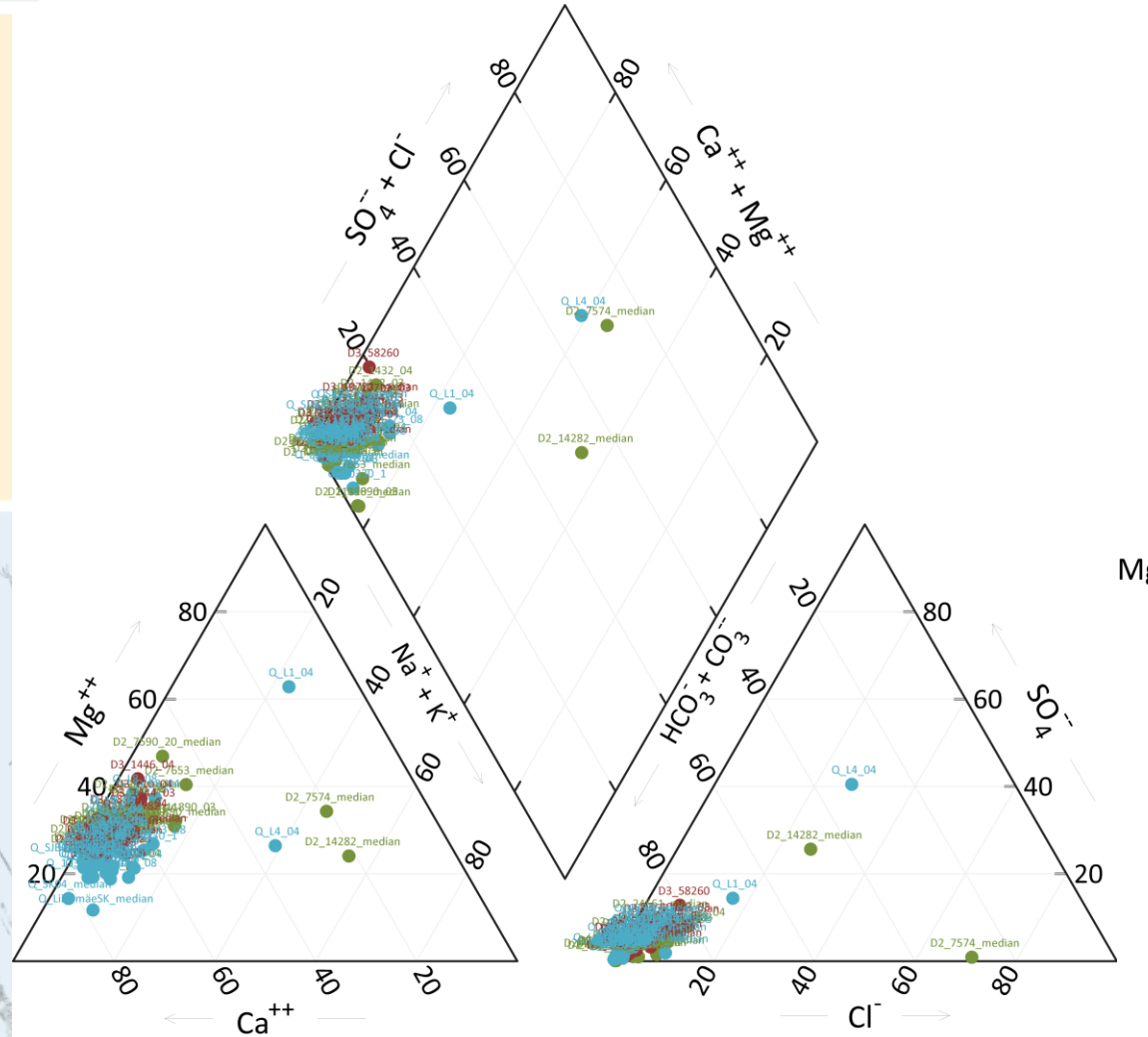
Database

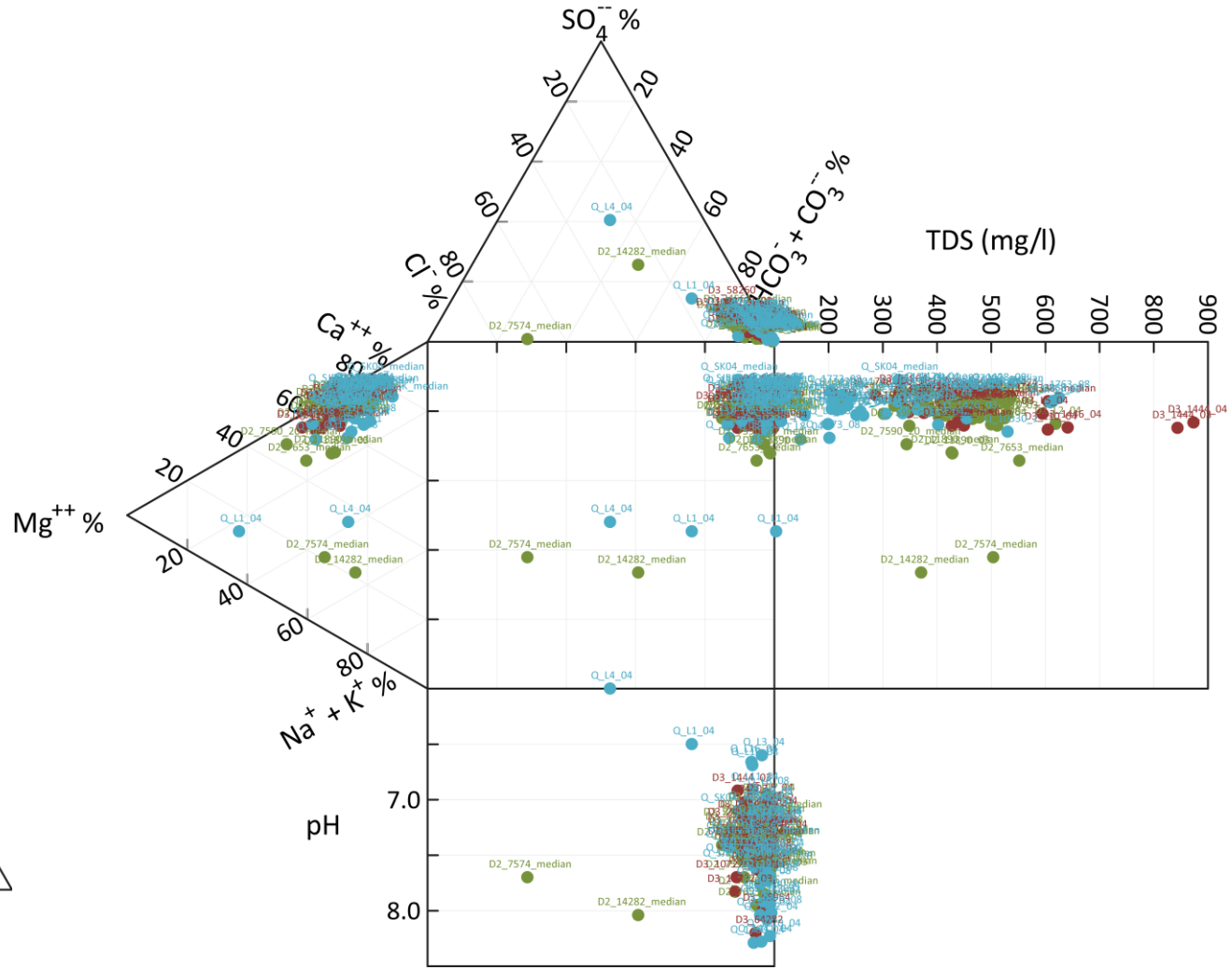
- A hydrochemical database has been assembled consisting of 406 groundwater observations from:
  - WaterAct
  - GroundEco
  - KESE
  - EELIS
  - VEKA
  - LEGMC

Study area

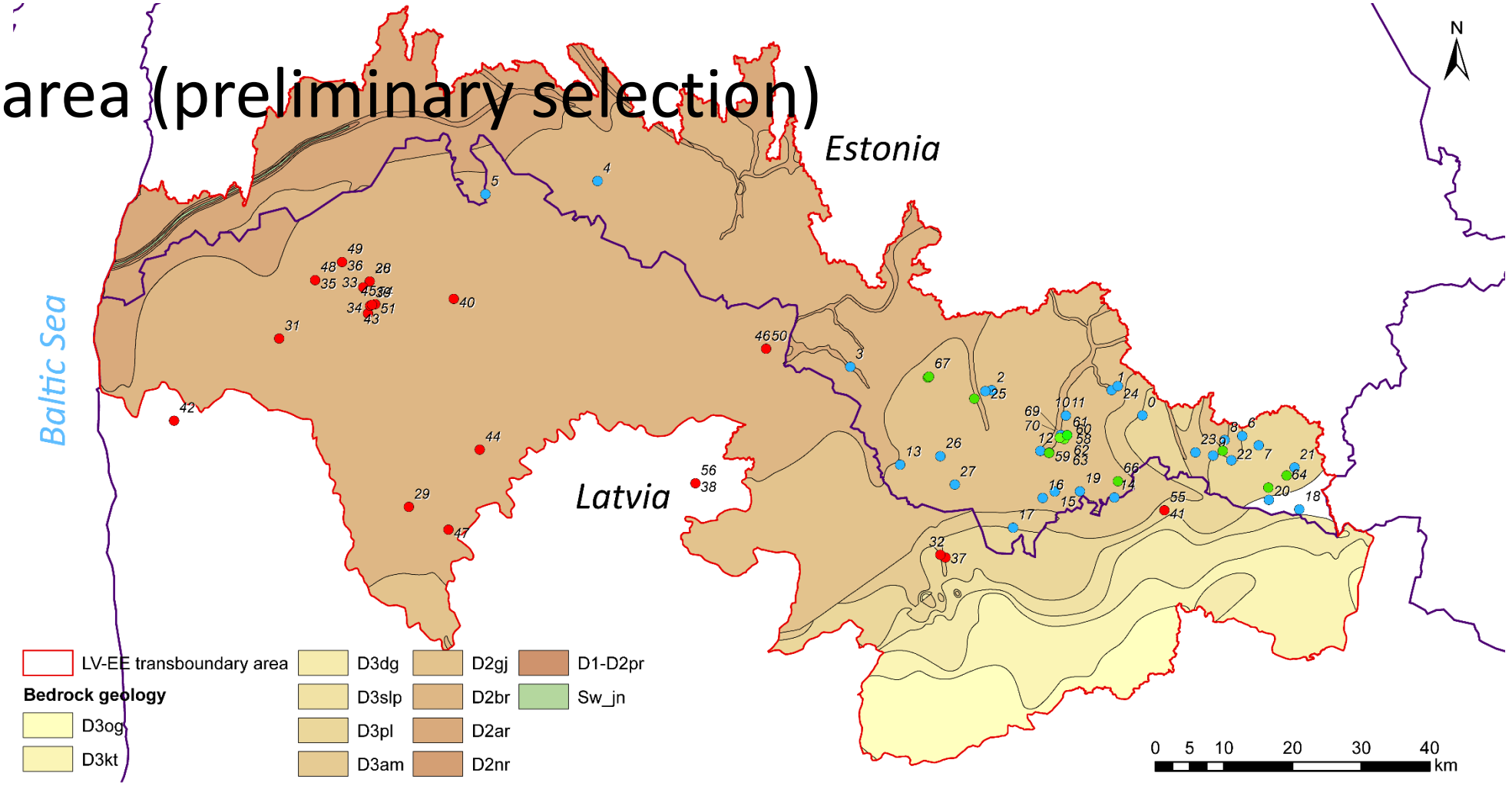

Baltic Sea
Estonia
Latvia
N
0 5 10 20 30 40
km
LV-EE transboundary area
Bedrock geology
D3og
D3kt
D3dg
D3slp
D3pl
D3am
D2gj
D2br
D2ar
D2nr
D1-D2pr
Sw_jn

General ion chemistry





Study area (preliminary selection)



ID	Spring	ID	Spring	ID	Spring	ID	Spring	ID	Spring	ID	Spring	ID	Wells	Aquifer
0	Veskiläte	11	Silmäviiläte 2 (grifoon)	22	Pütsepa allikate seirepunkt	33	Ģendertu avots	44	Velna pēdas avots	70	M1_spring	58	Lauda PK	D2
1	Mõõnoja läte	12	Roobi läte	23	Kitseoru allikate seirepunkt	34	Gudzonu avots	45	Vilkaču avots	71	Spiģu avots	59	Varstu PK 10890	D2
2	Saarjärve läte	13	Põrguhavva allikas	24	Süvvaoja allikate seirepunkt	35	Iģes velnalas avots	46	Zāģavots	72	Veselības avots	60	Liivamäe SK	Q
3	Kaagjärve allikas	14	Külmläte	25	Märdeläte	36	Jaunlīču avots	47	Zilaiskalns avots	73	Acu avots	61	SK04	Q
4	Timmu raviallikas	15	Laurimäe allikas	26	Roodsi-mõtsakunna allikas	37	Lauvas mutes avots	48	Iģes velnalas avots	74	Zīļu avots	62	Hansi_pk	D2
5	Raudpõllu allikas	16	Tundu läte	27	Valgemäe allikas	38	Oliņu avots	49	Jaunlīču avots			63	M1PA6	D2/Q
6	Pikätükümäe allikas	17	Lilleoru allikas	28	Dauģēnu cirka avots	39	Oļu alas avots	50	Zāģavots			64	Misso	D3
7	Puupõlluallikas	18	Korgõssaarõ Silmaallikas	29	Dikļu avots	40	Pantenes avots	51	Vilkaču avots			65	Varstu PK 10890	D2
8	Vorstimäe allikas	19	Tuurimäe silmaallikas	30	Dauģēnu dzelzs avots	41	Sauleskalna avots	54	Velnakmens avots			66	Krabi	Q
9	Hutitaja allikas	20	Lättepera allikad	31	Karogupītes avots	42	Ķiršu avots	56	Oliņu avots			67	Lüllemäe	D2
10	Silmäviiläte 1	21	Viinavabriku allikad	32	Gaujienas avots	43	Velnakmens avots	69	M3_spring			68	Ruusmäe	D2

Classification of springs (preliminary)

- First we need to have a clue where the water is coming from.
- The groundwater observations from the springs and wells were classified by using **discriminant analysis**
  - Presumed classifications (D2, D3, and Q) were used as dependent variables.
  - In addition to quantitative hydrochemical variables, some qualitative spatial variables were/will be used (bedrock outcrop, quaternary deposits and thickness, land use).

You shall be D3!

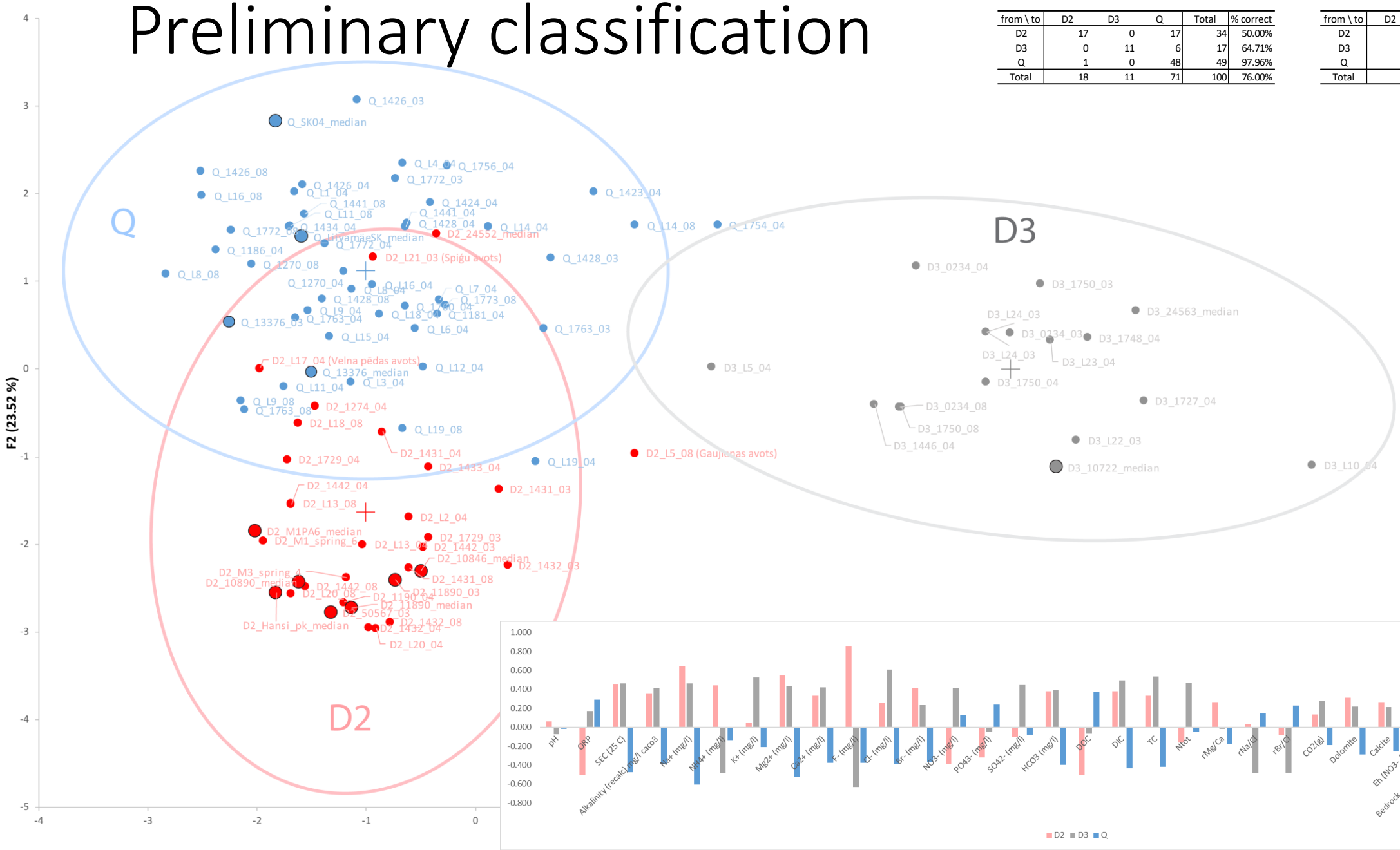
Preliminary classification

Confusion matrix for the cross-validation results:

from \ to	D2	D3	Q	Total	% correct
D2	17	0	17	34	50.00%
D3	0	11	6	17	64.71%
Q	1	0	48	49	97.96%
Total	18	11	71	100	76.00%

Confusion matrix for the estimation sample:

from \ to	D2	D3	Q	Total	% correct
D2	34	0	0	34	100.00%
D3	0	17	0	17	100.00%
Q	0	0	49	49	100.00%
Total	34	17	49	100	100.00%



- Thank you for the attention!

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VIDZEME THE ONLY WAY IS UP!

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