GEOLOGICAL SURVEY OF ESTONIA

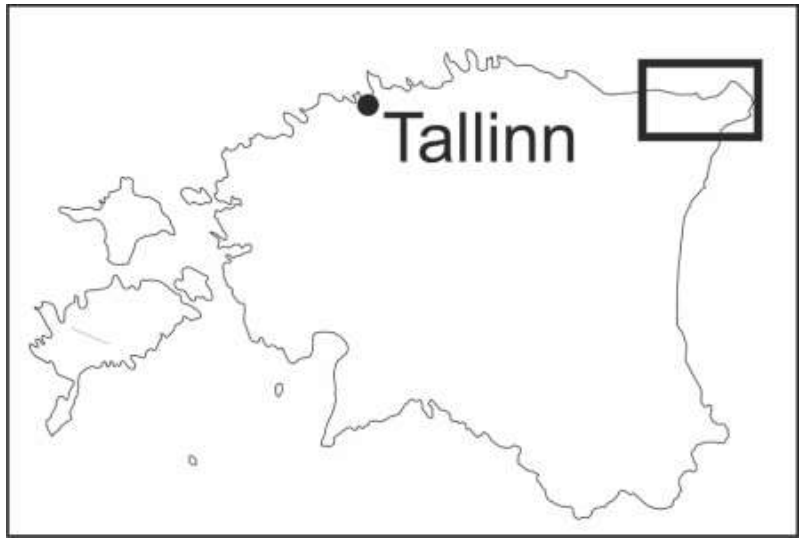
cleanest

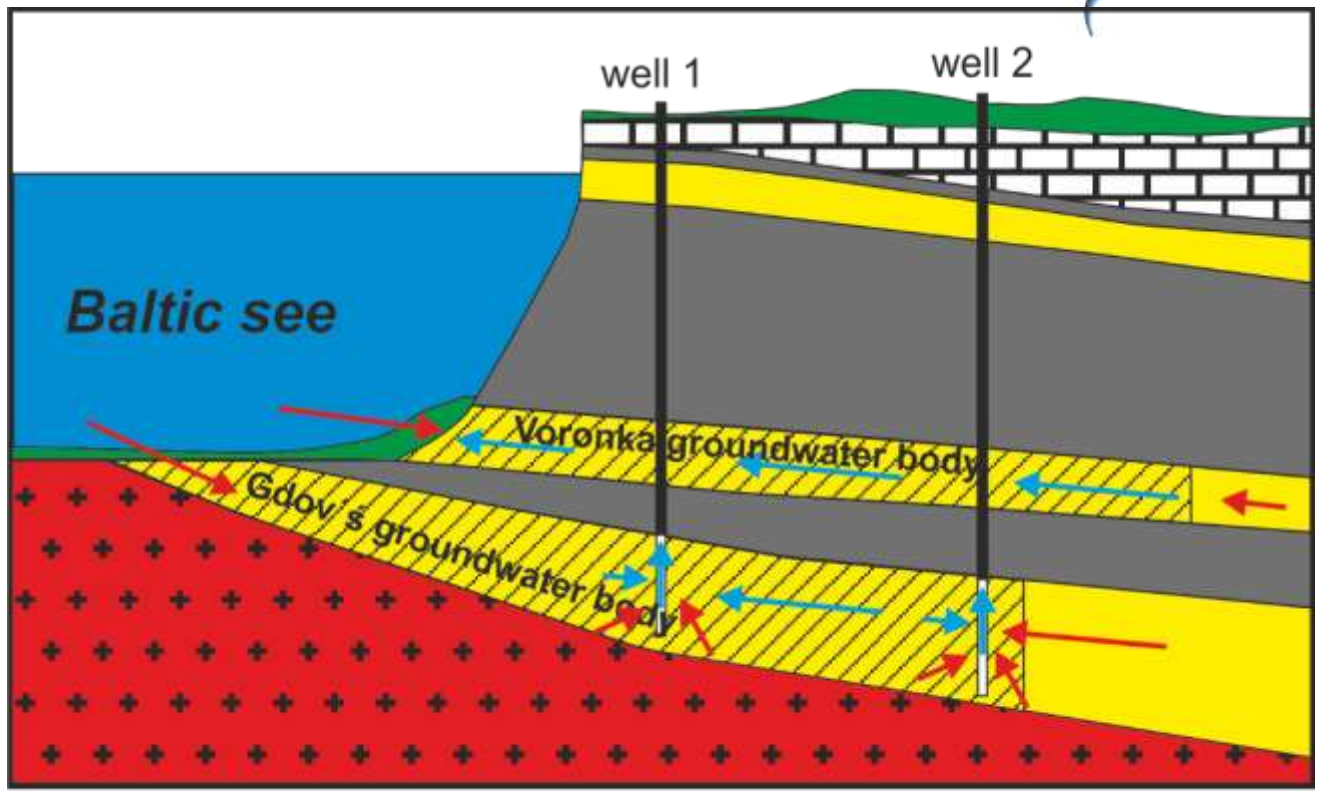
Problems related to national groundwater monitoring network and groundwater-surface water interaction in groundwater bodies of the Viru-subbasin, Estonia

Valle Raidla, Merle Truu

2022

Prologue: Gdov's groundwater body



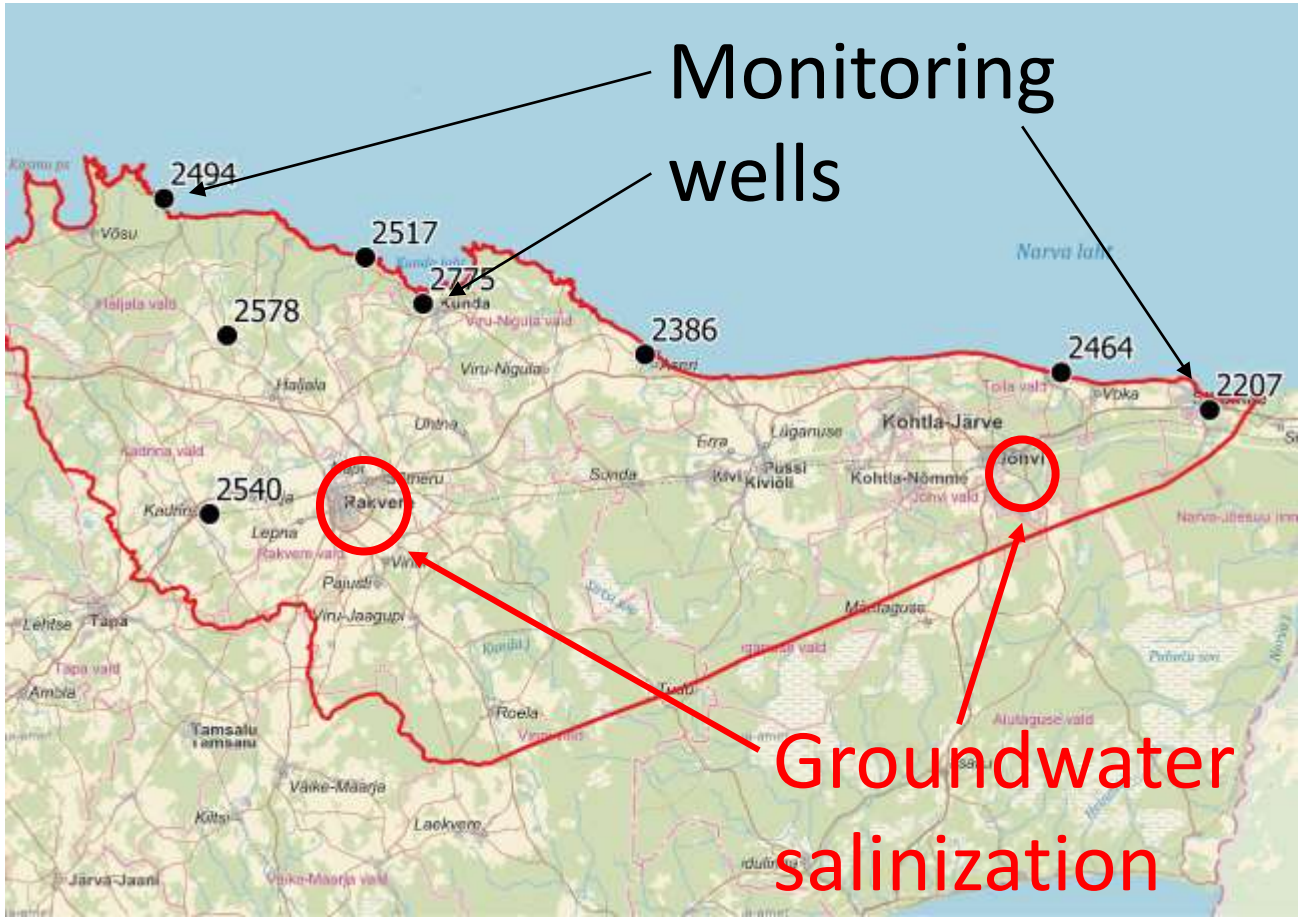


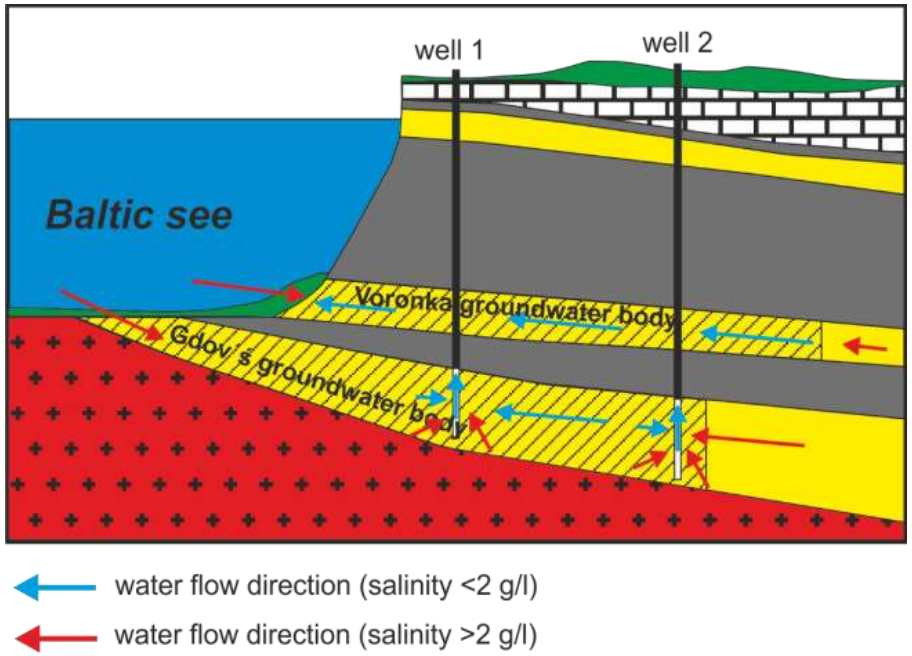
water flow direction (salinity <2 g/l)

water flow direction (salinity >2 g/l)

Fresh water body between two salt water basins.

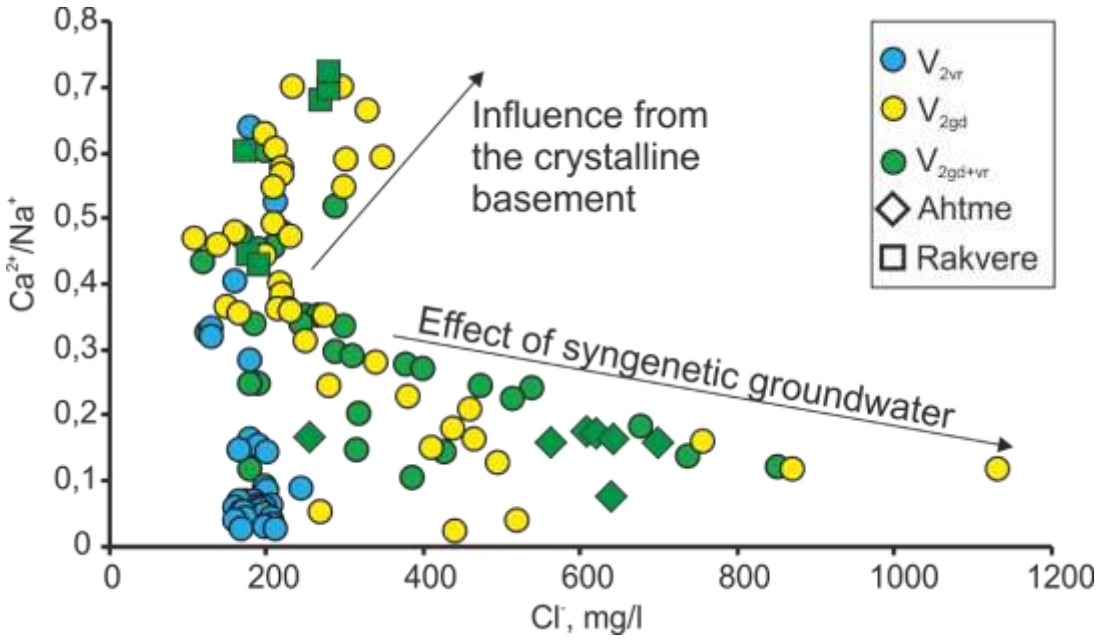
Prologue: Gdov's groundwater body

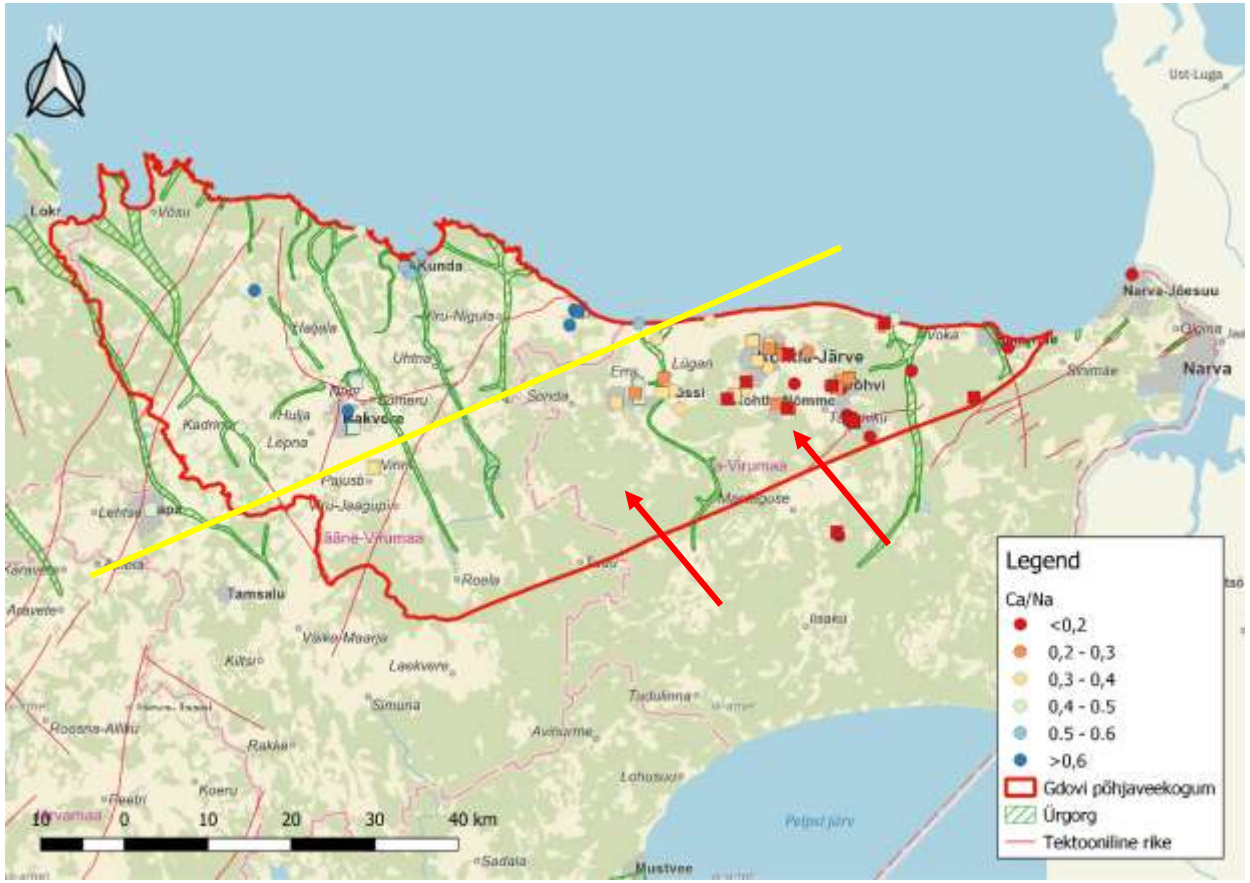




Water salinization (increased Cl and Na) became a problem for the groundwater body, but not on the coast but inland.

Prologue: Gdov's groundwater body

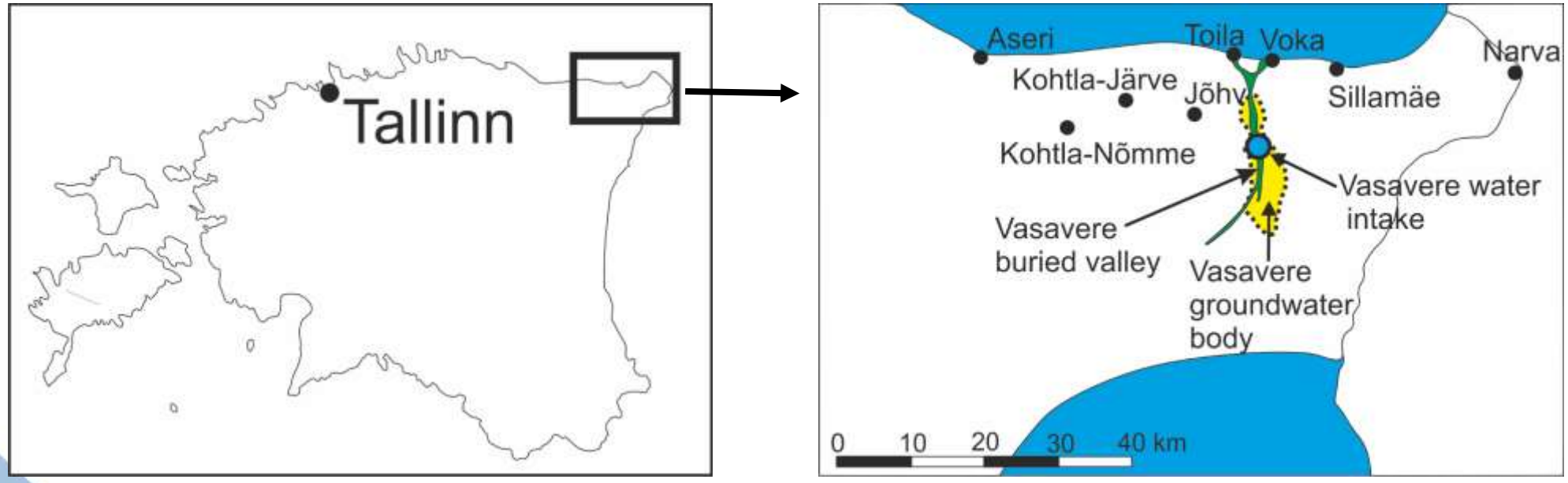




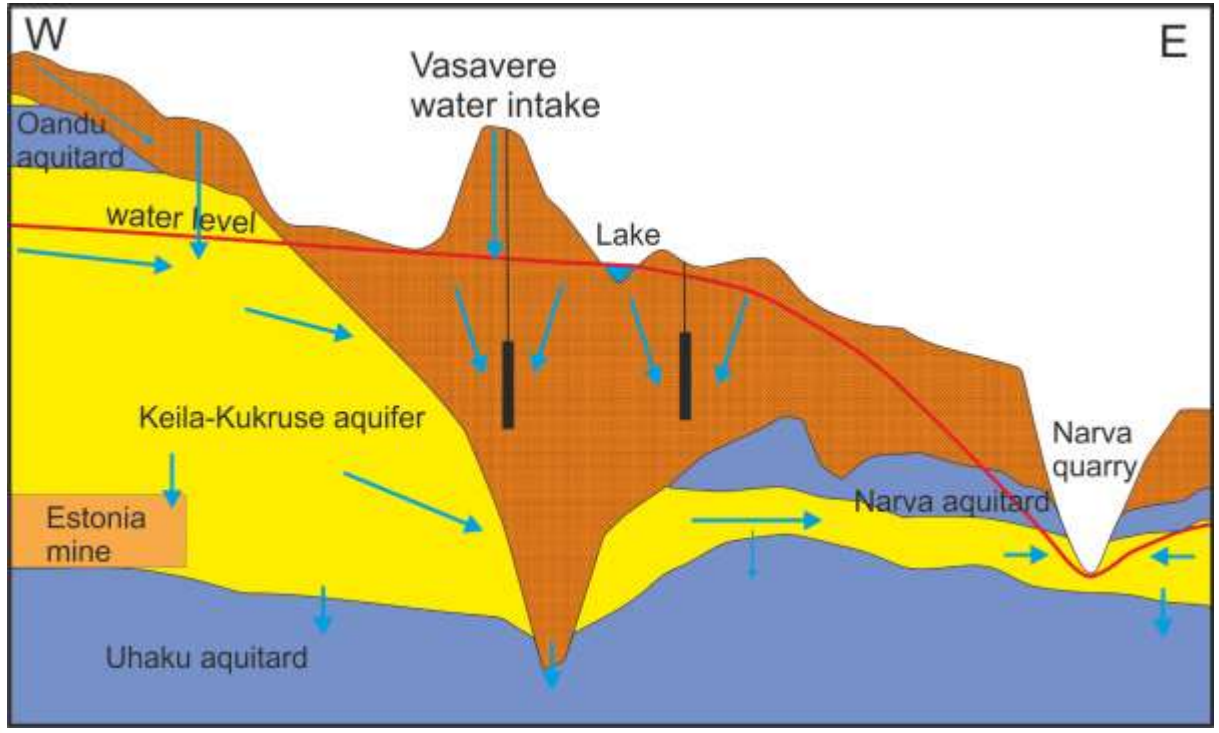
It turned out that almost half of the ground-water body was affected by the southern mineral water.

Problem: Vasavere groundwater body

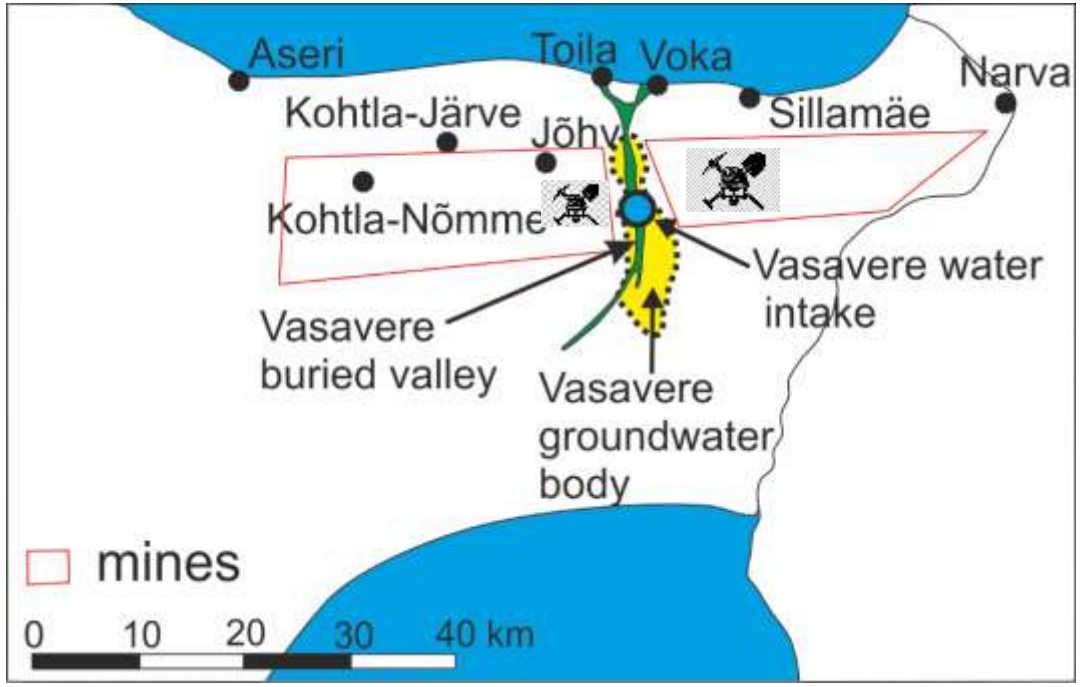
- According to the status assessments of the groundwater bodies carried out in 2014 and 2020, the chemical status of the Quaternary Vasavere groundwater body was found to be poor due to the upward trends of COD_{Mn} (chemical oxygen demand), NH_4^+ and NO_3^- values.
- It is essential to understand the causes of the trends because the groundwater body is used as an important source of water supply for the surrounding areas.
- Given the above, a study was performed within the LIFE IP CleanEST project in 2019–2021.



Site description: Vasavere groundwater body

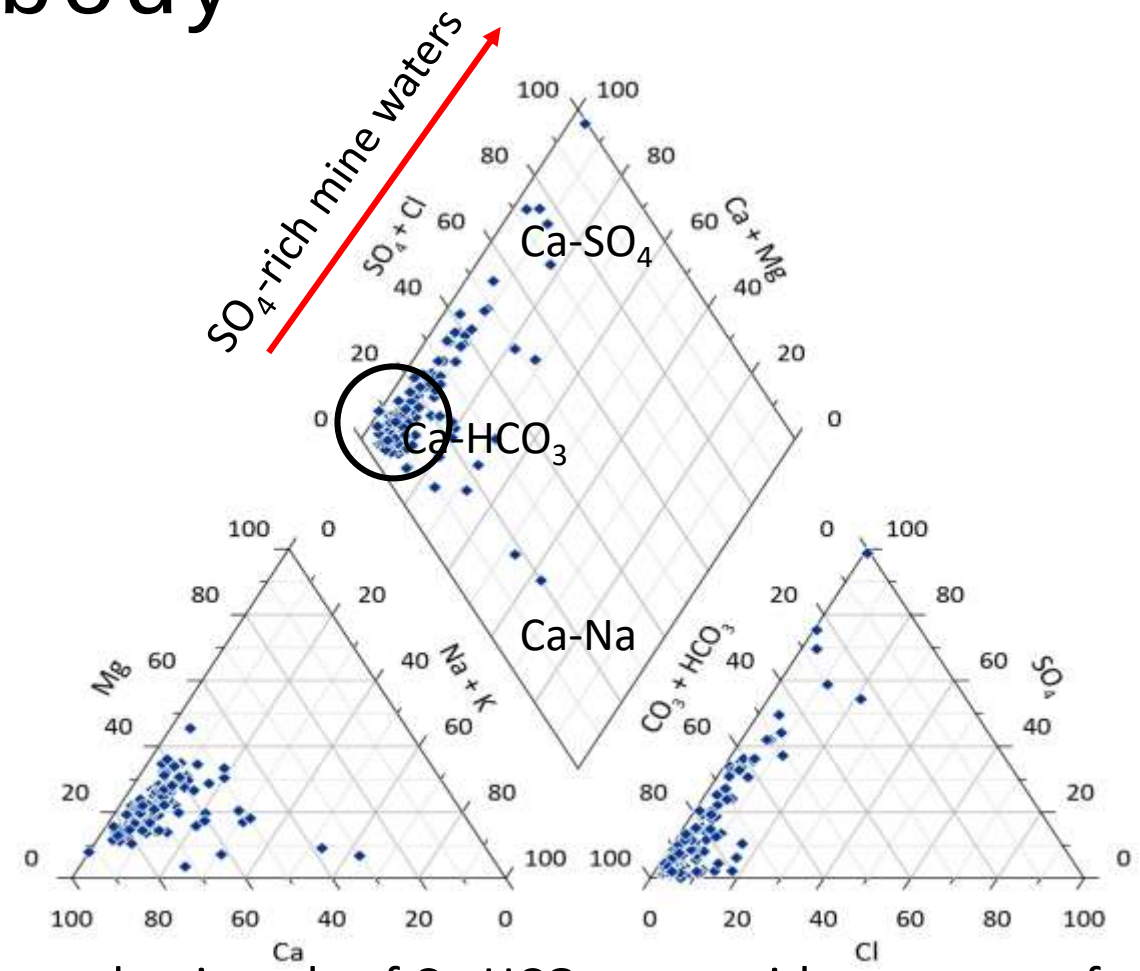


The majority of the groundwater body is located in the buried valley of Vasavere, which is filled with fluvioglacial sand.



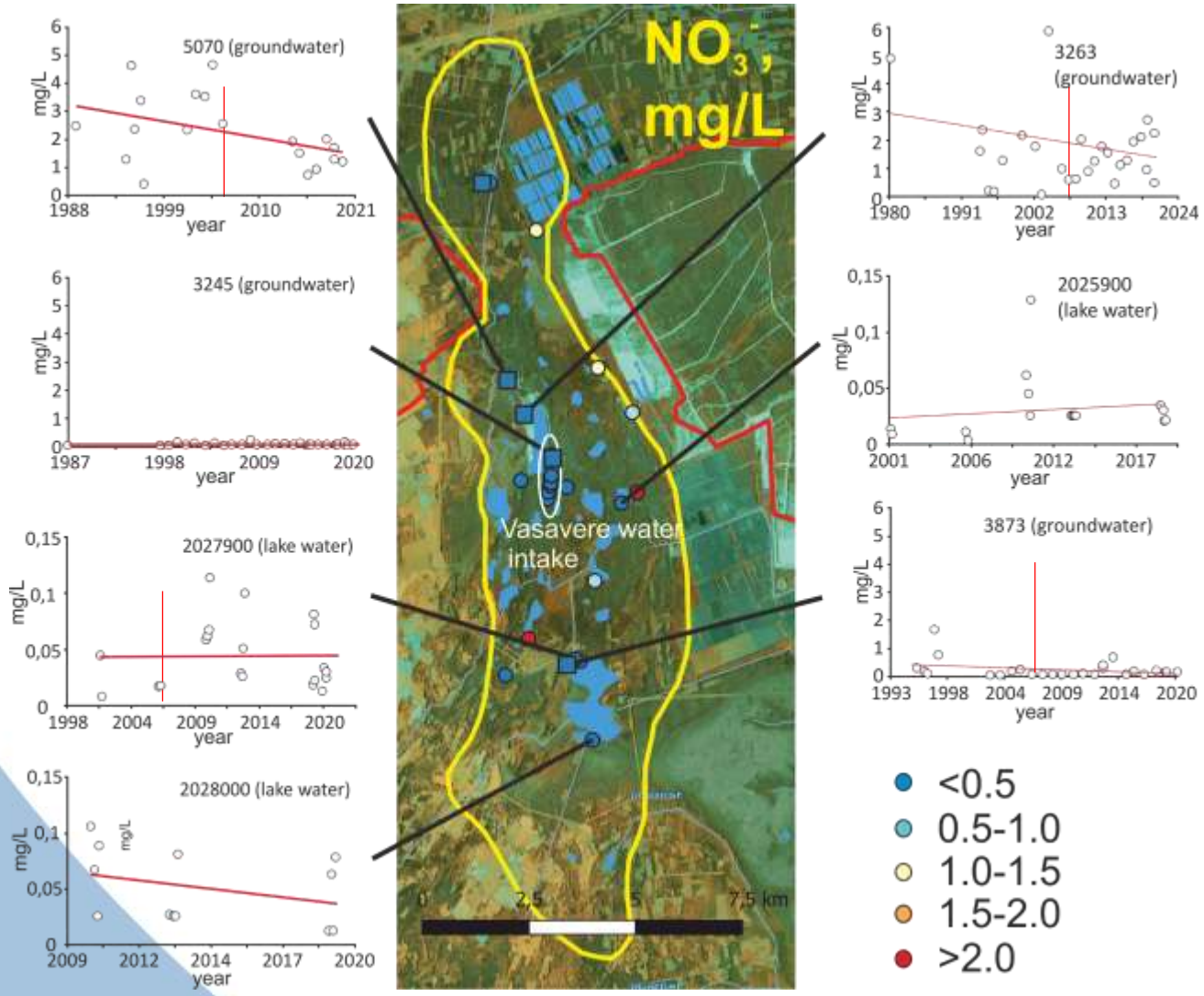
The groundwater body and local surface water ecosystems are affected by the adjacent oil-shale mines, the water abstraction, peat cutting and forest drainage.

Site description: Vasavere groundwater body



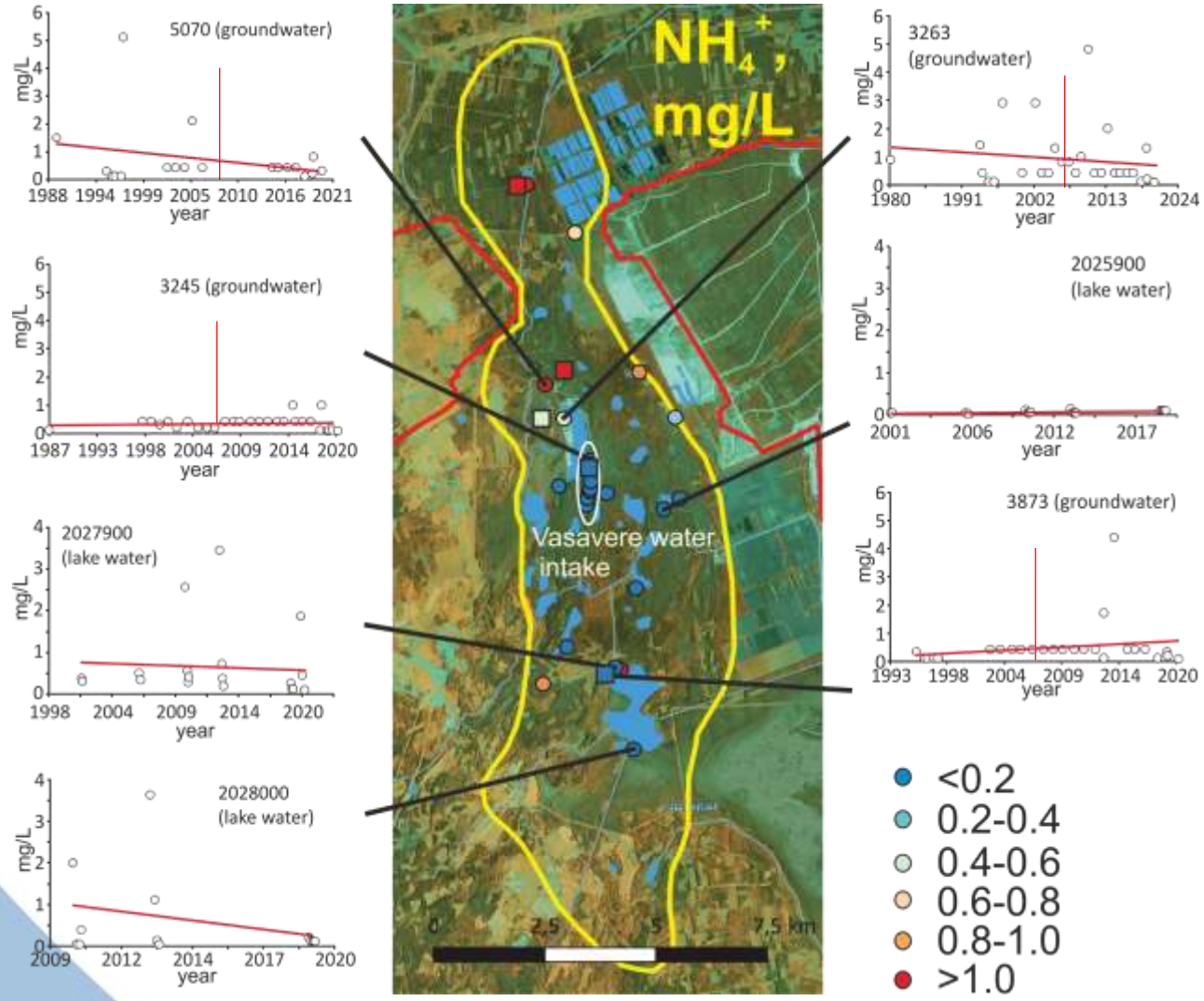
Water in the groundwater body is predominantly of Ca-HCO_3 type, with a content of total dissolved solids of 0.2–0.5 g/L.

Results



- Nitrate concentrations were below 2.2 mg/L in all wells, and the detected growth trends can be considered statistically insignificant.
- An increasing trend of NO_3^- observed in the four boreholes in years 2007 to 2014, however, it occurs at very low concentrations.

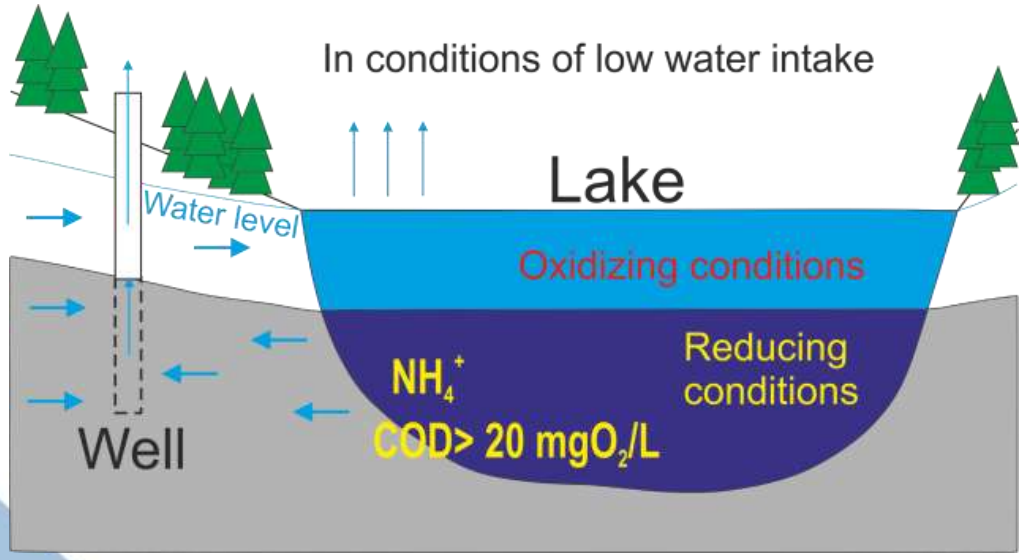
Results

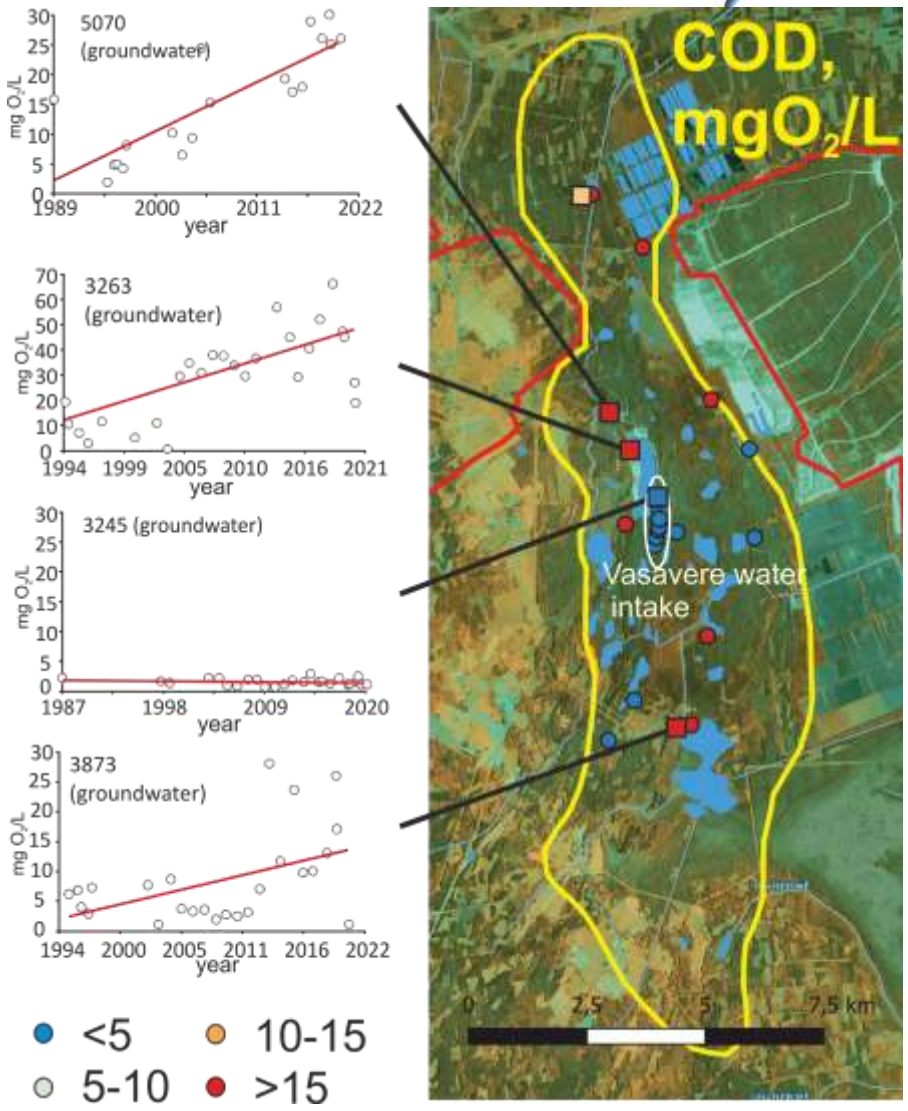


Elevated NH_4^+ levels (0.92–1.85 mg/L) were detected in four wells, but statistically the increasing trends are unreliable.

Results

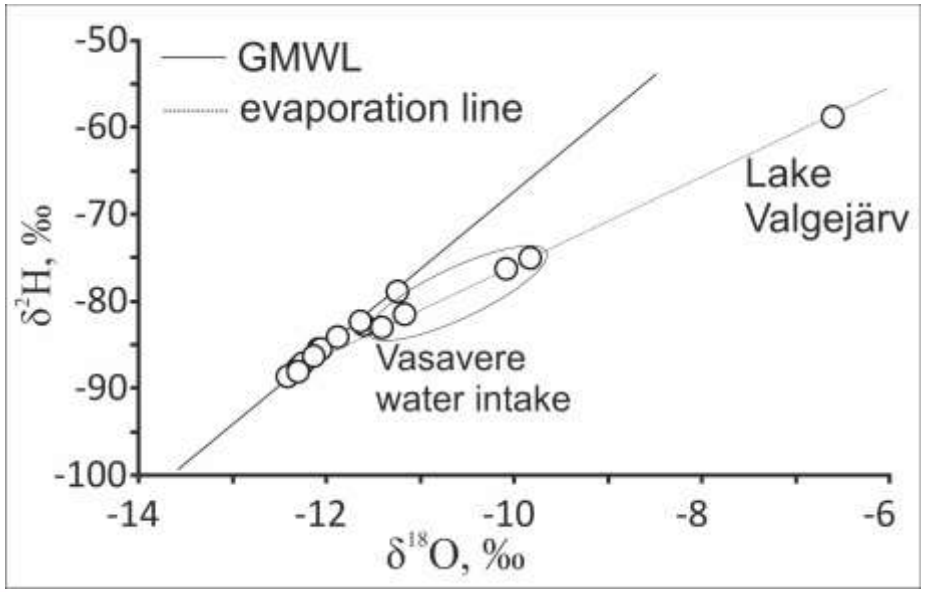
- The COD values vary widely, and in 8 wells the results ranged from 22 to 42 mgO_2/L.
- A clear increasing trend of COD content was detected in three wells.
- Higher NH_4^+ and COD_{Mn} values are more characteristic of wells which are located near wetlands.



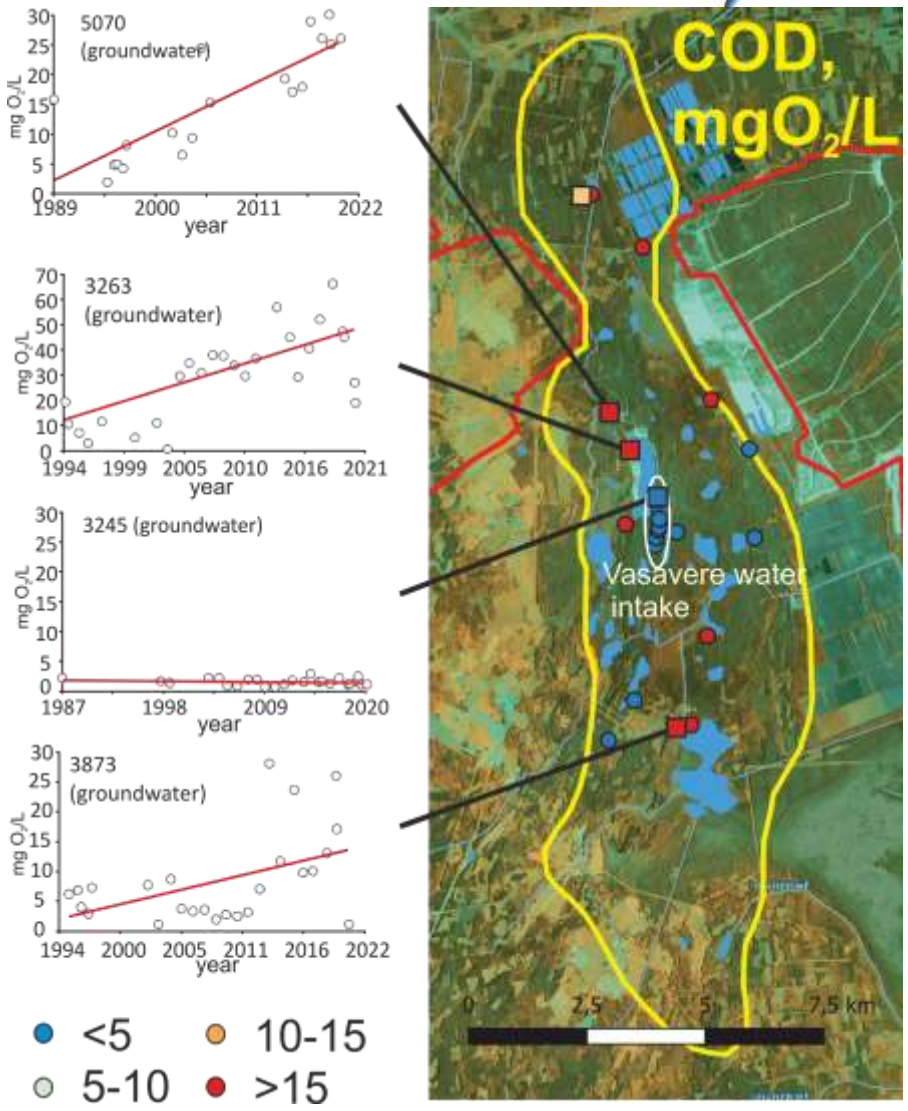


Results

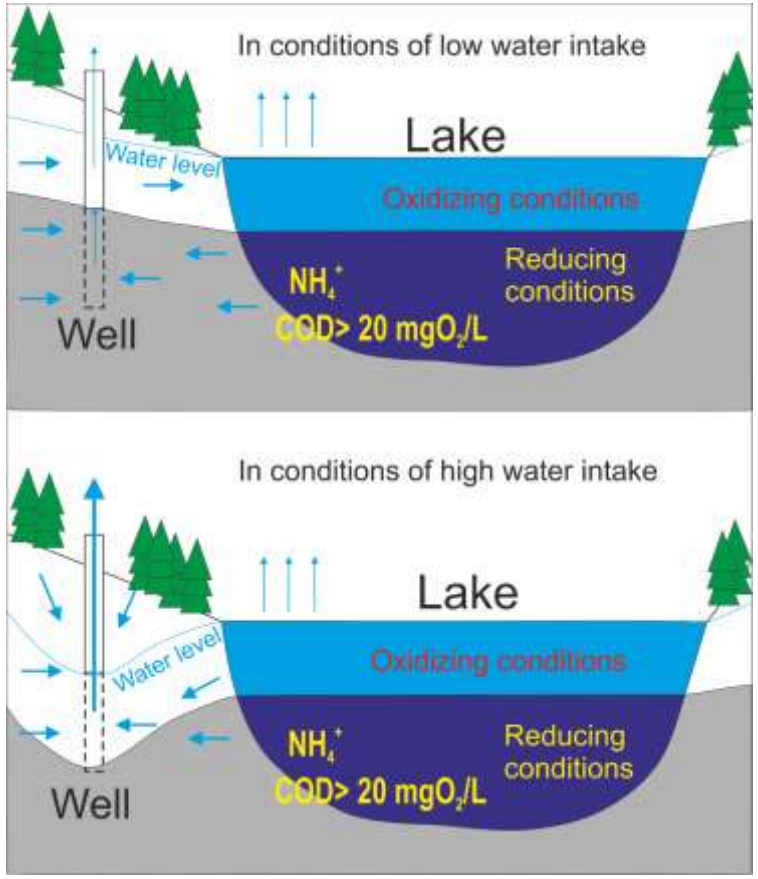
At the same time, high COD values are not found in the wells of the Vasavere water intake, which is located among the lakes.

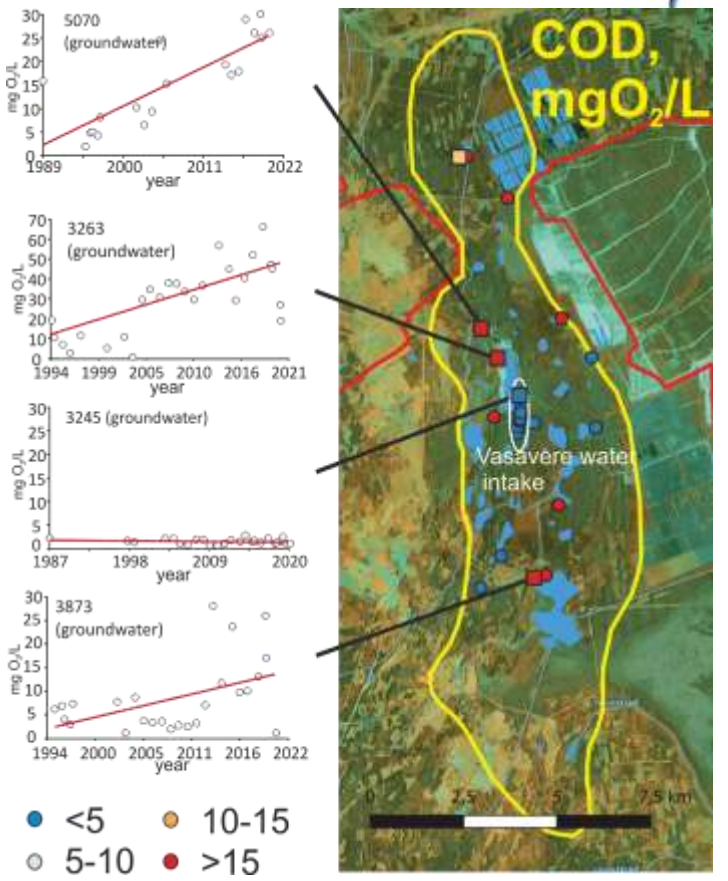


The isotopic composition of the water in the wells in that area indicated a significant evaporation effect.



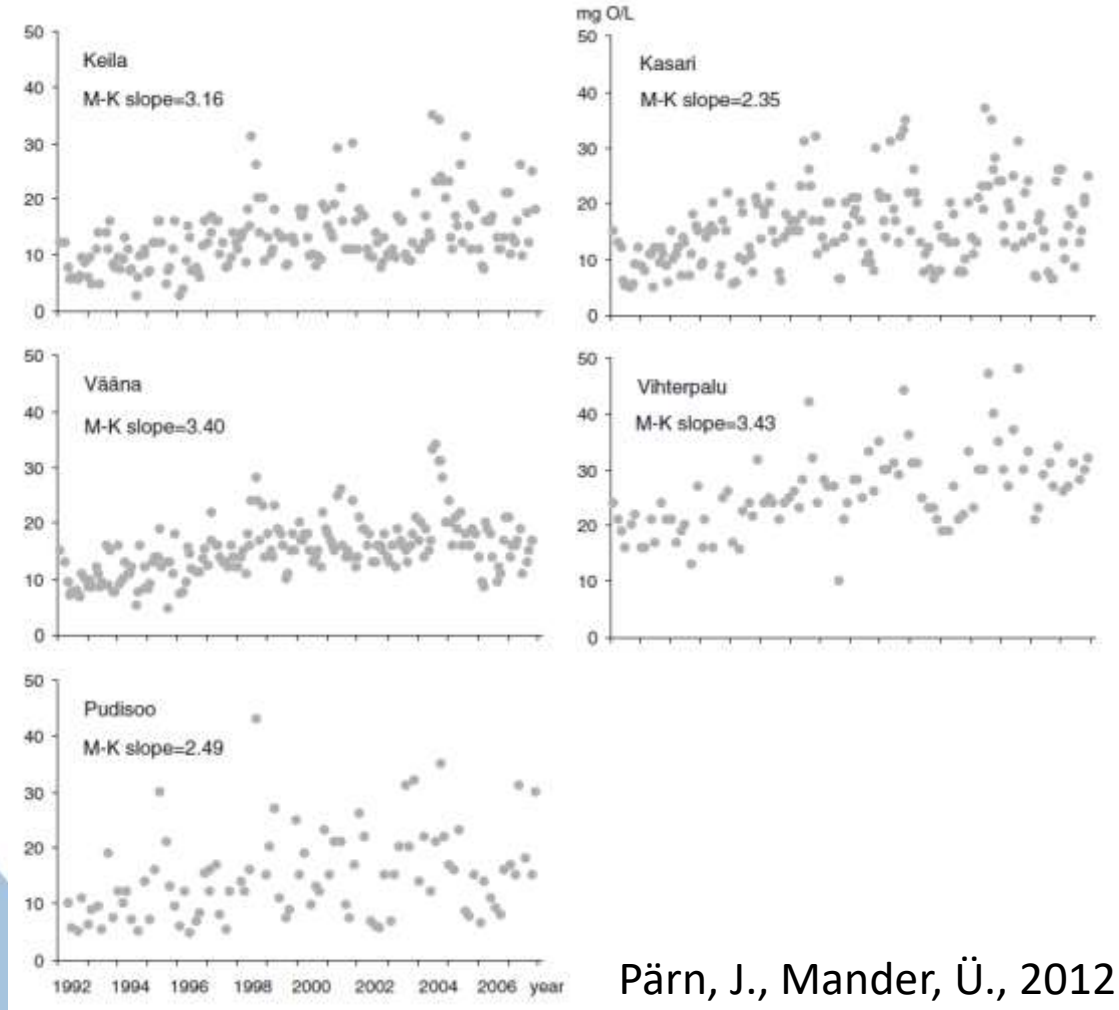
Discussion



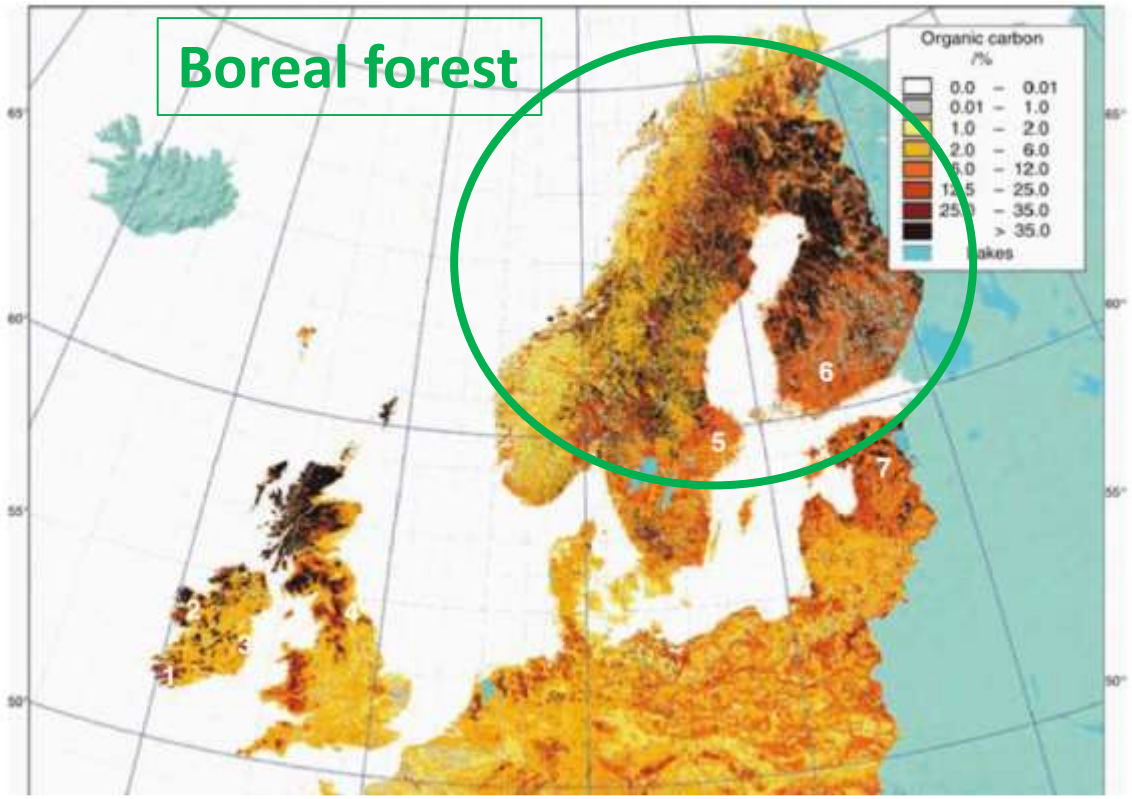


Apparently, water of the Vasavere water intake mainly originates from the surface layer of the nearby lake(s). This would also explain the presence of oil products and phenols in the wells in the vicinity of the Pannjärve quarry.

Discussion

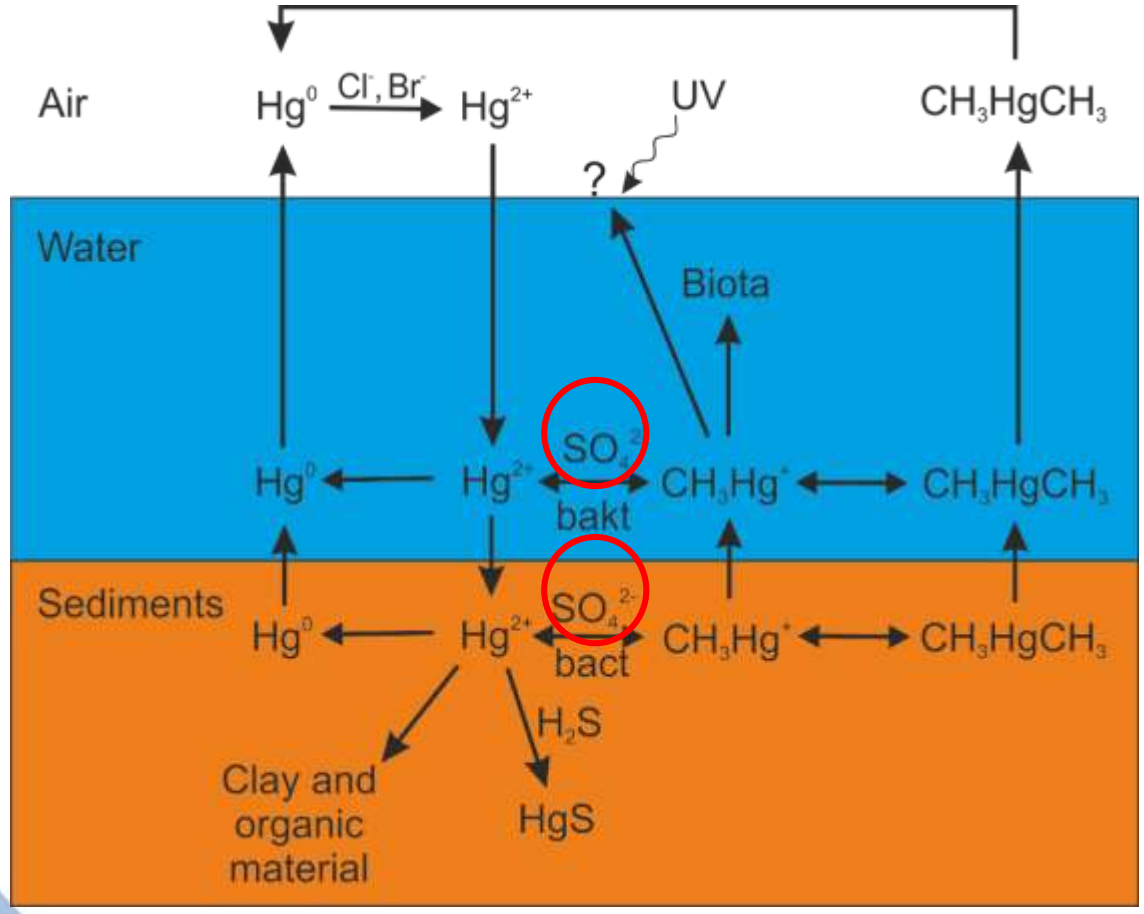


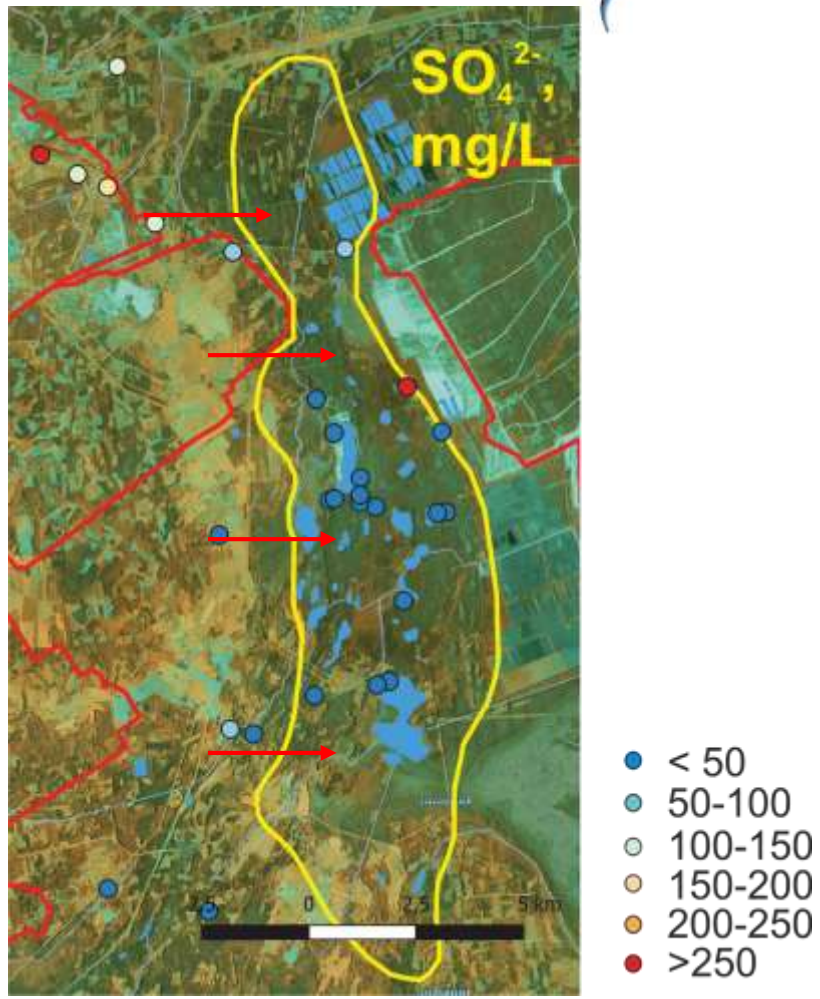
Pärn, J., Mander, Ü., 2012.



The global warming has become more obvious in Estonia, causing the replacement of the boreal, organic matter accumulating system with a much faster decay cycle.

Discussion

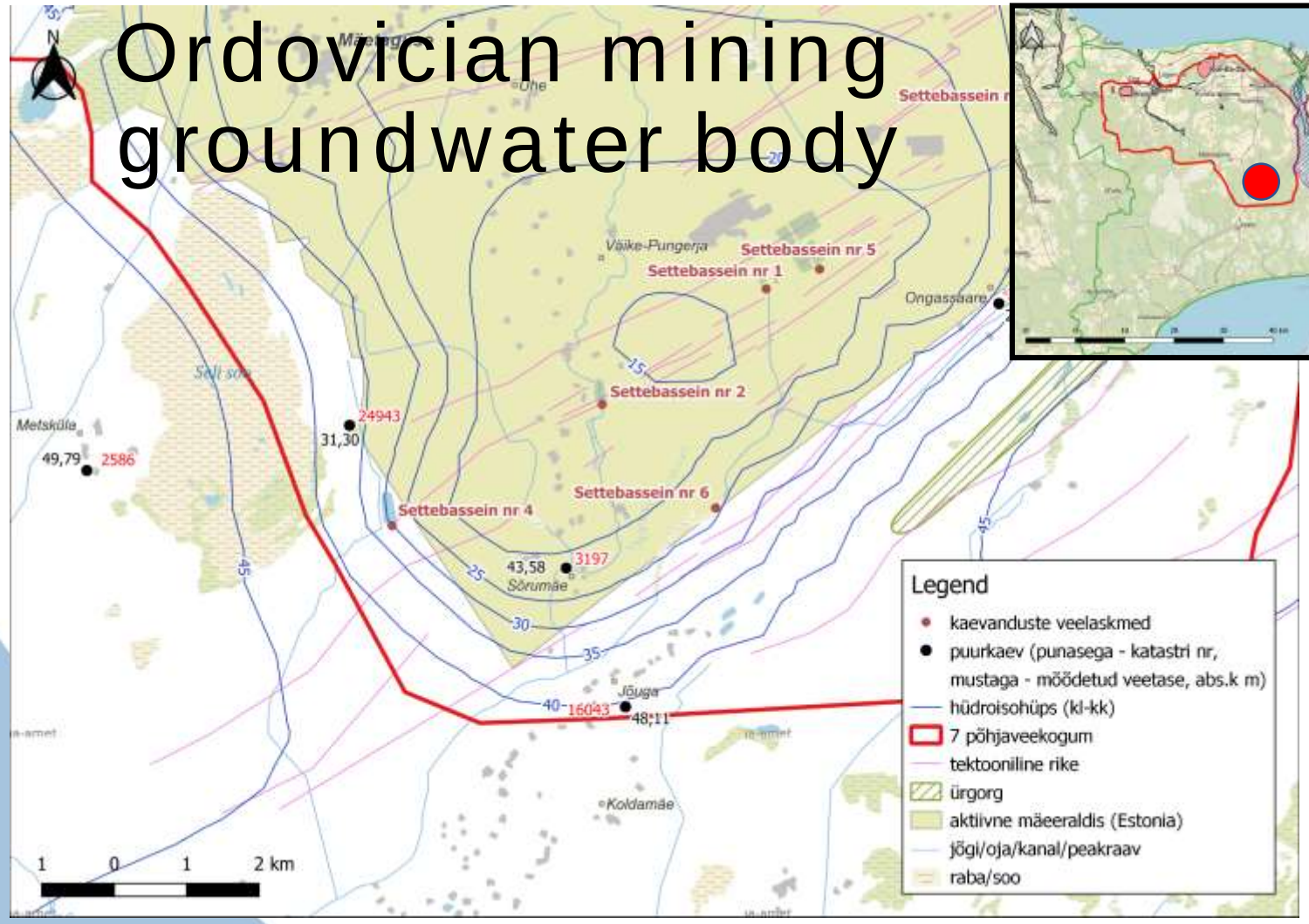


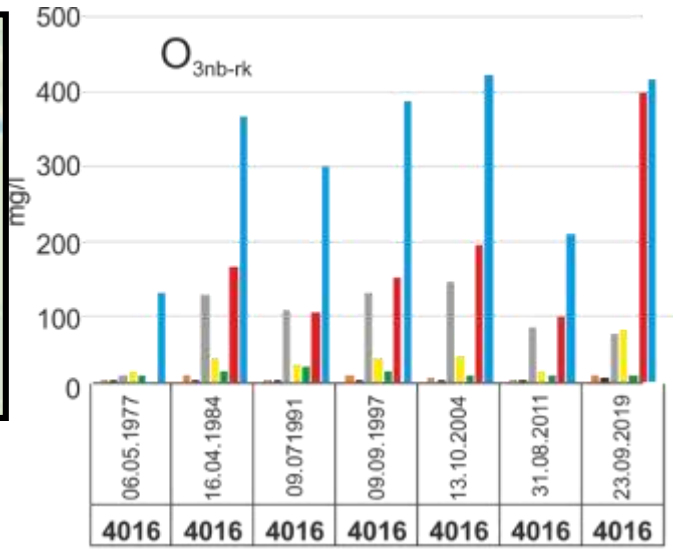


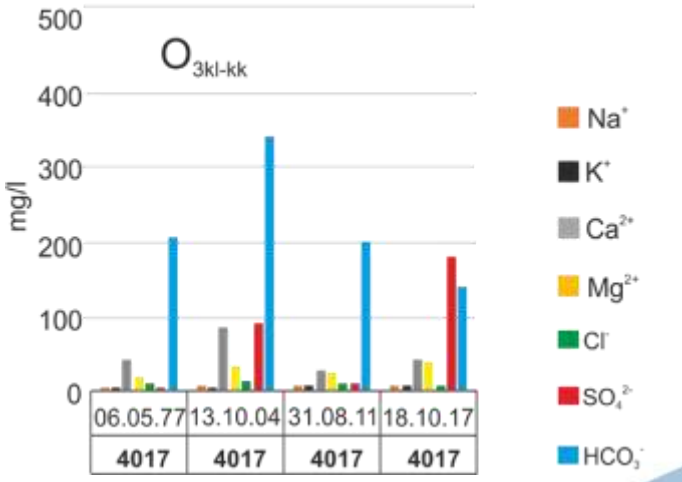
Degradation of organic material could release heavy metals

Discussion

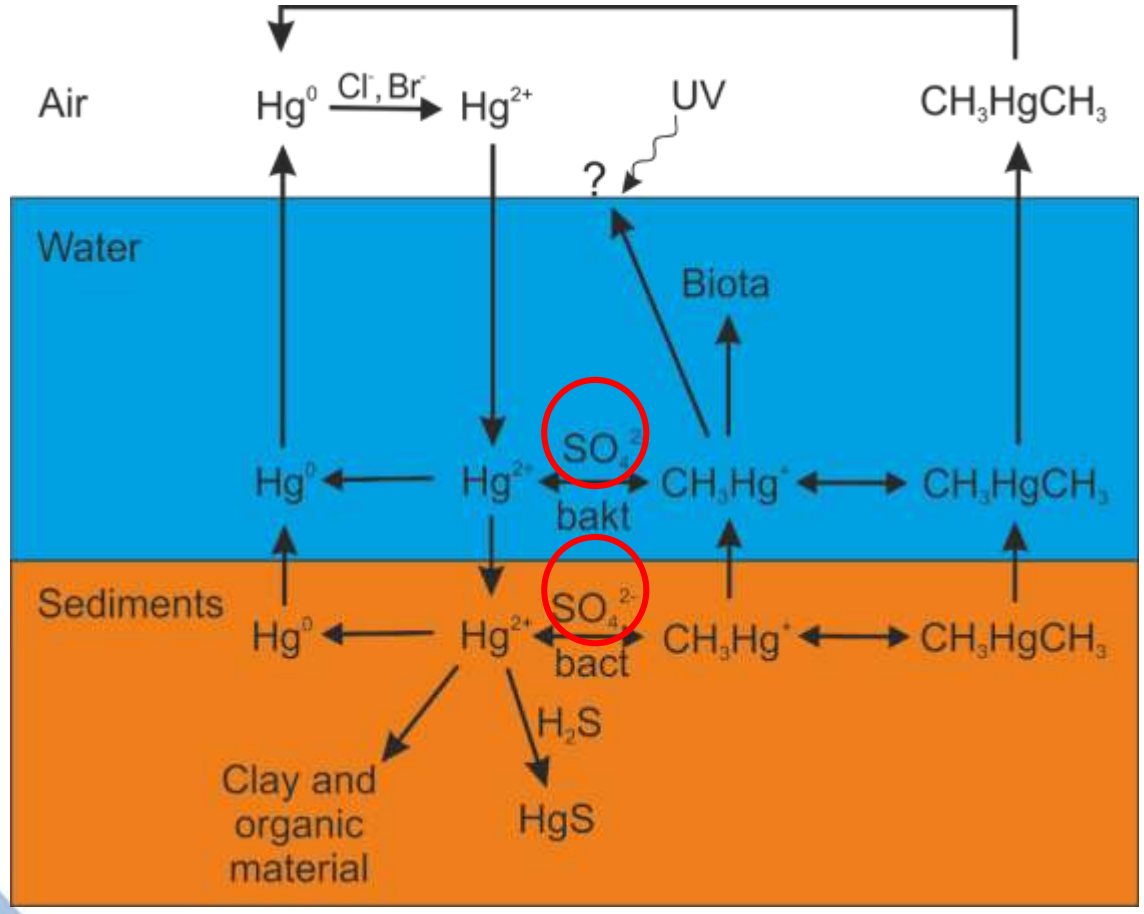
Ordovician mining groundwater body

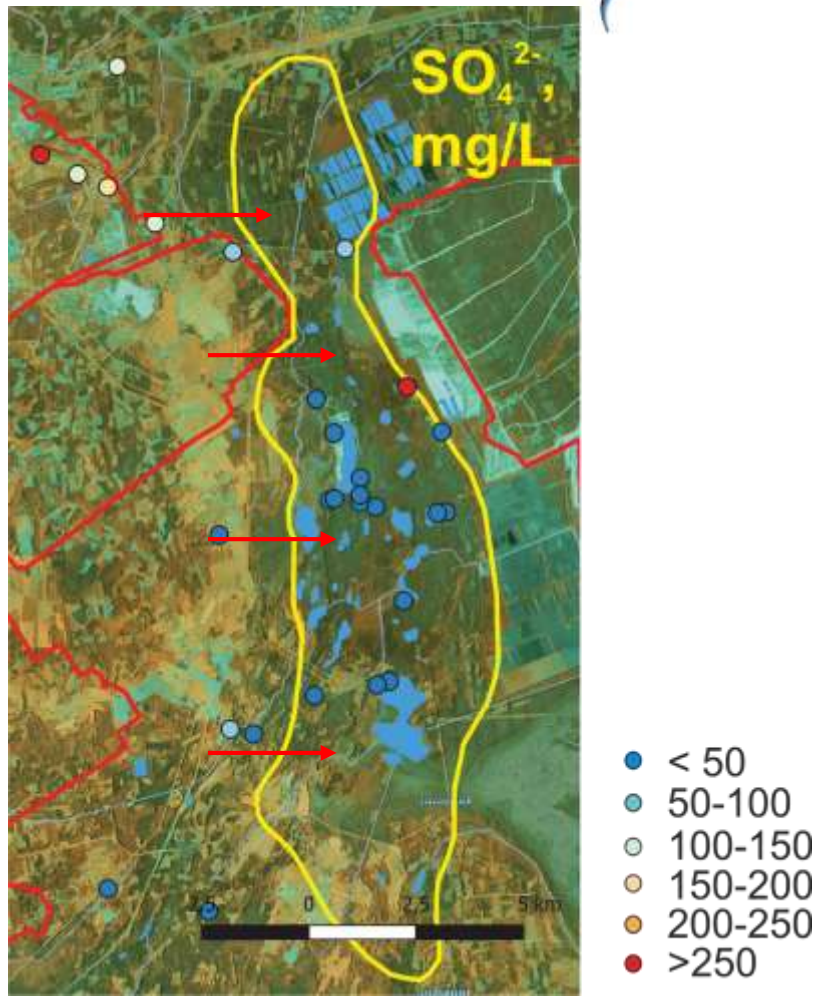






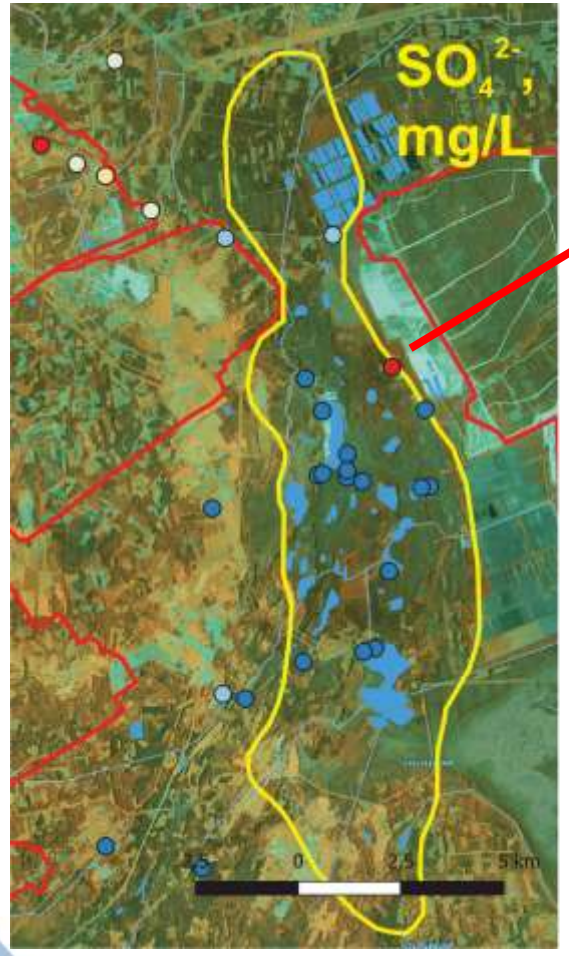
Discussion



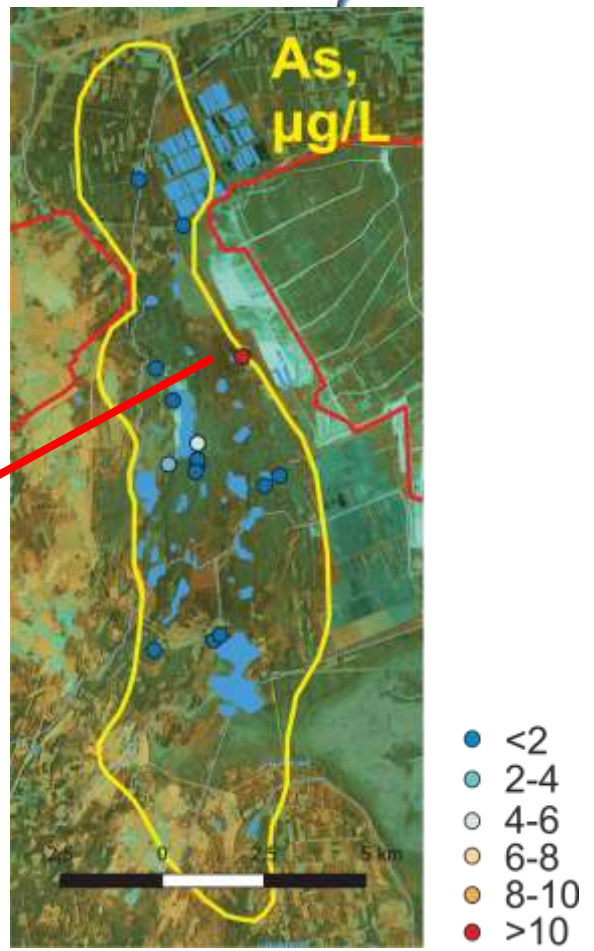


Degradation of organic material could release heavy metals

Discussion

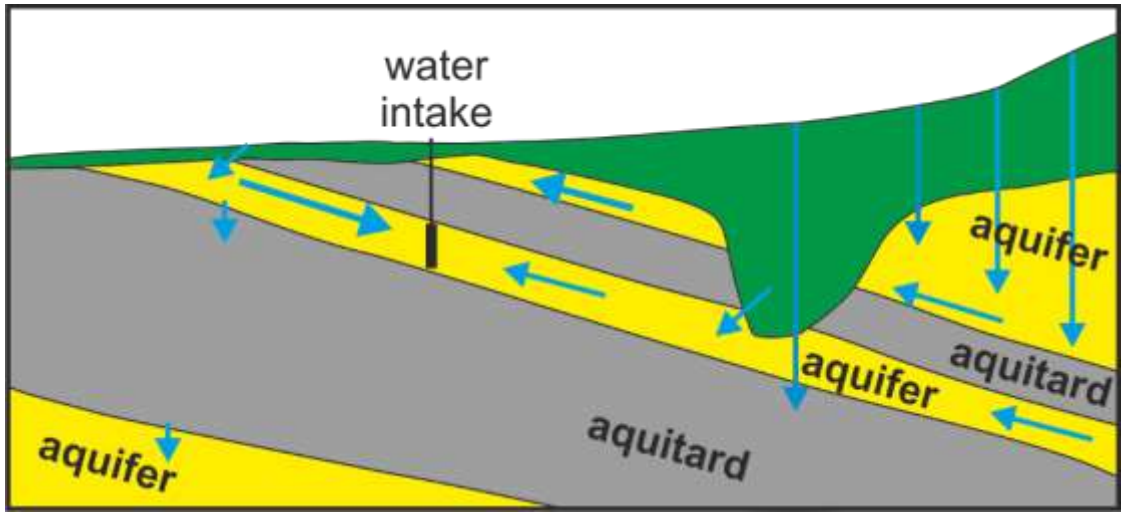


$$FeAsS + 2H_2O + 2O_2 \rightarrow FeOOH + SO_4^{2-} + As^{5+} + 3H^+$$

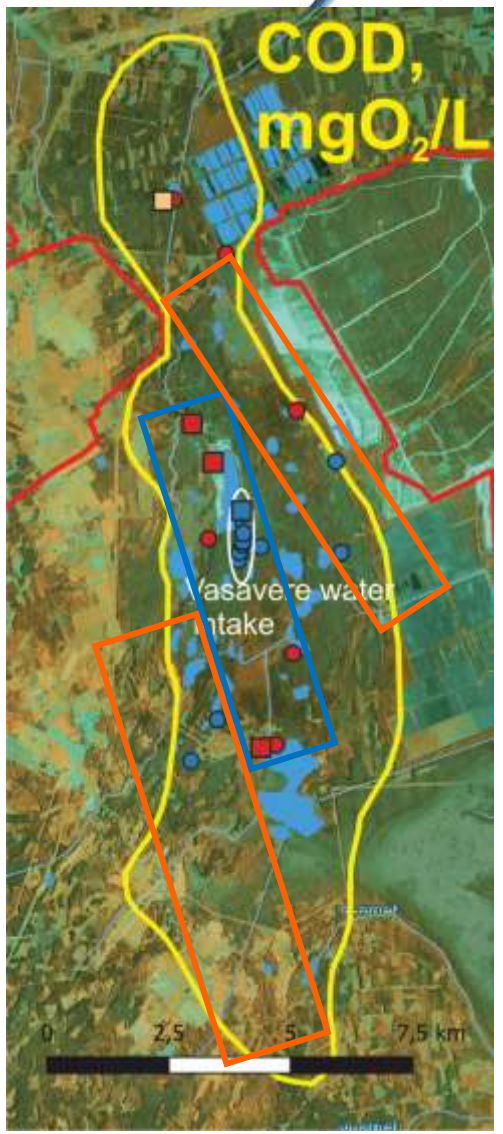


A long drought and a strong storm events could stimulate oxidation of sulphide minerals and release heavy metals.

Conclusions



- Groundwater affects the surface water bodyes, but the surface water also affects the groundwater.
- In the light of global climate changes, it becomes more critcal to predict what will happen next.
- The monitoring network must be dynamic, both spatially and methodically.
- The problem. Resources.



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Greater flexibility and inventiveness could help to avoid problems in the future.

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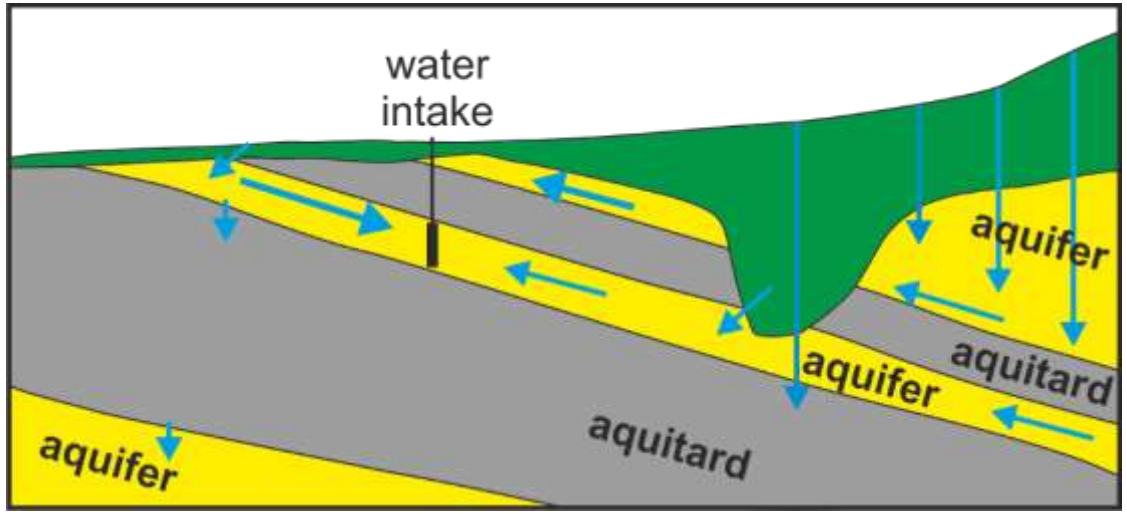
Thank you for your attention!

Conclusions

Conclusions



- Groundwater affects the biota, but the biota also affects the groundwater.
- In the light of global climate changes, it becomes important to predict what will happen next.
- The monitoring network had to be dynamic, both spatially and methodically, in interaction with new knowleges.
- The problem. The more we know, the more expensive it becomes to acquire new knowledge. Where is the critical degree of knowledge?

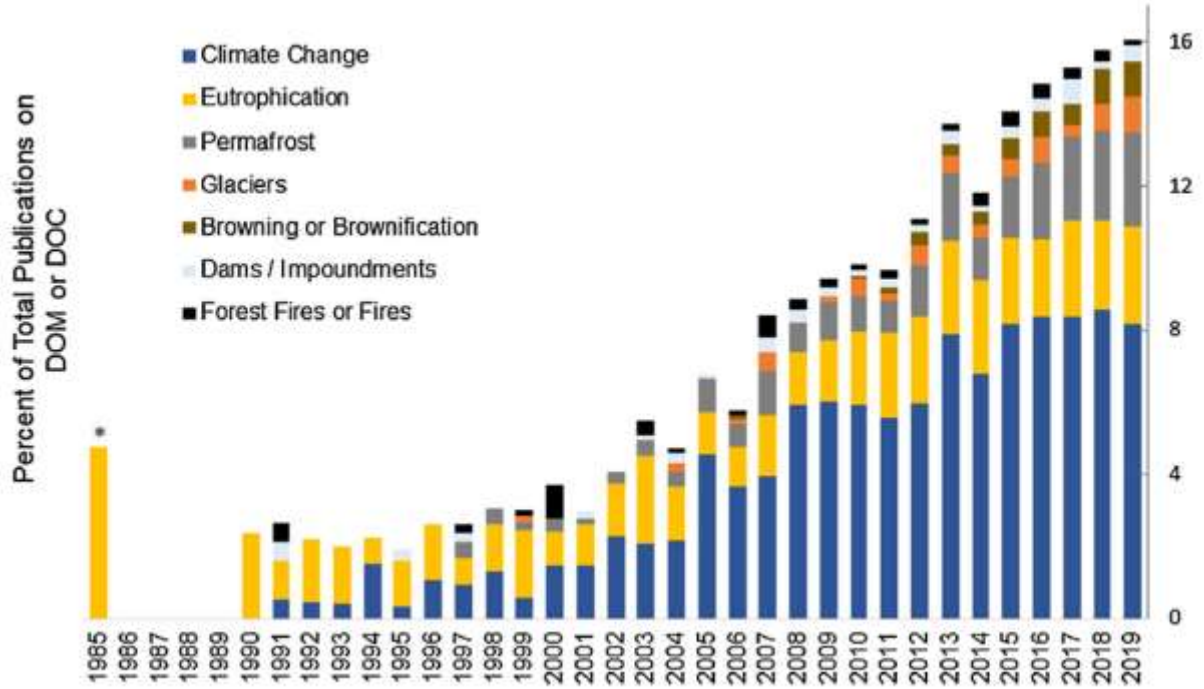
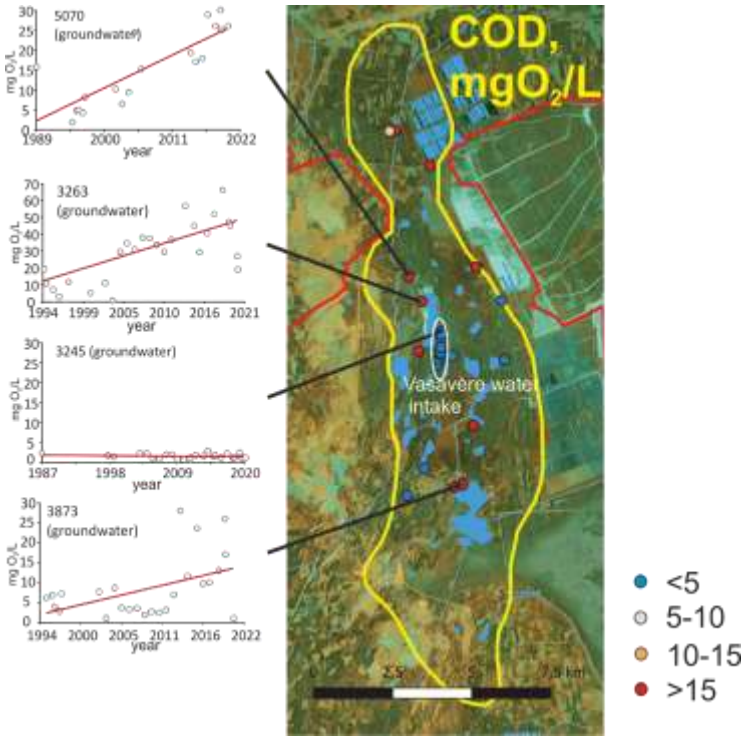


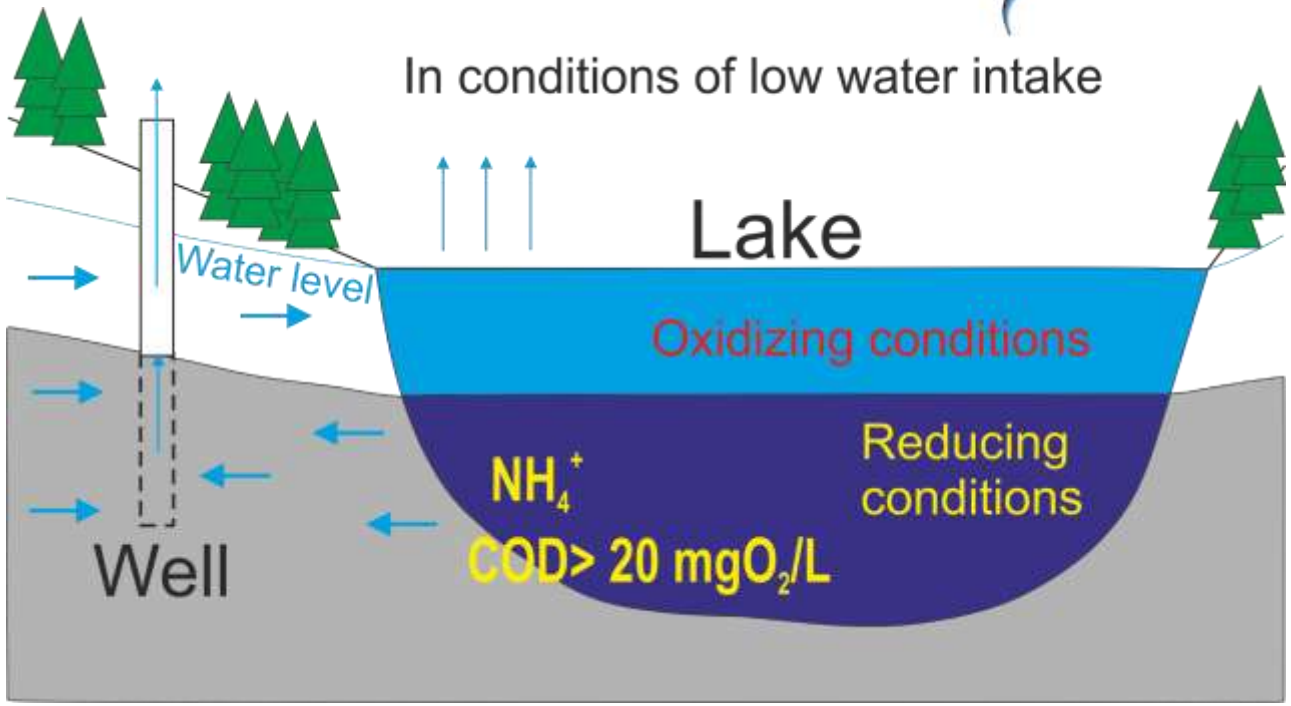
Fig. 1 Evaluation of the percentage of publications with "dissolved organic matter" (DOM) or "dissolved organic carbon" (DOC) and selected global changes over time, starting in 1985, the year *Biogeochemistry* began publishing. Data is based on searches performed in Web of Science (August 6, 2020). Raw data and search details are available in the supplemental information. *In 1985, 1/25 (or 4.8%) of publications on DOM or DOC were on eutrophication

Kokkuvõte

- Kõrgemad PHT ja NH_4^+ väärtused on iseloomulikud märgalade läheduses asuvatele puurkaevudele ning PHT kasvutrendid võivad olla põhjustatud intensiivsemast järve vee valgumisest puurkaevudesse või/ja globaalsest soojenemisest tulenevast kiirenenud aineringest.
- Põhjus tagajärg seoste ja nende ulatuse hindamine saab kriitiliseks globaalsete muutuste valguses. Oluline on mõista protsesside dünaamikat mitte statistiliste näitajate pime kasutamine.
- Seirevõrk peab olema dünaamiline (seda ka metoodika osas) täiendades teadmisi ja tagasisidestusega seirevõrku.
- Probleem. Mida rohkem me teame seda kallimaks muutub uute teadmiste hankimine. Kus asub kriitiline teadmiste määr.
- Ökosüsteemidest tulenev signaal põhjavees on üheltpoolt loomulik kuid läbi veebilansi muutuse võib see kujuneda väga tugevaks.

Discussion



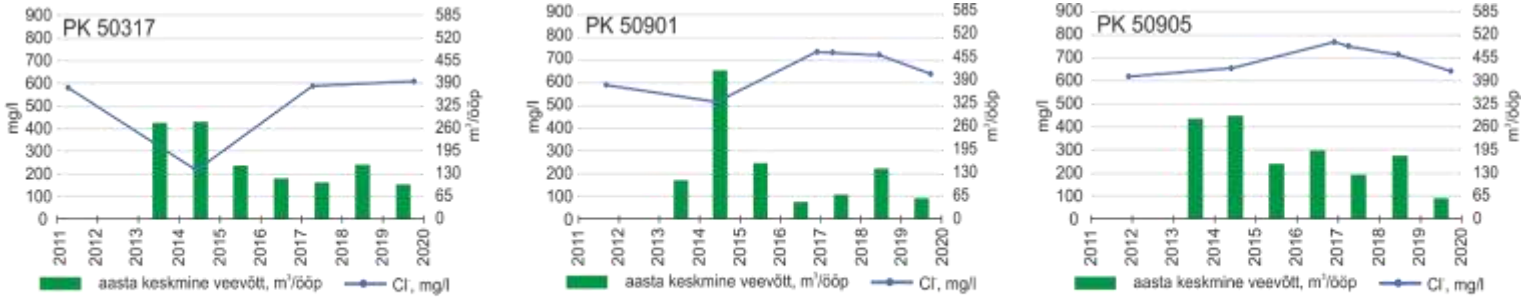


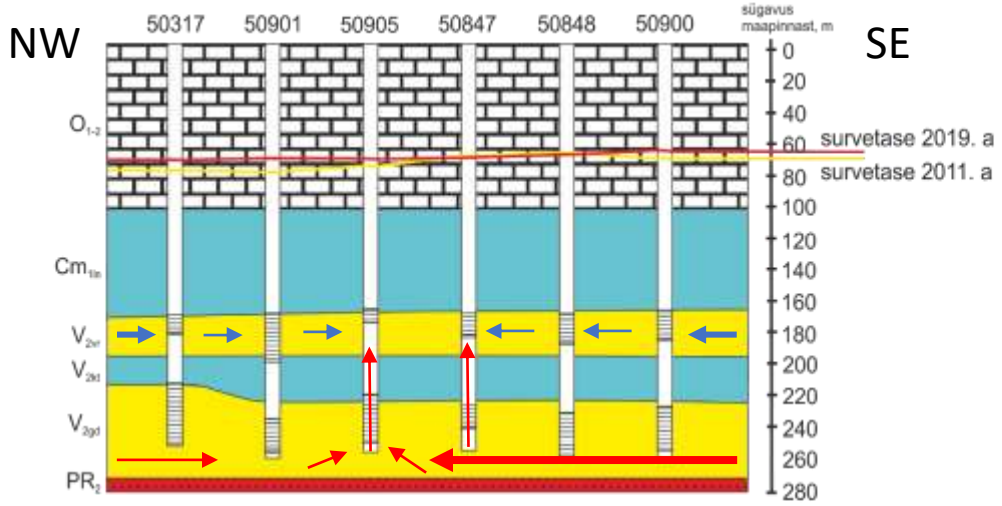
The large fluctuation of ammonium ion values indicates that high NH_4^+ contents and COD values in the groundwater body are of local origin and primarily related to the proximity of wetlands.

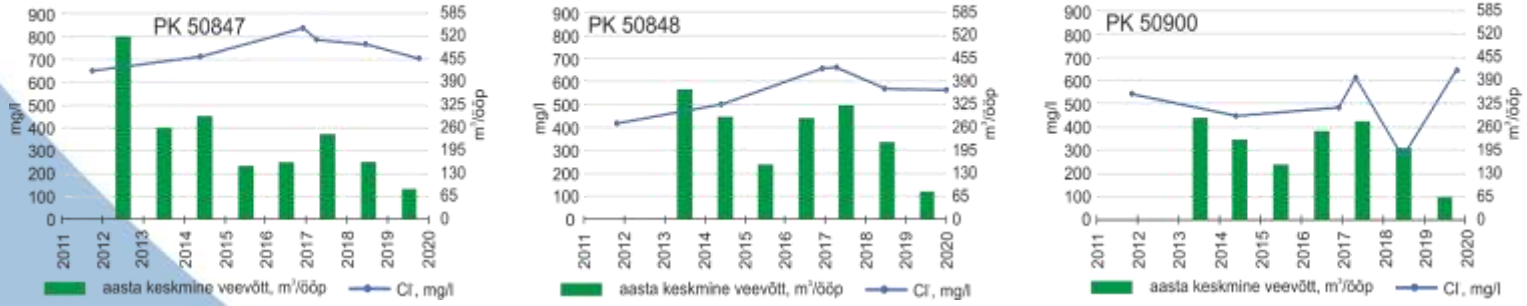
Several groundwater monitoring wells are also located near lakes or bogs.

it could mean water from deoxygenated lake(s) infiltra the well. Increasing trends in COD may be caused b intensive lake water intrusion into wells, increased hum on lakes and/or accelerated circulation due to global wa

Gdov's groundwater body

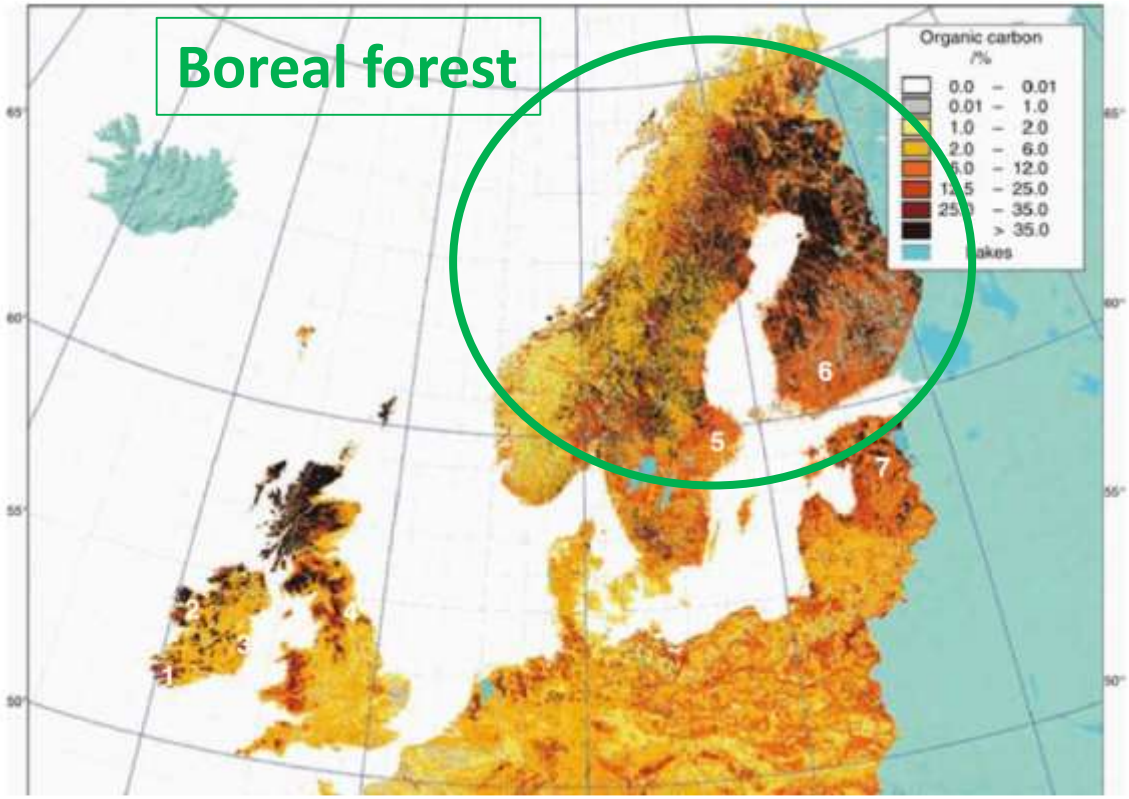






Due to the construction of the wells, the salinization of the upper Voronka water body will take part, which normally is unfeasible.

Discussion



The upward trends of COD_{Mn} values may be caused by more intense infiltration of lake water into monitoring wells, increased human pressure on lakes and/or accelerated nutrient circulation due to global warming.

In the course of the Life project, it has become clear that several "problems" often result from the lack of a monitoring network.