SWAT+ water quality and quantity modelling systems for Latvia and Lithuania

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LIFE IP CleanEST International conference, 25-26/Oct, Narva, Estonia

EU LIFE Programme integrated project

"Implementation of River Basin Management Plans of Latvia towards good surface water status"

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2. Components of SWAT+ modelling system
3. Input data & model setups
4. Modelling frame
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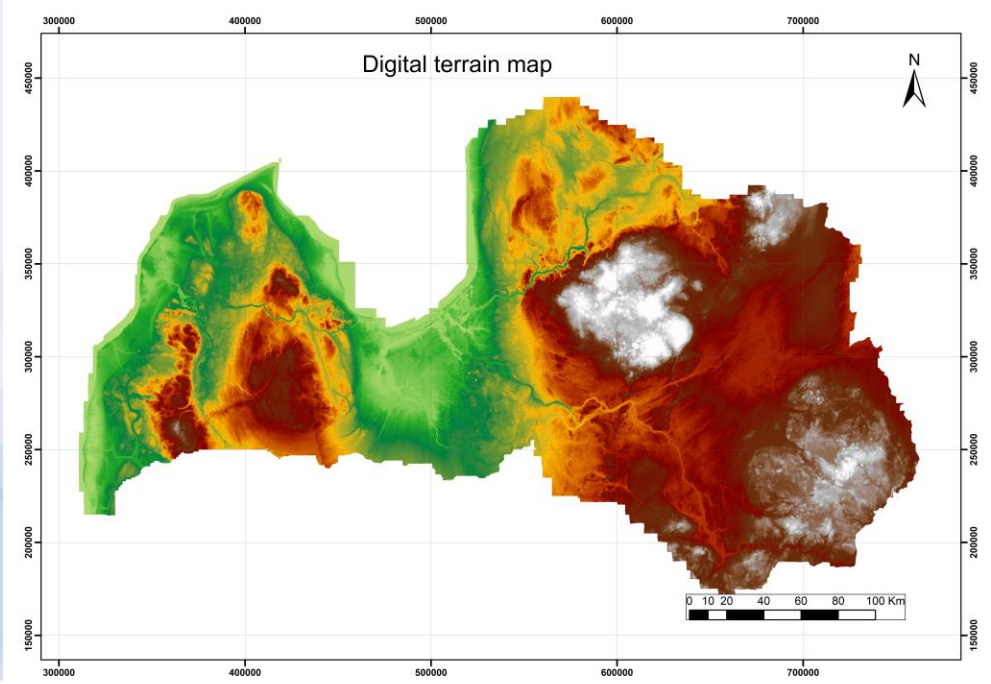
1. Why&when

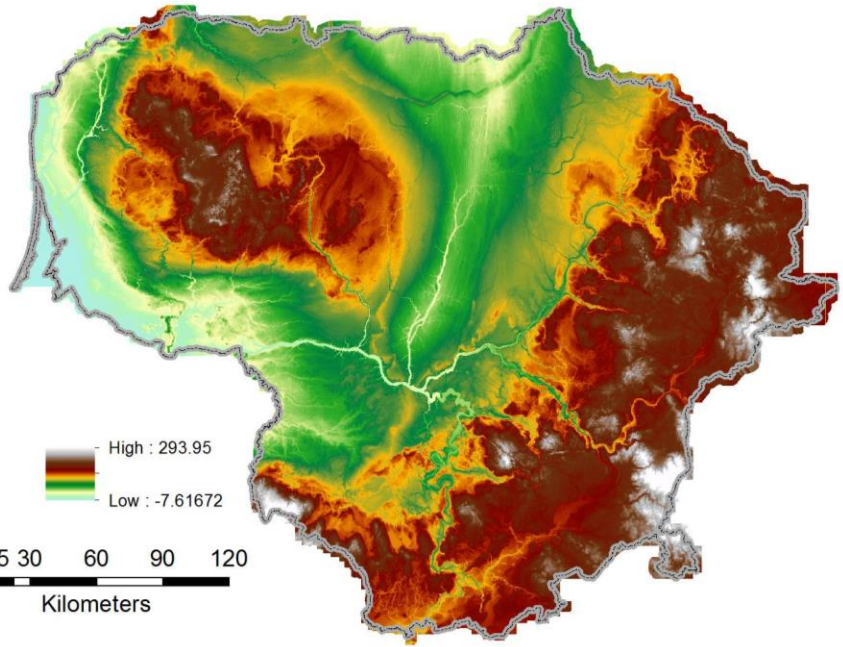
- 2012-2013: SWAT for Lithuania (EPA)
- 2014-2015: SWAT/LT in RBMP (consortium)
- 2020-2022: SWAT+ for Latvia (GoodWater)
- 2021-2022: SWAT to SWAT+ in LT (EPA)

2. Components of water quality modelling system

- Input data (preprocessed and harmonised)
- Data storage system (database, versioning of components)
- SWAT+ model software
- System of scripts (building model system, executing runs)
- Postprocessing (PAICSWAT & QGIS)

3. Data – terrain (harmonized to 5m grid)





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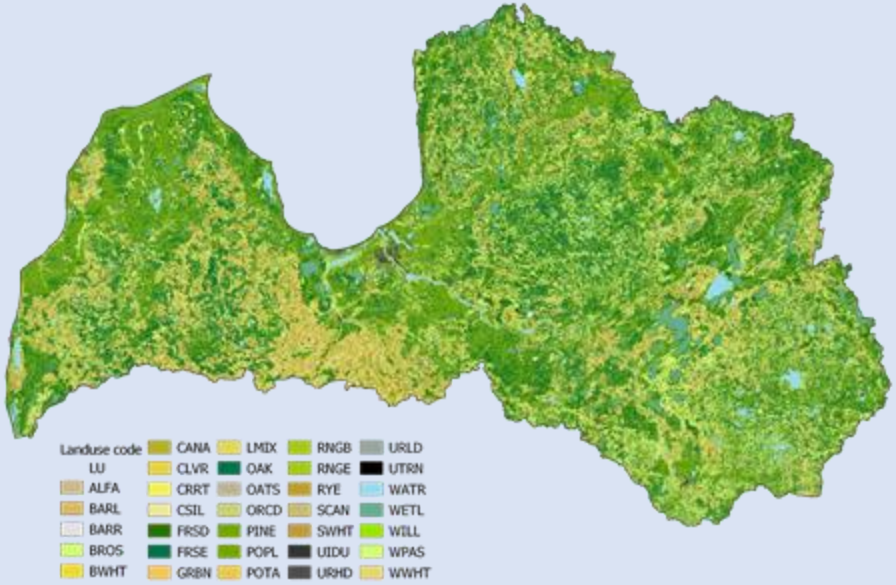
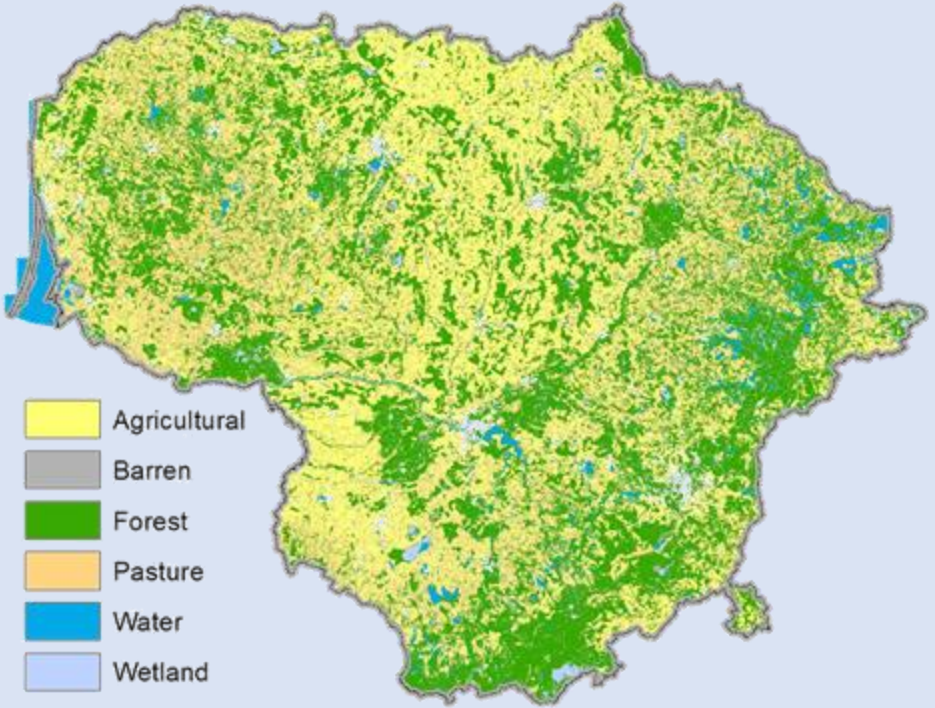
3. Data – land use incl crops (LV 33, LT 56 classes)





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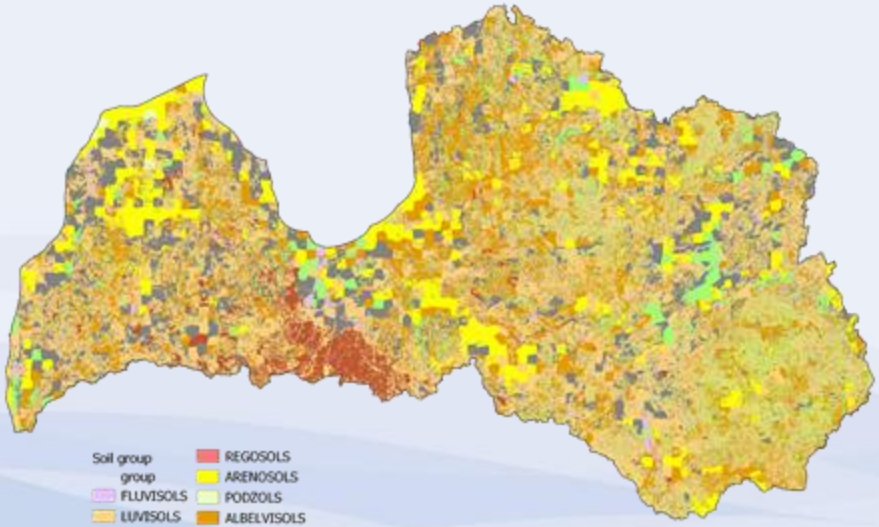
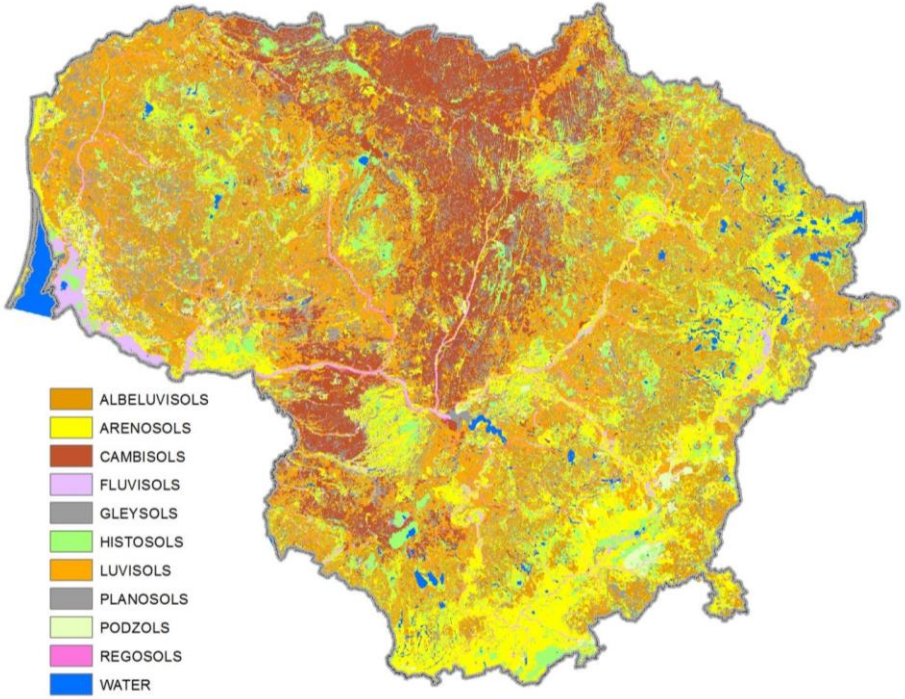
3. Data – soils (aggregated LV 54, LT 86 classes)





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3. Data – river network & model setup

Watersheds 179/106
Catchments 3780/1237
HRU 500’000

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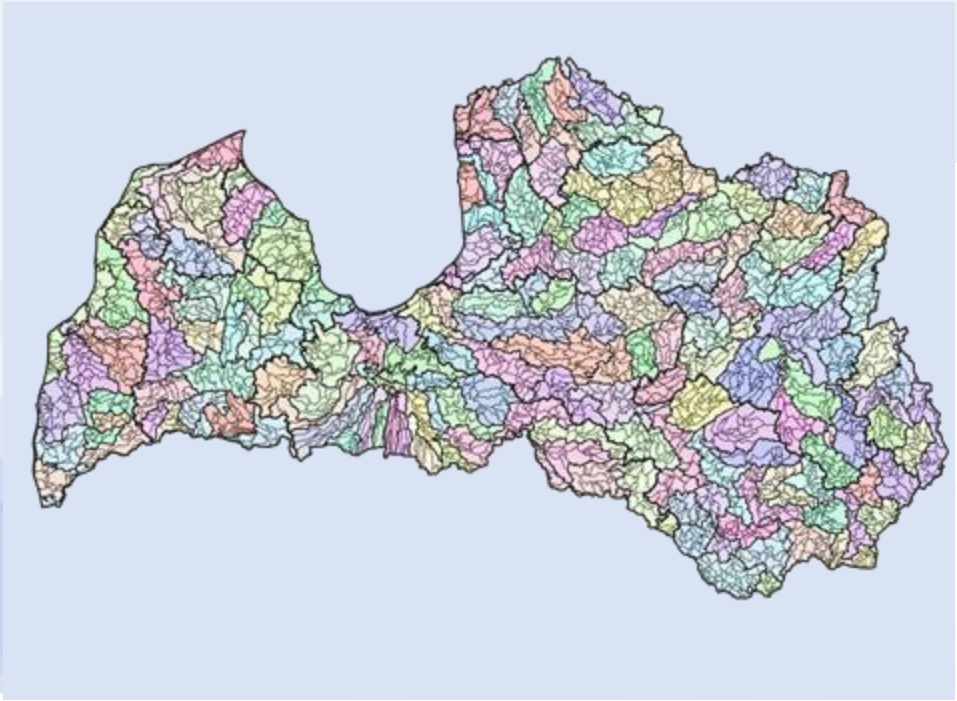
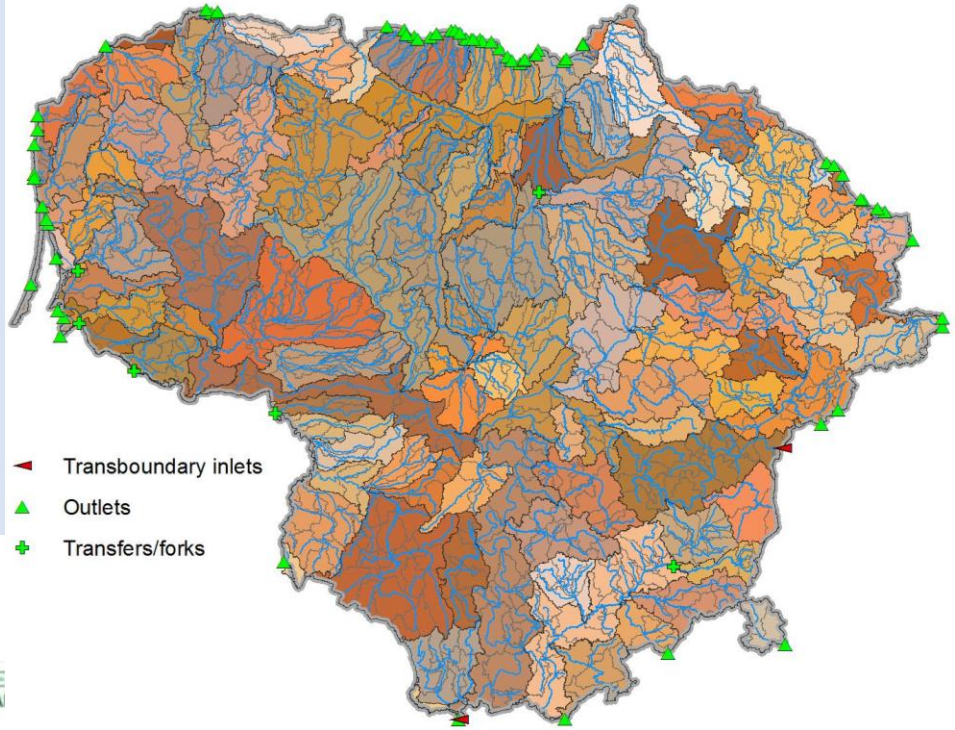
3. Model setups watersheds & catchments





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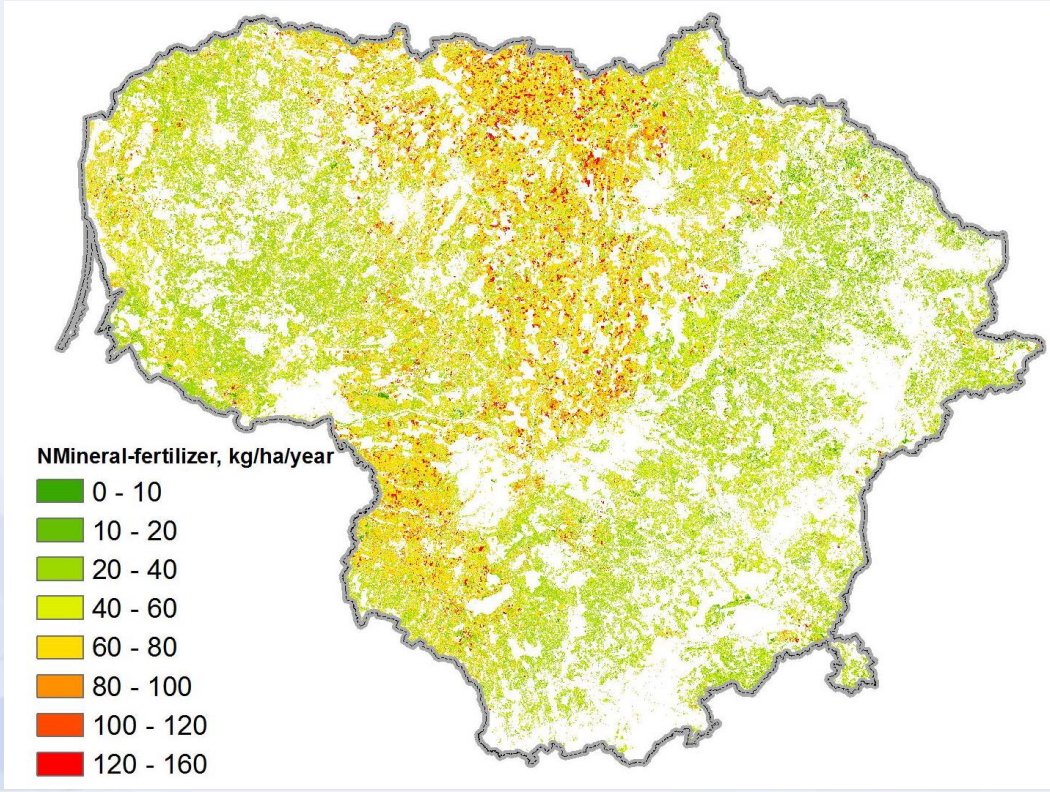
3. Other data/models

Transboundary flows
Fertilisation model (mineral, manure)
Agricultural practice (plant management model)
Atmospheric deposition
Meteorological obs

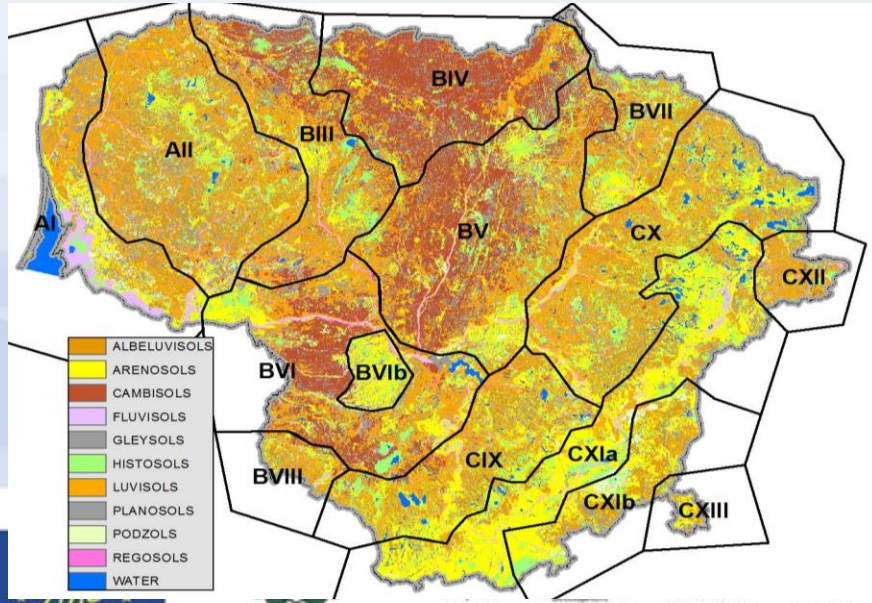


4. Modelling frame

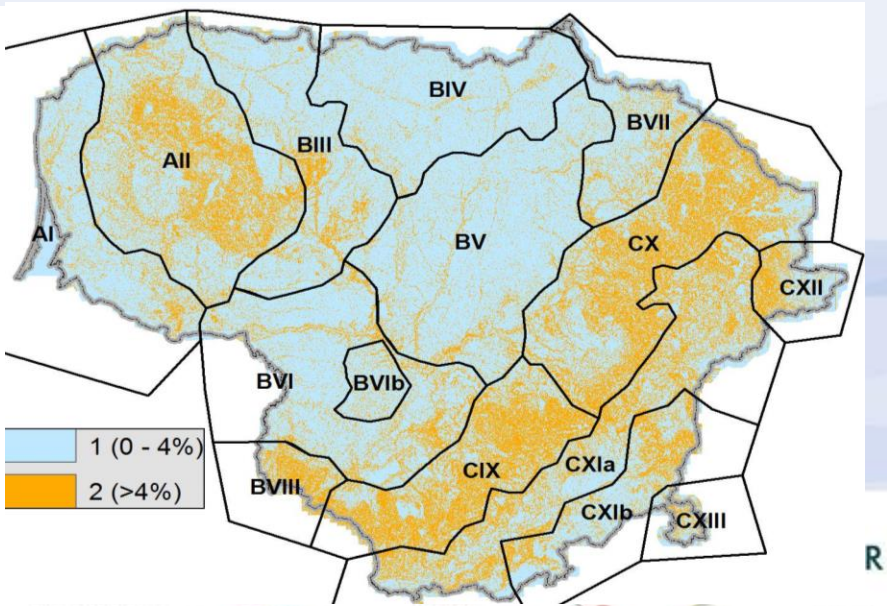
- Storage: Postgre database, SVN versioning system
- SWAT+ Fortran code debugged (100+ errors!), Github
- Python scripts:
  - ➢ Building system from data
  - ➢ Executing run
  - ➢ Extracting results
- Postprocessing (PAICSWAT for timeseries & QGIS templates)

5. Calibration/validation

- Regionalisation, calibration in regions: NSE&PBIAS for Q, N&P concentrations (!)
- Validation: transfer of coefficients, NSE&PBIAS criteria

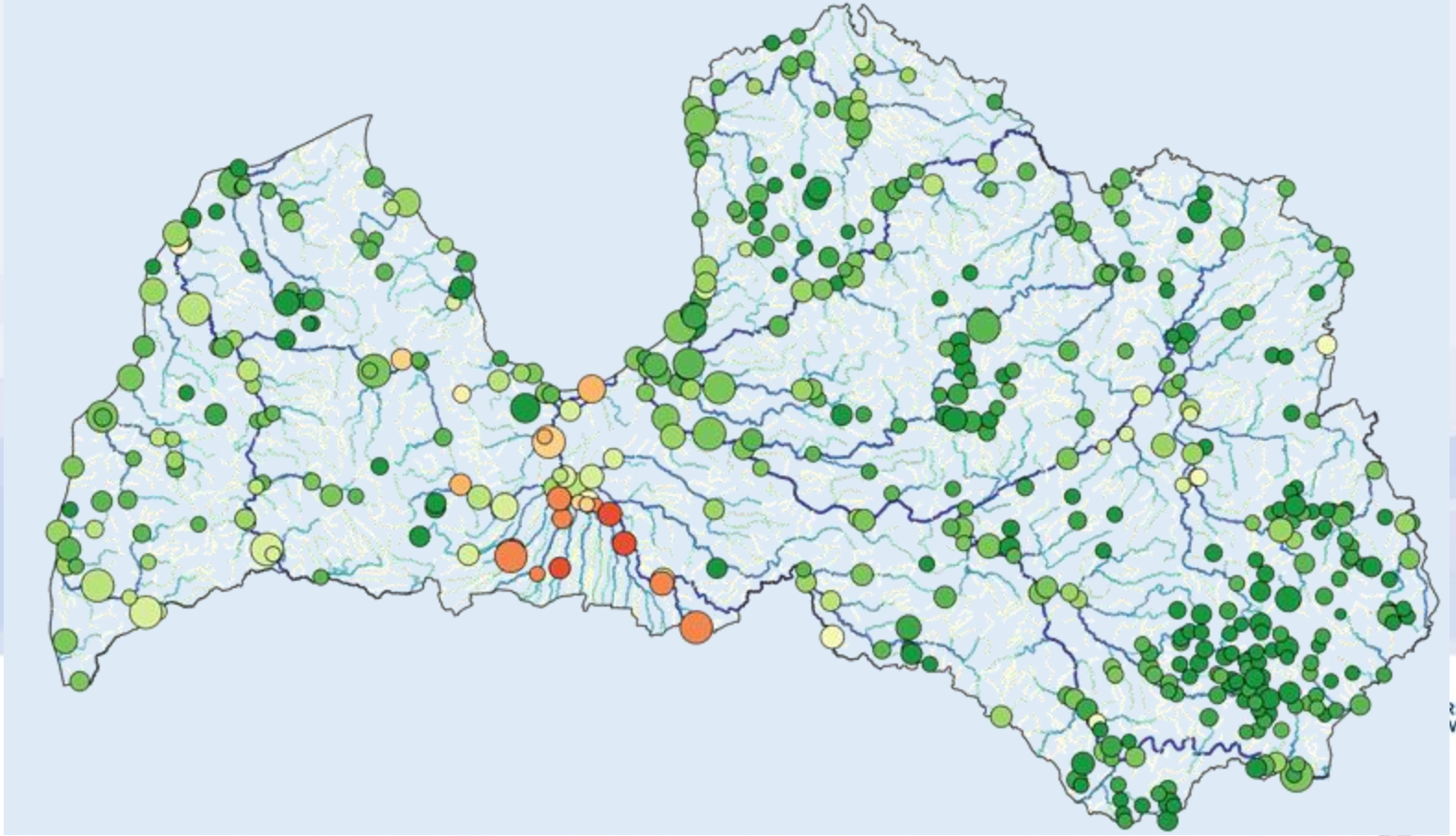


Hydrological regions and soil map



Hydrological regions and slope classes

5. Cal/Val: obs data (N-NO3)



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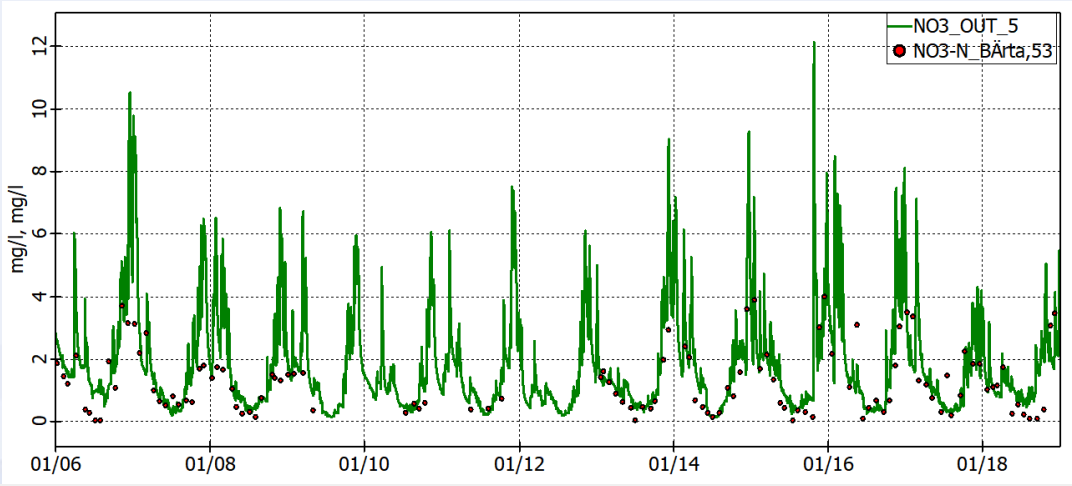
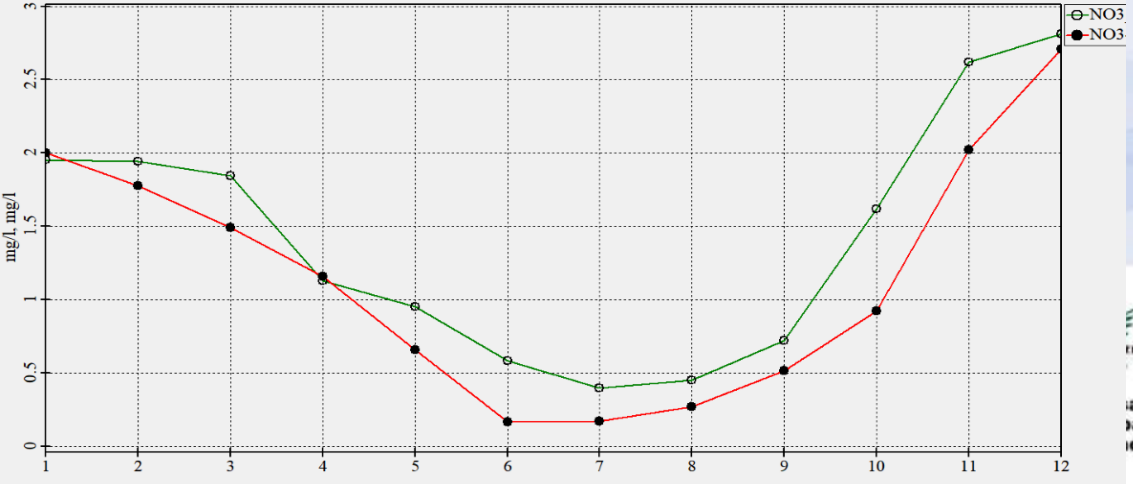
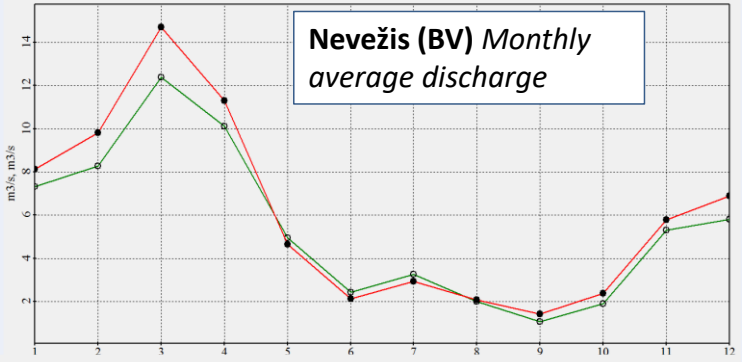
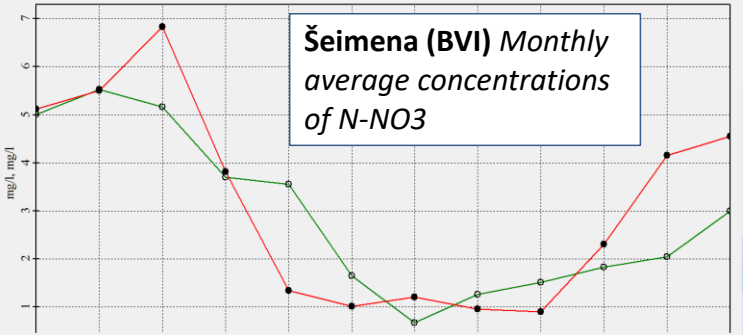
5. Cal/Val: LT Nevežis, LV Bārta



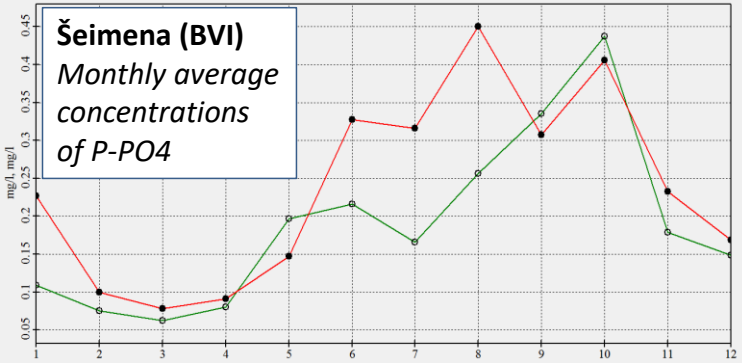




Nevežis (BV) *Monthly average discharge*

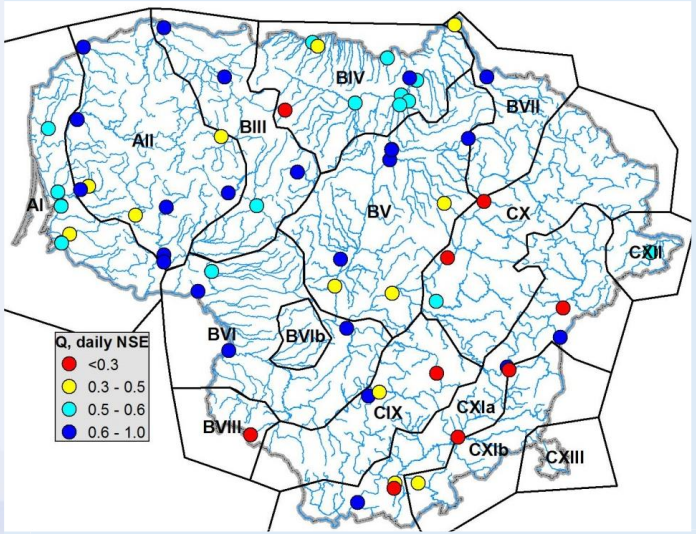


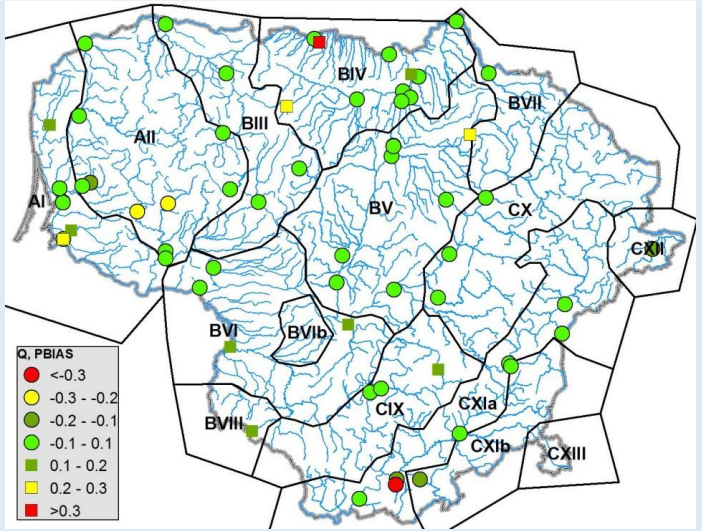
Šeimena (BVI) *Monthly average concentrations of N-NO3*

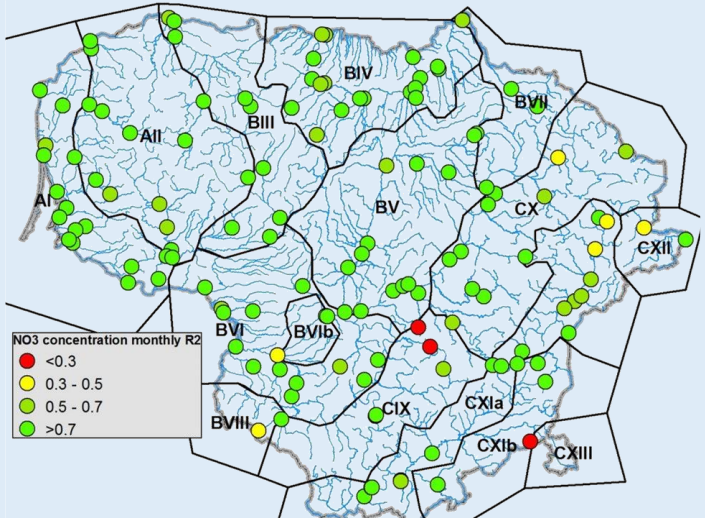


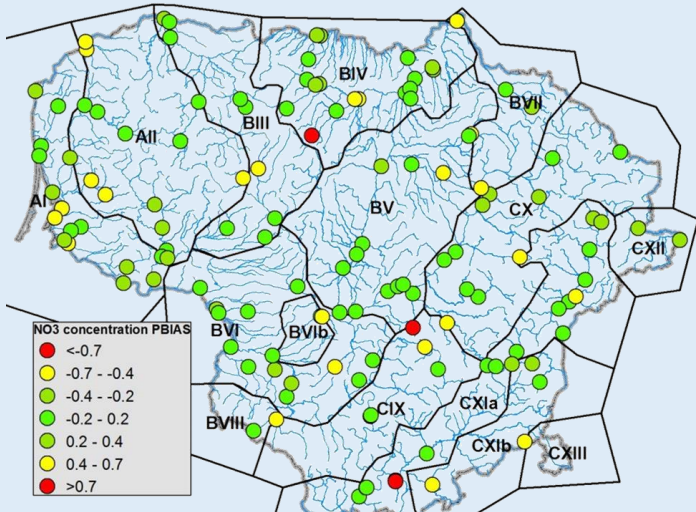
Šeimena (BVI) *Monthly average concentrations of P-PO4*

5. Val: overall maps (LT)









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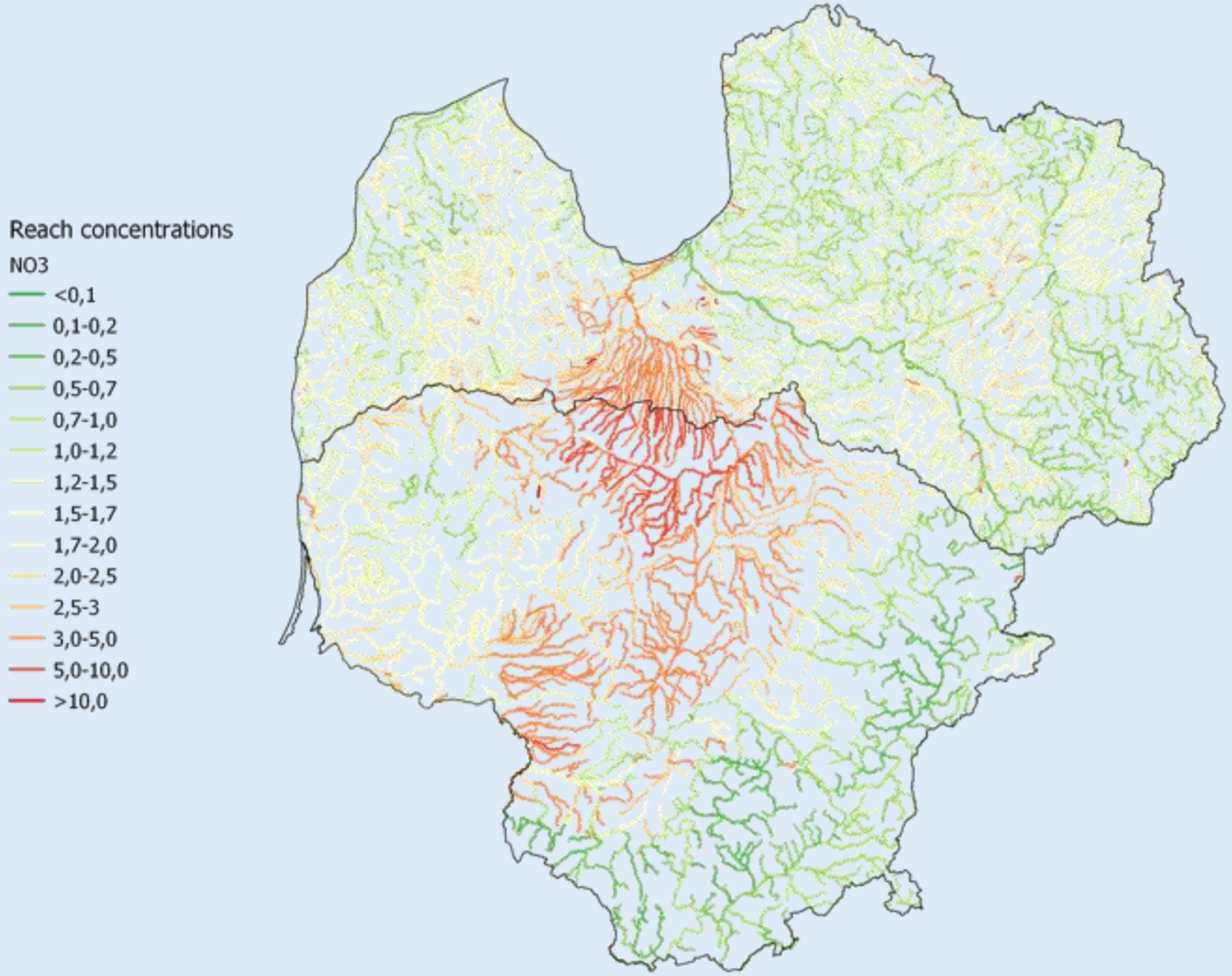
6. Results

In stream N-NO3



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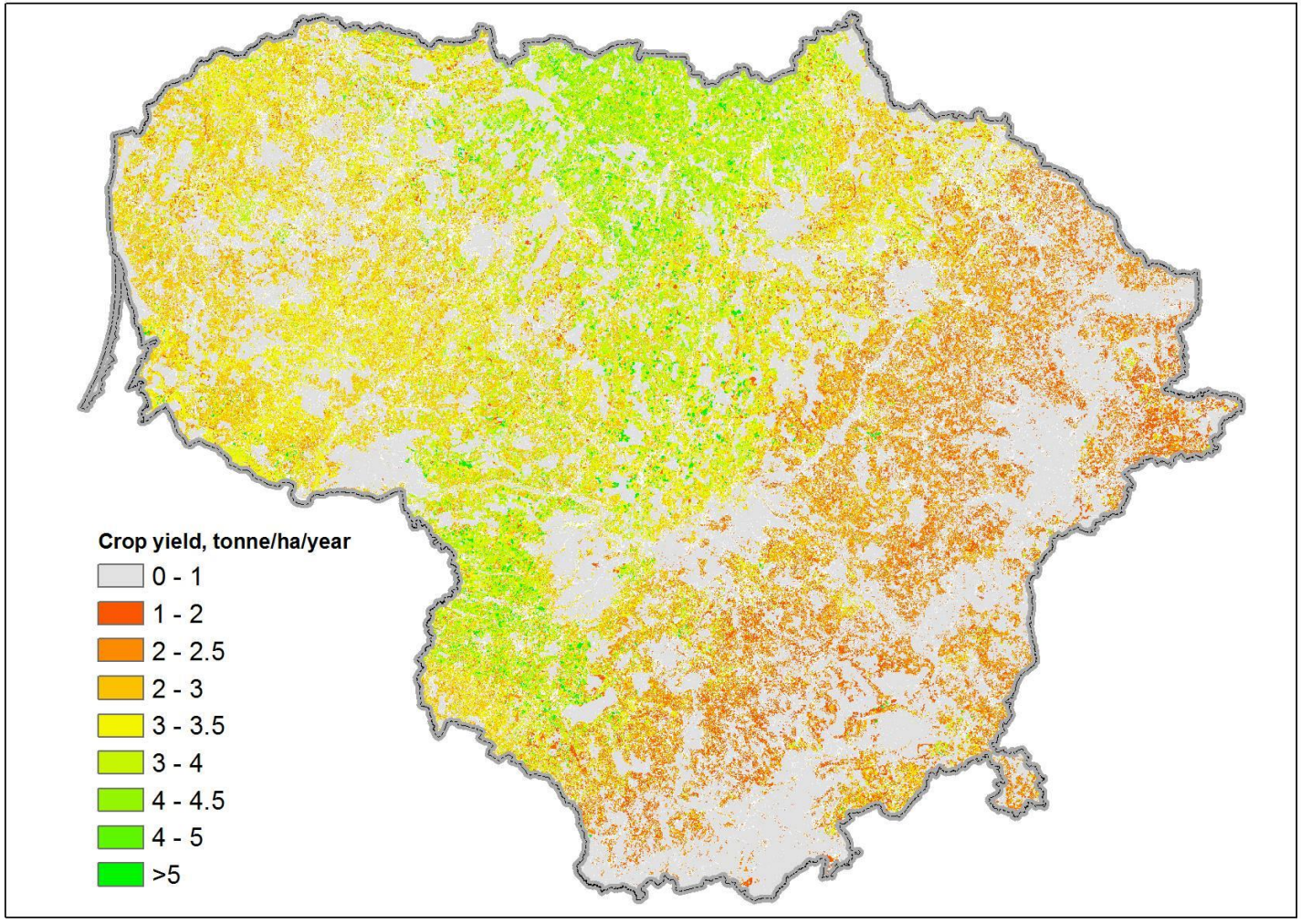
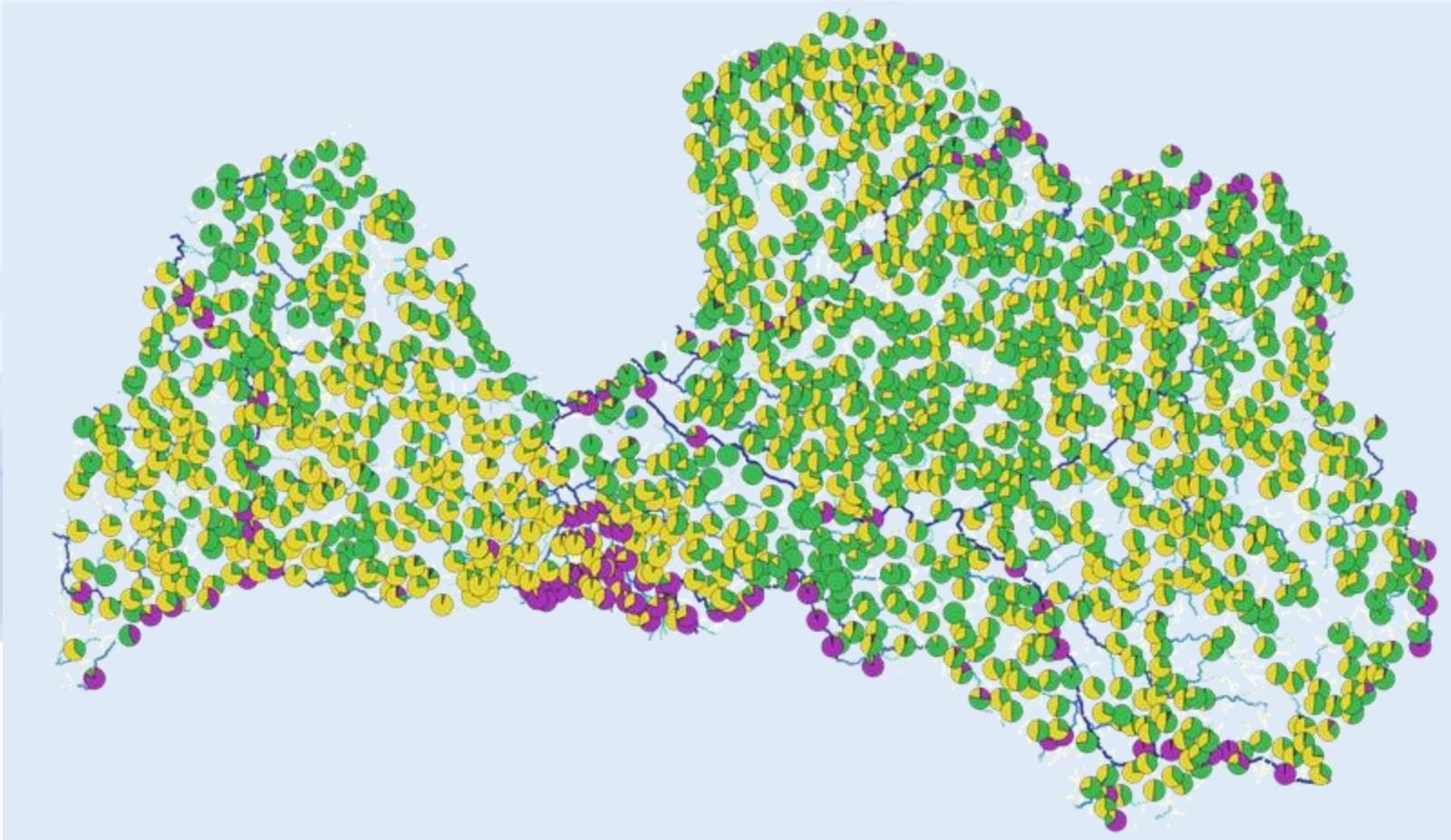
6. Results

Crop yield



6. Results: source apportionment (N-NO3 LV)



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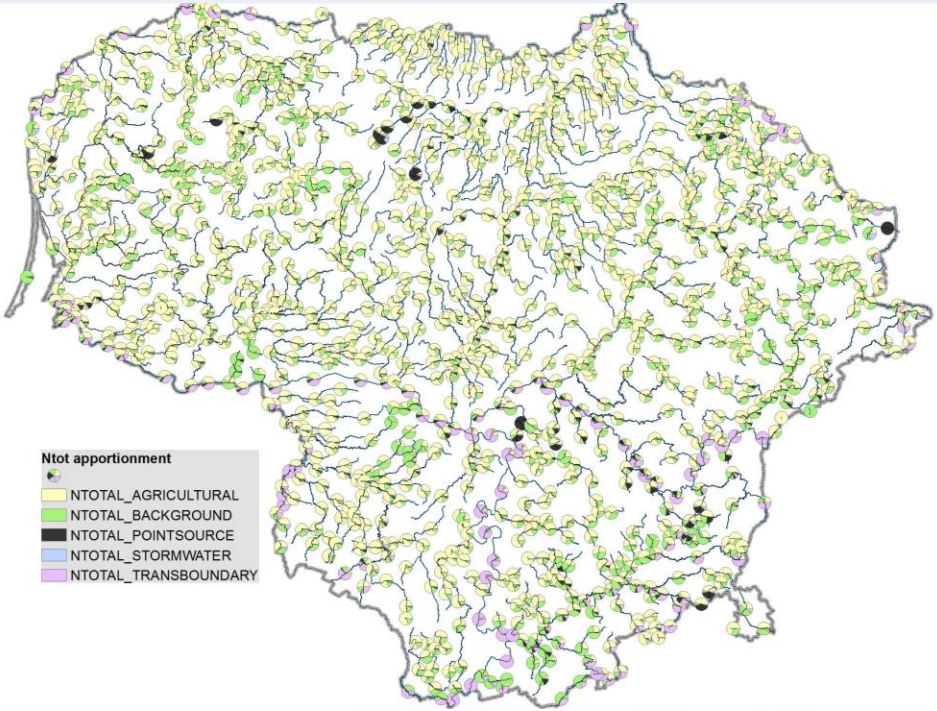
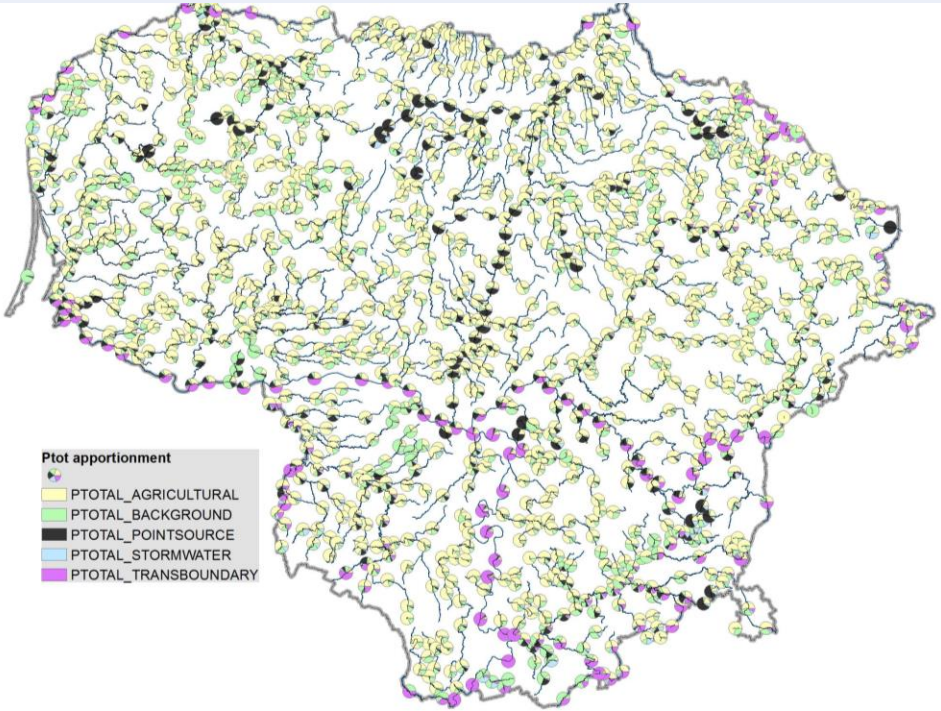
6. Results: source apportionment (N, P LT)





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ZEMNIEKU SAEIMA
Pasaules Dabas Fonds
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6. Results: method for optimisation of measures: list of measures, translate to parameter change

Name	Cost, EUR/m^2
0.NoMeasure	0
1.Catch crops	0.0087
2.Plant cover in winter	0.0058
3.Planting of winter crops	0.0022
4.Crop rotation	0
5.Buffer zones	0.002
6.Reduced fertilization	0.0004
7.Limited fertilization on high risk areas	0.001
8.Non-plough technology	-0.0051
9.Substituting autumn ploughing with spring ploughing	0.0014
10.Postponing a sod ploughing to late autumn	0.0006
11.Converting arable land into perennial grasslands	0.0248
12.Converting arable land and grasslands to forests	0.0175
13.Catch crops+Reduced fertilization	0.0091
14.Plant cover in winter+Buffer zones	0.0078
15.Plant cover in winter+Limited fertilization on high risk areas	0.0068
16.Plant cover in winter+Buffer zones+Limited fertilization on high risk areas	0.0088
17.Planting of winter crops+Reduced fertilization	0.0026
18.Crop rotation+Reduced fertilization	0.0004
21.Crop rotation+Buffer zones	0.002
22.Buffer zones+Limited fertilization on high risk areas	0.003
23.Crop rotation+Buffer zones+Limited fertilization on high risk areas	0.003
24.Reduced fertilization+Non-plough technology	-0.0047
25.Catch crops+Limited fertilization on high risk areas	0.0097
26.Catch crops+Buffer zones+Limited fertilization on high risk areas	0.0117
27.Limited fertilization on high risk areas+Non-plough technology	-0.0041
28.Buffer zones+Postponing a sod ploughing to late autumn	0.0026
29.Reduced fertilization+Postponing a sod ploughing to late autumn	0.001
30.Buffer zones+Reduced fertilization+Postponing a sod ploughing to late autumn	0.003
31.Buffer zones+Reduced fertilization+Non-plough technology	-0.0027

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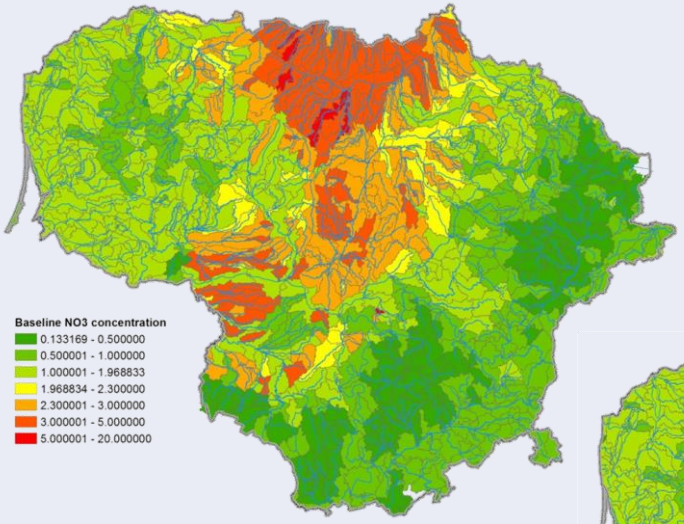
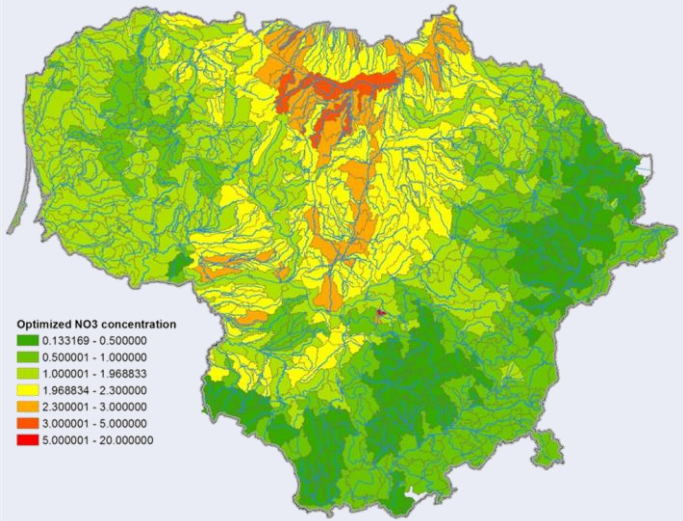
6. Results: genetic optimisation (cost, reduction)

Optimization – optimized nitrate concentrations



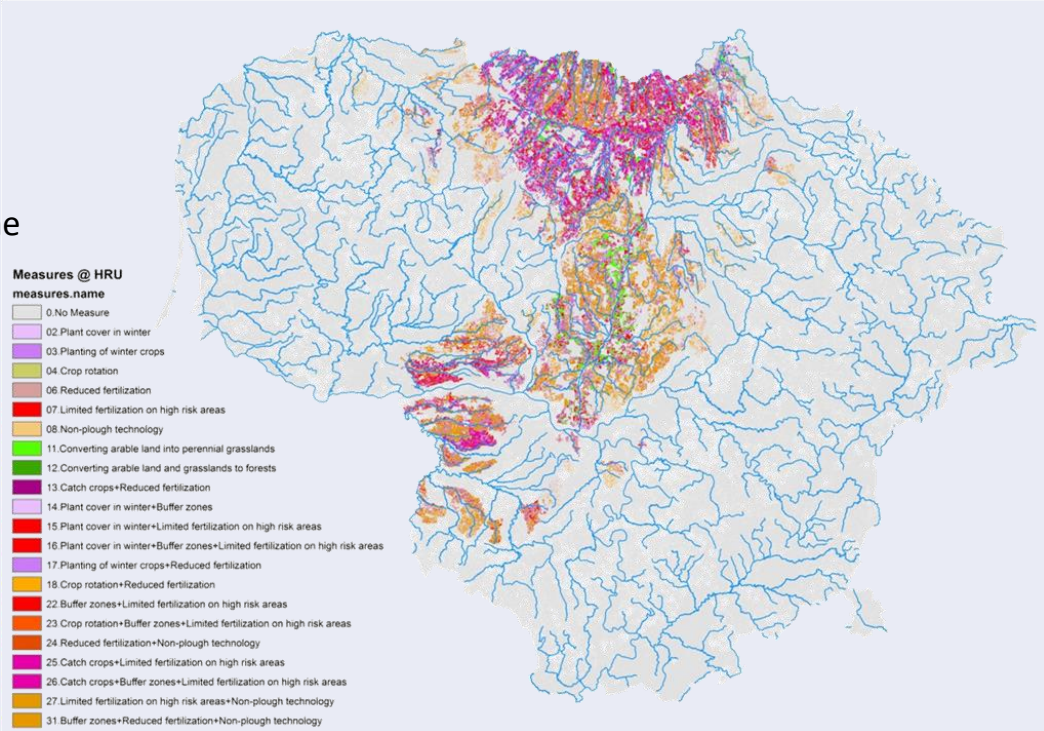
- Concentrations reduced significantly
- Not in all river stretches concentrations reach target value
- If pointsource contribution is high, significant reduction of agricultural pollution are necessary to reach the target



Optimization target concentration of N-NO3 2.3 mg/l

6. Results: distribution of measures

- 8 out of 12 single measures and 13 out of 17 combined measures are considered as optimum at least in some of the HRUs
- Non-plough technology (having negative cost) selected for subbasins where the minor improvements of water quality was necessary
- Catch crops, plant cover in winter and similar in moderately polluted stretches
- Conversion to grasslands and forests in subbasins with high point-source contribution



EU LIFE Programme integrated project
"Implementation of River Basin Management Plans of Latvia towards good surface water status"

Thank you!

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The integrated project "Implementation of River Basin Management Plans of Latvia towards good surface water status" (LIFE GOODWATER IP, LIFE18 IPE/LV/000014) has received funding from the LIFE Programme of the European Union and the State Regional Development Agency Republic of Latvia.

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