VEMALA in KLIVA

Hydrology in Laihianjoki

Marie Korppoo, Markus Huttunen, Mikko Sane, Tiia Vento, Nasim Fazel

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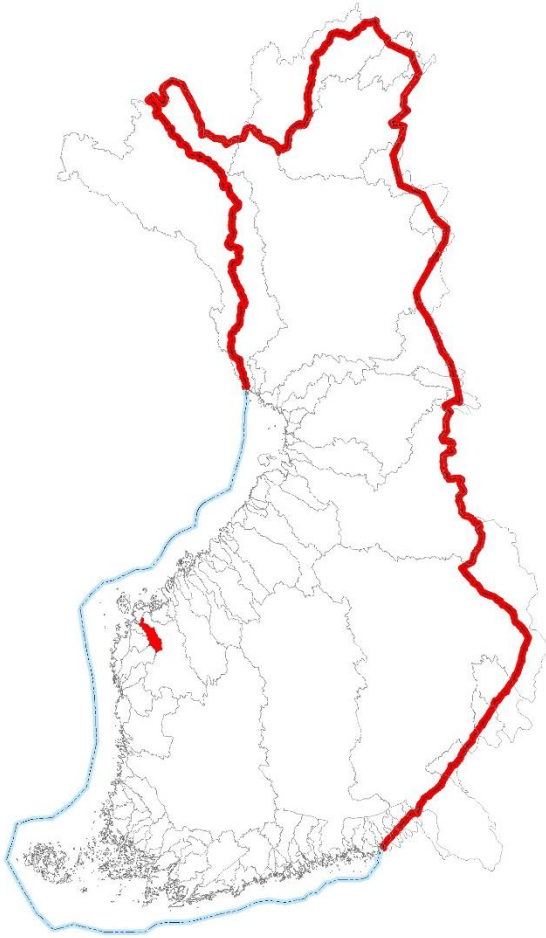
VEMALA in KLIVA- Laihianjoki catchment

- Aim:
  - ✓ Simulate water quantity in Laihianjoki.
  - ✓ Simulate climate change scenarios
  - ✓ Explore different scenarios to remediate possible acidity risks (water-retaining structures)

- Modelling with VEMALA model (Huttunen et al., 2016, syke.fi)



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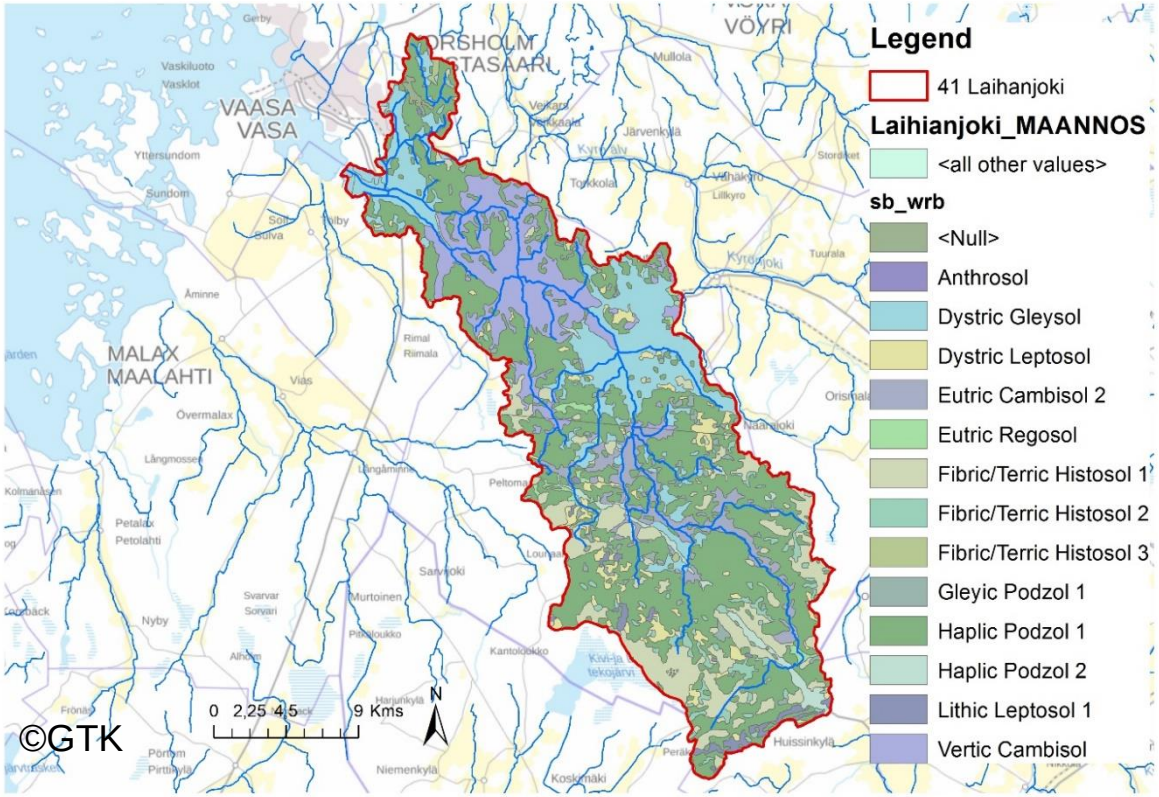
Huttunen, I., Huttunen, M., Piirainen, V., Korppoo, M., Lepistö, A., Räike, A., Tattari, S., Vehviläinen, B., 2016. A national scale nutrient loading model for Finnish watersheds – VEMALA. Environmental Modelling and Assessment 21(1), 83–109.

Laihianjoki catchment – soil types (GTK)

Classes	bottom layer	surface layer
Vertic Cambisols (incl. Eutric Cambisol 2)	clay	clay
Histosols 1 (incl. **Dystric Gleysol**, Umbric gleysol 3, Anthrosol)	organic	organic
Haplic Podzol 1	till	till



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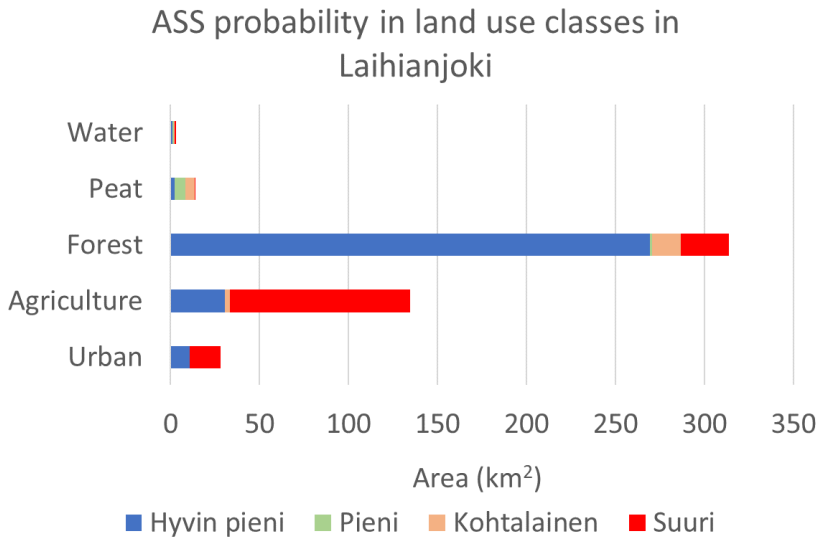
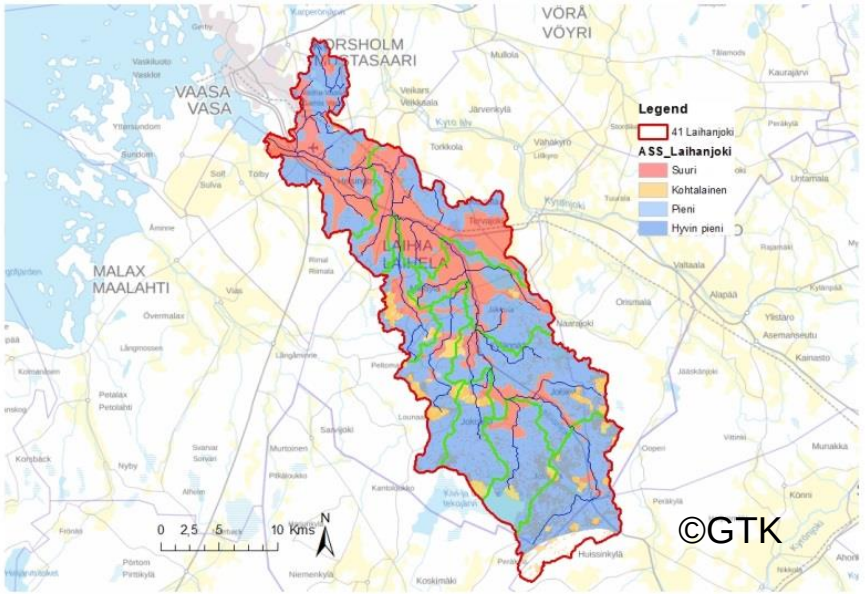
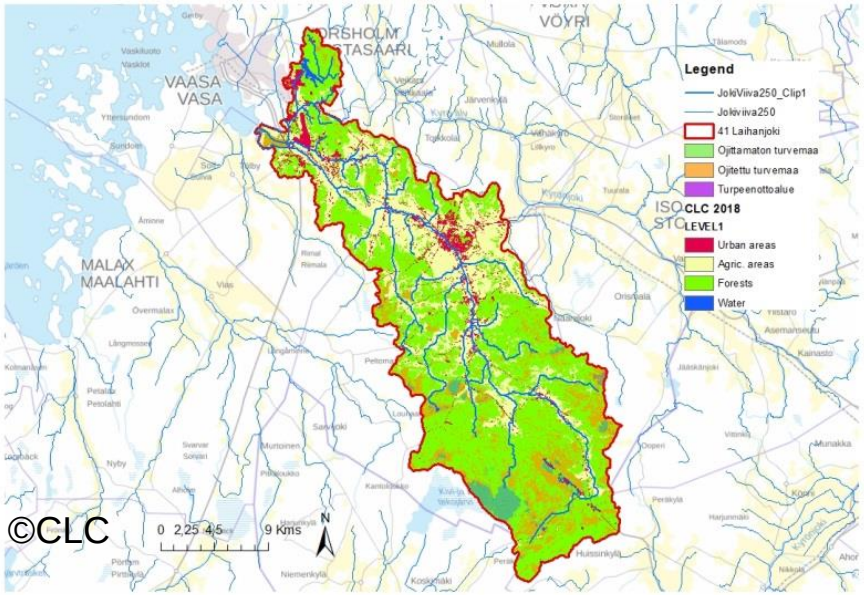
Soil type, land use and acid sulphate soils (ASS)

- ✓ Acid sulphate soils (red) and agricultural areas (light yellow) are both located in the downstream part of the catchment in the low lying areas close to the river.
- ✓ **ASS** mostly on top of **clay** and **organic agricultural fields**







Hydraulic properties of ASS

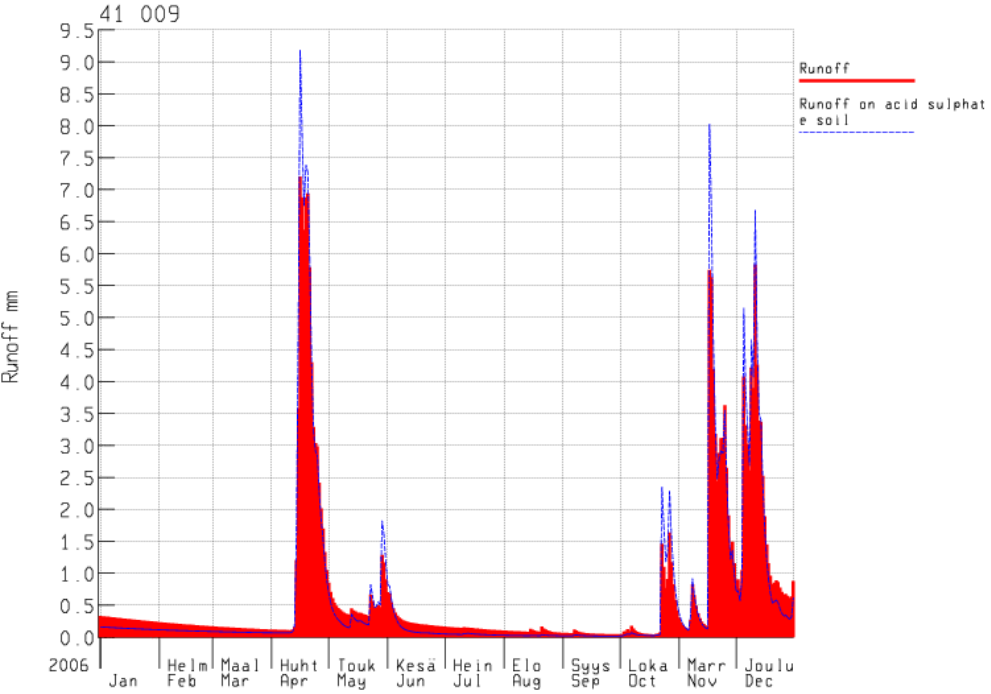
- ✓ After droughts, structure of the ASS change to incorporate cracks (strong structure) (Österholm et al., 2015)
  - ✓ preferential flow becomes available
  - ✓ combined with a low pH and high acidity down to this depth
  - ✓ Long-term effect

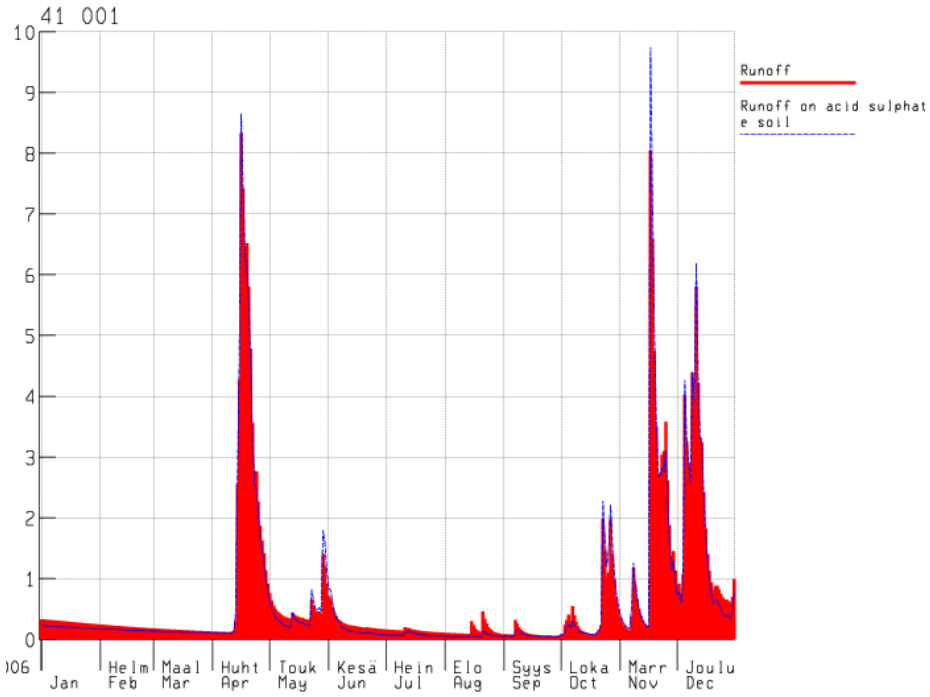
- ➢ Simulation of ASS in VEMALA with high hydraulic conductivity properties.

P. Österholm et al., 2015. Groundwater management of acid sulfate soils using controlled drainage, by-pass flow prevention, and subsurface irrigation on a boreal farmland. Acta Agriculturae Scandinavica, Section B — Soil & Plant Science, Vol. 65, No. Supp. 1, 110–120

ASS runoff timing and scale

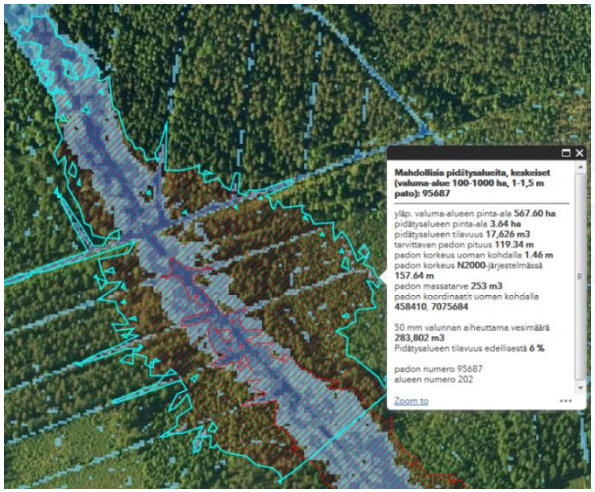
- High hydraulic properties of the ASS means the effect on the acidity comes early in the flood peak

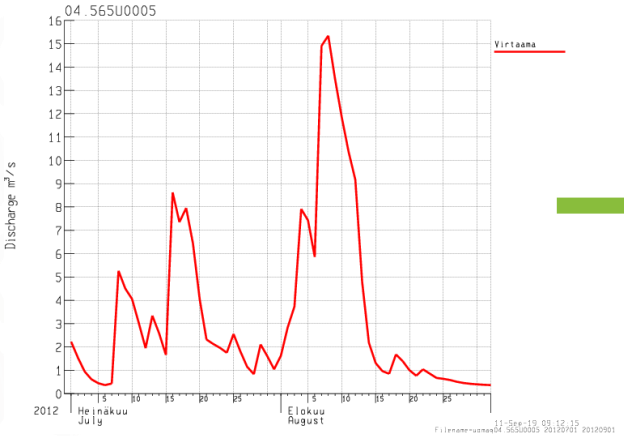


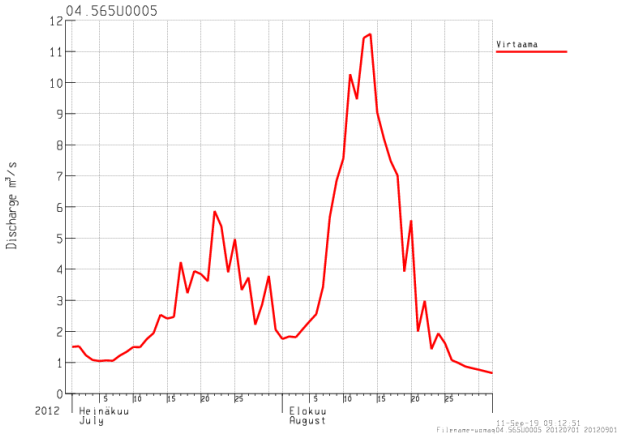


Identify suitable locations for water retention structures (Mikko Sane,SYKE)

- Identification of potential retention pools whose properties are: Dam height of 1-1.5m, catchment area of 100-1000ha and no urban/agricultural areas
- Description of the maximum retention capacity (Volume of the dam): https://syke.maps.arcgis.com/
- VEMALA simulates the changes in the flow







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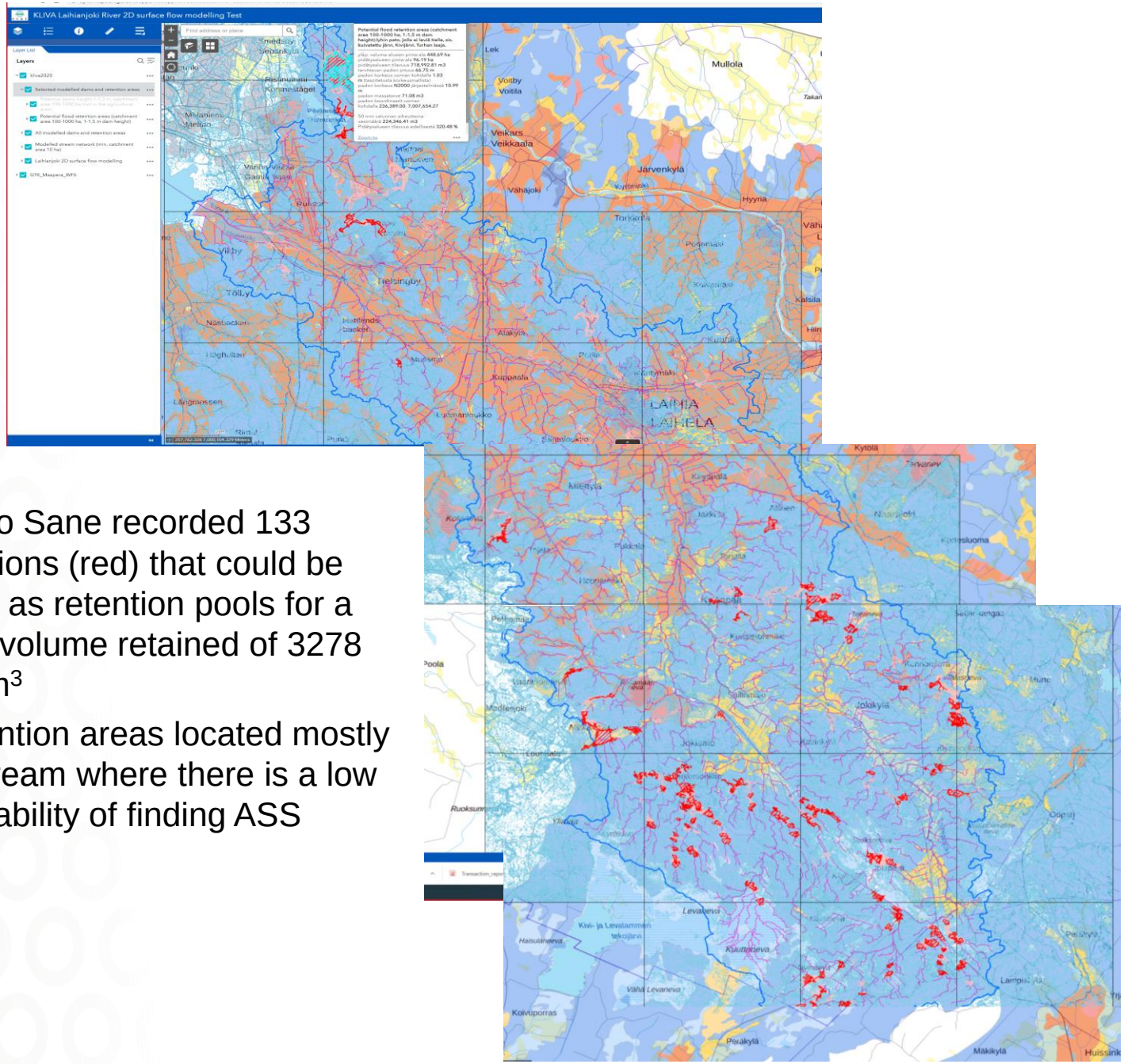

- ✓ Mikko Sane recorded 133 locations (red) that could be used as retention pools for a total volume retained of 3278 000m^3
- ✓ Retention areas located mostly upstream where there is a low probability of finding ASS

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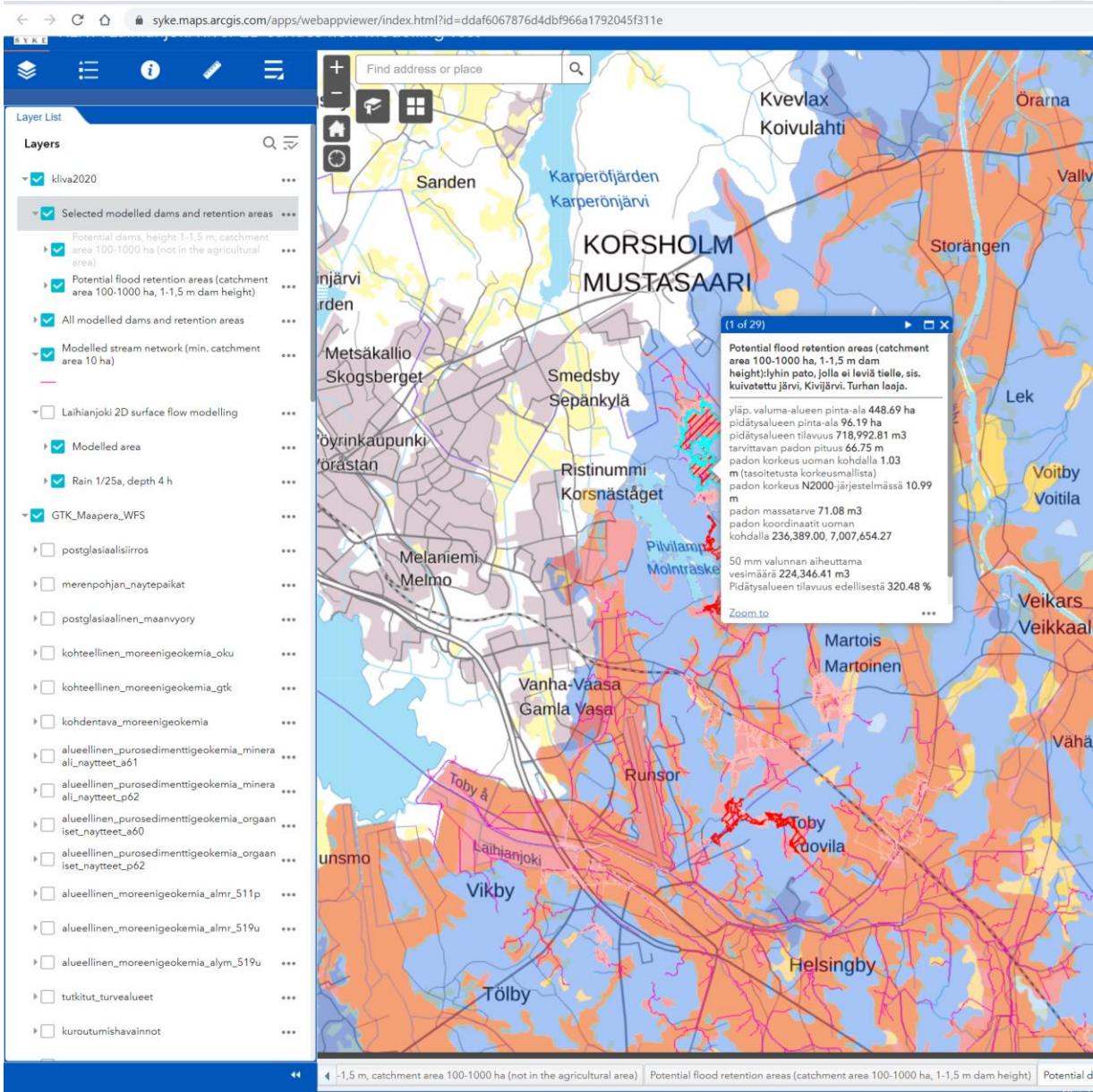
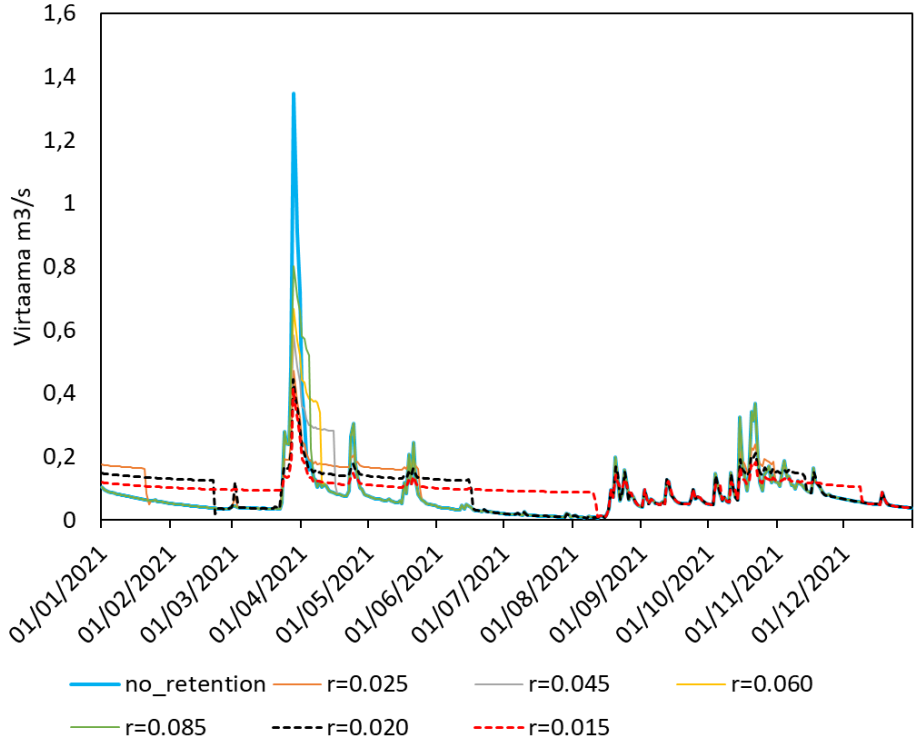
Kivijärvi retention pool

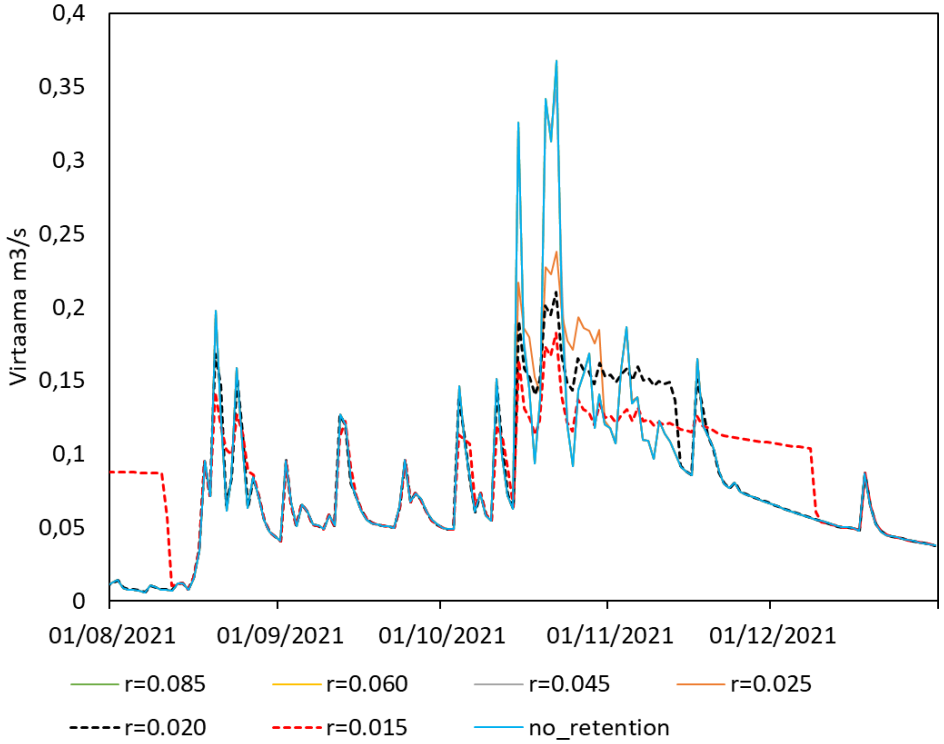
- ✓ ASS located in low lying land, downstream part of the catchment, more agriculture, less availability for retention pools
- ✓ Kivijärvi (drained lake) fits these criteria with a dam height of about 1m and length of 67m, a volume of 720 000m^3 (about 20% of the total volume retained) and a retention area of about 100ha



Effect of the retention dam in Kivijärvi

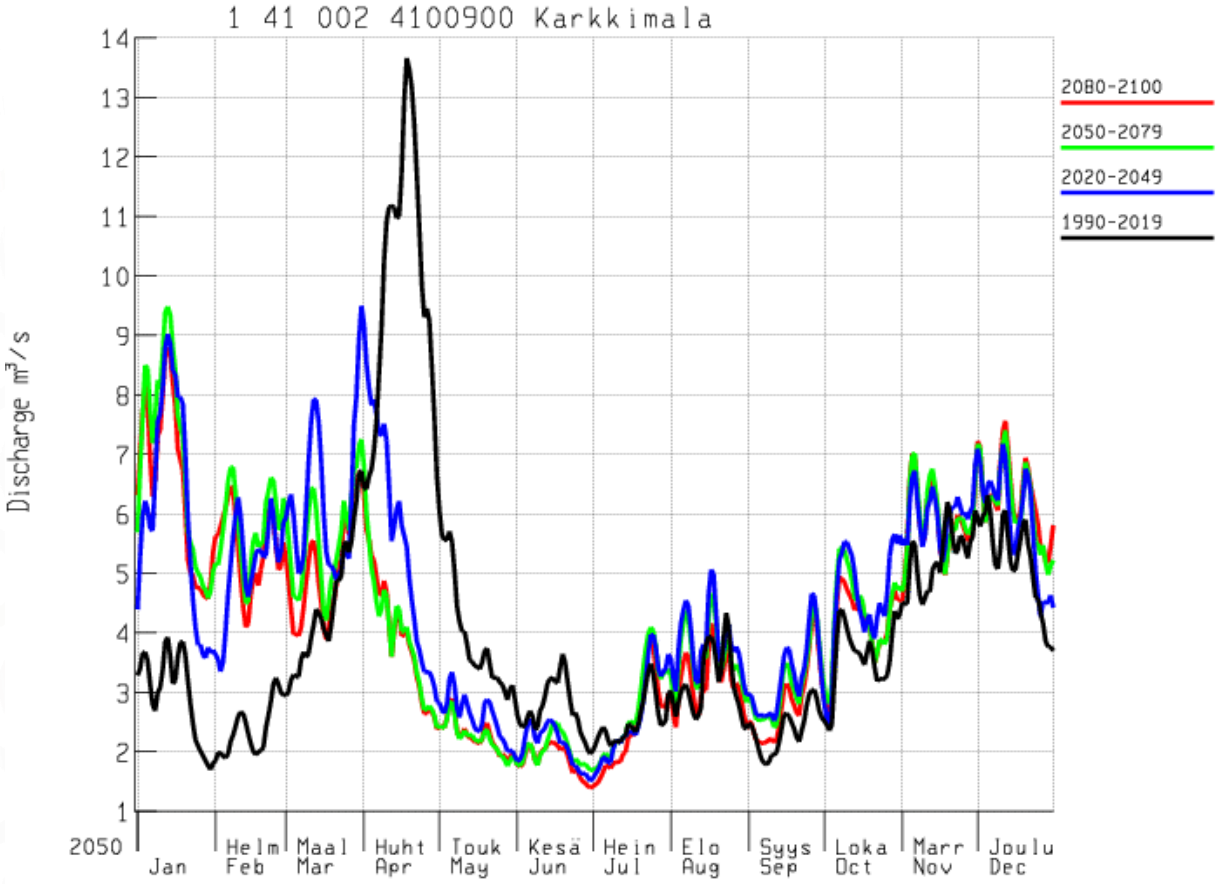
- Depending on pool size and outflow pipe size, either cuts the flood peak or retain water over a longer period.
- High retention means a dilution of the small discharge peaks after the summer droughts, otherwise flushed through
- Low flows are not affected
- Need for the use of controlled drainage in the fields to focus on the ASS areas





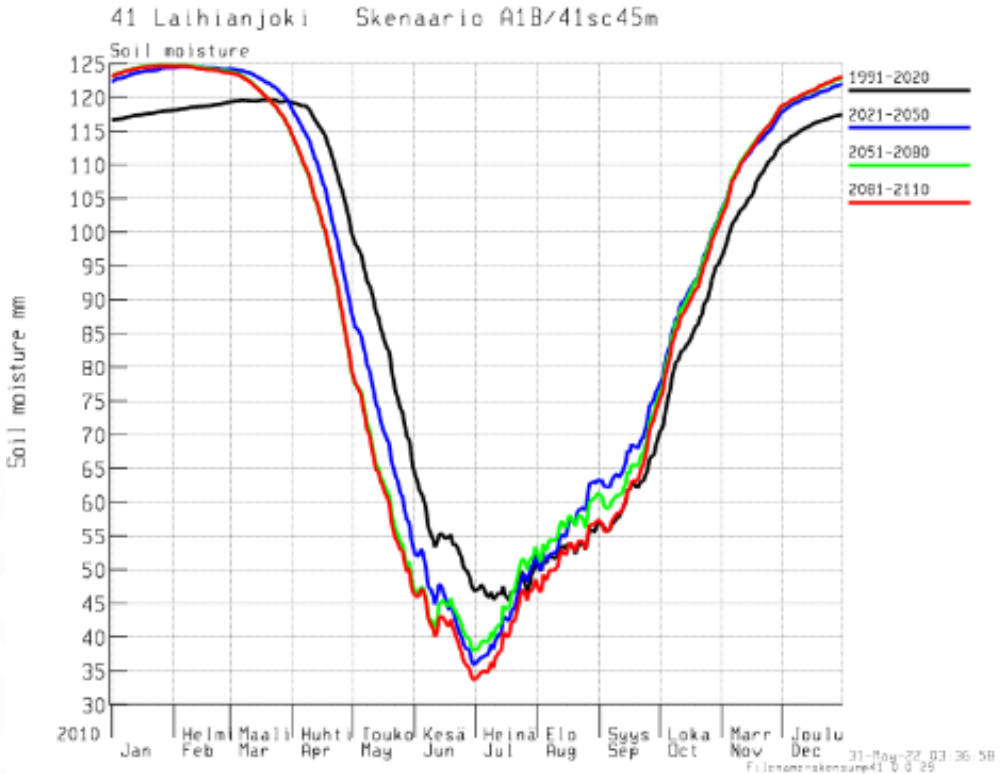
Moderate climate change scenarios in Laihianjoki

- Shift of the spring flood peak towards winter rain
- Increase in annual average precipitation in Finland
- Decrease the minimum discharges in central and southern Finland.



Climate change effect on soil moisture

- Increase temperature -> longer growing season -> increase the likelihood of a drought during summer and early autumn but still rare
- Drying of the soil could start earlier by 2-3 weeks
- Effect on plant growth during establishment of the roots
- Soil moisture needed the most in spring



Conclusion

- **Climate change** is expected to:
  - Increase average precipitation in Finland,
  - Decrease the minimum discharges in central and southern Finland.
  - Increase temperature -> longer growing season -> increase the likelihood of a drought during summer and early autumn but still rare
- **Drought** conditions would increase the probability of acid peaks to the river system during the autumn rains thus decreasing the water quality of the freshwater ecosystem in **ASS catchments** further.
- Possible **controlled drainage in the fields** in the summer could help dilute the acid peaks in the ASS areas.
- **VEMALA** can be applied over all ASS in Finland.
- Feasibility: Dams should not conflict with other environmental objectives, such as fishing (e.g. barriers to fish migration) and ownership considered

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Kiitos, kliva.org

Marie Korppoo, Markus Huttunen, Mikko Sane, Tiia Vento, Nasim Fazel
marie.korppoo@syke.fi

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