Monitoring of transboundary waters between Finland and Russia - *Example of cross-border harmonization*

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Training Workshop Strengthening The Basis For Exchange Of Data And Information On Priority Themes
&
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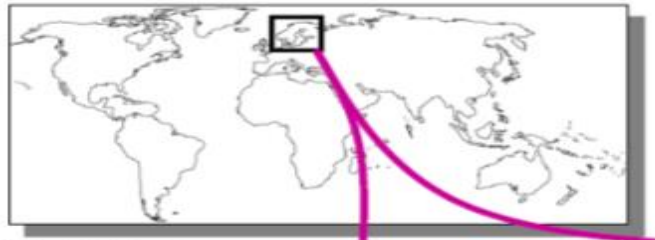
Finland and transboundary waters



From conflict to successful cooperation

VERY DIFFICULT STARTING POINT

WW2: Finland lost land to Soviet Union = Vuoksi River Basin became transboundary, and Finland lost its new hydropower stations

→ Finnish-Russian transboundary cooperation, with Vuoksi River as its backbone

→ Now recognised as the most successful transboundary cooperation in the world (e.g. Strategic Foresight Group 2017)

Altingoz, Belinskij et al. 2018: Promoting Development in Shared River Basins (World Bank)

Ref. INBO Europe annual meeting 2019 Marko Keskinen

River basins

- The agreement covers most of eastern frontier (about 1000 km) with the exception of sea areas.
  - All trans-boundary inland waters
  - 19 river basins
  - Most waters flow from Finland to Russian
  - The largest river basins along the common border are those of the Vuoksi and Paatsjoki, both with several hydroelectric power plants
  - Main interest has long been on watercourses in South-East Finland.

Joint Finnish-Russian Commission on the Use of Frontier Waters

The agreement

- The agreement was made in **1964** between the Soviet Union and Finland.
- Long-term and large-scale transboundary cooperation on water management has been carried out between Finland and Soviet Union/Russia.
- The most important issue is <u>to regulate on impacts in neighbouring country</u>
  - Regulation of water flow when there is a threat of floods or water scarcity
  - Preventing pollution and monitor water quality
  - Make sure that fish can freely migrate and prevent or minimize harms for fish stocks
  - Common understanding of risks, benefits and costs in the broad sense

The annual meeting of the Commission is the formal decision-making body
Both parties (FI and RU) appoints a chairman and provides the commission with experts and secretaries

Commission will have its 57. meeting in August 2019

Issues

- Annual reports
  - water quality trends
  - waste water loads,
  - water protection measurements,
  - water regulation and rules,
  - actions done to protect fish populations
- Special reports e.g.
  - updated monitoring program,
  - flood risk management
  - developing joint hydrobiological monitoring

Working groups

- The practical work and preparing of issues in the commission is done in two main working groups:
  1) the integrated water management group
     - Experts for fisheries work in the sub-group of the integrated water management group.
  2) the water protection group
     - The frontier guards group helps experts in monitoring work.
- One annual meeting per group (in spring)
  - Preparing joint reports and attachments to commission
  - Nowadays 3 day meeting, including group meetings and one seminar day with changing topics
- One annual meeting of the commission (in autumn)
  - The reports provided by each group are discussed and accepted (usually some 20 annexes)
  - Excursion to some interesting place (industrial plant, hydro power station, subject of restoration, …)

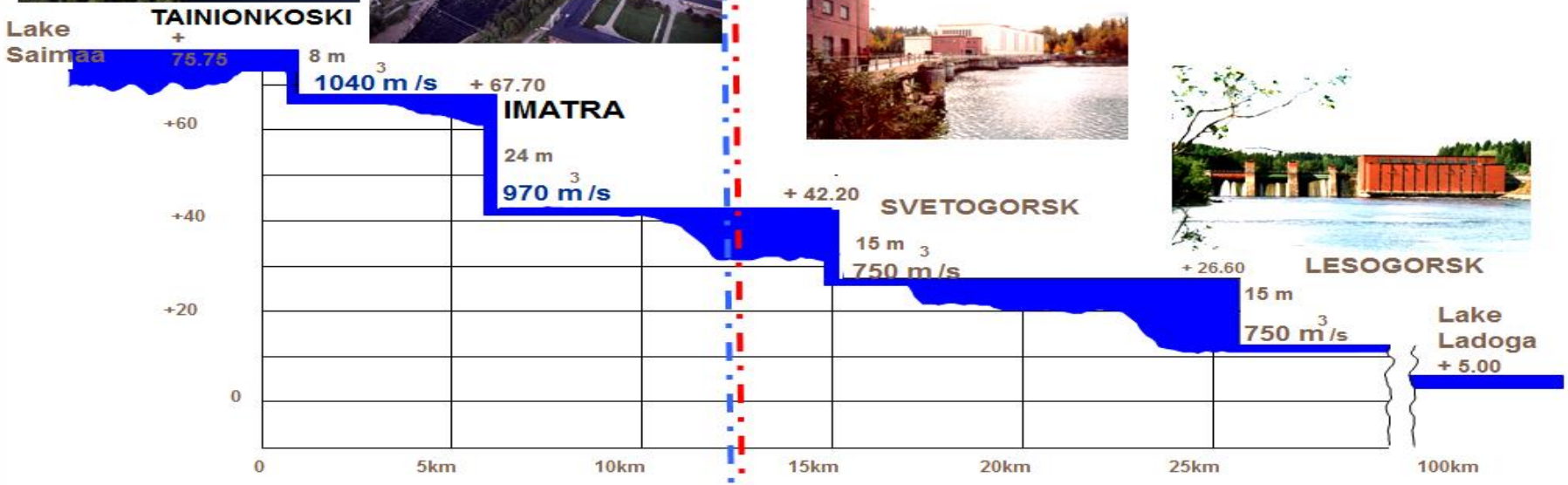
Quantity issue: The Lake Saimaa - River Vuoksi System

- Catchment 70 000 km^2
  - Finland 77 %, Russia 23 %
- Lake Saimaa
  - surface 4 460 km^2
  - precipitation ~ 600 mm/a
  - water level fluctuation 3,3 m, annual mean 0,7 m
- River Vuoksi natural discharge
  - mean 600 m^3/s
  - max 1170 m^3/s
  - min 220 m^3/s

The profile and power plants of the River Vuoksi

VUOKSI

Total head (utilized) = 63 m
Installed power = 440 MW
Normal annual production = 2500 GWh



Max. power	62 MW	178 MW	100 MW	100 MW
Normal annual production	300 GWh	1000 GWh	600 GWh	600 GWh

FINLAND | RUSSIA

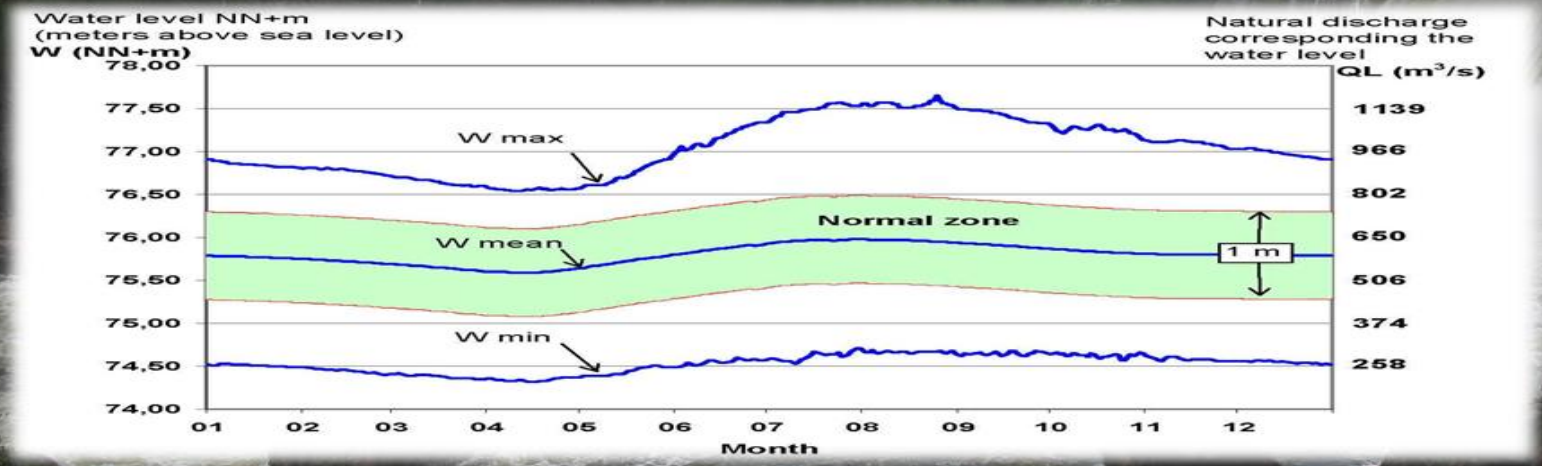
Fortum

Lake Saimaa and River Vuoksi Discharge Rule

- Hydropower and flood risks main challenges at the starting point in 1970s
- Initiative of the Russian Party at the Joint Transboundary Commission 1973
- Development targets at the outset
  - Increase winter discharge and minimum flows in River Vuoksi
  - Prevent exceptionally high and low water levels in Lake Saimaa
  - Prevent exceptionally high and low flows in River Vuoksi
- First plan 1979 accepted by Joint Commission
- Jointly accepted 1989, implemented 1991

The Discharge Rule

- Natural water level and discharge in normal circumstances
- When water level forecast goes beyond normal zone discharge may be increased or reduced
- Natural discharge resumed when flood or drought threat ceases



IWM in practice?

- Flow management policy aims at maximally beneficial overall result for both countries
- In case of flood or draught alert, Finland, being upstream, alters flow to the transboundary Vuoksi River
- If hydropower stations on Russian side cannot utilize natural flow – this may cause losses for energy production
- After exceptional flow period the overall balance is counted and compensation of eventual losses are negotiated
- Both countries avoid flood damages which may be larger than losses

➢ Win-Win situation (or no loose – no loose)

Quality issues: The water protection group

Main interest has long been on watercourses in the South-East Finland

Stress for watercourses are caused by

- pulp and paper mills
- hydropower
- municipalities
- agriculture

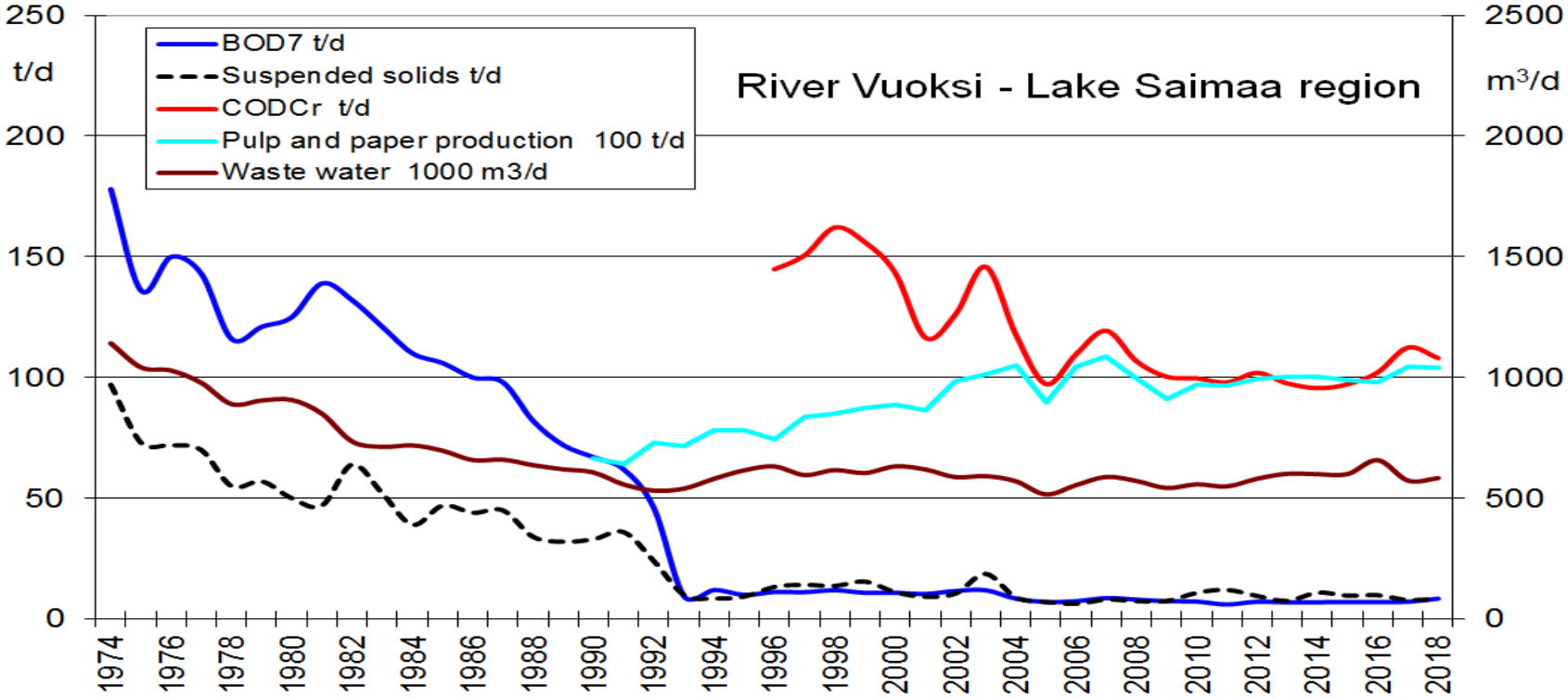
Annual report of loading

Both parties report

- Point-source loading to bordering rivers
- Any special occasions during a year like
  - accidents,
  - difficulties in water purification in waste water plants
- How loading has changed in time
  - table and time series
- Water protection actions done in the latest year
  - New development in purification processes
  - Changes of environmental permits of industry and municipalities
  - Actions made to protect waters from diffuse pollution

Annual report of loading

How loading has changed in time in River Vuoksi-Lake Saimaa region



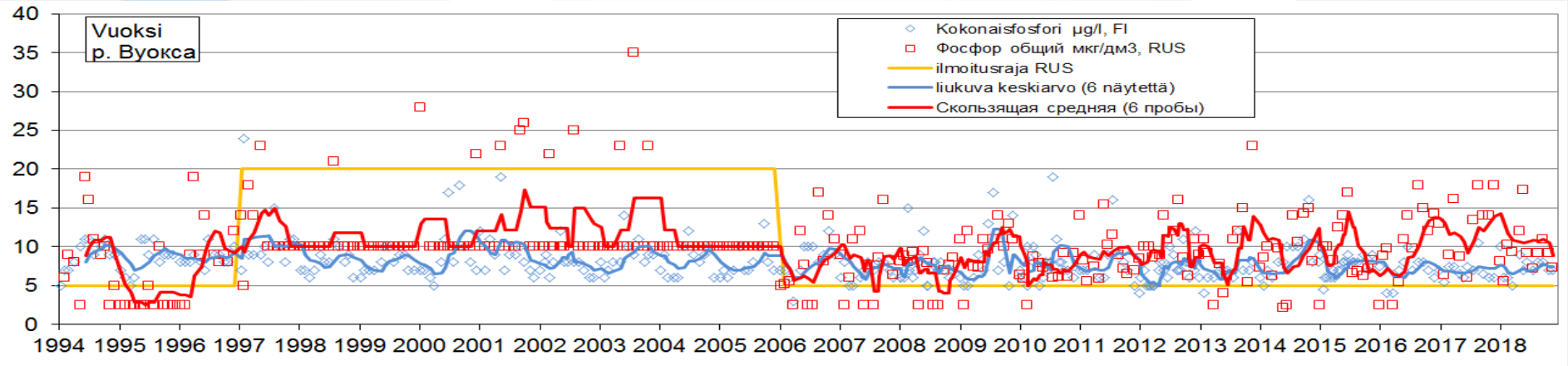
The development of the water quality in the transboundary watercourses

- The reduction of the load has meant an improvement in water quality in both the river Vuoksi and Hiitolanjoki rivers.
- Both the content of organic and phosphorus and nitrogen have reduced in these rivers significantly since 1970s.
- The water quality of the river Vuoksi on the border area has been classified as good.
- The water quality of the Vuoksi river clearly deteriorates on the Russian side before Lake Ladoga.

Annual report of water quality monitoring

Joint report of monitoring results of most important rivers in the latest year and how water quality has changed in time

- Example of reported data:



Total phosphorus (µg/l) in Vuoksi 1994-2018.
Sampling dates and moving average of 6 samples.

Finland Russia Detection limit of Russia

Sampling

- Normal routine:

  Sampling every month in a same day in the Finnish side and in the Russian side

- Special cases:

  Joint sampling (intercalibration) once in every 2 years, in March-April, only some water quality parameters and synthetic sample

- No automatic sampling, only manual sampling

Intercalibration: Water sample from same sampler to two different bottles. One for a Finnish laboratory and the other to a Russian laboratory

Developing analytical methods

- In 1960s, 1970s, 1980, 1990s a lot of work was done to develop analytical methods together
- Used standards and practical laboratory work were studied
- Intercalibration tests were done every 2-3 years
- Total nutrient (P and N) were added to monitoring programme not until early 1990s
- Detection limits are now low in both sides
- Data is comparable.

Intercalibration

Variables: Ptot, Ntot, Fe, Mn

One RU laboratory and two FI laboratories participated in this process.

Table 2.

Water samples of River Vuoksi taken at the same site.

Table 3. Synthetic samples (made by RU this time)

We were very satisfied for the whole process and for the results.

Таблица 2 – Результаты анализа пробы природной воды, р. Вуокса

Показатель	SYKE	MetropoliLab	ФГУ «Балтводхоз»
Железо общее (Fe), µg/l	77 ± 8	83 ± 16	64,81 ± 25
Марганец (Mn), µg/l	2,8 ± 1	3,1 ± 1	2,98 ± 1,0
Азот общий (Ntot), µg/l	470 ± 71	420 ± 64	405 ±30
Фосфор общий (Ptot), µg/l	6 ± 1,5	7 ± 1	9,2 ± 2,6

Таблица 3 – Результаты анализа синтетических проб

Показатель	Fe, µg/l	Mn, µg/l	Ntot, µg/l	Ptot, µg/l
Синтетическая проба Финляндии				
Теоретическое значение	55	6,5	370	7
SYKE	59 ± 6	7 ± 1	400 ± 60	7 ± 1,5
MetropoliLab	58 ± 12	6,7 ± 1	370 ± 56	8 ± 1
ФГУ «Балтводхоз»	58 ± 22	6,9 ± 2,2	370 ± 30	5,9 ± 1,6
Синтетическая проба России				
Теоретическое значение	79,5	16	501	12,4
SYKE	81 ± 8	16 ± 2	530 ± 80	11 ± 2
MetropoliLab	78 ± 16	15 ± 3	490 ± 73	11 ± 2
ФГУ «Балтводхоз»	81,8±31	16,0±5,2	517±41	12,1±3,4

Результаты анализов хорошо сопоставимы, и стороны очень удовлетворены результатами оценки.

Monitoring program

Renewed document in August 2015

Joint monitoring program of bordering waters between Finland and Russia

- History of FI-RUS monitoring
- Maps of sampling sites with co-ordinates
- Sampling depths and times
- Variables

River Vuoksi: Distance between sampling sites 2.9 km

Monitoring program

variables, units, sampling frequencies

Variable	Unit	Sampling frequency
Discharge	$m^3 s^{-1}$	
Secchi depth	m	12 times per year
Temperatute	°C	
Ogygen	mg/l	
Oxygen saturation	%	
pH		
Conductivity	mS/m	
Suspended solids	mg/l	
Turbidity	FNU	
Colour	mg/l Pt	
COD_{Mn}	mg/l	
BOD_7	mg/l	
Total P	µg/l	
Total N	µg/l	
Fe	µg/l	
Mn	µg/l	
Na	mg/l	
Cu	µg/l	4 times per year
Zn	µg/l	
Hg	µg/l	
Ni	µg/l	4 times per year, every 3. year
Pb	µg/l	
Cr	µg/l	
Cd	µg/l	
As	µg/l	
Chlorophyll a	µg/l	7 times per year

Summary of water quality reporting

- Water quality sampling once a month on a same day at the both side of the border, usually the first Tuesday of a month (agreed beforehand)
- Data exchange with e-mail monthly (pdf)
- If any special happens, e-mail or phone call to contact persons as soon as possible
  - Accident
  - Exceptional discharge or result
  - Change of sampling day
- In January, data exchange of whole last years data in Excel-format by e-mail
- In February, data is joined to earlier years data in SYKE and time series and tables are made and send to Russia.
- In March, both parties prepare the annual report using the last years report as a template. Russian party write in Russia and Finland in Finnish. After translation versions are joined usually very easily.

Data processing in SYKE

National databases

- SYKE has SQL databases for quality elements
- Water quality data transferred from ~ 100 laboratories as transition files from laboratory systems to SYKEs system with automatic quality control
- Phytoplankton and macroinvertebrates stored to databases by laboratories, software for data storage
- Data use
    - Graphics in WQ-software of data to .csv, .xls,..
    - Data directly from database using sql
    - Direct connection to databases with Excel, PowerBi, ArcMap..

Data processing in SYKE

Cross border co-operation with Russia

- Russia sends every year an Excel file including whole data of reporting year
- Variable codes are added in SYKE
- RU and FI data are joined using those variable codes, sampling sites and dates
- Data of a reporting year is joined to past years data and graphics are updated

  - If there would be more data e.g. from plenty of more sites it would be definitely more practical to use strict format for data deliver and add Russian data to sql database. This will be done in the near future.
  - There were time we used telefax or ordinary mail to send laboratory result to each other. So nowadays data handling is very smooth.

Biological and chemical monitoring

- At present, no joint monitoring programme, no data exchange
- Under preparation a plan for testing periphyton (Diatomes) monitoring in the way it is done under WFD
- Russia uses saprobic approach
- Maybe these methods are able to join (see e.g. Rolauffs et al 2004. Hydrobiologia 516:285-298)
- Fish monitoring could be also possible in the future

- Finland gives information to Russia if any priority substance fails to achieve environmental quality standard

Projects contributing to cross-border work

- Finland reports its river basin management plans and all detailed data according to WFD guidelines to EU
- Russia has its own monitoring guidelines, methodologies and classification systems
- For Finland, it is important to have water protection projects with Russia where we enhance our view over the environmental state of rivers and the coastal waters by using modern / automated monitoring techniques and promote cross-border data exchange.
- We have quite many projects on-going or starting soon.
- The results of these projects will be presented to the Commission.

Challenges

- Climate change
  - Increased occurrence and variability of heavy precipitation and drought periods
  - Shorter snow period, more abundant autumn and winter floods, less severe spring floods
  - Alterations in ice conditions
    - Ice and snow cover essential for Saimaa seal nesting
- Forecasting and optimal flow control become crucial

  -> real-time data and better forecasts on hydrology and meteorology
- Flood risk management tools: e.g. mapping and planning
- Transboundary early warning systems

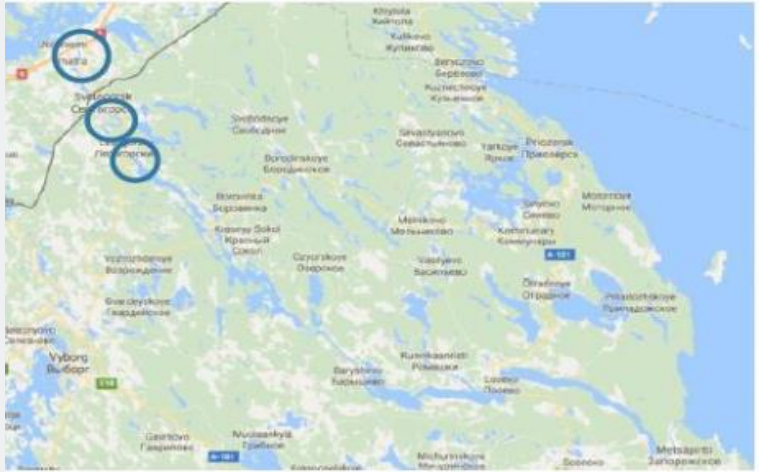
More challenges

How countries deal with climate change?

- Brownification of surface waters has been noticed in Finnish rivers and lakes.
  - COD_{Mn} concentrations have increased.
  - Changes in quantity and quality of terrestrially derived DOM.
  - This phenomenon has also been observed in upstream lakes with no human impact, only long-distance transport of air pollutants.
- In Finland climate change is taken very seriously.
- In Russia water administration and experts are more skeptical.

More challanges – need for fishpasses

- In Finland: Imatrankoski rapid, famous touristic attraction (now dry)
- Power plant with no fish pass
- Imatra urban brook was constructed 2015, new habitat for trout
- In Russia: Fish passes are needed to 2 power plants (Svetogorsk, Lesogorsk)
- Would enable migration of Lake Ladoga salmon to Imatra



Power plants at R. Vuoksi

Site of Imatra urban brook

Experiences of Finland

- Difficult starting point – Finland lost 2nd WW and downstream of River Vuoksi was merged to Soviet Union.
- Joint transboundary integrated water resources management has been achievable even with two very different societies
- Survived cold war and collapse of Soviet Union
- Ukraine crisis → tension between Russia and EU
- **Pragmatic, clear focus on finding joint ma**

Joint sampling by Russian and Finnish experts at the transboundary river Vuoksi