COFI-Water

Strengthening water quality monitoring and assessment in Colombia

Suomen ympäristökeskus
Finlands miljöcentral
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COFI WATER

IDEAM

SUOMI
FINLAND

COFI-Water project

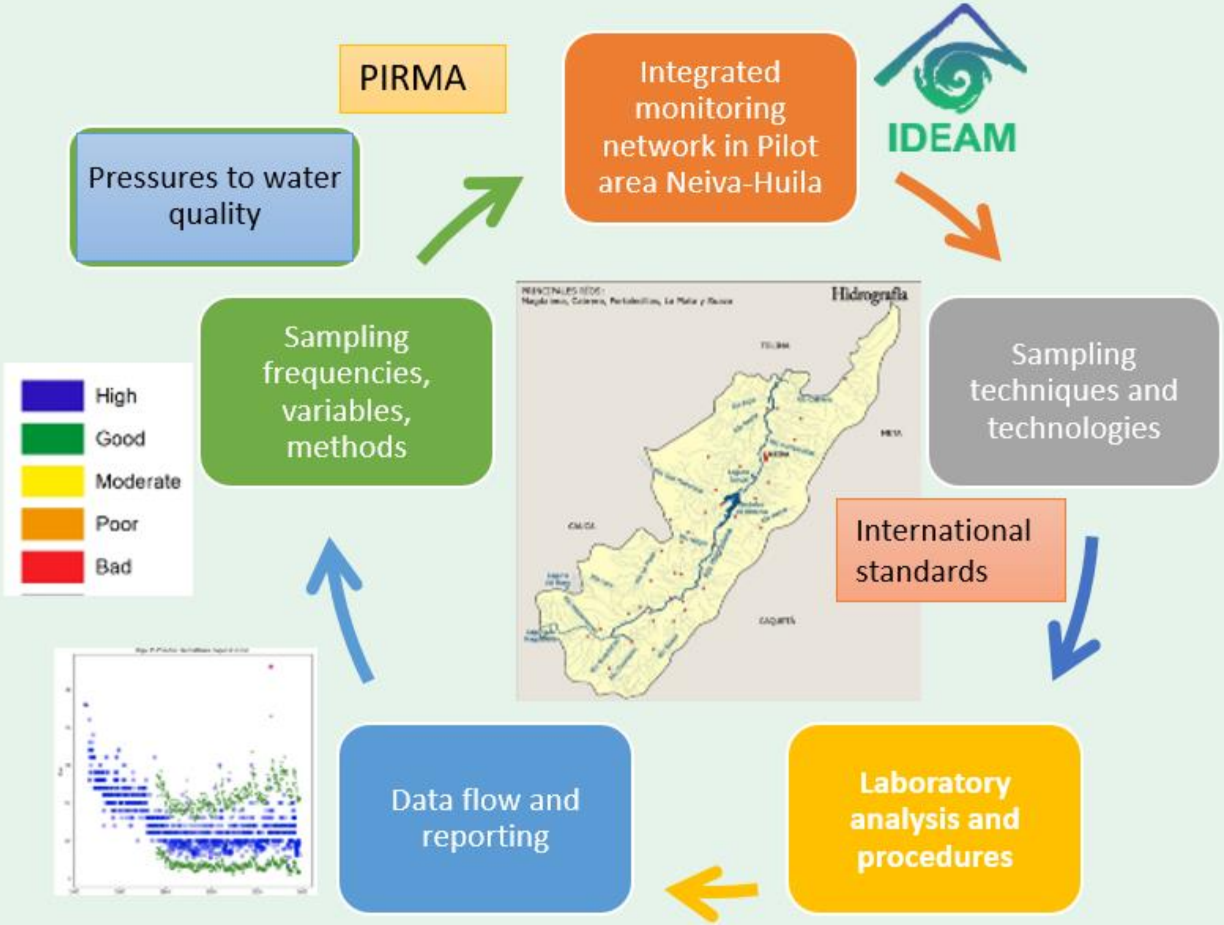
The project "**Strengthening water quality monitoring and assessment in Colombia** (COFI-Water)" was a joint initiative between the Institute of Hydrology, Meteorology and Environmental Studies (IDEAM) and the Finnish Environment Institute (Syke). It was financed by the Ministry for Foreign Affairs of Finland (MFA) through Institutional Cooperation Instrument (ICI) in 2019-2023.

The collaboration aimed to enhance IDEAM's capacities to plan, establish and operate water quality monitoring systems at national level in Colombia. COFI-Water helped IDEAM in implementing the activities outlined in the "Roadmap for the monitoring of the quality of surface water in Colombia" (2016). The **long-term** effect produced by the development invention i.e. **impact** of the COFI-Water project is **strengthened water quality monitoring and assessment in Colombia.** The goal was to have an operative national water quality network which offers high quality data for assessment needs.

The aim of the project was that Colombian authorities could **systematically measure and monitor the quality of their surface waters and the affecting variables**. The implementation of international standards and monitoring guidelines are needed to ascertain quality and that both sampling and analysis of waters are done accordingly. **Timely and reliable water monitoring** is essential to target reducing harmful impacts on social and natural processes, especially on human health and to promote sustainable society with equitable access to water and sanitation as well as the basis of livelihoods. All outputs and activities of the project were connected to the monitoring cycle (Figure 1).

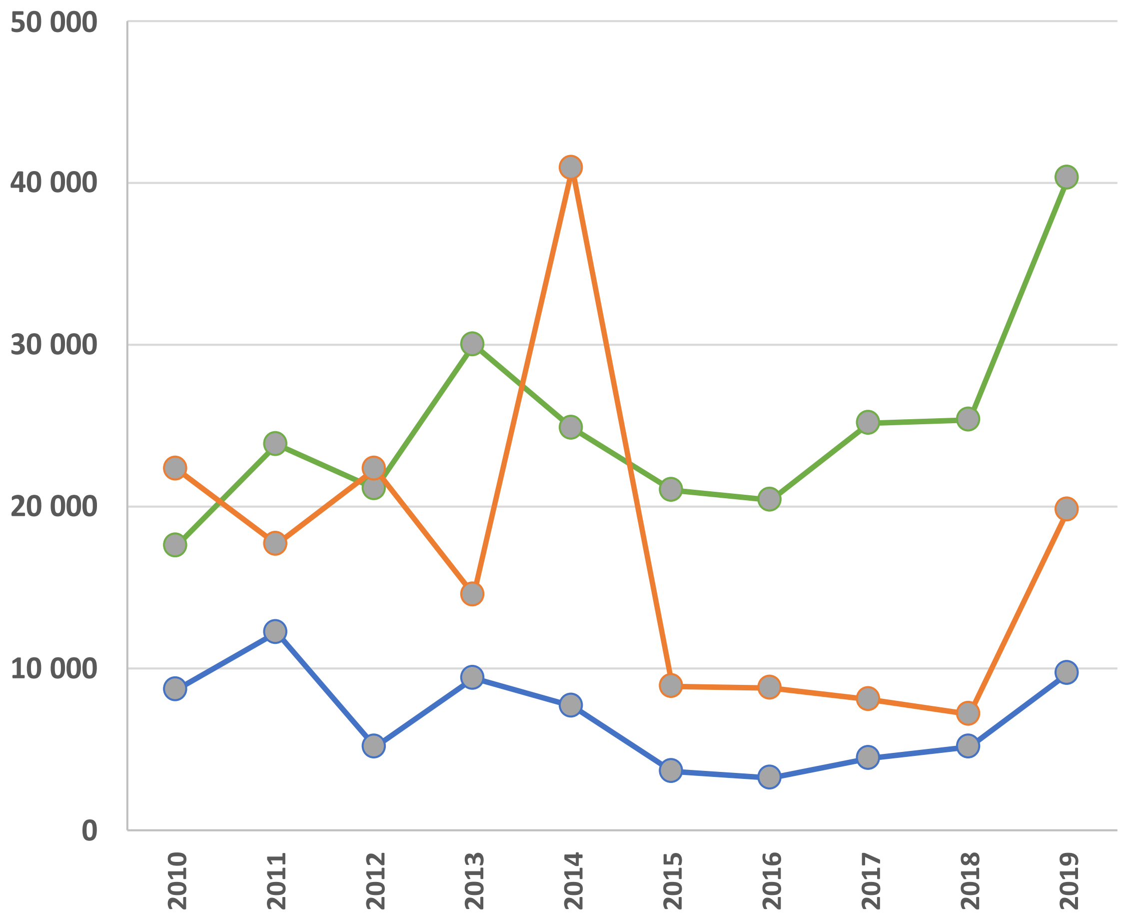
Special focus of the project was on **pesticide monitoring** in aquatic environment and on required related sampling and analysis methods.

Figure 1. Outputs and Activities connected to Monitoring Cycle



PIRMA = Regional Institutional Program for Monitoring the Quantity and Quality of Water, Colombia

Figure 2. Estimated use (tons/year) of pesticides in Colombia.
herbicides, fungicides, insecticides



Data source: fao.org/faostat/en/#data/RP

Pesticides in Colombia

Colombia is one of the world's largest producers of coffee, bananas, and palm oil, and these crops are often heavily sprayed with **pesticides** to protect them from pests and weeds. Pesticide sale has increased in South America more than in any other continent (FAO 2022, Figure 2). Valbuena et al. (2021) found out that a high proportion of pesticides sold in Colombia was classified to the worst category according to acute toxicity. Further, they concluded that integral information and monitoring system is needed in Colombia to assess pesticide risks to humans and the environment. The importance of this is supported by recent human health study, in which Meléndez-Flórez et al. (2022) detected chromosomal alteration in Colombian people occupationally exposed to pesticides. Affected people are likely signs that pesticides may harm the ecosystems too. **Even when pesticides are present in low concentration, they could create severe problems.**

According to the screening study carried out by IDEAM and Syke, pesticide concentrations in water samples were mainly low (below quantification limits) but a potentially risky concentration of insecticide dicholorvos was observed in one sample. Based on this mini-screening, the overall risks caused by pesticide on aquatic biota was likely acceptable in 2/3 big rivers. However, many pesticides were detected by passive samplers indicating their presence in the sampling sites. It is likely that their concentrations in some upstream sites have been much higher.

Recommendations

- Pesticide monitoring in Colombian rivers should continue.
- This includes that analytical methods will be further developed and cover as many potentially risky substances as possible with relevant detection limits.
- One way to study the relevance is to check those substances found in mini-screening either in water or in passive samplers.

Sampling methods

Sampling guidelines and documentation

Traditional grab water sampling and sample transportation is at a good level in IDEAM. Documentation is available in the laboratory system (Good practice manual). A Syke expert performed an audit of IDEAM's sampling procedure. Some deviations between the written instructions and the implemented sampling were noticed. Auditing is a good tool to regularly check the operating procedures.

Sampling techniques and technologies

Syke produced three videos for training purposes: grab water sampling, bottom fauna collecting, and measurements with a field meter (see links below). During the study tour, training was given to use different kinds of sampling techniques for water sampling and biological sampling (periphyton). New methods were introduced to experts of IDEAM: passive sampling of pesticides and metals, using satellite data, and on-line monitoring for water quality monitoring.

Together with Syke's experts, IDEAM's experts have gone through the tendering and procurement process of a multiparameter probe (Hydrolab, HL7), seen the installation of the probe, and received user training in connection with it. They are already familiar with the data obtained from the probe. Besides, two new field meters (Horiba, U-50G) were procured to help sampling.

Co-operation with private sector

New technologies and solutions for on-line monitoring provided by Finnish and Colombian private sectors have been demonstrated and discussed during the trainings and workshops.

Sampling videos

Three training videos were produced within the project:

(Versiones en español aquí)

Water sampling from a stream with a Limnos sampler

Measurement of water quality in a stream with a Horiba field meter

Collecting benthic fauna in a stream with the Kick-Net method

Recommendations

- Performing audits for all kind of sampling procedures is recommended.
- Producing videos for training needs help to keep quality of sampling in good level, which is an absolute prerequisite for high-quality water quality monitoring results.


Photo 1. Danilo Uasapud takes sample of macroinvertebrates.

Monitoring methods and new approaches

In **traditional grab water sampling** the results describe the concentration of the studied parameter at certain moment of time i.e., time of sampling. Grab water sample contains both particle bound as well as dissolved fraction of the chemical. In grab water samples the concentrations of studied chemicals may remain below the laboratory's detection limits which means that a more sophisticated sampling method is needed. Also, the transportation of e.g., one liter of water sample to the analyzing laboratory can affect to the stability of the sample.

Passive sampling provides a tool to collect chemicals for longed time period, e.g. 2-4 weeks to concentrate the low chemical concentrations, which can remain undetectable in grab water sample, to measurable level. This means that lower concentrations can possibly be observed with passive sampling than with grab sampling. Passive sampler collects the dissolved fraction of the chemical, which is the bioavailable fraction and, depending on the chemical, could be more harmful to organisms than the particle bound fraction. The result from a passive sampler is a time weighted average concentration of the compound during the study period. Therefore, grab sampling and passive sampling techniques measure different things.

Development of the IDEAM laboratory quality management system

One of the goals of the project was to strengthen the capacity of IDEAM's laboratory in accordance with the international standard ISO/IEC 17025. When aiming to provide up-to-date information of water quality, the reliability of the produced water quality data is of high importance. IDEAM's laboratory is aiming to get ISO/IEC 17025 accreditation and has already conducted an internal audit by the Accreditation Group of the Subdirectorate of Environmental Studies of IDEAM, which acts as the accreditation body for the environmental laboratories in Colombia.

Several training sessions were held throughout the project, covering topics of data management tools, laboratory information management system, calculations of measurement uncertainty of the produced results, method validation as well as laboratory quality assurance and quality control. Also, specific topics related to the standard ISO/IEC 17025 were included. Syke provided introduction to and practical training for measurement uncertainty calculation software (MUkit). The software was available initially in English and during the project also translated in Spanish and is now in use in IDEAM's laboratory.

An interlaboratory comparison between IDEAM and Syke laboratories for pesticide analysis was conducted to get information of the current status of the method. IDEAM laboratory also participated in Proftest Syke proficiency test for natural water analyses (Koivikko et al. 2023).

Recommendations

- The first scope of accreditation could be only for some parameters.
- Achieving accreditation and maintaining it would require more permanent staff.
- Performing internal audits is recommended.

ENVICAL MUkit

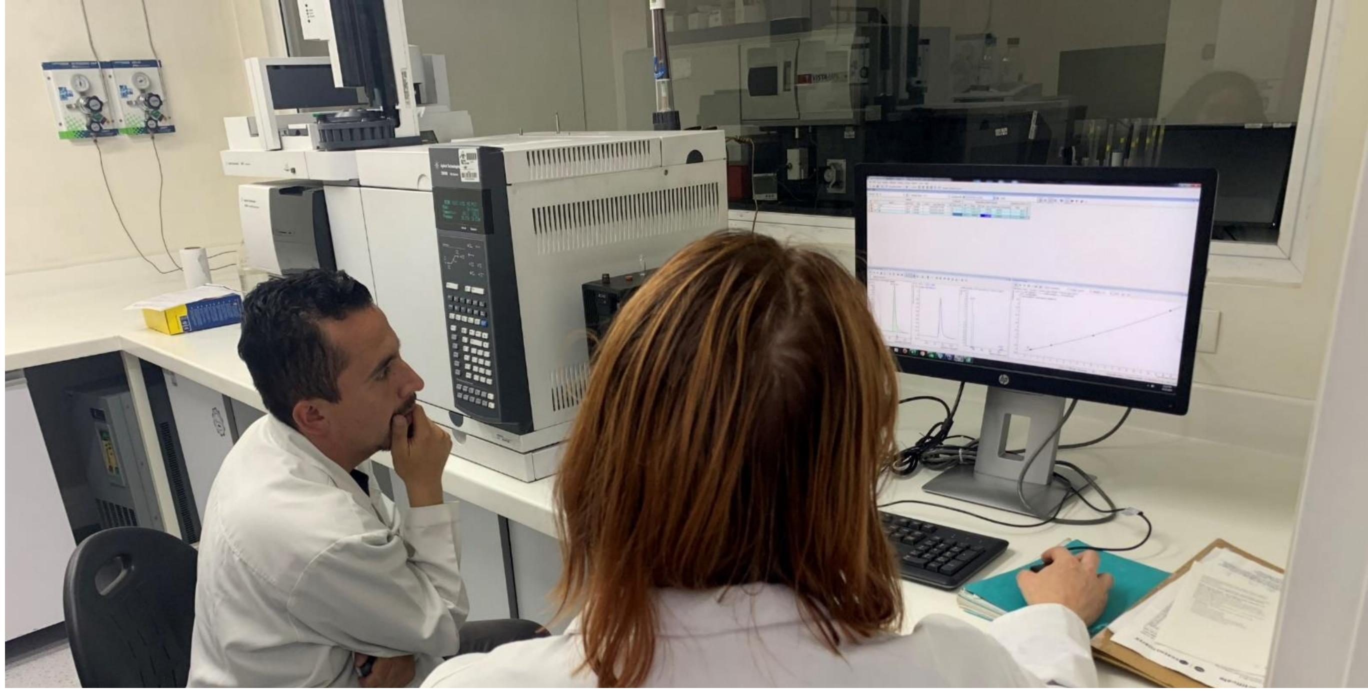


Photo 2. Rodrigo Pérez and Marja Hagström examining the GC-MS/MS results.

Photo 3. IDEAM laboratory.


Photo 4. Rodrigo Pérez and Carlos Velásquez preparing DGT samples for analysis.

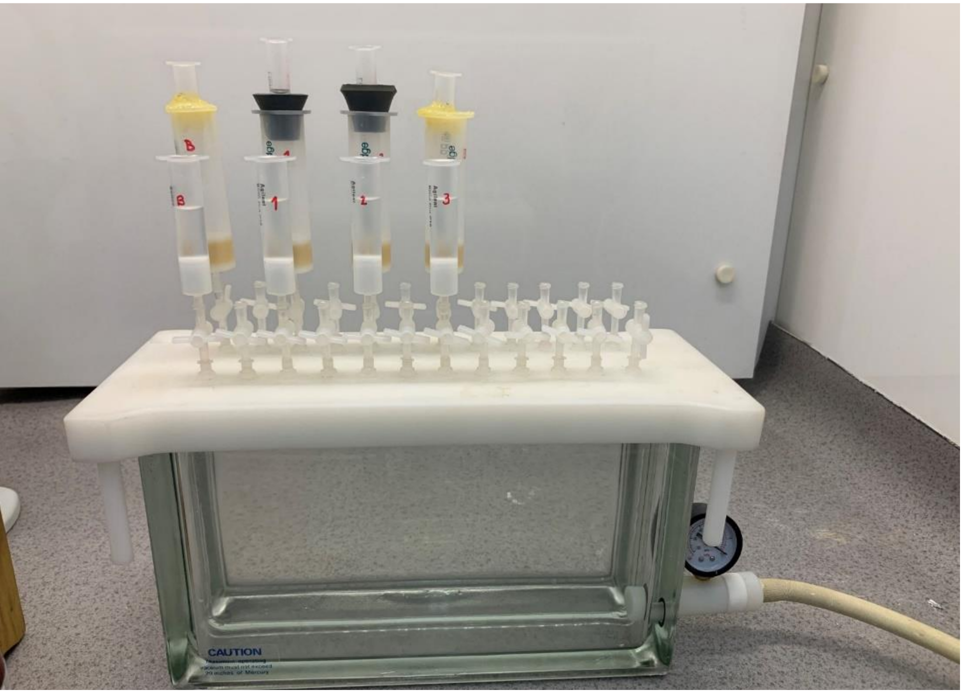


Photo 5. Solid-phase extraction for pesticide analysis of grab samples.

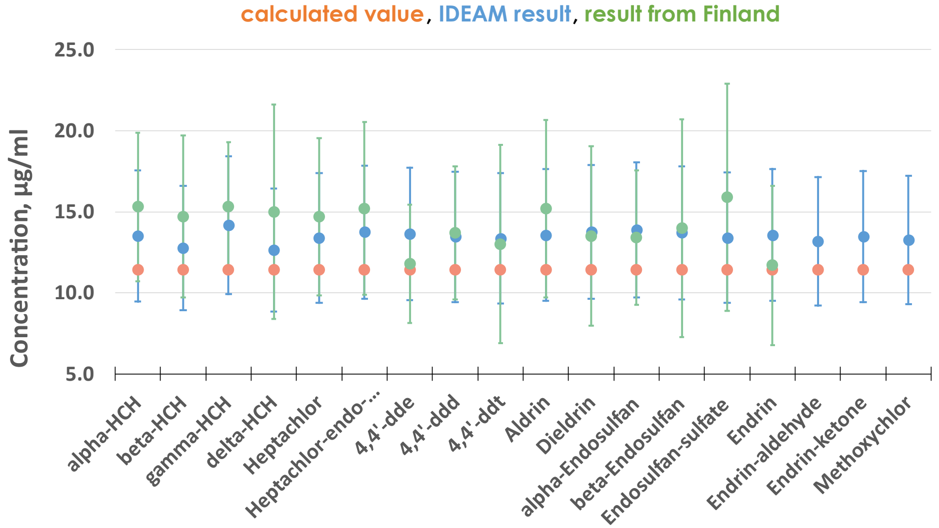
Pesticides – Monitoring methods and analysis

Method development

- For the method IDEAM uses for pesticide analysis, the levels of limits of quantification (LOQ) have been relatively high and suggestions how to lower limits were presented during the project. In general, it is important to keep analytical instruments in good condition with regular monitoring and cleaning procedures. For that purpose, Syke created a simple troubleshooting guideline for GC-MS/MS instrument to be used in IDEAM. According to IDEAM, they have managed to lower the LOQs with one order of magnitude during the project.
- Syke offered IDEAM new type of SPE cartridges for extraction efficiency comparison tests. Results showed only small differences in extraction efficiencies within substances analysed.
- An interlaboratory comparison between two laboratories for pesticide analysis was conducted to get information of the current status of the method in IDEAM laboratory (Figure 3).

Sample treatment and analyses in IDEAM laboratory in photos 2-5.

Figure 3. Interlaboratory comparison results, sample D



Recommendations

Method development should be further continued paying attention especially in instrument maintaining and column condition.

Photo 6. Diego Cortés collects the passive samplers at Paicol station.

Photo 7. Passive samplers after deployment.

Photo 8. Removing the DGT samplers from the incubation rack.

Passive sampling deployment at Paicol station

The Paicol station, Paicol being the pilot area of the COFI-Water project, is located south from Neiva, the department of Huila at the river Páez. The river Páez is a tributary of the river Magdalena, which is the main river of Colombia and discharges finally to the Caribbean Sea.

The passive samplers were placed at Paicol station as it was considered as a safe location for the samplers (Photo 6). Two types of passive samplers were used (DGT and Chemcatcher) (Photos 7-9). The samplers were retrieved after two weeks' deployment. Pesticides and heavy metals were analysed both in Finland and in the IDEAM laboratory.

Photo 9. Ofelia Angel packs the samples in labelled bags.

Passive sampling: Results of pesticide analyses

In the DGT and the Chemcatcher passive samplers, analysed in Finland, 19 different pesticides were detected (Table 1). The total number of analysed pesticides was 275. From DGT passive sampler, three pesticides were detected and one of which was below the quantification limit (LOQ).

From the Chemcatcher sampler, 17 pesticides were detected, four of which were below the LOQ. Only **triclosan** was detected in both passive sampler types. Triclosan is a biocide and used in personal care products like in toothpaste. In DGT and Chemcatcher passive samplers, analysed in Colombia, concentrations of all pesticide were below the LOQ.

Table 1. Pesticides detected in passive samplers at Paicol station.

Pesticide	Pesticide DGT 1	Pesticide Chemcatcher 1	Pesticide DGT 2	Pesticide Chemcatcher 2
	FI	FI	CO	CO
	µg/sample	µg/sample	µg/sample	µg/sample
2,4-D	**ND**	<0.0025**	na	na
4-chloro-2-methylphenol	0.0027	**ND**	na	na
Atrazine	**ND**	0.0021	**ND**	**ND**
Azoxystrobin	**ND**	0.0014	na	na
2,6-Dichloro-benzamide (BAM)	**ND**	<0.0025**	na	na
Diethyltoluamide (DEET)	0.2	**ND**	na	na
Dimethoate	**ND**	**ND**	**ND**	**ND**
Dimethomorph	**ND**	0.0056	na	na
Dinoterb	**ND**	0.008	na	na
Diuron	**ND**	0.0033	na	na
Carbofuran	**ND**	<0.0013**	na	na
Chlorpyrifos	**ND**	0.0028	**ND**	**ND**
Clothianidin	**ND**	0.0029	na	na
Metalaxyl	**ND**	0.0084	na	na
Oxadiazon	**ND**	0.017	na	na
Pendimethalin	**ND**	0.0032	na	na
Propiconazole	**ND**	<0.0025**	na	na
Cyproconazole	**ND**	0.0031	na	na
Thiamethoxam	**ND**	0.006	na	na
Triclosan	<0.0025**	0.009	na	na

** denotes for detection of concentration <LOQ, na = not analysed or analysis not available, **ND** = analysed, but not detected

Passive sampling: Results of elemental analyses

From the metal DGT passive samplers analysed in Finland, all analysed elements were discovered (Table 2). In IDEAM 10 elements were analysed and of those, Hg was analysed only in IDEAM. Passive sample treatment in IDEAM laboratory in photos 10 and 11.

The concentrations measured in IDEAM were generally orders of magnitude higher than the ones analysed in Finland. As no interlaboratory comparison was conducted, it is difficult to say if these differences derive from passive sampler extraction or analysis devices.

Photo 10. Extraction of the passive sampler in IDEAM laboratory.

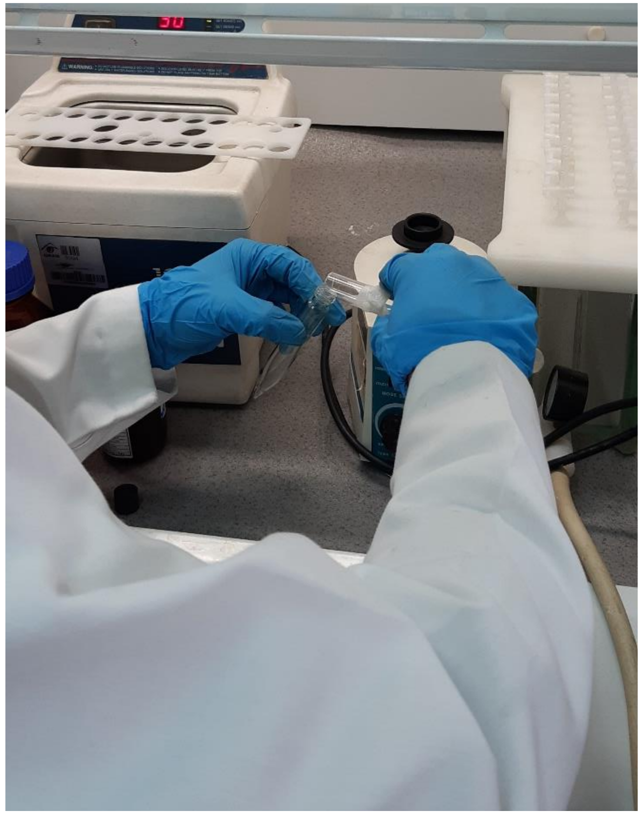


Photo 11. Transferring the extract of the passive sampler into analysis tube in IDEAM laboratory.

Table 2. Time averaged concentration of elements in two metal DGT passive samplers analysed in Finland and in IDEAM.

Element	Average result of metal DGT 1 and 2	Time averaged concentration of analyte measured by DGT	Average result of metal DGT 3 and 4	Time averaged concentration of analyte measured by DGT
Analysed in	FI	FI	CO	CO
	ng/sampler	C_{DGT} (ng/L)	ng/sampler	C_{DGT} (ng/L)
Al	1300	9000	7900	55000
As	0.34	2.1	na*	na
Ba	260	na	na	na
Ca	320000	na	na	na
Cd	9.4	47	250	1400
Co	14	78	na	na
Cr	3.0	24	630	4100
Cu	47	220	5000	26000
Fe	550	3100	7500	40000
K	980	na	na	na
Mg	21000	na	na	na
Mn	4600	29000	7300	41000
Na	9700	na	na	na
Ni	49	260	630	3600
P	180	1300	na	na
Pb	0.83	3.2	630	2600
S	3900	4500	na	na
Se	0.54	na	na	na
Sr	660	na	na	na
Ti	5.4	na	na	na
U	10	na	na	na
V	3.2	14	na	na
Zn	120	650	5000	27000
Hg	na	na	130	500

* na = not analysed or analysis not available or no diffusion coefficient available.

Photo 12. Diego Cortés takes a grab water sample.

Grab water sampling: Results of pesticide analyses

Four grab water samples were taken from three Colombian rivers (the river Paéz, the river Neiva, and the river Magdalena, Photos 12 and 13). From the river Neiva, two parallel samples were taken to monitor repeatability of the used methods. From samples analysed in Finland only six substances were detected out of 275 substances that had been analysed (Table 3). In IDEAM, no pesticides were detected from the grab water samples.

Photo 13. A) Sampling site at the river Paéz, B) grab water sampling, and C) dividing the water sample into subsamples.

Table 3. Detected pesticides in grab water samples, their use (B=biocide, H=herbicide, I=insecticide, F=fungicide), selected predicted no effect concentrations (PNEC) of them and observed concentrations in grab water samples. All concentrations are given in µg/l.

Substance	CAS	Use	PNEC	River Páez, Paicol Station	River Neiva, Desembocadura (parallel samples)		River Magdalena, Puente Santander
2,4-D	94-75-7	H	0.2 [a]	ND	ND	ND	0.012
Azoxystrobin	131860-33-8	F	0.55 [b]	ND	ND	ND	0.01
Dichlorvos	62-73-7	I	0.0006 [c]	ND	0.002 [g]	0.002 [g]	ND
Diethyltoluamide (DEET)	134-62-3	B	50 [d]	<0.005 [f]	0.023	0.023	0.019
Oxadiazon	19666-30-9	H	0.088 [e]	ND	ND	ND	0.006
Thiamethoxam	153719-23-4	I	0.04 [f]	ND	<0.010 [h]	<0.010 [h]	<0.010 [h]

a) German AA-EQS (taken from Weisner et al. 2022), b) Swedish proposal for limit value (Boström&Gönczi 2022), c) EU AA-EQS (Directive 2013/39/EU), d) PNEC estimated from available literature data (Siimes et al. 2019), e) Swedish preliminary limit to evaluate surface water concentration results (SLU & Agritox 2018), f) Proposed AA-EQS (EU COM 2022), g) Concentration exceeds PNEC value, h) Substance detected but concentration below quantification limit.

Utilization of the flow and water quality data of the Paicol hydrological monitoring station

Project purchased a multiparameter water quality measurement probe (Hydrolab, HL7, Photo 15) which was installed at Paicol station in the river Páez in June 2022. The probe includes sensors for six parameters: turbidity, conductivity, dissolved oxygen, temperature, pH and suspended solids.

The data recorded by the HL7 probe is collected by a datalogger (Photo 14). The probe and the datalogger were connected through the SDI-12 communications protocol with a 50-meter installation cable.

The Paicol station was selected as a pilot area because i) it is guarded, ii) it already has a hydrological station, iii) the catchment area size and characteristics are suitable to learn to use the multiparameter probe and iv) of the information it provides, e.g. for possible SWAT modeling.

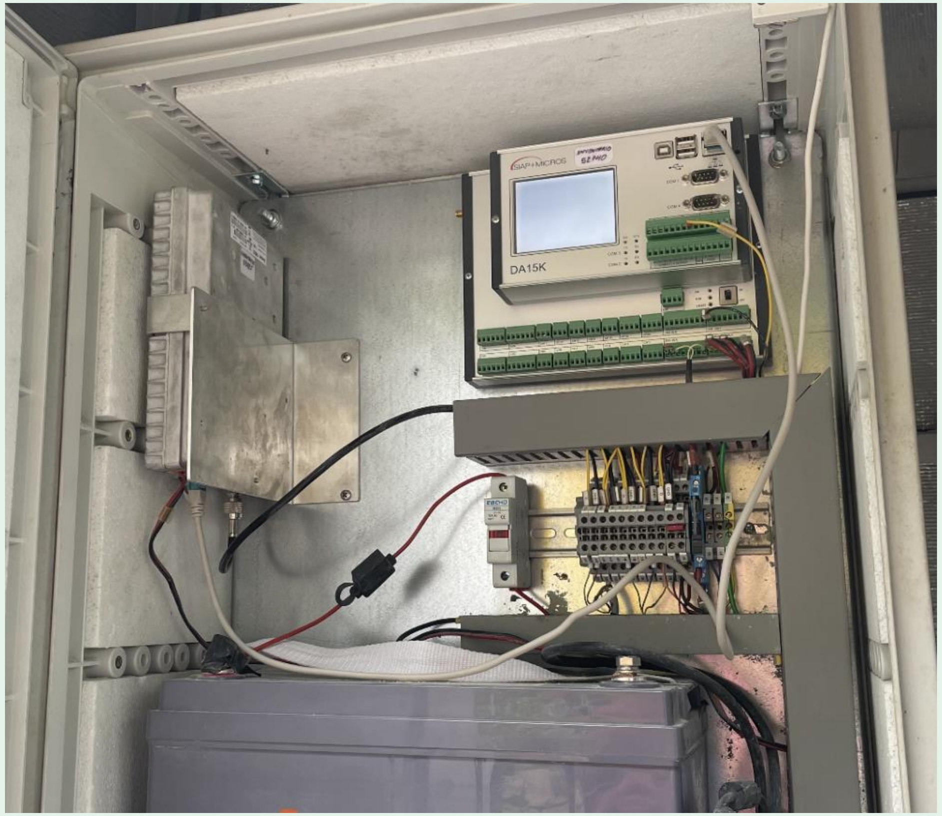


Photo 14. Datalogger.

Photo 15. The multiparameter probe (Hydrolab, HL7) lifted from water.

Time series of the Paicol monitoring station

The automatic water quality monitoring at the Paicol station was started on 22nd June 2022, and the measurements are still ongoing. In Figure 4, we present results till 3rd March 2023. During this period, there were three water samples taken from the river with the HL7 probe.

The sensor-measured, so-called “raw” turbidity recorded at the times of sampling (7th Sep. 2022 at 08:45, 14th Oct. 2022 at 08:45 and 14th Nov. 2022 at 08:30) were plotted against the turbidity (NTU, Figure 5A), as well as against the concentrations of total suspended solid (TSS, mg/l, Figure 5B) and total phosphorus (P_{tot}, µg/l, Figure 5C) determined from the water samples at the laboratory.

Linear regression equations were formed on the base of the three samples and the corresponding sensor recordings. The coefficients of determination (R^2) of all three equations were quite high (0.95–0.96). However, the number of samples is so far too low for reliable calculations, and more samples are needed to confirm the correlation.

Moreover, the plan is to build a SWAT catchment model setup for the river Páez basin, in which the Paicol automatic monitoring station is. The model outputs include water flow and transport of sediment, nutrients and pesticides.

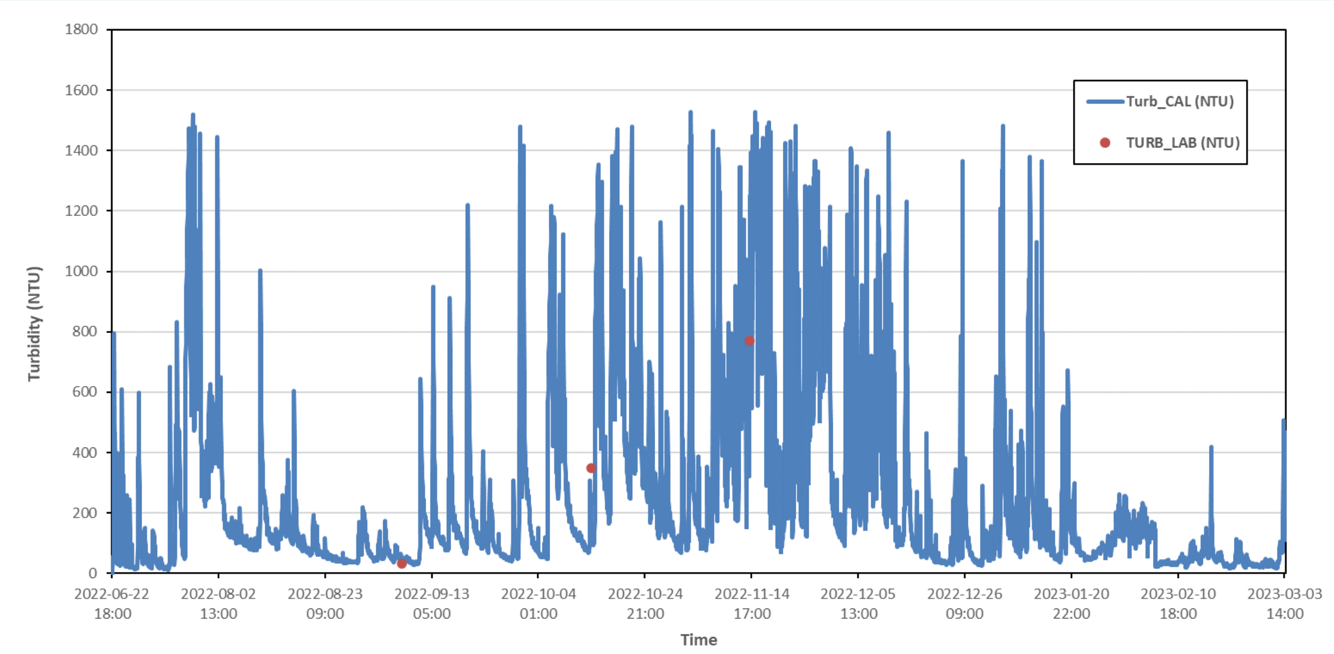


Figure 4. Timeseries of turbidity in water measured with HL7-probe (Hydrolab).

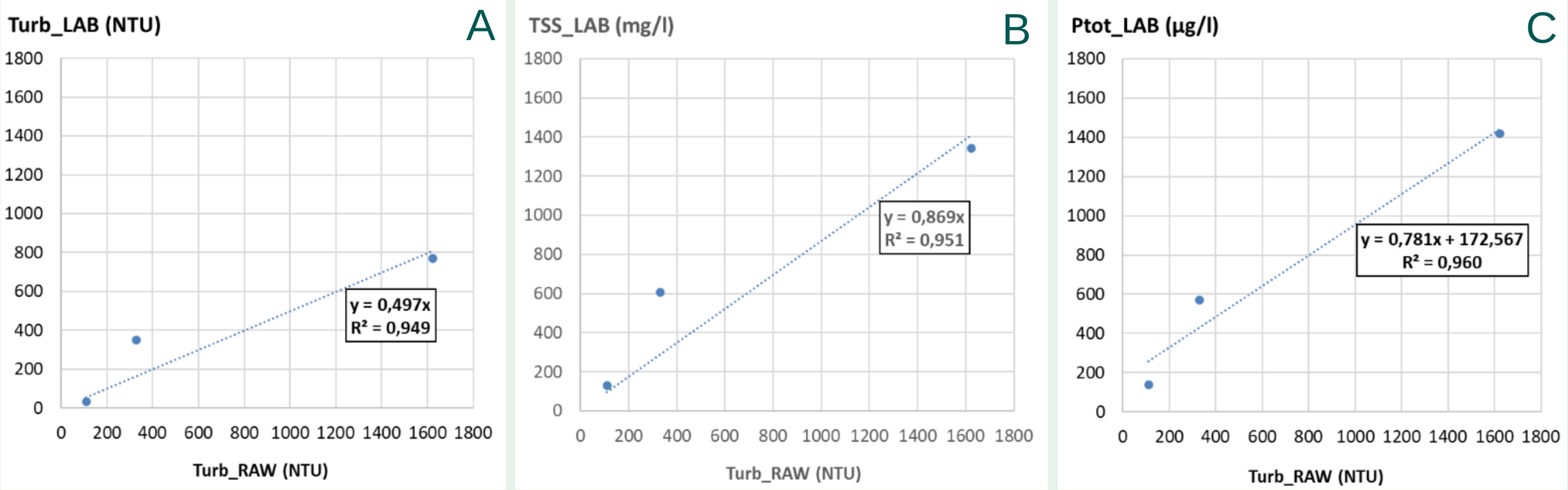


Figure 5. Correlations of turbidity measured with sensor of HL7-probe and samples analysed in laboratory.
A) Turbidity, B) Total suspended solids, C) Total phosphorus.

Recommendations

- More samples are needed to confirm the reliability of the equations.
- Online-data can be used as an early warning system to detect emissions, illegal mining etc.
- SWAT model could be used to simulate and predict the transports of nutrients, sediment, and pesticides in the river Páez.
- This requires availability of various GIS data, as well as a trainings for the IDEAM personnel to use the model.

Usage of satellite data in water quality monitoring

Satellite data
Syke experts demonstrated the use of satellite data in the pilot area. They used the level-1 (L1C) data of the instrument Sentinel-2 MSI. The instrument provides data in 10-meter spatial resolution for 13 bands of different wavelengths. The Sentinel-2 mission covers years 2016 onwards, year 2015 being the pre-operational phase.
The data is accessed through the Sentinel-Hub CloudAPI, which provides the feature information service (FIS) used for computing the daily regional statistics for each of the determined regions.

Turbidity retrieval algorithm
The numerical formula used for retrieving the turbidity estimates from raw Sentinel-2 MSI level-1 data is a simple band ratio algorithm based on the red band (B4, 664.6 nm central wavelength/31 nm bandwidth) and the coastal aerosol band (B1, 442.7 nm/21 nm).

B4 Red (665 nm) / B1 Ultra blue (443 nm)
The coefficients were calibrated using a validated turbidity product at the Finnish coastal region (Baltic Sea, Europe) with turbidity range of approximately between 0 and 60 FNU. Hence, the turbidity estimates for this pilot area are based on extrapolation outside the model training range.

Cloud removal
As the Sentinel-2 operates on optical wavelengths, clouds prevent from observing the river water and must be removed. The cloud removal is based on the global cloud mask band (CLM) available at the Sentinel-Hub platform. The clouds are automatically identified for every Sentinel-2 observation, and those observations with high cloud coverage were removed from the time series.

Model extrapolation and local in-situ data
The in-situ data provided for the regions of interest is sparse and there are only a few data points per region coinciding with the Sentinel-2 mission timeline. Therefore, the local in-situ data could not be used for model training. Although the model fit is good, the model was trained using turbidity data from the Baltic Sea and extrapolated to the Colombian rivers.
If the water composition regarding turbidity constituents is drastically different from the Baltic Sea, model extrapolation might be more uncertain.

Figure 6. Model validation

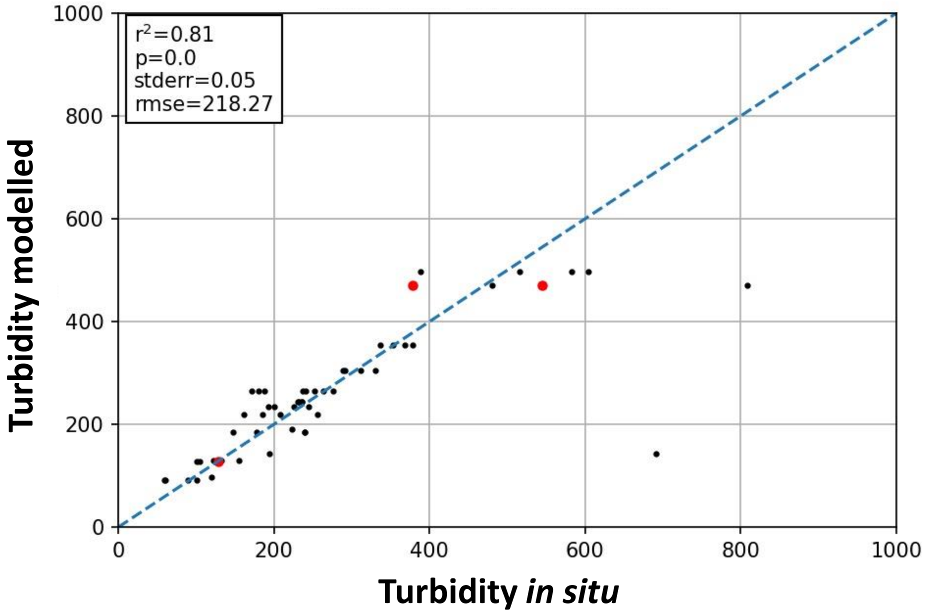


Photo 16. Example for area used for satellite data at Paicol station.

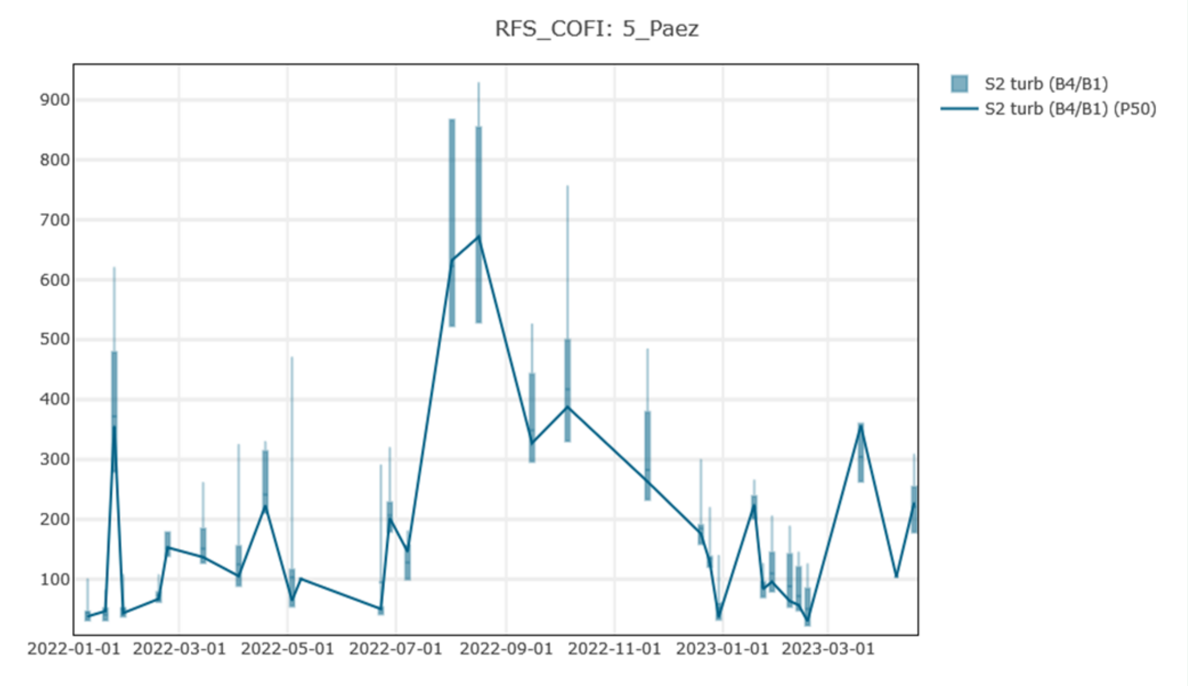


Figure 7. Turbidity measured with satellite data at virtual measuring station 5 in the river Paéz during 2022-2023.

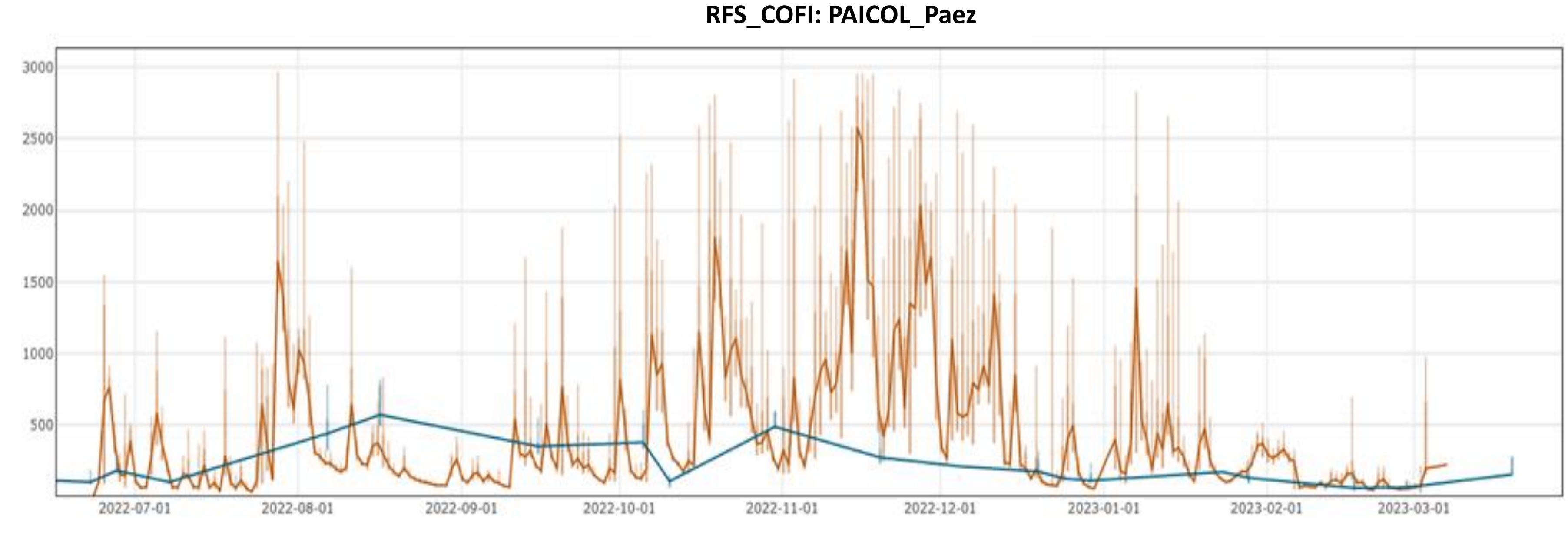


Figure 8. Continuous turbidity measurements (brown line) combined to satellite data at Paicol station (blue line).

Atmospherical effects

The source data for the algorithm is level-1 data, which is not corrected for atmospherical effects. Within the scope and resources of this project, atmospherical correction algorithms relevant for Colombian rivers were not assessed. Instead, a band ratio algorithm was selected to compensate for the atmospherical effects. Different band ratios were explored, and the best performing was selected and fitted to the ground truth data.

The standard algorithm for correcting the effects of atmosphere to the observations over land areas (called Sen2Cor) does not perform optimally over water areas. For this reason, band ratio algorithms were used (see time series in Figures 7 and 8). These algorithms typically compensate part of the differences in e.g. aerosol composition between the observation days and help to provide robust results over time series of observations.

The influence of water vapour in the atmosphere at the latitudes of the regions of interest cannot be assessed without further experimentation. The uncertainties could be assessed by providing additional local in-situ measurements and mitigated by scientific algorithm development.

Recommendations

- The uncertainties could be mitigated by providing additional local in-situ measurements of turbidity with accurate sampling coordinates and more dense temporal coverage (e.g. a dedicated measurement campaign).
- The sampling sites should be located at the river segments preferably more than 200 meters wide and 300 meters long, and deep enough for the riverbed not being visible through the turbid water.
- The sampling coordinate accuracy is crucial for rivers with highly separated waters (high turbidity on one side, low turbidity on the other).
- Sentinel-2 overpasses are sparse at this latitude, so model development will benefit from longer in-situ-timeseries.

Peer learning

In 2018, Finnish and Colombian colleagues got to know each other and planned the COFI-Water project together. The project started in 2019, and Syke experts visited the pilot area in Neiva. In the spring of 2020, an almost 2-week training focused on the laboratory and its quality assurance was organized.

After that, the travel ban caused by the Covid-19 pandemic got the teams used to working remotely. Project meetings, Project Board meetings, and trainings were organized with the help of virtual meeting systems. Training sessions lasted 2-3 hours. Translations were provided to/from Spanish-English and all presentations were made available in both languages. Documents and presentations were shared via cloud services.

In autumn 2022, when the pandemic situation was favorable, Syke arranged an intensive week-long study tour to Finland. Close work was carried out in Helsinki area. At that time, it was possible to organize demonstrations of water quality analysis and field work both in the laboratory and in field conditions. The excursion to the high-tech wastewater treatment plant that serves Helsinki and its nearby municipalities, built inside bedrock, was an exciting experience.

In the spring of 2023, Syke experts visited IDEAM in Bogota and Neiva in two groups. During the first group's trip, passive samplers were installed, and after two weeks, the second group took the samplers to the laboratory.

During these trips, reporting of the project's outputs and actions to complete the project were planned.

Photo 17. As an evening activity of the Study Tour, getting to know the Suomenlinna Sea Fortress of Helsinki in Finland.

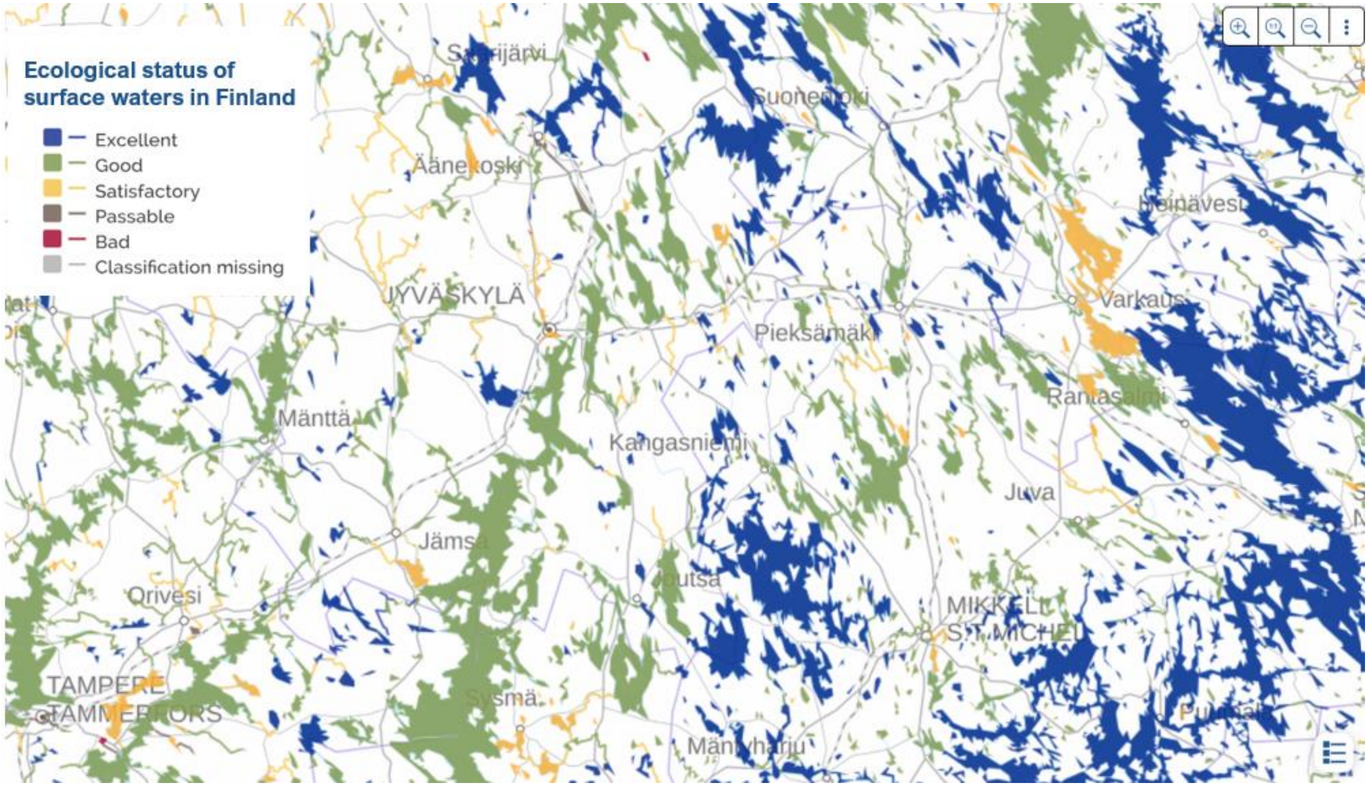


Figure 9. In Finland, surface waters (rivers, lakes, coastal waters) are classified according to their ecological status every six years. The picture shows part of Finland. The map of the whole of Finland can be viewed in detail on the webpage Source of research-based information on water (vesi.fi) Map service.

Recommendations

- When updating the monitoring program for the coming years, it is recommended to keep in mind the specific purpose of the monitoring and what is the role and responsibilities with the various actors.
- A common, open information system and the good reporting tools connected to it are essential in sharing high-quality and timely information.

Monitoring, assessment and reporting

The current network for monitoring water quality managed by IDEAM consists of 148 sampling locations, with a manual sampling frequency of 1-2 times a year. The results are published in the annual bulletin and every four years in the publication called "Estudio Nacional del Agua - ENA". Limited resources determine the extent of the monitoring network and the number of samples to be taken annually, as well as the variables to be monitored.

When updating the monitoring program for the coming years, it is recommended to keep in mind the specific purpose of the monitoring and what is the role and responsibilities of the various actors.

A common open information system and related good reporting tools are essential for sharing high-quality and up-to-date information.

In the longer term, the common goal of the actors could be, in addition to sharing site-specific information, to prepare a map of the state of the waters like in Figure 8, where surface waters are shown colored according to five different status categories.

The member states of the European Union, including Finland, follow common guidelines for assessing the ecological status of waters (Water Framework Directive - European Commission (europa.eu)). Finland has used a similar kind of presentation method since the beginning of the 1970s, and since the 2000s, in accordance with the guidelines of the EU. Water bodies are delimited according to their typology. Reference conditions have been set for each type of water. The status classification is evaluated using biological elements (variables). Physico-chemical, hydrological and morphological elements play a supporting role in this classification.

The presentation of the state of waters in areas (km^2) and lengths (km) has been well received in the media and among citizens. It also helps decision-makers to understand the state of surface waters and where measures to alleviate the effect of pressures of human actions (emissions, hydrological and morphological changes) must be directed.

Legislation should support the monitoring of human pressures on surface waters and the implementation of measures to reduce them.

Syke in brief

The Finnish Environment Institute (Syke), under the auspices of the Ministry of the Environment and the Ministry of Agriculture and Forestry, is both a research institute and a centre for environmental expertise. Syke is the national research and development centre of the environmental administration in Finland.
Syke is responsible for carrying out environmental research, monitoring and assessment, publishing and disseminating the results, and maintaining appropriate information systems.
In Finland, water quality monitoring started in 1960's and Syke has continued the developing of monitoring and assessment since its establishment in 1995 as its predecessors before.

Syke experts and their field of expertise

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Suomen ympäristökeskus
Finlands miljöcentral
Finnish Environment Institute

IDEAM in brief

The Institute of Hydrology, Meteorology and Environmental Studies of Colombia (IDEAM) was established in 1993, it is an entity of the Colombian government linked to the Ministry of Environment and Sustainable Development. It is responsible for the management of scientific, hydrological, meteorological and environmental information in Colombia.
IDEAM manages meteorological and hydrological data bases in the country, gathers information, gives forecasts and alerts and advices the population on climate behaviour. It is in charge of monitoring the biophysical resources of the country in matters related to its pollution and degradation; crucial for the decisions made by the environmental authorities.

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