



We make water quality visible.

Watergenics AISRAS

- addressing sudden changes in ion concentrations with real spectroscopy -

- time

15th International Mine Water Association Congress
April 21 – 26, 2024

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COMPANY INFORMATION

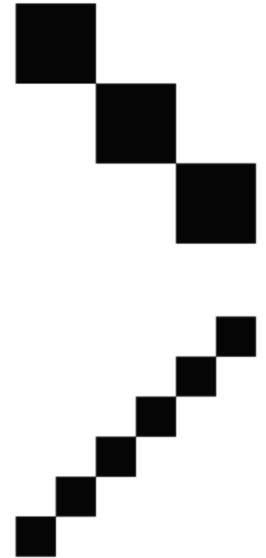
What we do:	We build Sensors and Analytics for Industrial Wastewater Treatment
Founded in:	2019 in Berlin, Germany
Team Size:	15
Turnover for 2024:	\$ 1.6 M

Competencies

Process Chemistry, Chemometrics, Hydrogeochemistry, Thermodynamic modeling, Machine Learning, Photonics Engineering, Industrial IoT Engineering, Economic modelling of water runoffs, Transnational Business Operations

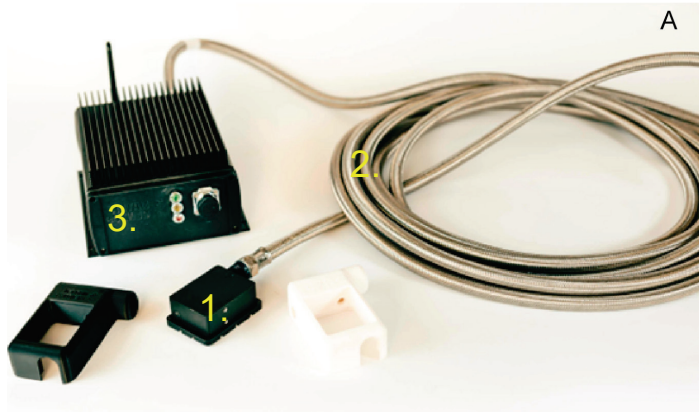
Commercial Focus

Water treatment optimization (closed feedback loop) in the mining industry



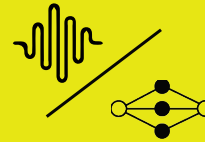
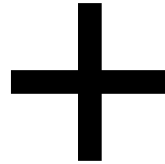
PRODUCT

Hardware



Main hardware :

1. Reflection chamber
2. Fibre-optical transmission
3. Spectrometer and processing unit



Chemometrics
proprietary Machine Learning (ML) models for processing the Raman spectra



Method for automated labelling of Raman spectra

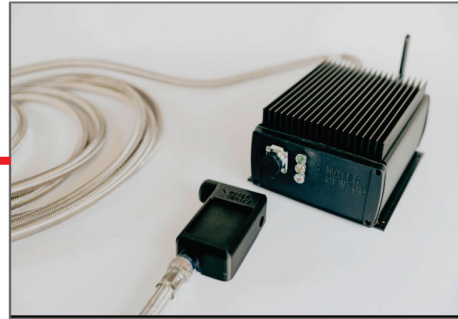
PRODUCT

ABAI_A

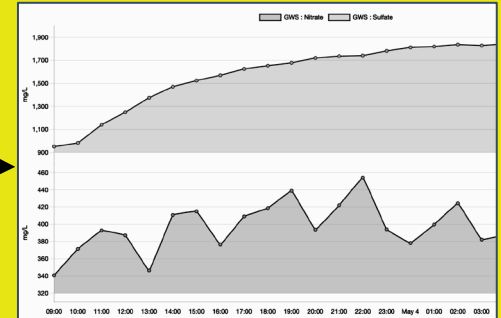
Water



Sensor



Chemical
Concentration Data



Actionable Insights

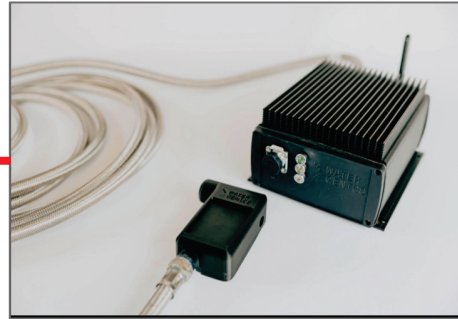
PRODUCT

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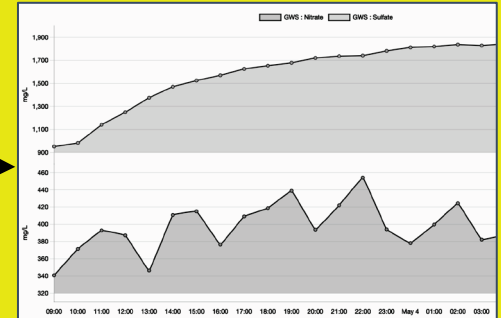
Water



Sensor



Chemical Concentration Data



Harsh waters:

Chemical Concentrations > 20,000 mg/L
High Turbidity, High TSS > 50,000 mg/l
pH: 11.1, Temperature 80° C

Actionable Insights
in real-time

PRODUCT

Parameters available now:

Sulfate (SO_4^{2-} , HSO_4^-), calcium sulfate, hydrogen sulfide, phosphate, nitrate, **carbonate** (CO_3^{2-} , HCO_3^-), calcium, acetate, benzoic acid, lithium carbonate, water hardness, and total iron.

Parameters available in the next 6 to 9 months:

manganese oxides, chloride, silica, cyanide, ammonium.

More parameters planned:

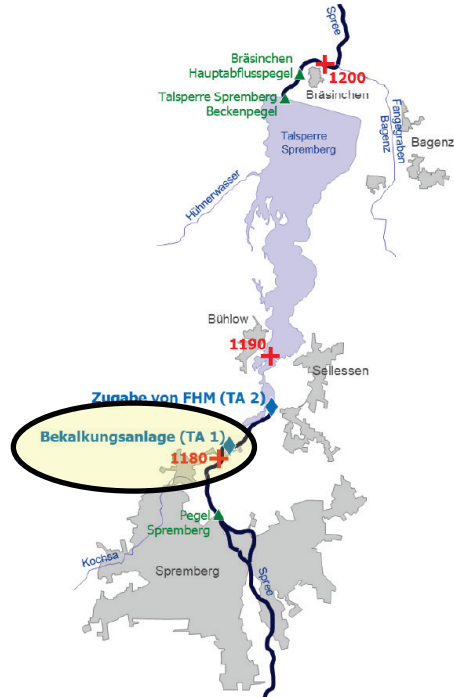
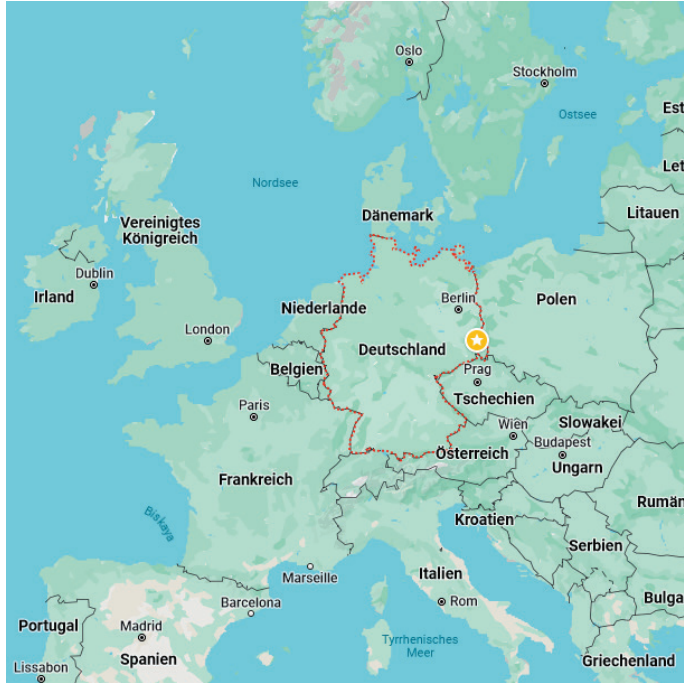
platinum, palladium, ruthenium, iridium, gold, nickel, lithium.

- Uses no reagents.
- Low maintenance and Plug & Play.
- API integration in the operating system.
- Aggregation of data according to your needs.
- Concentrations varying from **1 to 22,000 mg/L**
- **Accurate:** < 10 % Deviation from Lab Results
- **Precise:** < 1 % Standard Deviation

WATERGENICS | We make water quality visible.



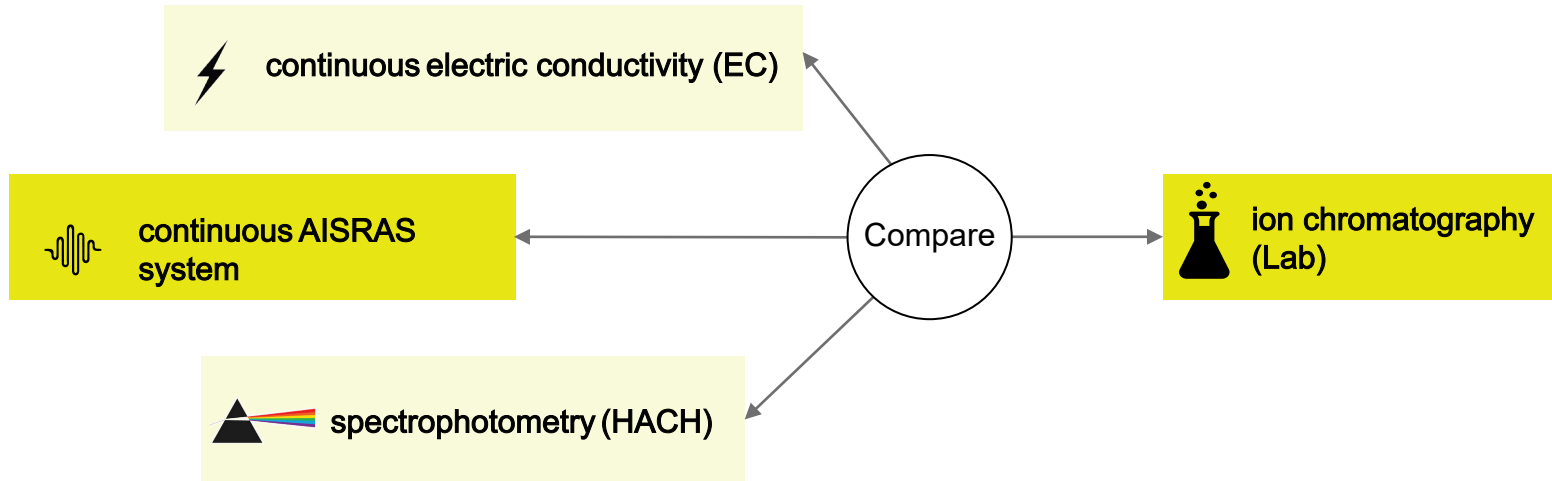
LMBV Location



Aims

LMBV: Responsible for post/legacy lignite mining remediation in eastern Germany

Aim: Estimate measuring accuracy of AISRAS in AMD environment



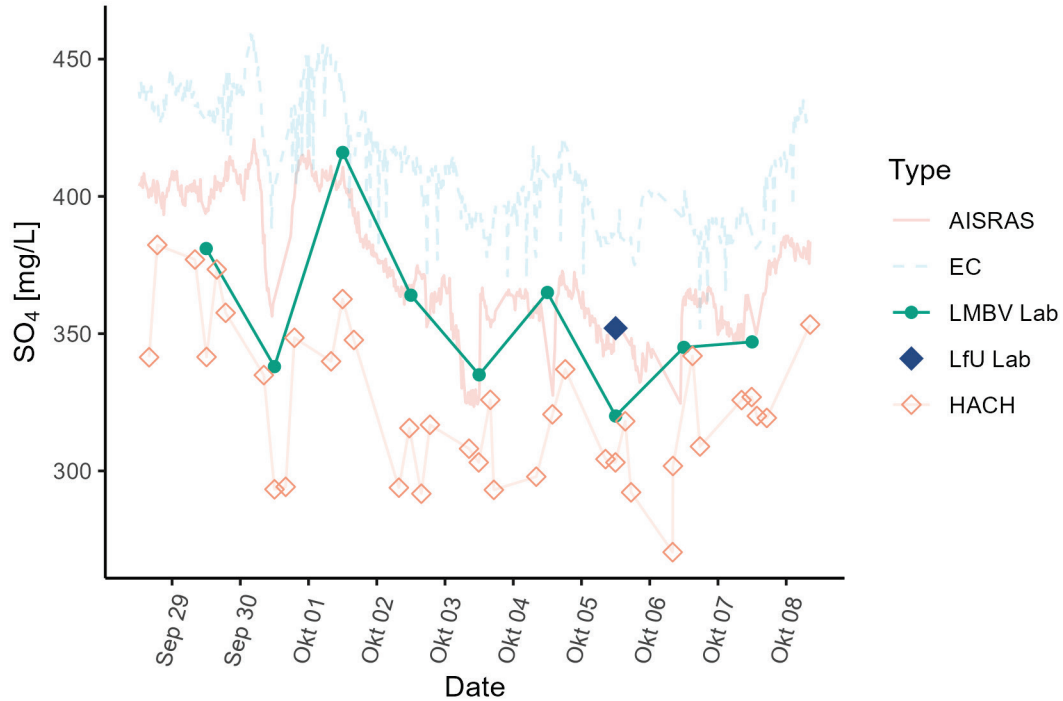
➤ Field experiences

Application Experiences:

- Simple Installation
- Generally good performance
- Reflection chamber is **self-cleaning** → no problems with biofouling



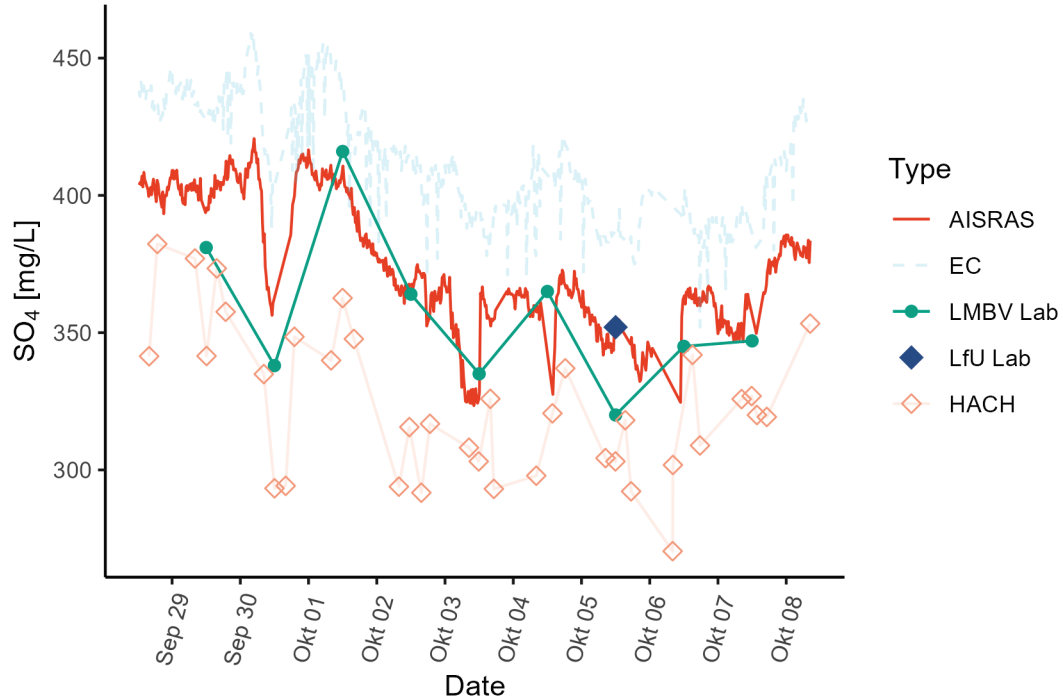
Results



Lab Measurements:

- LMBV Lab = gold standard
- LfU Lab = further independent reference

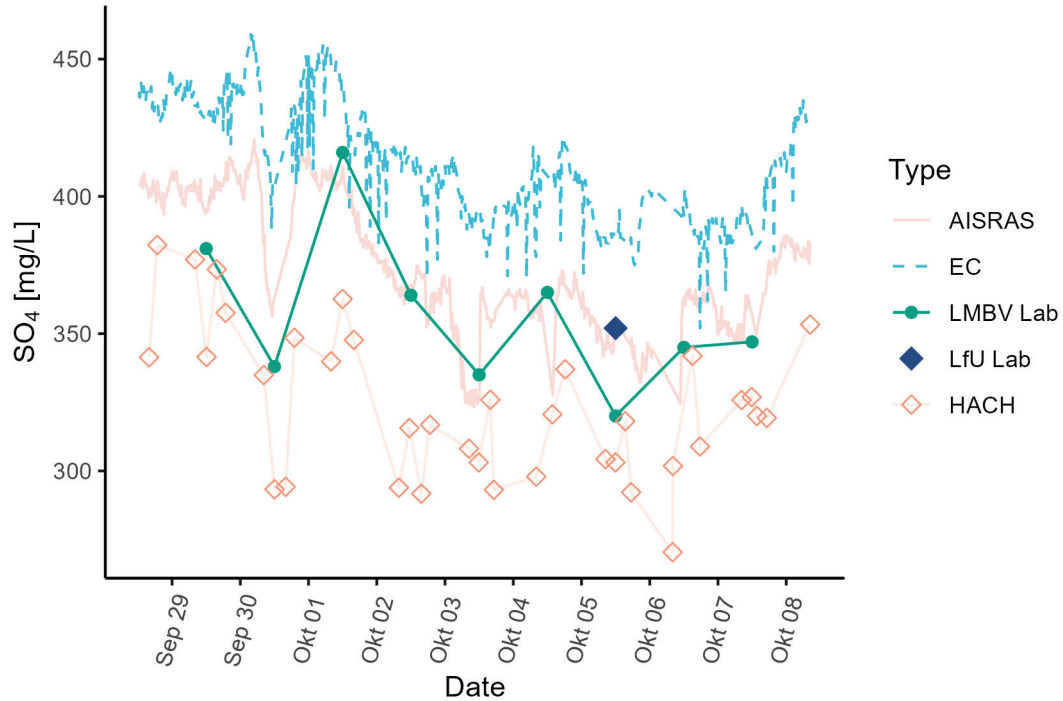
Results



AISRAS vs. LMBV Lab:

- Good fit
- Reveals sudden events

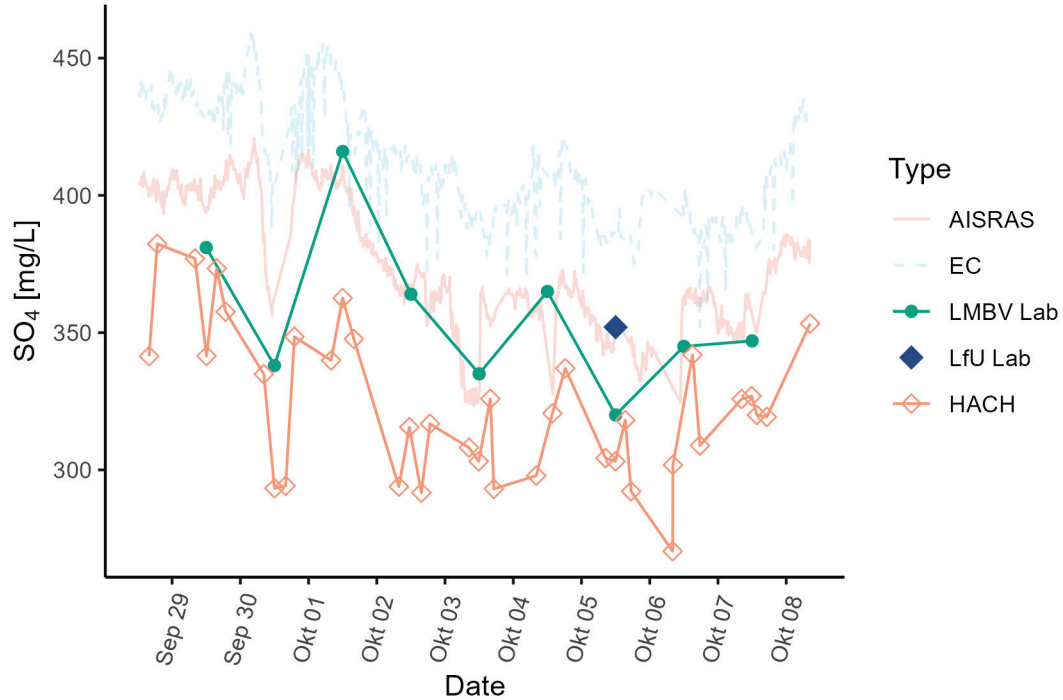
Results



EC vs. LMBV Lab:

- EC overestimates
- EC reveals sudden events
- EC shows spiky behaviour

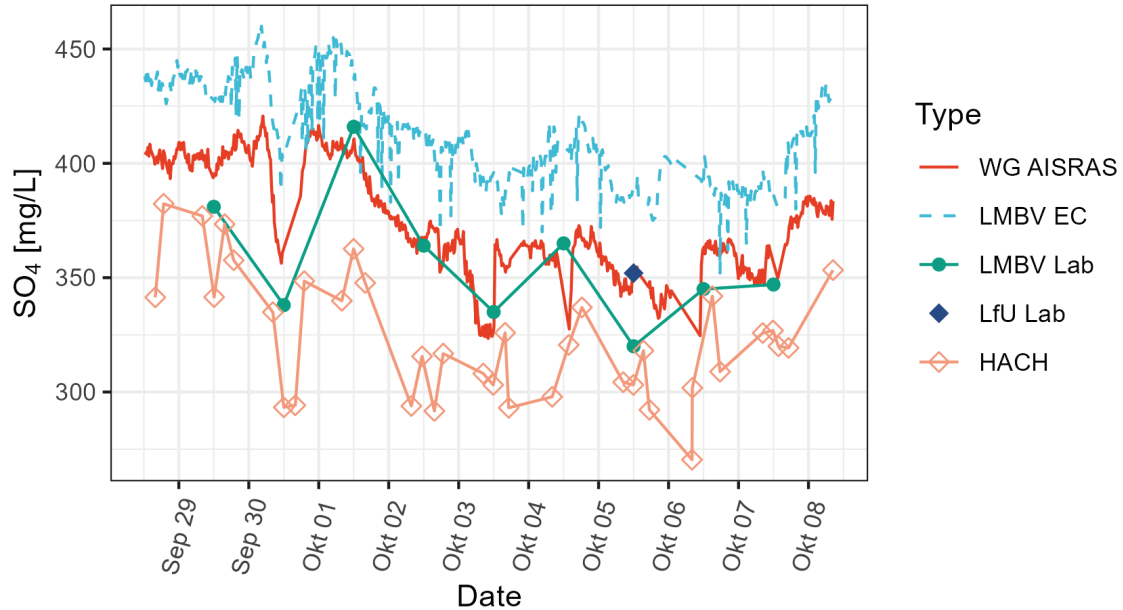
Results



HACH vs. LMBV Lab:

- Underestimated
- Limited temporal resolution
- Confirms sudden real time events

Results



All data:

Consistent Trends: All methods confirm functionality.

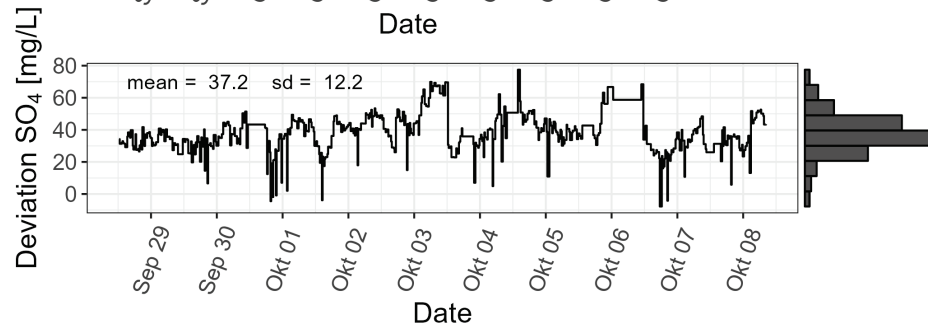
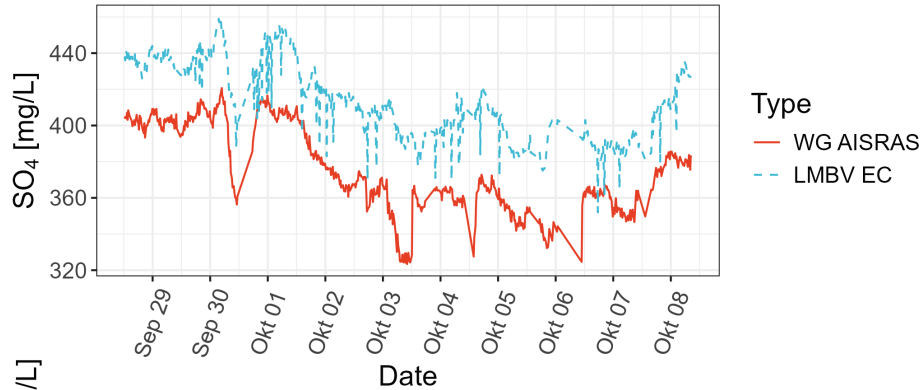
Real-time Responsiveness: shown by realtime methods.

Discrepancies in Detection: Not all changes detected by both realtime methods.

Measurement Discrepancies: HACH underestimated, EC overestimated.

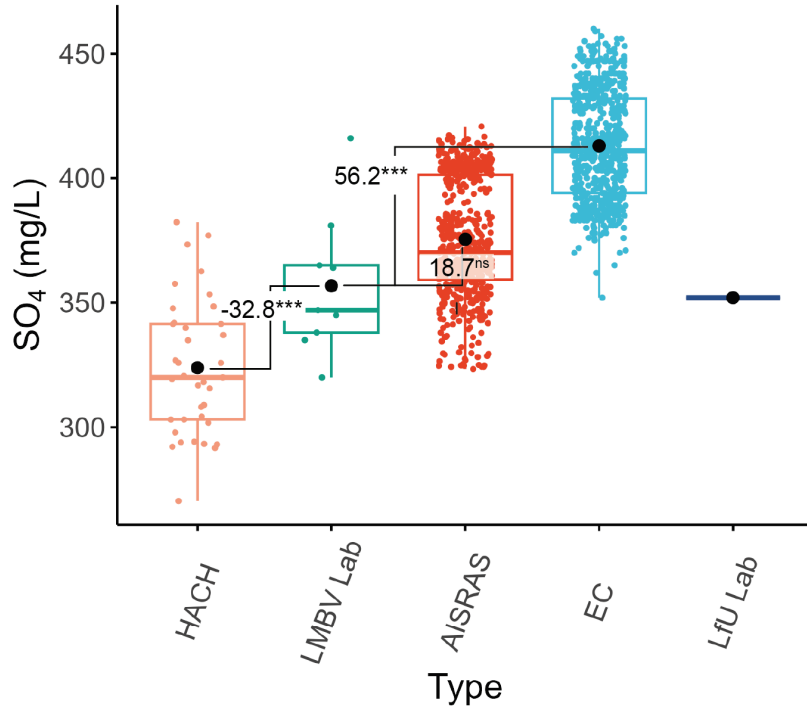
Sensor Maintenance Implications: EC requires maintenance, AISRAS does not (so much).

Results



Offset between AISRAS and EC relatively consistent

Results



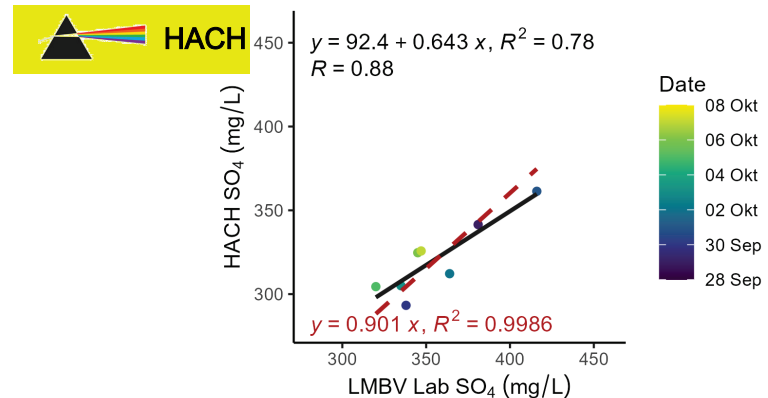
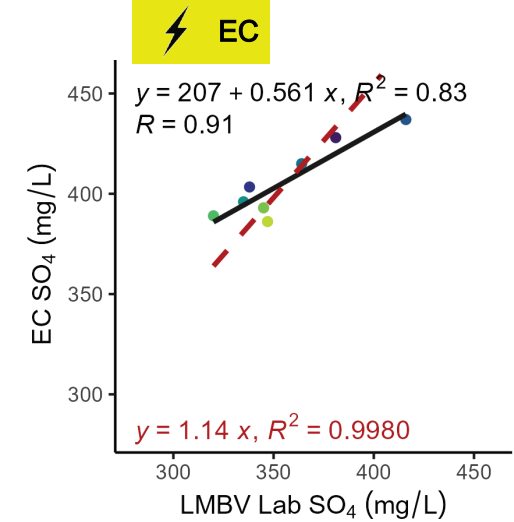
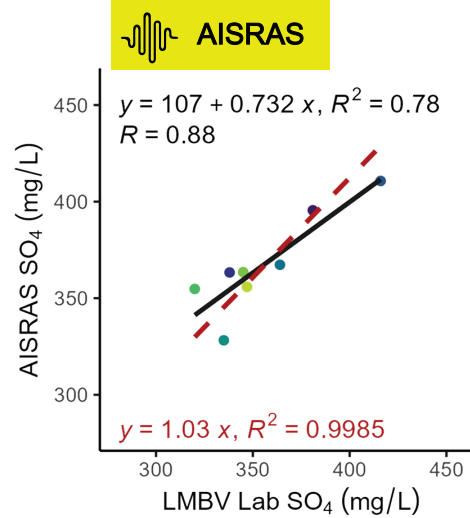
Significance of Differences:

- AISRAS vs. Lab: insignificant differences
- EC and HACH vs. Lab: significant offsets

Results

Regression:

- Linear coefficient closest to 1 for AISRAS
- Best fit for AISRAS when forced through origin
- In a practical situations
→ when offset unknown, AISRAS performs best



Summary

- AISRAS:
 - effectively detects sulfate in real-time with high temporal resolution.
 - lowest deviation from lab
 - No historical calibration curves necessary.
- HACH slightly underestimated sulfate compared to lab data, low temporal resolution
- A longer-term comparison between EC and AISRAS commences .. Currently (2014)
→ stay tuned
- AISRAS can simultaneously estimate multiple ions
(e.g. nitrate, carbonate, calcium, and iron)

EXAMPLE INSTALLATIONS

We proudly provide realtime data for:

Measurement of carbonate @ SQM lithium brine refinery in Antofagasta (Chile)



Total iron and sulfate for environmental compliance & AMD treatment @ Barrick (Chile)



Sulfate 200 km north of the Arctic Circle at air temperatures -25°C @ Boliden & LKAB (Sweden)



Sulfate in remote installations for without connection to an electricity grid @ LMBV (Germany)



Sulfate, hydrogen sulfide and iron for AMD treatment and law compliance @ RAG (Germany)



Sulfate and calcium sulfate saturation @ Veolia & AGA (France & Ghana)





We make water quality visible.

Follow the water.

April 2024

Annex – details regression

Points used for regression

