THOË-S : AN INTERACTIVE VERSION OF THE DGT AUTOSAMPLER DESIGNED TO RECORD TIME SERIES OF POLLUTANTS CONCENTRATIONS.

EXAMPLE OF TRACE METAL MONITORING IN A RIVER IMPACTED BY MINING

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Introduction

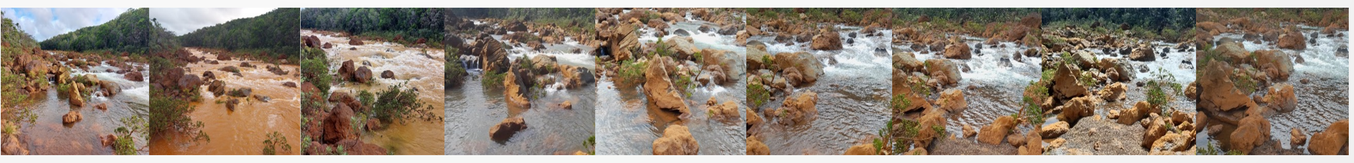
The use of passive samplers, in particular DGT® devices, to determine concentrations of dissolved metals in waters are becoming more common-place for use in regulatory monitoring.

DGT offers improvements in data quality for:

- monitoring long-term trends
- measurement of riverine fluxes
- for regulatory monitoring tasks

→ **Time-series**

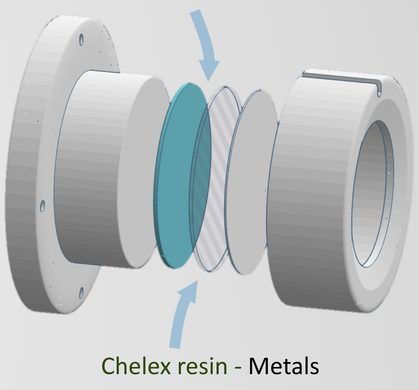
Case study: Monitoring two rivers, impacted and not impacted by mining activities



Methodology

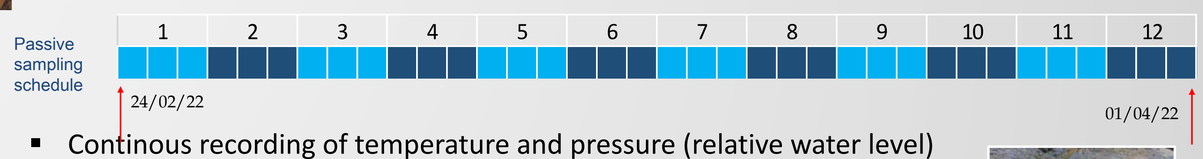
- Time series of Cd, Cr(VI), Co, Cu, Fe, Mn, Ni, Pb, Zn concentrations (sequential exposures of doubled layered DGT's);
- Manuel deployment of DGT devices;

NMDG resin - Chromium VI



Chelex resin - Metals

- Sampling frequency : 3 days



- Continous recording of temperature and pressure (relative water level)

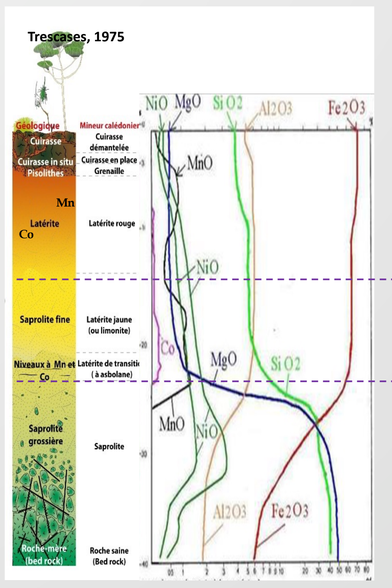
Results

Concentration (µg/L) time series in two rivers Kwé and Trou-Bleu

- **Co and Mn:** robust correlation ($0,86<R^2<0,97$) rainfall/concentration for both of the 2 catchments;
- **Ni:** similar concentrations for the entire sampling period, variation is limited;
- **Zn:** no variation in Kwé river but unexpected correlated concentration with rainfall ($R^2=0,88$) in Trou-Bleu basin.
- **Cr(VI):** concentrations up to 10 times higher in Kwé river compared with Trou-Bleu river.

Combined diagram of daily cumulative precipitation, water height, as well as concentrations of Co, Mn, Ni, Fe and Cr(VI) measured in the dissolved fraction in the Kwé River.

Explanation



Solubilisation of Fe, Mn and Co and Ni from ***Yellow Laterites*** (Goethite/Gibbsite). High content in Cr(III) that is oxydized by Mn(III/IV) into Cr(VI)* in the permanent water table.

Leaching of deeper open-cast layers mined in the Kwé basin

$Cr(OH)_{3\,(aq)} + 3\,MnOOH_{(s)} + 4\,H^{+}_{(aq)} \rightarrow CrO_4^{2-}{}_{(aq)} + 3\,Mn^{2+}_{(aq)} + 5\,H_2O$
oxydation de Cr(III) par Mn(III)

$2\,Cr(OH)_{3\,(aq)} + 3\,MnO_{2\,(s)} + 2\,H^{+}_{(aq)} \rightarrow 2\,CrO_4^{2-}{}_{(aq)} + 3\,Mn^{2+}_{(aq)} + 4\,H_2O$
oxydation de Cr(III) par Mn(IV)

*Fandeur et al, 2009

Main conclusions

Significant improvement of the monitoring with sequential passive sampling, but how to resolve :

- site accessibility difficulties

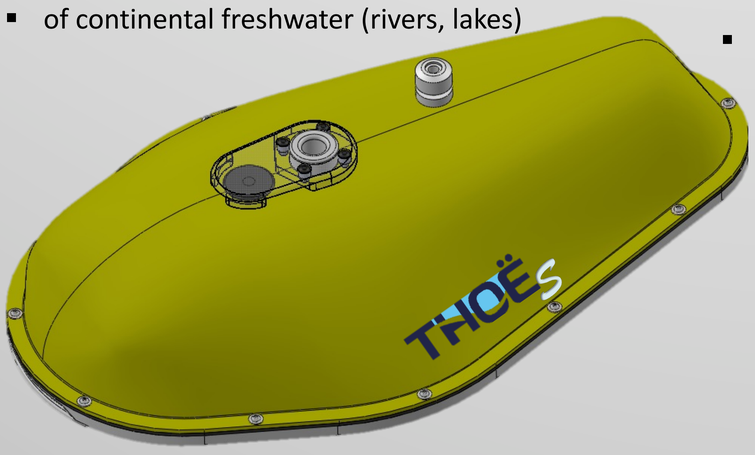
Solution → THOËS

- Cost: Reduce monitoring burden (logistics)

Innovation/ improvements

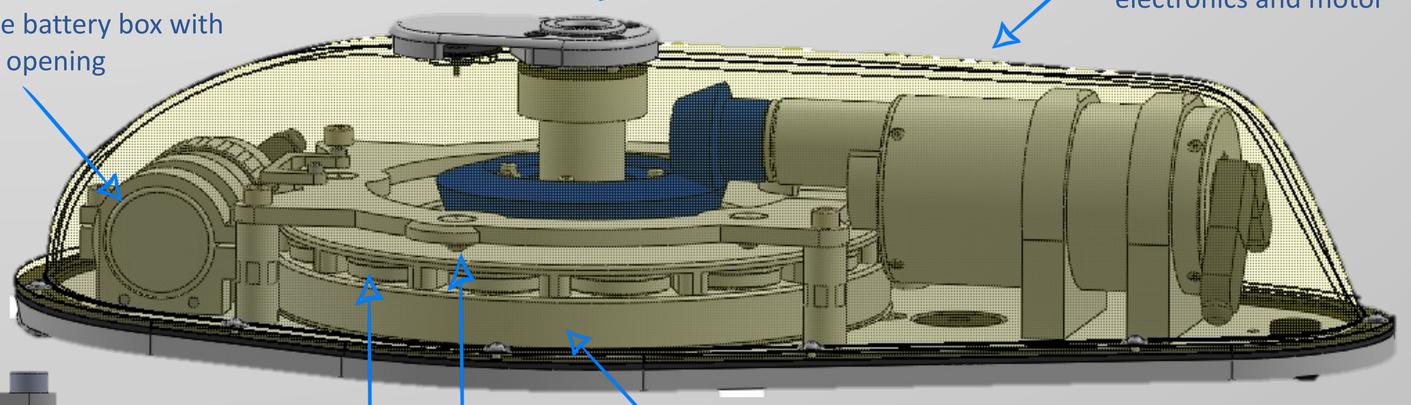
OBJECTIVES: Monitoring/research study:

- of the coastal fringe (0-100 m)
- of continental freshwater (rivers, lakes)



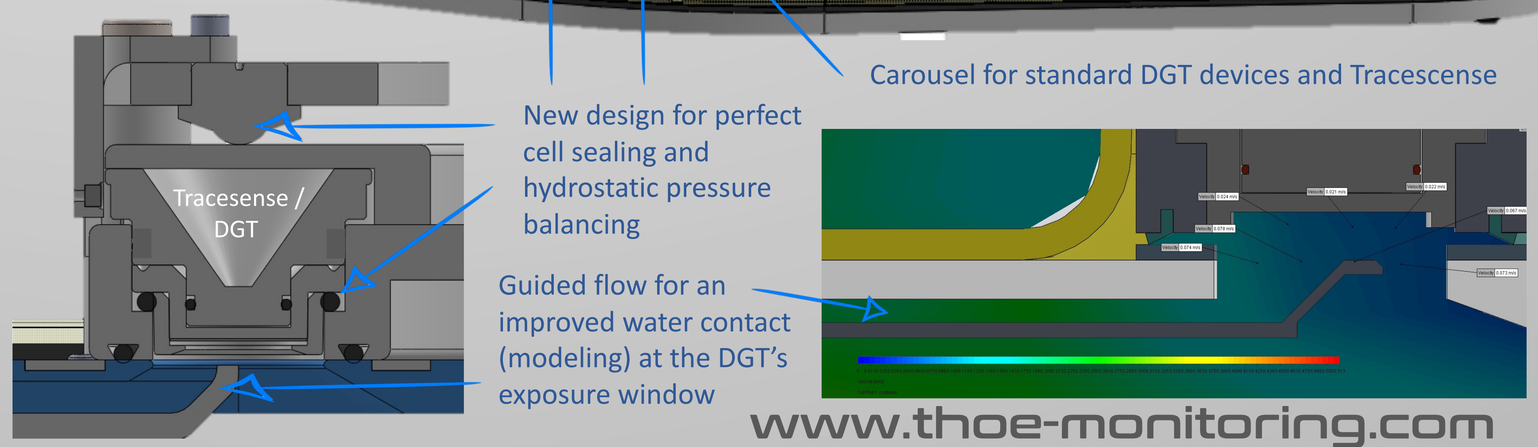
Main characteristics

- Programming/connection: WiFi/Bluetooth and USB C
- Number of measurement steps: 12 (possibility of triplicates)
- Autonomy: 1 year
- Immersion depth: up to 100 m



Main innovations:

- Optimization of the water flow in contact with the DGT
- 4G communication (PC and Smartphone)
- Remote interrogation by the operator
- (Re)programming/data transfer
- Acquisition of physico-chemical parameters (P, T°C) and capability of a CTD probe connexion
- GPS positioning
- Simplification of assembly



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