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Integrated passive flux measurement in groundwater: design and performance of iFLUX samplers

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The monitoring and management of soil and groundwater is a challenge. Current methods for the determination of movement or flux of pollution in groundwater use no direct measurements but only simulations based on concentration measurements and Darcy velocity estimations. This entails large uncertainties which cause remediation failures and higher costs for contaminated site owners. On top of that, the lack of useful data makes it difficult to get approval for a risk-based management approach which completely avoids costly remedial actions.

The iFLUX technology is a key development of Dr. Goedele Verreydt at the University of Antwerp and VITO. It is supported by the passive flux measurement technology as invented by Prof. Mike Annable and his team at the University of Florida. The iFLUX technology includes an in situ measurement device for capturing dynamic groundwater quality and quantity, the iFLUX sampler, and an associated interpretation and visualization method.

The iFLUX sampler is a modular passive sampler that provides simultaneous in situ point determinations of a time-averaged target compound mass flux and water flux. The sampler is typically installed in a monitoring well where it intercepts the groundwater flow and captures the compounds of interest.
The sampler consists of permeable cartridges which are each packed with a specific sorbent matrix. The sorbent matrix of the water flux cartridge is impregnated with known amounts of water soluble resident tracers. These tracers are leached from the matrix at rates proportional to the groundwater flux. The measurements of the contaminants and the remaining resident tracer are used to determine groundwater and target compound fluxes. Exposure times range from 1 week to 6 months, depending on the expected concentration and groundwater flow velocity.

The iFLUX sampler technology has been validated and tested at several field projects. Currently, 4 cartridges are tested and available: 1 waterflux cartridge to monitor speed and direction of flow and 3 cartridges to monitor different sources of pollution – VOC's, heavy metals and nutrients. The modular design enables to sample several types of pollution at the same time.

The principles and the design of the iFLUX technology will be presented, together with the results from performance and sensitivity analysis for different field scenarios and several field cases.