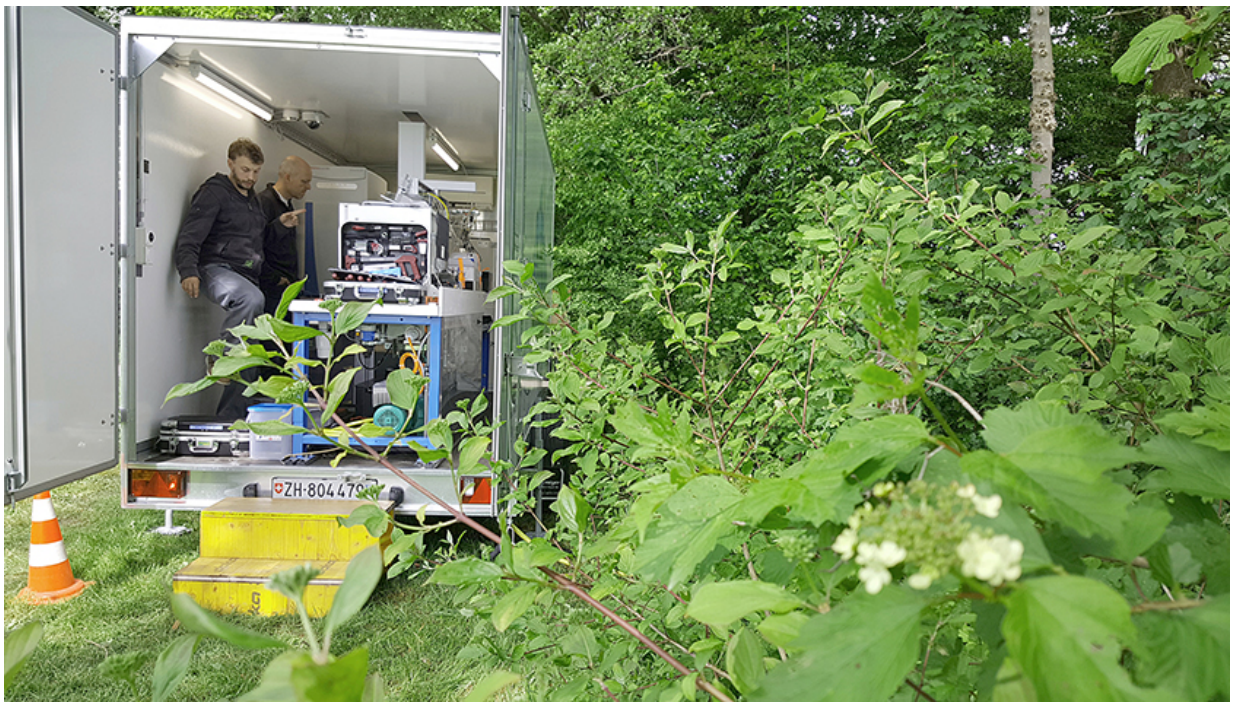


Short-term peak concentrations are severely underestimated

December 4, 2020 | Andri Bryner
Topics: Pollutants

The mobile and automated MS2field mass spectrometer allows measurements to be taken of harmful substances in surface waters with high temporal resolution. The initial measurements using the device are revealing the extent to which peak concentrations of pesticides, for example, have been underestimated by traditional methods.

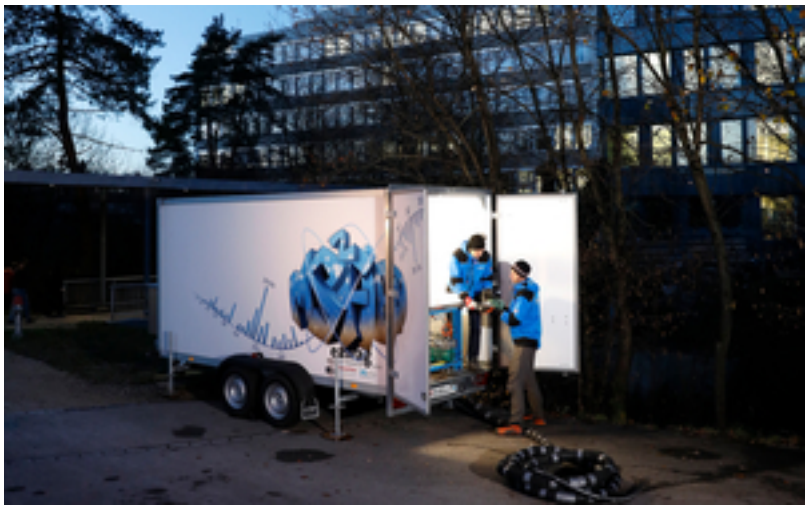
Although it is actually only a prototype, the fully automated mobile water laboratory known as MS2field is already delivering reliable – and controversial – data. In an article published today in the journal Aqua&Gas, the Eawag researchers responsible for the platform describe not only how it works, but also how they used it to measure pesticide concentrations in a small stream in an agricultural area.

Watch the video on Youtube

Acutely toxic peak concentrations

MS2field automatically collects, prepares and analyses a sample every 20 minutes, allowing major changes in concentration – by several orders of magnitude in the space of hours or days – to be detected with unprecedented clarity. Over the same measurement period, the researchers also collected conventional composite samples – each of them over a period of 3.5 days – which they analysed in the laboratory in the traditional way. In doing so, the team was able to demonstrate the extent to which the traditional method underestimates peak concentrations because they are missed, or rather diluted. Taking the insecticide thiacloprid

as an example, the work has also revealed the importance of short-term peak concentrations from an ecotoxicological perspective. Indeed, the quality criterion enshrined in the Water Protection Ordinance with a view to preventing acute damage to aquatic organisms was exceeded on several occasions and many times over (by a factor of up to 30). For many pesticides, the peak concentrations recorded in the 20-minutely MS2field measurements exceeded the average concentrations recorded in the 3.5-day composite samples by a factor of up to 170.



The mobile water laboratory during testing at the Chriesbach stream outside Eawag in Dübendorf.
(Photo: Eawag, Aldo Todaro)

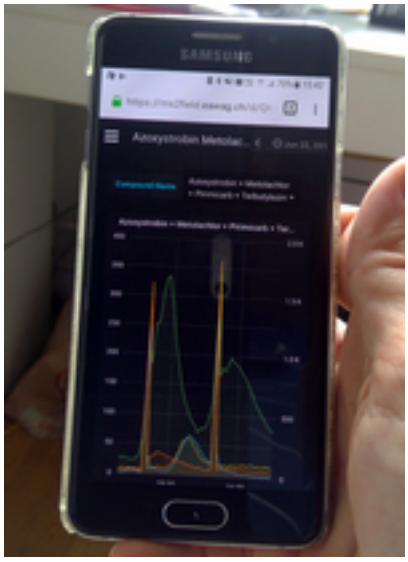
Conventional composite samples massively underestimate the risk

Christian Stamm, co-author of the study and deputy head of Eawag's Department of Environmental Chemistry, emphasises the significance of these unambiguous findings: "Recording peak concentrations is vital for the ecotoxicological assessment of contamination in surface waters. In the case of certain pesticides, even peaks lasting less than an hour have adverse effects on aquatic organisms. And if peak concentrations occur repeatedly, a second or third peak can have a greater impact still – even if it's smaller than the first – because the organisms haven't been able to recover in the meantime. Composite samples overlook this risk."

Ready for the backpack soon?

The researchers involved in the MS2field project are confident that their automatic measurement platform has a promising future. In terms of possible applications, the environmental chemist Heinz Singer cites measurements of the intake and effluent of a wastewater treatment plant as one example. Here, the online data could help to optimise removal efficiency for trace substances or to contain highly contaminated water in the event of rainfall. MS2field could conceivably also be used in drinking water monitoring thanks to the dramatically reduced time frame between sampling and the availability of results, which has often been lengthy until now. With ongoing advances in digitalisation and miniaturisation,

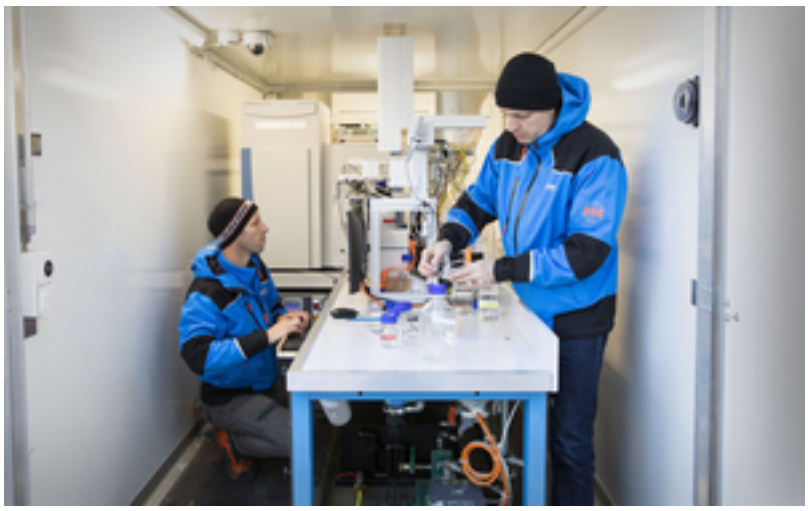
Singer is certain that MS2field will no longer take up an entire trailer in a few years' time. Rather, users will benefit from portable mini-laboratories that are suitable for use in the field. "We've taken some important steps towards this development," he says, pulling his mobile phone out of his pocket in order to call up the results of the latest measurements with MS2field at a wastewater treatment plant.



The measurement data can be accessed almost in real time, even on a mobile phone. (Photo: Eawag)

Automated, mobile, and precise

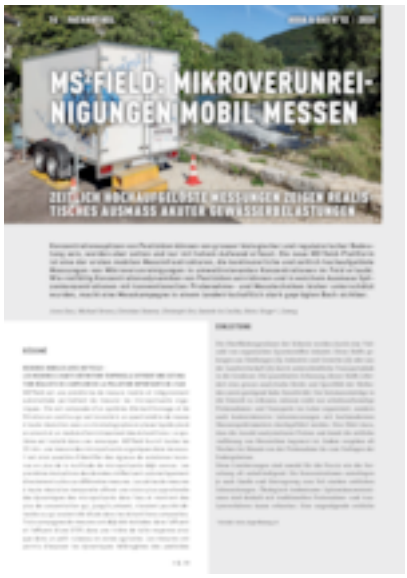
"MS2field" is the name that the interdisciplinary Eawag team has given their mobile water laboratory. "MS" denotes the platform's integrated mass spectrometer, and the suffix "2 field" refers to the system's flexibility for outdoor use – in the field, at a wastewater treatment plant or at bodies of water. In addition to the mass spectrometer at its core, the system also consists of an automatic, continuous sampling and filtration unit, a sample preconcentration module and a liquid chromatograph. Once the data has been collected, it is automatically analysed and sent to an Eawag server in encrypted form over a mobile communications network. At present, the system requires inspection and maintenance once a week.



A view of the measurement trailer's interior.
(Photo: Eawag)

Original article

Anne Dax, Michael Stravs, Christian Stamm, Christoph Ort, Daniele La Cecilia, Heinz Singer (Eawag) pdf in German



Mikroverunreinigungen mobil messen mit MS2field; Aqua&Gas 12/2020 [1 MB]

Cover picture: Eawag

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Video

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