

DNA-based environmental tracers

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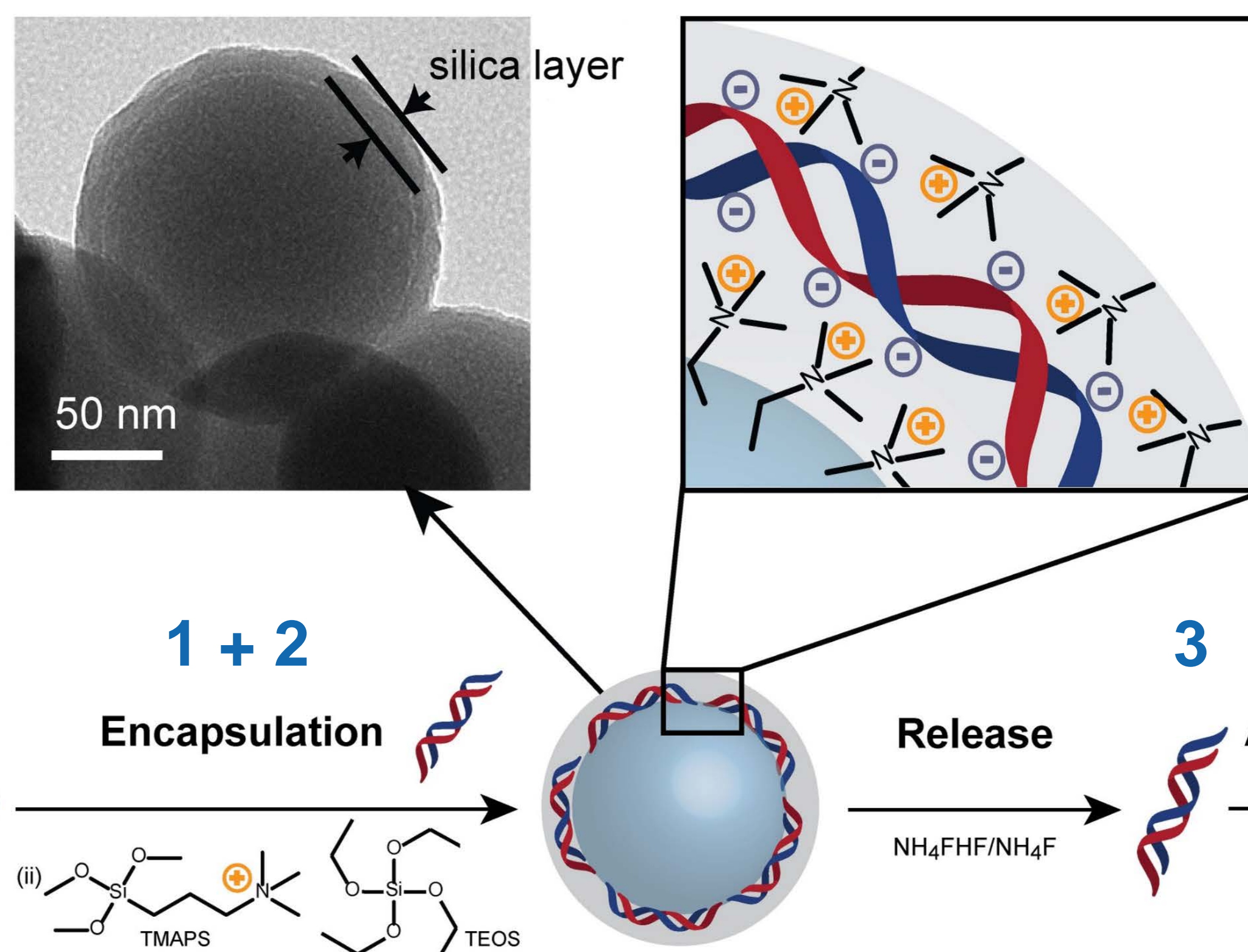


Abstract

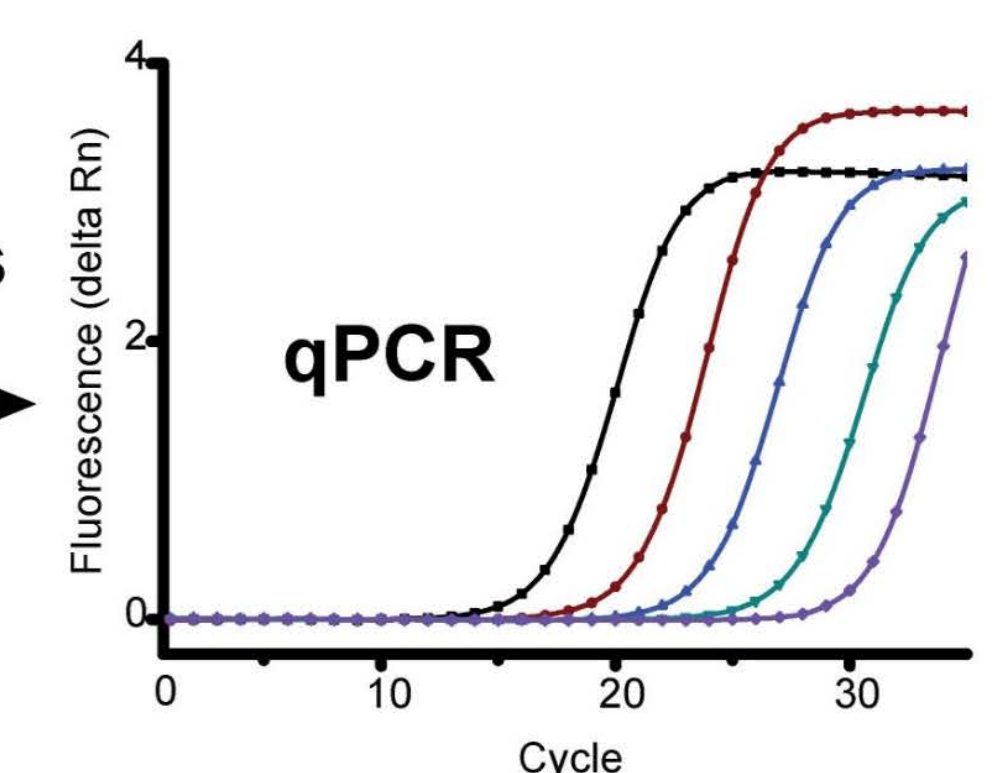
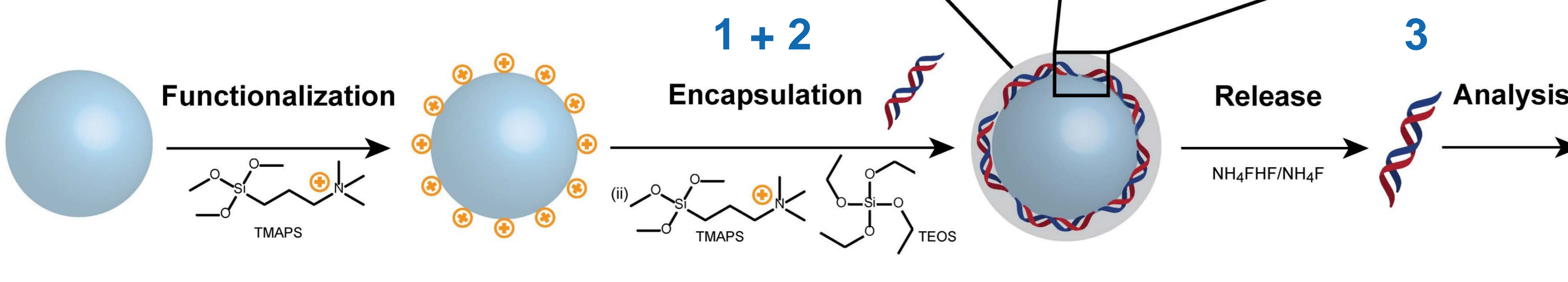
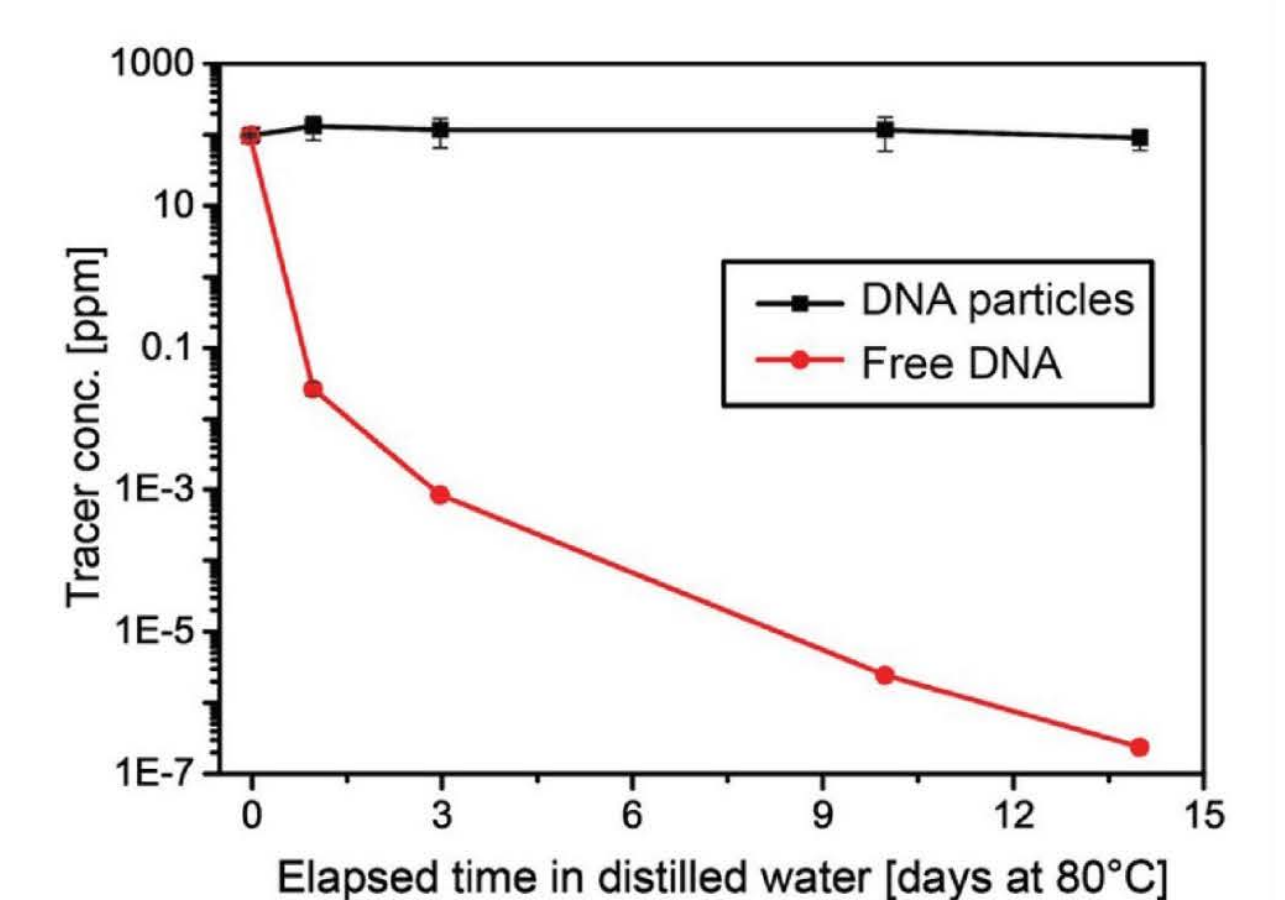
In the framework of the Horizon 2020 project S4CE, we are developing a **DNA based tracer technology** for **surface and underground tracing**. Encapsulating DNA in sub-micron silica particles increases its stability. Barcodes, as created with **unique DNA sequences** allow for **multitracing applications**. The impact of large scale tracer use is estimated by establishing an ecotoxicological profile through acute and chronic ecotoxicity assays.

DNA encapsulation in silica particles

- 1 DNA absorption on positively charged silica particles
- 2 Silica coating protects DNA from chemical and physical stress
- 3 DNA release by dissolving silica with diluted buffered oxide etch and quantification by quantitative PCR



2 Stability of encapsulated DNA

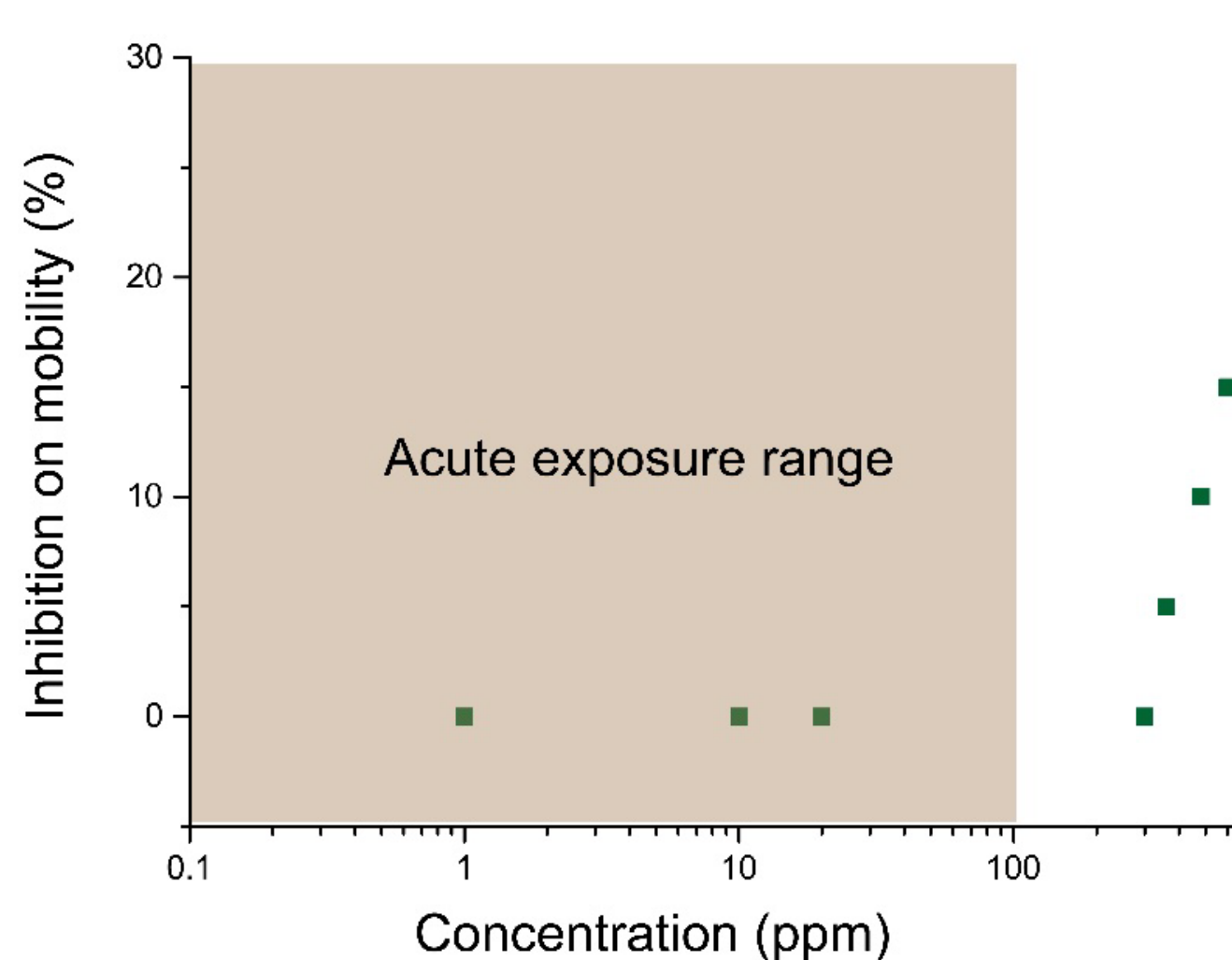


Standard ecotoxicological assays

- Exposure of small aquatic crustaceans (e.g. *Daphnia magna*) to DNA tracers
- Two maximum exposure scenarios
 - Acute : 100 ppm / 48 h
 - Chronic : 1 ppm / 7 days

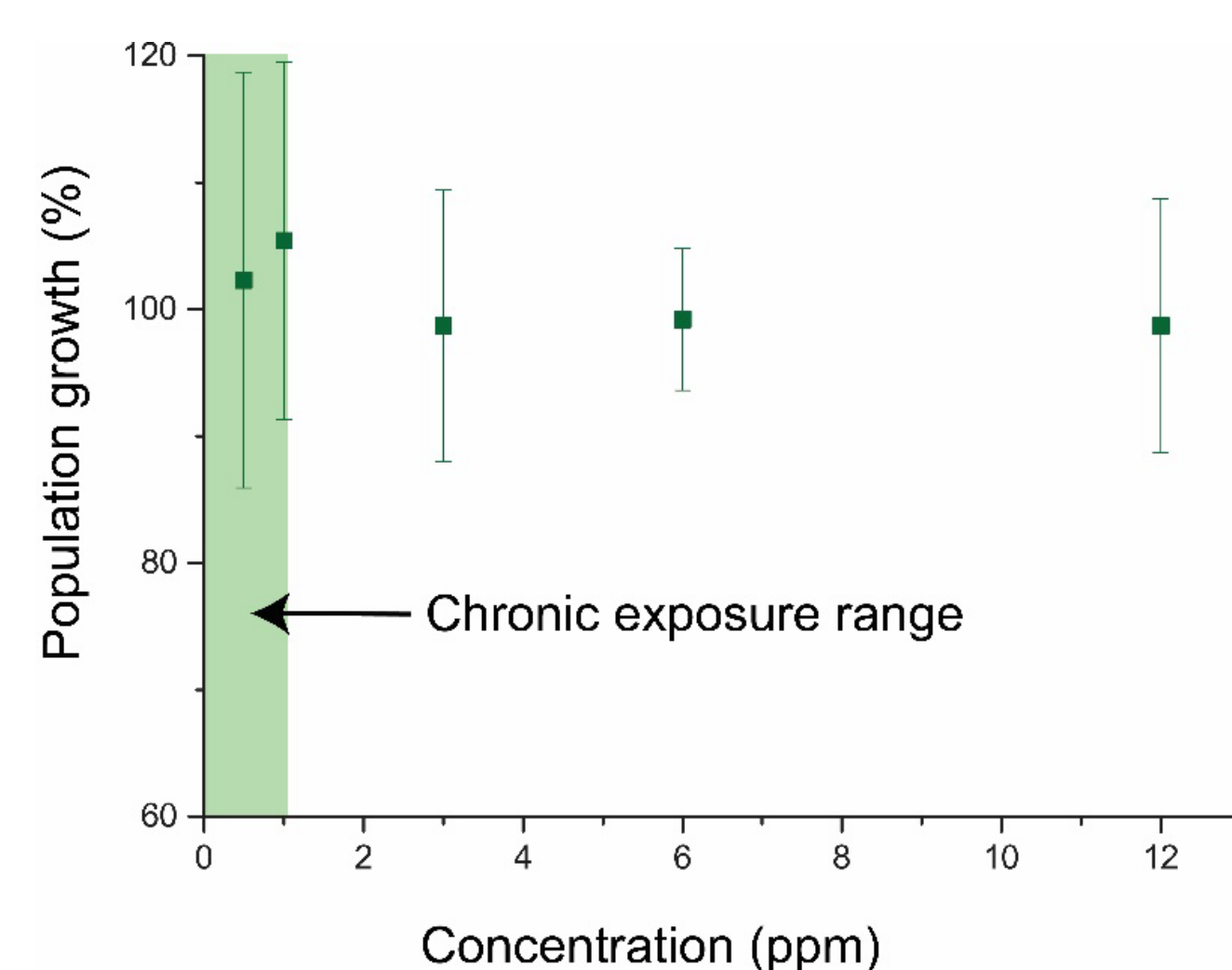


Acute exposure 48 h



- No inhibition on mobility observed up to 100 ppm

Chronic exposure 7 days

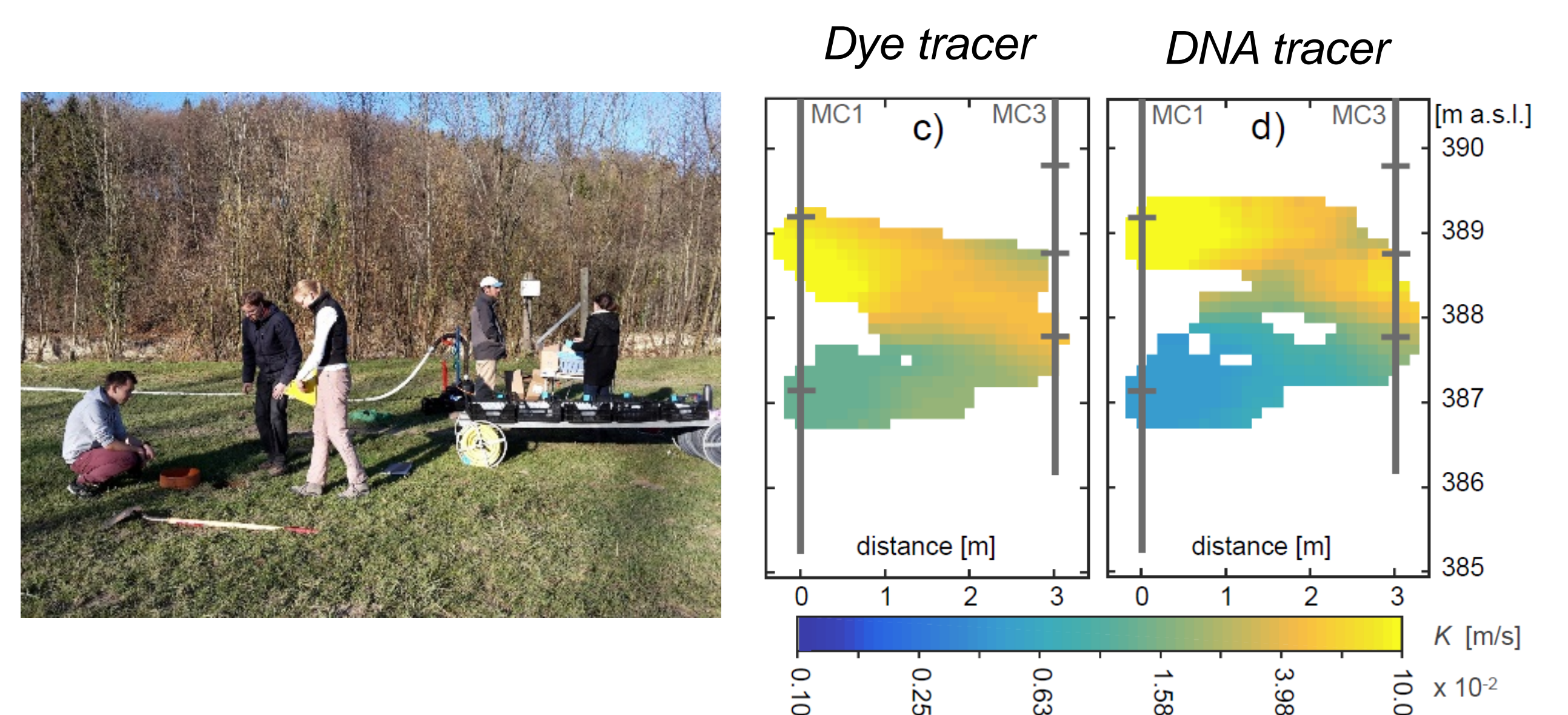


- No effect on reproducibility up to 12 ppm

Mikutis et al. *Environ. Sci. Technol.* 2018, 52, 21, 12142-12152
 Kong et al. *Environ. Sci. Technol.* 2018, 52, 23, 13681-13689

First field test of DNA tracers

- Hydraulic connectivity measurement of aquifer in Widen, CH
- Validation by comparing with traditional fluorescent dye tracer through tomographic reservoir imaging



Conclusion

- The DNA tracer showed no ecotoxicological effect in the exposure range of a typical tracer experiment.
- Field tests showed the applicability of DNA tracer compared to standard dye tracer.

