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Understanding surface water using DNA-tagged nanoparticle

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Surface water systems are of crucial significance in water resources management, but they also act as transport pathways of all kinds of contaminants. Improving the knowledge of contaminant transport in surface water systems requires detailed studies on its behaviour, for which active hydrological tracers are an established method. Traditional active tracing methods utilize fluorescent dyes, salts, isotopes, etc. However, drawbacks of these tracers are, for instance, the limited choices of tracers available and consequently the difficulty doing multitracer experiments, which are advocated more and more to get deeper insight in the spatial and temporal dynamics of hydrological systems. Furthermore, most tracers have a rather small dilution factor which is a limiting factor for application in cases of substantial dilutions such as in larger water bodies or when applied for longer travel distances. Lastly, there is an increasing concern about the potential negative impact on the environment, especially when applied in larger volumes for larger-scale experiments.

Recently, silica coated synthetic-DNA-tagged microparticles with a superparamagnetic core (SiDNAMag) have been developed which could solve some of the above mentioned obstacles. However, no systematic research has been done for the application of microparticles with SiDNAMag for surface water tracer measurements. Therefore the objective of this research is to understand the behaviour of SiDNAMag tracers in natural surface water and to come forward with a protocol for its application. Open channel tracer tests are performed in laboratory and field conditions. Here we want to present the first results of controlled laboratory experiments studying the behaviour of SiDNAMag in various water types and under different flow conditions. Results are analysed in terms of mass balance and breakthrough curves. From the experiences in laboratory conditions, an application protocol will be proposed.