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Extended Abstracts

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Groundwater and dependent ecosystems

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Groundwater in eco-hydrology

title: **From individual cells to aquifers: Modelling the groundwater ecosystem**

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INTRODUCTION

Groundwater is increasingly threatened by contamination. We know that micro scale heterogeneities influence the bioavailability (both in terms of contaminant concentration and biotic population density) and hence the decay rates of contaminants. In the WATERBUGMODEL project, a contaminant degradation model for the groundwater ecosystem is developed that accounts for the biological functions and processes of a complex community. With this model it will be possible to evaluate the importance of such heterogeneities and the various functionalities of microorganisms and higher organisms in natural attenuation and bioremediation.

APPROACH

Increasingly, microbial aspects and possibilities in contaminant degradation are acknowledged, but we still lack the in-depth insight in biological degradation processes. Field monitoring will always remain of limited explanatory power. Models with high spatial resolution can provide theoretical insights into the groundwater ecosystem that cannot be obtained from field sampling.

Protozoan predation stimulates microbial productivity (Mattison, Harayama, 2001). The same might be true for higher organisms and viruses in groundwater. To implement such biological components in current schemes of groundwater management, there is an urgent need for models taking into account the (i) patchy distribution of resources and microbial and faunal growth and (ii) the interactions in the groundwater food web in computational models of the groundwater aquifer ecosystem.

In conclusion, the major objectives of the scientific program of the WATERBUGMODEL project are:

- to explore the importance of spatial heterogeneity of organisms and pore structure on microbial degradation, as well as the prediction of feedback mechanisms,
- to evaluate the impact of protozoan and faunal grazing on microbial degradation, and thus
- to guide experimentation to verify the efficiency of management measures.

These goals are achieved by coupling the existing individual-based model platform iDynoMiCs to the GeoSysBRNS simulator (Centler et al., 2010), a model and solver for aquifer-scale groundwater-relevant processes and parameters. A hierarchical approach will be used to scale up the results from the grain surface scale to the aquifer field scale through the use of different geometries at process relevant scales for microbial degradation. In first steps the heterogeneous biological functions will be evaluated in simplified geometries.

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