Marie Skłodowska-Curie

Innovative Training Network

"HypoTRAIN"

Hyporheic Zone Processes – A training network for enhancing the understanding of complex physical, chemical and biological process interactions

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Deliverable D2.1

Set-up and validation of flume systems to study the link between ecological and biogeochemical processes in the hyporheic zone

Dissemination Level of Deliverable:

PU	Public	**X**
CO	Confidential, only for the members of the consortium (including the Commission Services)	

Content

Set-up and validation of flume systems to study the link between ecological and biogeochemical processes in the hyporheic zone

1. Technical background: Joint flume and bottle experiments

In the summer of 2017 ten HypoTrain ESRs collaborated in a joint flume- and bottle experiment at the so-called “ecolab” at the University of Birmingham.

The aim of the experiments was to compare the effects of hyporheic microbial diversity and varying bedforms on attenuation and transformation of micropollutants. The flumes represented small rivers and were setup under semi-controlled conditions, i. e. they were excluded from external water and matter inputs by protecting them with a tent. This facilitated a maximum comparability of the different treatments.

Flume experiments are assumed to represent natural river conditions more than bottle-incubation experiments. By setting up an experiment in flumes working like small-scale artificial rivers we aimed at capturing the processes occurring in rivers more accurately than in a simple bottle-incubation experiment, while at the same time being able to control external influences better than in a field experiment.

A Central Composite Face design (CCF) containing an imbedded fractional factorial design was implemented to evaluate the effect of two factors on transformation of micropollutants in the flumes. CCF is a common statistical approach that optimizes the number of experiments needed to identify the response of our predicted variable. The two factor variables tested were:

1. Microbial diversity, implemented by different dilutions of microbially active sediment from River Erpe.

> We hypothesized that microbial communities of higher diversity generally have a greater ability to degrade micropollutants than communities of lower diversity. The flumes containing a higher dilution of River Erpe sediment are expected to develop a microbial community of lower diversity and thus show lower degradation rates.

2. Hyporheic flow induced by varying amounts of bedforms that were manually formed before the injection of micropollutants.

> Hyporheic flow provides favourable conditions for microbial breakdown of micropollutants in sediments. Thus, we expect generally higher degradation rates of micropollutants in flumes of higher surface water-pore water exchange enhanced by bedforms.

The results of the flume experiments will be fitted to a quadratic model using multiple linear regression which will allow to screen for linear and non-linear responses to the variables as well as interactions.

In addition, we ran a set of bottle incubations simultaneously with the flume experiments. This way it was possible to test the influence of radiation as an additional variable. Furthermore, the results will be used to validate the outcomes of the flume experiments.

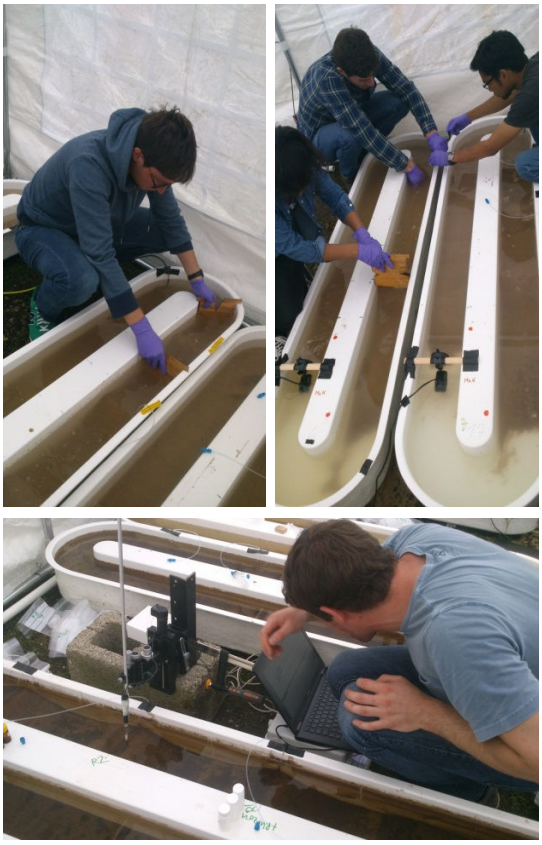

Figure 1. Joint preparation of flume experiments.

2. Internal communication and collaboration

Initially all participants met in Barcelona during the HypoTRAIN midterm review in February 2017 to discuss the concept of the study. After that the ideas were refined in several skype meetings and a substantial outline was prepared. The outline, a protocol and a timetable were shared in a google-doc document and developed jointly before and during the experiment. The communication platform “Mondo” (see deliverable 7.2) was used to share data after the experiment. In November 2017 the participants will meet at Stockholm University to discuss the

first results of the sample analysis at the different institutions and the preparation of joint publications.

3. Realization

The participating ESRs met at the University of Birmingham in June 2017 to prepare and set up the flumes (Fig. 2) and bottles (Fig. 3) together. In total 24 flumes and 28 bottles were filled with sediments from the River Erpe in different dilutions. After an incubation time of 12 days, the micropollutant standards (mostly pharmaceuticals) were injected aiming for an initial concentration of about 10 µg/L. Within the following 78 days surface and pore water samples from the flumes were collected ten times. The samples were prepared and stored for analysis of micropollutants at EAWAG Zürich and Stockholm University, respectively. From the bottle experiments only surface water was sampled (7 samplings within 42 days). Sediment samples were collected at 7 and 2 time points from flumes and bottles, respectively, for analysis of microbial diversity at University of Bayreuth. Additionally to micropollutant concentrations nutrient concentrations from flumes and bottles were measured at the University of Birmingham from five and one samplings throughout the experimental phase, respectively.

Figure 2. Flumes of the joint experiments at the University of Birmingham.

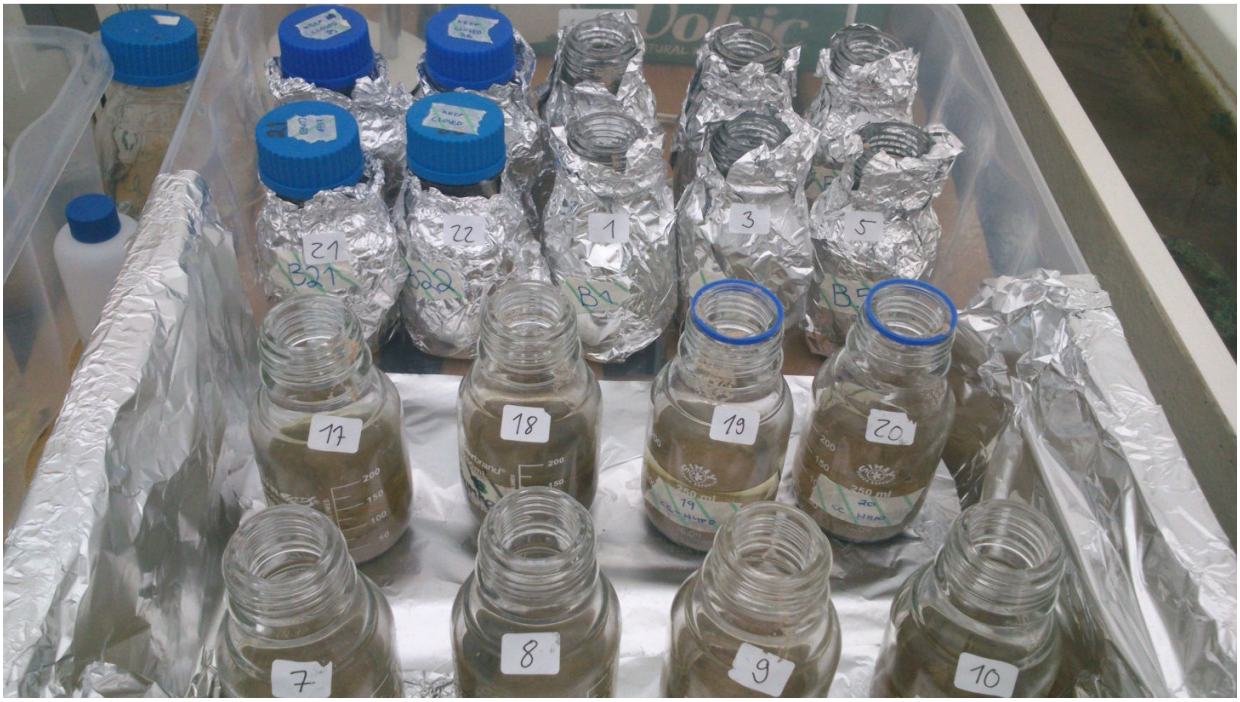

Figure 3. Bottle experiments done in conjunction with the joint flume experiments at the University of Birmingham.