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Fate and transport of trace organic chemicals of emerging concern in streams receiving significant loads from wastewater discharge

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12/2015

☒ **ongoing** ☐ **finished: MM/20YY**

Introduction - Motivation

The requirements of the European Water Framework Directive to maintain a good ecological and chemical status of surface waters requires more efficient treatment of discharges from point sources such as wastewater treatment plant effluents in order to minimise the input of various pollutants (such as pharmaceuticals, pesticides and industrial chemicals). The aim of this work is to develop a comprehensive characterization approach that allows identifying and classifying relevant organic micro-pollutants and their transformation products in wastewater treatment plant effluents, to assess the overall fate and transport, including toxicity, of these remaining chemicals in the receiving streams and propose source indicator compounds.

Non-Target Screening

Until now most of the compound screening that were applied on water samples have been targeted. It is only recent that with the advances in high resolution mass spectrometry the idea of non-target screening of samples has become popular, although not new, in order to provide a more complete view of the organic contents of different water bodies (Cleven et al., 2013; Hernández et al., 2015).

These organic compounds that are present in a sample are called in literature “Hidden Targets” (Letzel et al., 2015), as they are known in the chemical literature or MS reference databases, but unknown to the researcher regarding a specific sample (Cleven et al., 2013).

Sample Preparation and Analytical Measurements

The preconcentration of the samples is done with a combined RP-HILIC Solid Phase Extraction (SPE). This way it is ensured that regardless their polarity, all the trace organic compounds will be collected.

The Hydrophilic Interaction Liquid Chromatography (HILIC) and Reversed Phase – High Performance Liquid Chromatography (RPLC) are complementary techniques in the separation of organic molecules. The samples are analysed by the RPLC-HILIC-API-ToF-MS system, undergoing an extensive polarity screening. The development and robustness of the method has been described and applied previously (Greco et al., 2013; Greco et al., 2014; Rajab et al., 2013a; Rajab et al., 2013b)

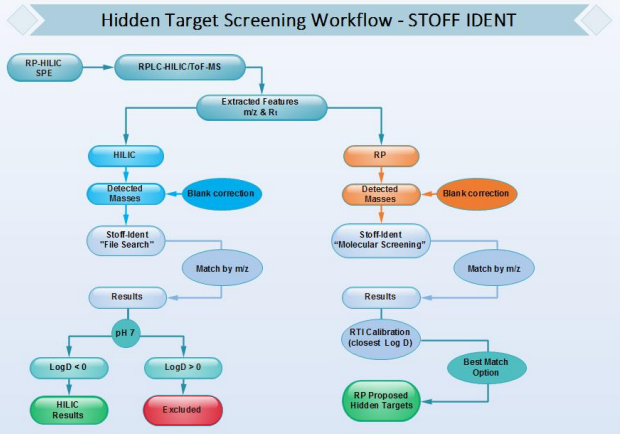

Fig. 1: Hidden Target Screening workflow using STOF-IDENT Database

Application on real samples

The Isar River was selected as the water body on which the research will be applied, because it is one of the most important Bavarian Rivers and a lot of work has been done already in order to protect the river's ecosystem against anthropogenic influence.

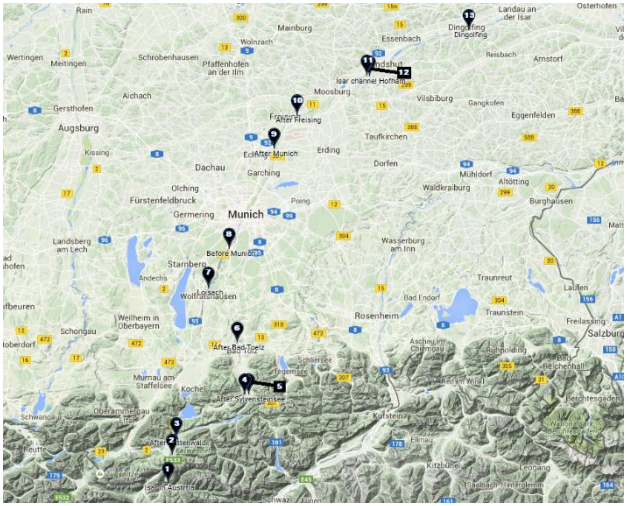

Fig. 2: Sampling Points on Isar River

The sampling points were selected in order to represent the changes in river water quality within its length, mainly by the discharge of WWTPs. Ten of the sampling points have been selected on the Isar River itself and three more are collected from three of its tributaries; Seinsbach, Jachen and Loisach rivers (Fig. 2).

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