

## NRP Endocrine Disruptors

### Final Summary

Original project title
<b>Integrative risk assessment for endocrine disruptors in Switzerland</b>
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### Integrative risk assessment for endocrine disruptors in Switzerland

*The objective of the project was to develop an environmental fate model for various substances with endocrine disrupting potential. The model was implemented as a mass flow representation from the source of emission to the final fate in the environmental compartments.*

*Based on chemical properties, the estimated quantities of the substances used, and their respective applications, the model predicts mass flows on a local level. By taking the respective water flows into account, these mass flows result in predicted environmental concentrations in surface water and groundwater. These concentrations can be interpreted as averaged levels with geographical resolution in the local scenario. The estrogenic equivalent concentration can be assessed by estrogenic equivalence factor-weighted addition of the individual substance concentrations.*

### Research questions

The model processes and visualizes mass flows on various levels of detail (e.g. region, political community, sewage treatment plant (STPs), activated sludge reactor, biodegradation processes). This allows to identify possible local hot spots with high concentrations of endocrine disrupting compounds (EDCs), and in turn, may lead to further measures not been considered without knowledge of the modelled endocrine potency.

In phase I we selected the substances, collected substance data on emissions and environmental behaviour, and set up a scenario to represent the Glatttal/Greifensee region in Switzerland. Model output was compared to current and past measurements to validate the model's calculation routines.

In phase II the model was modified as to represent the catchment area of Lake Thun and to be used as a prognostic tool, since measurements in surface waters from this region were not present at the beginning of the project.

## Results

The modelling results show that it is possible to estimate environmental concentrations and the corresponding ecotoxicity for various substances simultaneously based on a limited amount of data. The model allows the prediction of not only environmental concentration on a yearly average basis but furthermore for specific environmental scenarios such as rain events, improvement of STP etc.

From the 20 substances modelled in this project only a few substantially contribute to the overall endocrine disruption potential. For three of the endpoints used the steroid hormones dominate the endocrine potential. Only the application of the YES assay predicts a dominant endocrine potential for the degradation products of NPnEO in the year 2004, which decreases significantly in the year 2007 due to the new legislation (almost complete application ban of NPnEO-based detergents as of July 2006).

The contribution to the overall endocrine potential by substances such as Bisphenol A and the various UV screens is small. However, it has to be considered that not for all substances the endocrine potential for all endpoints is known. Also, in case of high local emissions (e.g. wastewater of a specific industry) these chemicals may become relevant.

On the basis of the model's geographical resolution it is possible to pinpoint several "hot spots" in terms of high endocrine potential in the modelled region. For the densely populated and industrialised Glattal/Greifensee region STPs discharging into relatively small receiving waters show highest endocrine potential (Estradiol equivalence concentration of up to 2 ng/L for the Vitellogenin synthesis induction endpoint). In the Thunersee region highest Estradiol equivalence concentrations in surface waters are also found downstream of STPs, but are at least one order of magnitude smaller. This is mainly due to the fact that about 65% of the region's wastewater is collected for treatment in the well-equipped STP Thunersee. Also, in the sparsely populated regions with smaller STPs the emissions of endocrine disrupting compounds are lower. Accordingly, the endocrine potential in Lake Thun is only in the range of picograms/L.

Modelling of unfavourable meteorological conditions (drought, rainstorm event) and comparing the result with yearly averaged model runs show an increase in endocrine disrupting potential by a factor of up to 4 for selected surface waters downstream of STPs. Especially during rainstorm events, where large amounts of wastewater are discharged untreated into surface waters, this leads to elevated pollutant concentrations.

## Perspectives

In addition to modelling the status quo of two different geographical regions possible future risk reduction measures have been assessed for two identified hot spots. Whereas an increase in sludge retention time in the existing STP had a moderate effect on the overall endocrine potential, an additional ozonation step showed significant reduction on most endocrine disrupting substances.

Measures like advanced treatment options in selected STPs (e.g. ozonation), the combined treatment of wastewater from different small and ineffective STPs in larger and more effective plants, or the re-direction of the treated wastewater to larger surface waters will lead to reduced endocrine potential in the effluent of identified hot spots.