A global exposure model for down the drain chemicals: A Case study and initial evaluations

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1. Introduction

a. The global use of a range of home and personal care products is increasing and this trend is likely to continue for the foreseeable future, as growth in emerging markets in South America, Africa and Asia continues. Industry has a responsibility to assess the environmental safety of chemicals used in consumer goods in all markets, not only in regions where regulations exist. Using spatially explicit data sets we present a global model, the Scenario Assembly Tool (ScenAT) to predict in-river concentrations of chemicals used in home and personal care (HPC) products. Here we present a case study and some initial evaluations looking at China and US using a selection of HPC ingredients. Key aims are to (a) present the ScenAT model and updates (b) present evaluation of model using monitoring data.

2. Materials and methods

ScenAT incorporates geographically explicit data on HPC product use, socioeconomic factors, including population and GDP estimates, to account for a population's ability to purchase certain products, domestic water use and disposal, sanitation practices and in river dilution factors, collected from official census and other sources. Initial model development focussed on 13 East and South Asian countries and now has been extended to 88 countries around the globle encompassing six continents. The spatial resolution of the underlying datasets are variable across countries due to data collection and dissemination by national agencies. However, as more spatially resolved data becomes available the model can be easily updated.

A case study has been performed estimating Predicted Environmental Concentrations (PECs) for Linear Alkylbenzene Sulphonate (LAS) calculated using a European per capita use value (Schroeder et al. 2002). As part of this activity regional and country profiles of important variables that influence the exposure of home and personal care products (e.g. water use and sanitation practice, receiving water dilution) are explored and the impact of these variables on emission estimates and PEC distributions in major regions around the globe are discussed.

A prelimary evaluation exercise has been performed in China modeling the chemical ingredient Triclosan which is used in multiple personal care products. A total of 213 tonnes were modeled using the "GDP method" described in Hodges et al. (2012) and Hodges et al. (2014) and a comparison of measured (median values) and simulated concentrations from Zhao et al. (2013), and modeled urban concentrations (median values) from ScenAT was undertaken.

Further evaluation has been undertaken in the United States. The Water Quality Portal compiles water quality monitoring programs in the US and has been data mined for 10 chemicals (LAS, Triethanolamine Quat, Triclosan, Methylisothiazolinone, Galaxolide, D5, Permethrin, Diethyl Toluamide, Trimethoprim, Ibuprofen). Based on the data sets available, 5 chemicals were prirotised and run throught the ScenAT model. The spatial and temporal characteristics of the montioring data have been analysed to understand the relationships between the modelled and the monitoing data.

3. Results and discussion

3.1. Distribution of Linear Alkyl benzene Sulphonate (LAS) PECs at Global Scale (88 countries)

Distributions will be shown for PECs, water use, dilution factors and sewage treatment connectivity for selected key countries. The PEC estimates for LAS (Figure 1) are likely to be a conservative (over) estimate especially for developing areas of the globe as a European per capita usage estimate has been applied to all countries. In areas where higher PECs are forecast, further understanding into disposal practices and how

products are used can be developed. For example, in water-stressed regions a significant fraction of treated wastewater is reused directly for irrigation, and in developing areas of the world products are sometimes used in a bucket and the waste water is disposed of onto the ground. In both cases waste water is not discharged into surface water so the approach used here (waste water is assumed to be discharged to surface water) will give higher PECs.

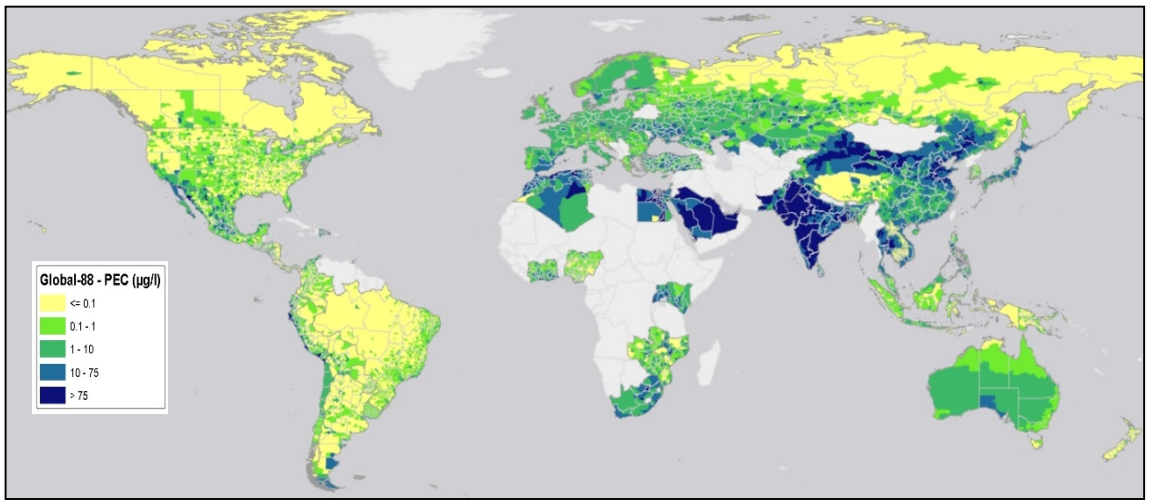

Figure 1 Distribution of Linear Alkyl benzene Sulphonate (LAS) PECs at Global Scale (88 countries)

3.2. Evaluation of ScenAT in China using TCN

Screening-level modeled PECs were slightly higher than measured data (by a factor of 1.2 to 6.0) for all five rivers (Figure 2).

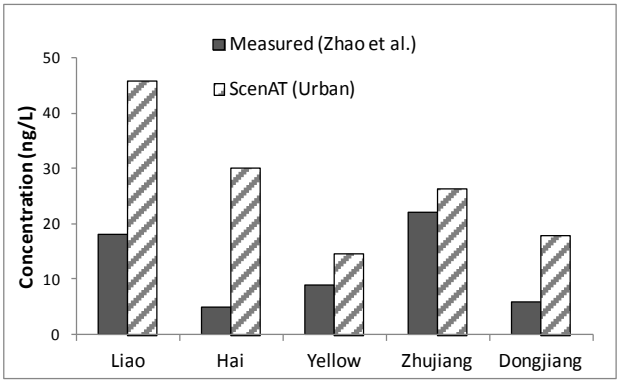

Figure 2: Comparison of measured concentrations of triclosan from Zhao et al. (2013), and modelled urban concentrations from ScenAT.

3.3. Comparison of ScenAT in US

The monitoring dataset showed good geographical coverage of the US and included temporal data, therefore a methodology to compare point locations (monitoring data) with polygons (ScenAT results) was created. For the majority of chemicals analysed good correlations were found bewteen modelled and observed data. The applicability of the proposed model evaluation methodology is discussed in relation to spatial and temporal resolution of datasets.

4. Conclusions

It is possible to generate improved PEC estimates at a refined spatial scale using screening level models. This allows identification of geographic locations for further investigation or more refined exposure modeling and can inform targeted monitoring campaigns.

5. References

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