iSTREEM™ - an internet-based national watershed scale model capable of determining where and when to monitor for chemicals from consumer products

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www.aciscience.org/iSTREEM.aspx

Abstract

In recent years, attention to anthropogenic chemicals in the environment has expanded beyond conventional industrial chemicals and pesticides to include those used in everyday consumer products such as pharmaceuticals, cosmetics and cleaning products. Though there is more interest, researchers are often not familiar with use patterns of consumer product ingredients and therefore have more difficulty estimating impacts to aquatic environments. The American Cleaning Institute developed and is sharing (at no cost) a national scale, Internet-based wastewater and river chemical concentration estimation model called iSTREEM™.

iSTREEM™ incorporates resident information from several **public database sources** and basic **user inputs** into a simple **algorithm** that generates GIS-based estimated concentrations of a subject chemical in effluent for more than 10,000 wastewater treatment plants, nearly 30,000 river reaches covering more than 200,000 miles and 1,700 drinking water intakes across the continental United States, or in regional watersheds including the Willamette River Basin.

Methodology

iSTREEM™ Public Database Sources

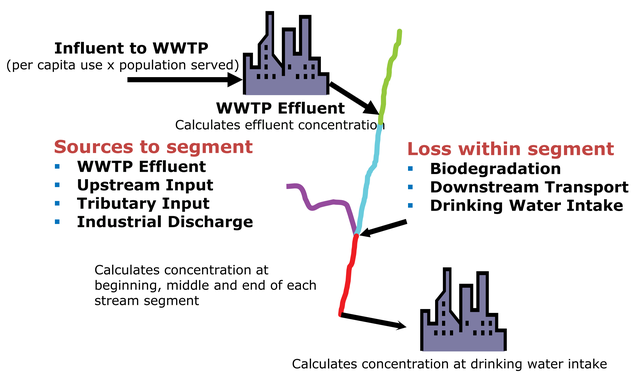
- USEPA River Reach File 1 & USGS NHD
- USEPA Clean Watersheds Needs Survey
- USEPA Safe Drinking Water Information System (SDWIS)

User Inputs

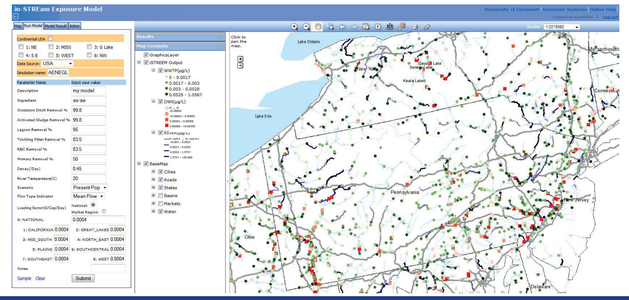
- Per capita use rate of chemical
- Chemical fate parameters: wastewater removal rates; in-stream loss

Algorithm

U.S. rivers are segmented, and modeled for downstream flow



Output



Case Studies:

Comparing Modeled Results to Regulatory and Effects Thresholds

iSTREEM™ effluent predictions vs. Oregon DEQ Priority Persistent Pollutant trigger levels

Effluent concentrations for two personal care product chemicals, the antibacterial agent Triclosan and the fragrance ingredient Galaxolide (HHCB), were compared trigger levels established by the state of Oregon

- Oregon DEQ Triclosan trigger level: 70 ug/L
- Oregon DEQ Galaxolide (HHCB) trigger level: 29 ug/L

Figure 1. Concentration of triclosan in effluent

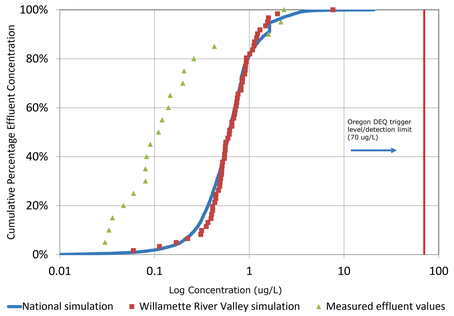
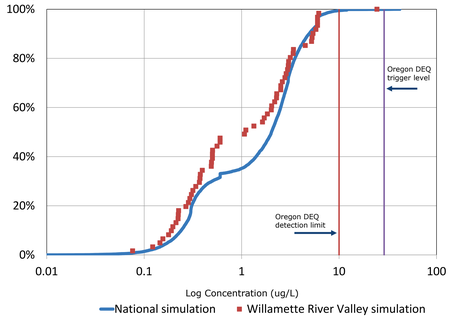


Figure 2. Concentration of HHCB in wastewater effluent



Observations:

- Concentrations from the Willamette River Valley simulation closely mirror those of the national simulation indicating that the distribution of treatment plant efficiency is similar between both.
- The simulation concentrations are significantly greater than the measured effluent concentrations suggesting the model is conservative in its estimates.
- The simulation concentrations are one to two orders of magnitude less than the Oregon DEQ trigger levels and detection limits suggesting that concentrations exceeding that level are unlikely and that environmental monitoring might not be necessary.

iSTREEM™ in-stream predictions vs. effects threshold

In-stream concentrations from iSTREEM™ were compared to effects thresholds for Triclosan and Galaxolide

- HC5 for Triclosan: 0.8 ug/L for aquatic species (Capdevielle et al., 2008)
- PNEC for Galaxolide (HHCB): 4.4 ug/L for freshwater aquatic species (SCHER, 2008)

Figure 3. Predicted in-stream concentration: Triclosan

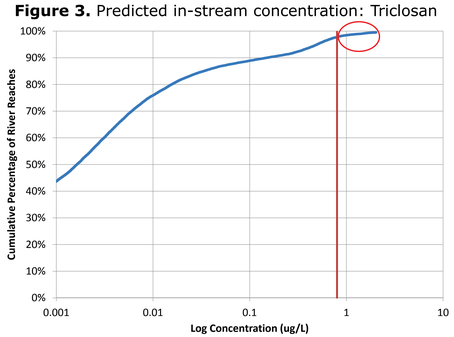
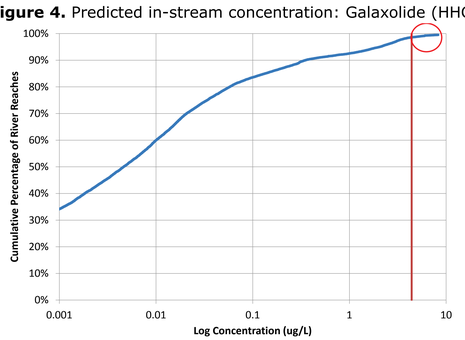


Figure 4. Predicted in-stream concentration: Galaxolide (HHCB)



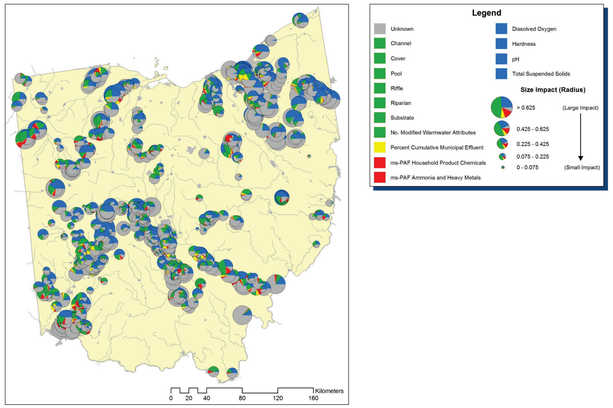
Observations:

- The simulations show that the likelihood of in-stream concentrations of Triclosan or Galaxolide exceeding a threshold value are low.
- iSTREEM™ can diagnose the conditions under which the threshold might be exceeded and provide insights into where to conduct environmental monitoring (river reaches in the red circled areas of Figures 3 and 4).

Conclusions

- iSTREEM™ provides the ability to predict concentrations of user-defined chemicals in wastewater effluent, receiving streams and at drinking water intakes on a national or a watershed scale.
- The concentration data generated by iSTREEM™ are easily represented as a distribution which can be compared to a regulatory or biological endpoint threshold.
- The GIS functionality and spatially-varied inputs permit analyses on a variety of scales (e.g. watershed, regional, national) and with a variety of geo-referenced data to compare the potential impact of multiple biological stressors (Figure 5).

Figure 5. Impact pies and risk attribution slices (from DeZwart et al., 2006)



Future Considerations

- Acquisition of river reach, and wastewater and drinking water facility information for Canada to make the model truly continental.
- Additional outreach to academic, industrial and regulatory communities to further the acceptance and utility of iSTREEM™.

References

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