Research needs for emerging contaminants

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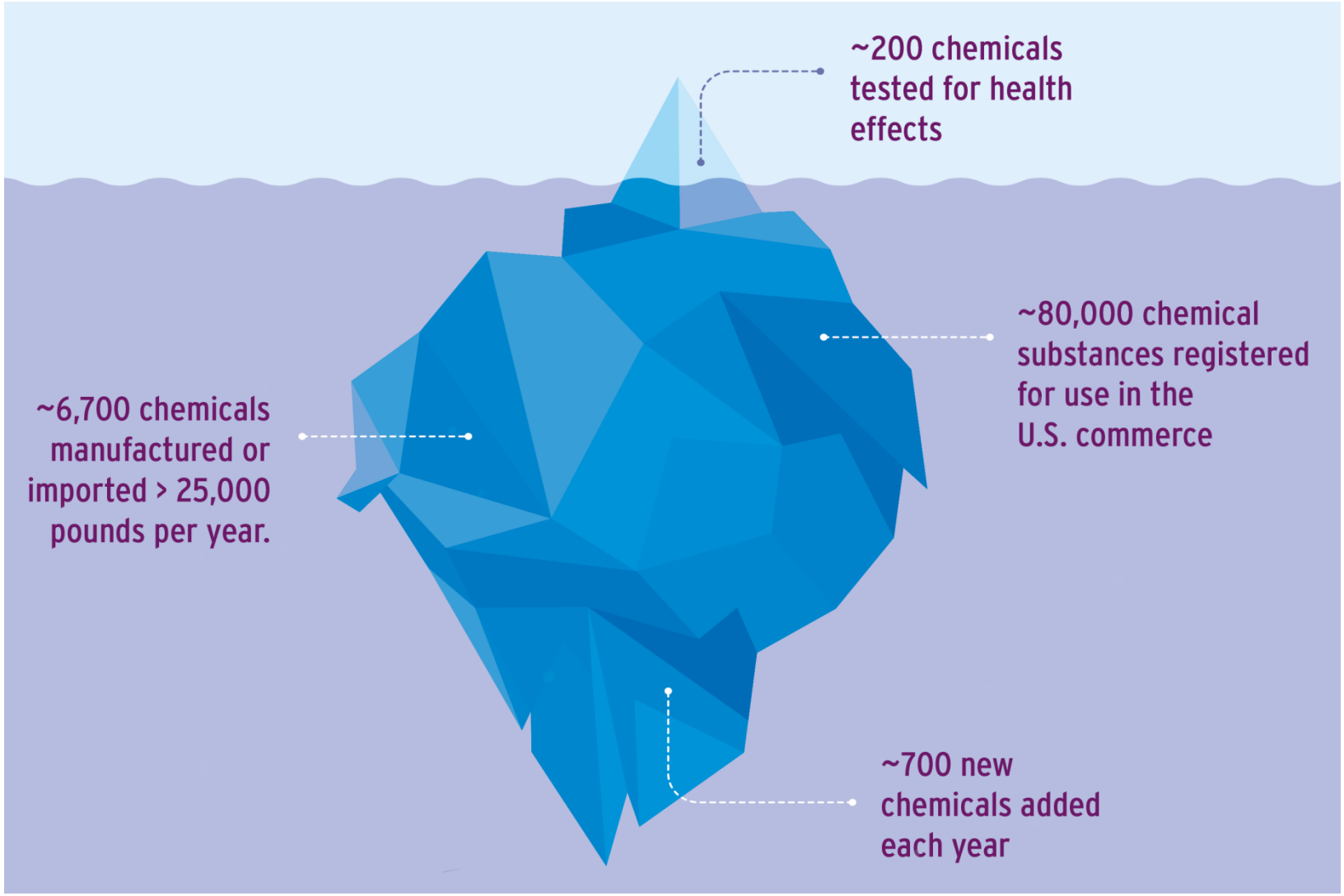
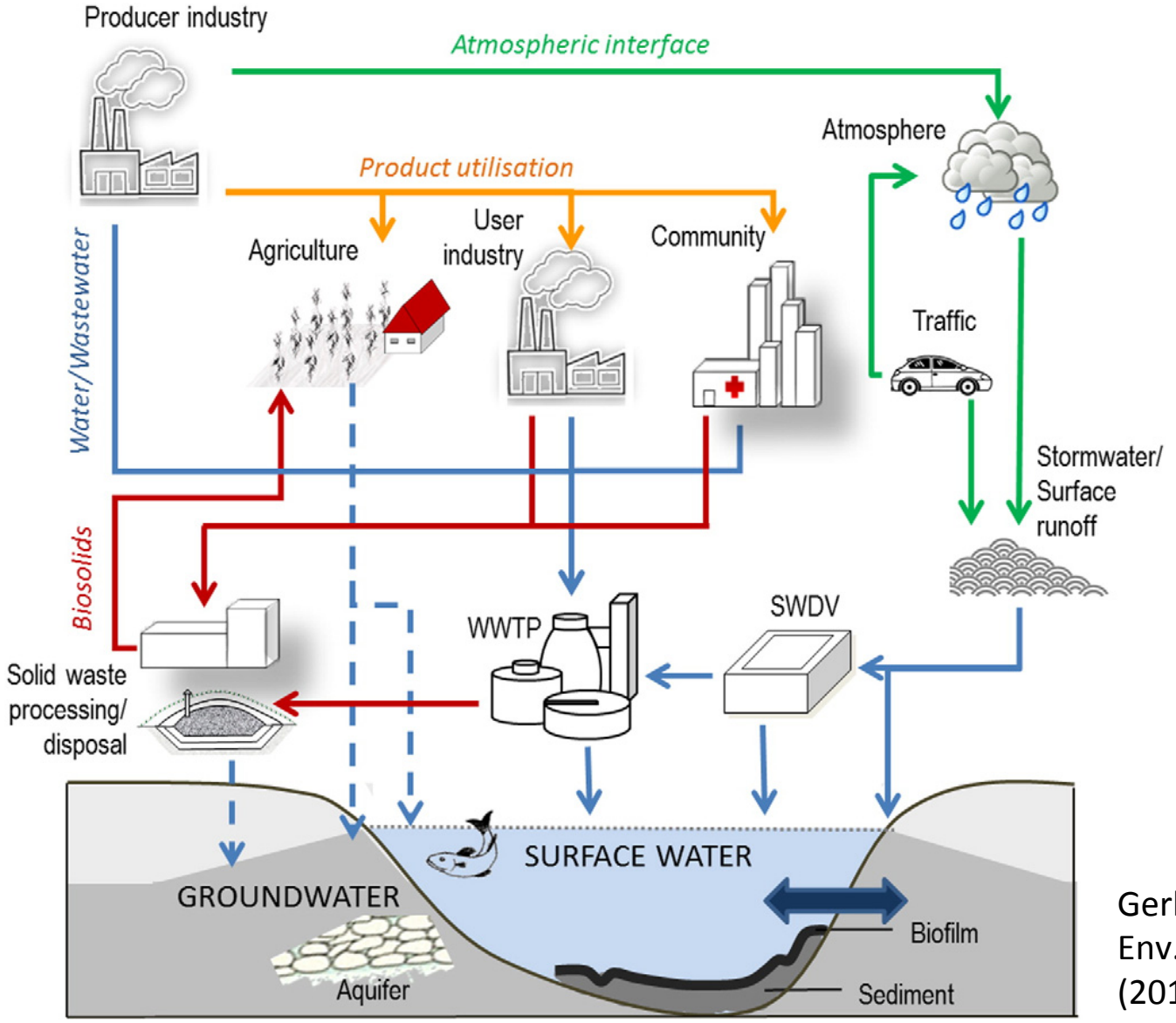
What do we know about chemicals that surround us?



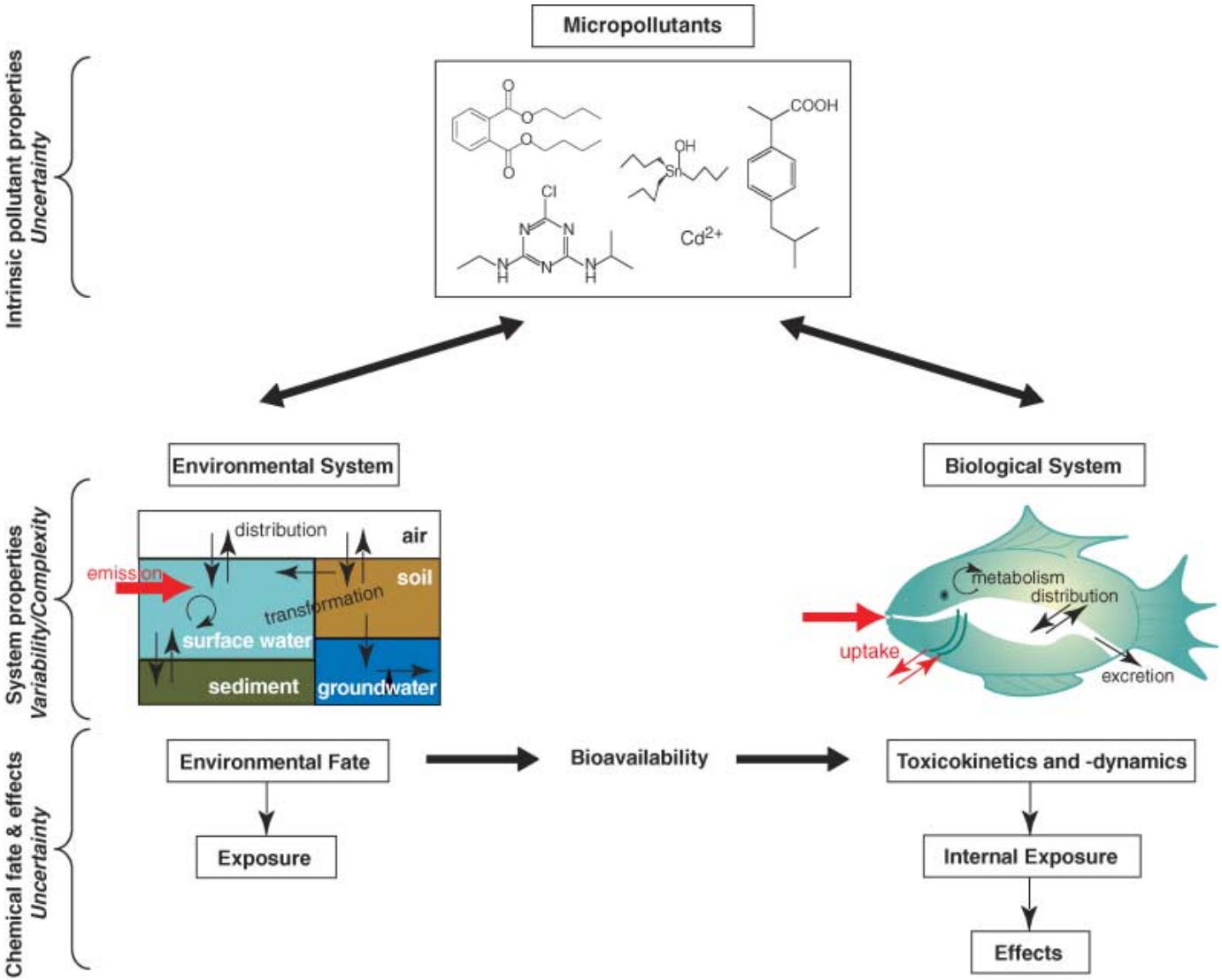
Woodruff, T. Identifying Cumulative Exposures to Chemicals in Pregnant Women – Non-targeted Screening of Environmental Chemicals. PPTOX IV, Boston, MA, Oct. 26-29, 2014.

How do emerging contaminants enter the aquatic environment?



Gerbersdorf et al., Env. Int. 79: 85-105 (2015)

Challenges associated with assessing risk associated with emerging contaminants



Schwarzenbach et al., Science 313: 1072-77 (2006)

Environmental Engineering and Science

- Characterize physical-chemical properties and (bio)transformation potential of emerging contaminants
- Develop treatment technologies for emerging contaminants
  - Polar compounds (e.g. 1,4-dioxane)
  - Persistent organic pollutants (e.g. organofluorine compounds, flame retardants)
- Develop management strategies for treatment residuals
  - Recover nutrients, energy
  - Remove emerging contaminants from residuals
- Develop best management practices for non-point sources (e.g. fire fighting training sites, agricultural runoff, urban stormwater)
- Environmental fate and transport models
  - Surface water
  - Sediments
  - Subsurface

Analytical chemistry

- Challenges
  - Occurrence at ppb to ppt levels
  - Time-consuming sample preconcentration is required prior to analysis with expensive equipment
  - Low temporal and spatial resolution of occurrence data
  - Non-targeted analysis (finding/identifying unknown unknowns)
- Research Needs:
  - Develop rapid analytical methods
  - Expand mass spectral libraries for emerging contaminants
  - Increase temporal and spatial resolution of occurrence data by identifying indicator compounds that can be analyzed with relative ease
  - Develop international sampling protocols and analytical methods

Biological monitoring

- Challenges
  - Detect presence of emerging contaminants at levels below those that can be detected by analytical chemistry methods
  - Identify effects associated with chronic (rather than acute) exposure
  - Assess the effects of contaminant mixtures
- Research needs
  - Online biomonitoring: What organisms should be selected to answer human-health related questions
  - Biomarkers: Diversity of toxicological endpoints, chronic/acute effects, mixtures (additive, synergistic, antagonistic effects)
  - Complementary techniques: Passive samplers (selectively capture contaminants with different characteristics) followed by bioanalytical assays to identify chemical stressors for different contaminant fractions
  - Human exposome: To what extent do contaminants in the aquatic environment contribute to our overall body burden?

Environmental Policy

Challenges:

- Most regulations associated with chemical pollutants were developed in the 1970s-1980s
- The list of compounds that may need to be regulated keeps expanding

Research needs:

- Instead of continuing to expand the list of regulated contaminants, would the specification of treatment techniques be sufficiently protective (e.g. all drinking water treatment plants must include a granular activated carbon filter)
- Are there unintended consequences if advanced treatment processes are required for all drinking water and wastewater treatment plants (e.g. increased carbon footprint, increased air pollution resulting from increased energy demand)