Intelligence Tools for Environmental Threats: Integrated Technologies for Chemical Hazards

Session: M&S in Support of Operations

Prepared by Dr. Jodi L. Ryder
US Army Corps of Engineers
Engineer Research and Development Center
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US Army Corps of Engineers

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Overview

- -What is ERDC?

- -Need for this capability
- -Surveillance of TIC/TIMs
- -Chemical properties modeling
- -Chemical fate and transport modeling
- -Interactions with soils

- -Interoperability with other capabilities

- -Contacts

Term: TIC/M = Toxic Industrial Chemical, Toxic Industrial Material

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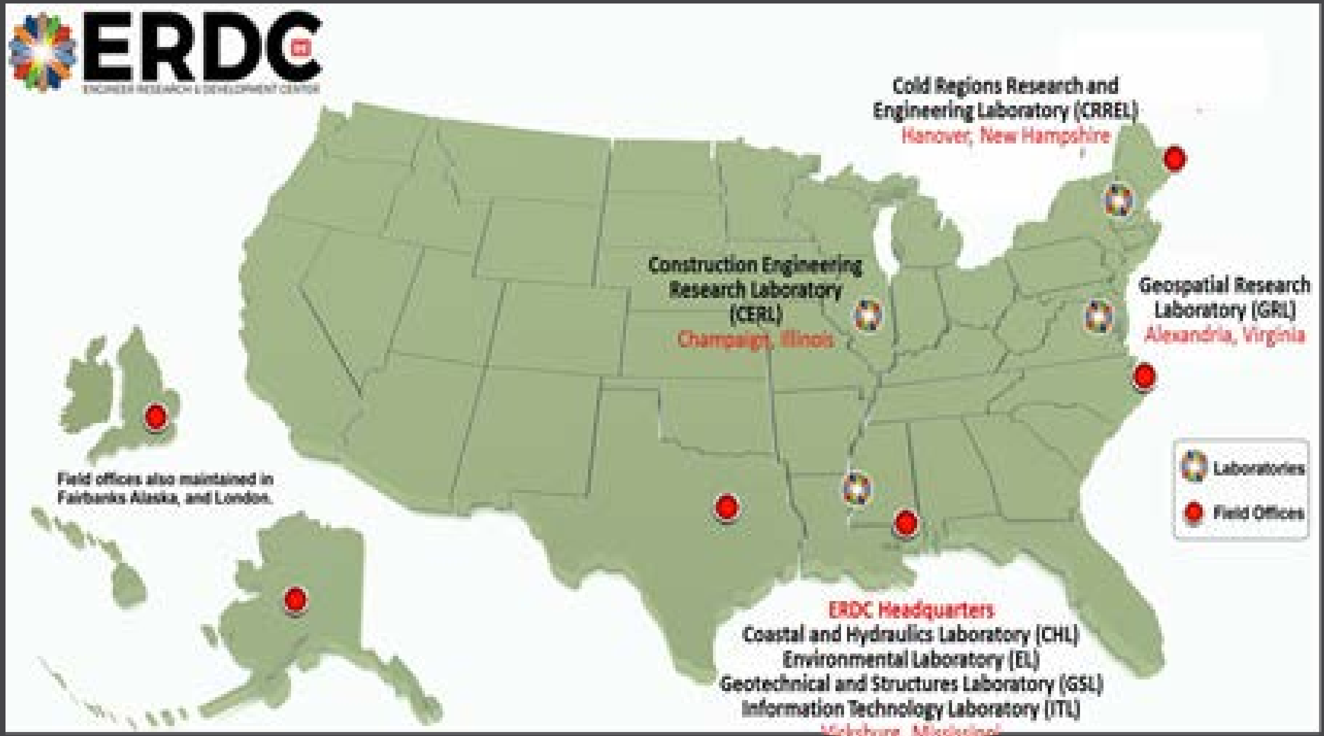
new ways to make the world safer and better



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ERDC Core Competencies

BLAST AND WEAPONS EFFECTS ON STRUCUTRES AND GEO-MATERIALS

CIVIL AND MILITARY ENGINEERING

COMPUTATIONAL PROTOTYPING OF MILITARY PLATFORMS

COASTAL, RIVER, AND ENVIRONMENTAL ENGINEERING

COLD REGIONS SCIENCE AND ENGINEERING

BATTLESPACE TERRAIN MAPPING AND CHARACTERIZATION

MILITARY INSTALLATIONS AND INFRASTRUCTURE

Need for integrated chemical hazard capabilities

Technology currently in this space:

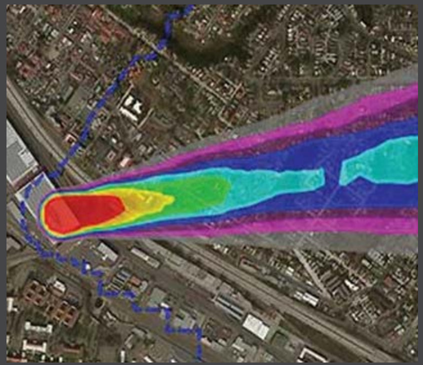
- JACKS
- JWARN
- JEM
- HPAC
- CBRN-IS
- ICWater
- SHARC

- Individual media models/single domain

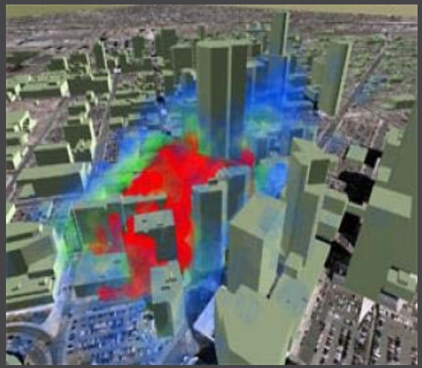
Limitations of technology currently in this space:

- Static
- Restricted chemicals
- Robust plumes
- Breakdown products are not included
- Uses simple aerial dispersion
- Does not assess multi-domain threats
- Does not assess mobility risks

CURRENT



GOAL



Objectives

- Improve mission planning and situational awareness by predicting TIC/M threats on timescales relevant for mission planning
- Mechanistic, quantitative models for rapid chemical environment evaluation and intuitive impact assessments
- Knowledge of industries' potential chemicals, including transport profiles, interaction and degradation across media in dynamic operating environments
- Include breakdown products of chemical agents of opportunity

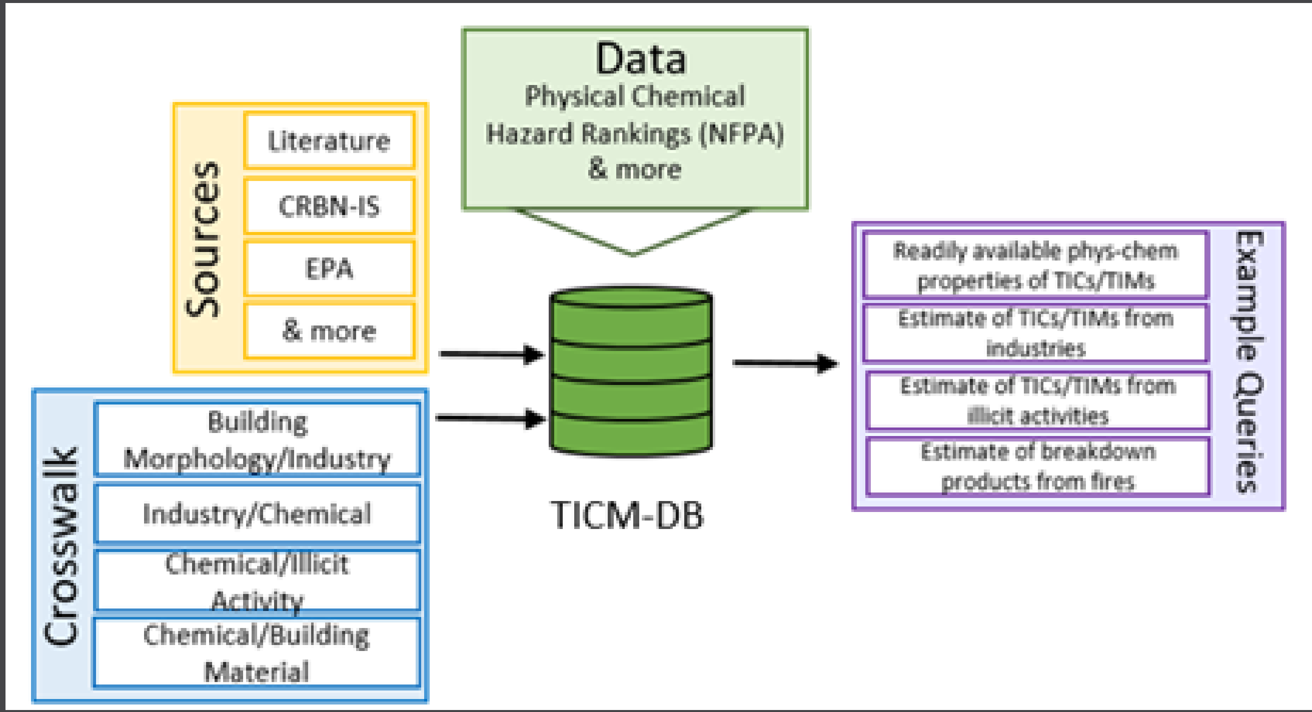
Surveillance of TIC/Ms

Current practice:

- Multiple databases specialized for each user group
- No breakdown products
- No connection

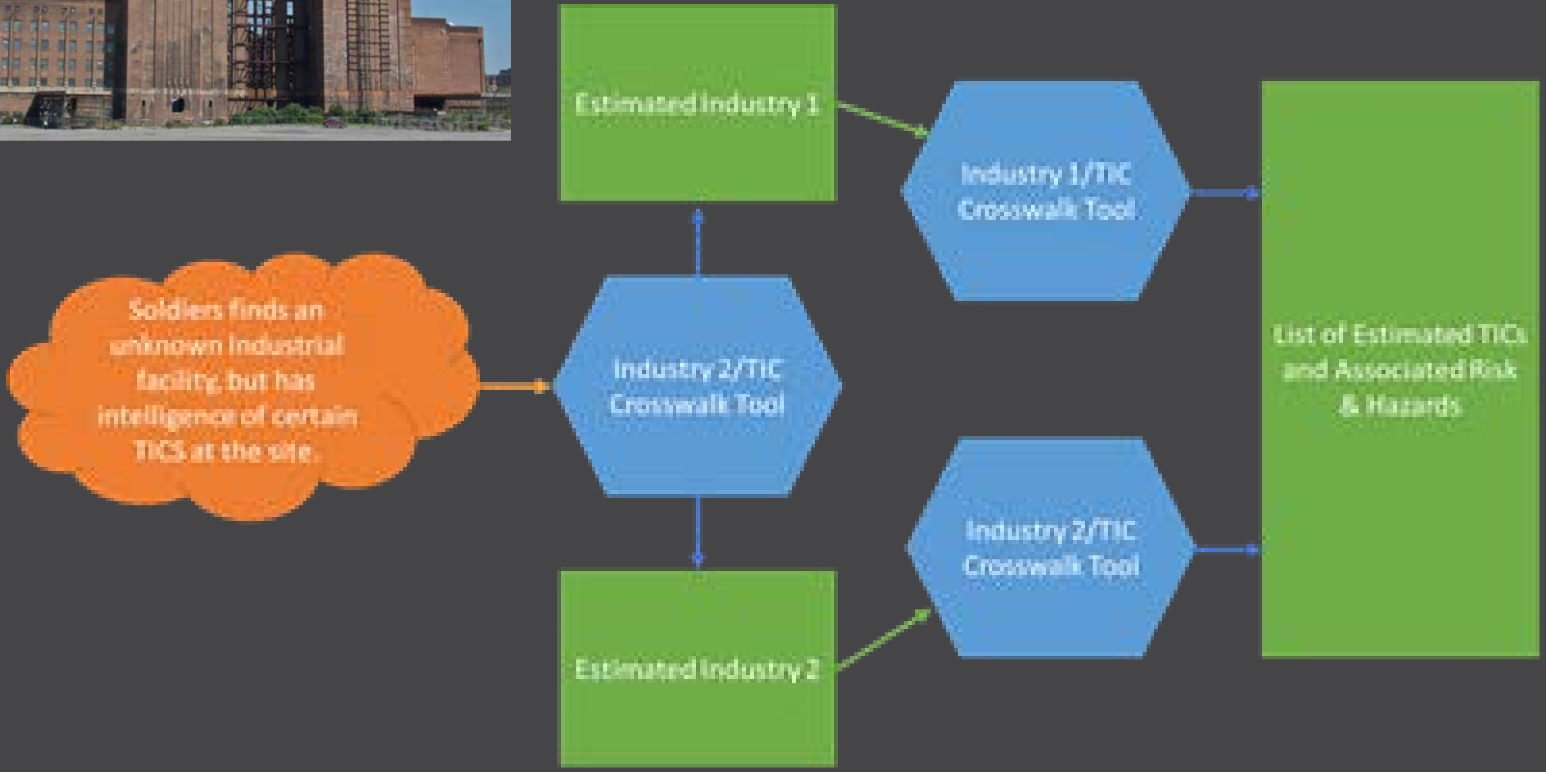
TICM-DB

- Focuses on urban and industrial battlefields



- TRI → US industries concept expanded by assuming limited number of designs

Understanding industry at a local level

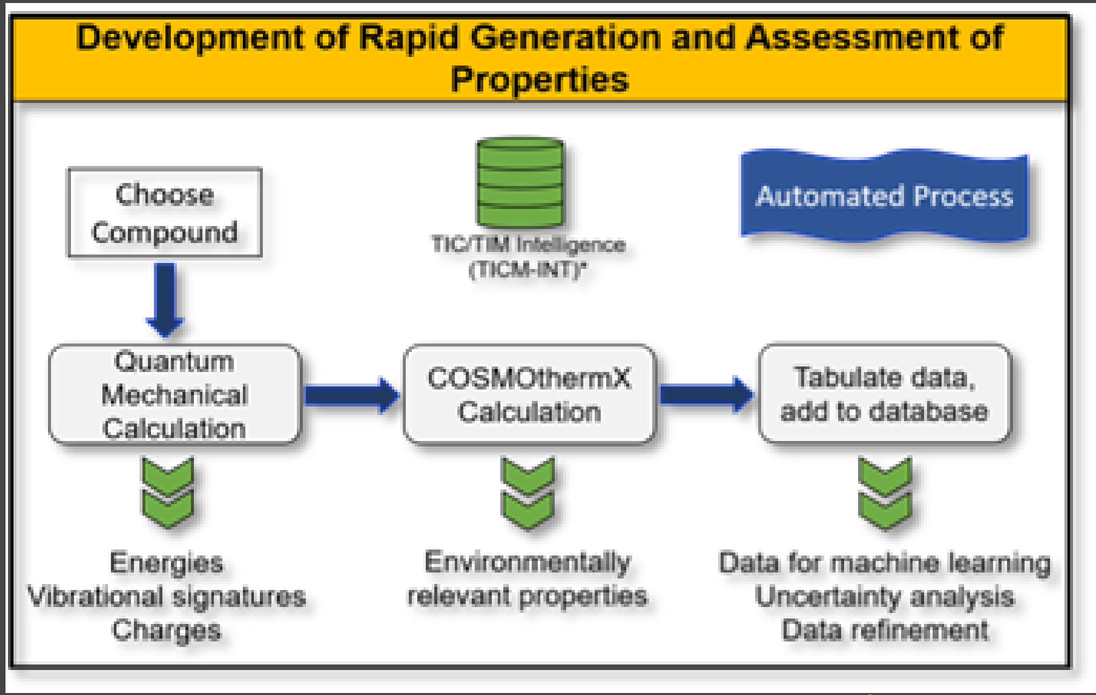


- Identify TICs from industries & industrial processes
- Tools to estimate volumes based on industrial processes, & production
- Worldwide regional differences in TICs usage/production

Chemical property tools

- Certain data needed in order to model exposure
  - Partitioning parameters
  - Reaction/degradation rates
- Vast number of potential TIC/Ms
- Many have not been measured or the measured values are proprietary

Efficient data generation with computational chemistry



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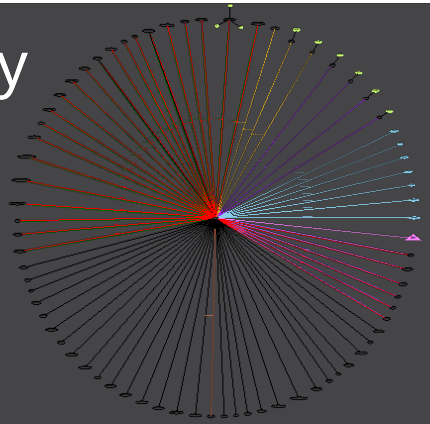
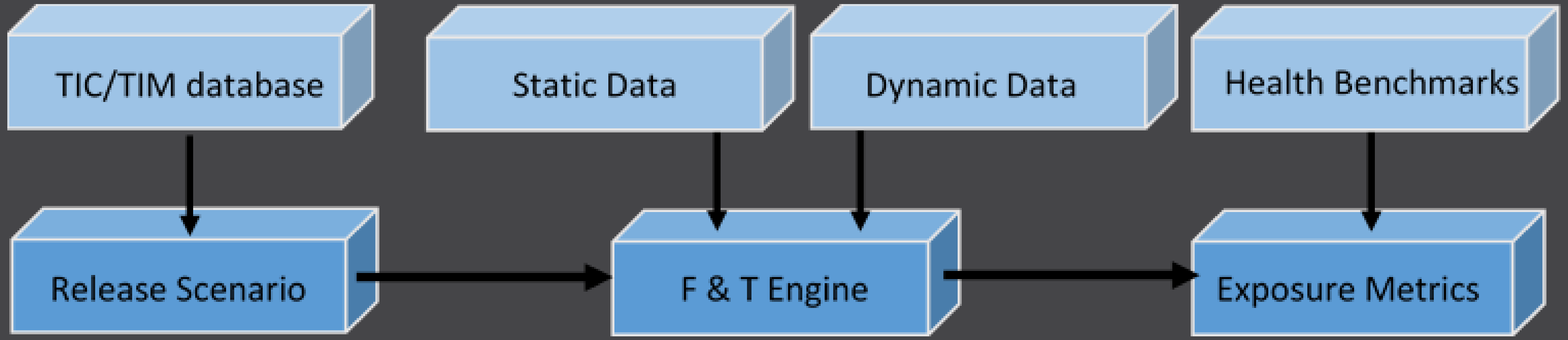
- Chemical reactivity mapping



- Fill in the gaps of sparse data
- QA/QC with computational vs experimental

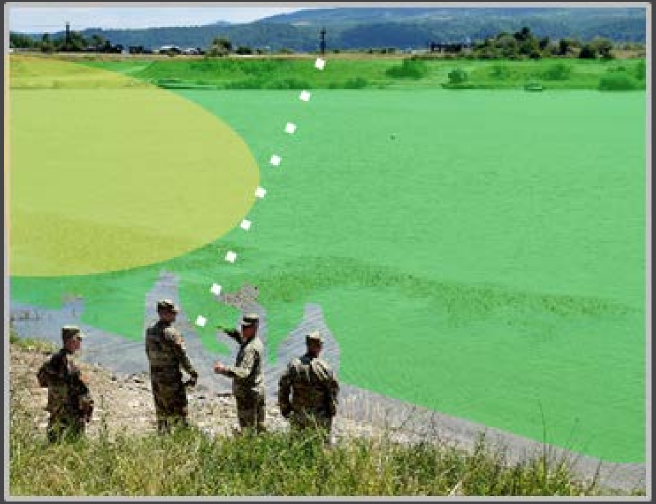
Dynamic release modeling for fate and transport

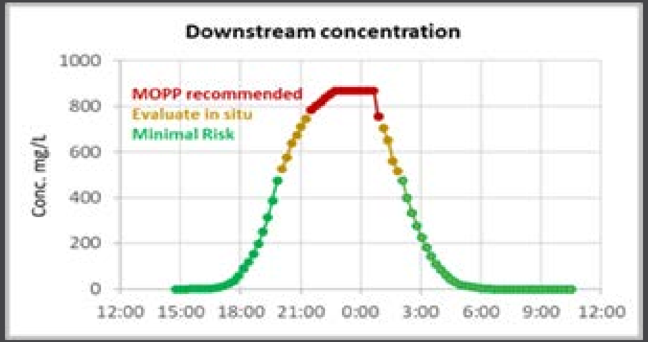


- Connecting material presence and properties to realistic exposure risk requires dynamic modeling of the natural environment

- Current methods rely heavily on user input for release scenarios

Information in an actionable format





- New tools like the SPT allow linkage of dynamic model components to provide more realistic bounds on system
- Scenarios bracket contaminant threshold concentration arrival

Soil exposure routes are significant and persistent

- Currently not predicting soil exposure route in the operational environment

- Soils are physically, chemically, biologically unique to their location

- Sorption/desorption, and the unique biogeochemical make up of pore water result in different TIC/M response in soils than in air or water alone

Soil analog methods

- Urban operations add an additional complexity due to human alteration

- Pedoinformatics techniques involve resampling soil classification data, mapping beyond standard soil classifications, and developing virtual or physical analogs

- Experimentally measurements of sorption characteristics for urban soils produce valuable data and validate computation chemistry models

For further information

Points of Contact:

Presenter:
Jodi L. Ryder, PhD
Jodi.l.ryder@usace.army.mil

Project Manager:
Christa M. Woodley, PhD
Christa.m.woodley@usace.army.mil

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Planned interoperability with other capabilities

- Routing algorithms traditionally ignore TIC/Ms or only respond after release.
- Capability in development to evaluate risk levels and plot alternative routes in response.