Specific Aims

On February 3rd, 2023, a train carrying vinyl chloride, butyl acrylate, plastics, fuel oils, and other chemicals derailed near the town of East Palestine, Ohio. The rupture of several rail cars, subsequent fires, and a controlled burn of intentionally released vinyl chloride to prevent a catastrophic explosion led to a fast-moving contamination event spreading released chemicals and their combustion by-products through the surrounding region over several days[1]. *The immediate effects of this evolving contaminant plume were evident in fish kills extending through small waterways into the Ohio River, reflecting the immediate ecotoxicity and potential human health risks caused by the accident.* The impacted communities of this accident include the immediate evacuation areas in a one-mile by two-mile area surrounding East Palestine, the other communities in Columbiana and Beaver Counties, and potentially some downstream communities along the Ohio River.

Thus, there is a *time-sensitive and critical need to mobilize environmental monitoring* to capture the extent of contamination in soil, water, and sediment surrounding this rapidly evolving accident, and to document the likely severe and ongoing impacts on the local environment of this region and its highly interconnected waterways. Such information will be vitally important to design effective health risk assessments, exposure interventions, and remediation strategies.

Based on the preliminary data released by the US EPA, several contaminants remain at higher than mg/L levels in several water samples, including but not limited to oil, gasoline, and diesel range organics from C6 to C40[2]. Soil contaminations from directly leaked chemicals and combustion byproducts are confirmed by US EPA reports that various aromatic contaminants such as benzene and certain polycyclic aromatic hydrocarbons (PAHs) are present at high concentrations in soil and sediment [3]. *These persistent and accumulated contaminants are a continuing source of re-exposure for impacted residents.* Also, the impacts of persistent contaminants like dioxins on local crops, livestock, and livelihoods are concerning due to bioaccumulation and biomagnification. *Overall, the direct and indirect exposures of these contaminants to the impacted communities pose huge long-term human health risks.*

Given the short half-lives of most contaminants in the air and the high dilution factor of the atmosphere, soil, water, and sediment are more likely to act as the accumulative sinks of the released and/or produced contaminants from this accident. The overall objectives of this proposal are to determine the post-derailment chemical exposome (the totality of exposures) profiles in the impacted environment, conduct fate and transformation modeling, and conduct human health risk assessment modeling, thus evaluating the long-term health impacts caused by this accident. Specifically, the following two aims will be performed:

Aim 1: *Collect 75 evenly distributed soil, water, and sediment samples* in the impact communities that are serving as natural sinks of the released and/or produced chemicals following this human-made disaster, and conduct rigorous *targeted and non-targeted analyses on persistent combustion byproducts.* These include dioxins, furans, chlorinated furans, chlorinated PAHs, and polychlorinated biphenyls measured by gas chromatography-mass spectrometry (GC-MS), liquid chromatography-tandem MS (LC-MS/MS), and LC-High resolution MS. *Non-targeted analyses will be performed by LC-high-resolution MS on highly-contaminated samples* based on the results from targeted analyses in order to discover potential emerging contaminants. **Hypothesis**: *The concentrations of the persistent contaminants in these environmental matrices from East Palestine will be higher than their screening levels in Ohio and Pennsylvania.*

Aim 2: *Perform a model-based comprehensive evaluation of the long-term environmental fate, human exposure levels, and health risks of quantified chemicals to assess the risk of adverse health effects from released/generated chemicals in the impacted communities*. A state-of-the-art computational model that we previously developed called ”PROduction-To-Exposure“ (PROTEX), will be used to evaluate the magnitudes of the release of chemicals or generated byproducts during the derailment emergency, long-term fate and distribution of chemicals across the multiple environmental matrices, human exposure via various pathways, and resultant cancer and non-cancer risks[4]. **Hypothesis**: *Chronic adverse health risks caused by these persistent combustion byproducts are nonnegligible. and this comprehensive and multicomponent modeling approach provides can predict various adverse health risks caused by persistent contaminants in the exposome profiles from the impacted communities.*

Given that some released chemicals have short half-lives in the environment, the sampling of environmental matrices needs to begin as soon as possible by performing both immediate analysis and sample banking to create a record of evolving regional contamination. This project will provide critically needed data on types and levels of contaminants currently impacting human health in East Palestine and surrounding Columbiana and Beaver Counties. Disseminating results as soon as possible is expected to benefit the communities, municipalities, and regulators (US EPA and OH/PA DEP) ensuring that key stakeholders are empowered to make informed decisions about exposure interventions and remediation.