



Leading with Science®

HNS Spill Modeling Using **CHEMMAP**



Applications of CHEMMAP

CHEMMAP-based services can be used for consequence analyses as part of risk assessments for unplanned Hazardous and Noxious Substance (HNS) and alternative fuel releases from vessels, facilities, or other sources. Examples include:

- HNS releases from container ships or of cargo for chemicals shipped in bulk
- Ammonia and alternative fuel spills from vessels and shoreside storage tanks
- Chemical releases of firefighting foams from offshore facilities
- Assessments related to permitting of construction, transport, or port activities

CHEMMAP-based services can also be applied to a variety of non-shipping discharges including:

- Consequences of CO₂ releases from undersea pipelines or legacy wells used for carbon capture and sequestration (CCS) efforts
- Transport and fate of emerging contaminants such as PFAS, microplastics, or pesticides including estimates of bioaccumulation, exposure, and source attribution

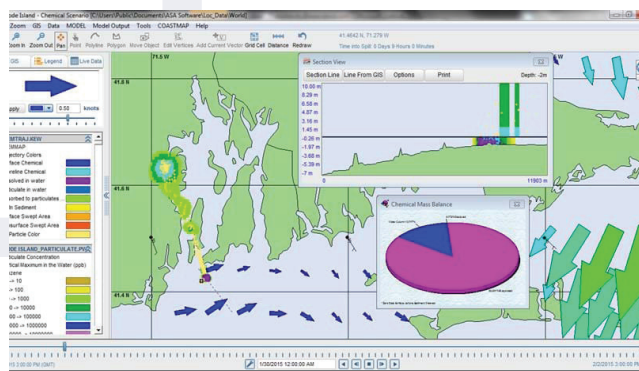
HNS/Chemicals Releases Modeled

- Ammonia and other emerging fuel alternatives
- Acids & bases, including sulfuric acid, caustic soda
- Petrochemicals, such as styrene, toluene
- CO₂ and associated pH changes
- Persistent organic pollutants, including PFAS
- Chemicals associated oil & gas production
- Plastic nurdles and microplastics
- Other HNS chemicals

Transport and Fate Model Capabilities

CHEMMAP simulates the following processes:

- Initial plume dynamics
- Slick spreading, transport, and entrainment of floating materials
- Evaporation and volatilization (to atmosphere)
- Transport and dispersion of dissolved and particulate materials in the water column and in the atmosphere
- Dissolution and adsorption to suspended sediments
- Sedimentation and resuspension
- Natural degradation
- Shoreline entrainment
- Boom and dispersant effectiveness



Model Modules

Trajectory & Fates Model

Determine trajectory and fate for a variety of chemicals including acids, bases, ammonia, and other HNS chemicals at a discrete time and set of conditions (deterministic scenario). Environmental data supplied by the RPS Environmental Data Server.

Mass balance output

Both stochastic and trajectory and fate model analyses provide:

- Detailed mass balance output files and graphical results
- Time varying results including volatilization, degradation, dissolved mass, surface concentration, and accumulation in sediment
- Sensitivity assessments to a variety of environmental factors including release depth, currents, wind speed, or river flow.

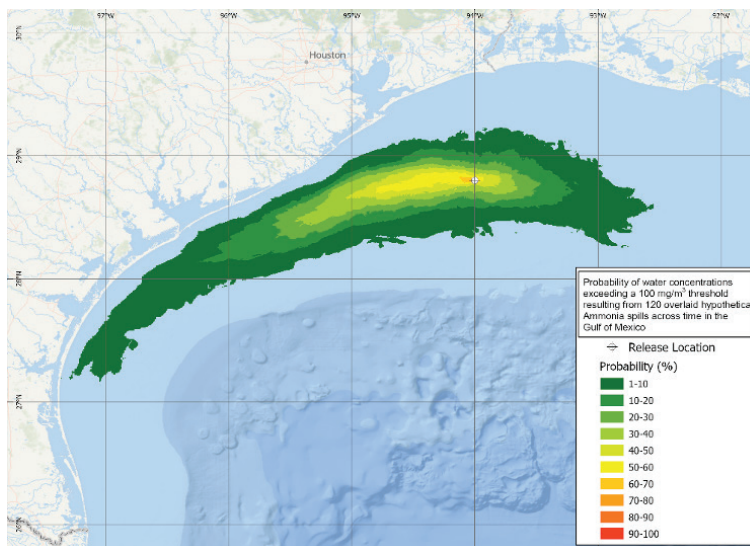
Stochastic Model

The stochastic model is used to predict the trajectory and fate of the released substance across variable time and environmental conditions to simulate a complex, more representative modeling scenario. Results may be summarized as:

- Range of expected contamination and the probability of exceeding thresholds of concern
- Frequency distribution of model results, for which statistics are calculated and plotted

Environmental, Chemical and Biological Databases Used in Modelling-Based Analyses

- Environmental database - includes coastline, bathymetry, shoreline type, ecological habitat type, and temporally varying ice coverage, temperature, and salinity
- Chemical database - includes physical-chemical parameters for hundreds of chemicals and other HNS and tools that allow us to add new chemicals, duplicate chemicals already in the database and make changes to chemical data while preserving the original values.
- Biological databases - can be set up for any area of the world. For the U.S., RPS has developed a biological database containing seasonal or monthly mean abundance by species and habitat type for each biogeographic region of the U.S.



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