ALOHA Development

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Overview

- Background on the CAMEO software suite (developed by NOAA and EPA)
- Fire and explosion modeling capabilities added to ALOHA (*complete*)
- ALOHA integration with HYSPLIT dispersion model and transition to web-based platform (*in progress*)

CAMEO Software Suite

CAMEO*fm*:
EPCRA Data Management

CAMEO Chemicals:
Chemical Database & Reactivity Tool

ALOHA:
Air Dispersion Model

MARPLOT:
Mapping Tool

CAMEO Suite: Critical Information

- **Air dispersion** – toxic, flammable, and explosive threats
- **Chemical** – physical properties, LOCs, response recommendations, and reactivity predictions
- **Geospatial** – sensitive locations, facility hazardous inventory, and impacted population estimates

ALOHA:
Fires and Explosions

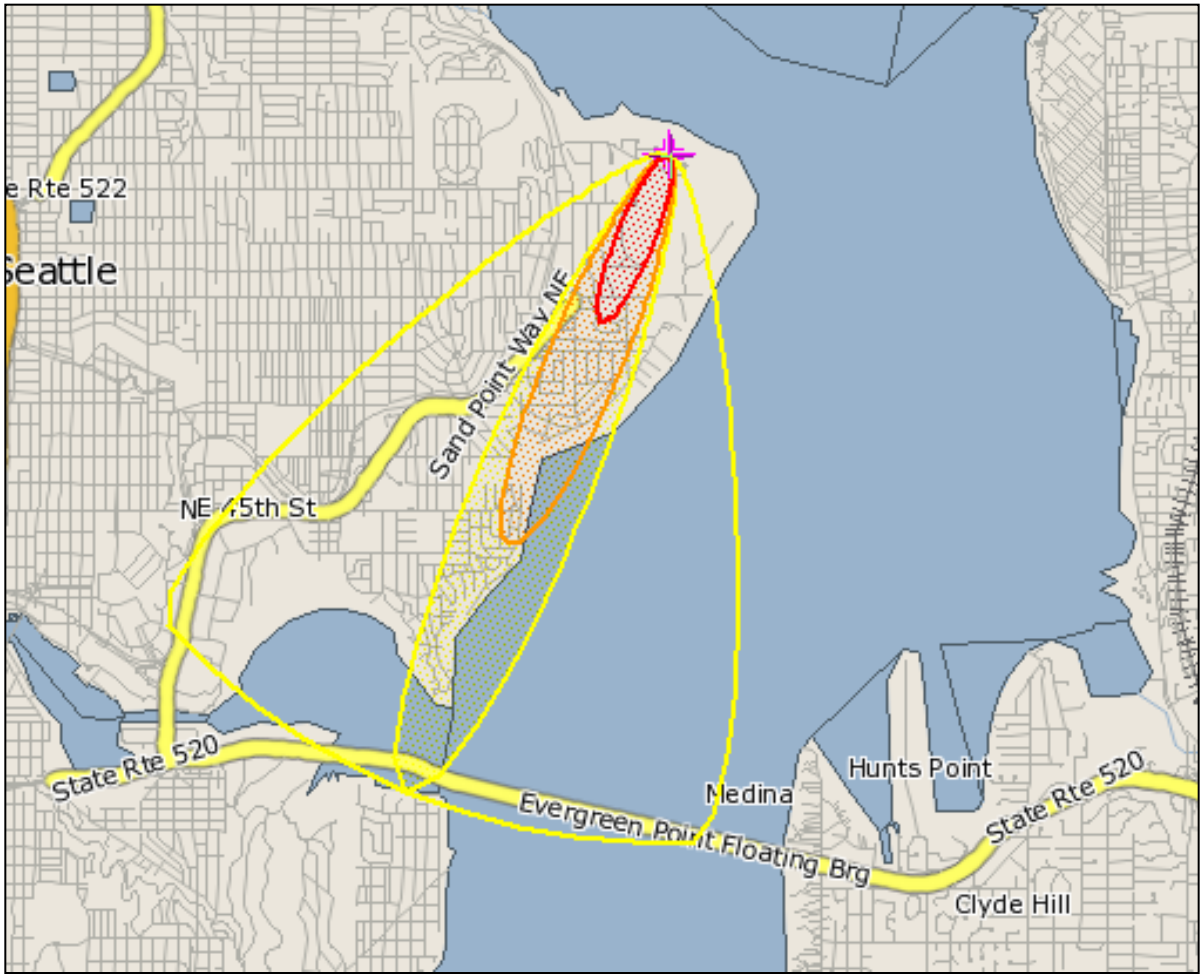
ALOHA: Background

- Gaussian and Heavy Gas dispersion algorithms
- Designed for short-duration, short-range incidents (scaling model)
- Multiple time-dependent source models (tank, puddle, gas pipeline, and direct)
- Upgraded to include fires and explosions

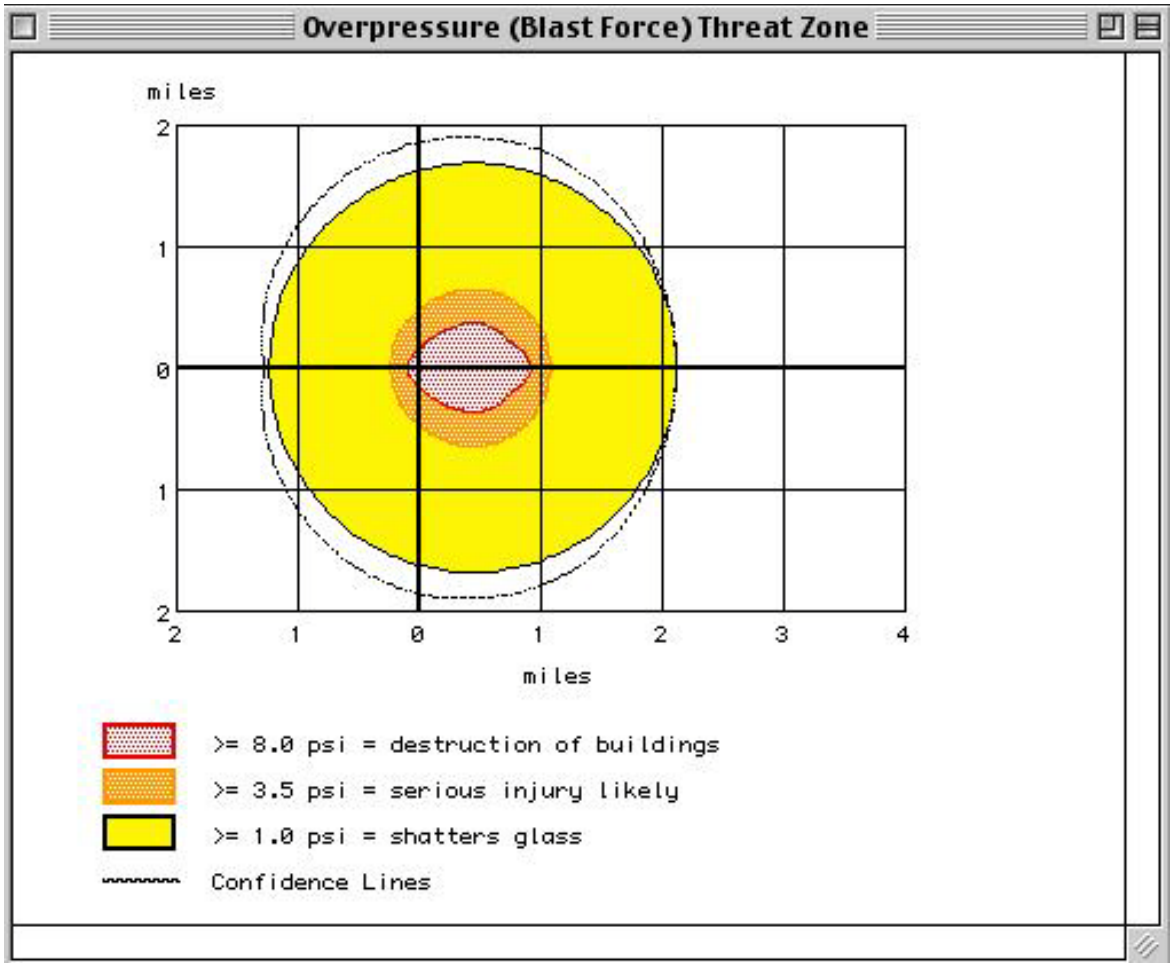
ALOHA Sources and Scenarios

Source	Toxic Scenarios	Fire Scenarios	Explosion Scenarios
Direct			
Direct Release	Toxic Vapor Cloud	Flammable Area (Flash Fire)	Vapor Cloud Explosion
Puddle			
Evaporating	Toxic Vapor Cloud	Flammable Area (Flash Fire)	Vapor Cloud Explosion
Burning (Pool Fire)		Pool Fire	
Tank			
Not Burning	Toxic Vapor Cloud	Flammable Area (Flash Fire)	Vapor Cloud Explosion
Burning		Jet Fire or Pool Fire	
BLEVE		BLEVE (Fireball and Pool Fire)	
Gas Pipeline			
Not Burning	Toxic Vapor Cloud	Flammable Area (Flash Fire)	Vapor Cloud Explosion
Burning (Jet Fire)		Jet Fire	

ALOHA Output: Toxic Threat Zone



ALOHA Output: Overpressure Threat Zone



Technical Challenges: Model

- For toxic releases, ALOHA uses a 3-5 minute averaging time. For a fire or explosion scenario, the averaging time is significantly shorter (10 or 20 seconds) to account for the instantaneous nature of the threat.

- One of ALOHA's strengths is its ability to account for time-dependent releases. Many of the fire and explosion algorithms used in ALOHA 5.4 had to be modified to work with the time-dependent source strength calculations.

Technical Challenges: Interface

- Don’t ask questions responders can’t answer.
- Minimize non-conservative results and guide users to credible science (“minimum regret”). Responders may have limited knowledge of uncertainties.
- Consider differences in fire and explosion scenario effects and terminology.

ALOHA is first and foremost a response tool and many of the design criteria were established with first responders in mind.

Quality Assurance Results

Sample Scenario Comparison Results - Propane Railcar BLEVE

Model	Fireball Diameter	Burn Duration	9.5 kW/m² Distance	5 kW/m² Distance
ARCHIE	271 yd	16 sec		
RMP*COMP			880 yd*	
HAM			709 yd	1013 yd
ALOHA	249 yd	14 sec	617 yd	850 yd

* RMP radiation level is distance to 2nd degree burns

ARCHIE - Automated Resource for Chemical Hazard Incident Evaluation
RMP*Comp - Risk Management Plan Guidance for Offsite Consequence Analysis
HAM - Maritime Hazard Assessment Model

Data Comparisons: Source Term

Non-boiling pool evaporation	• 16 cases (Kawamura and Mackay 1985, 1986, 1987). • ALOHA predictions were within 42% of measured values.
Propane evaporation data	• 18 trials (Welker and Cavin, 1981). • ALOHA averaged 116% of measured rates. • 83% fell within a factor of two (for 3 trials where polystyrene foam formed the substrate, it was greater than a factor of two).
Pool fire burn estimates	• Burn regression rate estimates for pool fires were also compared to experimental data and differences of 16% for non-cryogenic and 32% for cryogenic were noted. This is an area of uncertainty in the model.

Data Comparisons: Dispersion

Gaussian - Prairie Grass	• 212 comparisons. • ALOHA predicted 142% of observed overall mean concentrations.
Heavy Gas - DEGADIS	• 12 trials from these experiments: Desert Tortoise (NH_3), Goldfish (HF), Maplin Sands (LNG & LPG), Burro (LNG), Eagle (N_2O_4), and Thorney Island. • ALOHA distances averaged 107% 27% of DEGADIS-predicted distances. • 70% DEGADIS-predicted concentrations fell within a factor of two of measured values.
Heavy Gas - Goldfish (HF)	• ALOHA predictions averaged 48% measured concentrations.

Usability Testing

- User-Centered Design
  - Complex drills were conducted to identify decision makers and the evolution of the decisions
  - User Domain Analysis
  - User Scenario Testing

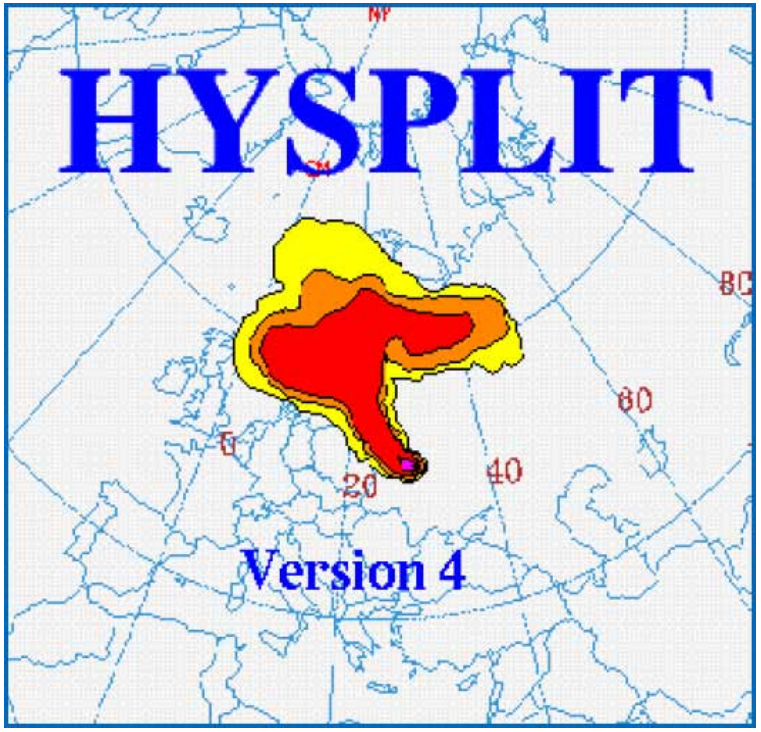
No model can be evaluated independent of the context in which it is to be used.

Web ALOHA: HYSPLIT Integration

HYSPLIT Dispersion Model

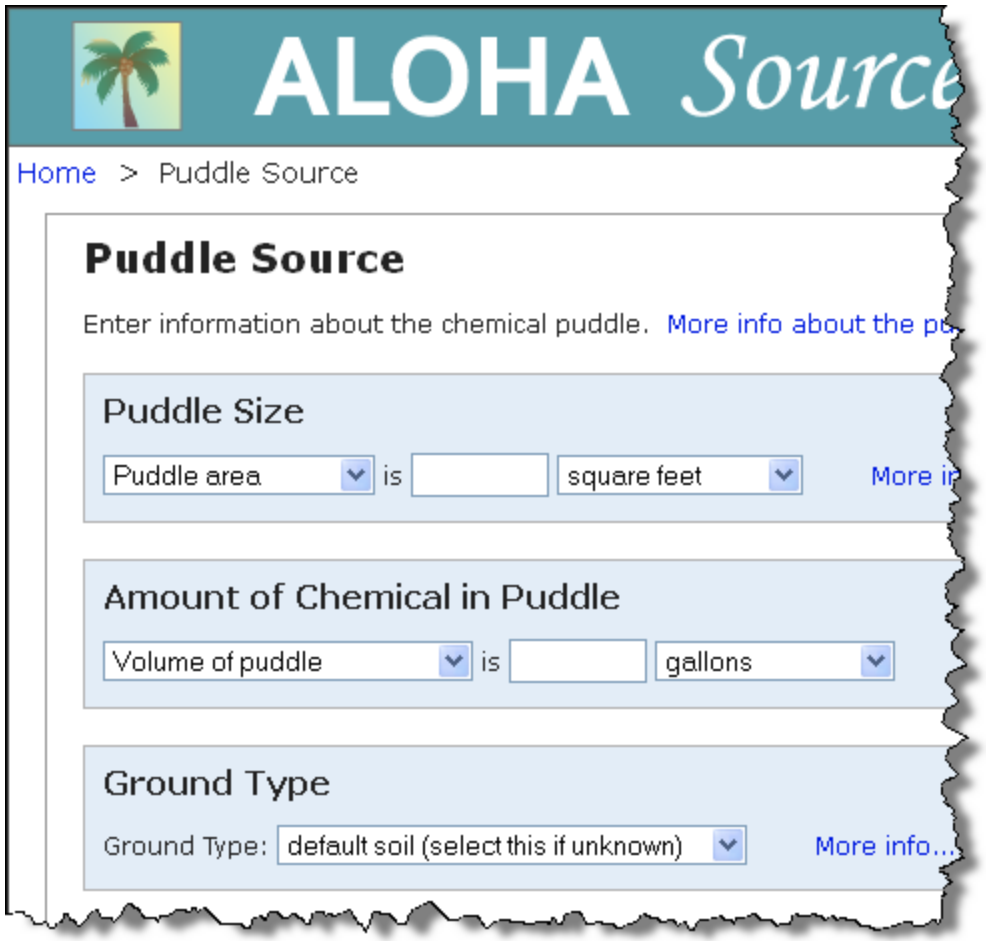
Hybrid **S**ingle-**P**article **L**agrangian **I**ntegrated **T**rajectory model

- Puff or particle dispersion
- 3-dimensional particle distribution (horizontal and vertical)
- Access to various forecast datasets (e.g., 48-hour, 12-km NAM tile)



Air Resources Laboratory (NOAA)

Integration: Phase 1



Initial integration of web version of HYSPLIT and ALOHA

- Use ALOHA for **chemical selection** and **source strength** estimates
- Use HYSPLIT for **weather forecasts** and **dispersion modeling**

Integration: Phase 2

- Incorporate ALOHA dispersion models (including Heavy Gas) into web version for smaller-scale releases
- Add fires and explosions capabilities
- Integrate with CAMEO Chemicals for more seamless access to chemical datasheets and response recommendations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