# NCAR Atmospheric Transport & Dispersion Emergency Response Program

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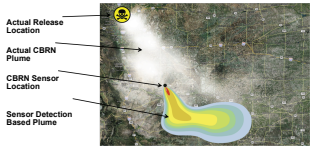
## Source Term Estimation (STE)

### Scenario:

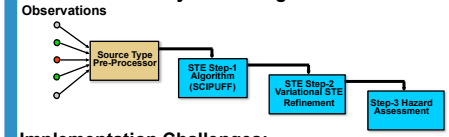
- A sensor or sensor network detects CBRN materials
- Detection is used as source for forecast
- The initial forecast may not reflect the actual threat




### STE algorithm design constraints:

- Second-order Closure Integrated PUFF (SCIPUFF) model & Joint Effects Model (JEM) system design
- Suitable to run on a laptop (e.g. computationally efficient)
- Answer within seconds to minutes of starting the STE job

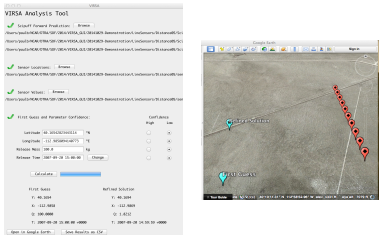
### System Design




### Implementation Challenges:

- Questionable accuracies of available data
- Inconsistencies between available observations
- Limited quantities of data

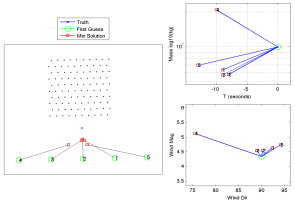
### Standalone Version for STE



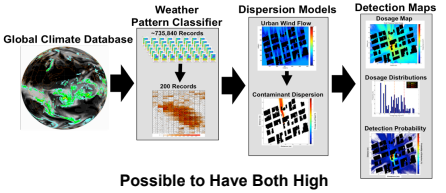



### Results

STE results for location, mass time, wind speed, and wind direction




## Instrument Placement




**Possible to Have Both High Fidelity T&D and Representative Weather Conditions**

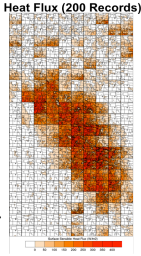
### SOM configuration

- Tuned for variables of interest (Winds, Surface Sensible Heat Flux, Humidity)
- Randomly initialized data vector
- Set an influence radius
- Best matching unit: Euclidian distance

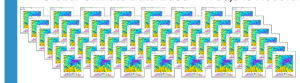
### Output

- Physically consistent patterns
- Frequency of occurrence of patterns
- Date/time for most representative day

Surface Sensible Heat Flux (200 Records)

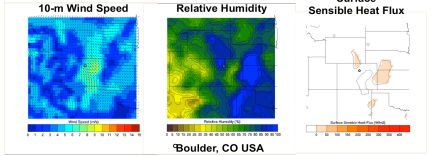


Global Climate Data Base – ~735,840 Records

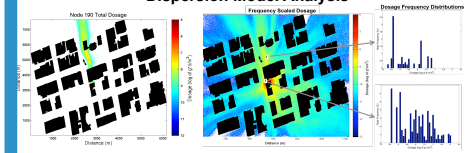


### Most Frequent Weather Pattern

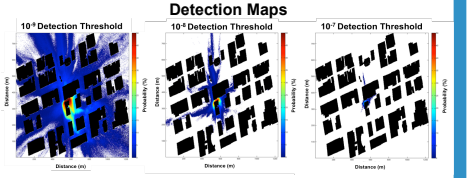
Date and Time: 08.14.1986 – 06:00




### Dispersion Model Analysis

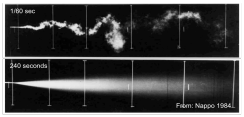


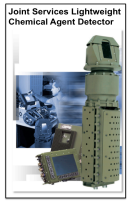

### Detection Maps

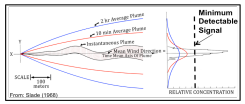



## Virtual THreat Response Emulation Analysis Testbed (VTHREAT)

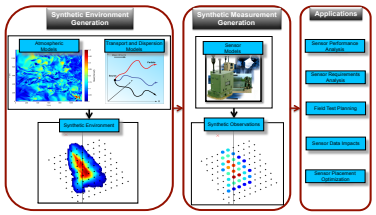
### Can we *Reduce Costs* by Utilizing High Fidelity Simulated Releases and Sensor Observations to Better Characterize the Test Prior to Execution?



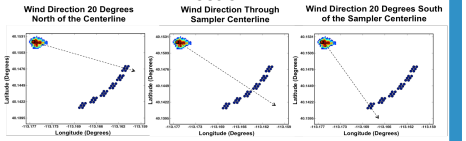



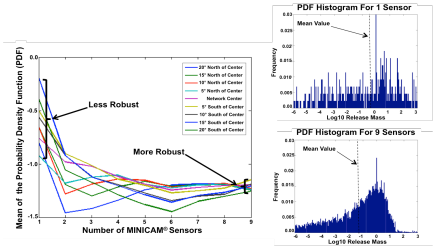

### System Design




### Is the Sampler Configuration Design Robust in the Face of Uncertainties in the Wind Direction?



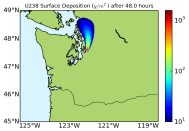

### Robustness to Wind Direction Uncertainty is Related to the Spread In the Mean of the Metric PDF

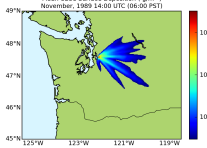



## Consequence Assessment Analysis

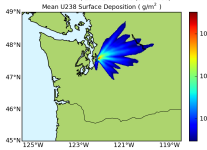
### How Much Data Do We Need For An Accurate Consequence Assessment?

- Radioactive particle release
- Buoyant release
- Maritime complex terrain
- Daytime

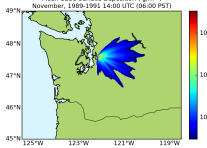



November 1989




November 1980




November 1989-1991

### It Takes ~20 years of Data to Achieve 95% Representativeness