The Graniteville Train Crash: Emergency Response Support Provided by the Savannah River National Laboratory

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RETS/REMP NUMUG
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Outline

- Accident Details
- Support from SRNL and SRS
- ATG's Capabilities
- Modeling Effort
- Post Analysis
- Prior Training/Preparation
- Summary

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Accident Details

- Time of accident: 2:39 am Thursday January 6, 2005
- Location: Graniteville, SC
- Situation: Norfolk Southern Railroad freight train collided with stationary train parked on a siding
- Accident involved rail cars containing chlorine, cresol, and sodium hydroxide
- Chlorine greatest airborne concern due to high volatility

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Graniteville Train Wreck

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Photos Courtesy of Augusta Chronicle

Mutual Aid Agreements with Local Governments

Mutual Aid Agreements signed in 1996 establishes SRNL partnerships with local Emergency Response agencies

- Participants are Aiken, Barnwell, Allendale, Richmond, and Columbia counties
- Agreements Identified three primary areas of collaboration:
  - Establish meteorological monitoring in critical hazard zones
  - Provide custom hazard consequence assessment software
  - Provide EMA directors consultation and support, as needed, during hazardous material or severe weather emergencies

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SRS Assistance

- SRSFD
  - 16 On duty
- Fire/Haz-Mat/ Law Enforcement Agencies
  - Approximate 30 volunteer members from SRS
- WSRC Emergency Management
  - 7 Critical Incident Stress Counselors

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SRS Assistance (cont.)

- SRS Operations Center (SRSOC)
  - 6 Personnel
  - Logistics requests
  - DOE Headquarters Briefings
  - Department of Homeland Security Briefings
- Wackenhut Services Incorporated
  - 7 Personnel
- SRNL Atmospheric Technologies Group
  - 6 Personnel
  - Consequence modeling & meteorological data
  - Weather forecasting & consulting

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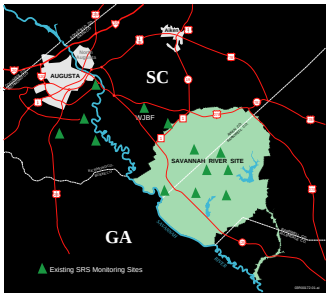
SRS Tower Network

- 9 towers on SRS (200ft)
- 4 towers Richmond county (120 ft)
- 1500 ft TV tower
- data available every 15 minutes



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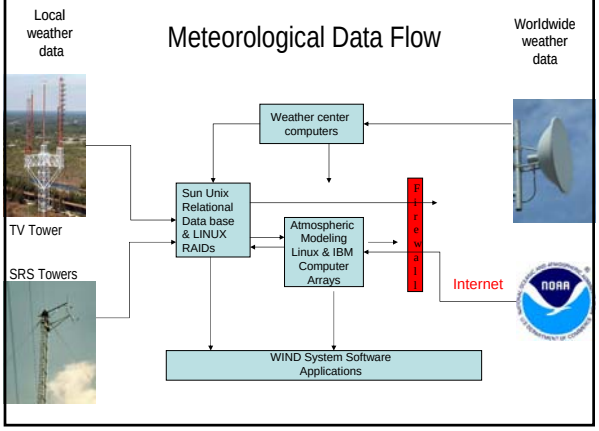
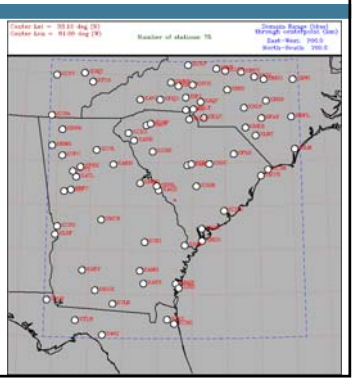
Meteorological Data Flow



Regional Observing Stations

NWS Observing Stations
SC & GA

- SRNL forecast models use weather analyses derived from data from NWS observing stations
- SRNL receives data from all NWS stations across all USA (as well as world wide)
  - Surface observations
  - Upper air balloon soundings



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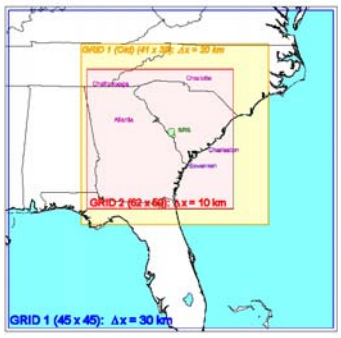
Regional Atmospheric Modeling at SRS

SRNL Forecasts Weather Conditions 24-36 hours For South East USA

- SRNL uses the Regional Atmospheric Modeling System (RAMS) to forecast winds etc. at SRS for:
  - emergency response
  - prescribed forest burns
  - operational forecasting
- Model runs updated every 12 hrs



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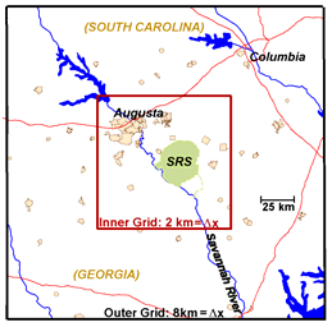
Local Atmospheric Modeling at SRS

SRNL Forecasts Weather Conditions 3 - 6 hours For SRS & environs

- SRNL uses RAMS to nest a fine scale forecast FOR winds etc. at SRS for emergency response
- Model runs updated every 3 hrs



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Consequence Assessment Modeling

- Hierarchical Menu of Consequence Assessment Codes
  - Area Evacuation (immediate phase, < 5 km)
  - Puff / Plume (early phase, 0.5 - 50 km)
  - 2DPUF (early- intermediate phase, 1 - 100 km)
  - LPDM (intermediate phase, 5 - 300 km)
  - Stream II (aqueous)
- Supporting codes:
  - NARAC, CAMEO/ALOHA, HOTSPOT, VSMOKE, HPAC, HYSPLIT

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Modeling Considerations

- Estimating a Chlorine release rate
  - Extent of damage (small crack vs. large rupture)
  - Amount of inventory remaining
- Dense gas behavior for Chlorine
  - Boiling point -29.3 F
- Other chemicals

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Synopsis of Meteorological Conditions - Morning of Jan 6

- Surface high (1022 mb) off the Southeast U.S coast producing south to southwesterly flow over Georgia and South Carolina
- Partly cloudy sky with areas of fog
- Observations from the SRS Regional Tower Network

Wind:	SSW 2-4 mph (sfc); 6-8 mph (200 ft)
Temp:	Mid 50s F
RH:	90%
Atm. Stability:	Slightly stable to neutral

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Initial SRNL Response (Day 1)

- Assistance requested shortly after 7:00 am
- First Puff-Plume model result web-posted for external access by 8:00 am
- Subsequent model results posted throughout the day (every 2-3 hours) with updated meteorology from local meteorological towers
- Ongoing discussions with Aiken County EOC and SC DHEC including briefings on current and forecast meteorological conditions
- Weather support for the SRS on-scene responder teams

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Ongoing SRNL Response (Day 2)

- Continued posting of model results posted throughout the day (every 2-3 hours)
- Ongoing discussions with Aiken County EOC including briefings on current and forecast meteorological conditions
- Modeling to support recovery actions
  - Case 1: Spill of rail car with 40% inventory
  - Case 2: Spill of rail car with 100% inventory

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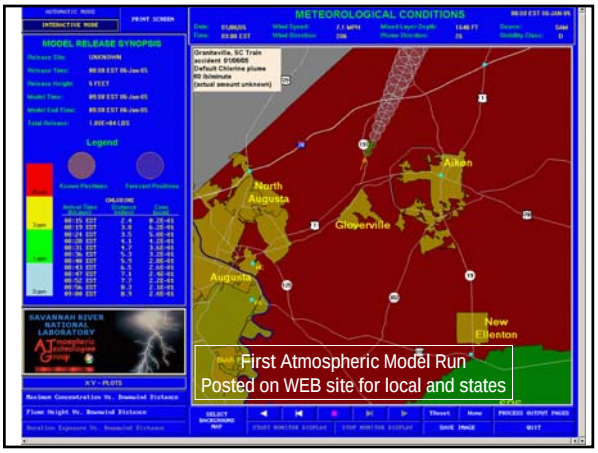
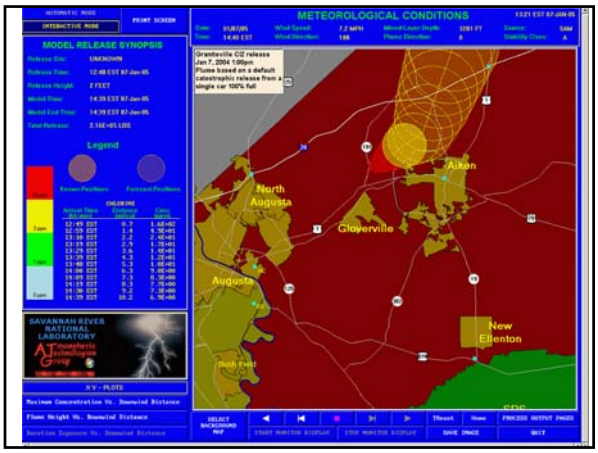




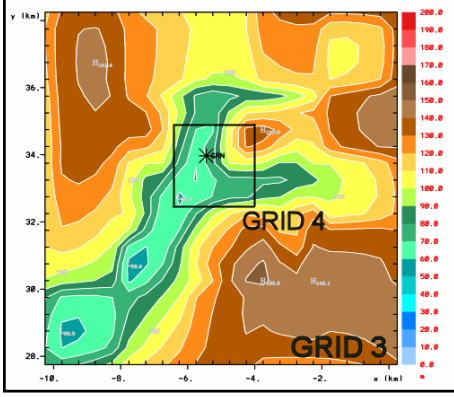
Puff/Plume results integrated with GIS

Local Atmospheric Modeling at SRS

SRNL Forecasts Weather Conditions 12 hours For SRS & environs

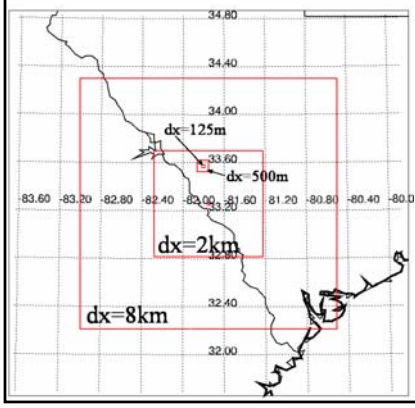
- SRNL uses RAMS (to nest a fine scale forecast for winds etc. at SRS for emergency response
- Forecast wind fields updated every 3 hrs

Land-Use Features for Inner Grids

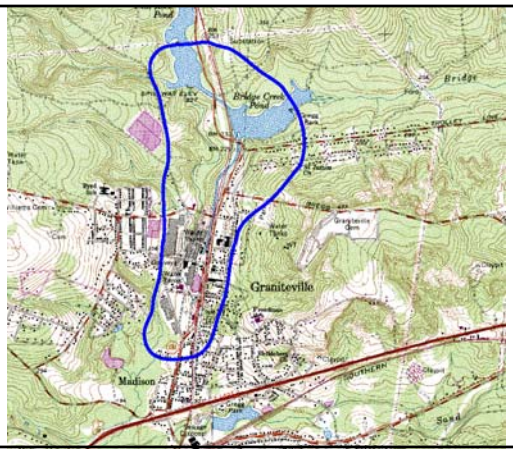


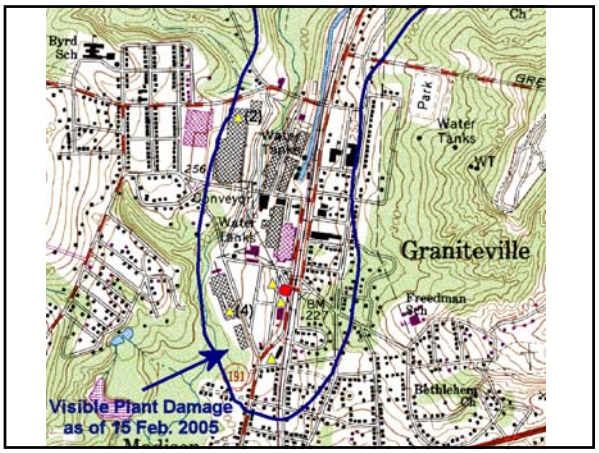
- Topography shows north-south oriented valley in which Graniteville is located.

Incorporation of Nested Grids



- Lowest level above ground (outer 2 grids, 15 m AGL; inner 2 grids, 7 m AGL).
- Initialize model with RUC and nudge to lateral BC's every 3 hours
- Simulate from 18UTC, 05 Jan to 00UTC, 07 Jan

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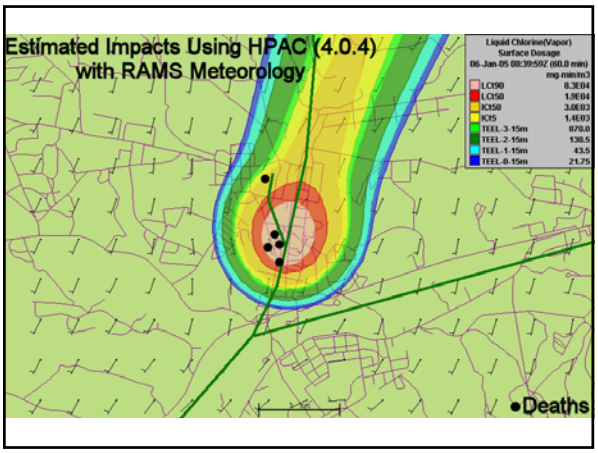
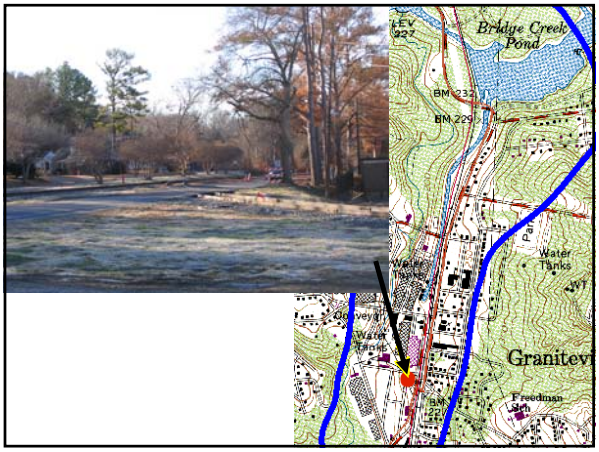
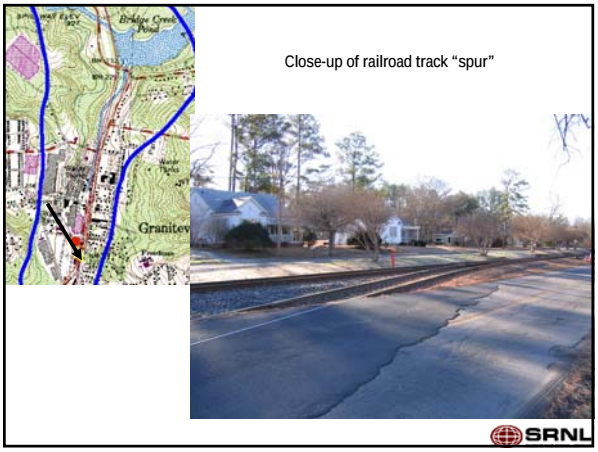
Water Tanks
Graniteville
Freedman Sch
Bethlehem Ch
Visible Plant Damage as of 15 Feb. 2005


Estimated Impacts Using HPAC (4.0.4) with RAMS Meteorology
Liquid Chlorine(Vapor)
Surface Dosage
LC90
LC50
IC50
IC15
TEEL-3 15m
TEEL-2 15m
TEEL-1 15m
TEEL-0 15m
Deaths


Bridge Creek Pond
Water Tanks
Graniteville
Freedman Sch


Close-up of railroad track "spur"
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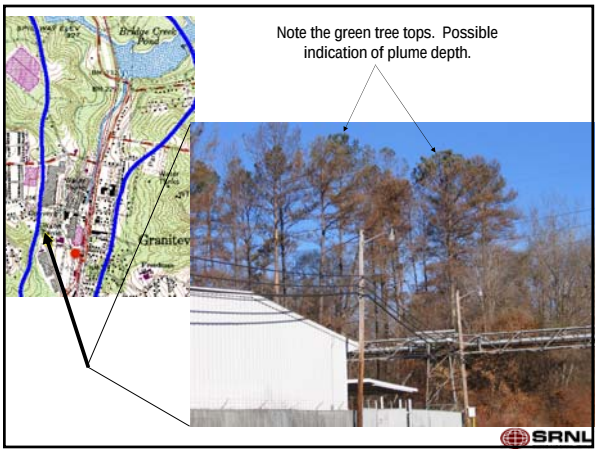
Bridge Creek Pond
Graniteville


Note the green tree tops. Possible indication of plume depth.
Graniteville
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Prior Training / Preparation

- Annual Emergency Response Organization exercises
- Scenarios for accidents involving multiple tankers for an onsite railway (non-SRS shipments)
- Multiple chemical types used (HF, NH_4, etc)
- Use of ALOHA for source term
- Integration with ATG's models
- Post analysis in our own backyard

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Summary

- SRNL resources worked as designed, providing timely information directly to the local decision-maker
  - Aiken County Joint Operations Center
  - State authorities in Columbia (DHEC)
- Very positive feedback from Aiken County authorities.

'*It was very crucial to give us up-to-date wind conditions and plume models*'

- Mike Hunt, Aiken Co. Sheriff

courtesy Augusta Chronicle