

Lawrence Livermore National Laboratory

LLNL Support for the National Atmospheric Release Advisory Center (NARAC) and Interagency Modeling and Atmospheric Assessment Center (IMAAC)



Ron Baskett
NARAC-IMAAC Program

Lawrence Livermore National Laboratory, P. O. Box 808, Livermore, CA 94551
This work performed under the auspices of the U.S. Department of Energy by
Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344

NARAC-IMAAC Provides Consequence Management Tools, Services & Products

Event information

- Weather data
- Nuclear, radiological, chemical, biological source information
- Sensor data



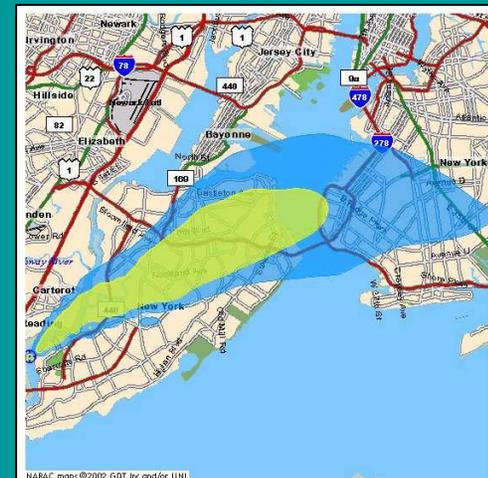
Plume Models and Expertise

- Advanced, automated 3-D plume modeling anywhere in real-time
- Scientific and technical staff provides training/assistance and detailed analysis 24 hrs x 7 days



Incident Management Information

- Health effects, exposed population and facilities
- Casualty/fatality/damage estimates
- Response strategies
- Protective action recommendations
- Geographical information

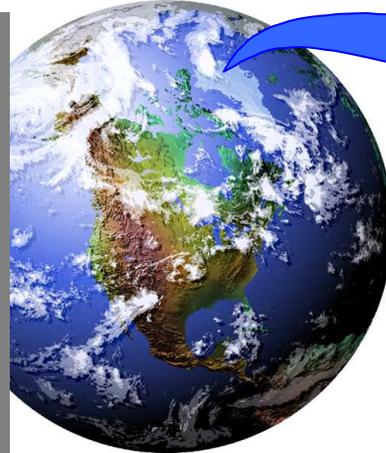


National Atmospheric Release Advisory Center (NARAC)

Real-time Weather Data, Plume Model Predictions and Expertise

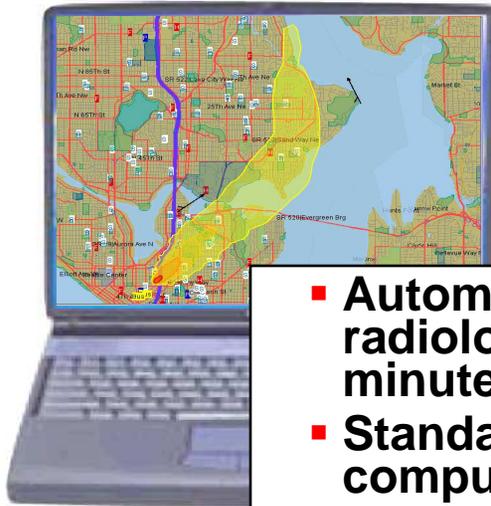
Access to world-wide weather data and geographical information:

- Observed & forecast weather data
- Terrain & land surface
- Maps
- Population



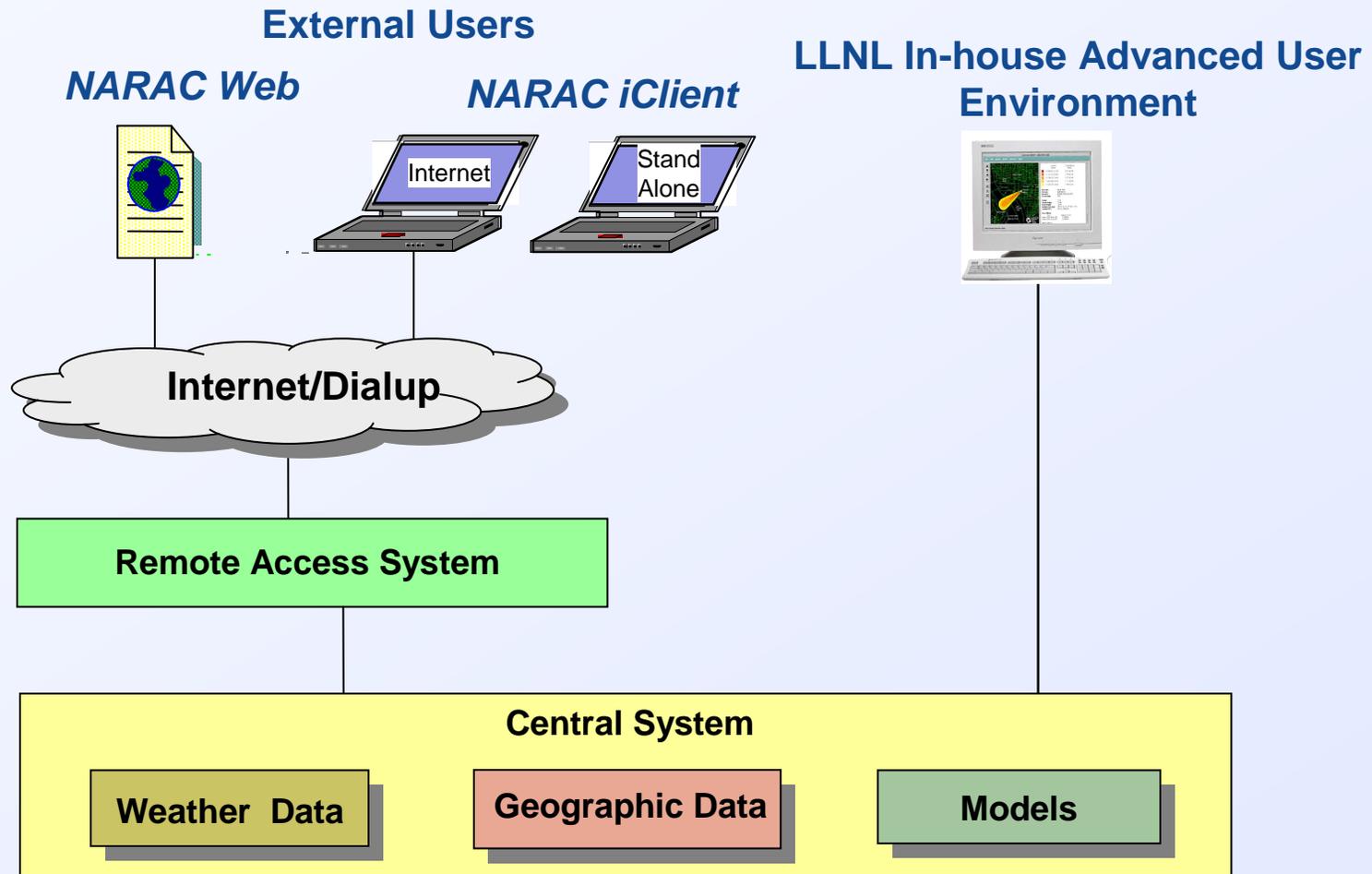
National Atmospheric Release Advisory Center (NARAC):

- Computer systems for 3-D plume simulations
- Un-interruptible, backup power
- 24x7 scientific & technical support

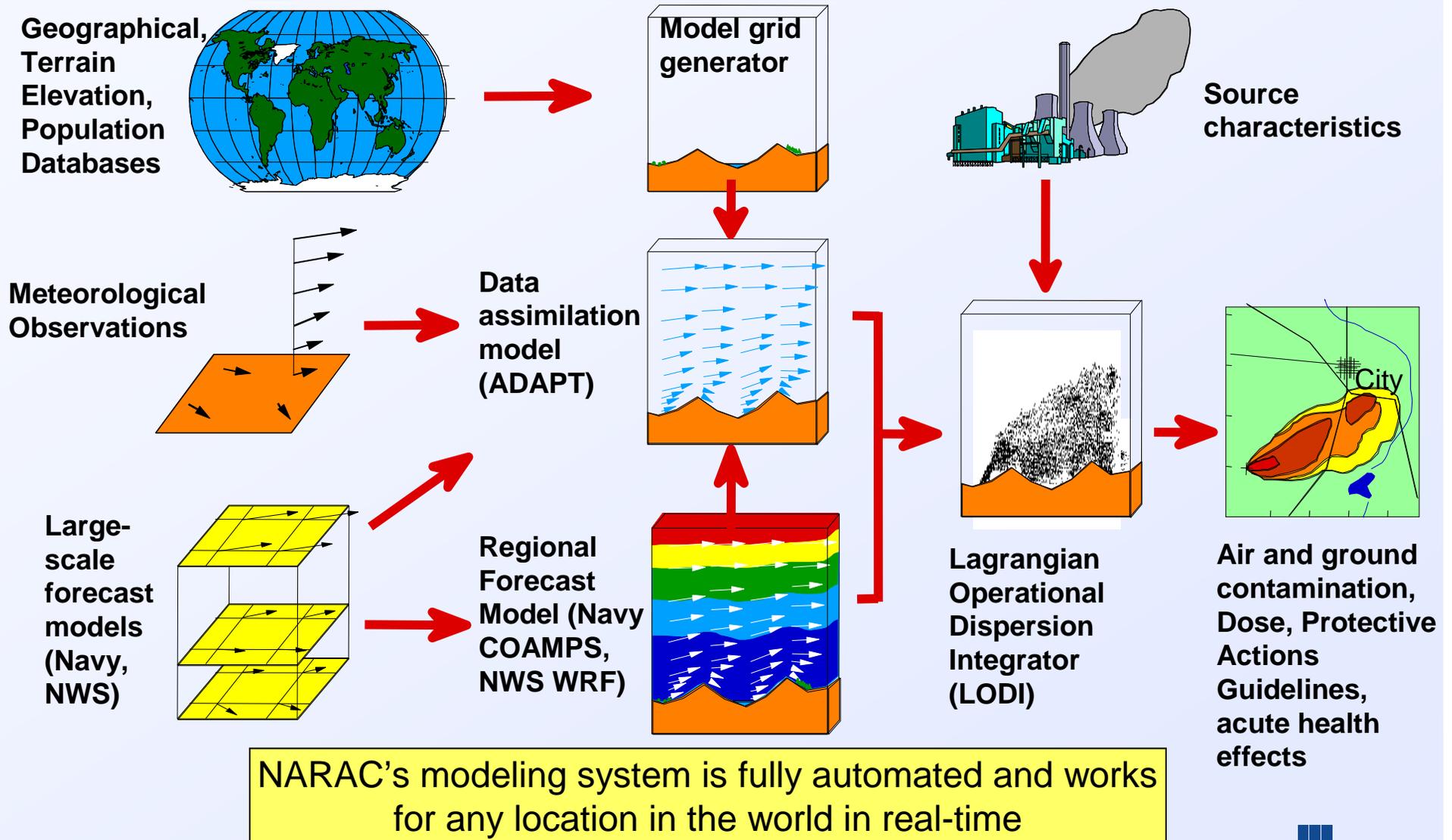


- Automated real-time 3-D plume model predictions for nuclear, radiological, chemical or biological releases available in minutes from national center using Internet/Web tools
- Standalone simple plume modeling tools for end-user's computer require no connection to NARAC

Component-based LLNL NARAC-IMAAC Computer Systems Support In-house and External Users



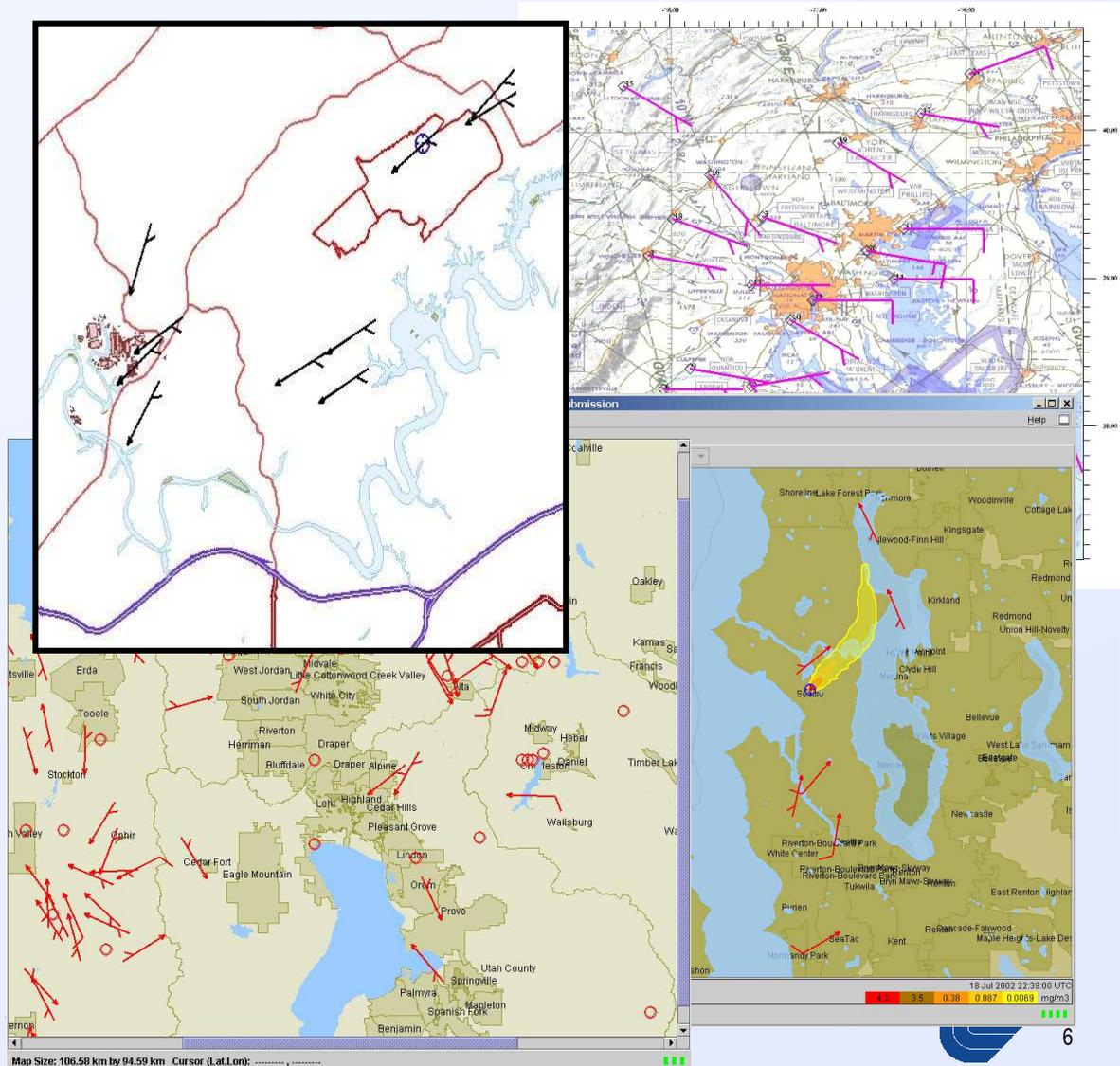
NARAC's Central Modeling System Provides Automated 3-D Plume Model Predictions



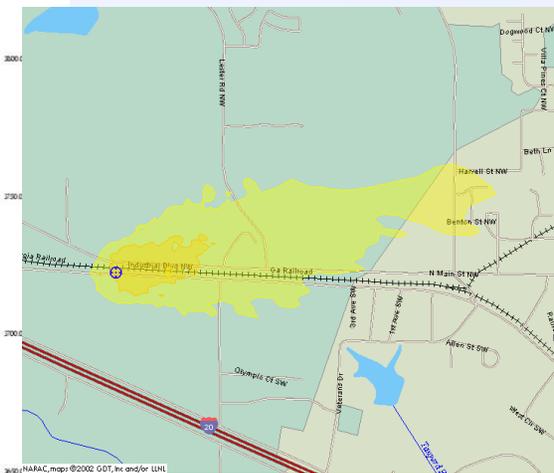
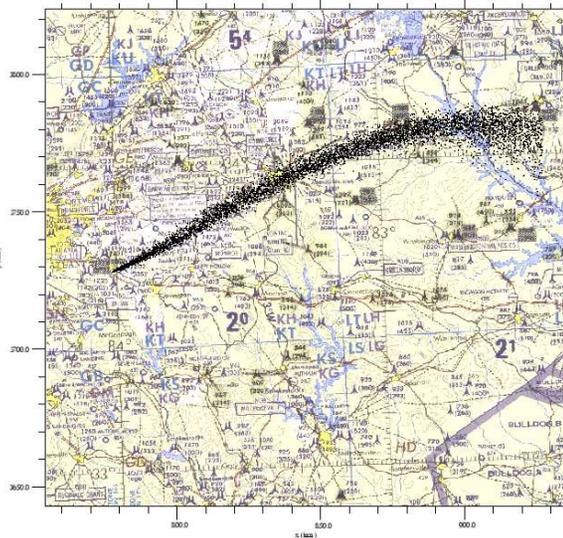
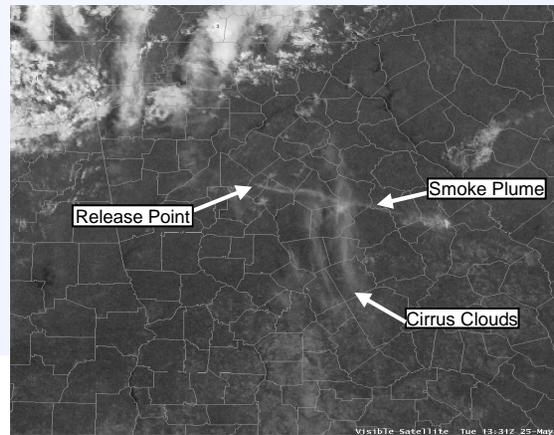
Global Meteorological Data Acquisition

- Over one million meteorological observations per day from around the world are collected and stored by NARAC
- Weather forecast model predictions from global and regional models are continuously collected from the U.S. National Weather Service and the U.S. Navy
- Special meteorological observation networks supplement global and regional data collected routinely by NARAC
- NARAC meteorologists analyze quality of data
- Users can view maps and tables of wind data

Lawrence Livermore National Laboratory



IMAAC/NARAC Inter-Agency Response to Conyers, GA Chemical Plant Fire

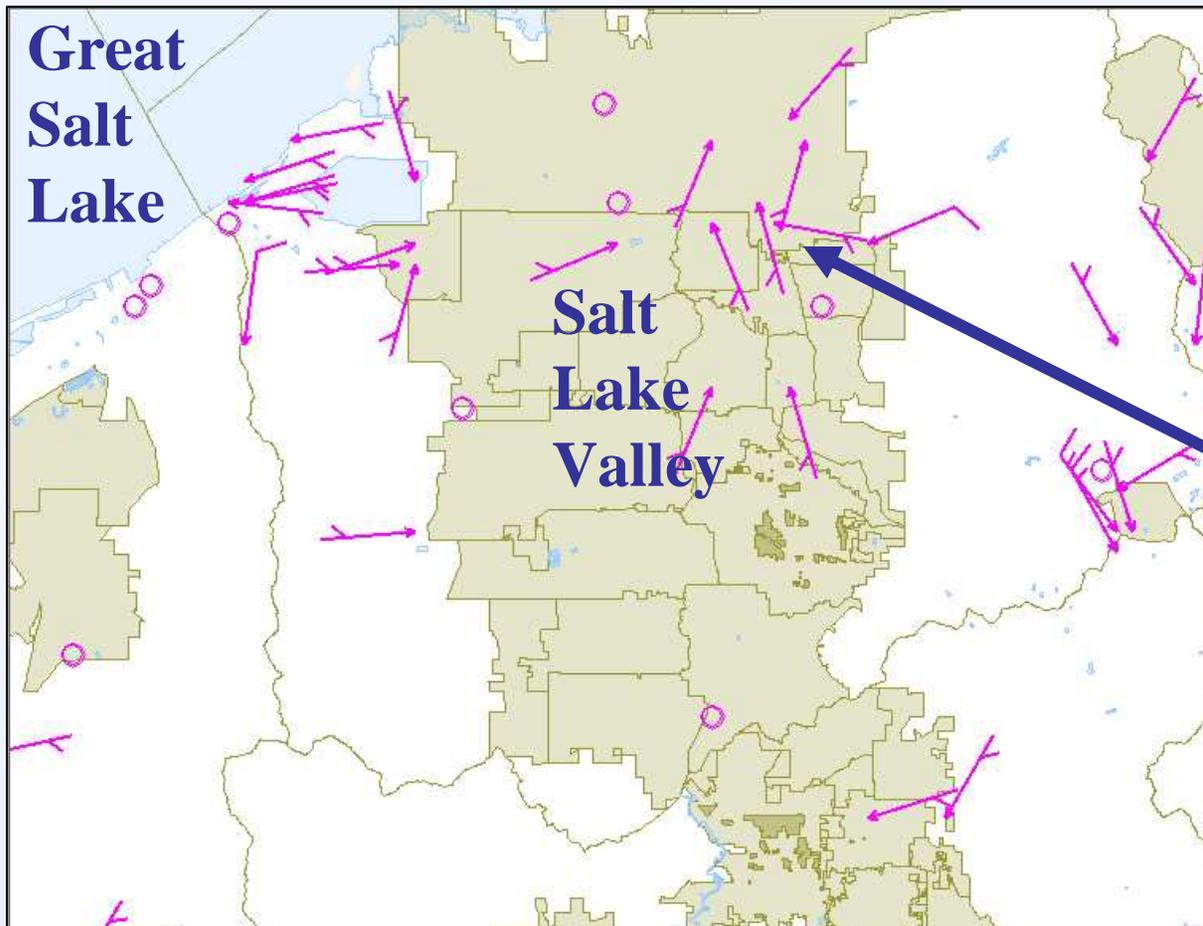


- 250,000 lbs of chlorine compounds burned over a two-day period (May 25-26, 2004)
- Current conditions and forecasts
- Plume predictions refined with EPA field measurements
- IMAAC/NARAC products used by Federal (DHS, DOE, EPA), state of Georgia, and local officials to guide:
 - Location of incident command sites
 - Safe approach routes
 - Sheltering and Evacuation areas
 - Guiding sampling teams



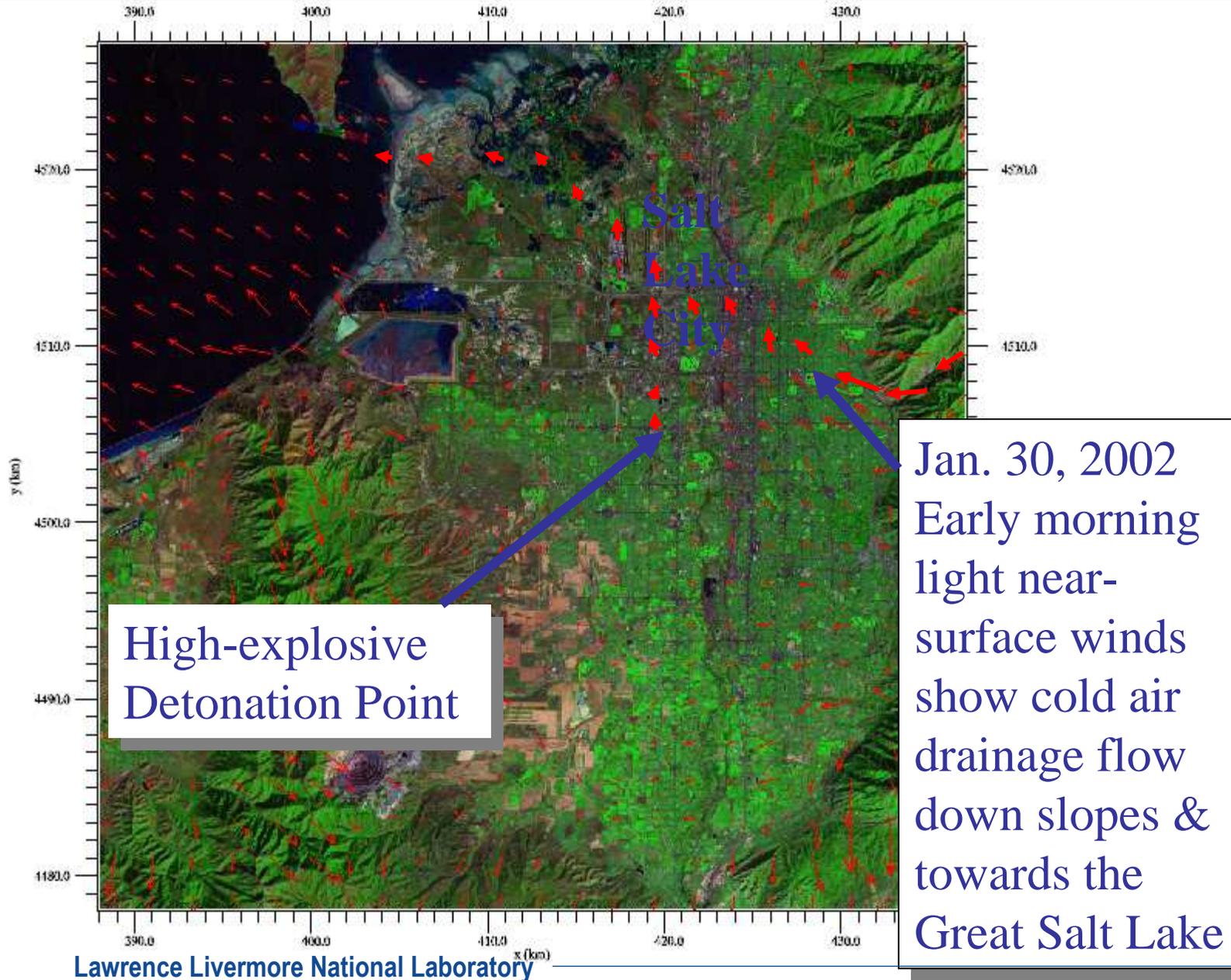
Case Study: Hypothetical RDD in Salt Lake City Winter Olympics 2002

Mesonet Surface Wind Observations

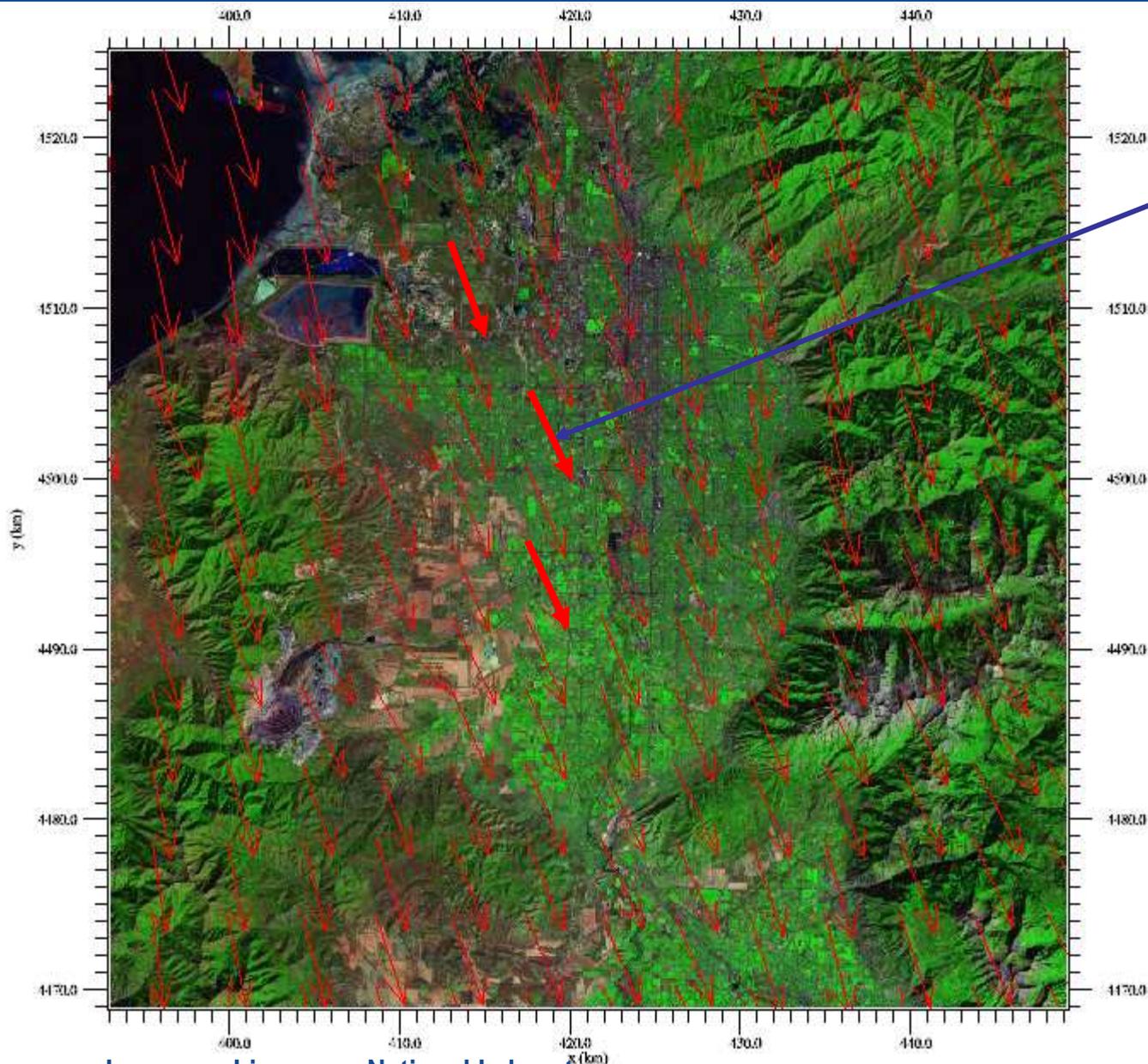


Jan. 30, 2002
Early morning
light near-
surface winds
show cold air
drainage flow
down slopes &
towards the
Great Salt Lake

Case Study: Hypothetical RDD in Salt Lake City – NARAC ADAPT 3-D Model Surface Winds



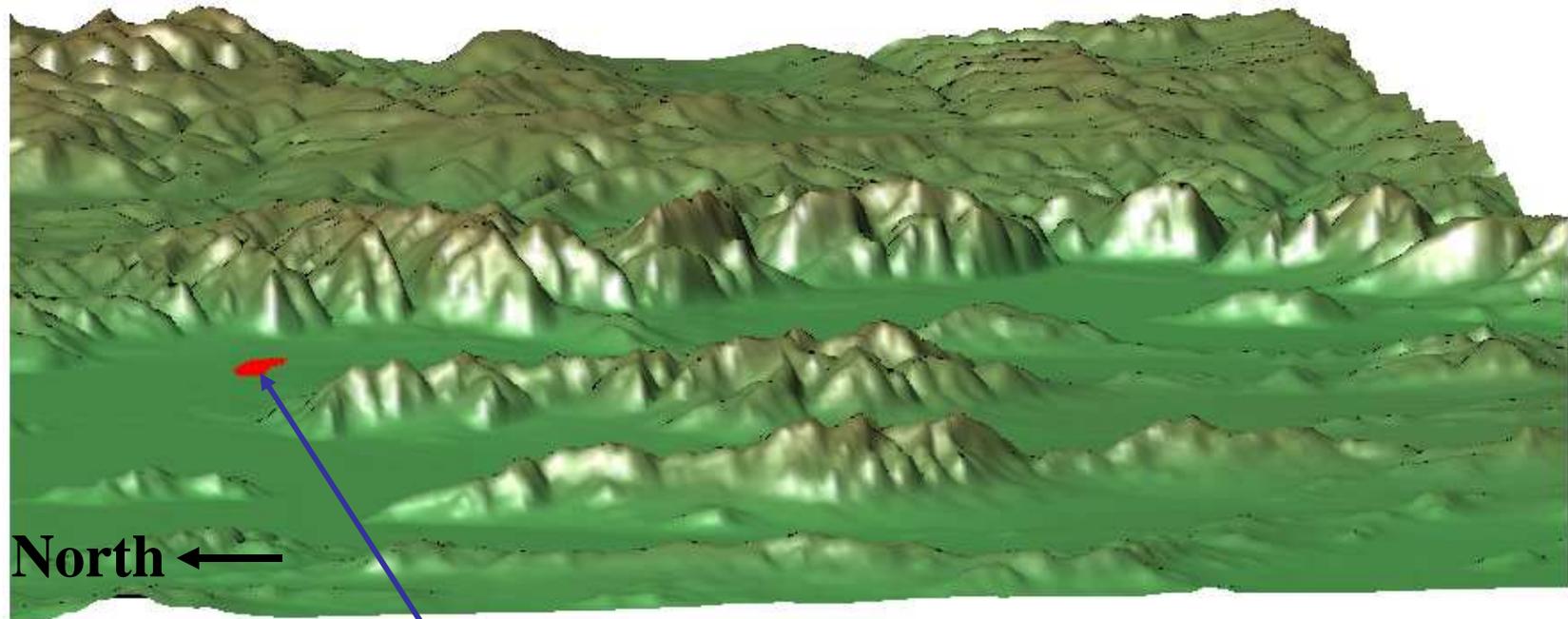
Case Study: Hypothetical RDD in Salt Lake City – NARAC ADAPT 3-D Model Upper-level Winds



Stronger
Upper-level
winds from the
north

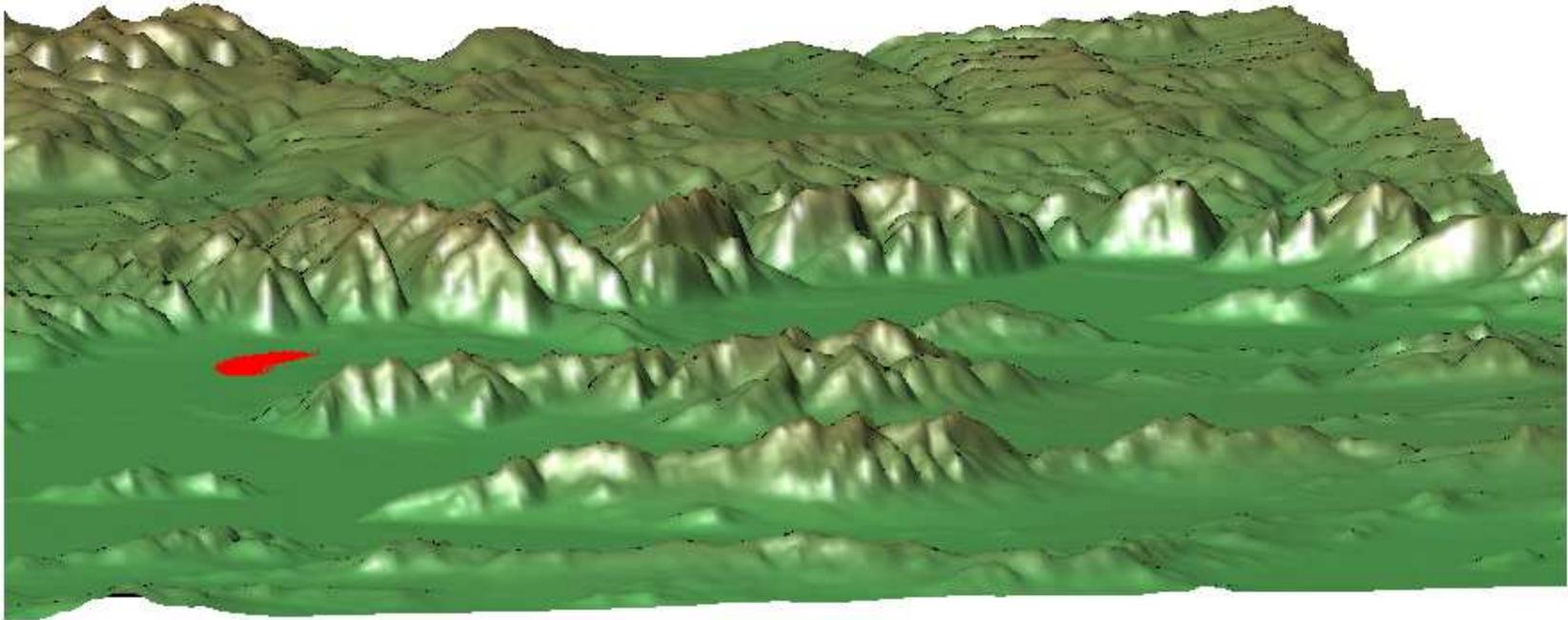


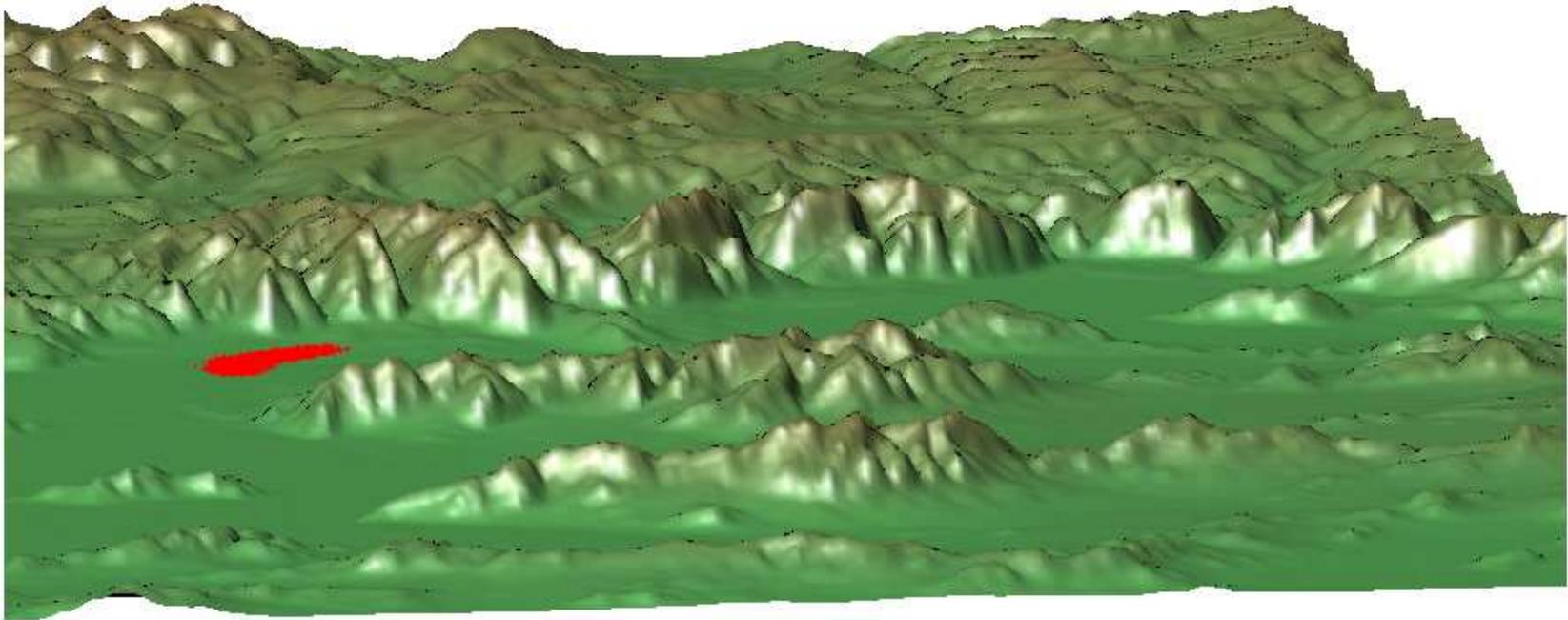
Case Study: Hypothetical RDD in Salt Lake City – NARAC LODI 3-D Model Particle Dispersion Simulation

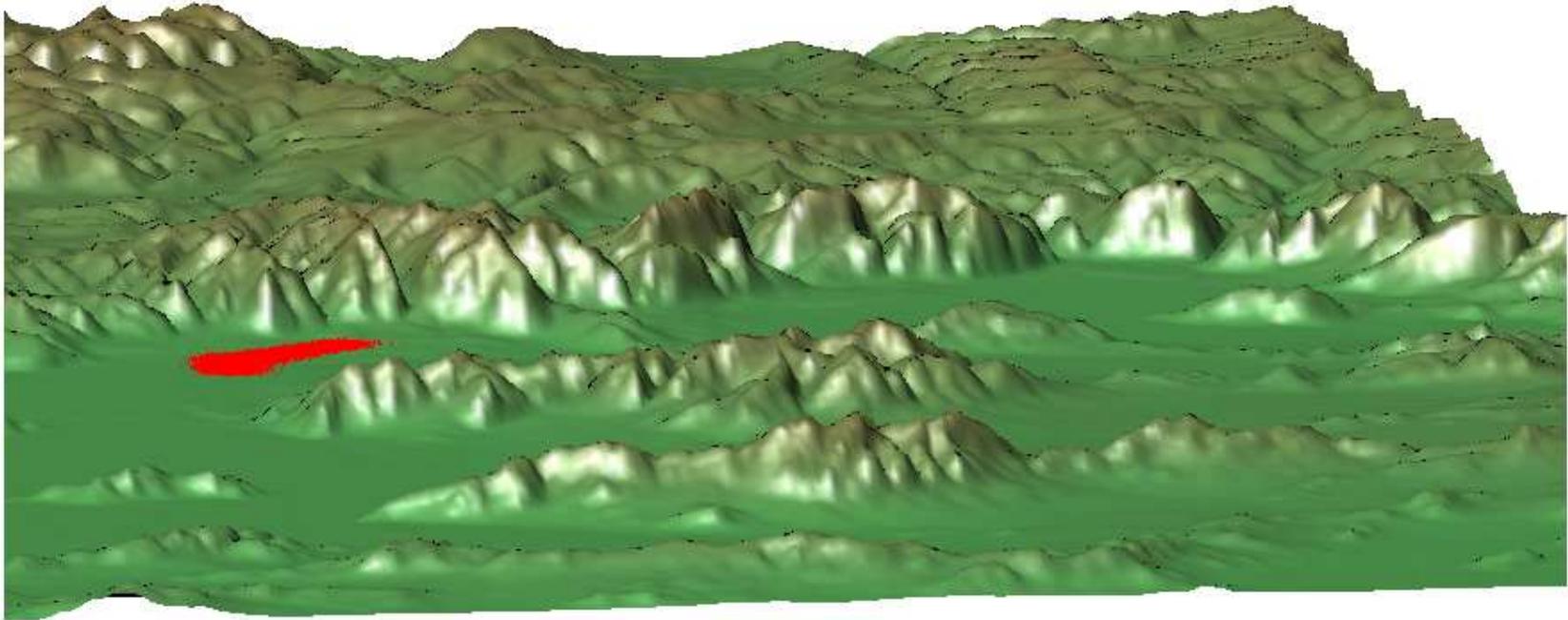


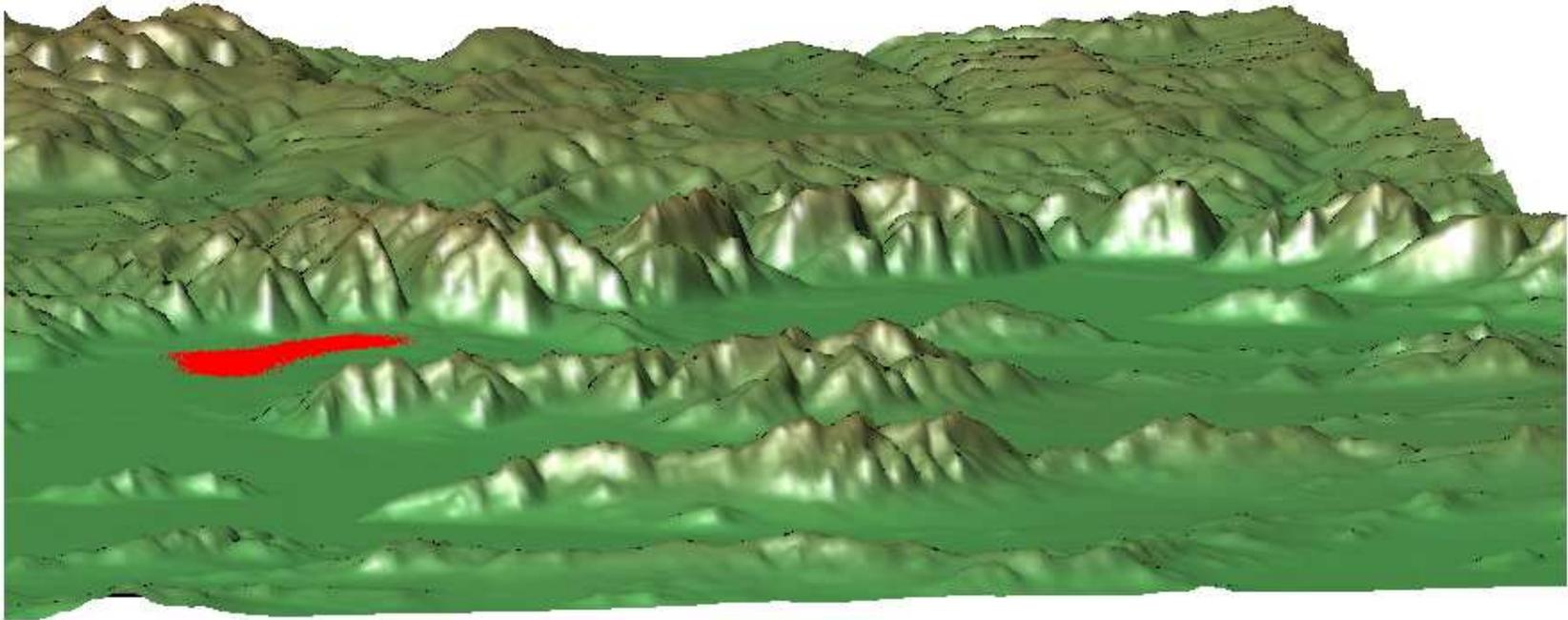
Detonation Point

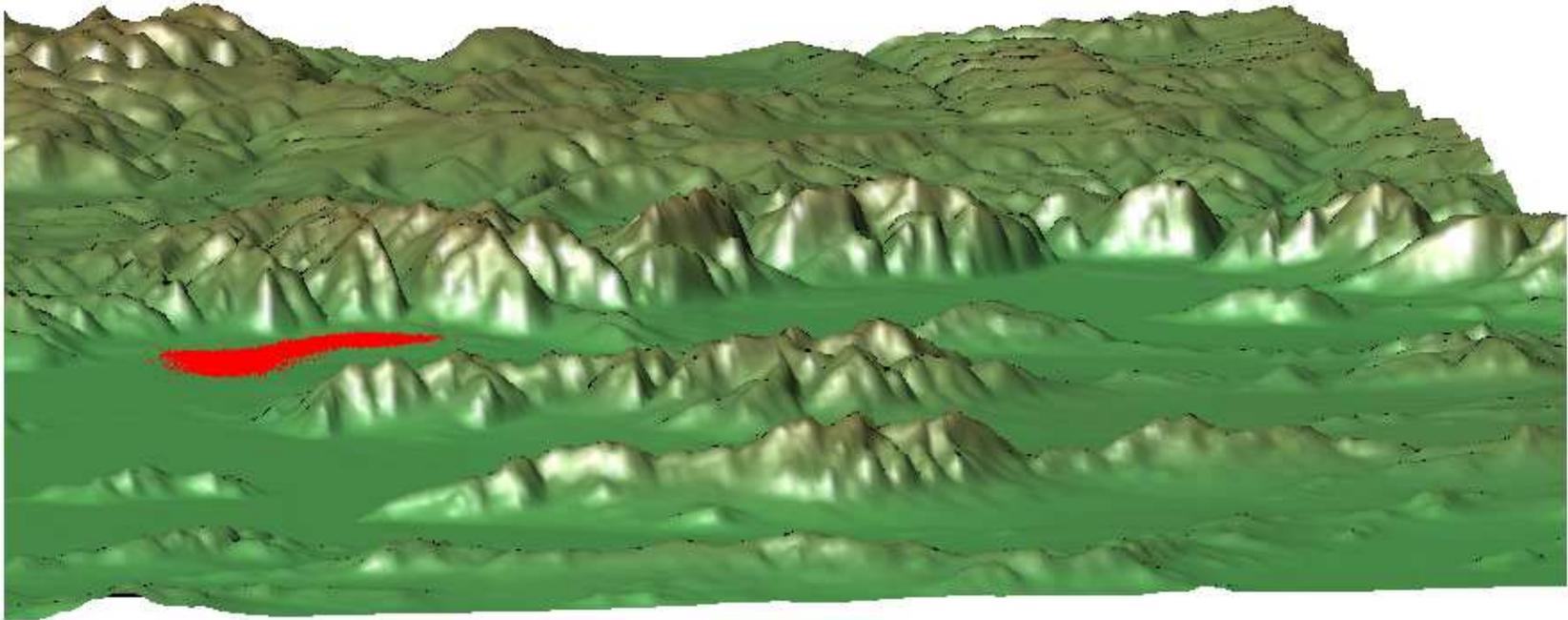
Red particles show LLNL NARAC ADAPT/LODI dispersion simulation using SNL ERAD explosive source characteristics (particle size distribution and spatial distribution of mass from surface to several hundred meters above ground) — Simulation begins at 05:00 MST (ends at 11:00 MST)

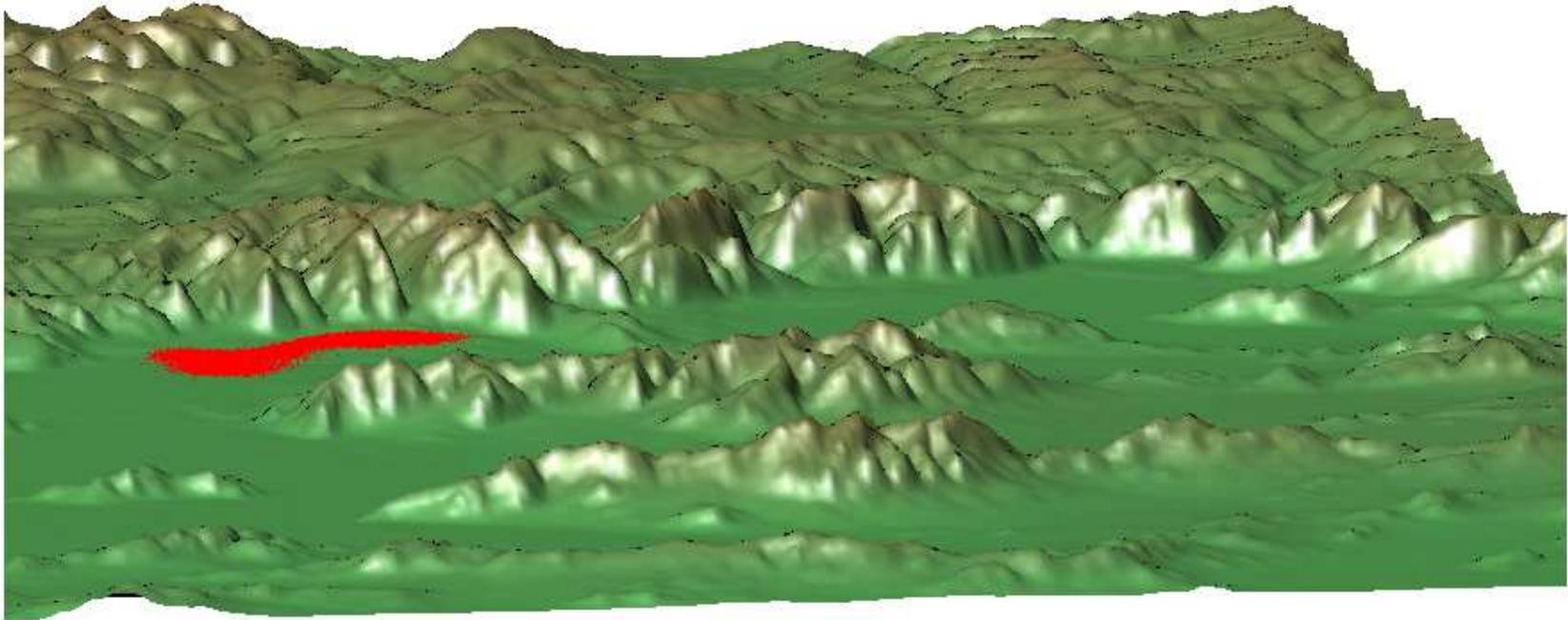


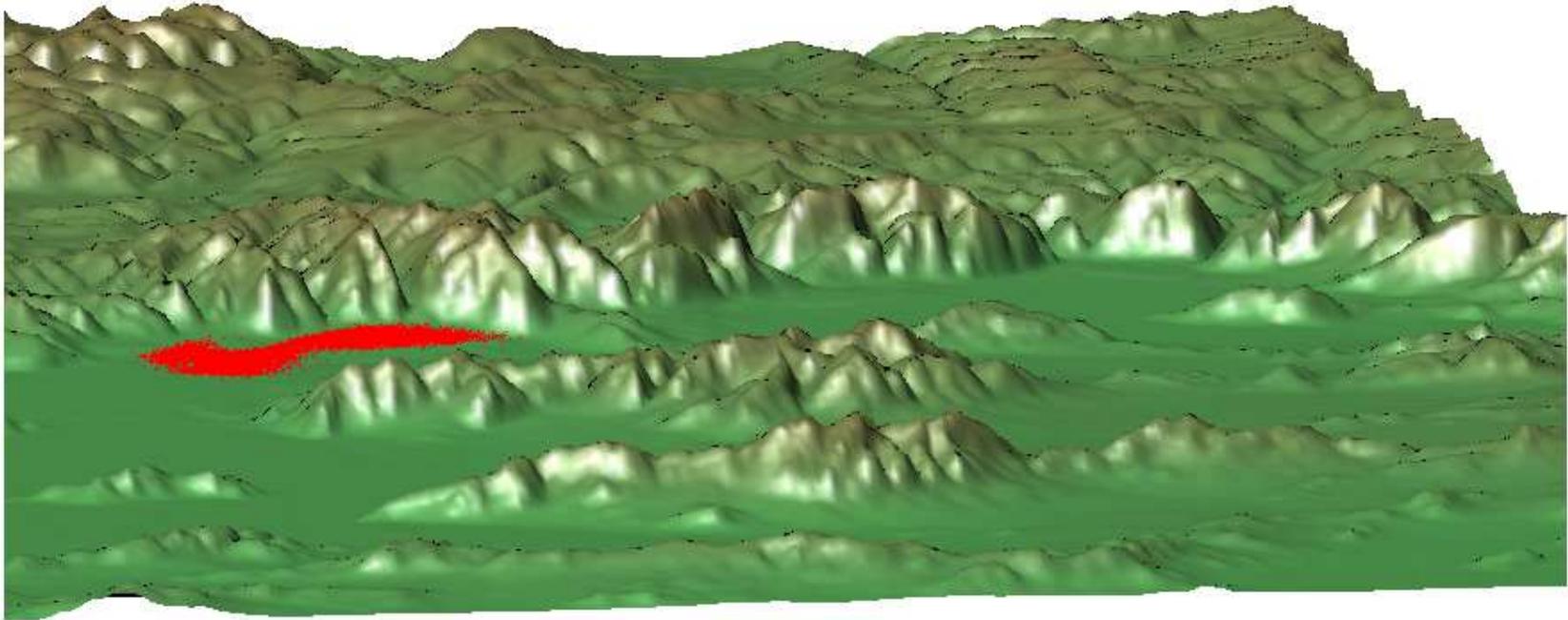




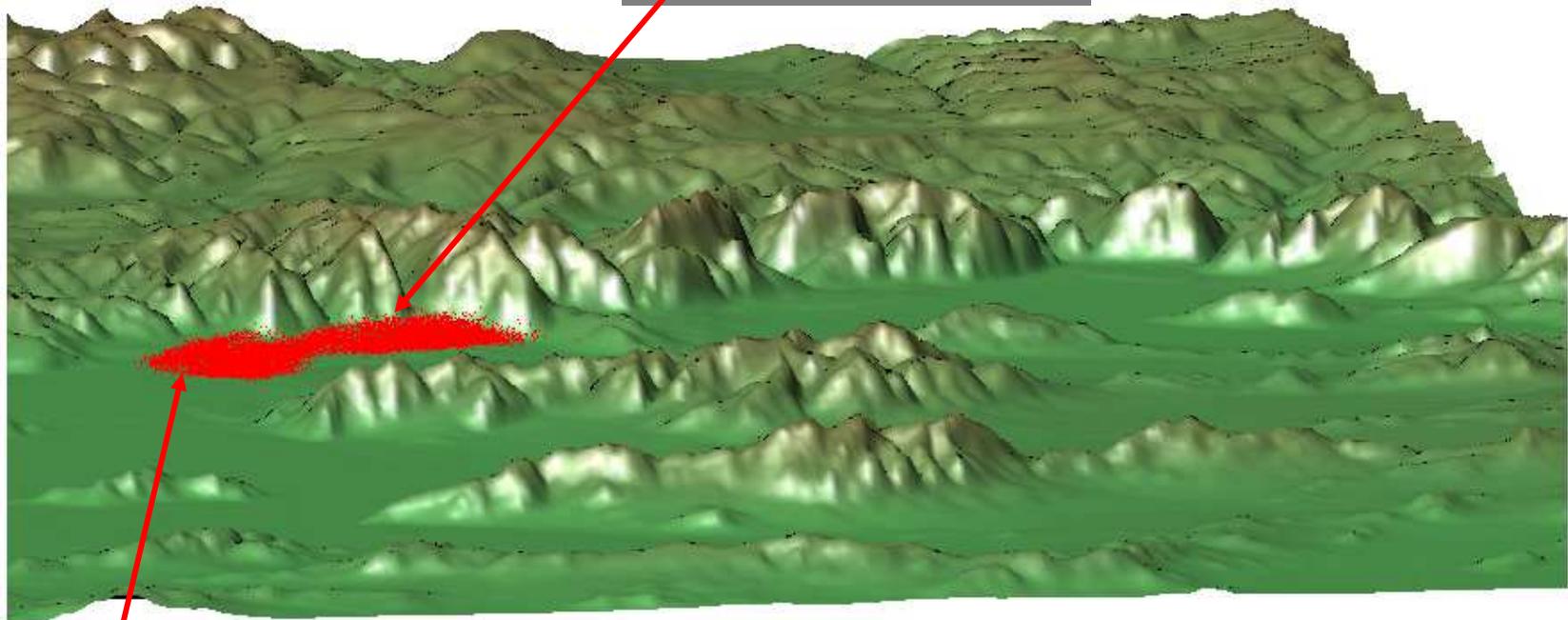






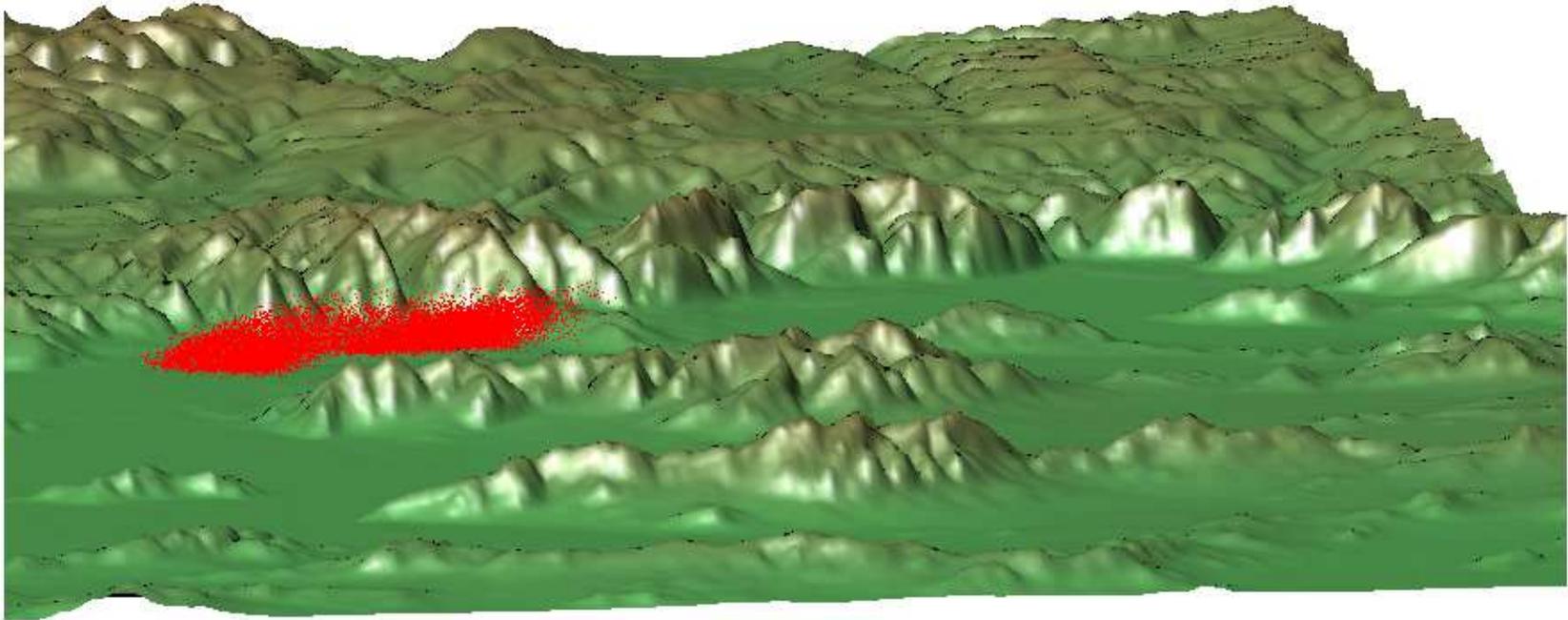


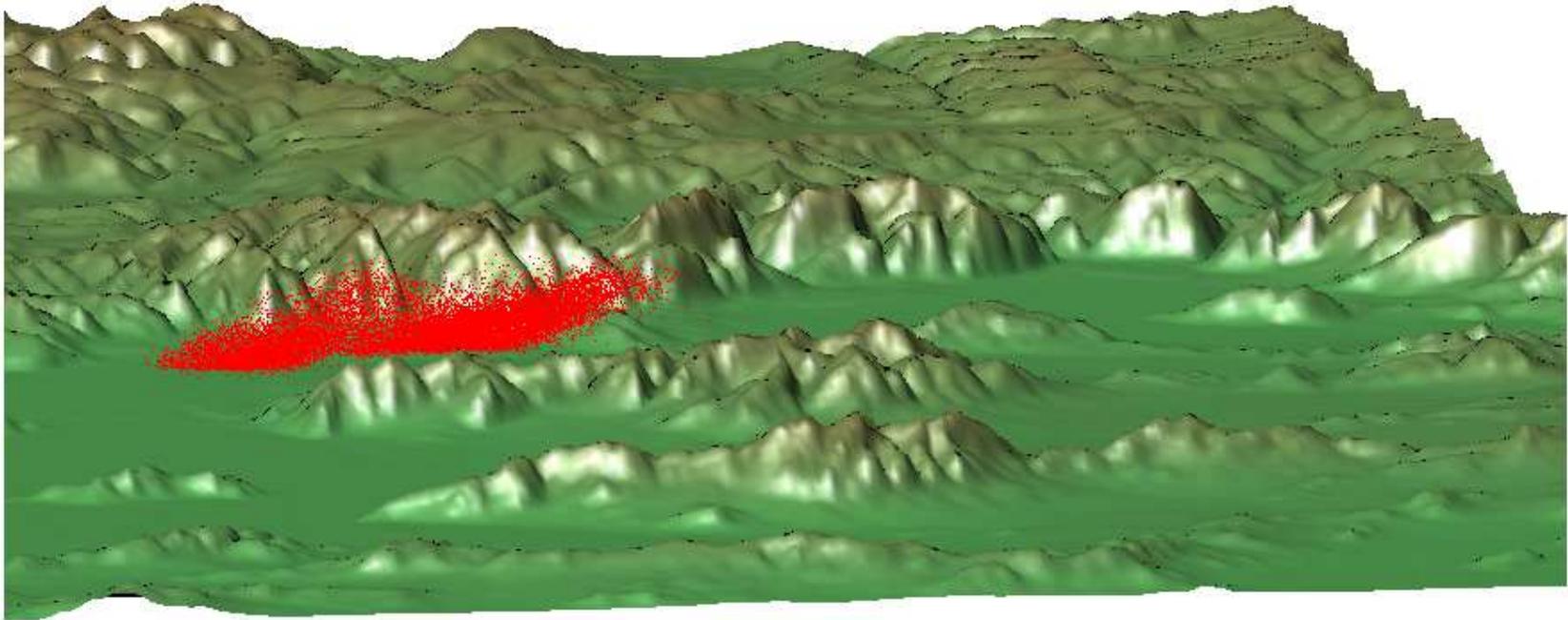
Upper level
cloud transported
southward

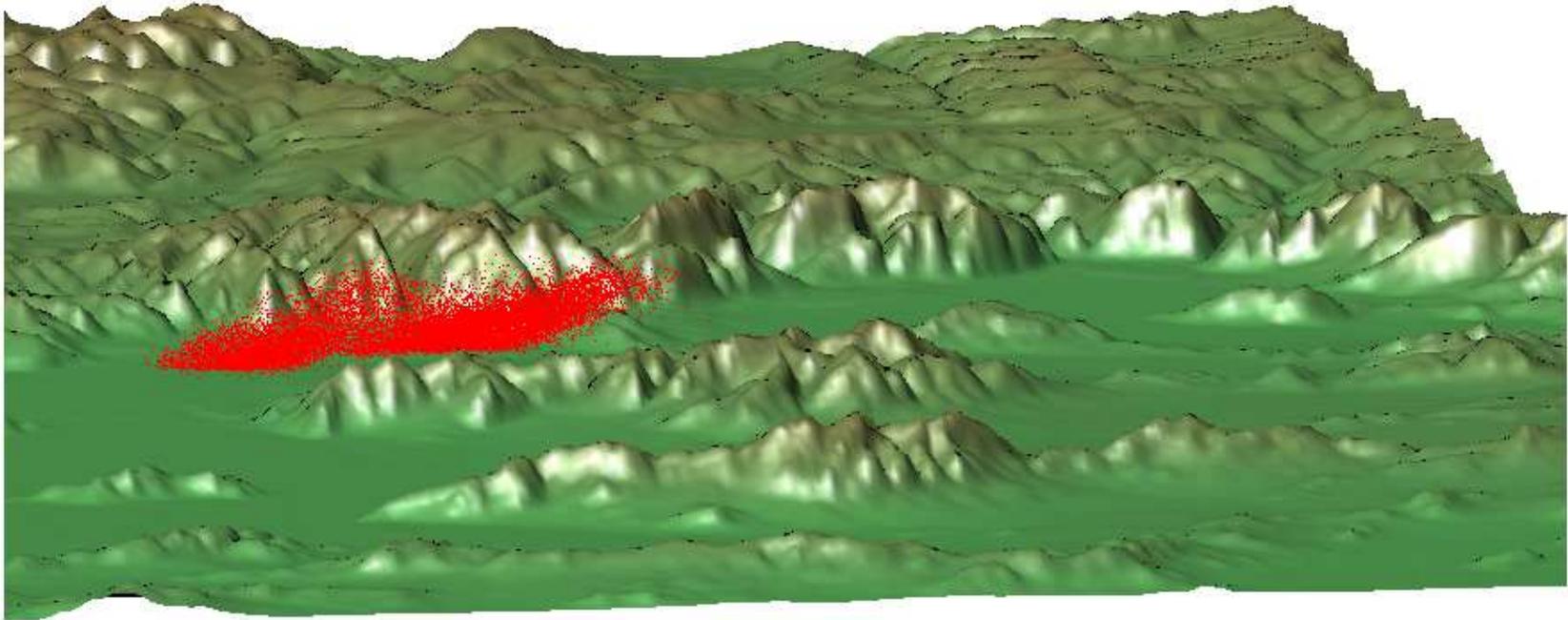


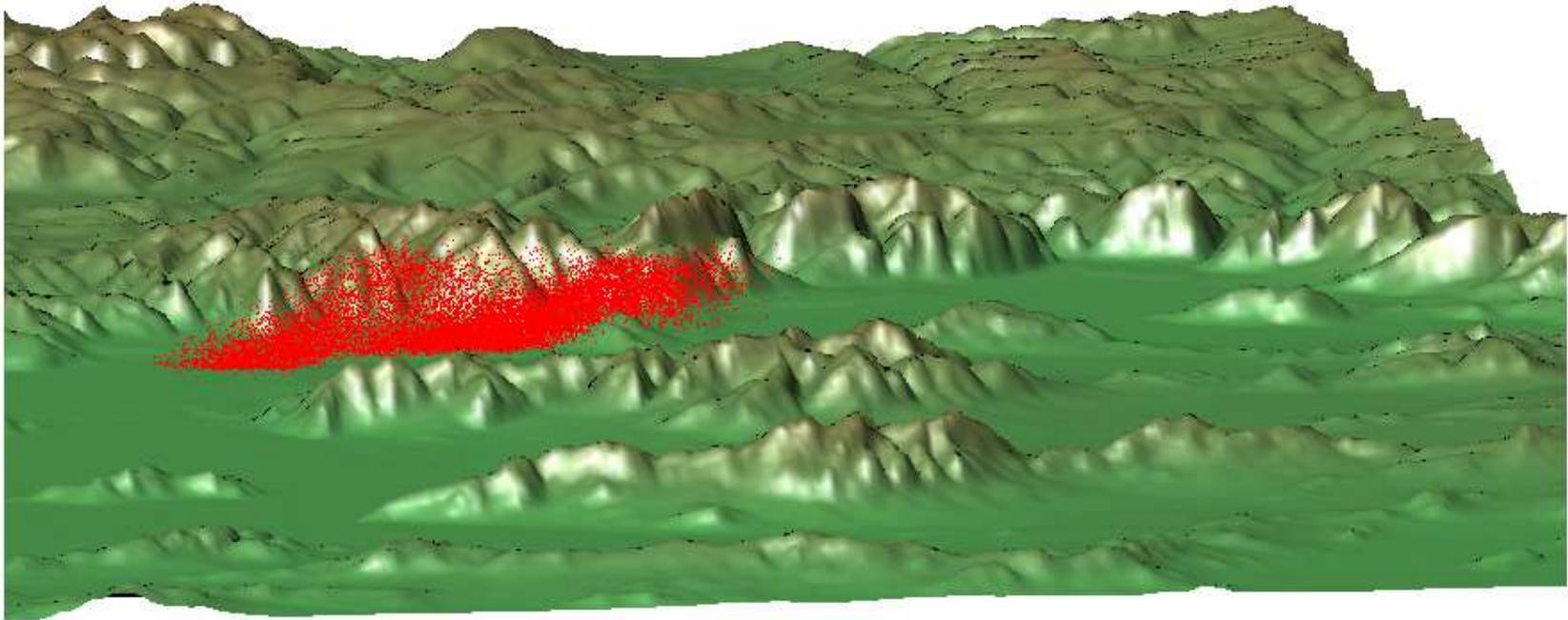
Lower level
cloud transported
northward by
surface winds

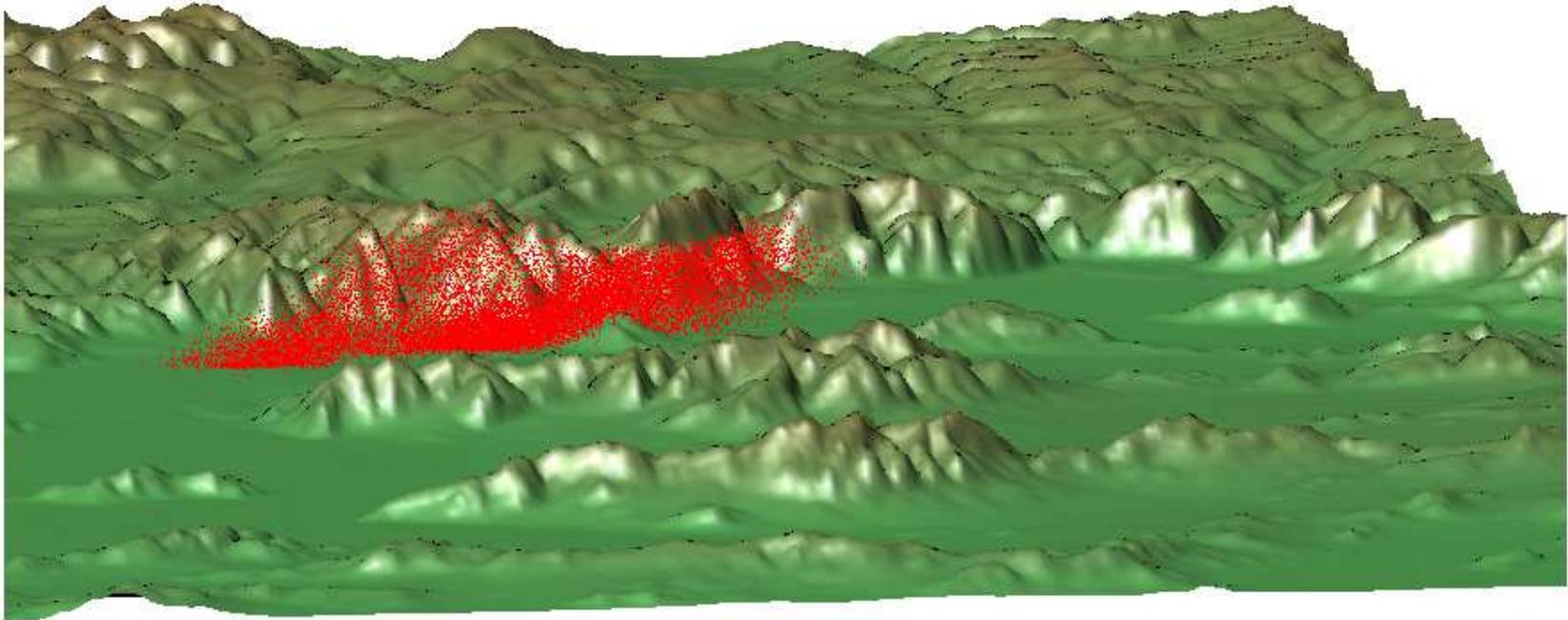
Note: Increase
mixing begins as
daytime heating
of surface occurs

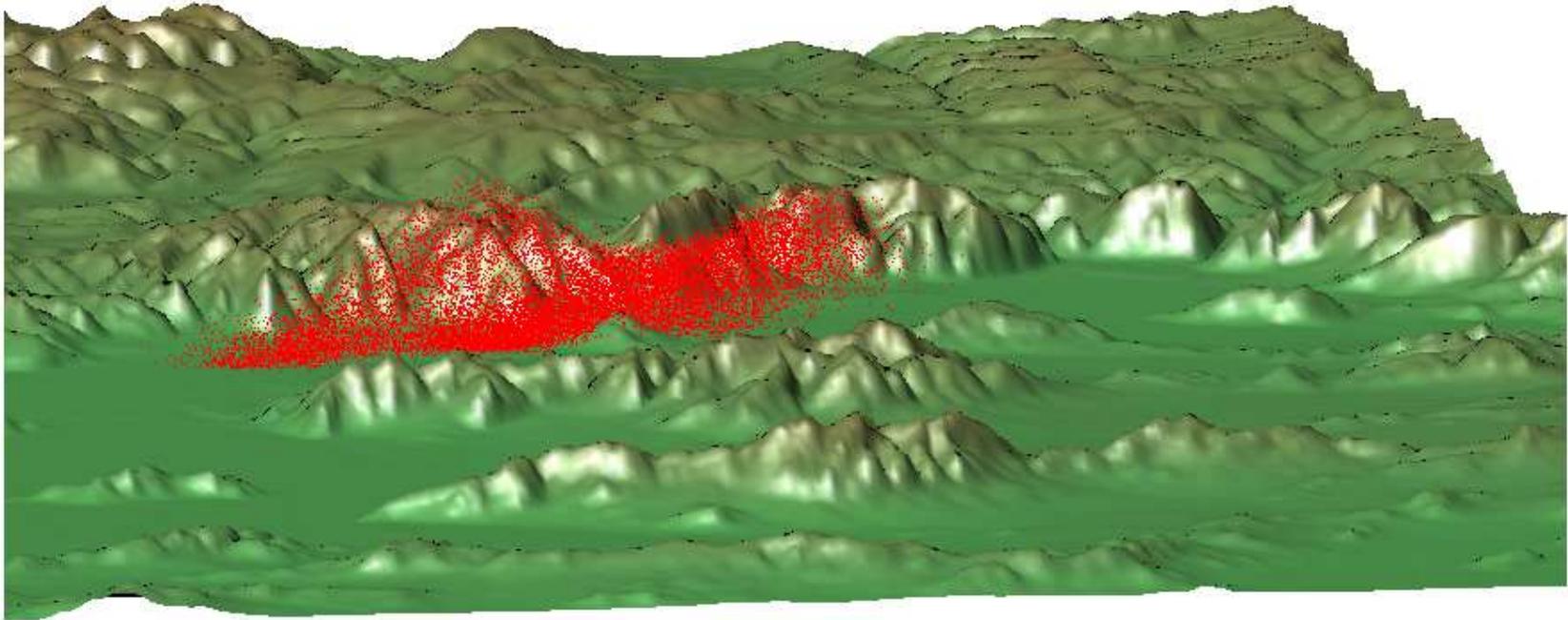


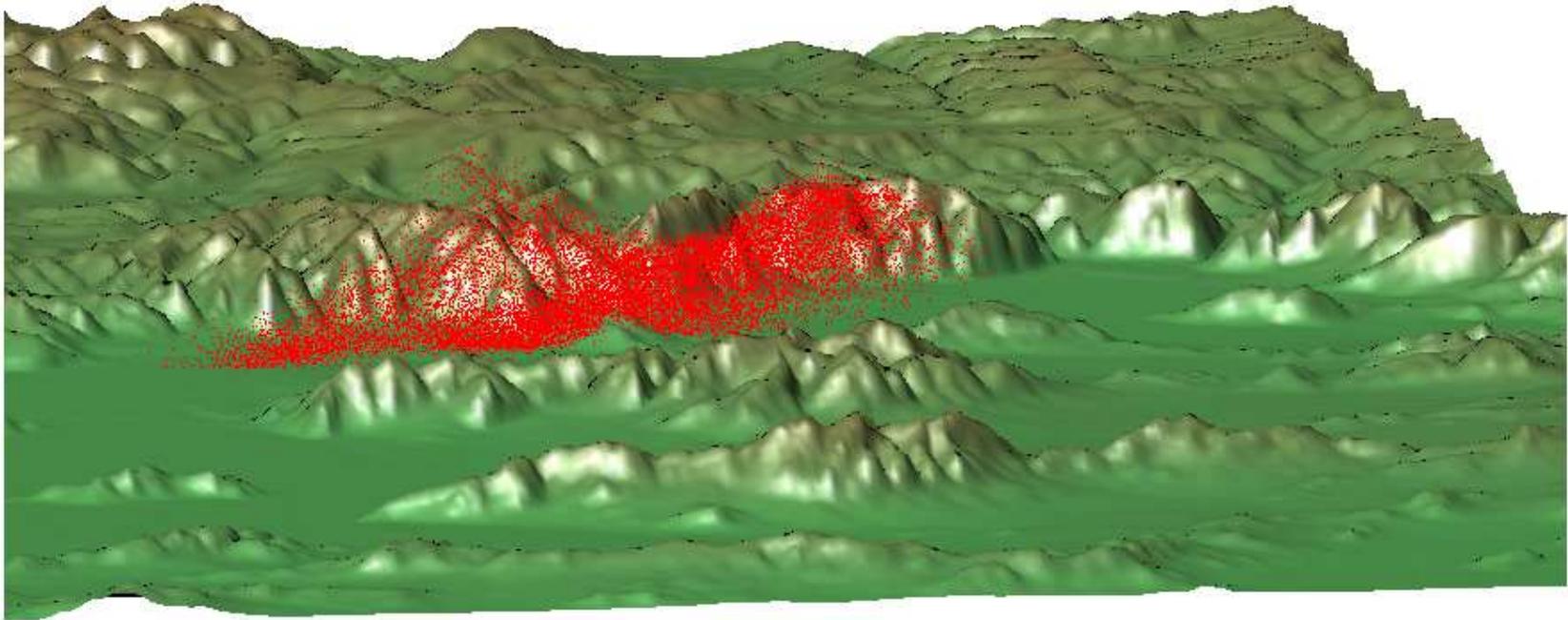


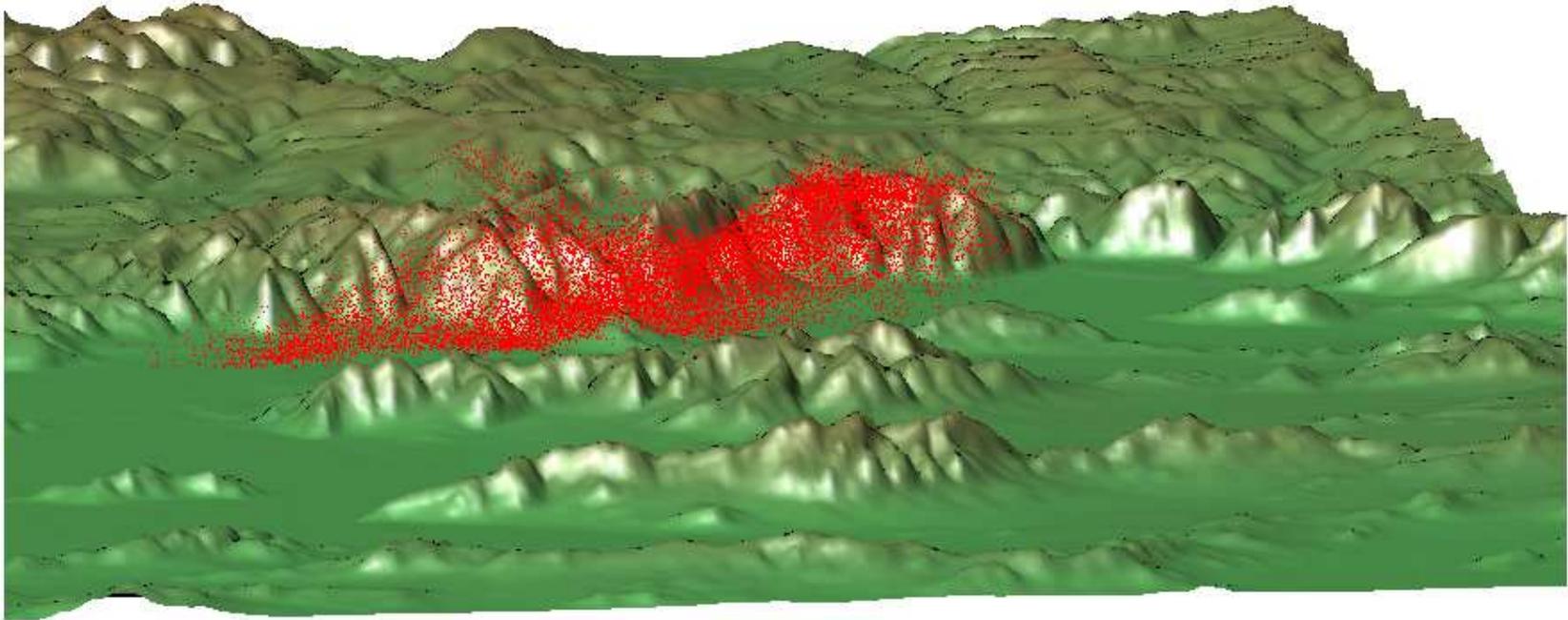


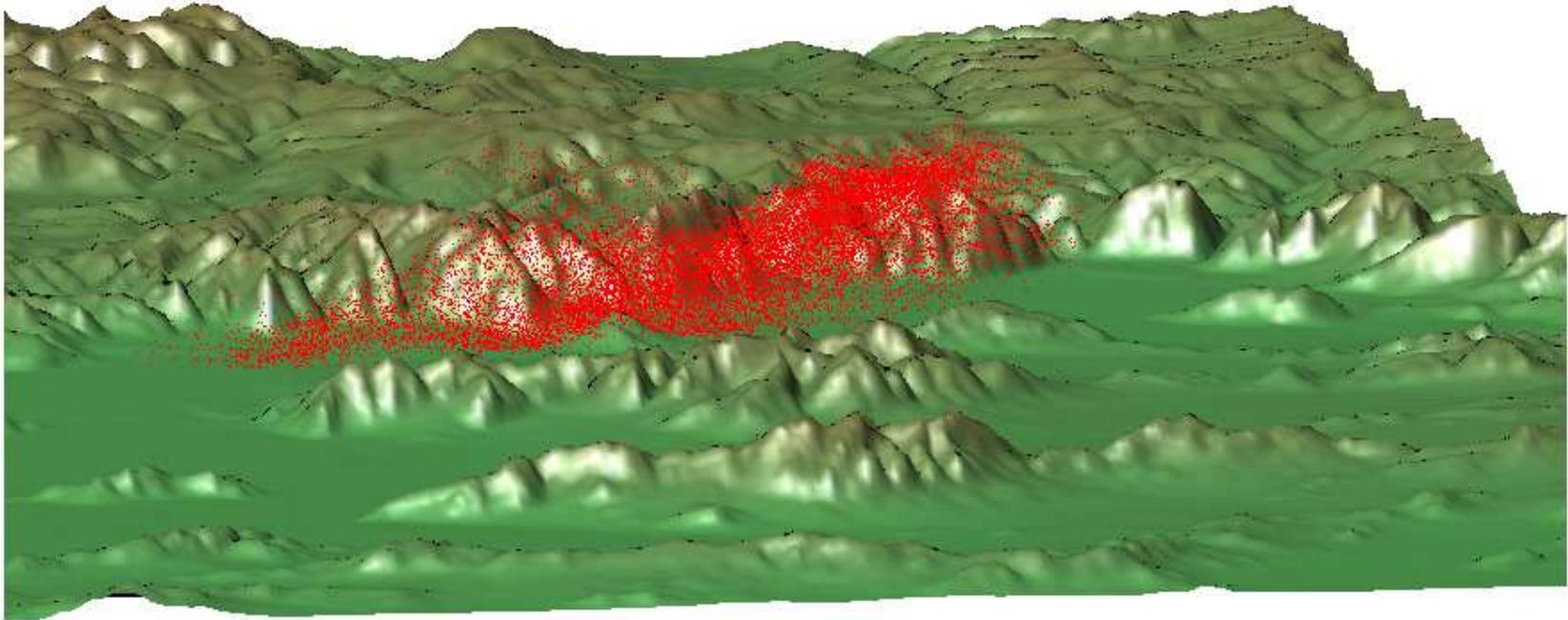


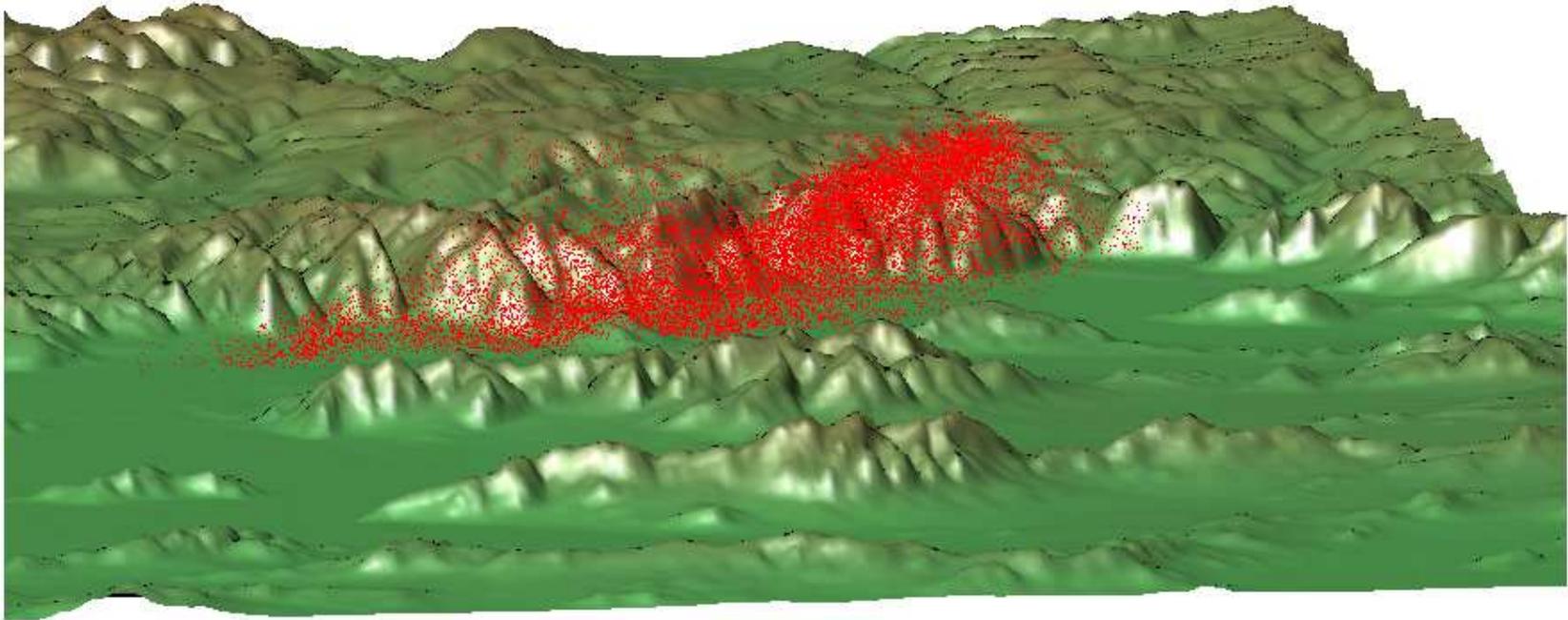


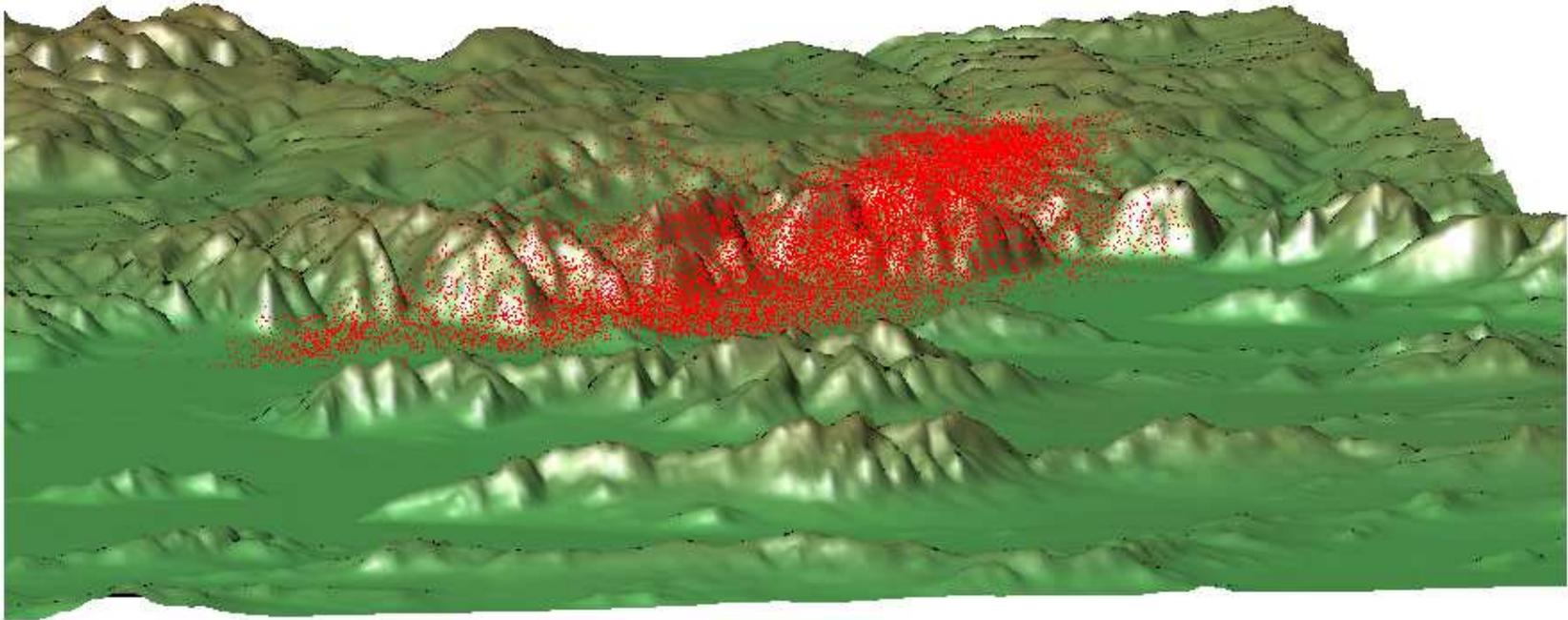


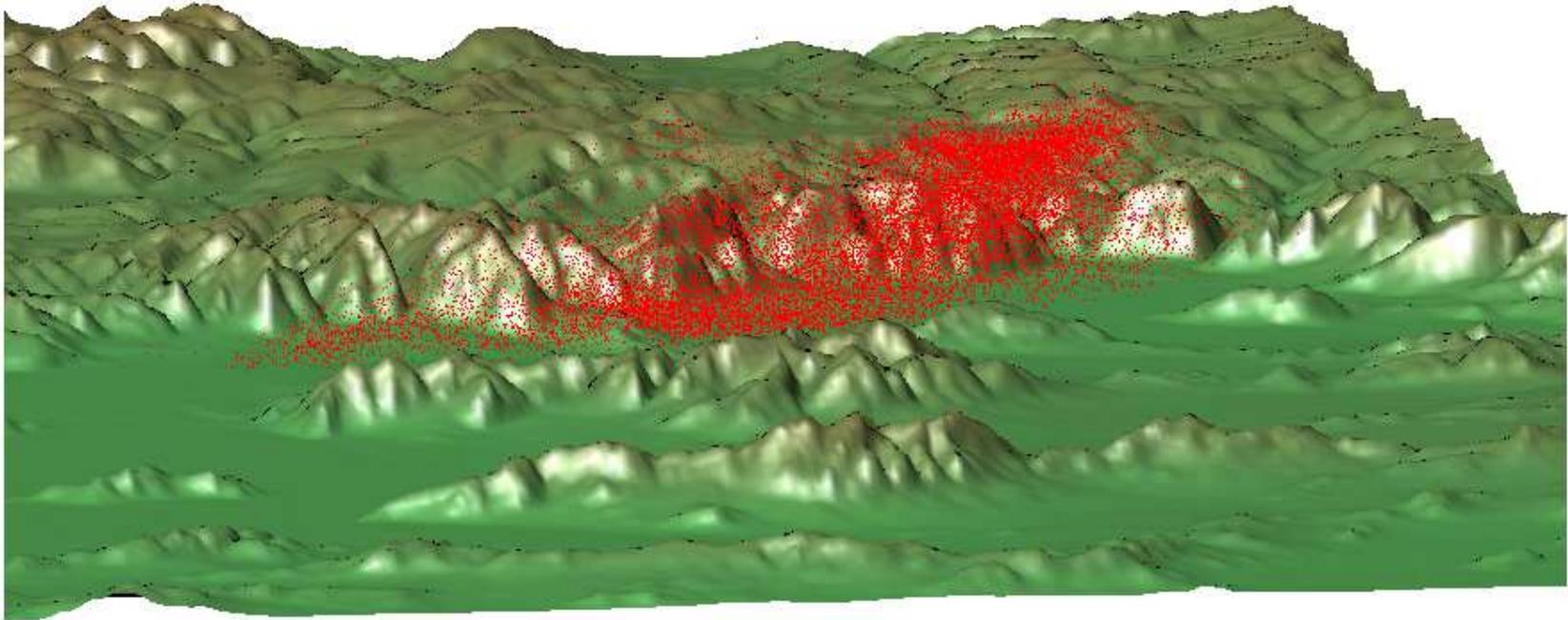


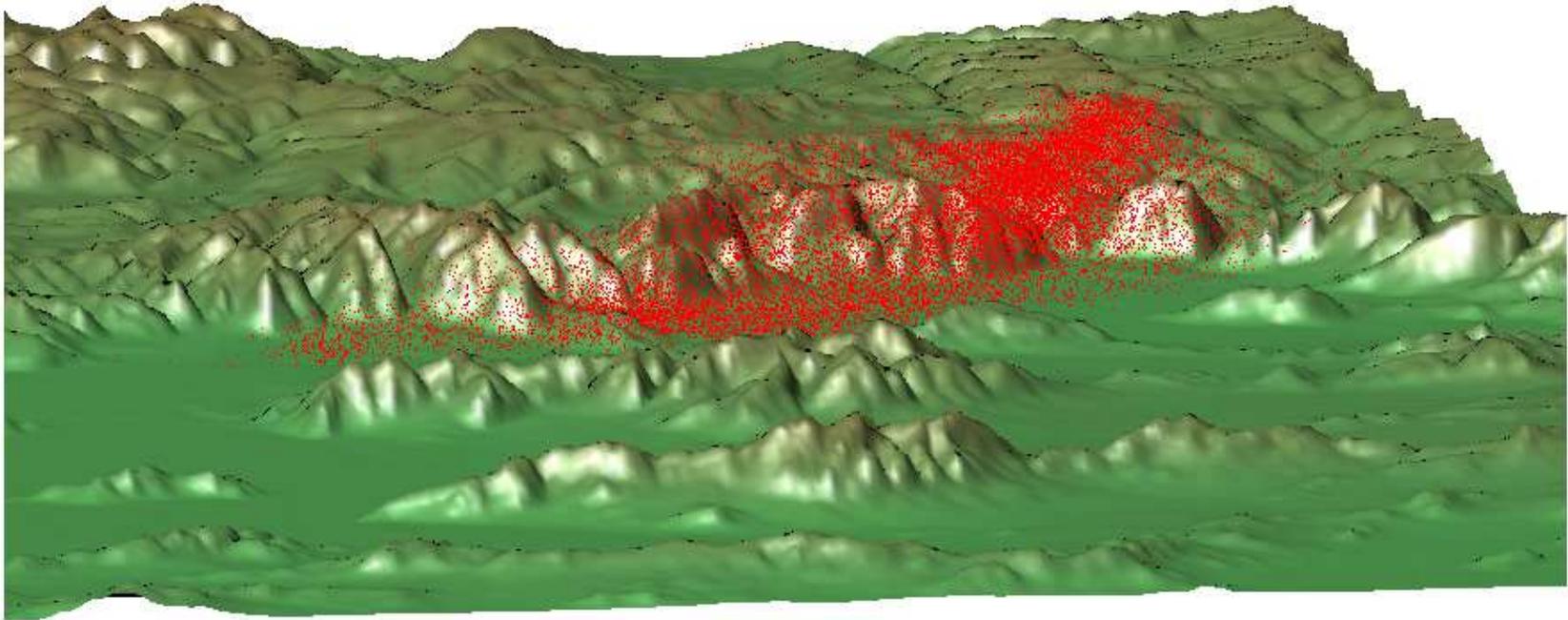


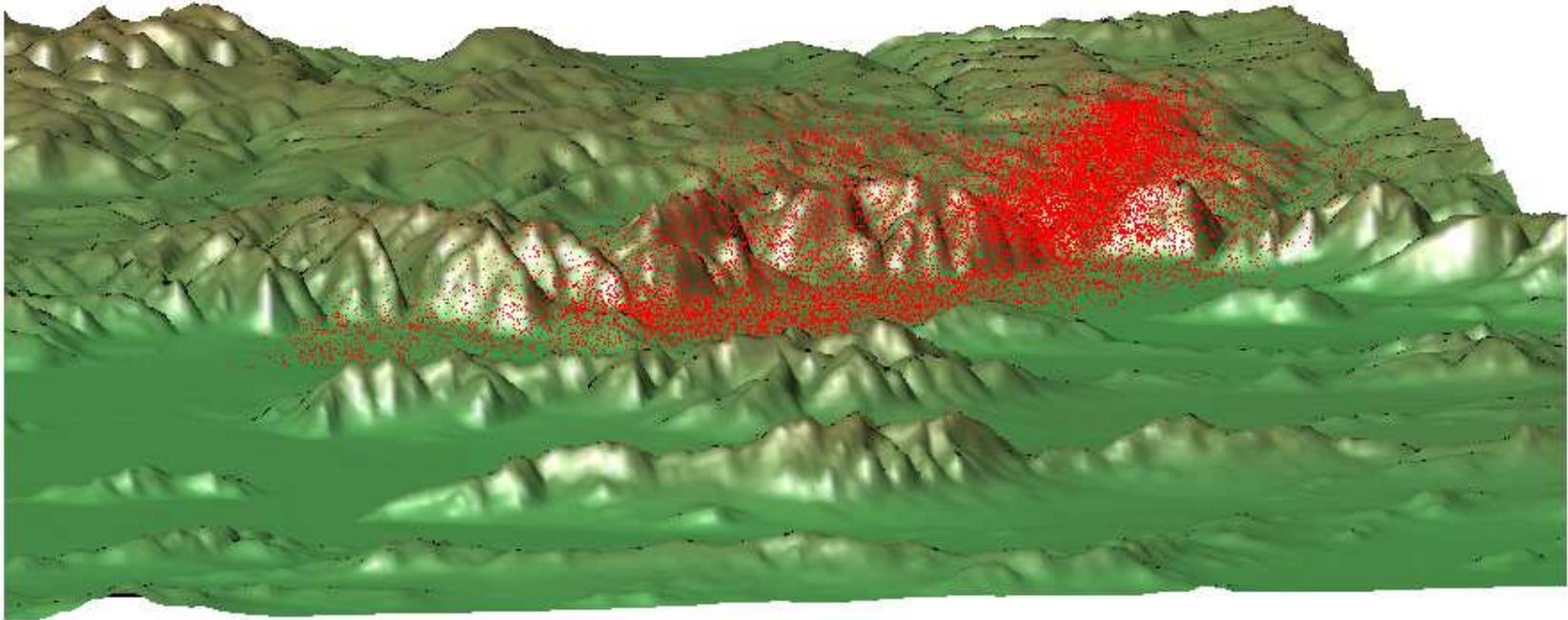


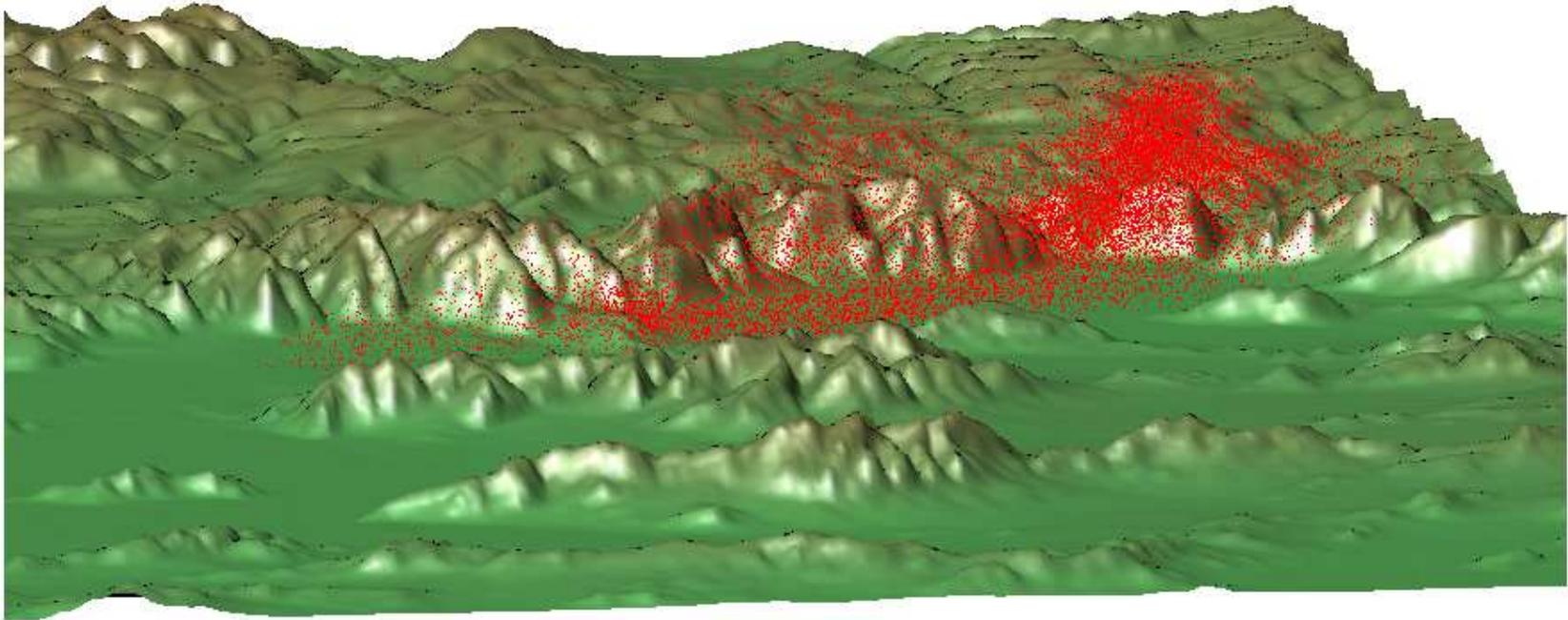




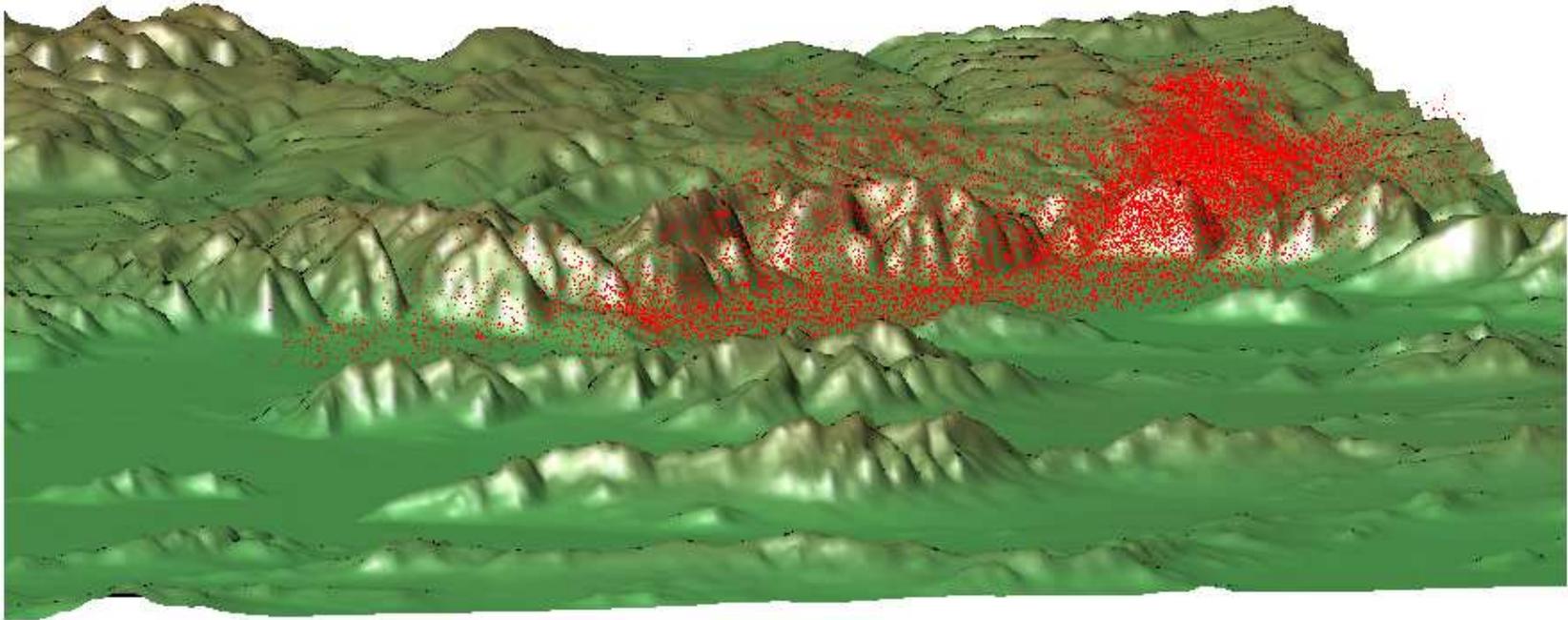




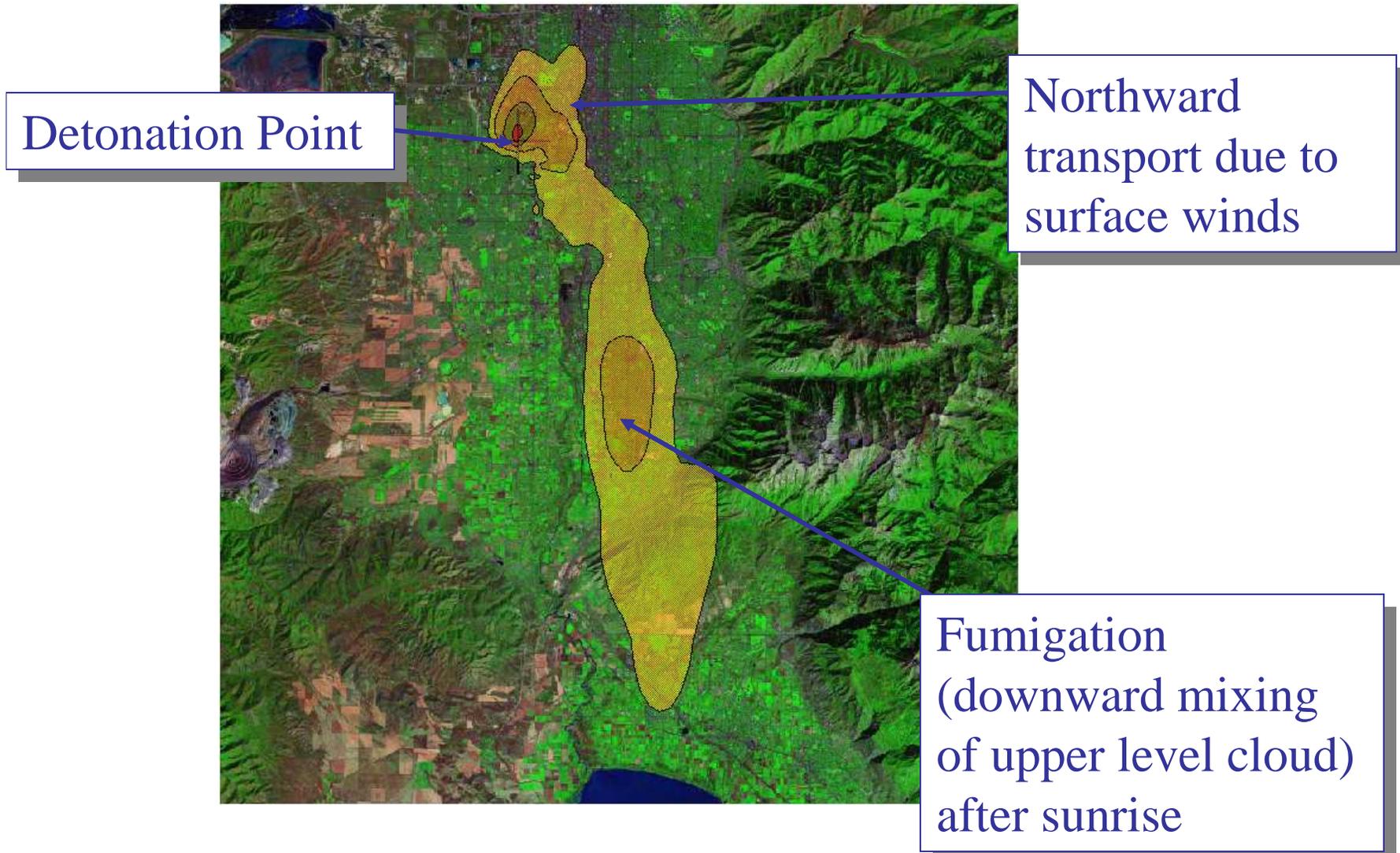




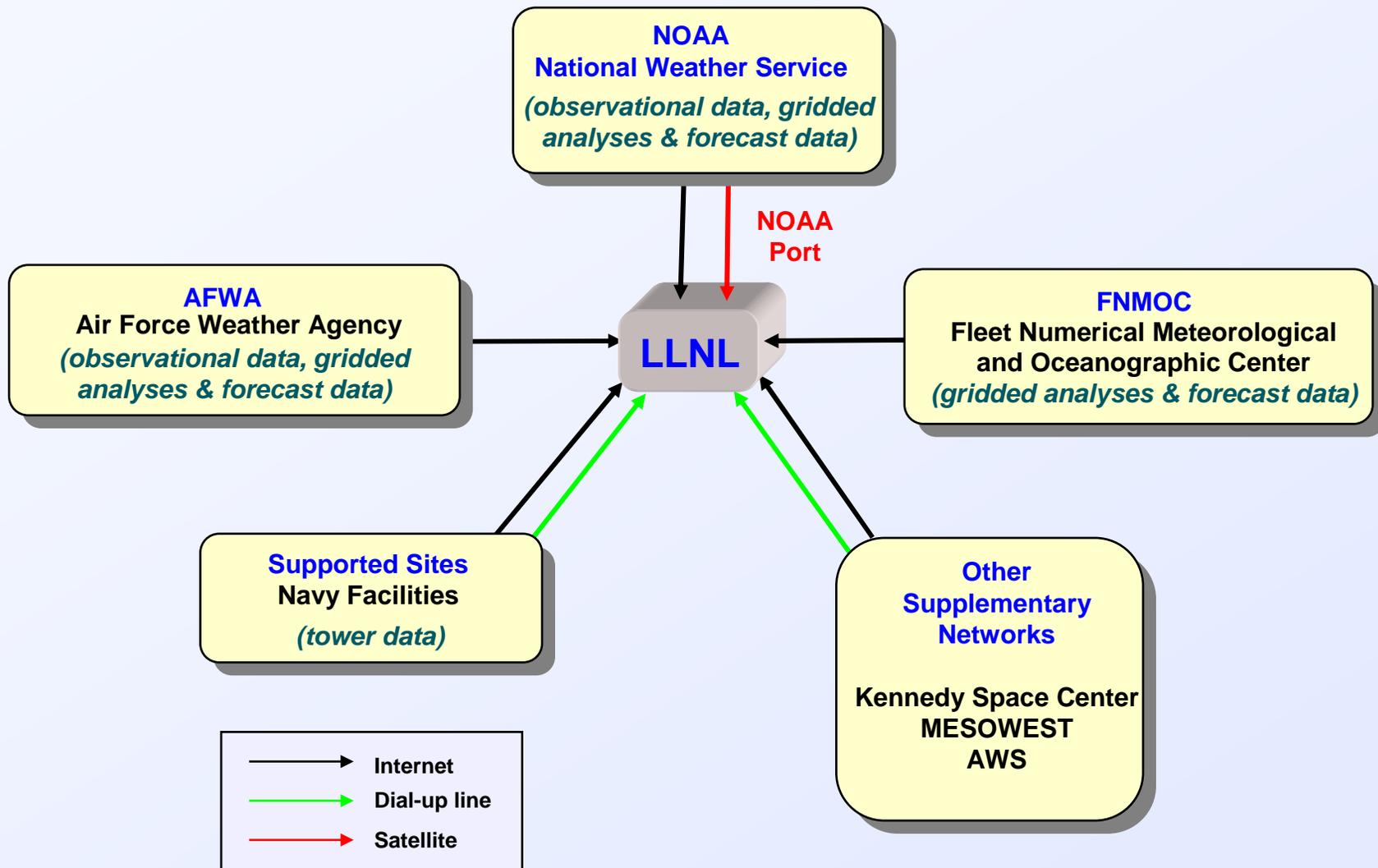
Case Study: Hypothetical RDD in Salt Lake City – NARAC LODI 3-D Model Particle Dispersion Simulation



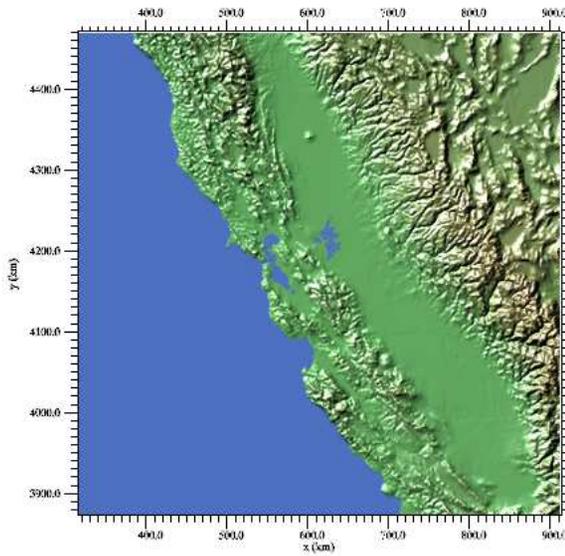
Case Study: Hypothetical RDD Ground-level Time-integrated Dose



Redundant Weather Services Provide Automated Meteorological Data

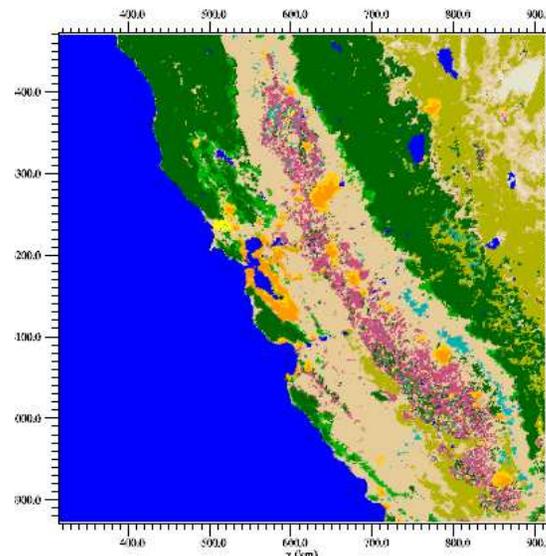


Extensive Geospatial Databases Underlie Assessments



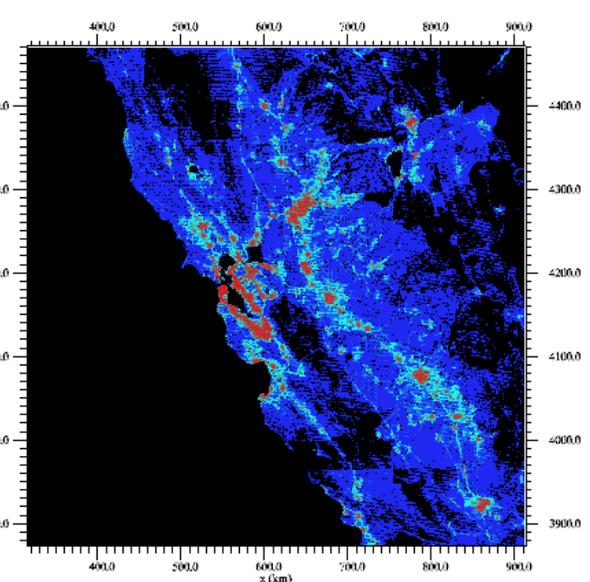
Terrain Elevation
is used for lower boundary of 3-D meteorological flow and dispersion models

Global coverage
NGDC 10km
USGS 1km
NIMA DTED (1km, 100m, and 30m)
U.S. coverage
USGS DEM 30m



Urban and Rural Land Characteristics
are used to model their effects on wind and turbulence

Global coverage
ORNL 1km GLCC
U.S. coverage
USGS 200m LULC
USGS 30m NLCD
NGA/SAIC US 3D building data
LBNL US building air infiltration data

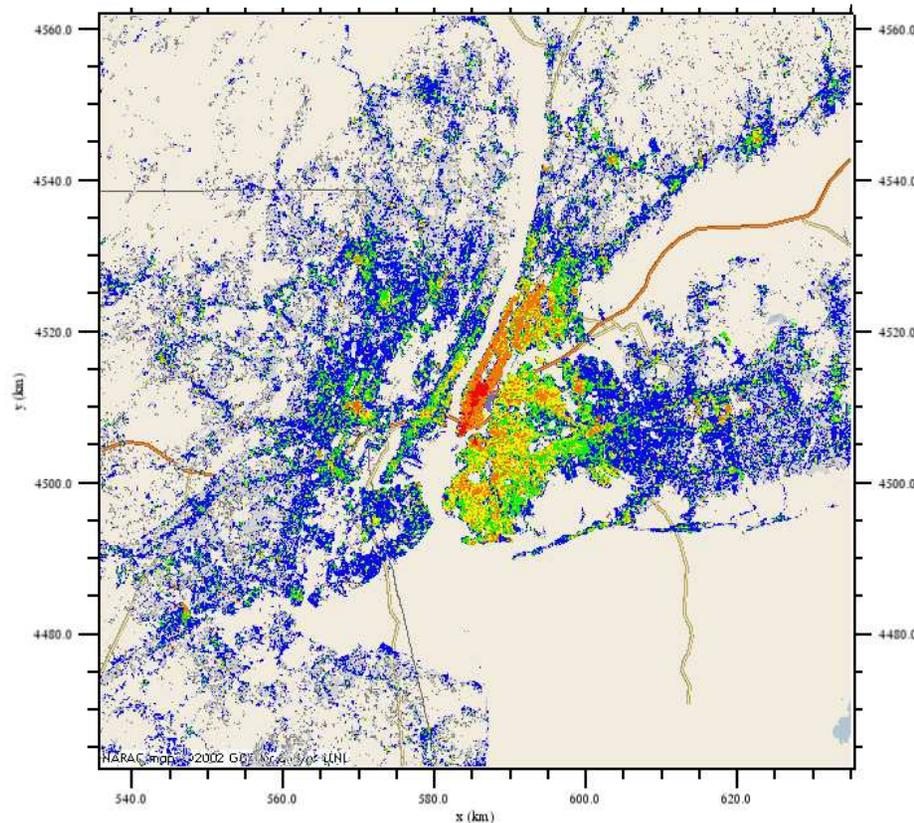


Population Density
is used to estimate the population affected by the plume

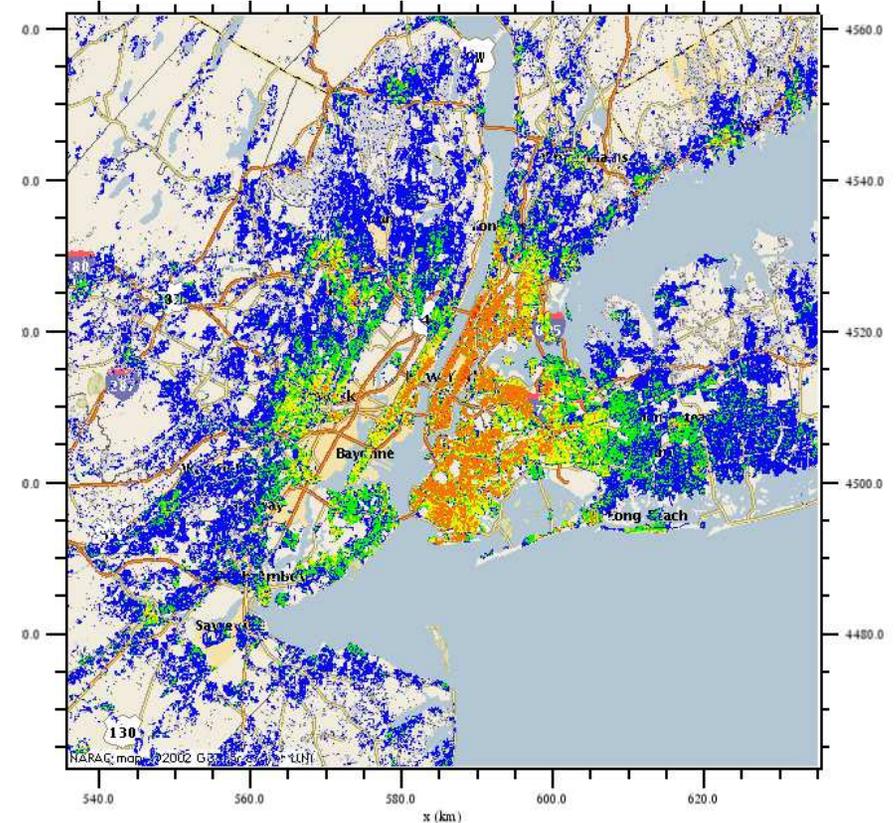
Global coverage
ORNL 1km LandScan
U.S. coverage
ORNL LandScanUSA day-night population
Census Bureau population

LandScanUSA High-resolution Day-night Population Database from DHS/ORNL Integrated Into NARAC/IMAAC Model Calculations

Daytime Population Density New York City Area



Nighttime Population Density New York City Area



Oak Ridge National Laboratory LandScanUSA day-night population data provided by
DHS/Office of Infrastructure Protection/Infrastructure Information Collection
Division

Lawrence Livermore National Laboratory

Web tools



NARAC-IMAAC Web and iClient Software Tools Provide Remote Users with Access to NARAC-IMAAC Predictions

- Automated reach-back to plume modeling with real-time weather data
- Sharing of predictions with other users or groups of users through *IMAAC/NARAC Web*
- Output formats
 - GIS Shape files
 - PDF
 - HTML/XML
 - PowerPoint
 - JPG/PNG graphics
 - Consequence reports
- *iClient*: Stand-alone capabilities: Simple Models and geographical information displays

Lawrence Livermore National Laboratory

The image displays two software interfaces. The top interface is the NARAC Web browser-based tool, showing a map of a coastal area with a plume model overlay. A table on the right lists prediction levels and their corresponding actions.

Level (uCi/m ³)	Area (km ²)	Pop	Descr
>=1,200	0.07	29	Consider evacuate to avoid 1 rem in...
>=41	6.4	1,785	Consider relocate around 2 Rem dose
>=16	17.6	4,738	Consider relocate around 0.5 Rem dose/year
>=6	30.8	19,325	Consider relocate around 5 Rem dose over...

The bottom interface is the NARAC iClient desktop application, showing a similar map view with a detailed data table and various control panels for source location and material selection.

NARAC Web Login

(see <https://narc.llnl.gov>)



Providing emergency managers with browser based access to NARAC *

Authorized users of this system can:

- Enter a simplified description of an atmospheric release.
- Send this information to NARAC for processing.
- Receive an initial prediction, based upon NARAC's sophisticated 3-D model, within 5 to 10 minutes.
- Share the prediction with other authorized users.

*[IMAAC Web Login](#)

User ID:
Password:

[Forgot password?](#)

For emergencies only, you can alternately reach NARAC at (925) 424-6465

If you are emergency manager without an authorized login or would prefer to talk to someone directly, you can contact NARAC at 925-424-6465. Between 7:30 AM to 4:15 PM Pacific Time, Monday-Friday, this call will put you in direct contact with one of our trained operations staff members who will ask you a short series of questions to determine the nature and severity of the incident. At all other times, your call will be answered by LLNL's emergency duty officer, who will forward your request to our on-call staff.

NARAC Web Capabilities

This is an **Initial Operational Version** of the NARAC Web System. Enhancements will continue to be made as the system matures. This version contains the following features:

- Security –user login/password; encrypted (https) communications.
- Ability to specify a predefined release location (site), or select a location from a map.
- Output in the form of a one-page standard NARAC HTML Report.
- Ability to initiate a run and come back later to view it.
- Ability to delete previously created runs.
- High level state, regional, and local maps, including Interstates, major highways, local streets political boundaries, water, major landmarks, etc.
- Ability to share runs with other NARAC Web users.

How To Become a Registered User

During this Initial Operational Period, we must regrettably limit access to a select group of registered users. Once the system becomes fully operational, additional registered users will be added on a regular basis. We are still working out the details of exactly how new users will be validated and added to the system. If you are an emergency manager at any level of local, state, regional or federal government with a legitimate need to access this system, then NARAC would like to hear from you. Please fill out the [account request](#) and someone will contact you with details and a timetable for becoming a registered user.

Done

narcweb2.llnl.gov

NARAC Web:

Notifications of new NARAC predictions and updates will be sent by email and posted to the HOME page.

Home Page - Start Here - Mozilla Firefox

History Bookmarks Tools Help

https://narcwebx2.llnl.gov/NaracWeb/jsp/user/starthere.jsp?click=0

Latest Headlines

NARAC Web

Fair Livermore Municipal
70.0° F Wind: E 3.45 mph

Welcome, Brenda Pobanz (mgr) (Manager) - [Help](#) - [Sign Out](#)

1 new msg

New Run View Runs Members My Profile Home Manage

Welcome back **Brenda Pobanz (mgr)**, your last login was 11/01/2007 23:00 UTC.

[New Messages](#) [Past 10 Days](#) [Past 30 Days](#)

11/02/2007 19:05 UTC -- NARAC folder access granted (T4 Exercise) [Go To Folder...](#)

You have been granted access to folder, T4 Exercise.

DHS Threat Level

ELEVATED Significant Risk of Terrorist Attacks.

[Privacy & Legal Notice](#). If you have questions about NARAC, please contact: [NARAC Support](#)

NARAC can be reached, 24/7, at (925) 424-6465.

Done naracwebx2.llnl.gov

NARAC Web:
Select pre-defined or user-defined radiological, nuclear, chemical, and biological airborne release scenario

Create A New Run - Mozilla Firefox

https://naracwebx2.llnl.gov/NaracWeb/jsp/quest/NewQuest.jsp

NARAC Web
National Atmospheric Release Advisory Center

Fair 70.0° F
Livermore Municipal
Wind: E 3.45 mph

Welcome, Brenda Pobanz (mgr) (Manager) - Help - Sign Out

No Msgs

New Run View Runs Members My Profile Home Manage

Create New Run in Folder: [/USA/NARAC/pobanz2](#)

Select either a predefined scenario or a release to create your own

Predefined Scenarios:

Category: Radiological Dispersal Device

Scenario: RDD Cs-137 Russian Seed Irradiator details

- RDD Cs-137 Russian Seed Irradiator
- RDD Co-60 Teletherapy
- RDD Ir-192 Therapy Source
- RDD Pu-238 US RTG
- RDD Am-241 Well/Log Source

Point Release details

Explosive Release details

Chemical Spill Release details

Sprayer Release details

Nuclear Detonation details

Line Source Release details

Privacy & Legal Notice. If you have questions about NARAC, please contact: [NARAC Support](#)

NARAC can be reached, 24/7, at (925) 424-6465.

- DeLorme Street At...
- Google Earth
- Google Earth Pro
- iClient v1.6
- Mozilla Firefox
- MyDVD Plus
- Adobe Acrobat 7.0 Standard

NARAC Web:

Enter Airborne Source Information

Explosive Detonation Scenario - Mozilla Firefox

https://naracwebx2.llnl.gov/NaracWeb/jsp/quest/expQuest.jsp

NARAC Web
National Atmospheric Release Advisory Center

Fair 70.0° F
Livermore Municipal
Wind: E 3.45 mph

Welcome, Brenda Pobanz (mgr) (Manager) - [Help](#) - [Sign Out](#)

No Msgs

New Run View Runs Members My Profile Home Manage

Create Explosive Scenario Run in Folder: [/USA/NARAC/pobanz2](#)

Run Name:

Run Description:

Level:

Detonation time of release: (MM/DD/YYYY hh:mm timezone)

/ / : Get all timezones available

Site Family:

Site:

Location: Fine tune location from

Latitude:

Longitude:

Downwind Distance: km

Release Height: ft

Material List:

Material Type:

Material Name:

Strength Type:

Strength: Ci

HE Amount: lb

Model:

Enter met data manually? yes no

Done naracwebx2.llnl.gov

- Internet Explorer
- Shortcut to Recordings
- DemosOver ...
- Burn CDs & DVDs with ...
- DeLorme Street At...
- Google Earth
- Google Earth Pro
- iClient v1.6
- Mozilla Firefox
- MyDVD Plus
- Adobe Acrobat 7.0 Standard

NARAC Web:

Location may be chosen by map or address look-up.

Location Selector - Mozilla Firefox

https://narcwebx2.llnl.gov/NaracWeb/jsp/vis/LocationPick.jsp

NARAC Web
National Atmospheric Release Advisory Center

Fair 70.0° F
Livermore Municipal
Wind: E 3.45 mph

Welcome, Brenda Pobanz (mgr) (Manager) - [Help](#) - [Sign Out](#)

[New Run](#) | [View Runs](#) | [Members](#) | [My Profile](#) | [Home](#) | [Manage](#)

1 new msg

100% | Select Location

Navigate By Map Address Lookup

Address or Intersection:

City:

State:

Zip Code:

Possible Matches (follow link to update map)
[Portland, OR](#)

Selected Location(s)
(45.529849 N, 122.667276 W)

©2005 Tele Atlas and/or LLNL
MapSize: 2.87 km by 2.87 km | Map Center: (45.529063 N, 122.663301 W) | Scale: 4.7814 m/pixel

[Privacy & Legal Notice](#). If you have questions about NARAC, please contact: [NARAC Support](#)

NARAC can be reached, 24/7, at (925) 424-6465.

Done | naracwebx2.llnl.gov

Internet Explorer | Shortcut to Recordings

DemosOver...

Burn CDs & DVDs with...

Delorme Street At...

Google Earth

Google Earth Pro

iClient v1.6

Mozilla Firefox

MyDVD Plus

Adobe Acrobat 7.0 Standard

- My Documents
- My Computer ZEPHYR
- My Network Places
- LLNL_CFDA...
- Recycle Bin
- Internet Explorer
- DemosOver...
- Burn CDs & DVDs wit...
- Delorme Street At...
- Google Earth
- Google Earth Pro
- iClient v1.6
- Mozilla Firefox
- MyDVD Plus
- Adobe Acrobat 7.0 Standard

NARAC Web:

Display plume model results

- Plume hazard areas

- Predicted health effects

- Affected population counts

- Geographical information (maps, aerial photographs, facilities of interest)

- Export formats: GIS shapefiles, PDF, Powerpoint, JPEG

Plume models run automatically for any location in country using NARAC 3-D atmospheric flow, transport and deposition models

IMAAC Radiological Release Protective Action Guidelines - Mozilla Firefox

https://narcwebx2.llnl.gov/NaracWeb/jsp/runs/Report.jsp?runId=run_200700008310&reportId=rpt_200700006720

NARAC Web

FAIR 70.0° F Livermore Municipal Wind: E 3.45 mph

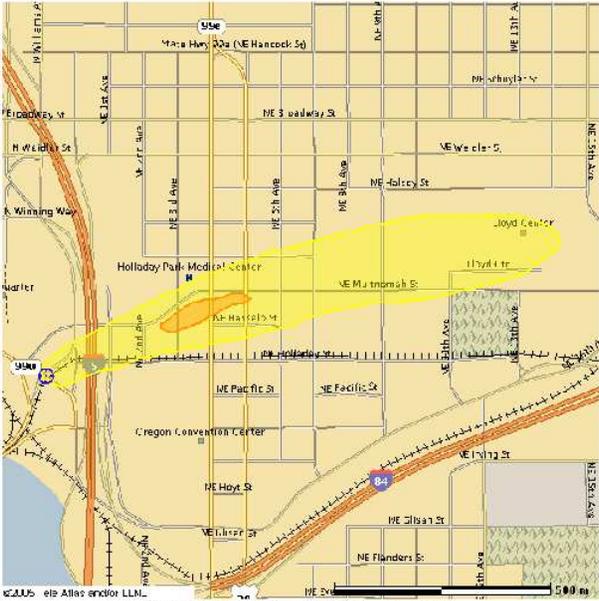
Welcome, Brenda Pobanz (mgr) (Manager) - Help - [Sign Out]

No Msgs

New Run View Runs Members My Profile Home Manage

TOPOFF4 (OR) Exercise Use Only - IMAAC Approved - FOUO
OR Set 3 - FRMAC-IMAAC Radiological Release Protective Action Guidelines
(4-Day Total Effective Dose Equivalent)

OR Set 3 - Cs RDD New Loc FRMAC-AMS Msrmts Model - Robust Data - Exercise



Actions and Long-Term Effects		
Description	(rem) Extent Area	Population
Exceeds upper limit EPA PAG for evacuation.	>5 510m 7,363m2	60
Exceeds lower limit EPA PAG for evacuation.	>1 1,236m 182,123m2	2,370

Note: Areas and counts in the table are cumulative.
 Effects or contamination from October 16, 2007 16:00 UTC to October 20, 2007 16:00 UTC at 10.0 m.
Release Location: 45.529746 N, 122.666600 W
Material: Cs-137 + daughters
Generated On: October 17, 2007 01:31 UTC
Model: ADAPT/LODI
Comments: Doses shown are total accumulated from the beginning of release.
 New Location at intersection of Hwy 99 and Holladay Street
 Adjusted to first set of FRMAC AMS Data resulting in a total of 2400 Ci of Cs-137.
 Assumed 750 lbs of HE based on 12.5 ft crater diameter.

Map Size: 1.4 km by 1.4 km Id: Production.roE16862.roC1
 NARAC Operations: (onDuty Assessor); narac@llnl.gov; 925-424-6465
 Tested by: (IMAAC OPERATIONS COORDINATOR; IMAAC; imaac@llnl.gov)
 Approved by: (IMAAC Coordinator; IMAAC; 925-424-6465)

TOPOFF4 (OR) Exercise Use Only - IMAAC Approved - FOUO

[Privacy & Legal Notice](#). If you have questions about NARAC, please contact: [NARAC Support](#)

NARAC can be reached, 24/7, at (925) 424-6465.

narcwebx2.llnl.gov

NARAC Web:

Air or ground
sampler data
display

Man Viewer - Mozilla Firefox
View History Bookmarks Tools Help
https://narcwebx2.llnl.gov/NaracWeb/jsp/vis/MapViewer.jsp
Started Latest Headlines
Viewer Field Measurements
NARAC Web
National Atmospheric Release Advisory Center
No Msgs
Welcome, Brenda Pobanz (mgr) (Manager) - Help - [Sign Out]
Fair Livermore Municipal
70.0° F Wind: E 3.45 mph
New Run View Runs Members My Profile Home Manage

OR Set 3 - FRMAC-IMAC Radiological Release Groundshine Dose Rate at 1 Day

Effects and Actions		
Description	(rem/hr) Extent Area	Population
2 mrem/hr boundary	>0.002 2,650m 773,833m ²	5,880

Note: Areas and counts in the table are cumulative.
Effects or contamination at October 17, 2007 16:00 UTC at or near ground level.

Layer Control: Field Measurements
Show Measurements:
Show Labels:
Threshold: 0
Use Stations: Maximum Value
Marker Size: Medium
Measurement Stride: 1
View Tabular Data
Update Map

Back to OR Set 3 - Cs RDD New Loc FRMAC-AMS Msmts

Pick data
layer here

NARAC Scientists can use sampler data to refine plume model predictions and reconstruct events

LLNL_CFDA... Remote Desktop ...
Recycle Bin NR iClient v1.6
Internet Explorer Shortcut to Recordings
DemosOver ...
Burn CDs & DVDs wit...
Delorme Street At...
Google Earth
Google Earth Pro
iClient v1.6
Mozilla Firefox
MyDVD Plus
Adobe Acrobat 7.0 Standard

NARAC Web:

Easily share plume model results with other authorized users

Select individual users and/or groups of users to share plume model results with others

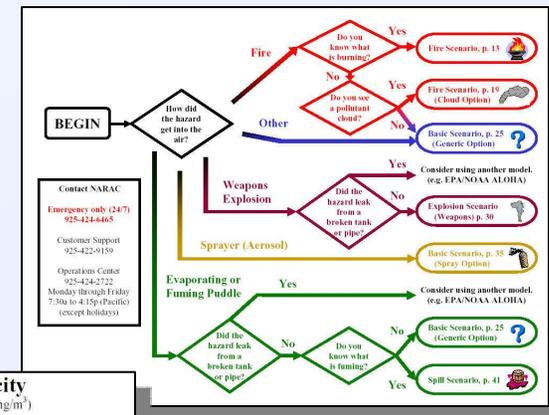
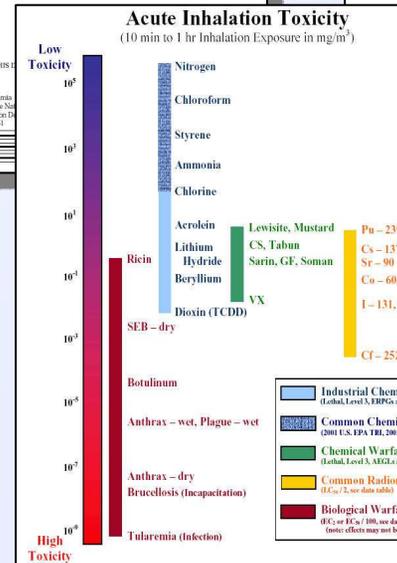
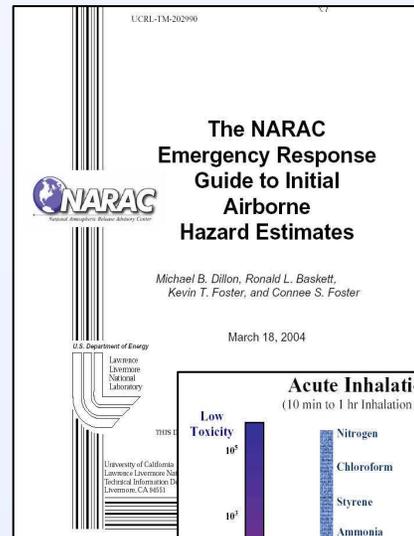
The screenshot shows the NARAC Web interface in a Mozilla Firefox browser window. The page title is "Share Item - Mozilla Firefox" and the URL is "https://naracwebx2.llnl.gov/NaracWeb/jsp/share/ShareItem.jsp?itemId=run_200700008310". The page header includes the NARAC Web logo, weather information for Livermore Municipal (70.0° F, Wind: E 3.45 mph), and a welcome message for Brenda Pobanz (ca). The main content area is titled "Share: OR Set 3 - Cs RDD New Loc FRMAC-AMS Msmts". Below this, there is an "Access Level" dropdown set to "Observe". There are two columns of user and group selection: "Users:" and "Groups:". The "Users:" list includes names like "Pendergrass, William - pendergrass1" and "Petty, Tonya - petty1". The "Groups:" list includes "DOE - RAP Region 0" through "DOE - RSLGIS" and "DOE - SNL AL". A green arrow points from the "Users:" list to the "Groups:" list. Below the selection lists is a "Comments:" text box containing "Exercise Calculation". There is a "Notify By:" section with "Default is none." and checkboxes for "Email" and "Web Notification" (checked). At the bottom, there are buttons for "Share It", "Remove Shared Access", and "Reshare" (with a note: "(sends new notification to all who have access)").

For more information see
<http://narmac.llnl.gov>



Guidebooks and Training Material

- Model technical manuals
- Web-based training
- Step-by-step guide to software use
- Guide books for determining model inputs from known information



Explosion Scenario (Weapons):

Use when a weapon has exploded.

1. Run iClient to open the Session Manager Window.
2. Select "Explosive Dispersal" from the Scenarios Menu.

NARAC uses the explosion information only to describe how hazards are distributed in the atmosphere. Unless explicitly specified, NARAC does not account for 1) changes in the hazard due to degradation or 2) the hot zones generated from explosions.

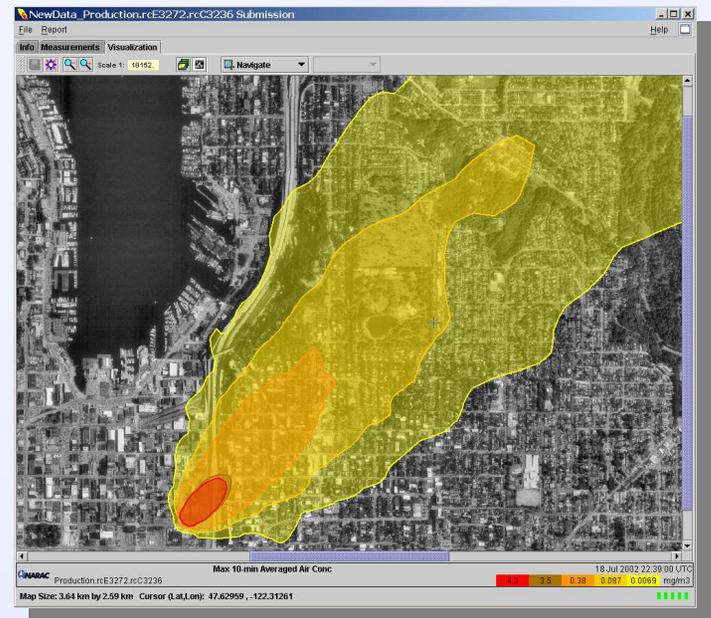
If a small explosion has just a hole in a container, use either a Basic (p. 25) or Spill (p. 41) Scenario or another model (EPAN/NOAA ALOHA, www.epa.gov/ceppo/canoe/aloha.htm).

SOURCE MODEL INFO

For an explanation on how explosive dispersal hazards in NARAC models, see page 12.

Standardization of NARAC and EPA/NOAA CAMEO/ALOHA Databases and Products Make National Tools More Complementary

- Completed standardization of hazard levels and color for both ALOHA v5.3 and NARAC plume modeling results
 - Red:** life threatening effects (AEGL3, ERPG3 or TEEL3)
 - Orange:** serious long-lasting effects (AEGL2, ERPG2 or TEEL2)
 - Yellow:** notable discomfort (AEGL1, ERPG1 or TEEL1)
- Chemical properties database standardized between CAMEO/ALOHA and NARAC
- Design of Software interface between CAMEO/ALOHA and NARAC iClient



AEGL: EPA Acute Emergency Guideline Level

ERPG: American Industrial Hygiene Association (AIHA) Emergency Response Planning Guideline

TEEL: DOE Subcommittee on Consequence Assessment & Protective Actions (SCAPA)
Temporary Emergency Exposure Limits