



# Urban Dispersion and Data Handling in JEM

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# Acknowledgements

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  - Support for link between SCIPUFF and UDM
- Tom Smith and Curt Wall – JPM-IS
  - Supply of JEM IRC MOUs
- DTRA
  - Supply of JEM through IRC MOUs

# Overview

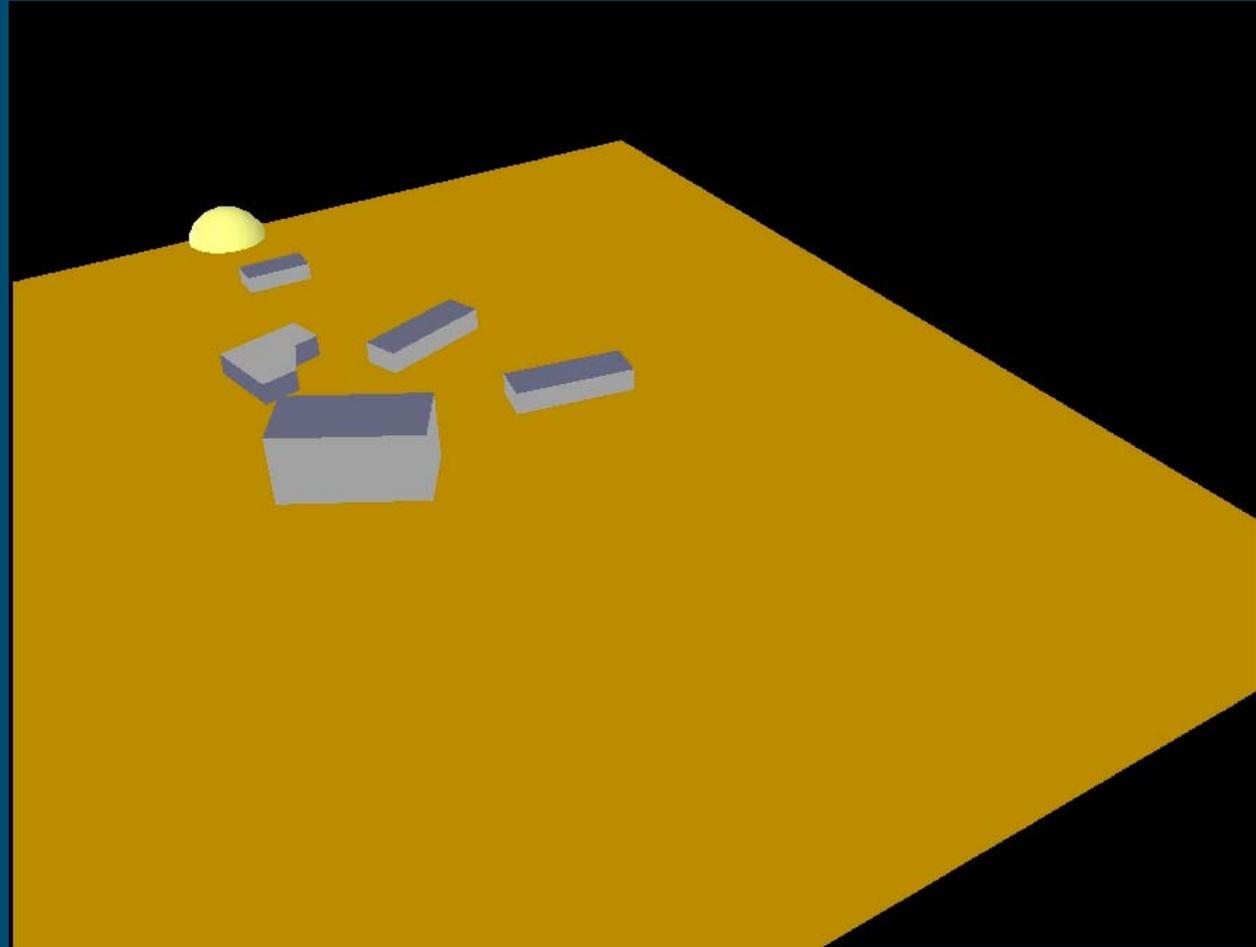
- UDM
- GEDIS
- JEM Urban Modelling Prototype (JUMP) development
- JUMP demonstration
- Future plans

# Dstl's Urban Dispersion Model (UDM)



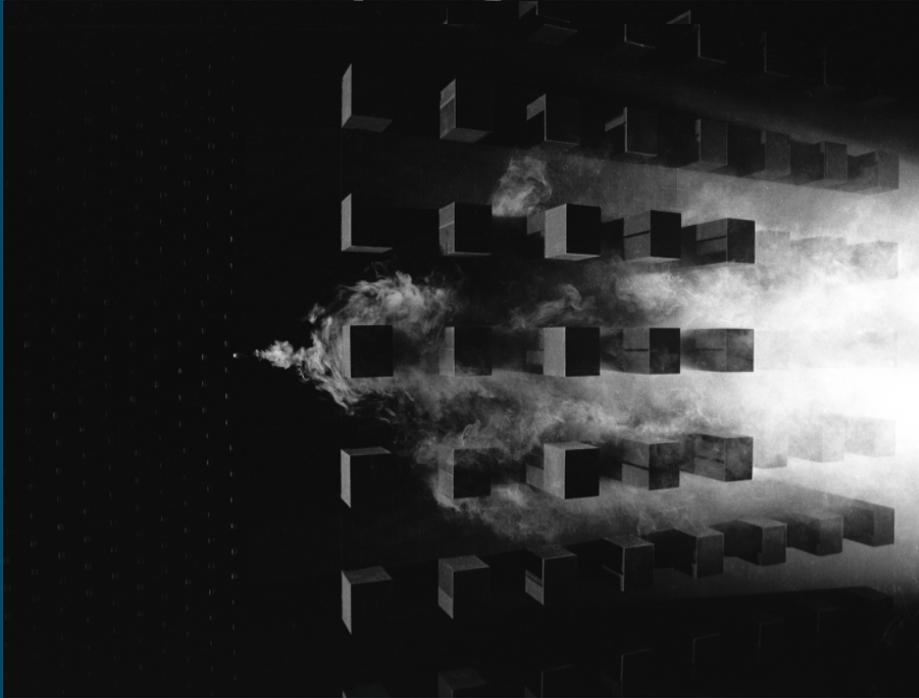
# UDM - Open Regime

- Gaussian puff model
- Open regime - puffs interact with individual, isolated buildings

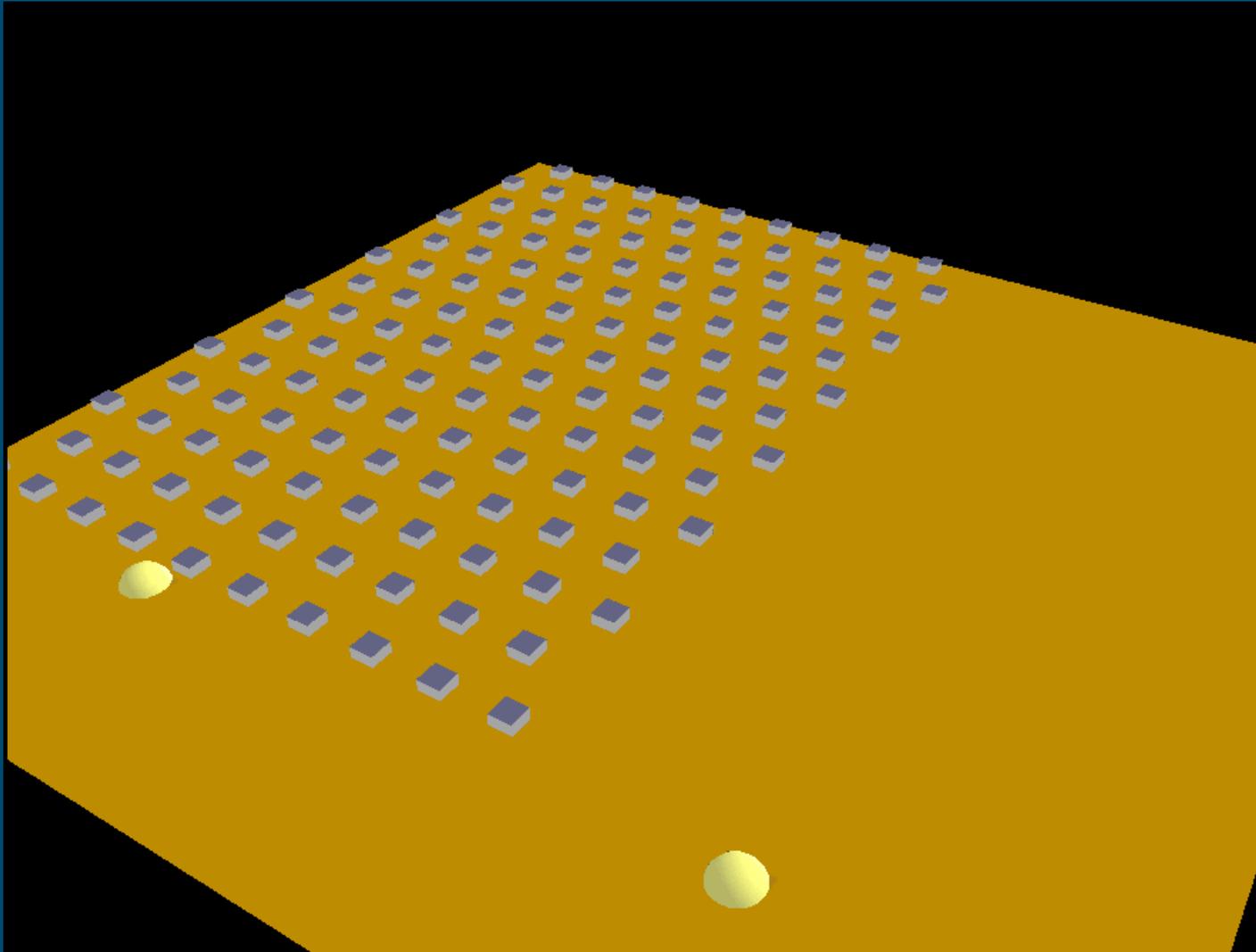


# UDM - Urban Regime

- Urban regime - puffs interact with array of buildings, dependent on
  - Puff height, building density, mean building height and width, wind direction, array being square or staggered
  - Data from 2500 wind tunnel experiments



# UDM - Urban Regime



# UDM - Key Features

- Link to GEDIS building database
  - Urban morphology extractor
  - Efficient
  - Robust to different representations of complex buildings
- Includes liquid droplets and particulates: size-dependent wet and dry deposition
- Includes secondary evaporation
- Various sources - moving, static, point, line, area, etc



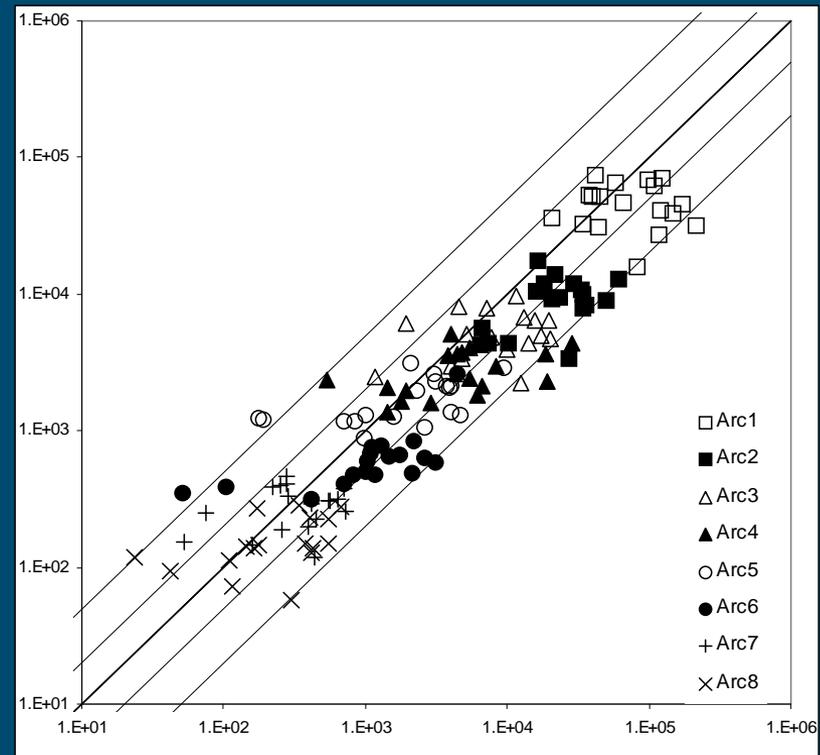
# Recent Developments

- Replaced R91 (stability category) by AERMOD (Monin Obukhov length based)
- Courtyard model added
- Radiological cloud shine
- Puff rise model
- Dense gases

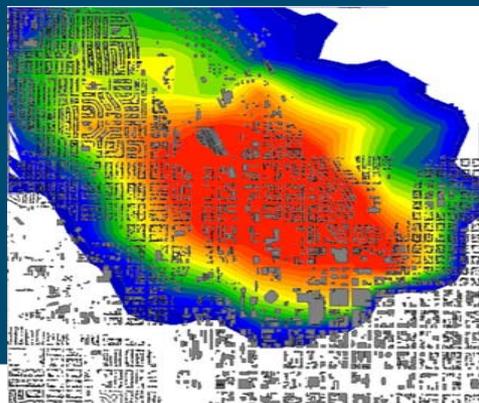


# Validation Status

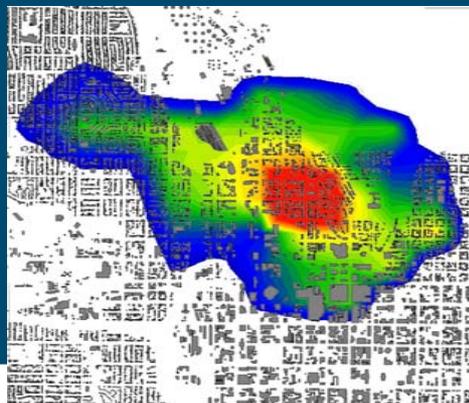
- Predictions from several urban models independently evaluated against data from URBAN 2000 (Salt Lake City), MUST (DPG) & JU2003 (Oklahoma City)
  - UDM performs well
  - Further validation being performed



Observations



Non Urban Model

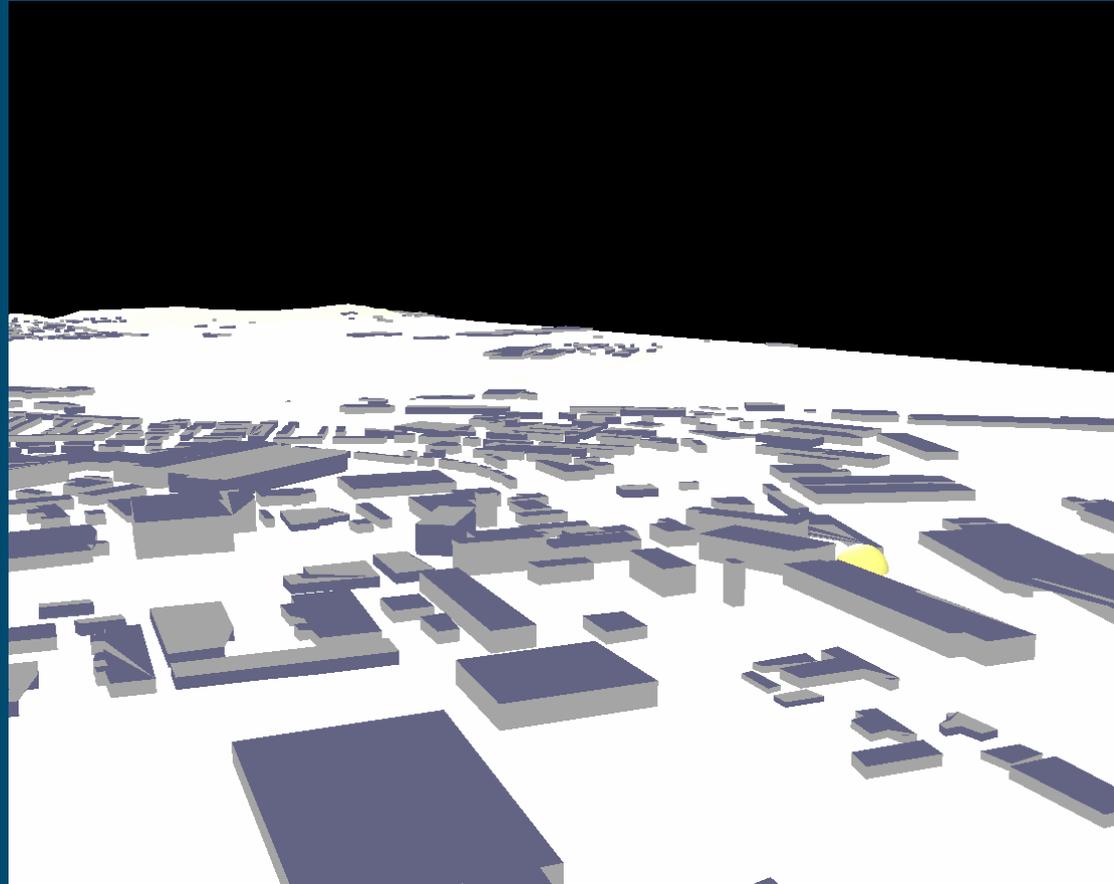


UDM



# SCIPUFF-UDM Link

- SCIPUFF able to provide all source puffs to UDM
- UDM models dispersion of each individual puff while interacting with buildings and urban ground areas
- UDM returns individual puffs to SCIPUFF when roughness canopy modelling appropriate
- Results of both models combined in SCIPUFF



# The Geographic Environmental Database Information System (GEDIS)

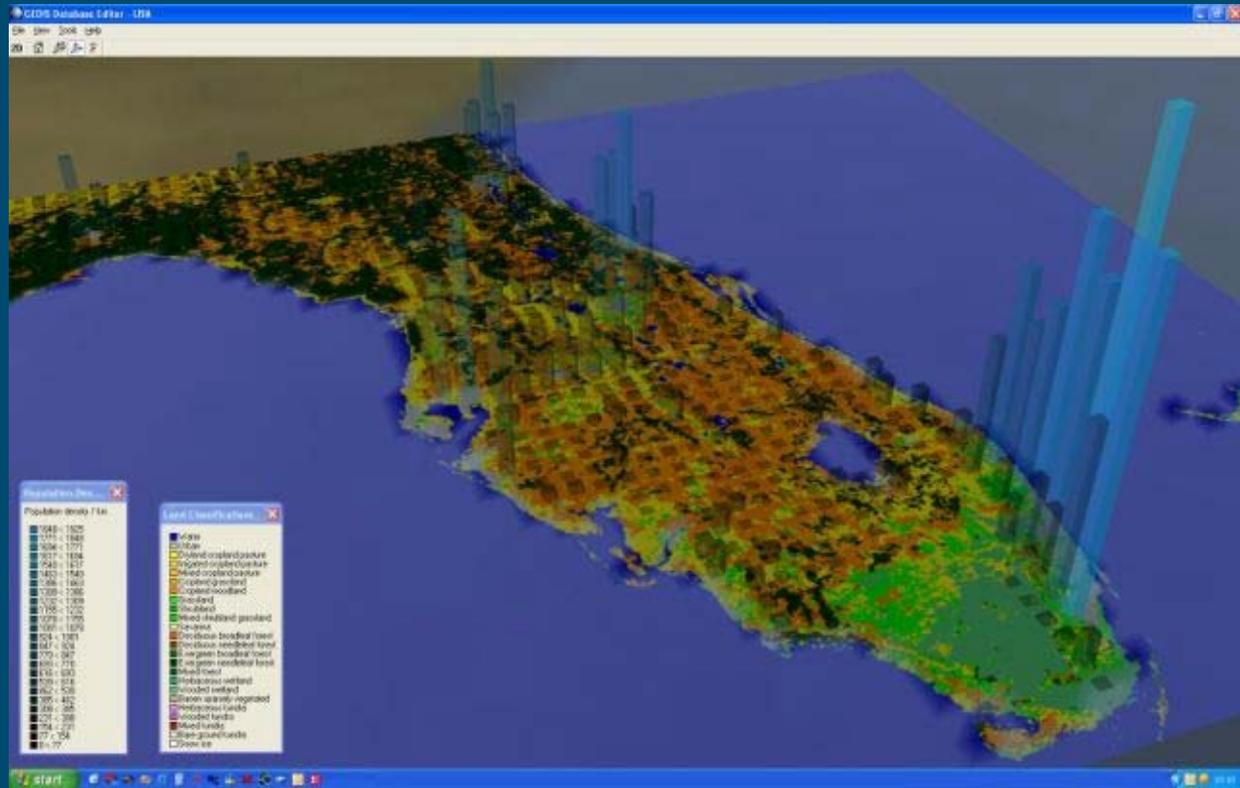


# GEDIS Overview

- Developed by Dstl for UK MOD and US DTRA
  - Subject of TTA for use in JEM
- Comprises set of GIS components & associated toolset applications
- Originally developed for storing urban data for urban dispersion models
  - Include data pre-processing, cleanup & quality assurance
  - Rapid data access
  - Import & export in standard formats (e.g. shapefile)
  - Rugged, with high level of testing
- Used by several urban models
  - UDM, UWM, MSS

# GEDIS Elements (1)

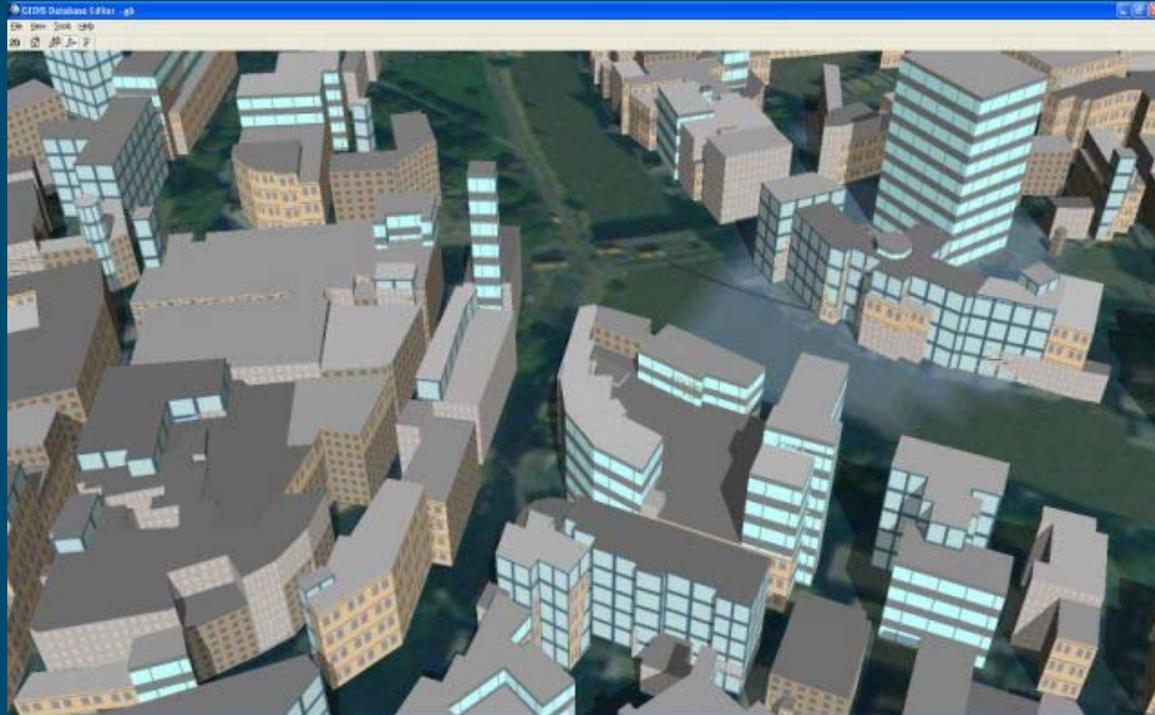
- Gridded data manager, stores
  - Multiple-resolution DTED terrain
  - ORNL population density data
  - USGS land classification data
  - Georeferenced aerial imagery



*Land classification and population density data for Florida*

# GEDIS Elements (2)

- Spatial object manager, stores
  - 2½D buildings with composite parts and courtyards
  - urban ground regions (for UDM)
  - Linear features such as roads and rivers
- Spatial R-tree architecture used to provide efficient access to feature data
- Queries based on coordinates & domains, with filters



*2½D composite buildings stored in GEDIS*

# GEDIS Elements (3)

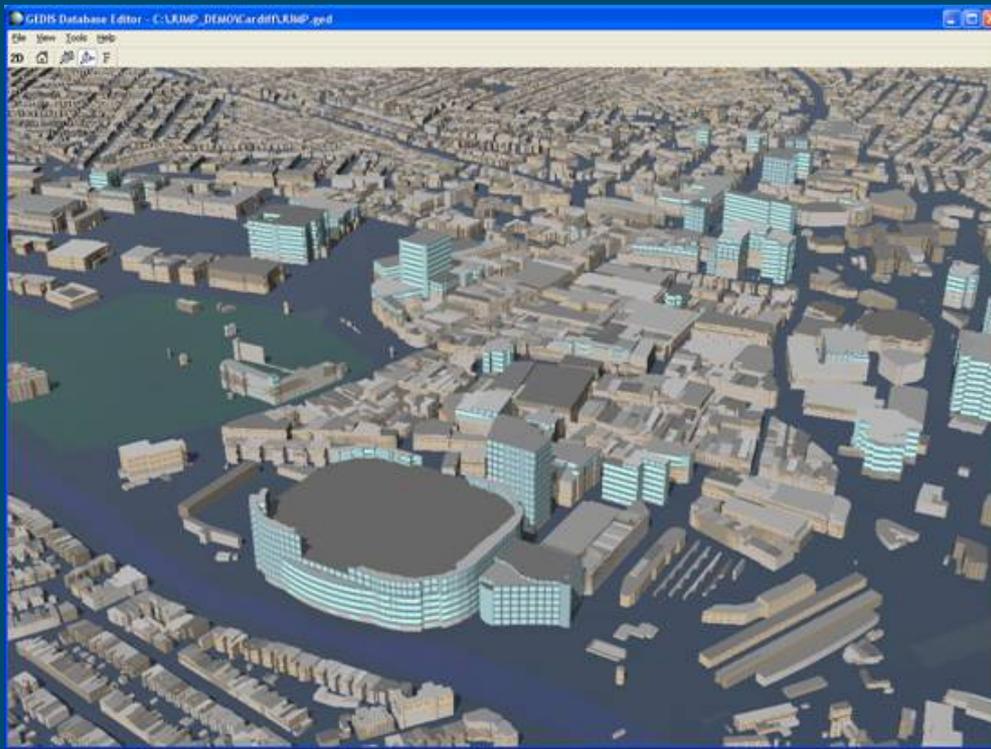
- Fusion of terrain, aerial imagery and building data





# GEDIS Toolset Applications (1)

- GEDIS Database Editor (2)
  - Allows visualization, creation, export and feature editing capabilities as a desktop application



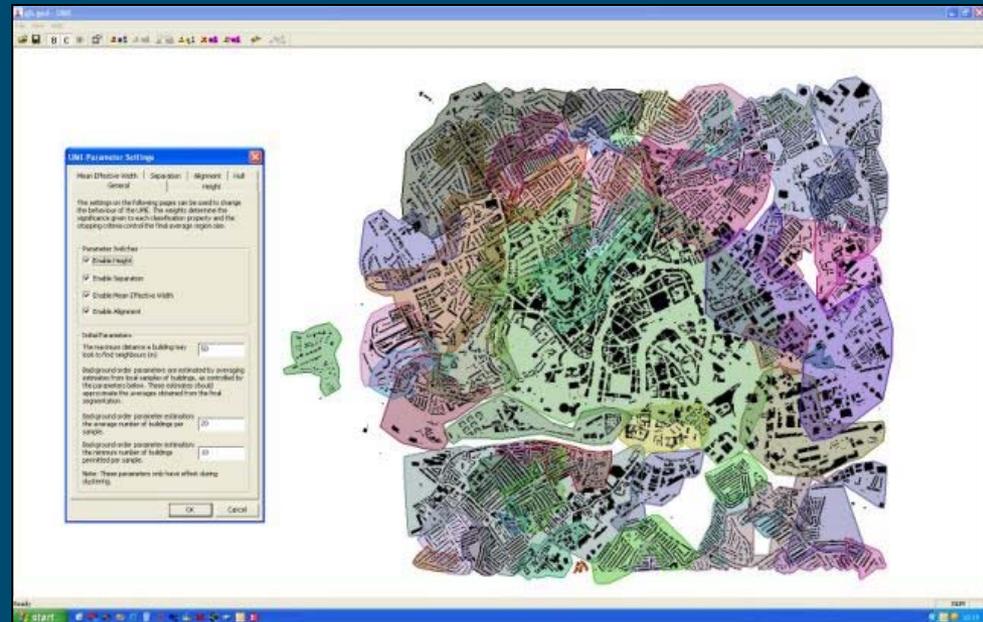
*3-D  
Visualization  
in the  
Database  
Editor*

# GEDIS Toolset Applications (2)

- Urban Density Calculator
  - Specifically designed to integrate GEDIS object representation of features with UWM (and similar models)
  - Feature data rasterized and urban properties such as canopy height & urban density calculated
    - Returned as UTM raster grids

# GEDIS Toolset Applications (3)

- Urban Morphology Extractor (UME)
  - Semi-automatically pre-processes building data to form homogenous areas categorised by various urban parameters (height, street alignment, building size and separation)
  - Areas created using statistical clustering algorithms
  - Data saved along with building data as urban ground areas
  - Provides client applications bulk properties of urban environments
    - These urban areas crucial to UDM calculations



UME User Interface

# Handling New Datasets

- Import source data
  - Import data as
    - Point, line, polygon, polygon-z data in ESRI Shapefile format
    - Raster data in any number of formats including DTED, Jpeg, and Bitmap
  - Tools includes conflation capabilities, allowing two separate datasets or sub-datasets to be merged into a single dataset
  - Duplicated or overlapping data can be automatically removed or merged
- Run UME on data
- Replace or augment current database

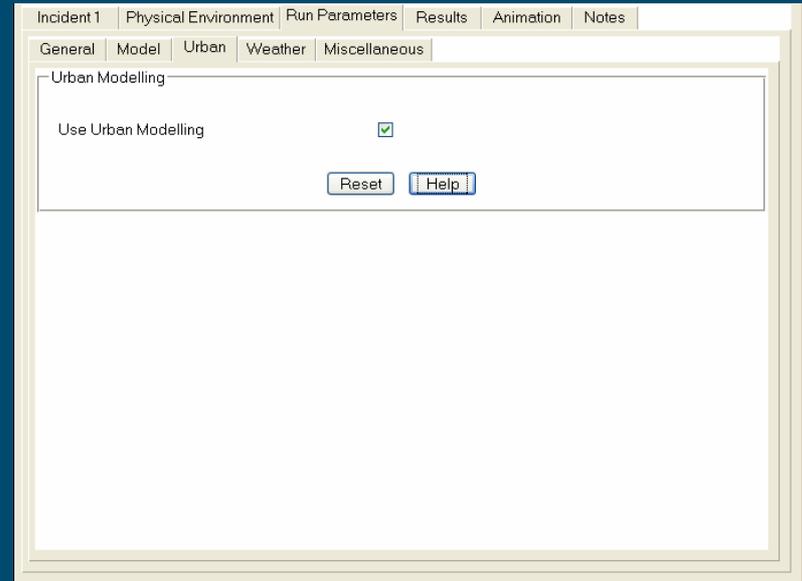
# JEM Urban Model Prototype (JUMP)

- Being developed to de-risk urban capability in JEM increment 2
  - Provides capability to demonstrate & also consider urban data issues
- JPM-IS / JSTO selected UDM for prototype as
  - Typical of urban models in terms of data requirements
  - Highly modular & easy to integrate
  - Proven capability

# JUMP Development Tasks

- Phase I

- Activate UDM calculation in JEM
- Display UDM output in JEM GUI
  - No buildings shown



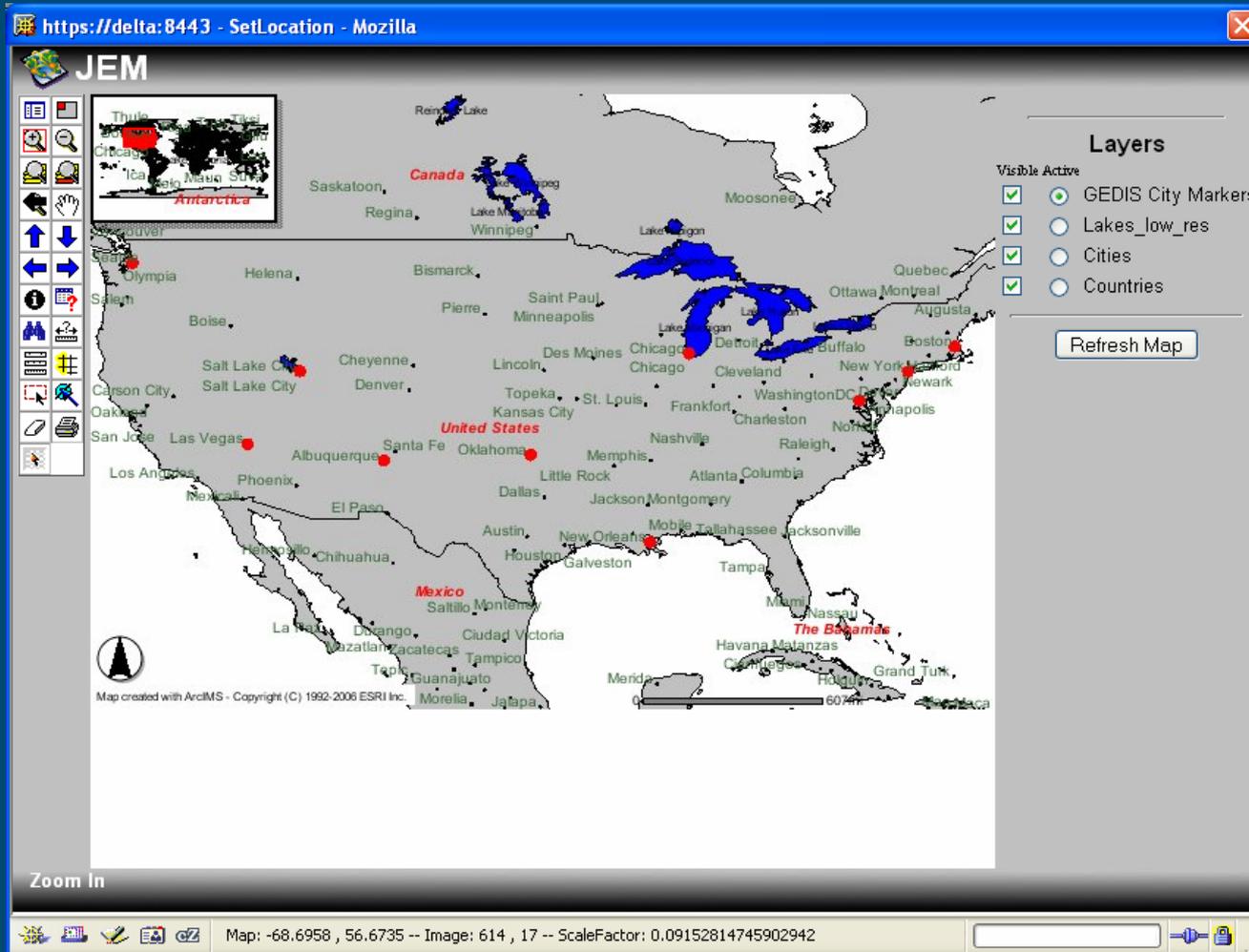
- Phase II

- Update to latest UDM & GEDIS
- Include urban model controls in JEM GUI
- Display urban data on the JEM ARCIMS map screen
  - Displayed urban data fixed & cannot be updated by user (data used in dispersion calculation can be)

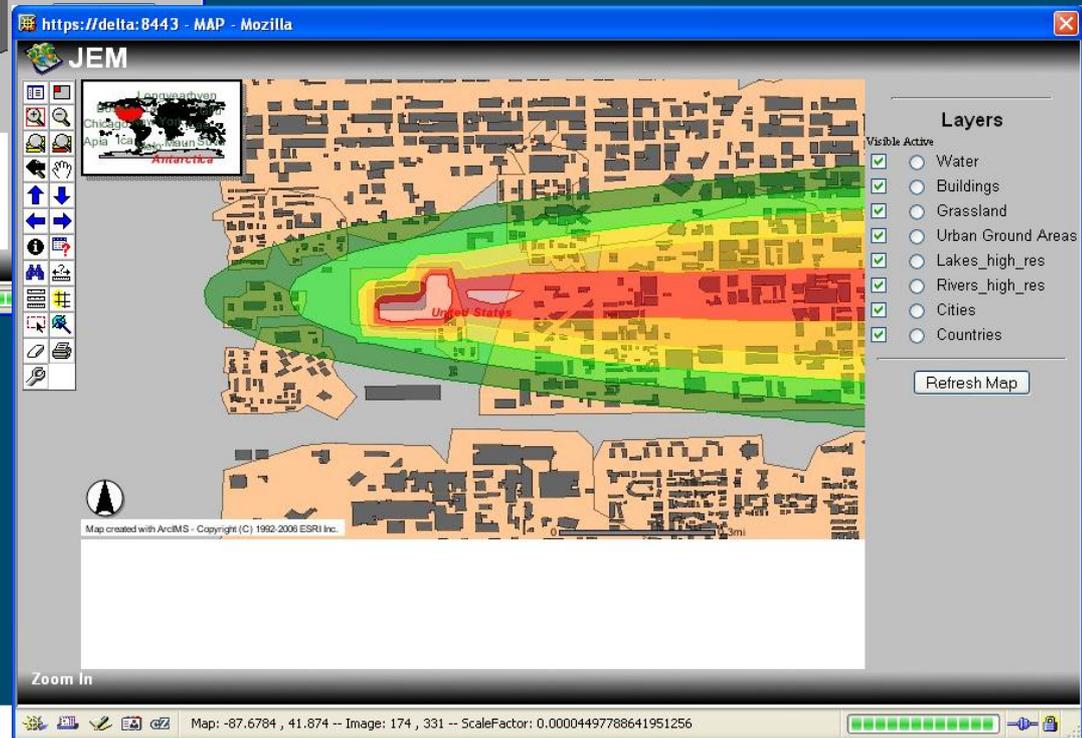
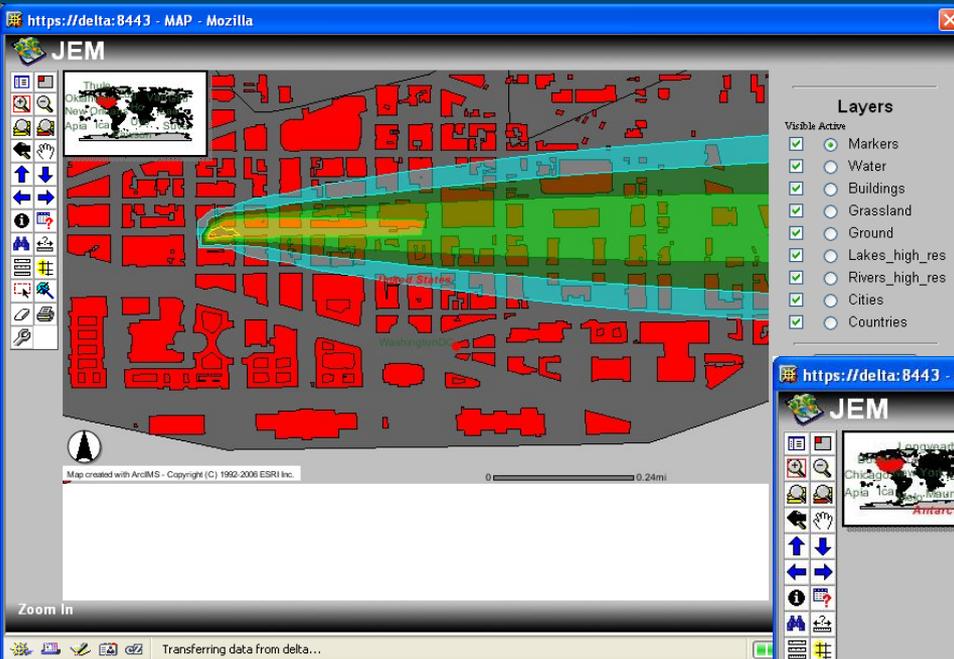
# JUMP Development Tasks

- Phase III
  - Export of geographic layer by GEDIS
  - Modelling service updates for geographic layer transfer
  - Visualisation service updates for geographic layer transfer
    - When urban database updated, ArcIMS background map layers are automatically synchronized
    - JEM administrator can then update urban data displayed
    - Requires JEM restart as JEM update capability not yet active
  - Create installation patch

# JUMP Example Screenshots (1)



# JUMP Example Screenshots (2)



**[dst1]**

# JEM Urban Modelling Prototype Demonstration

# Future Plans

- Complete testing & documentation
- Patch installation delivered to JSTO Jan 2007
  - Will not be included in general JEM release
- UDM & GEDIS both subject of TTAs for JEM