

# The Future of 3D GIS Visualization: the GPU and the Web

2009 Spring NEARC

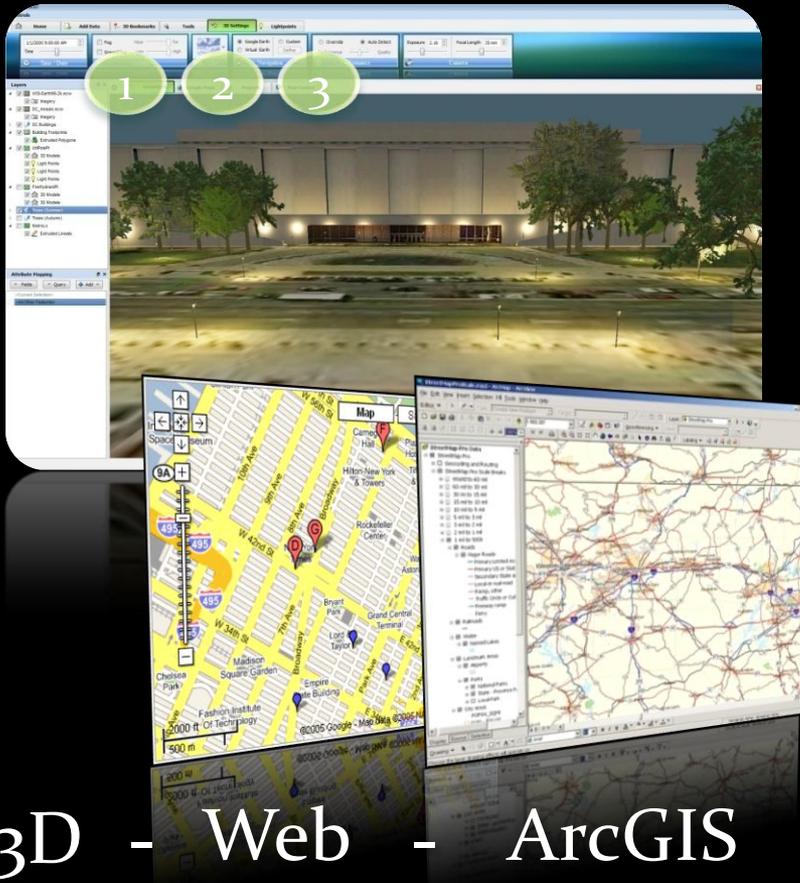
Geoweb3d

# Agenda

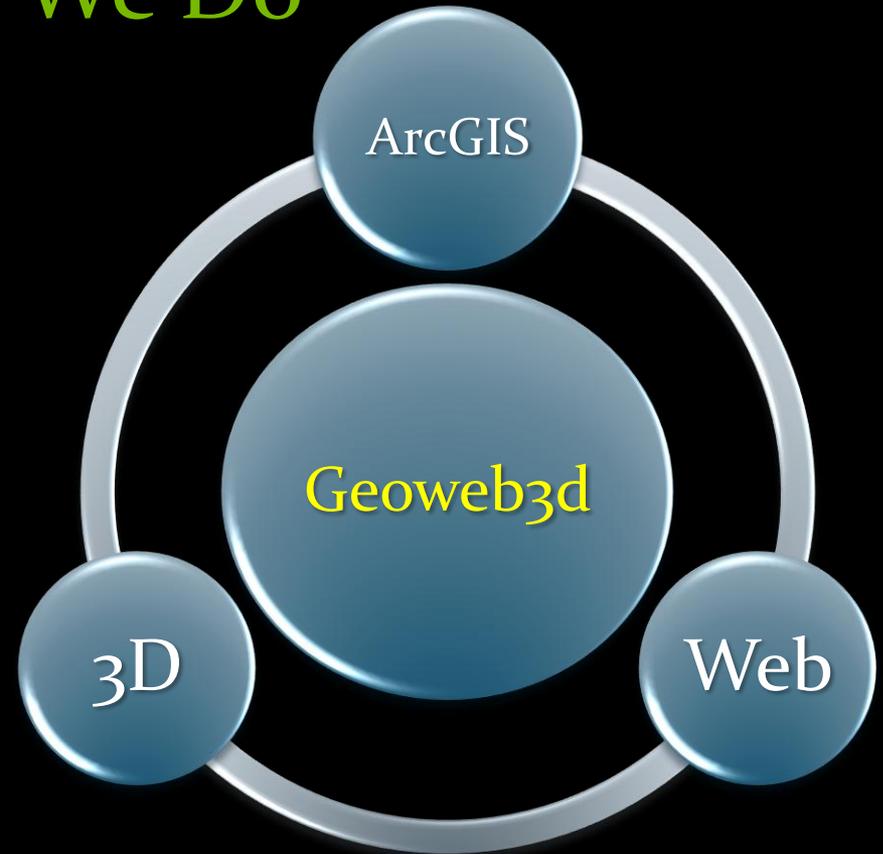
- Background
- Technology
- Benefits to GIS
- Examples
- Demonstration



# Background - What We Do



3D - Web - ArcGIS



Desktop, SDK

# What is a GPU?

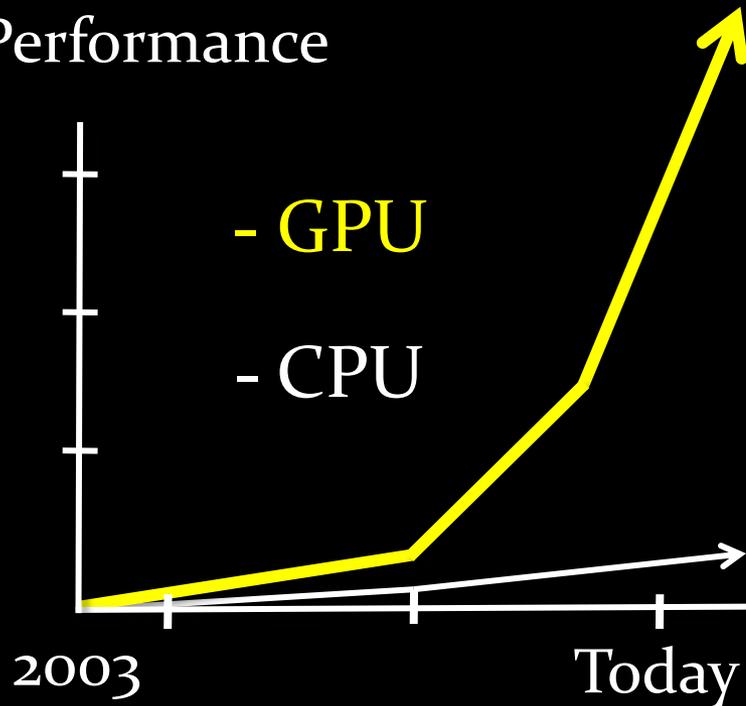
- Graphics Processing Unit
- The “CPU” of the Video Card
- Performance Explosion
  - Competition for \$20B Gaming Market
  - Competition for Mobile
- Low Cost, Standard Item
- Changing Computing



# How Can GIS Leverage This?

*... like it has the web*

Performance



**3D Visualization!**

*Gap Will Continue To Widen*

# Benefits to 3D Graphics

- Performance
  - Doubling every 6 months
  - In 5 yrs , that is **1000 x** today's performance
- Capabilities
  - Not what *can* we do, what *should* we do
- Data Volume, Quality
- 100% GPU Technology – 2012

# Benefits to 3D GIS Visualization

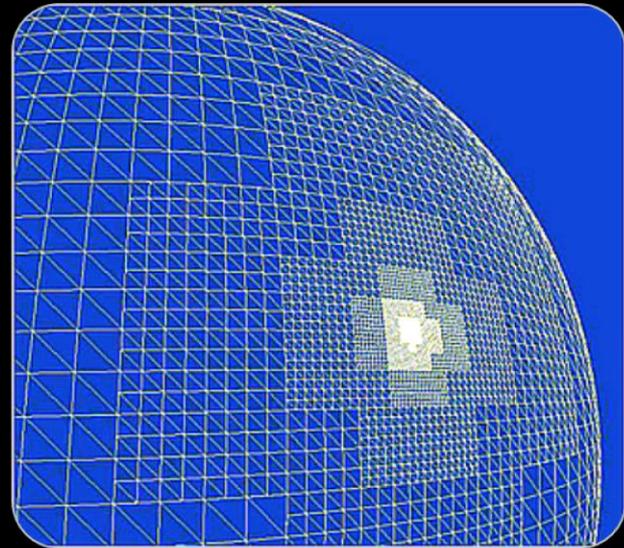
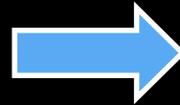
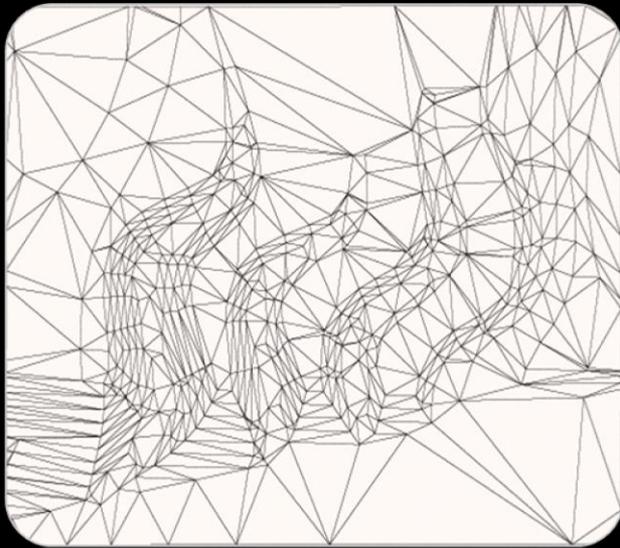
- GIS Data  $\Rightarrow$  Rich Scenery on Demand
- Performance, Accuracy, Volume of Data
- 2D – Legend & explanation, 3D – obvious



# Benefits to Digital Cities and Planning

- City-wide Building Visualization
- Massive Infrastructure Datasets
- Tracking Server for Vehicles / Assets
- Alternative Designs
- Interactive Navigation/ Animations

# Procedural Visualization



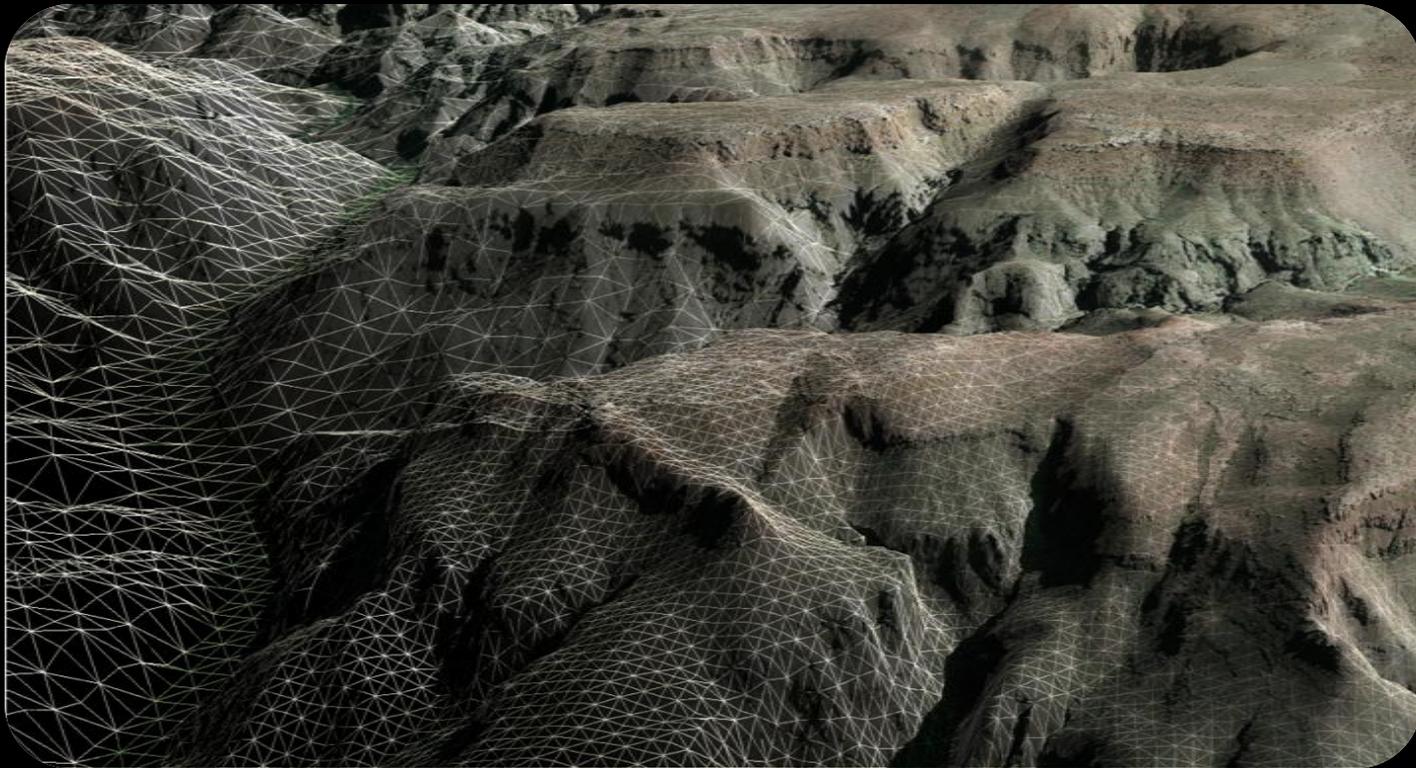
CPU

GPU

TIN (Triangular Irregular Network)

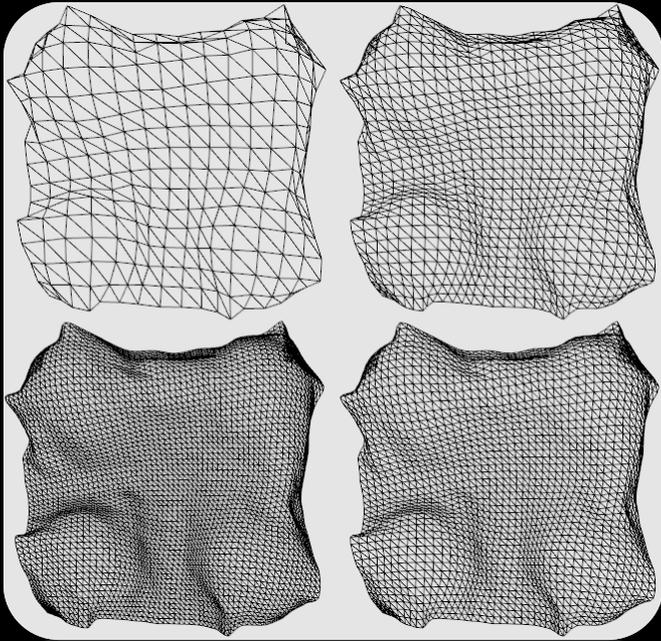
Adaptive

# Procedural Visualization



How?

# GPU Programming



- Geometry Stays on Card
- Program Per Vertex, Pixel
- Adaptive to Resolution
- Massively Parallel

**Thousands** of simultaneous programs

# Visualize GIS Data on Demand

- Eliminates Restructuring or Cooking Data
- Directly Load Native GIS Formats
- Dynamic and Enterprise Integration
- Leverage Growth of Available Geodata

# Interoperability & Scalability

- “Standards + Capabilities = Interoperability”
- Limited Reuse of 3D GIS Data *to Date*
- Standards
  - Imagery, Elevation – Native Formats Only
  - OGC, Collada, Kml, BIM, et al
- Separate Data & Visualization
  - Maximize Scalability

## Connection to Web GIS

- 3D Visualization from Native GIS Data
  - Where to Find the Data? Enterprise, Web
- **Mashup** Rich, Effective 3D Visualization
- Integrate Web Enabled Geospatial Apps
- Leverage Momentum of Web GIS
- Currently at it's Relative Infancy

# Benefits of ArcGIS Integration

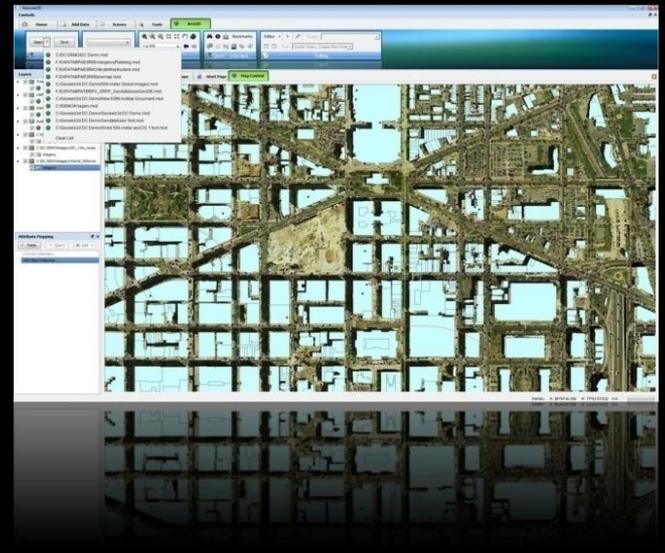
- Geoweb3d and ArcGIS are Complimentary
  - Each Extends the Other
- Scalability, Interoperability
  - Enterprise Solutions, ArcGIS 9.4+, 3D Analytics
- Extensibility
  - Compatibility with Extensions
  - e.g. Image Extension, Tracking Analyst
- Client-Server Model
  - Remove Need for Localized Data

# ESRI Geodatabase

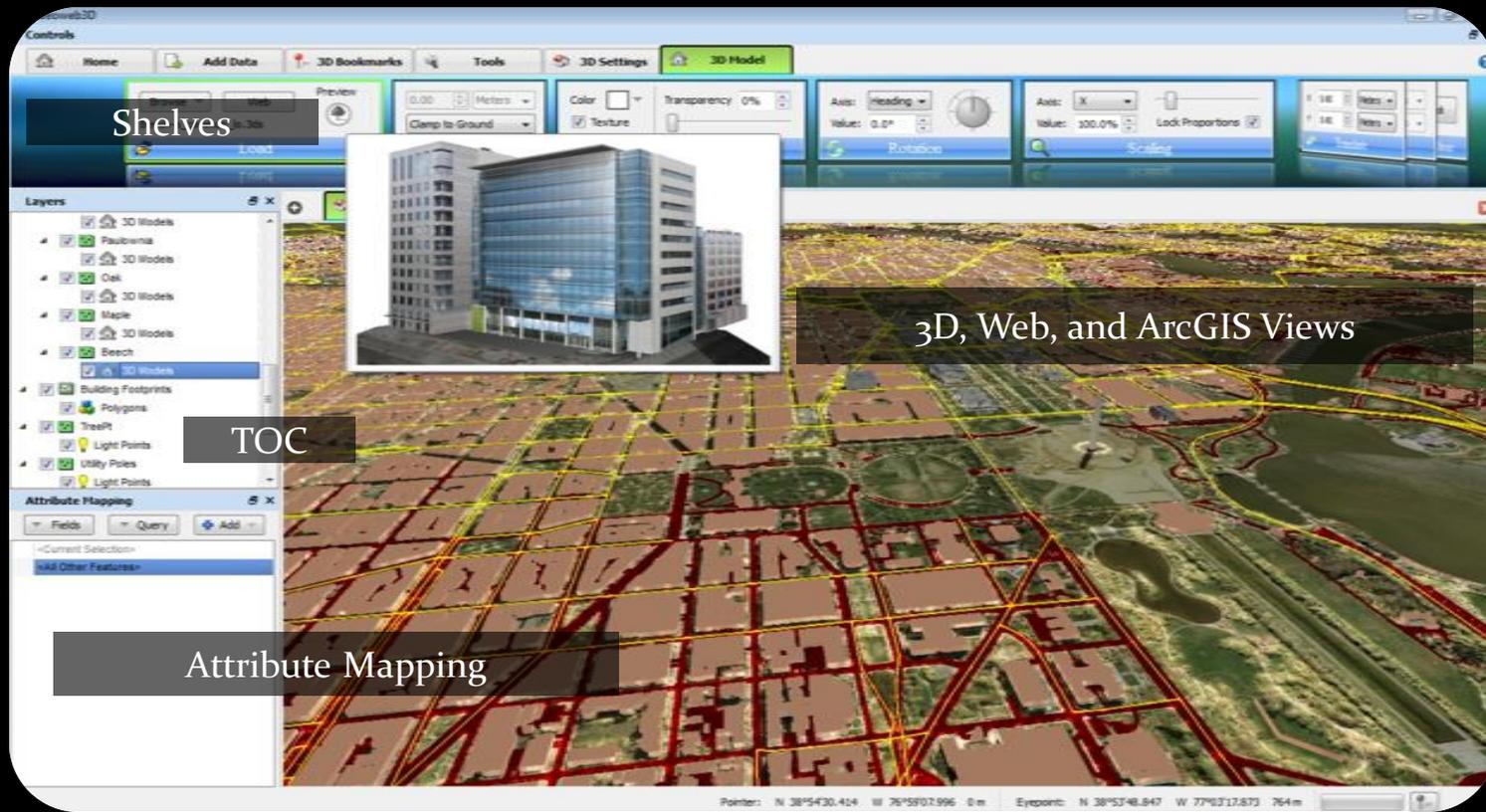
- Now - A *Primary* Visualization Format
  - Supporting Native Data Without Restructuring
- Abstracted API
  - Forward Compatibility
- Visualize Live Data
  - 3D Scene Concurrent to Remote Geodatabase Updates

# Embedded ArcGIS Map Control

- Tab Within Application
  - Share Data, Coordinate Views
- Editing
- Familiarity
- “Jump Start” to 3D
  - Start from Your Own Map Documents



# Examples



# Examples



Collada Models

Building Footprints

Trees

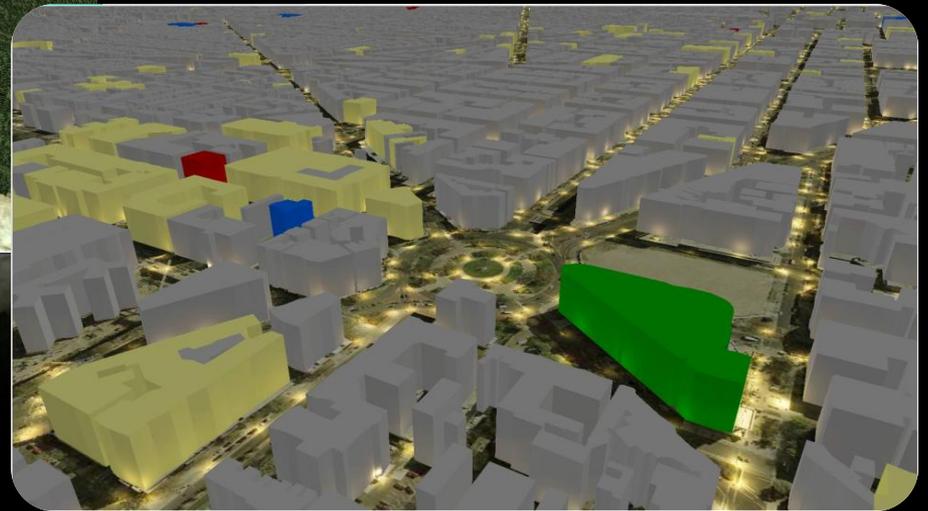
Fire Hydrants

Utility Poles

# Examples



Attribute Mapping



3 Million Trees

x 500 Polygons Per Tree

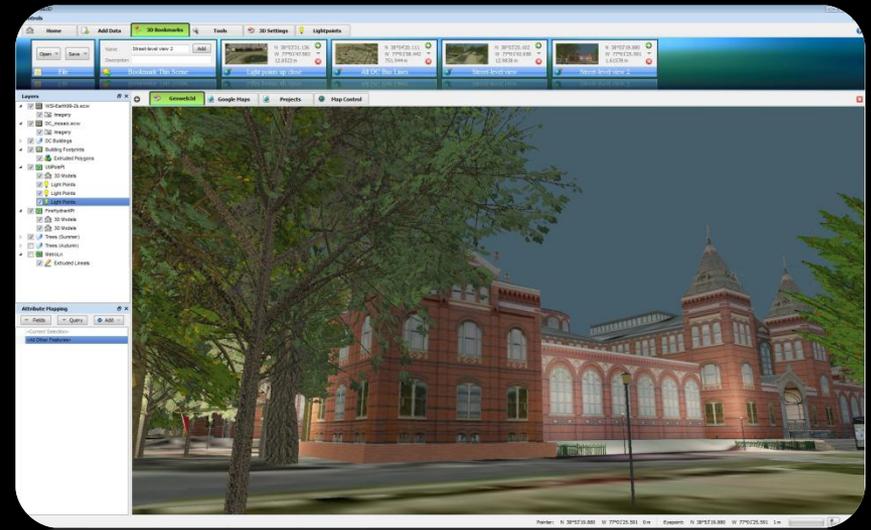
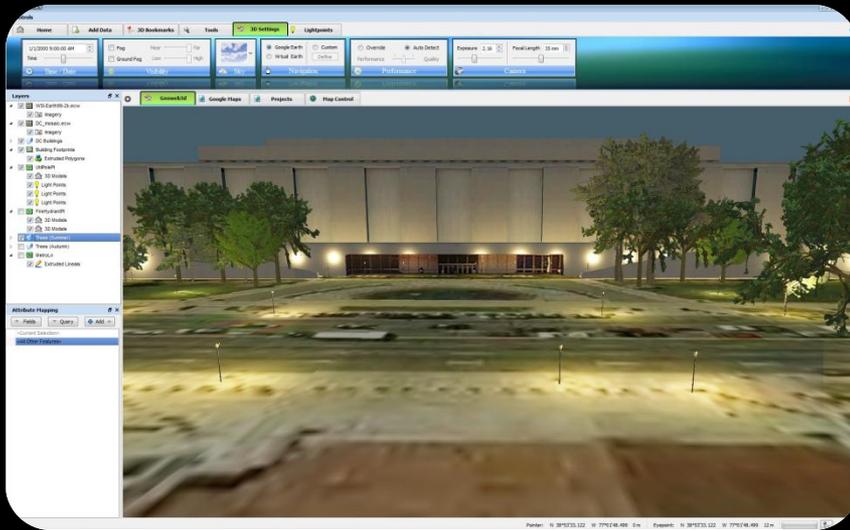
1.5 Billion Polygons

# Examples



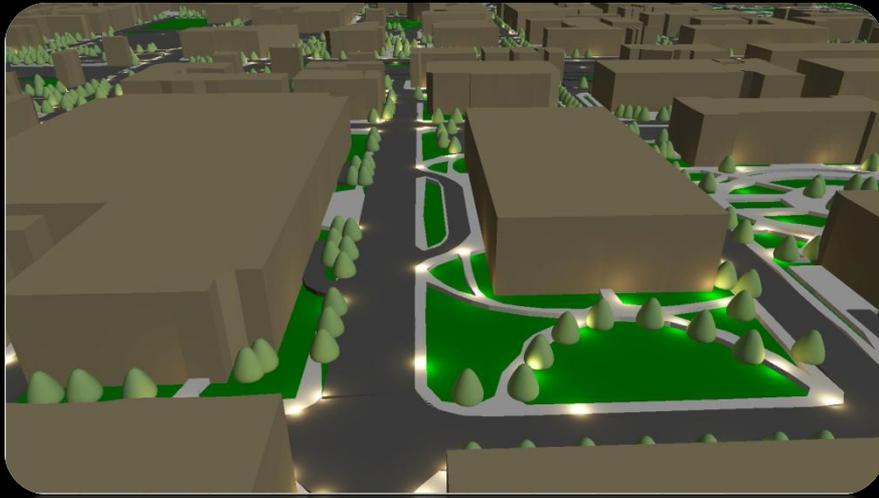
High Resolution DEM

# Examples



Accurate Lighting

# Examples

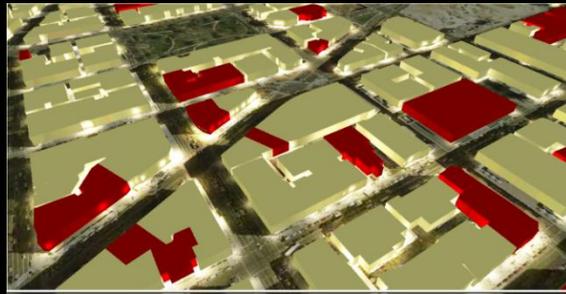


Thematic



Great Data = Great 3D

# Examples



Attribute Mapping



Move Beyond ...

1 Computer, 1 Window

# Challenges of Commodity Virtual Globes

- Not Developed for GIS
- Used by Default, Few Alternatives
- Injected Advertising
- Problems with Large Datasets
- Kml - Display, Sever Connection to Data
- Lack of Fine Controls (e.g. Layer Order)
- Animation, Simulation

# Benefits To GIS

- Remove Current Limitations
- Highly Effective 3D Visualization
- Maintain Connection to Data
- Browser Ready
- Scalability
- Enterprise Integration
- Tracking Server

# Conclusion

GIS Advancing to its Native 3D and 4D

Web 3D GIS Visualization Must Embrace This

GPU Technology Will Provide the Capability

# Demonstration

