



# 3D CARTOGRAPHIC TECHNIQUES

Nathan Shephard and Kenneth Field

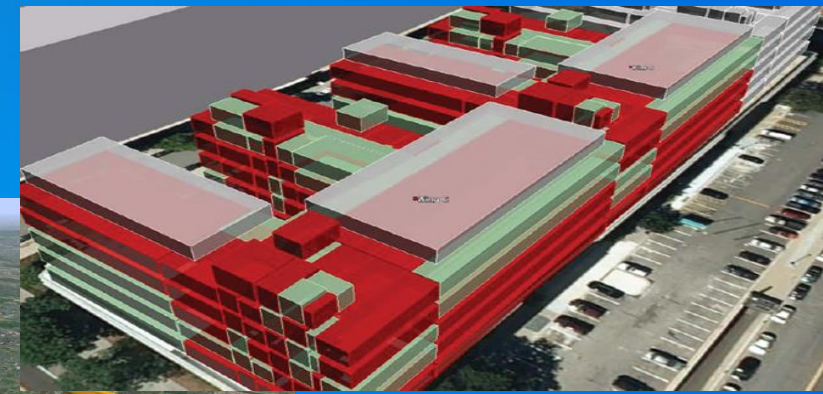
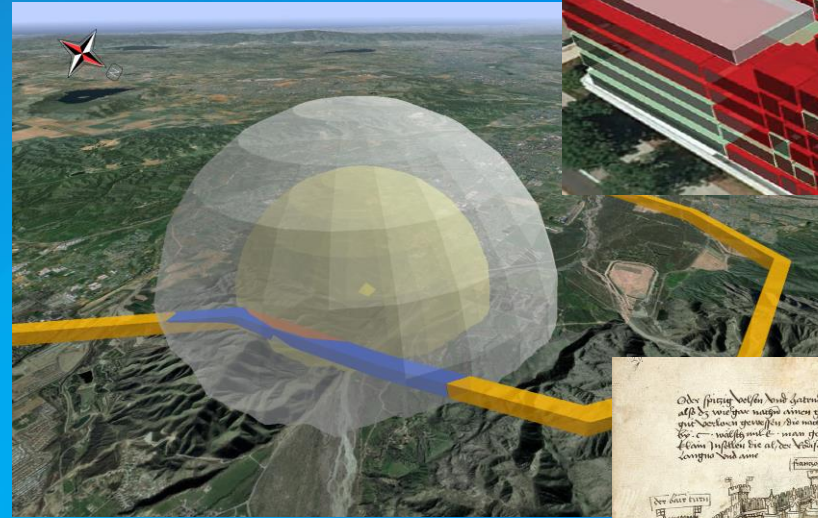
# Why create 3D views?

**“It’s cool, man!”**

*Which really means...*

- See vertically stacked content
- Show data in an easy-to-understand form
- Invite imagination and understanding

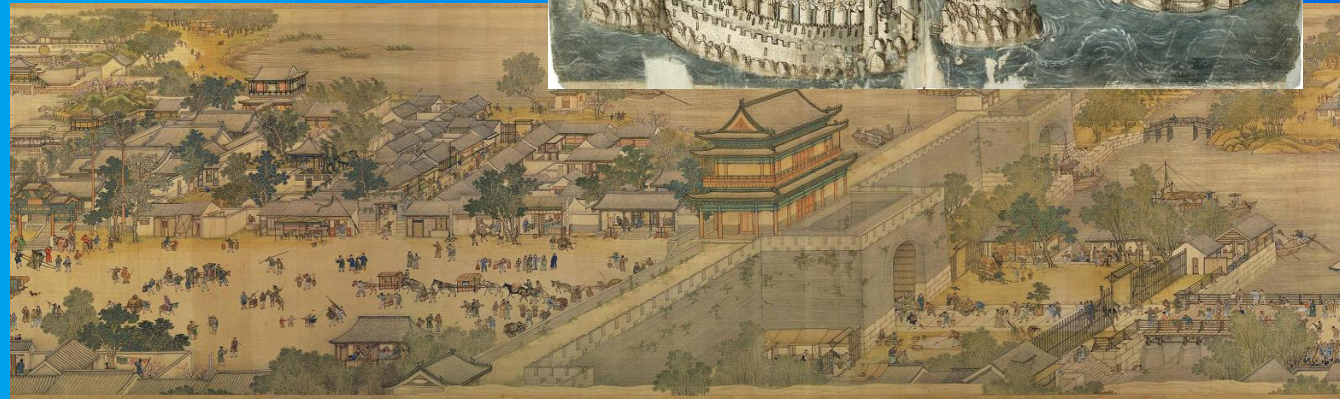
**3D is *how humans see the world***



Rhodes, Greece  
Konrad Grünenberg (1487)



“Along the River”, Keifeng, China  
Zhang Zeduan (1084-1145)





# Classic first attempt at 3D symbology...

## Population sticks

- *Manchester* : 2.8m
- *Birmingham* : 2.7m
- *Liverpool* : 1.5m
- *Leeds* : 1.5m



No useful information—

Bad information—

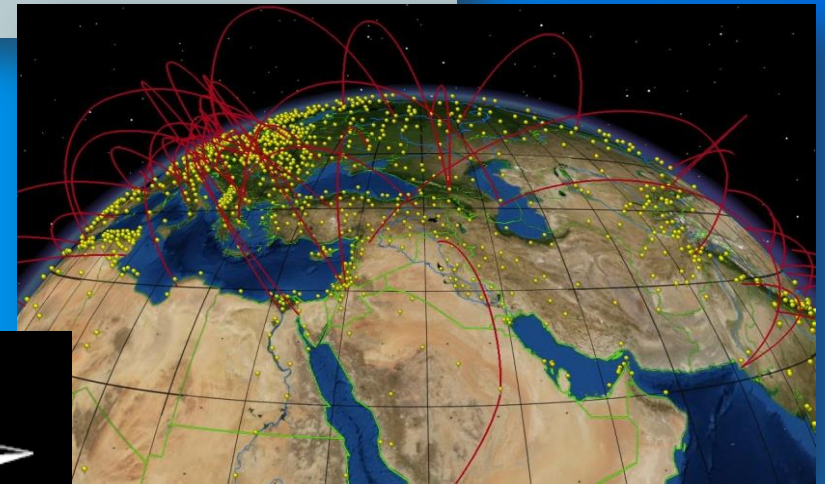
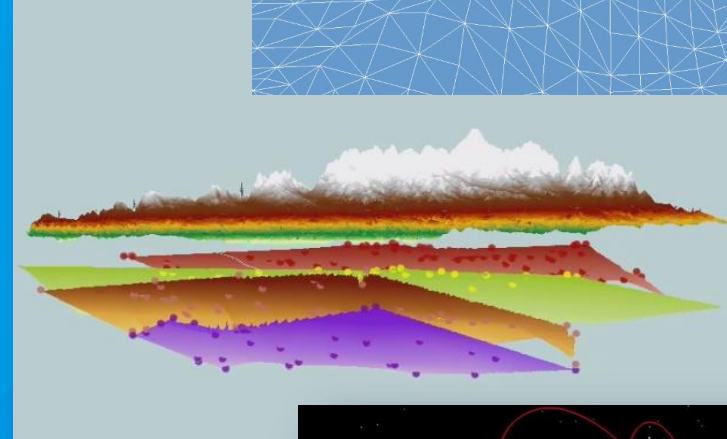
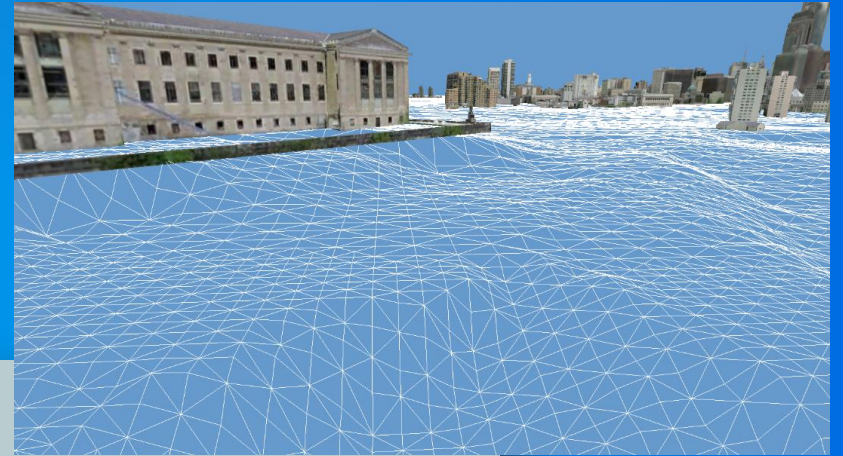
Labels

Real-world size symbols

← Use a isometric / axonometric view

# 3D View: **Four Main Elements**

- **Surfaces**
  - A ground (primary) surface
  - Plus optional other surfaces
- **Textures**
  - The “cover” on top of the surfaces (eg: aerial imagery, cartographic maps, etc)
- **Features**
  - That live on / relative-to the ground
  - That know their own absolute z's
- **Marginalia and effects**
  - Reference aids (eg: north arrow, TOC, ...)
  - Atmospheric effects (eg: lighting, fog, rain, ...)



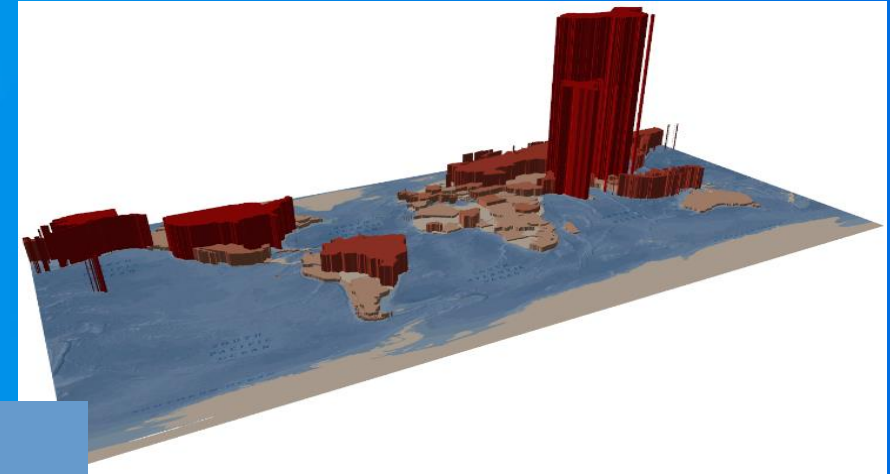


# Styles of Scenes

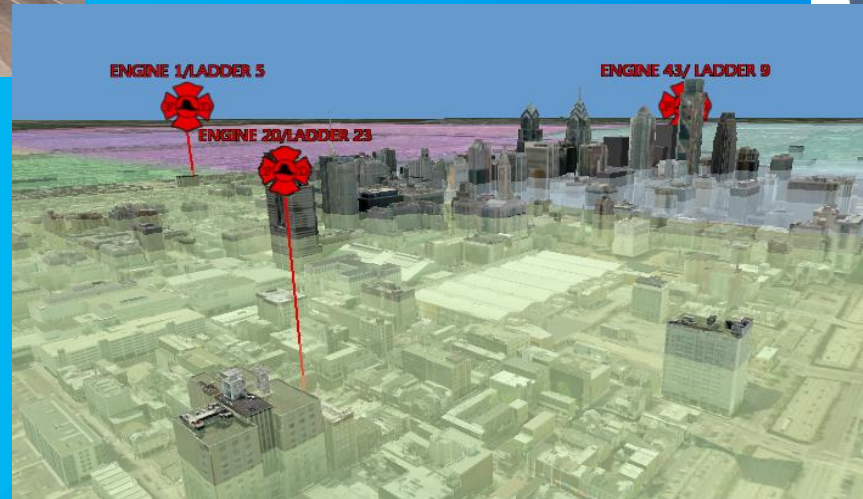
Photo-realistic  
(Real-World)



Cartographic  
(Representative)



Augmented Reality



# Photo-realistic Scenes

For 3D cartographers...

...they're kind of boring

DESIGN REQUIREMENTS?

→ Look outside

USEFULNESS?

→ Changes to the status quo

AUTHORING OPTIONS?

→ Mood effects (lighting, rain, fog, ...)



*Beautiful, ray-traced cityscape for Rotterdam, showing proposed new buildings with a setting sun and water reflections*



# Cartographic Scenes

For 3D cartographers...

...they're interesting!!

DESIGN REQUIREMENTS?

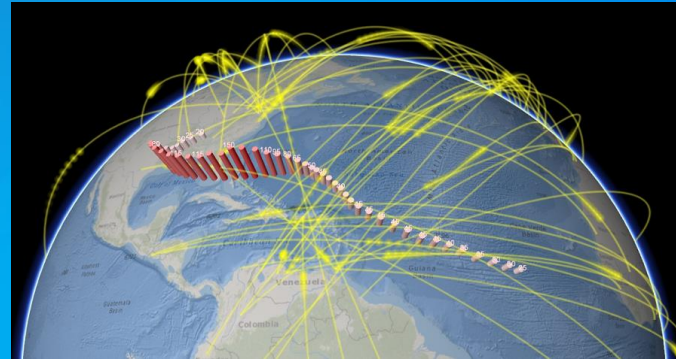
→ As rich / full as for 2D maps

USEFULNESS?

→ Powerful, eye-catching, immersive

AUTHORING OPTIONS?

→ Size, Shape, Offset, Textures, Text ...



*Int'l Flight Paths*



*Zoning Laws*



*LA Rail System*



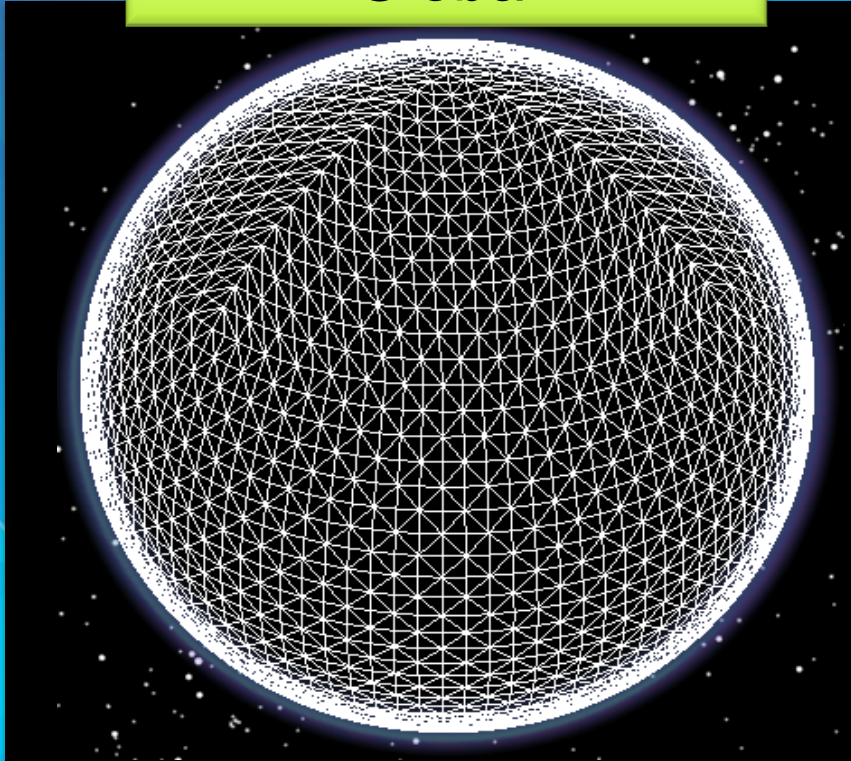
*Solar Impact*



*Air Corridor Risk*

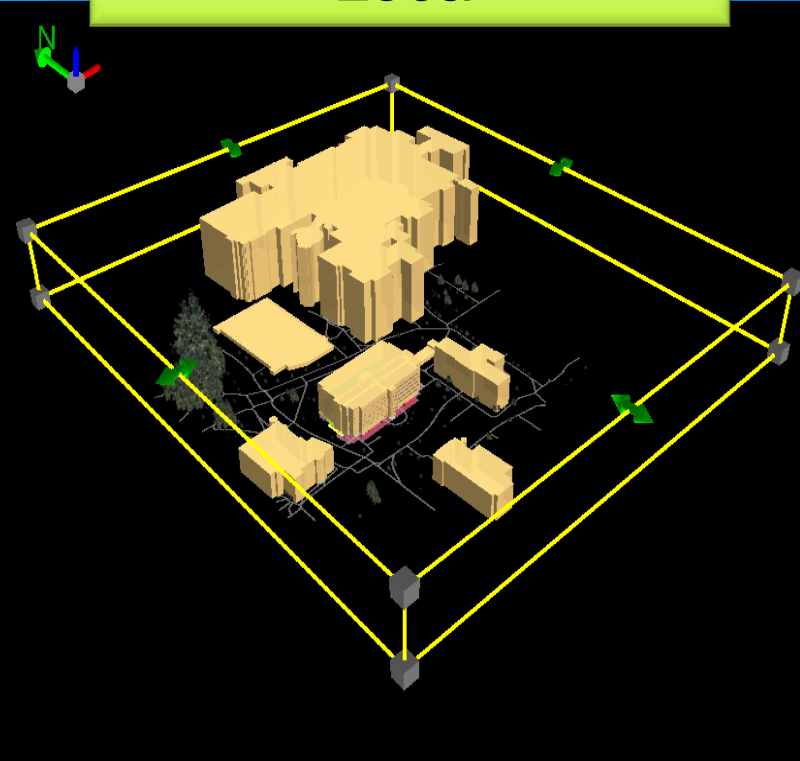
# Types of 3D Worlds

Global



Global Coordinate System (WGS84)  
Curvature of the earth  
'Global' context

Local

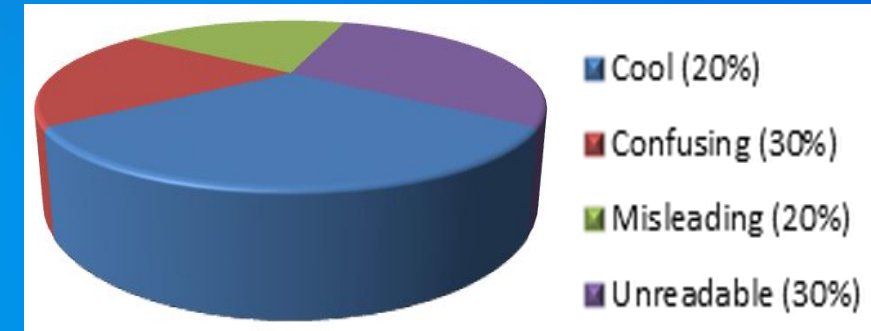


Projected Coordinate Systems  
Fishtank area-of-interest  
'Relative' context



# Beware, 3D can be evil...

- Perspective distortion = **lying**
- Content can be hidden = **lying**
- Continuous scale = **symbols change across scales**
- Easy to get disoriented = **annoying**
- Large amounts data = **slow**
- Hard to author = **scary**

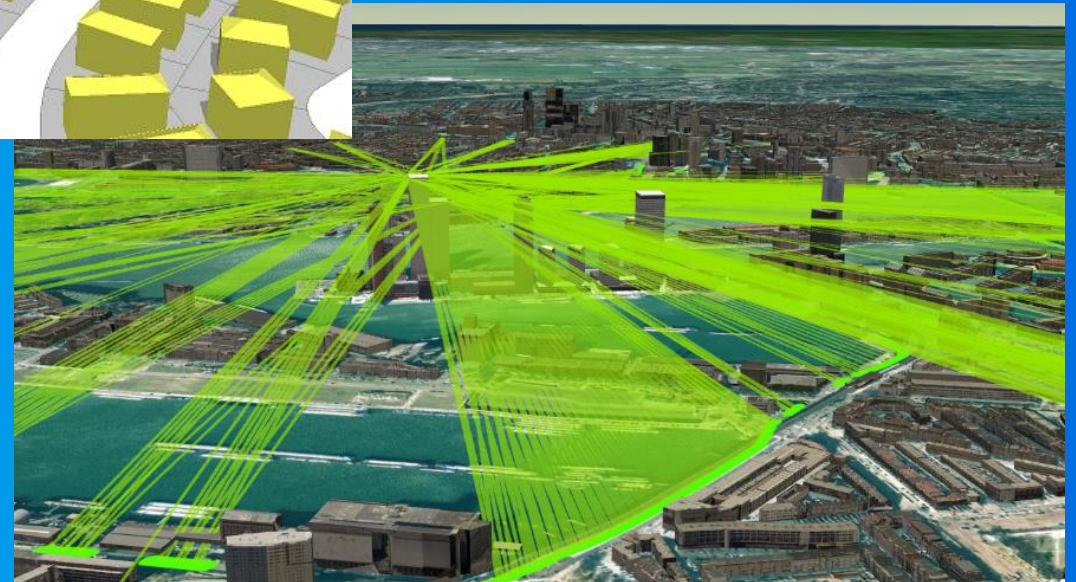
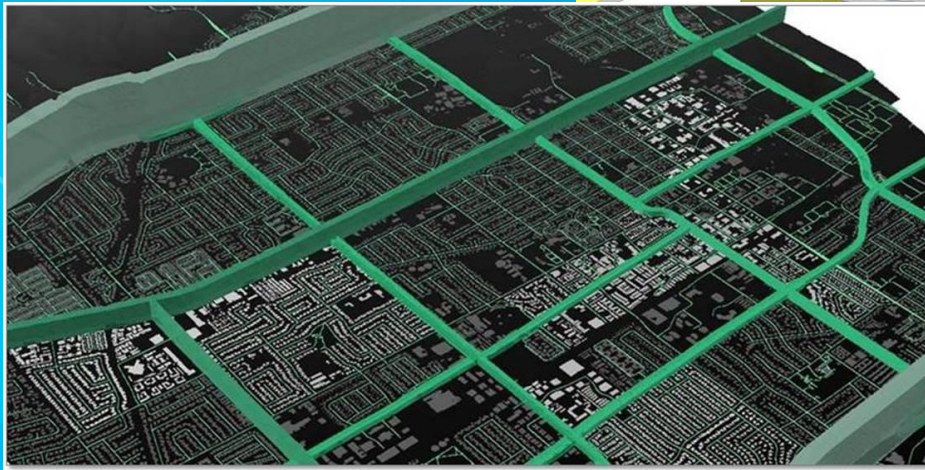
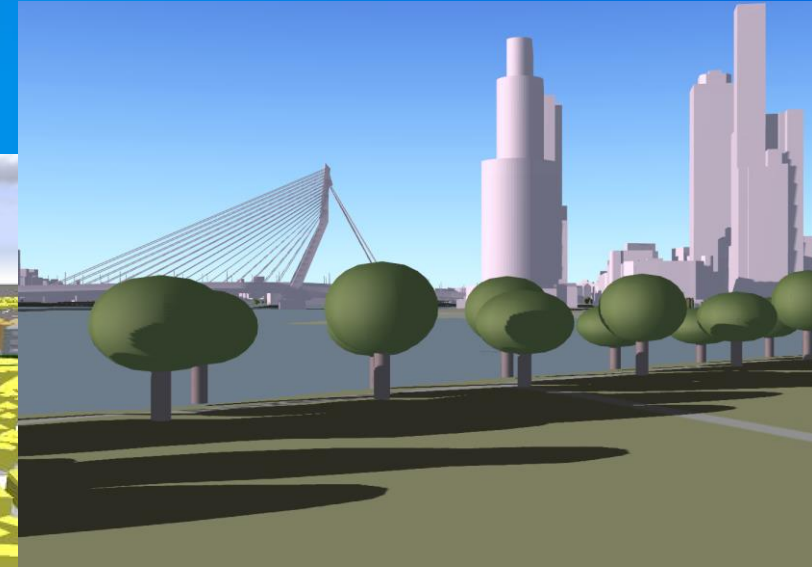


- + Major Roads
- + Minor Roads
- + POI's
- + Building Footprints

SCALE

# 3D View: **Familiar Symbols**

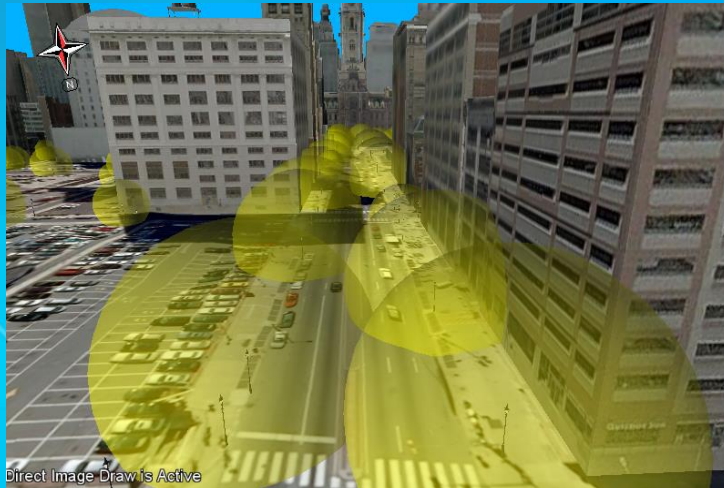
- Objects
  - Trees
  - Stylized shapes
- Colors
  - Green is good
- Use realistic elements
  - “Walls” as barriers



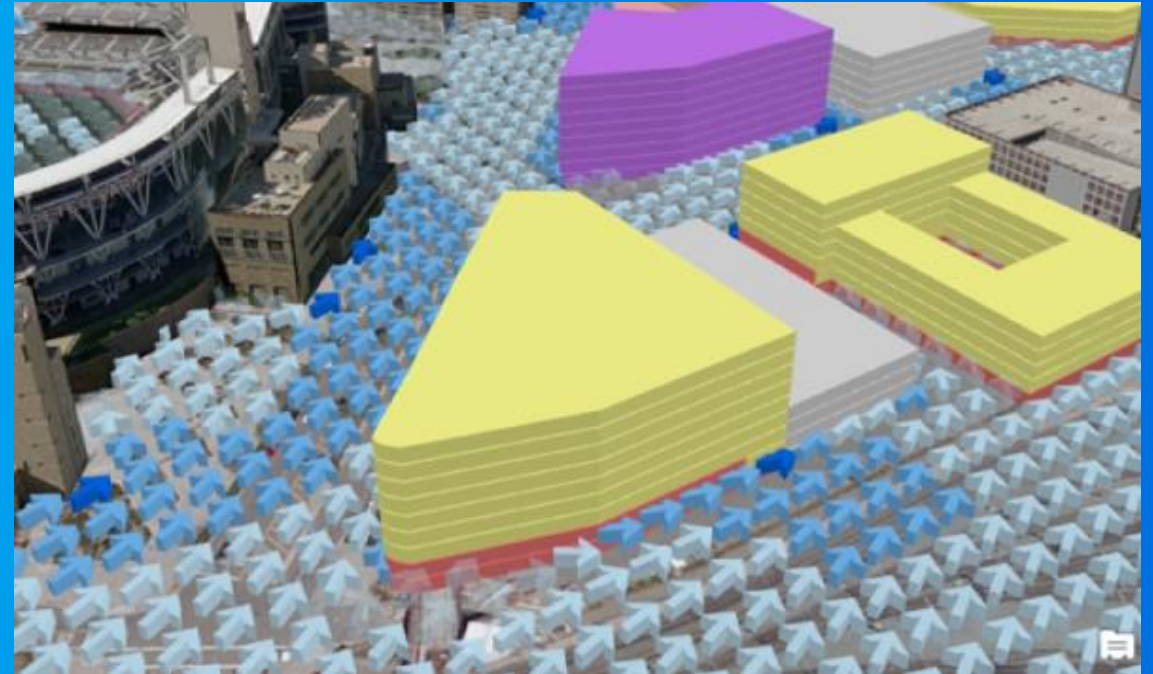


# 3D View: **Attribute-driven symbols**

- Change symbols based feature information
  - Size
  - Color
  - Transparency
  - Rotation
  - ...



*Street light coverage*

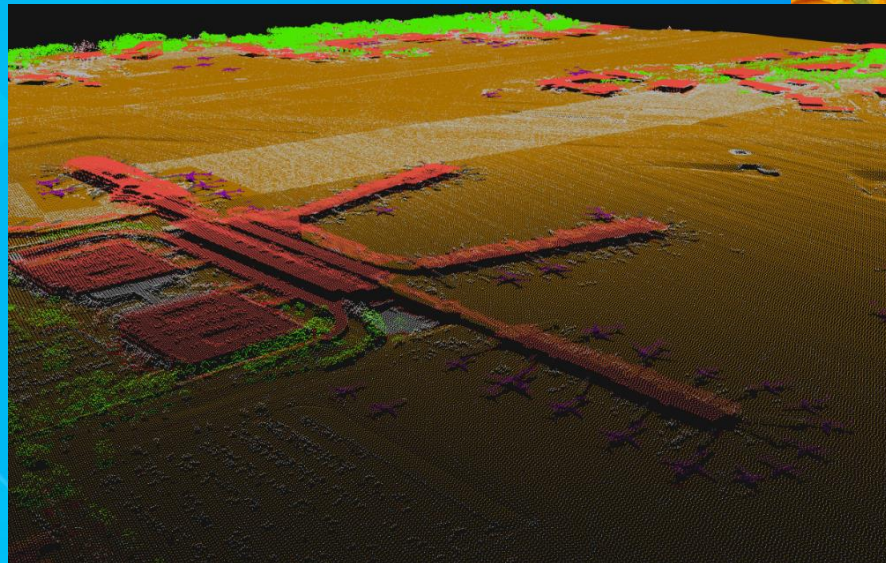
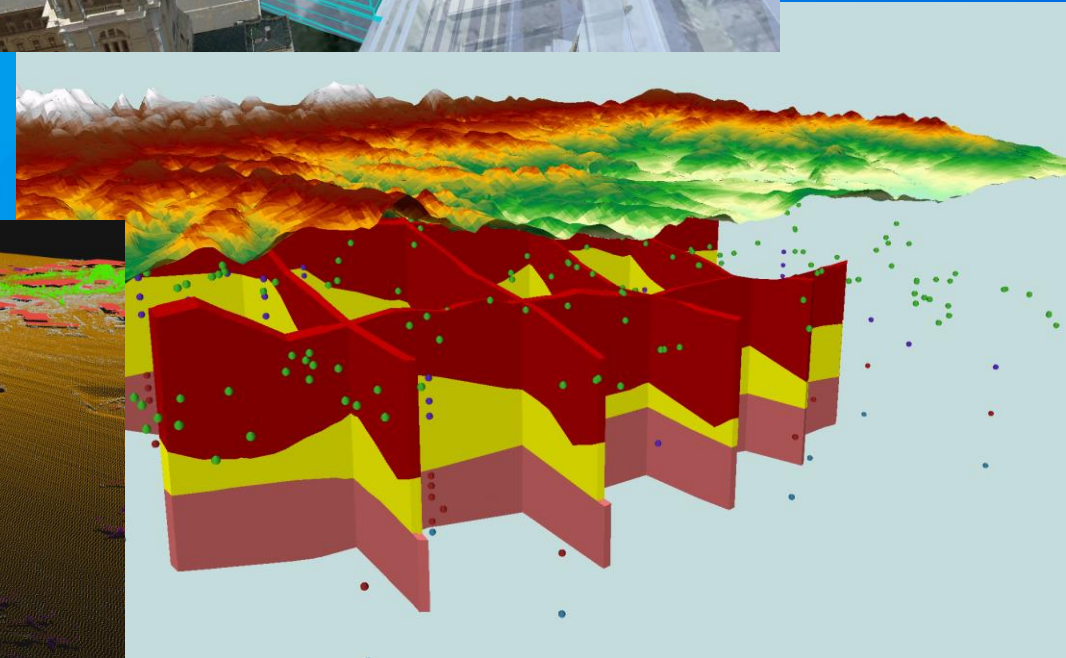
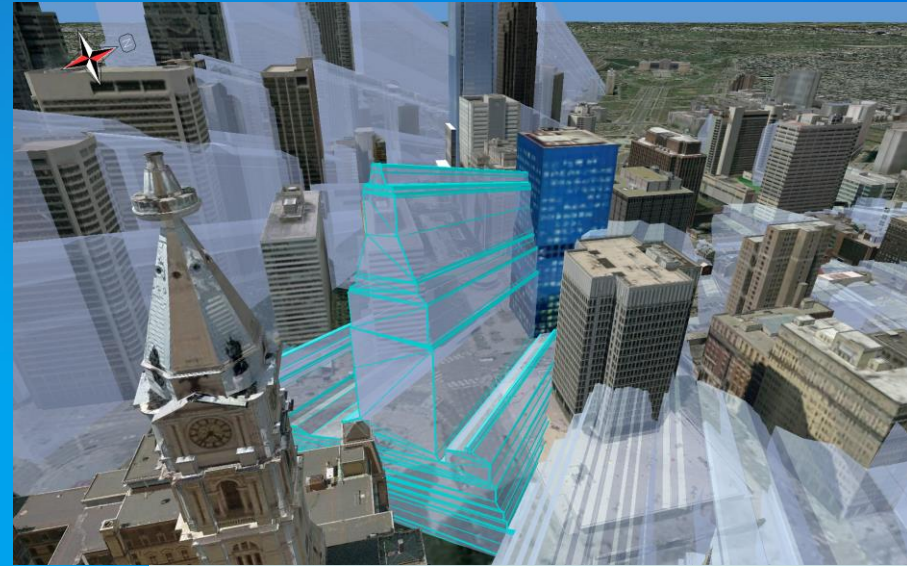


*Wind vectors through a proposed development*



# 3D View: **Super Powers**

- Fly around
- Use X-ray vision
- Expose invisible things
- Go underground
- See using radar





# JFK Crime Scene

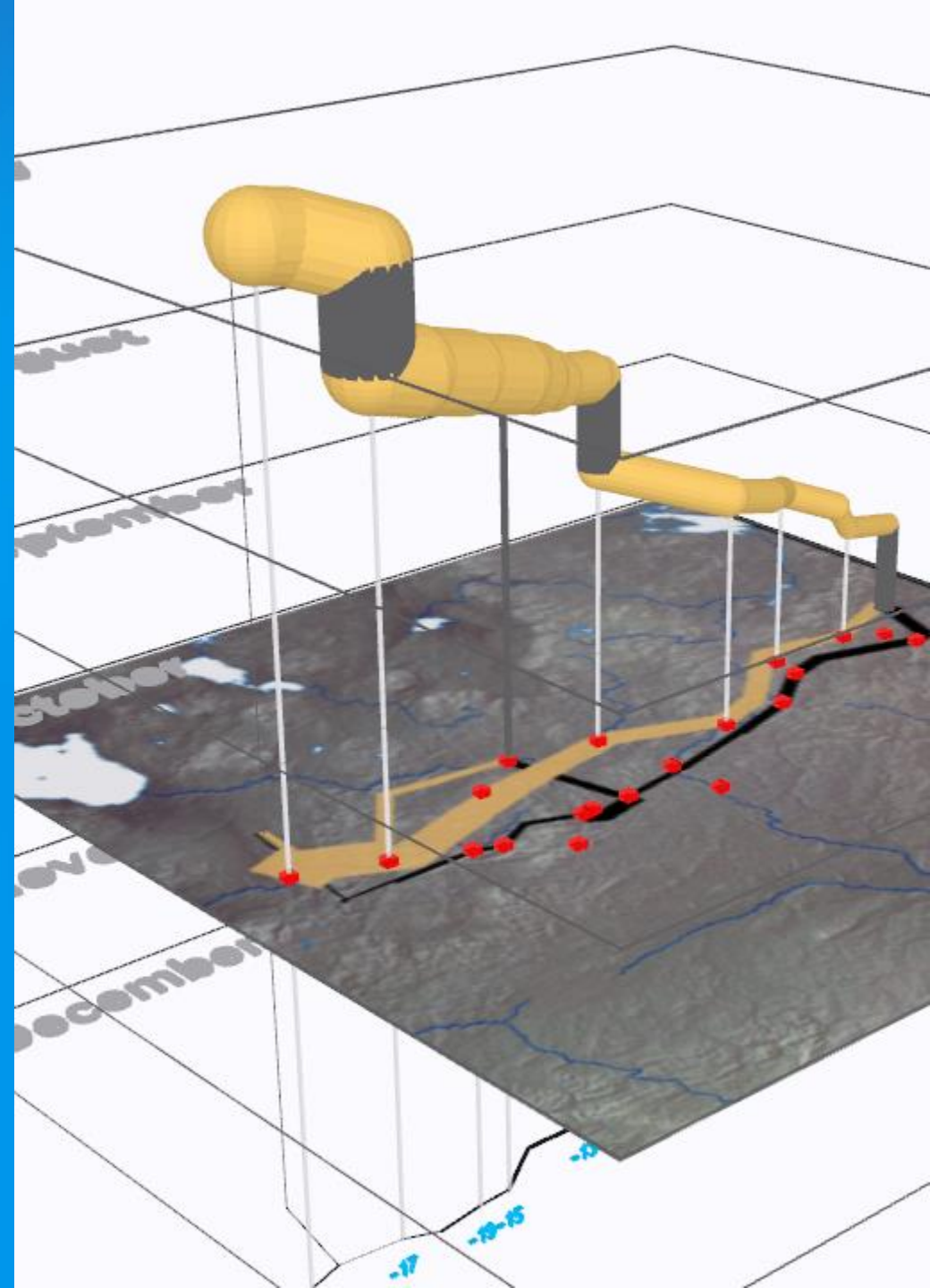
Nathan Shephard

<http://blogs.esri.com/esri/arcgis/2013/11/22/jfinteraktive-the-assassination-of-john-fitzgerald-kennedy/>



# Minard's Map – 3D

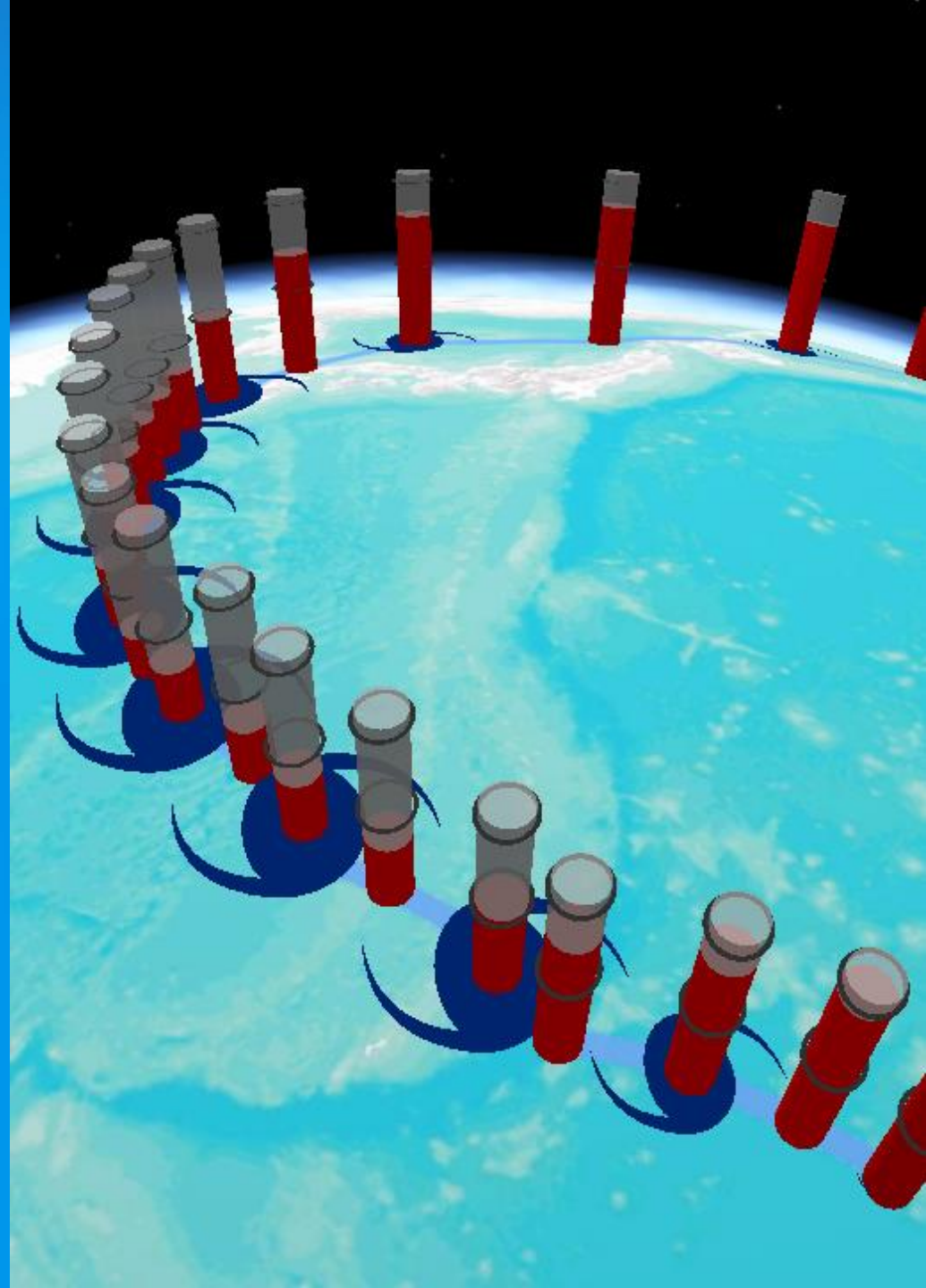
Kenneth Field





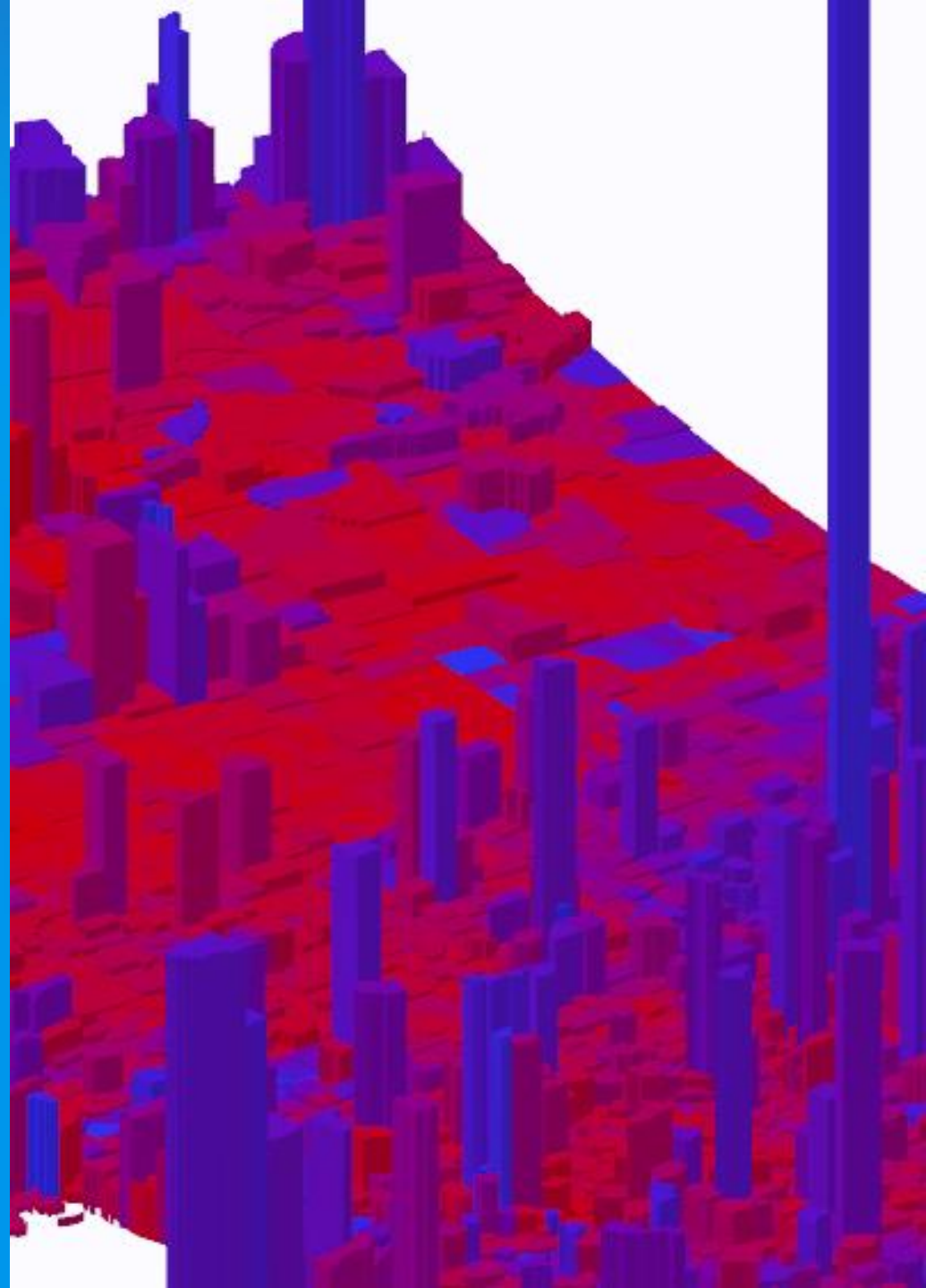
# Typhoon Nabi

Nathan Shephard



# Obama vs Romney

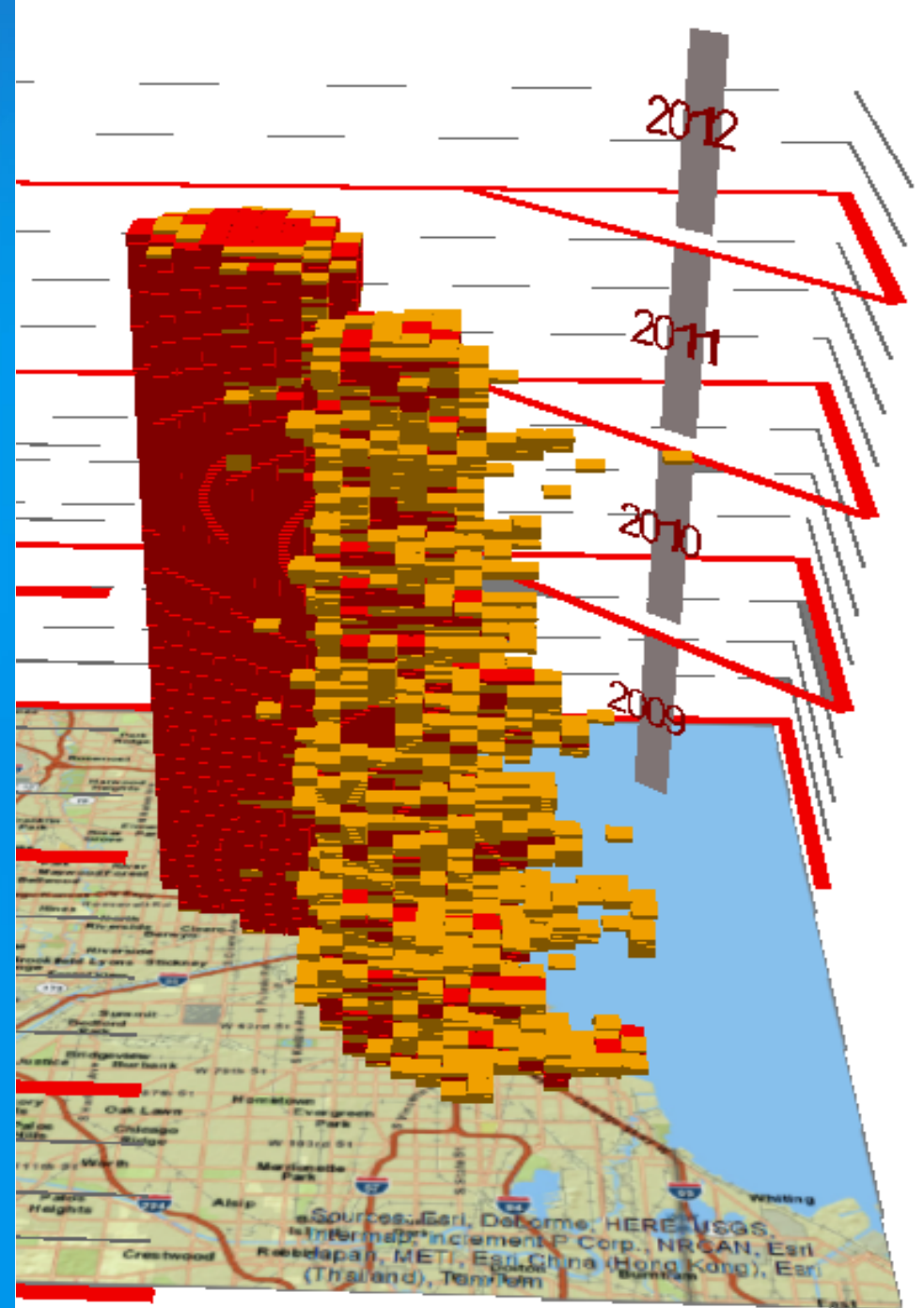
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# Chicago Narcotics

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# Helecxagon mapping

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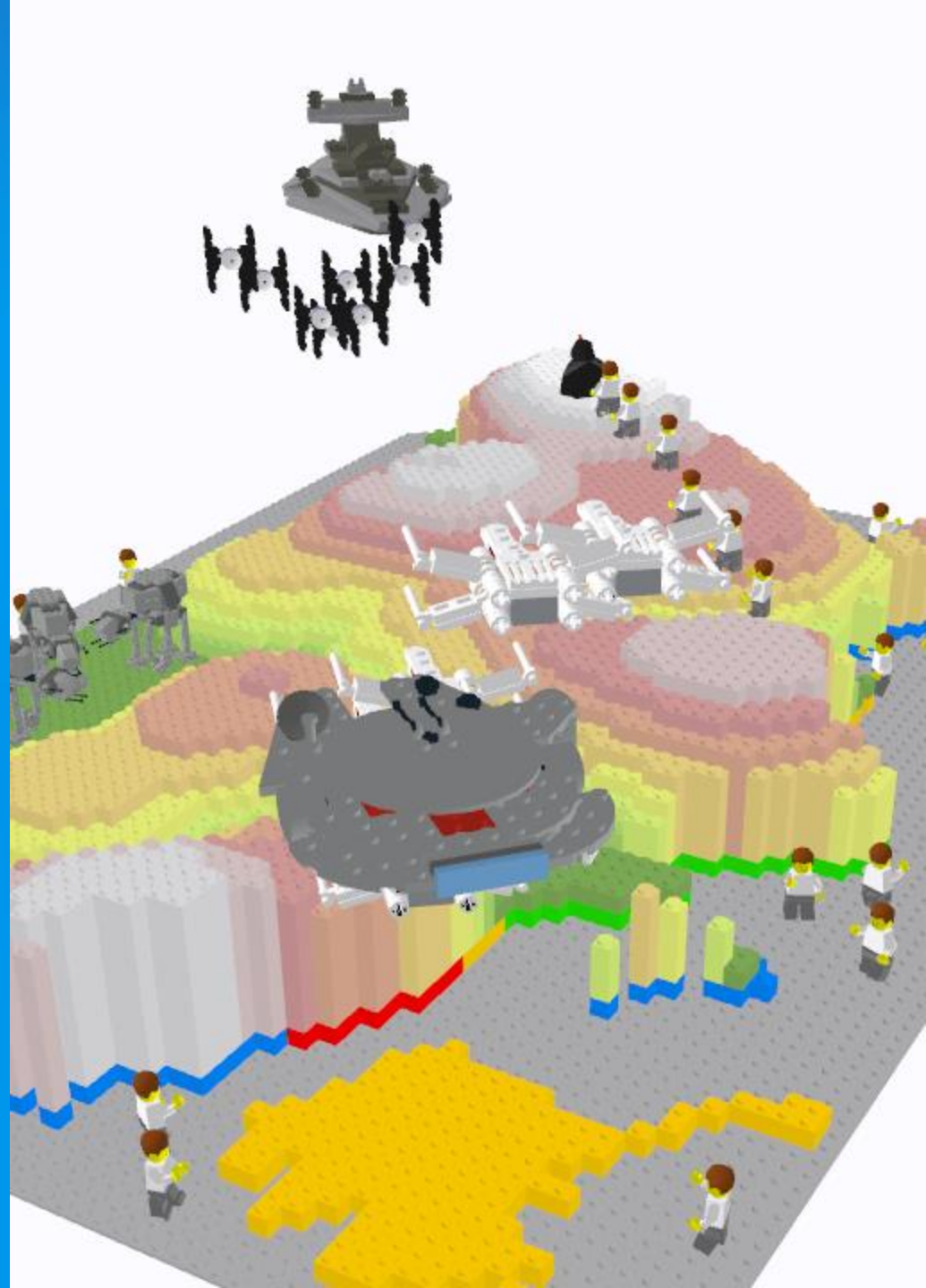
# Views of Mt Fuji

Nathan Shephard



# 3D fun with Lego

Kenneth Field





# Checklist for authoring better 3D scenes

- **Message** – what should the viewer see / learn?
- **Delivery** – pictures, videos, interactive scenes?
  - Occlusion, measurements, before/after, ...
- **3D canvas type** – global, or local?
  - Is an Axonometric / Isometric representation required?
- **Symbology** – realistic, thematic, augmented reality?
  - Size, Shape, Color, Textures, Transparency, ...
- **Mood** – Scene properties, such as shadows, lighting, haze
  - Gotham versus Pasadena
- **Guide users** – bookmarks, labels, popups, fly-throughs, voice-overs, ...
- **Be creative** – the z-axis does not have to be only for 'z' or 'time'

## 3D Guidelines (review at your leisure)

- Use dictates structure - Promotional maps require less structure. Thematics require more structure
- Impact - 3D can be powerful, eye-catching and immersive. Use to support attention-grabbing needs
- Content - Simplification and Generalisation have never been more important. Clean. Simple. Functional
- Texture - Avoid flat colours...add textures
- Natural realistic not photorealistic
- Symbols - Mimetic symbols support easier recognition
- Typography - Still important but don't overload. Rotate with scene if possible but not to be overbearing
- Projection - Use axonometric where possible to maintain scale particularly for analytical map functions



## 3D Guidelines (review at your leisure)

- Sky and haze – avoid sky but include haze which aids depth cue perception
- Space-Time Cubes - Good for linear data, OK for point, poor for area...try not to overload or stack (beware of 'inner holes')
- Z value does not have to depict height or time, use it to show 'what's important'
- Scene control - Avoids occlusions by supporting multiple views but avoid too much rotation
- Bookmarks - supports easy camera reposition, highlight key view points
- Interaction - Allow data to be recovered, overcomes measurement limits
- Narration - Guides and improves interpretation

# Thank you...

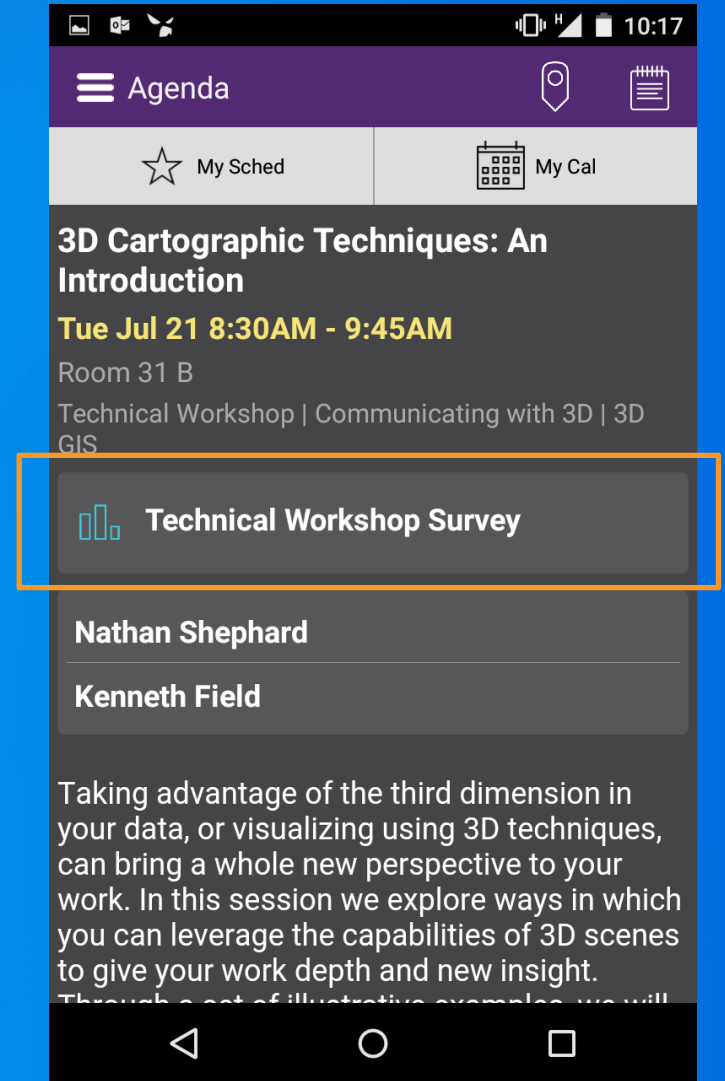
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Select 3D Cartographic Techniques in the Mobile App

Use the Search Feature to quickly find this title

Click “Technical Workshop Survey”

Answer a few short questions and enter any comments



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Understanding our world.