

Lecture 12

3D Modeling and Animation

Lecture Outline

1. Introduction to 3D Modeling
2. 3D Modeling and Mapping Processes
3. 2D, 3D mapping and visualization
4. ArcGIS Pro 3D Visualization
5. SAGA GIS 3D Visualization
6. ArcScene 3D Visualization – Extruding
7. 3-D Applications
8. Introduction to Animation
9. ArcGIS for Animation
10. References

1. Introduction to 3D Modeling

The rapid development of information technologies;

Hardware
Software

allow the creation of a virtual world that provide new possibilities for:

- interactive
- communication,
- Orientation
- environmental management monitoring.

1.1. Introduction to 3D Modeling – Digital Data

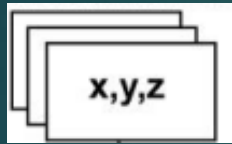
3D landscape modelling and visualization facilitate an attractive representation of environment by generation of perspective views based on different types of digital data –

- geographical,
-
- geological,
-
- architectural,
- biological, etc.
- Other

1.2. 3D Modeling Concept

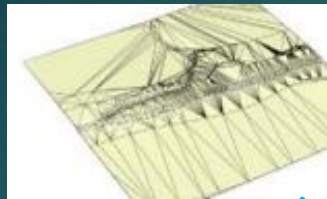
Schematic 3D landscape mapping process (modified,

Geospatial Data



Concept

3D model



Modeling

Cartographic 3D model









Symbolization

3D map



Visualization

Symbol Library

	3D tree
	3D building
	vegetation
	sand
	river
	ocean

2. 3D Modeling and Mapping Processes

3D mapping includes four general process steps:

1. concept,
2. modelling,
3. Symbolization
4. visualization

2.1. Conceptual Phase

The user context and the product specifications had to be defined.

Thus, choosing the map type is depended on:

- knowledge
- experience of users,
- possible future users
- the necessary geospatial data

2.2. Modeling Phase

The modeling step contains the processing of original thematic data sets

- raster
- vector
- transformations of data format and structure,
- objects geometry and semantics.

From the original geospatial data a complex structured 3D landscape model is created that allows to investigate in details the landscape as a static model, as well as to implement dynamic and interactive functionalities.

2.3. Symbolization Phase

The symbolization step involves adding the graphic attributes to the single objects of the 3D landscape model.

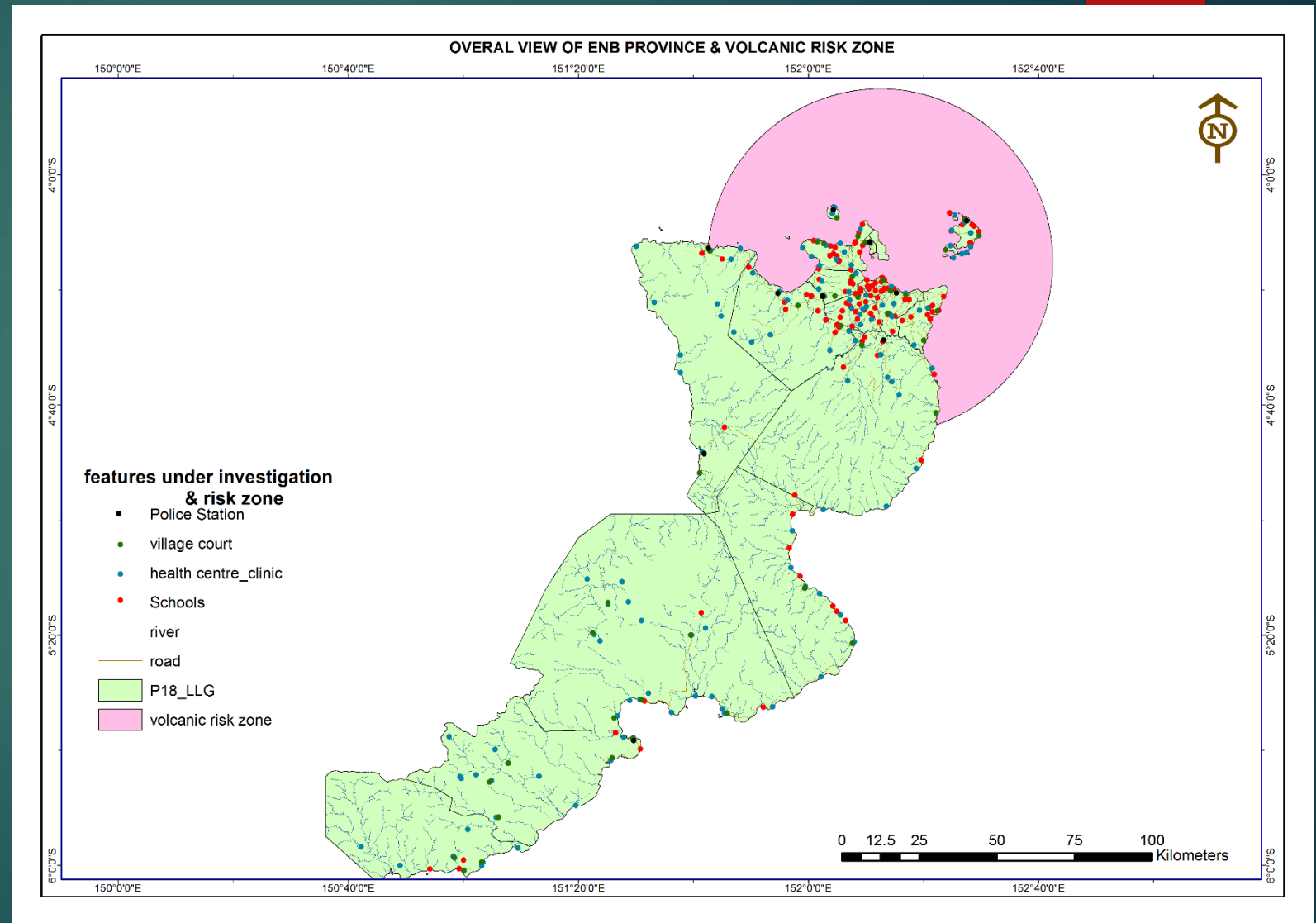
Thus, the graphic appearance of each object class is defined as in the legend construction for classic maps, and cartographic generalization rules are considered.

Thereby, the landscape model is transformed into a cartographic 3D model.

3. 2D, 3D mapping and visualization

Maps have always been about describing location, examining data, and telling a story.

Currently GIS platforms enhance storytelling of GIS data in ways that weren't possible before.



3.1. 2D and 3D Visualization

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While 2D will always enable us to create compelling stories about location,

3D and emerging interactive technologies are now enabling us to bring our data to a wider audience.



3.2. Differentiation of 2D and 3D

The functions of the 2D GIS and 3D GIS are ideally supposed to be the same.

3D systems, however, lack some of these functionalities due to some impediments.

While both the GIS maps display features in greater detail, the 3D adds another dimension.

In most cases, the 3D tools must be used together with the 2D GIS then be imagined and analyzed in the 3D setting.

3.3. True 3-D

- ▶ store data in structures that actually reference locations in 3D space (x,y,z)
- ▶ here z is *not* an attribute but an element of the location of the point
- ▶ if z is missing, object does not exist!
- ▶ *several* z 's possible for a single x - y pair,

3.4. 2.5 D Representations

- ▶ attractive displays of topography and other
- ▶ continuous surfaces from DEMs or TINs
- ▶ perspective plots computed from any viewpoint
- ▶ additional layers "draped" over the surface

3.5. Image Draping

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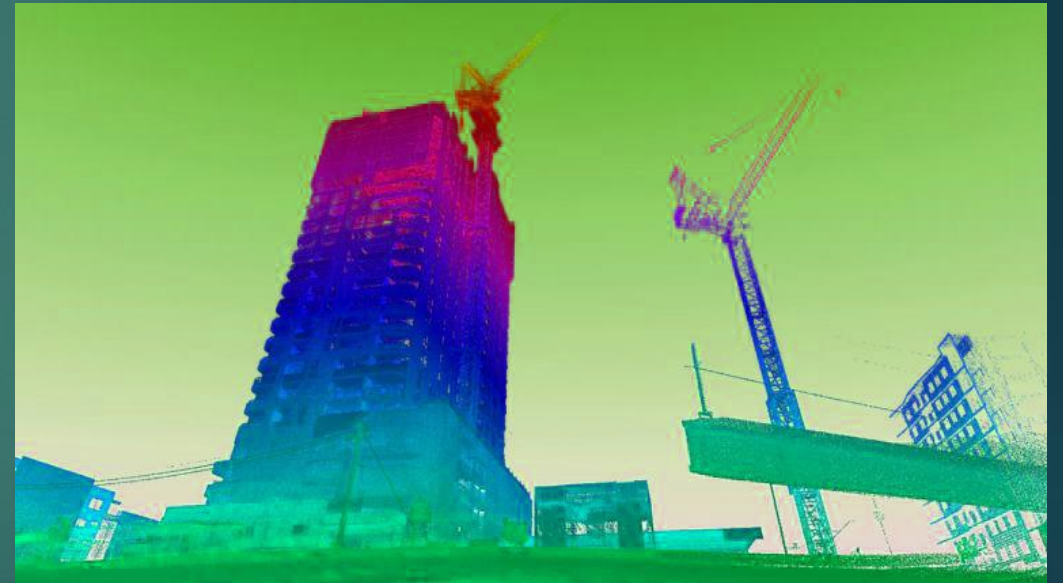
***Draping Satellite
Imagery on
Topographical
Features***



3.6. More Realistic 3D Visualization

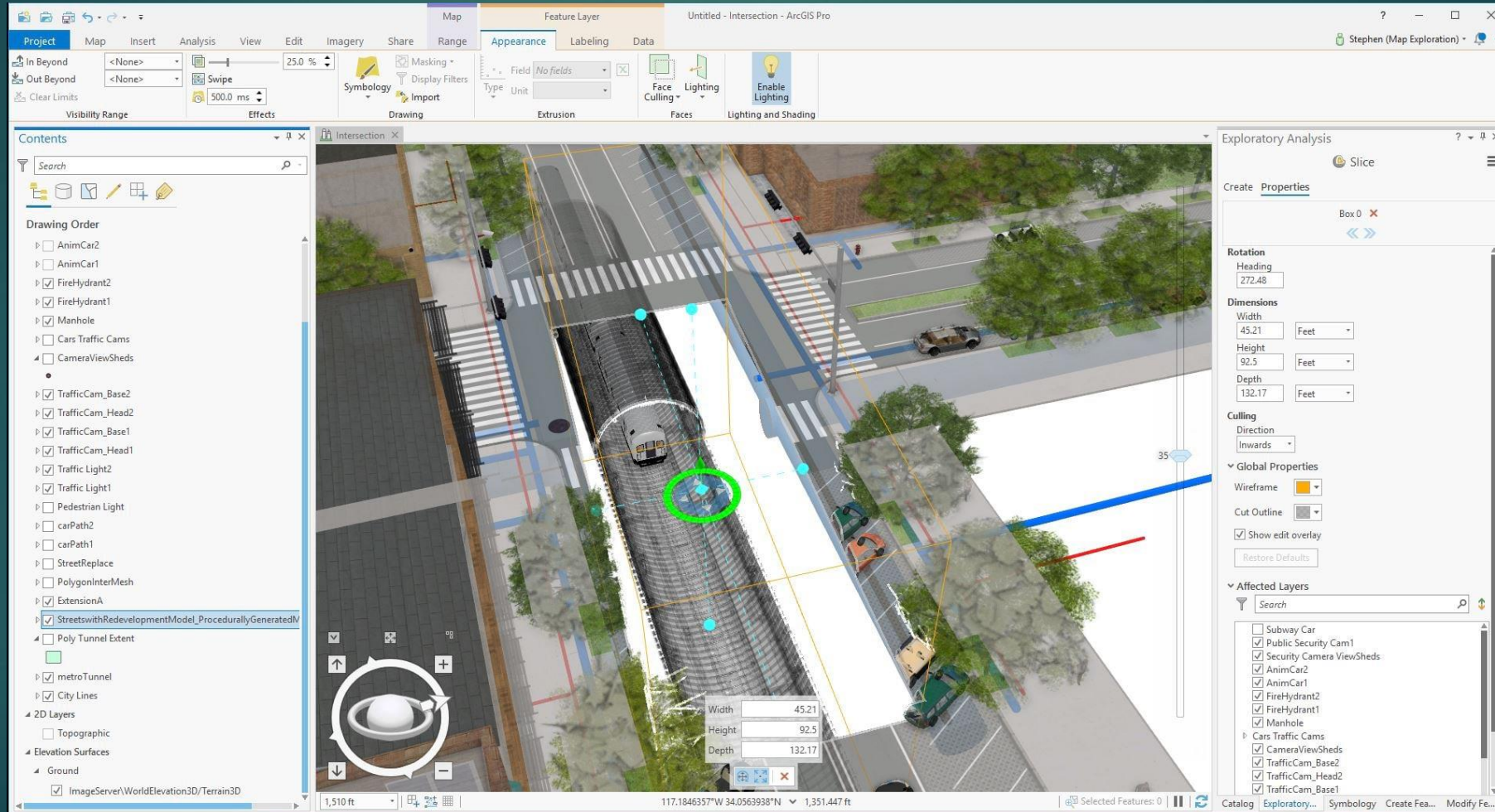
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The overall scope for 3D is growing exponentially, and so is our appetite to emulate our world with detail that is compelling and real.



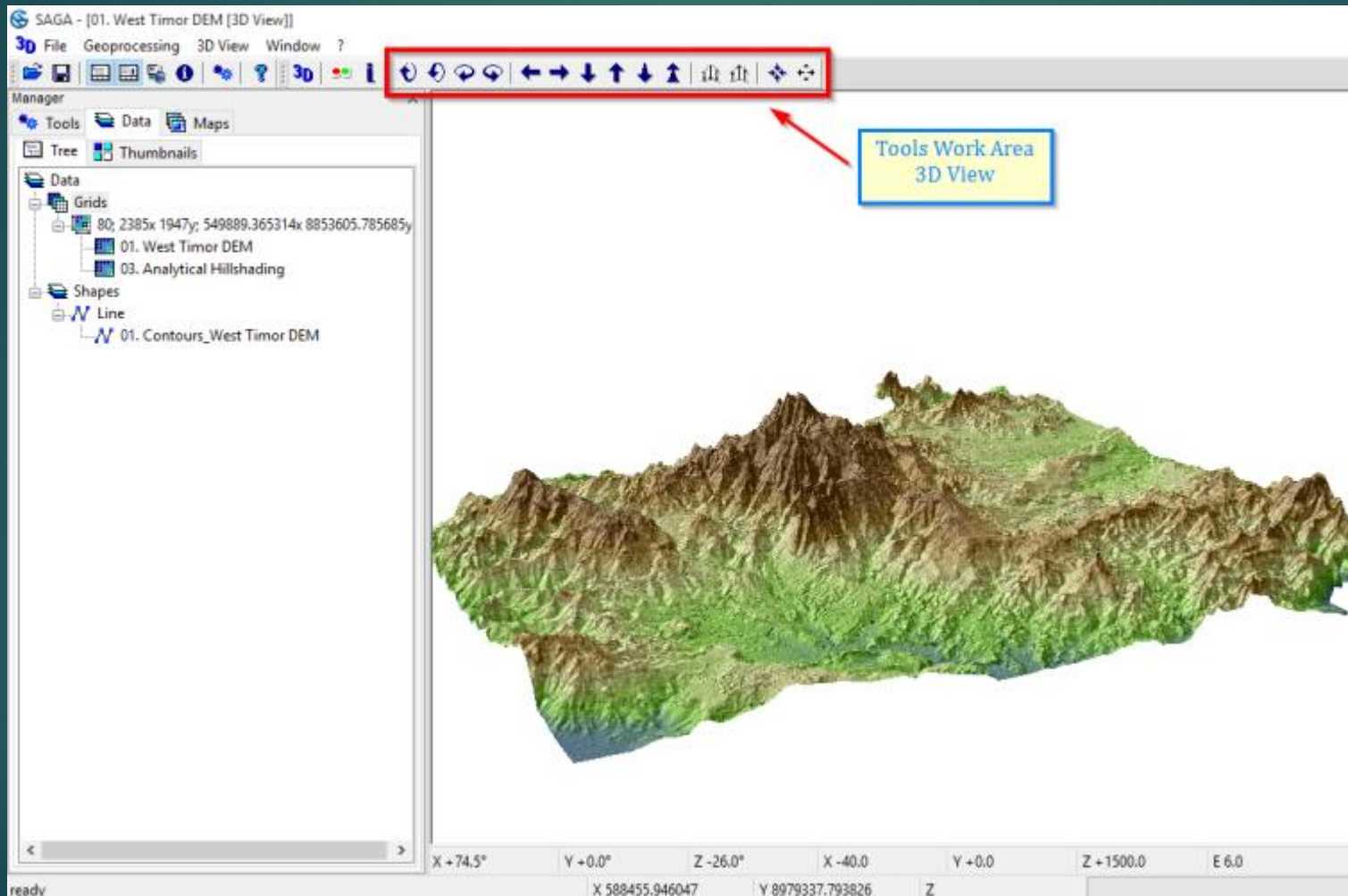
4. ArcGIS Pro 3D Visualization

ArcGIS Pro's Local and Global maps enable you to explore your 3D data with both analysis and visualization capabilities.



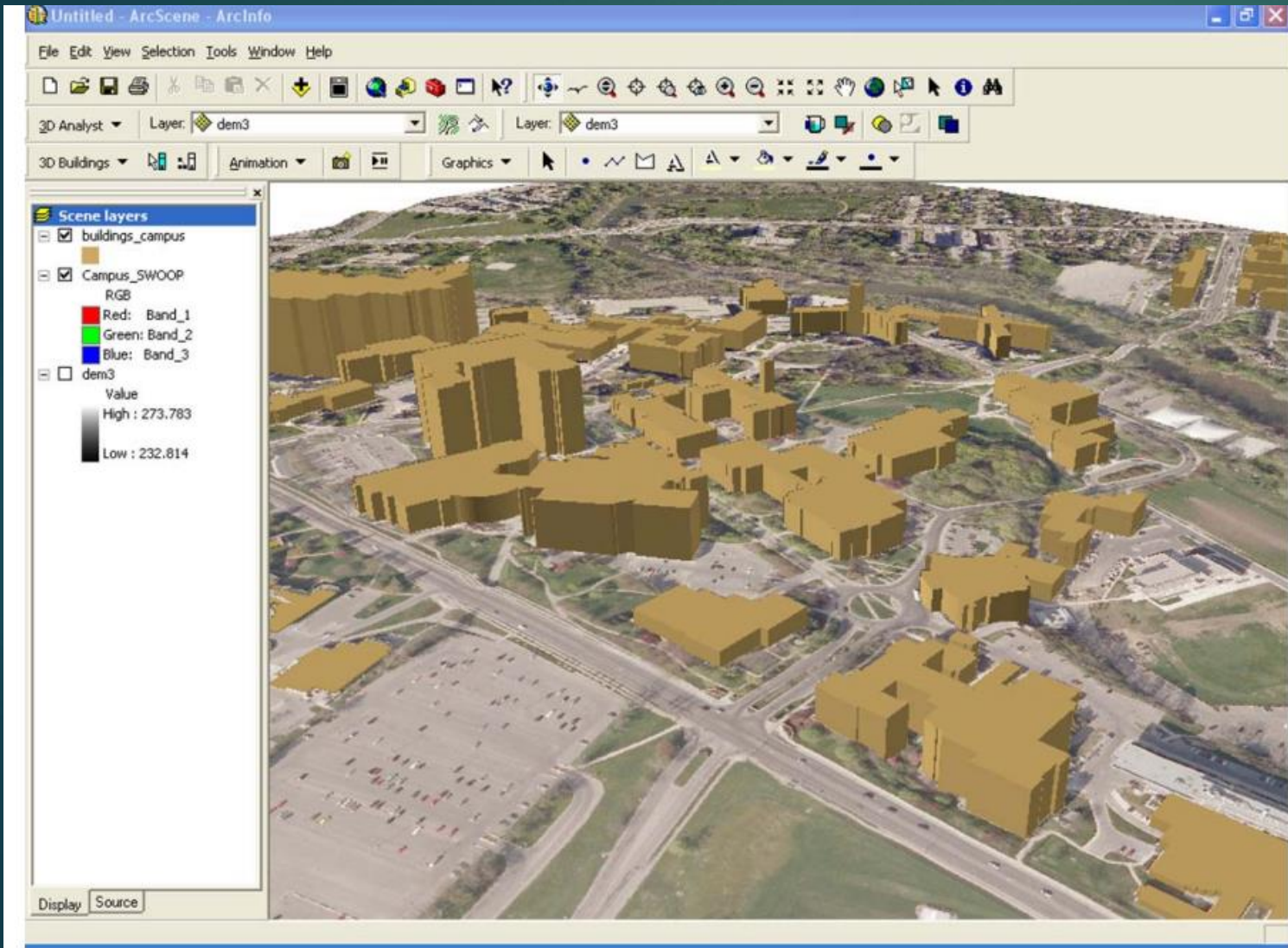
5. SAGA GIS 3D Visualization

First create a terrain map view. The terrain map view tool creates a hill shading layer and drapes it over the DEM data coloured with an elevation colour scheme.



6. ArcScene 3D Visualization - Extruding

Creating 3D in ArcScene – Extruding Features.



ArcScene contains a variety of 3D symbols for points, lines and polygon features that can be used to augment a scene. There are many symbols for many different types of features,

7. 3-D Applications

- ▶ geological/geophysical exploration
- ▶ engineering design of mines, quarries, dams, reservoirs, etc.
- ▶ scientific explanation of 3D processes such as ocean currents or lava flows

7.1 3-D Applications - Projects

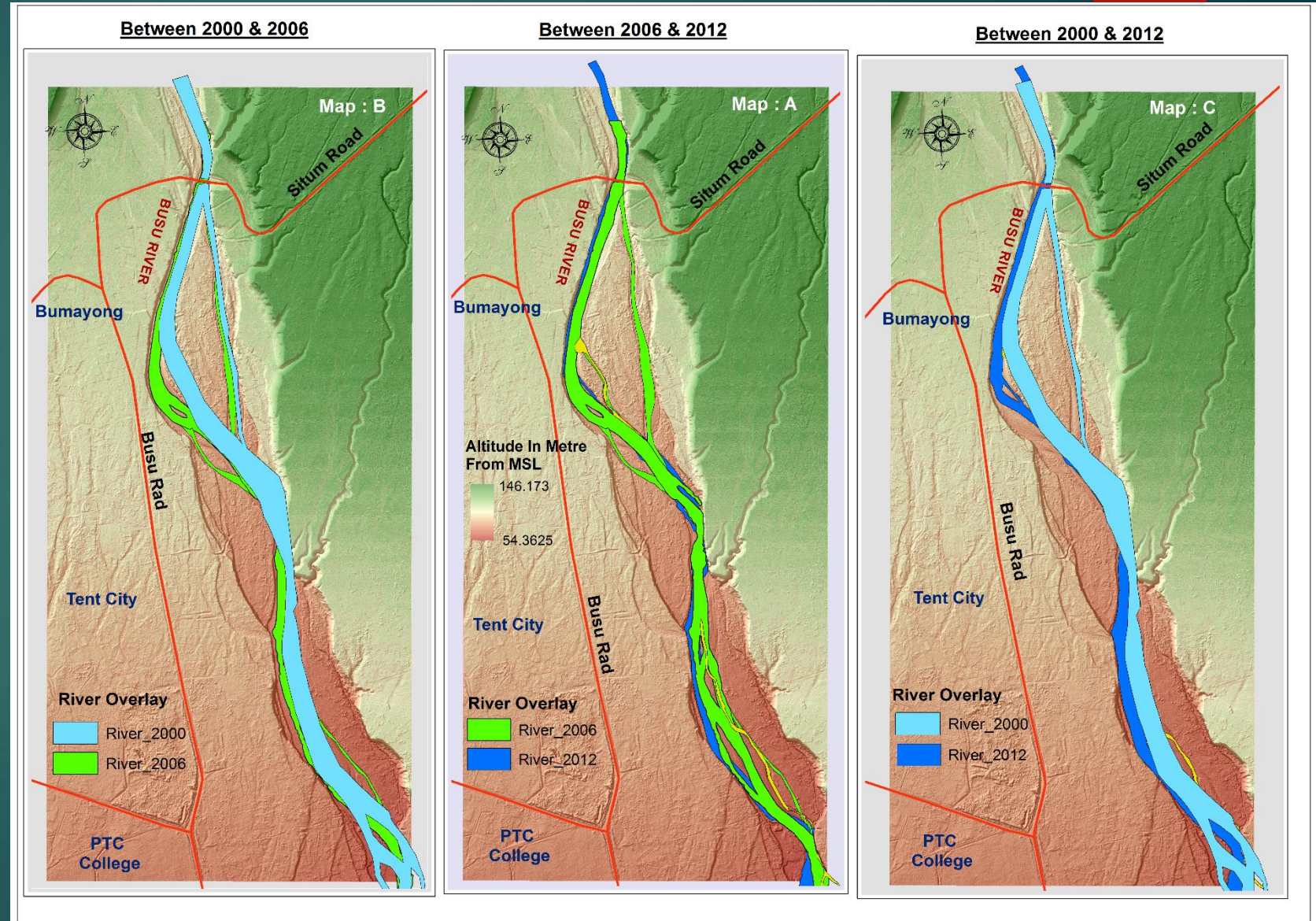
With 3-D mapping technologies gaining traction we aimed at providing solutions for projects such as:

- ▶ Topographical analysis and site planning for land acquisition and development.
- ▶ Flood inundation mapping and analysis for emergency management, land development, and insurance planning.
- ▶ Park, recreation, facility, and trail site locations.
- ▶ Corridor mapping for power lines, pipelines, roadways, and railways.
- ▶ Building footprint, height, and line-of-sight modeling analysis.
- ▶ Mapping and modeling historical development of cities and towns by combining 3D data with historical data for an area.

8. Introduction to Animation

An animation is a visualization of the changes to the properties of one object (such as a layer) or a set of objects (such as multiple layers).

Animations make your documents come alive by storing actions so they can be replayed as you choose.



8.1. Spatial Animation

Animations make your 3D documents come alive by storing actions so they can be replayed as you choose.

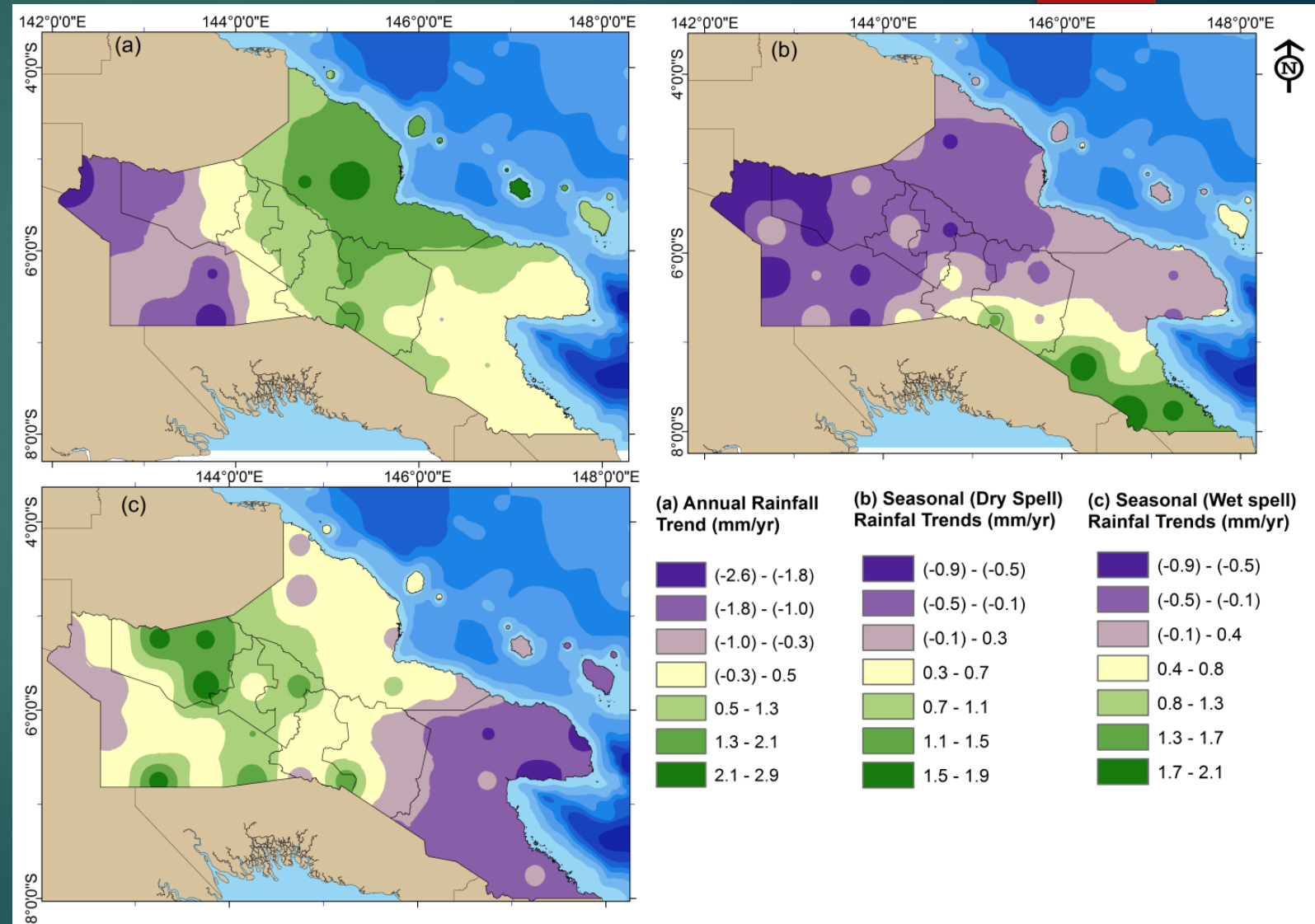
Animation helps visualize:

- changes in perspective,
- changes in the document's properties,
- Changes in geographic movements
- temporal changes.

8.2. Temporal Data for Animation

Adding temporal data to visualizations:

- Rainfall - Temperature change overtime
- Land Use Change Overtime
- Flood inundation
- Other



8.3. Temporal Features for Animation

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Temporal Features added by ESRI:

- Date and Time
- Basic 2D application

Complex temporal analysis and visualization require special software's to be use

9. ArcGIS for Animation

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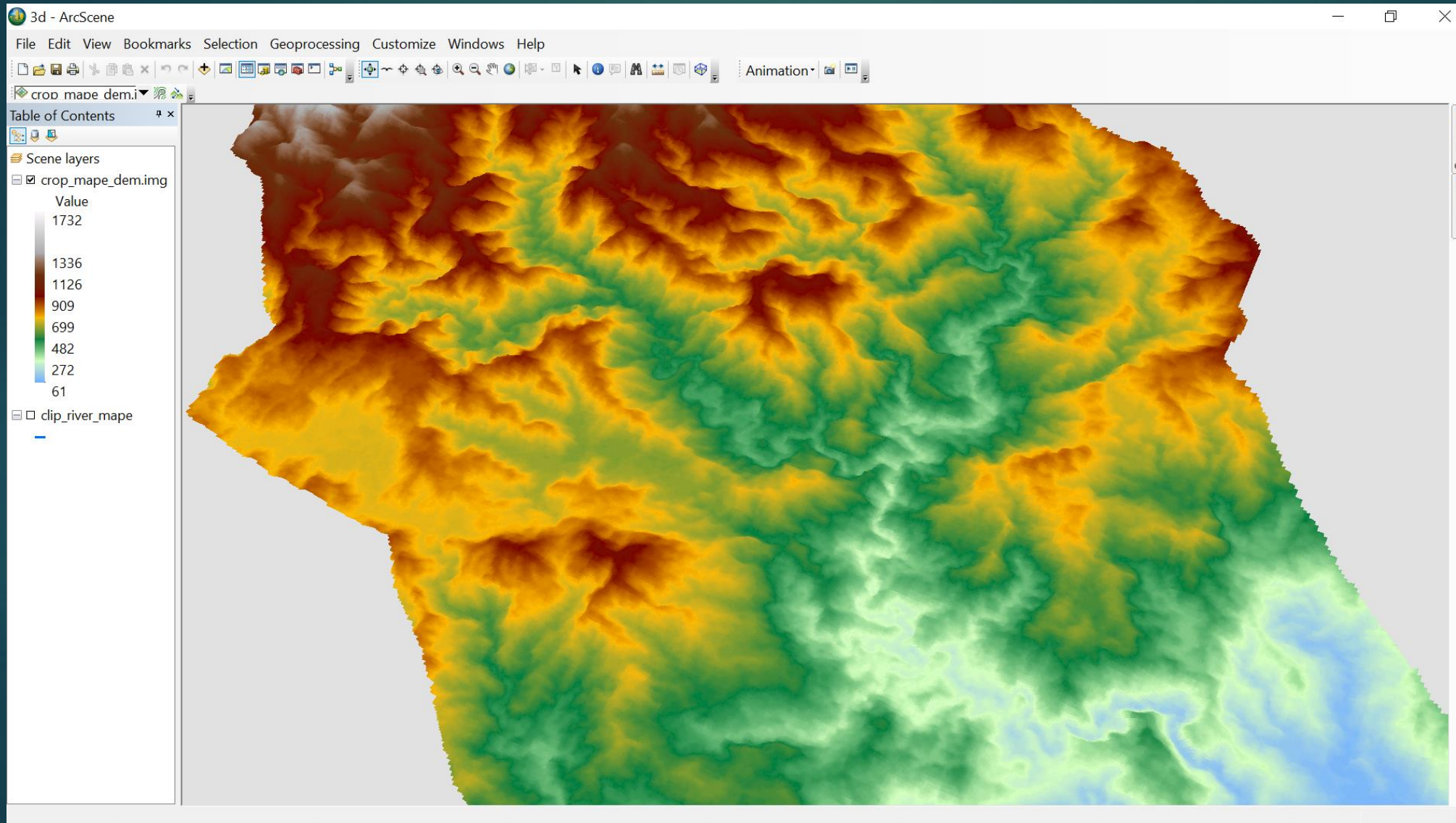
Create animations using the Animation toolbar in Arc.

ArcGIS allows different types of animations to be created in:

- ArcMap,
- ArcScene,
- ArcGlobe,

9.1. Arc Scene Platform

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9.2. Animation Properties

An animation consists of one or more tracks.

Tracks control dynamic changes of the properties of an object, such as:

- document's background color,
- layer's visibility,
- a camera's location.

Tracks are made up of a set of keyframes.

9.3. Animation Key Frames

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A keyframe is a snapshot of a particular object's properties at a certain time.

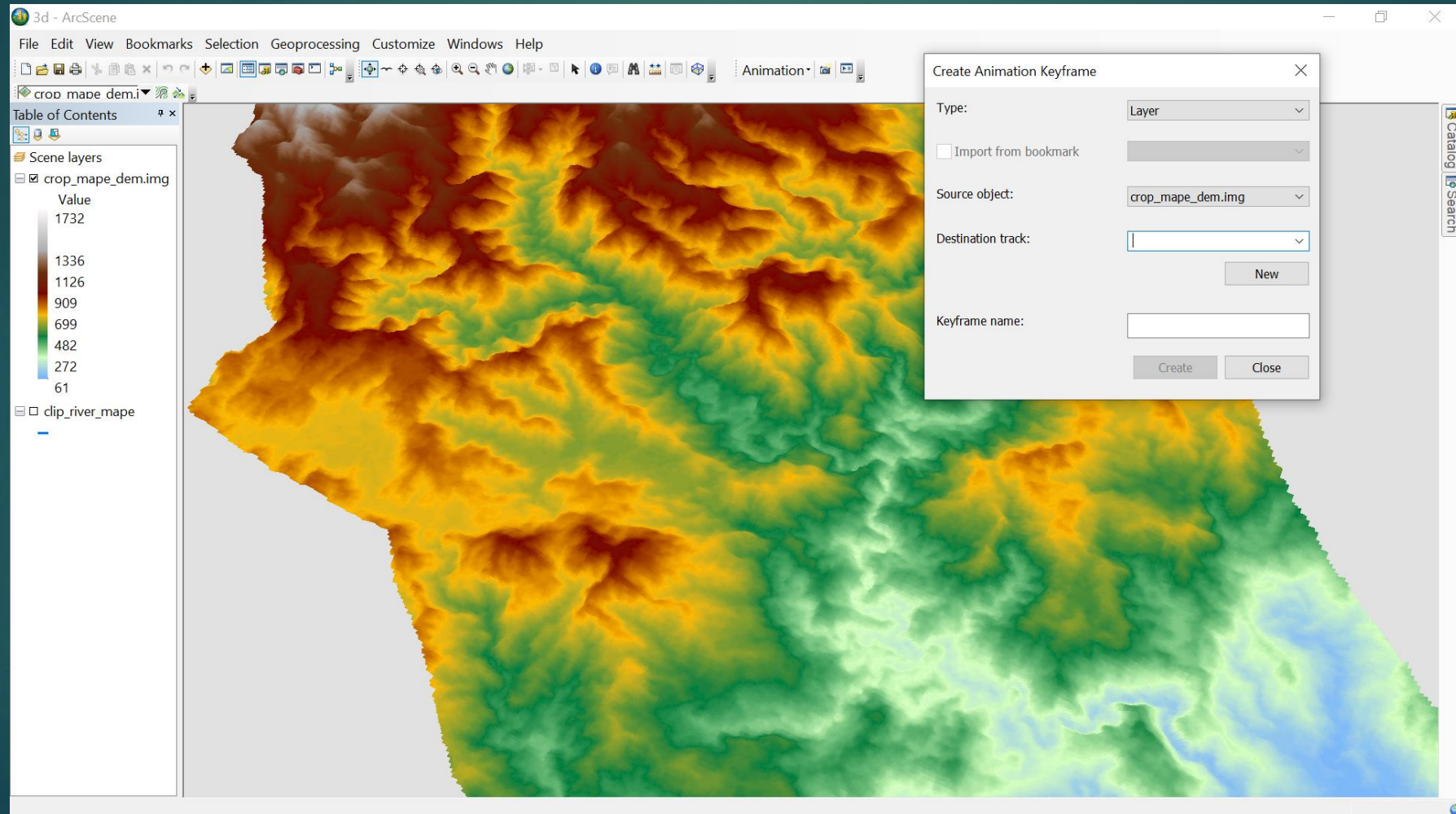
The object can be a scene or globe, layer, or camera.

For example, you can create a track with the scene or globe object that animates scene

9.4. Create Animation Key Frames

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Using the **Create Animation Keyframe** dialog box, you can create keyframes to build an animation.



9.5. Different types of Animation and Recording

During building an animation, you can do the following and at the same time doing recording

- Navigate through the display (zoom and pan in ArcMap, or navigate in ArcGlobe or ArcScene).
- Animate the transparency or visibility of layers.
- Move the camera or map view along a path.
- Move a layer along a path (ArcScene only).
- Animate data through time while moving the camera.
- Change the background color, lighting, or vertical exaggeration of a scene (ArcScene only).

10. References

Saga GIS tutorials. Retrieve from: <https://sagatutorials.wordpress.com/3d-visualisation/>

Zuppa, S., and Sauer, S,A (2008). GIS Procedural Guide Create a 3D Scene in ArcScene 9.2+. Retrieve from: https://www.lib.uwo.ca/files/madgic/gis_help/Using_ArcScene.pdf.

Dinkov, D., Vatseva, R., (2016). 3D MODELLING AND VISUALIZATION FOR LANDSCAPE SIMULATION. Retrieve from: <https://cartography-gis.com/docs/bca/iccgis2016/ICCGIS2016-33.pdf>

Haeberling, C. (2005) Cartographic design principles for 3D maps - A contribution to cartographic theory. In Proceedings of the 22nd ICA International Cartographic Conference, A Coruna, Spain.

Terribilini, A. (2001): Entwicklung von Arbeitsablaeufen zur automatischen Erstellung von interaktiven, vektorbasierten topographischen 3D-Karten. Dissertation, Institut für Kartographie der ETH Zuerich. Zuerich. Available at: <http://ecollection.ethbib.ethz.ch/ecolpool/diss/fulltext/eth14387.pdf>).