3D Visualization

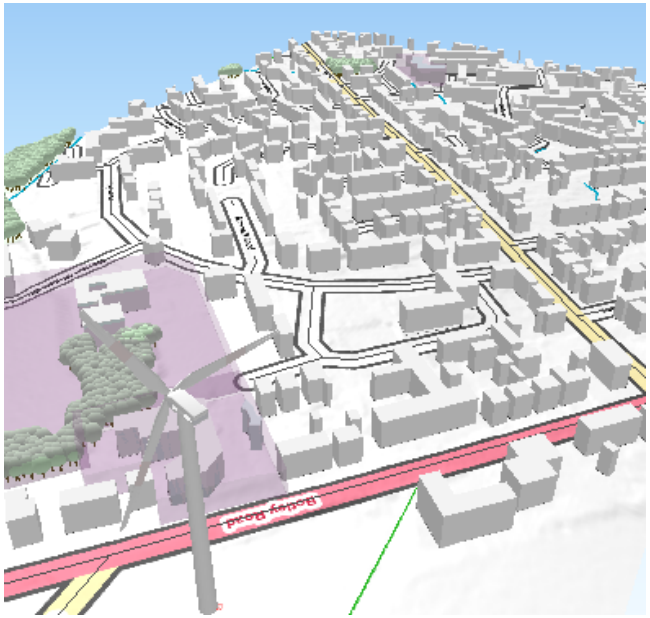
GEOG 5201 – Spring 2022

Outline

- 3D visualization
  - Background
  - 3D visualization of raster data
    - Terrain
    - Others
  - 3D visualization of vector data
    - Polygon data

Background

- Technological advancements have enabled more realistic depictions of the real world through more accessible 3D-mapping tools and virtual/augmented reality
  - ESRI's CityEngine
  - QGIS' QGIS2Threejs

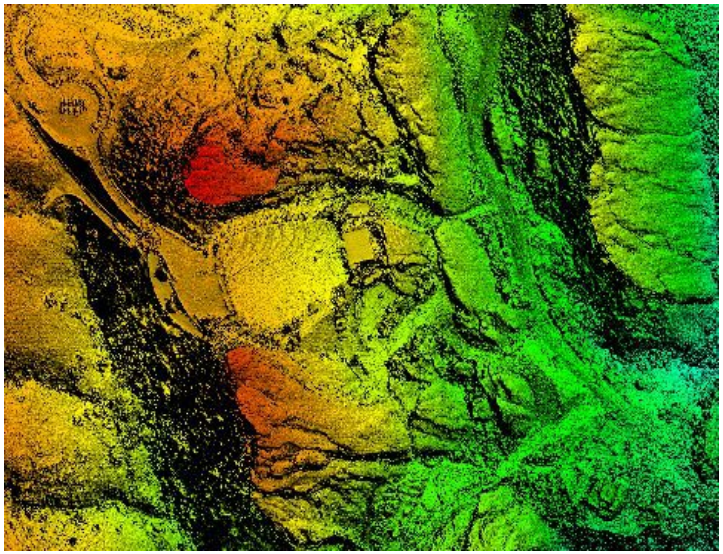


3D Visualization: Raster Data

- Raster data
  - Terrain
  - Others (e.g., climate)

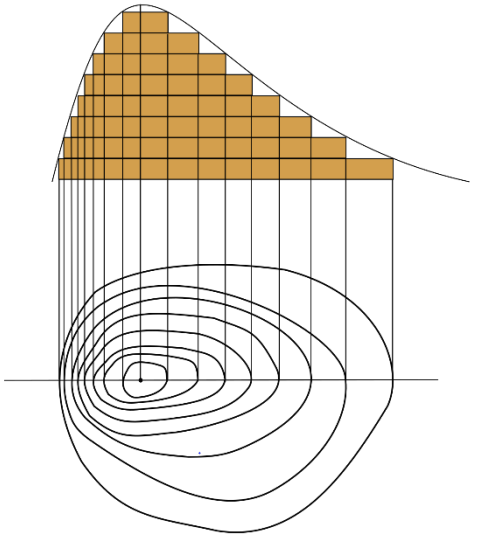
Terrain Visualization: Data

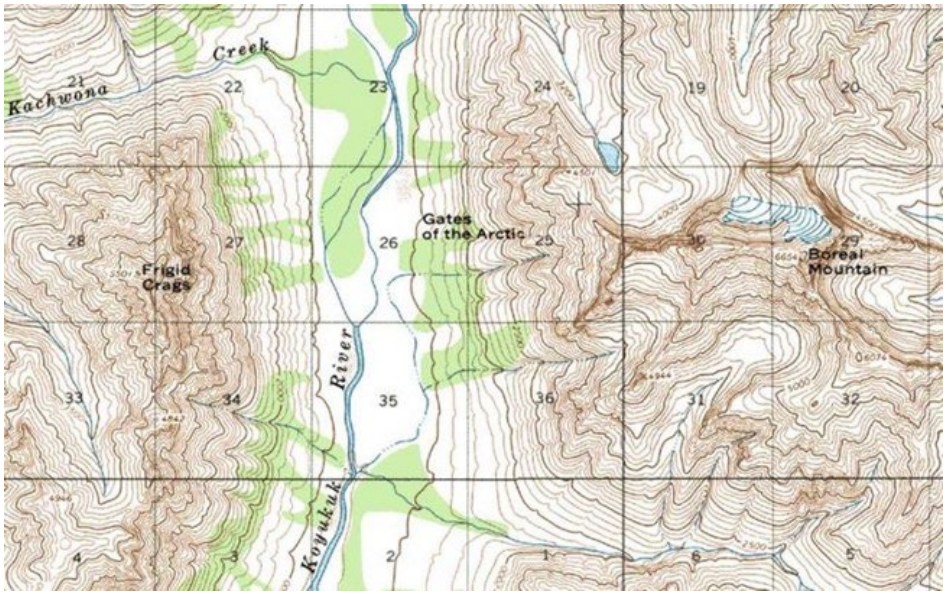
- Terrain: the Earth's elevation (both above and below sea level) and the associated features found on the Earth -- its landscape
- Digital Elevation Model (DEM): fundamental data for depicting terrain
  - Raster data that consists of elevation values above (or below) sea level for individuals point locations
  - Common data sources
    - USGS Earth Explorer
    - USGS EROS Data Center
    - USGS Astrogeology Science Center



Terrain Visualization: Vertical Views

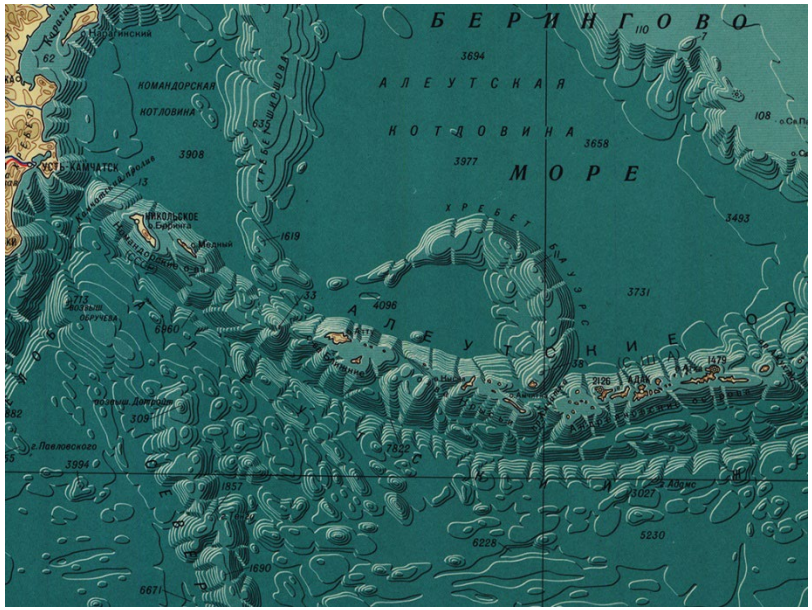
- **Contour-based methods**
  - Contour lines drawn on a map connect points of equivalent elevation
  - Gentle slopes are represented by lines spaced farther apart than steep slopes
  - Not present an immediately intuitive view of the landscape; require prior knowledge for proper interpretation

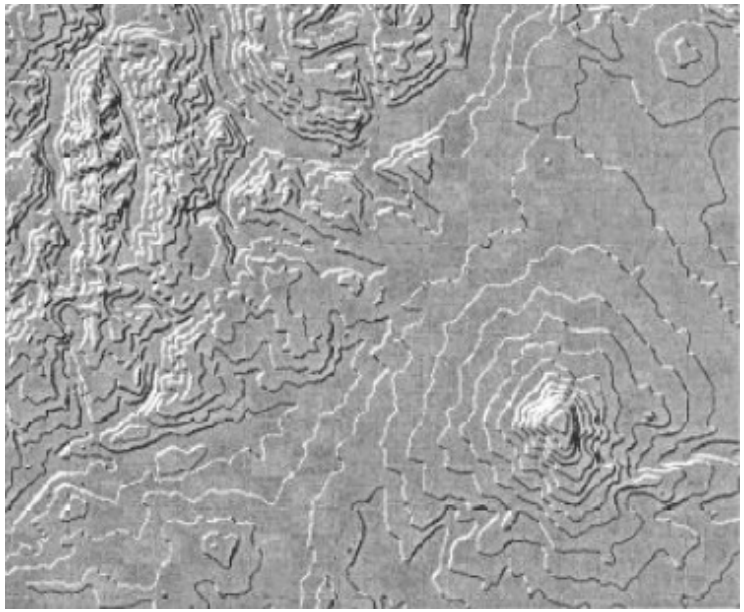




Terrain Visualization: Vertical Views

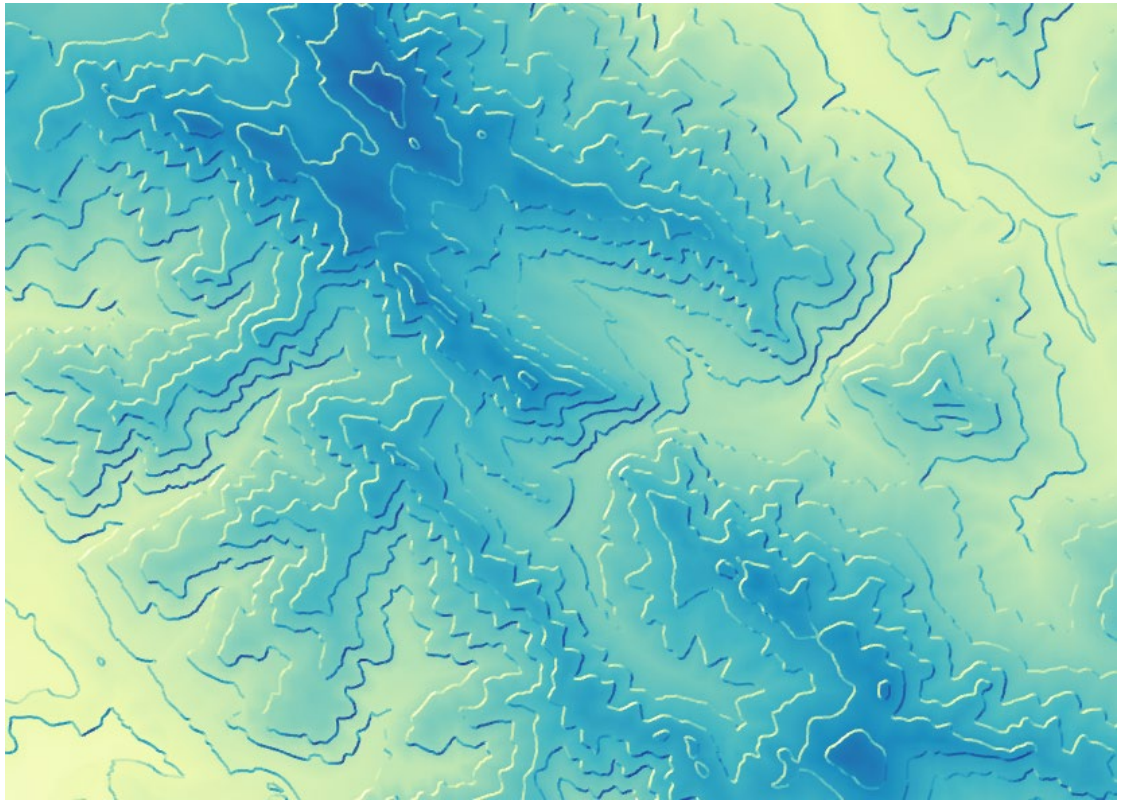
- **Tanaka contours**
  - Apply light source to a contour map
  - Contour lines perpendicular to the light source are thicker, and those parallel to the light source are thinner
  - Contour lines facing the light source are drawn lighter, and those in shadow are in black





Terrain Visualization: Vertical Views

- **Illuminated contours**
  - A simplification of Tanaka contours
  - Width of contour lines is not varied

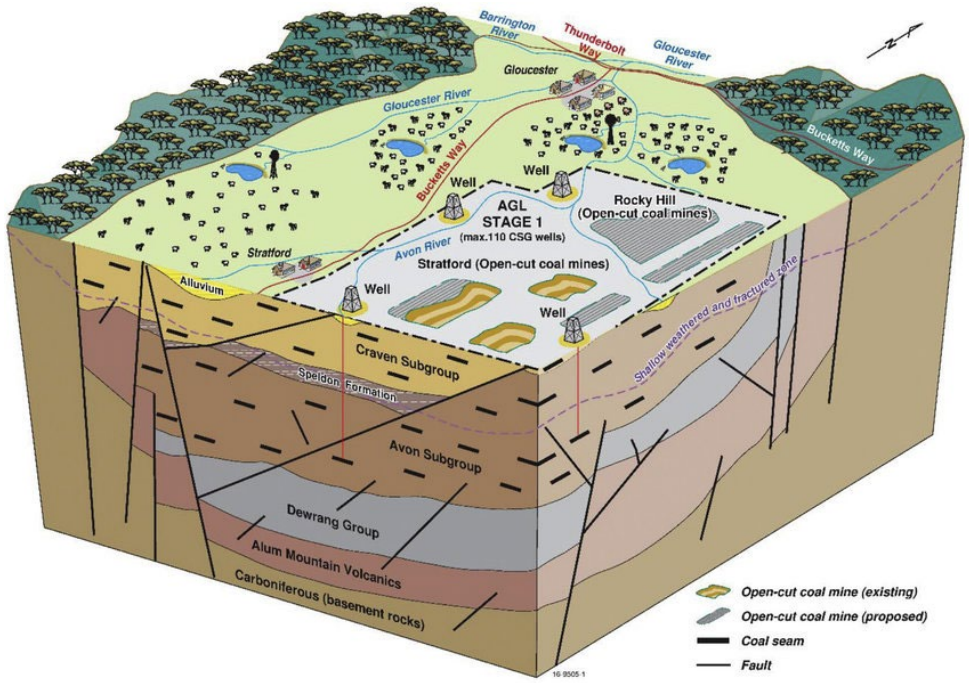


Question 4-1-1

What are the **advantages** of using Tanaka contours compared to traditional contour maps?

Terrain Visualization: Oblique Views

- **Block diagrams**
  - Commonly used in geology
  - Show the surface features of the ground as well as the underground structure



Question 4-1-2

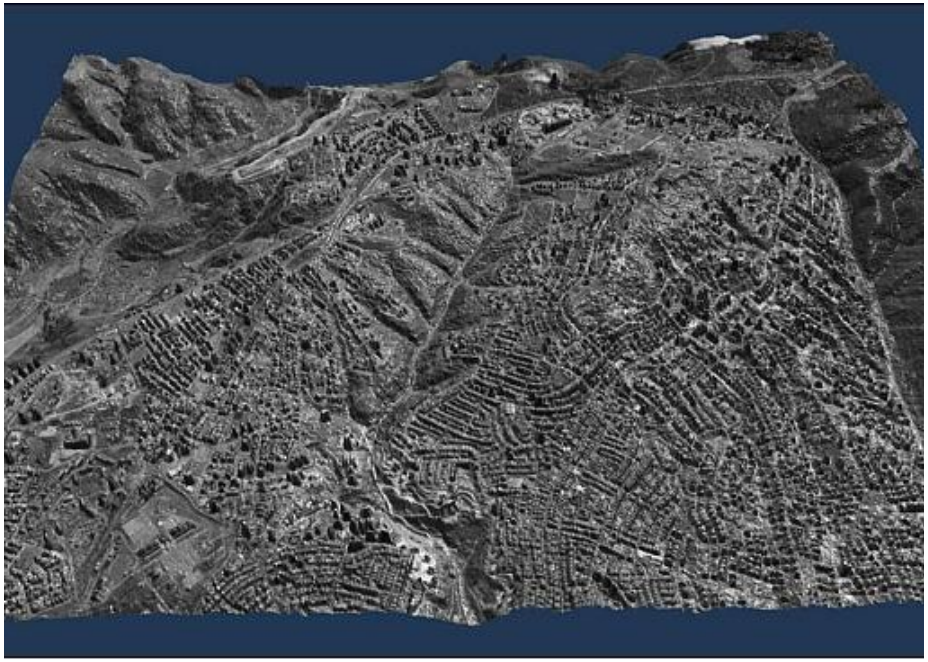
What are the **advantages** of using block diagrams compared to vertical-view maps?

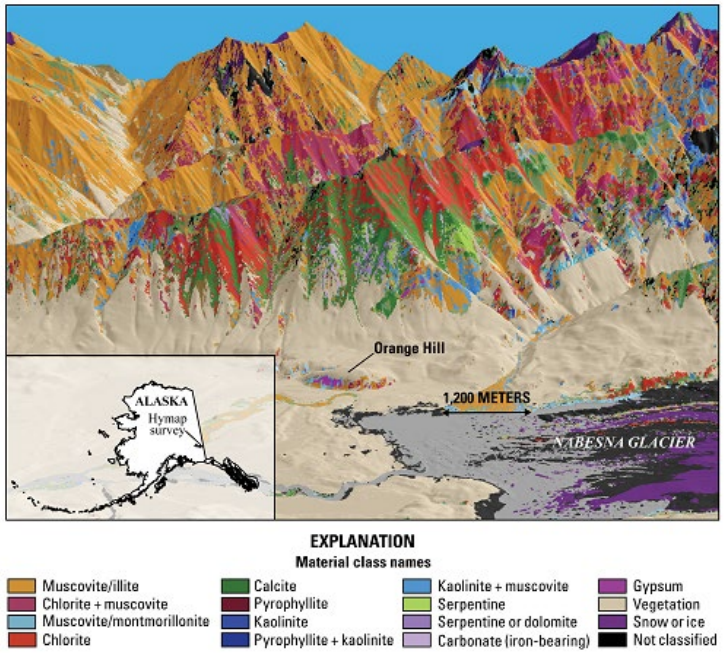
Terrain Visualization: Oblique Views

- **Panoramas (bird's-eye views)**
  - Wide-angle views of an area
  - Provide an easily-comprehensible view of the landscape

Terrain Visualization: Oblique Views

- **Draped images**
  - Most popular in recent years
  - Drape remotely sensed images (or other information, such as land use and land cover) on a 3D digital terrain model (e.g., DEM)



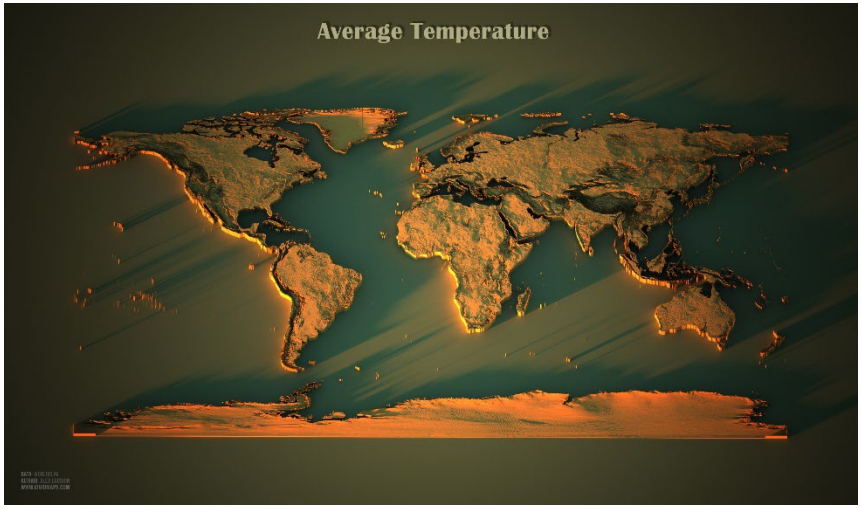


Question 4-1-3

What are the **disadvantages** of using oblique-view maps compared to vertical-view maps?

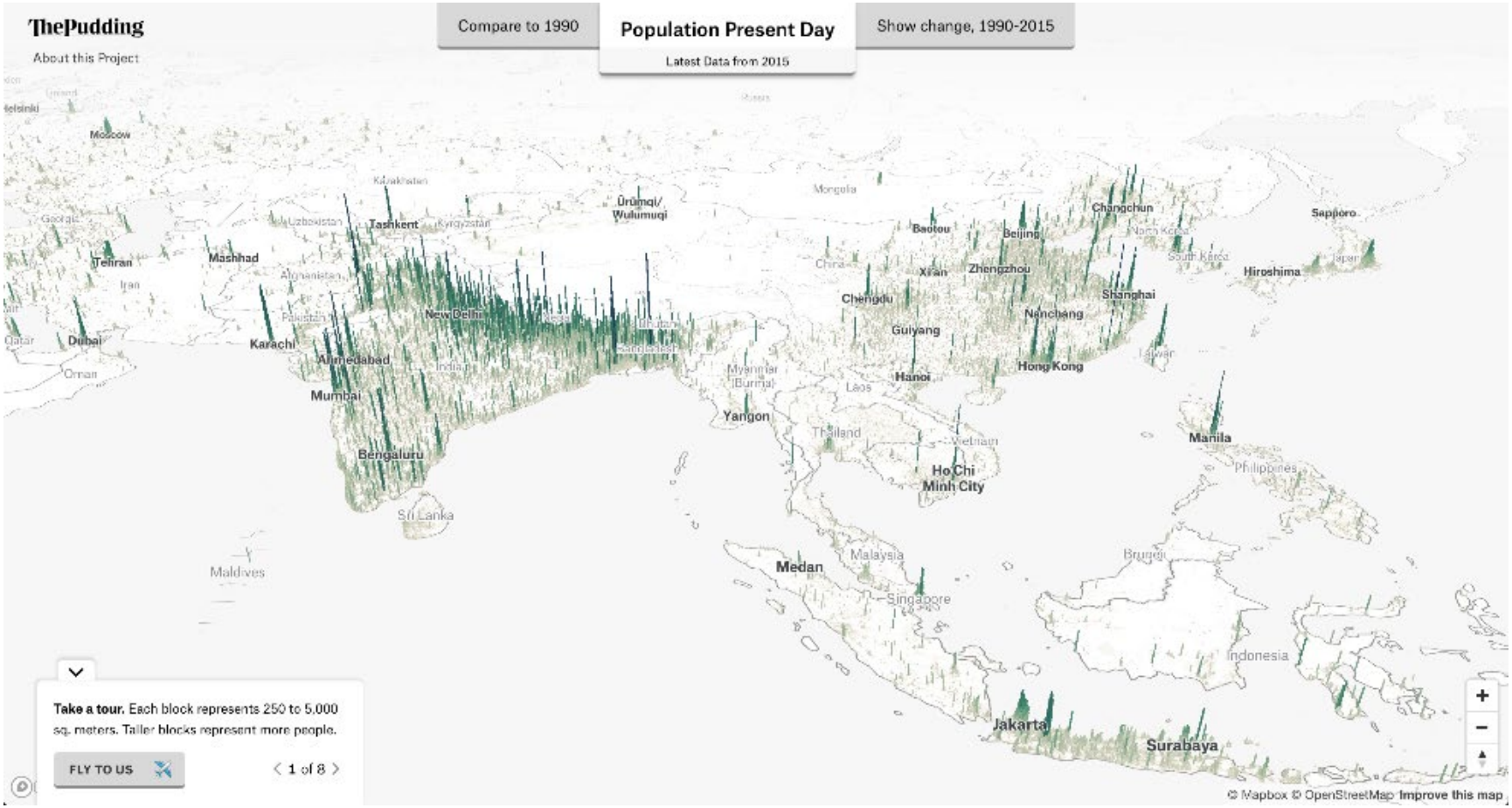
Visualization of Other Raster Data

Precipitation



Temperature

Visualization of Other Raster Data



Population density

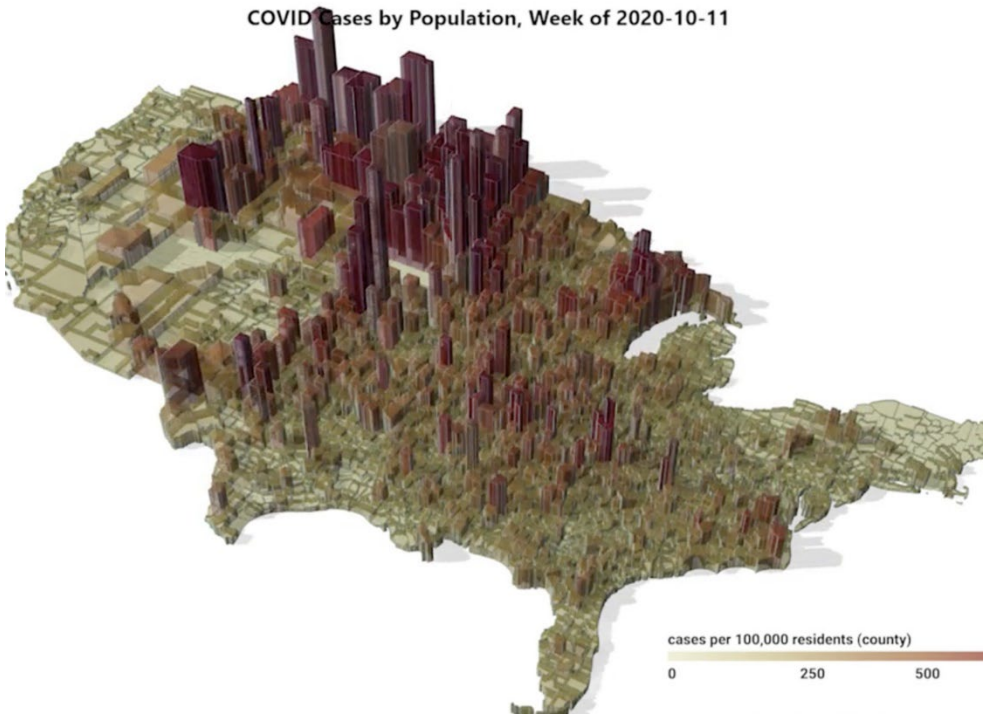
human terrain

Visualization of Polygon Data: Prism Maps

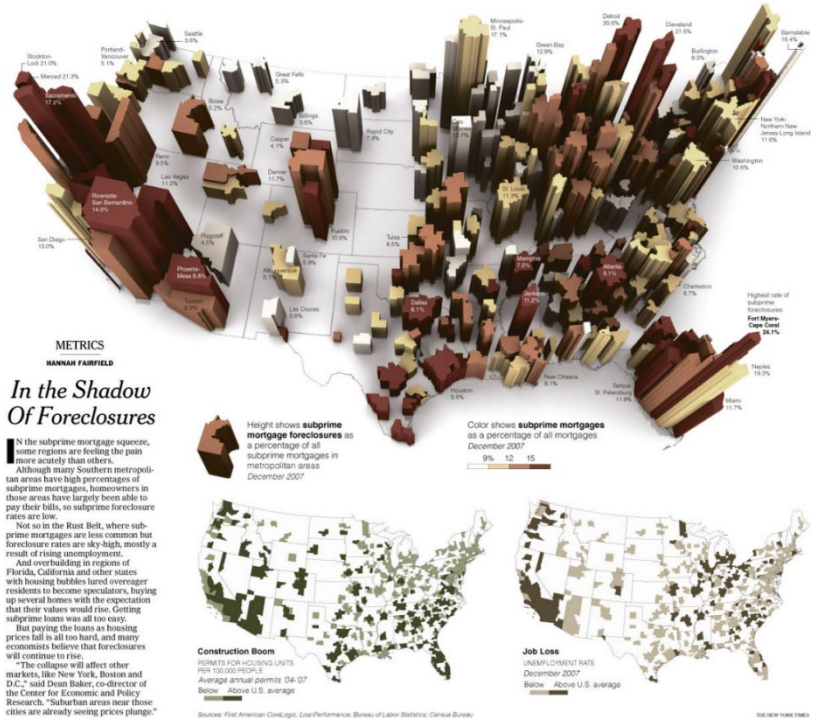
- Prism maps
  - A map where the height of a geography is raised according to a specified attribute
  - Extension for bivariate mapping
    - Height for one attribute, and color for the other

(a) Choropleth (b) Monochrome Prism (c) Coloured Prism

Visualization of Polygon Data: Prism Maps

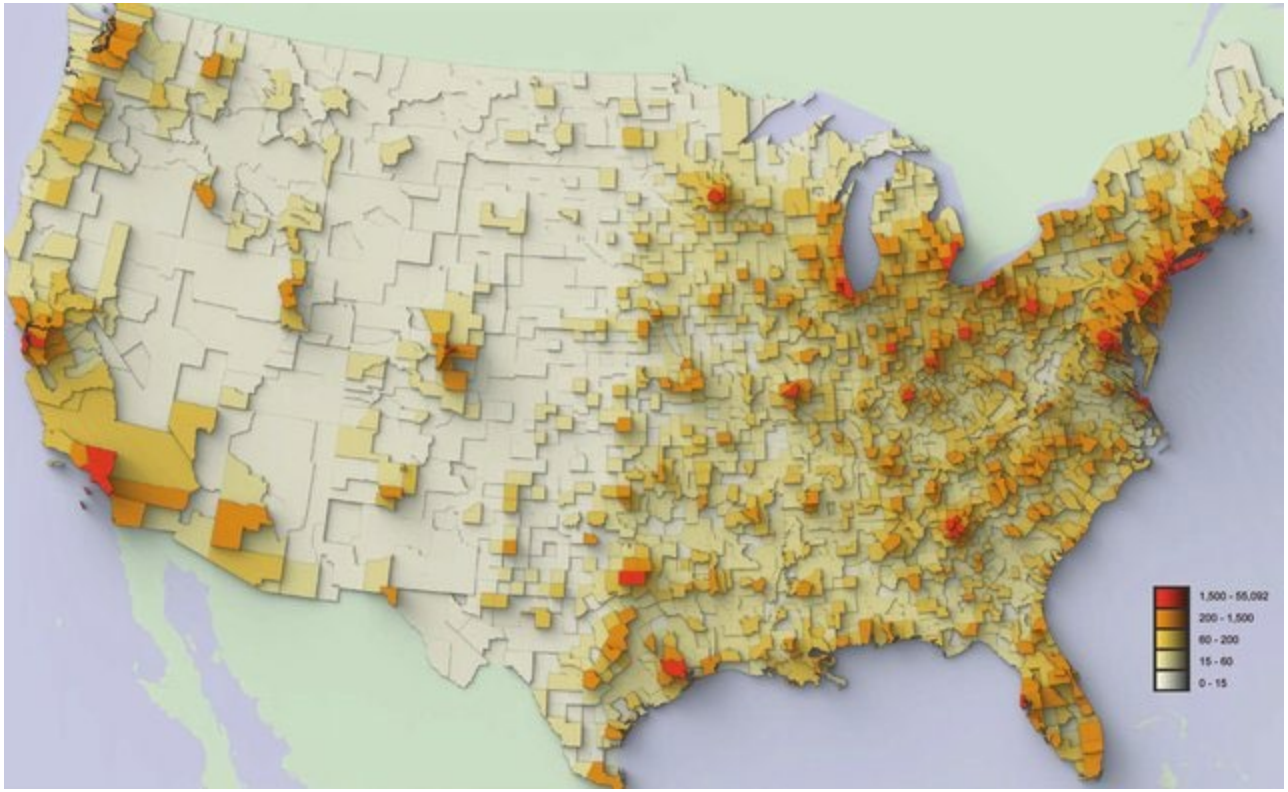


COVID-19
univariate



Subprime mortgage
bivariate

Visualization of Polygon Data: Prism Maps



An illuminated choropleth map (an improved prism map) showing population density of counties in the conterminous United States

Stewart, J., & Kennelly, P. J. (2010). Illuminated choropleth maps. *Annals of the Association of American Geographers*, *100*(3), 513-534.

Question 4-1-4

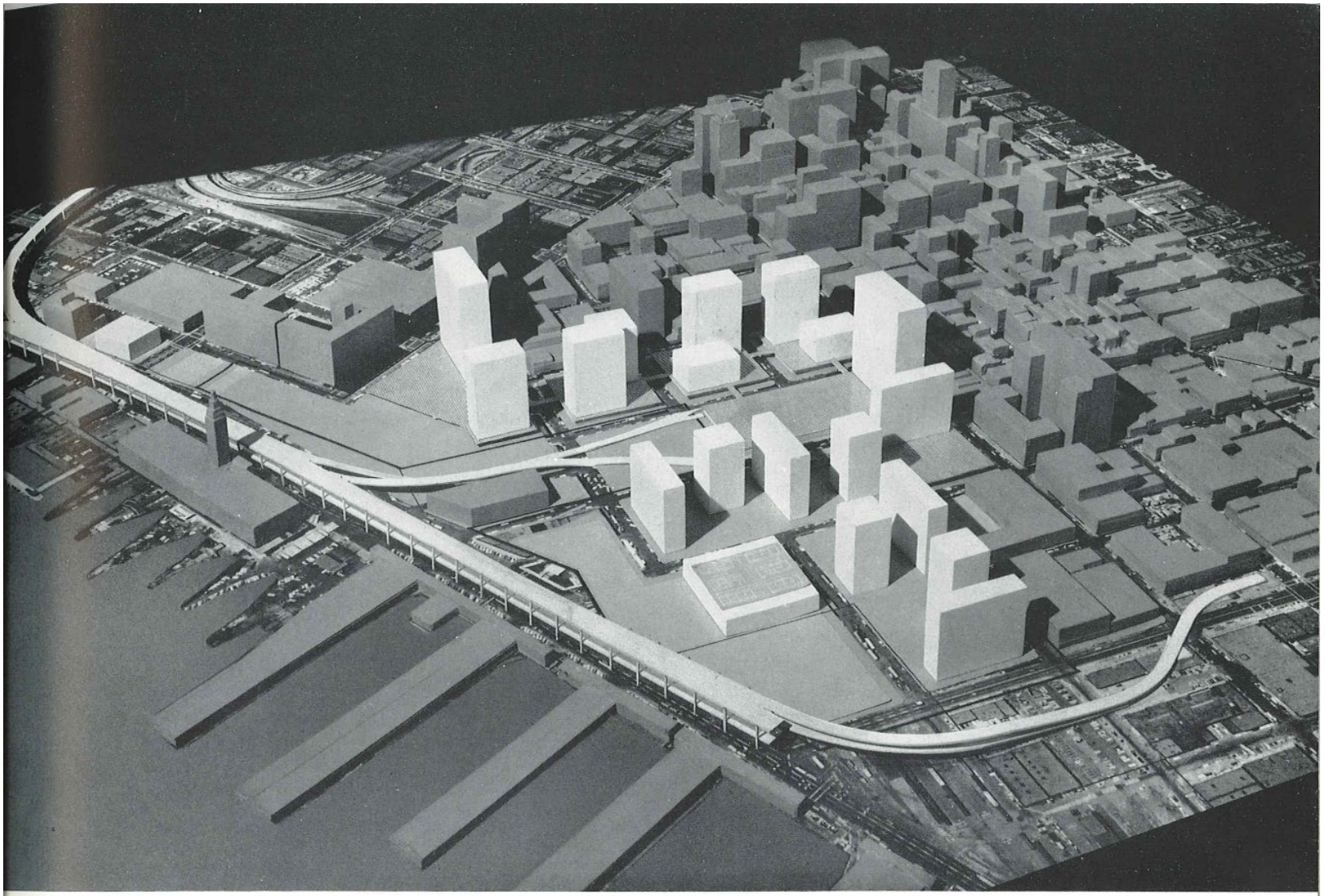
Recall the bivariate maps you created in Lab 2, what are the advantages and disadvantages of using colored prisms for visualization?

Visualization of Polygon Data

- 3D visualizations are also widely used to create city models

2D

3D



Model of the Golden Gateway Project (San Francisco Redevelopment Agency)

The New York Times

Reshaping New York

From buildings to bike lanes to painting over Broadway, how the city changed in 12 years of Bloomberg

Begin the tour