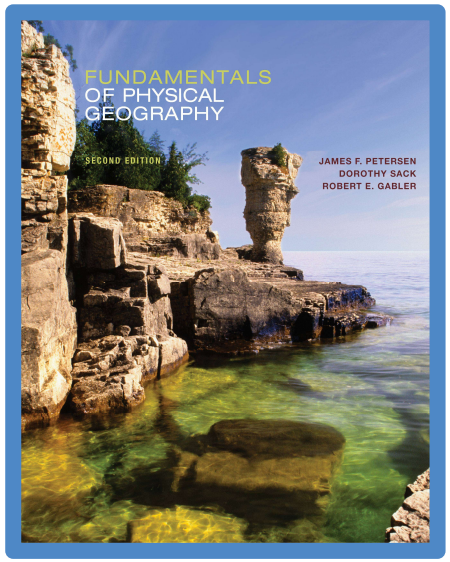
Fundamentals of Physical Geography 2e

Representations of Earth

2



- Peterson
  - Sack
    - Gabler

Maps and Location on Earth

- Overview
  - Cartography: science and profession of map making
    - Impacted by computer technology
- Earth's shape and size
  - Oblate spheroid

Are maps like this still valuable for learning about landscapes, or are they obsolete?

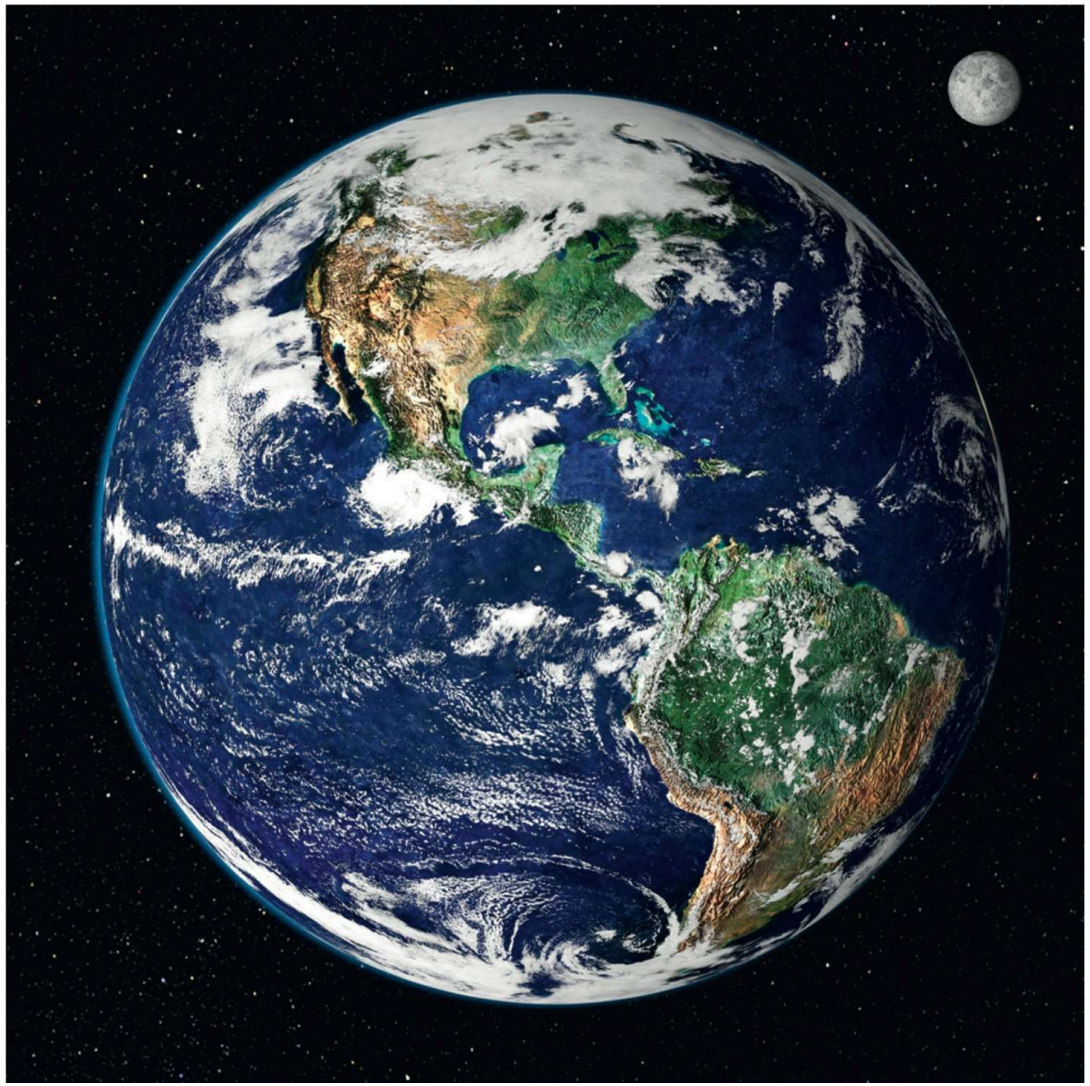
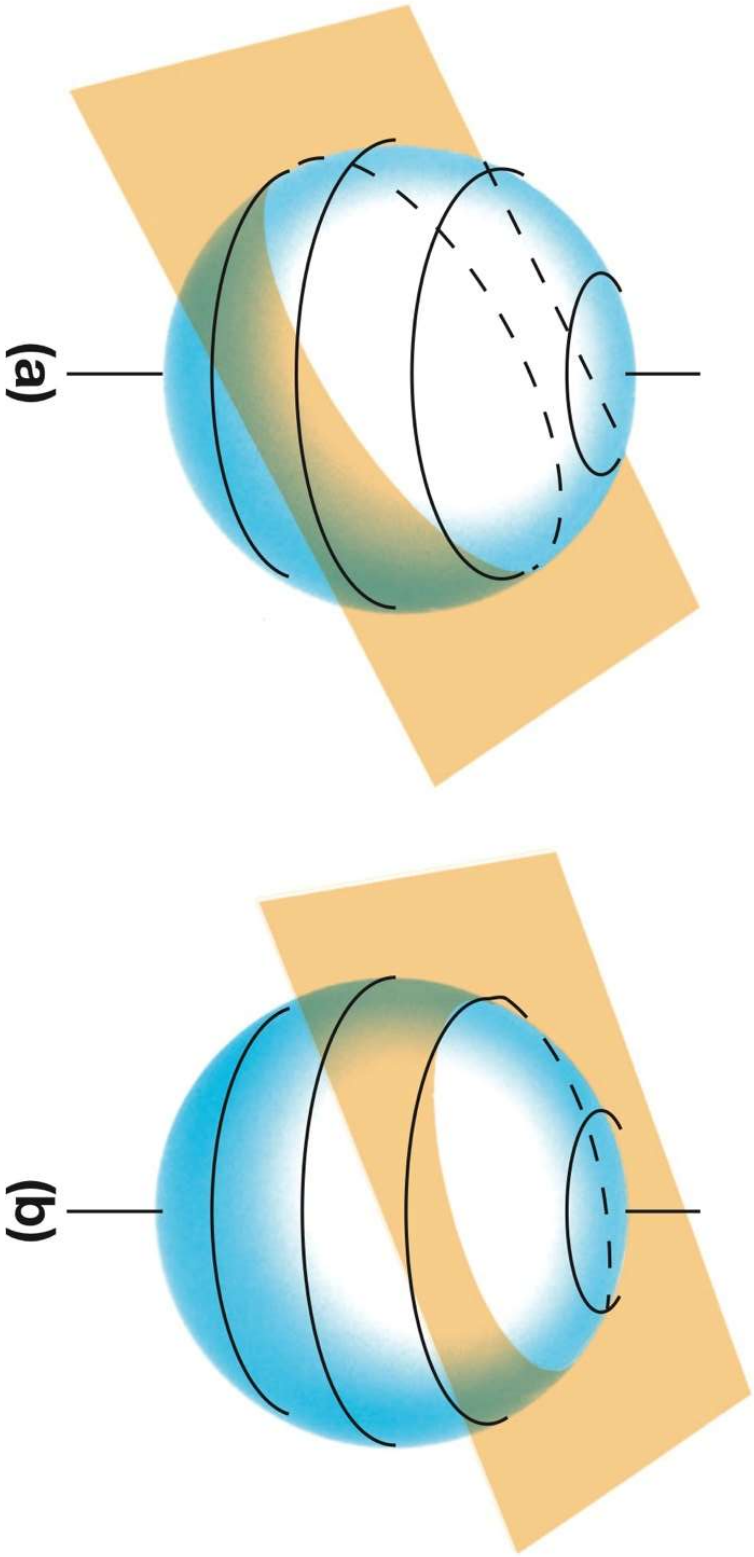


Image created by Retöckli, Nazmi El Saleous, and Marit Jenoft-Nilsen, NASA GSFC

What does this suggest about the degree of "sphericity" of Earth?

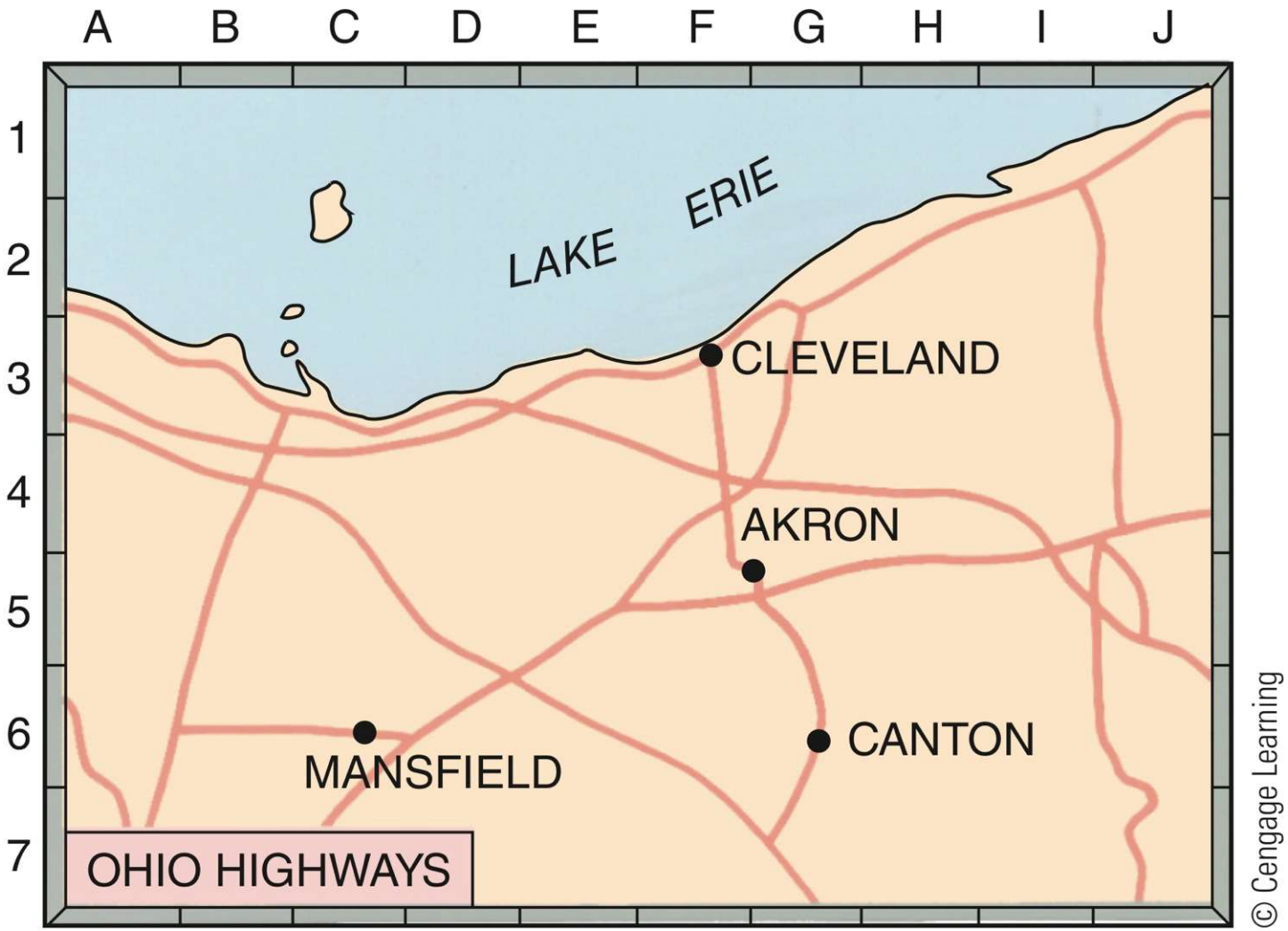
Maps and Location on Earth (cont'd.)

- Globes and great circles
  - Most accurate representation for entire world
  - Great circle
    - Divides earth into equal hemispheres
    - Circle of illumination
  - Small circle
    - Does not divide the planet into equal halves



Maps and Location on Earth (cont'd.)

- Latitude and longitude
  - Coordinate system: system of grid cells
  - Reference lines based on:
    - Earth's rotation *or*
    - Arbitrarily defined by international agreement



What are the rectangular coordinates of Mansfield? What is at location F-3?

Maps and Location on Earth (cont'd.)

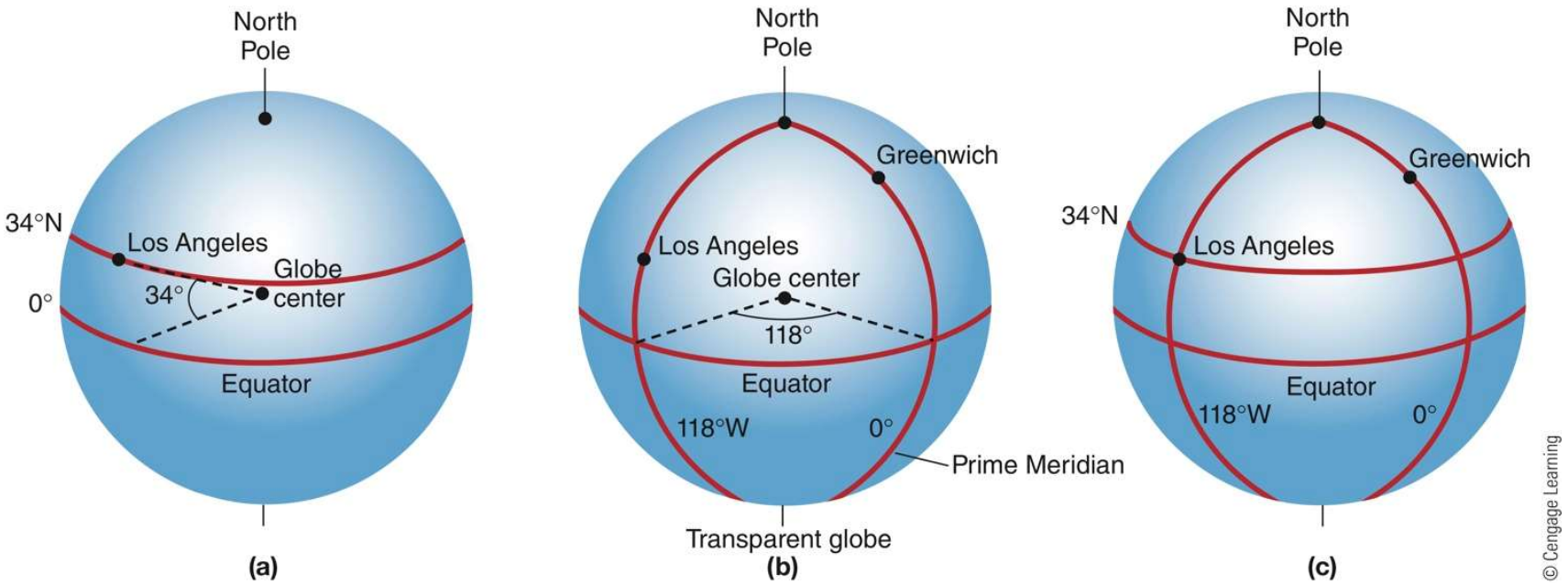
- Measuring latitude
  - Reference points: North Pole and South Pole
  - Equator: 0° latitude
  - Degrees north or degrees south of equator
  - Degrees: further divided into minutes (′) and seconds (″) of arc
    - Example of latitude: 23°34′12″S

Maps and Location on Earth (cont'd.)

- Measuring longitude
  - Prime meridian: 0° longitude
  - Longitude: angular distance east or west of the prime meridian
  - Measured in degrees, minutes, and seconds

Maps and Location on Earth (cont'd.)

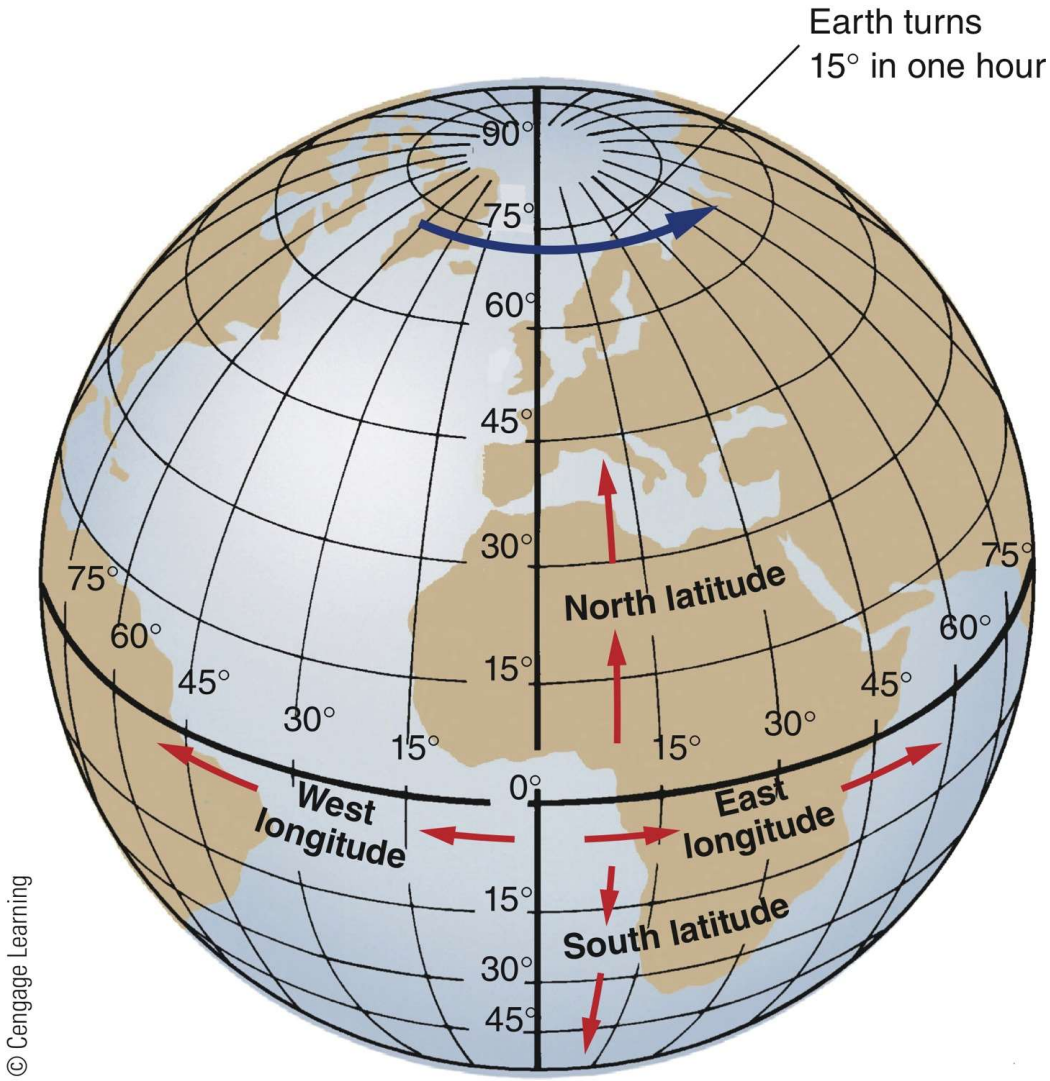
- Decimal degrees
  - Alternative to using minutes and seconds of arc
  - Very precise; well-suited to computer systems
  - Example:
    - Statue of Liberty location: 40.6894, –74.0447



What is the latitude of the North Pole, and does it have a longitude?

The Geographic Grid

- Parallels lines of latitude
- Meridians: lines of longitude
- Longitude and time
  - Time zones: based on the relationships among longitude, Earth's rotation, and time
  - Solar noon
  - Central meridian
  - Greenwich Mean Time (GMT)

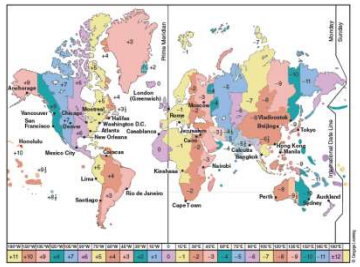


In what ways are the latitude lines (parallels) and longitude lines (meridians) different?

The Geographic Grid (cont'd.)

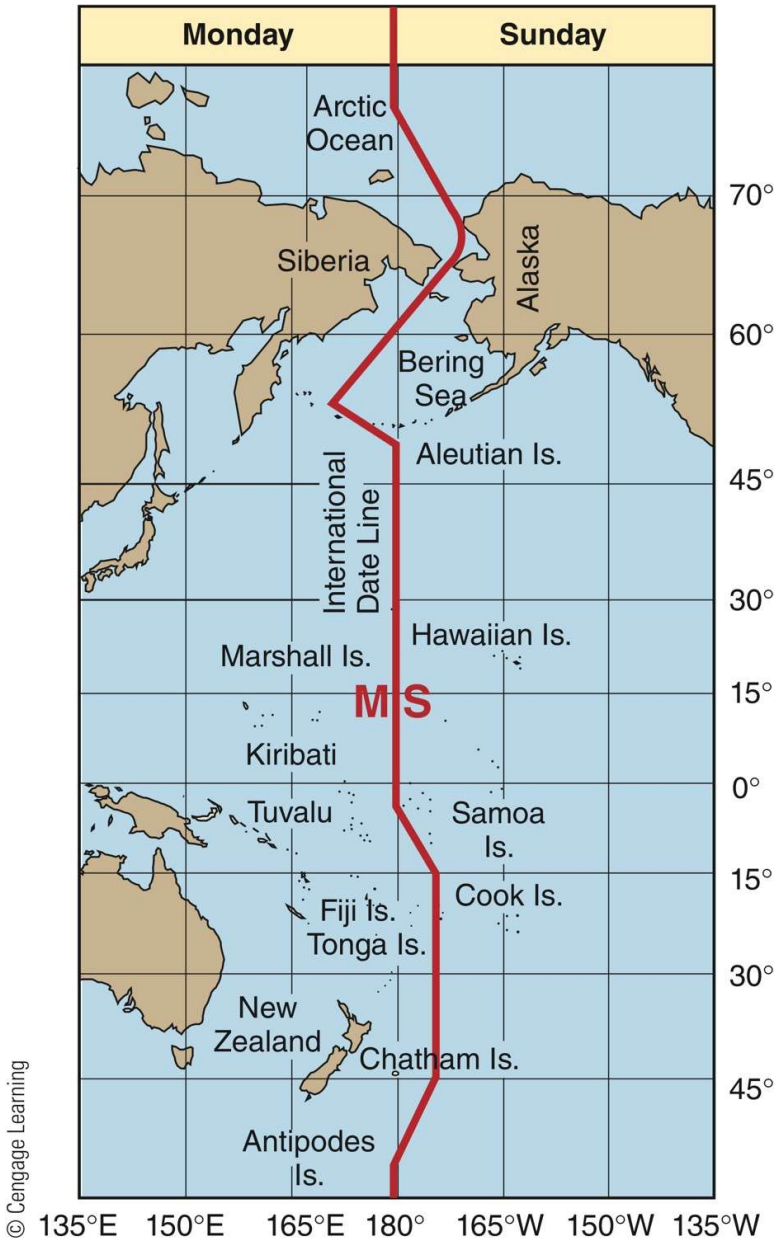
- The International Date Line
  - Generally follows the 180th meridian
  - Line adjusts the current day

Refer to Understanding Map Content 2.1



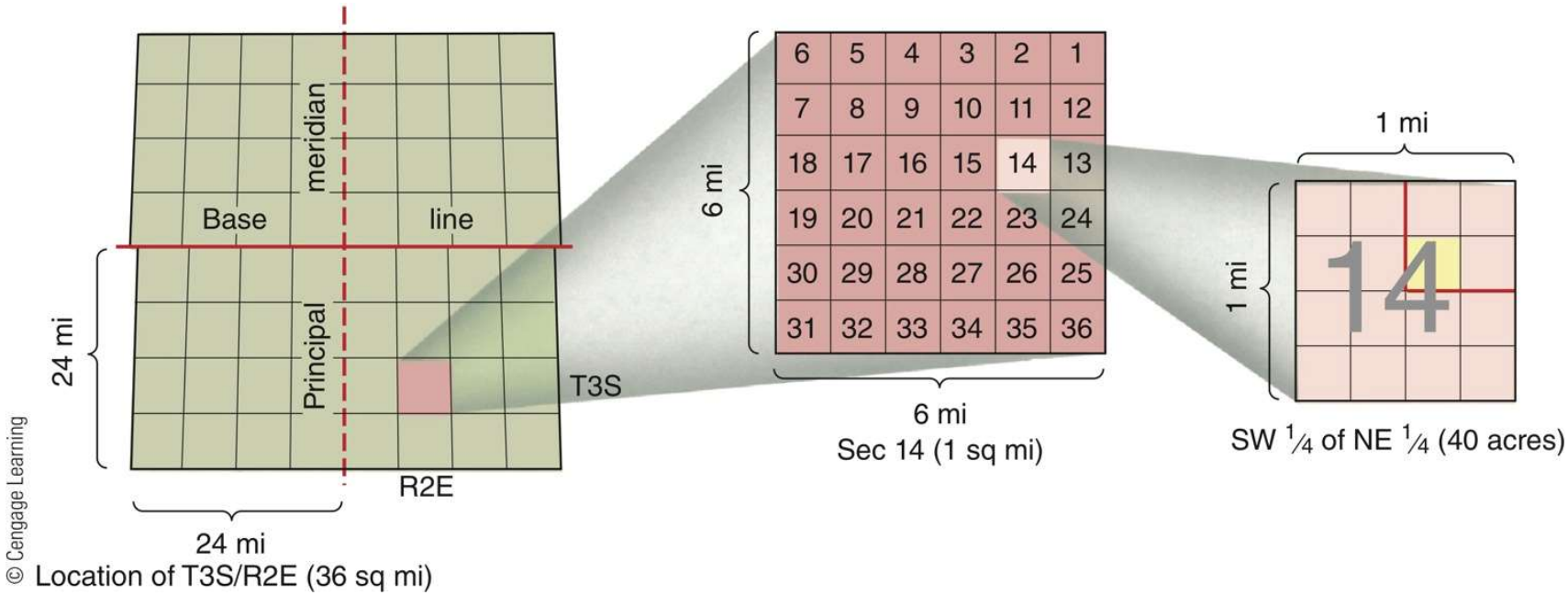
What is unusual about the east–west extent of the 15 degree East (–1) time zone? Boundaries are the result of political decisions, but what significant historical and physical geographic factors do you think might have influenced the present extent of this time zone? What significant landform features influence the two major deviations to the east and the one major deviation to the west of the International Date Line? What is unusual about the time zones in northern Russia? Can you suggest a physical geographic explanation for this deviation from the time zone pattern?

Why does the International Date Line deviate from the 180° meridian in some places?



The Geographic Grid (cont'd.)

- The U.S. Public Lands Survey System: Township and Range System
  - Principal meridians and baselines
  - Township
  - Range
  - Sections
  - Quarter sections
  - Quarter-quarter sections

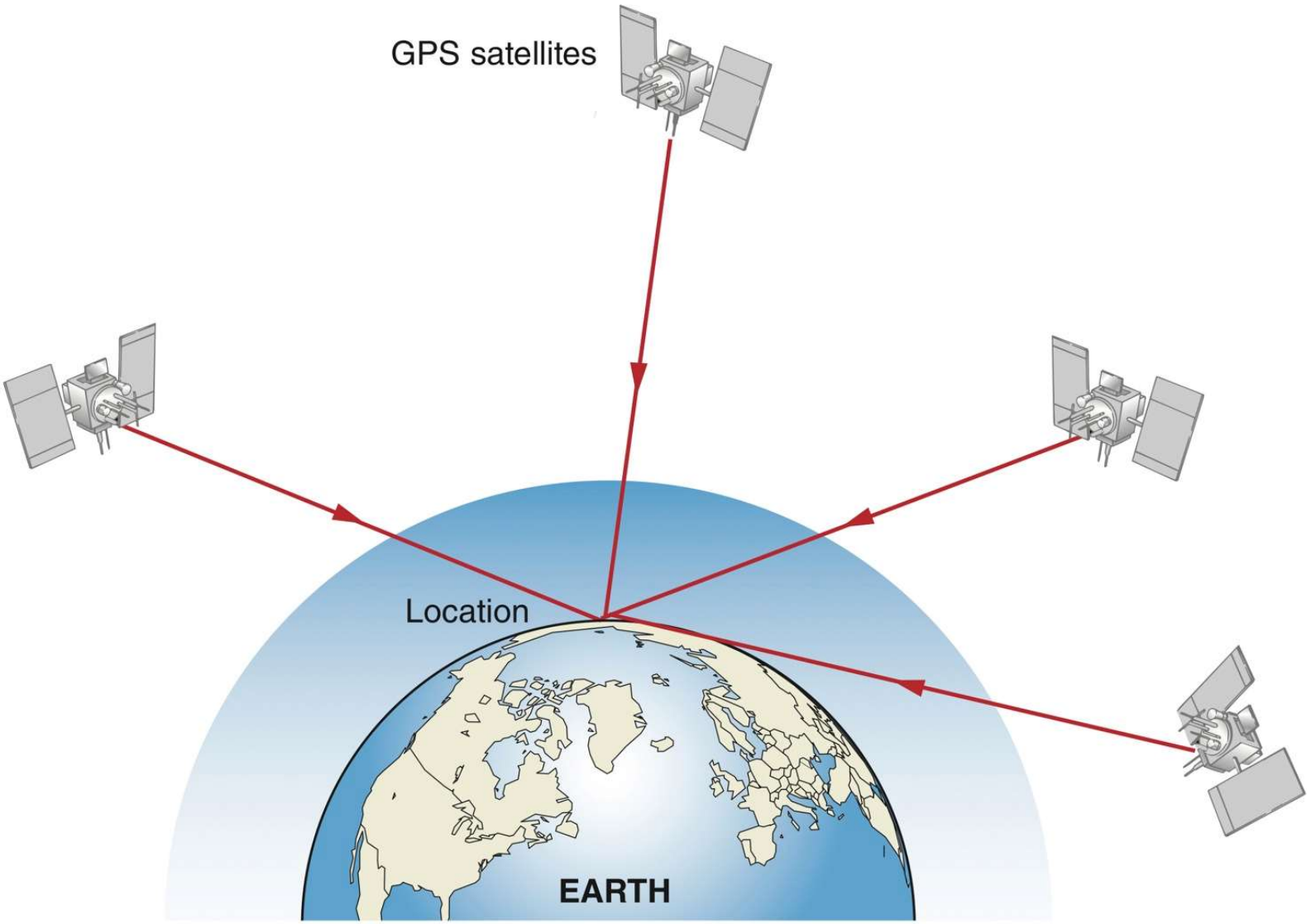


How would you describe the extreme southeastern 40 acres of section 20 in the middle diagram?

How do you know this photo was not taken in the Midwestern United States?

The Geographic Grid (cont'd.)

- What is a geographic grid?
- The Global Positioning System (GPS)
  - Radio signals transmitted by a network of satellites orbiting 17,700 km (11,000 mi) above Earth
  - Principle of triangulation
  - Numerous GPS applications

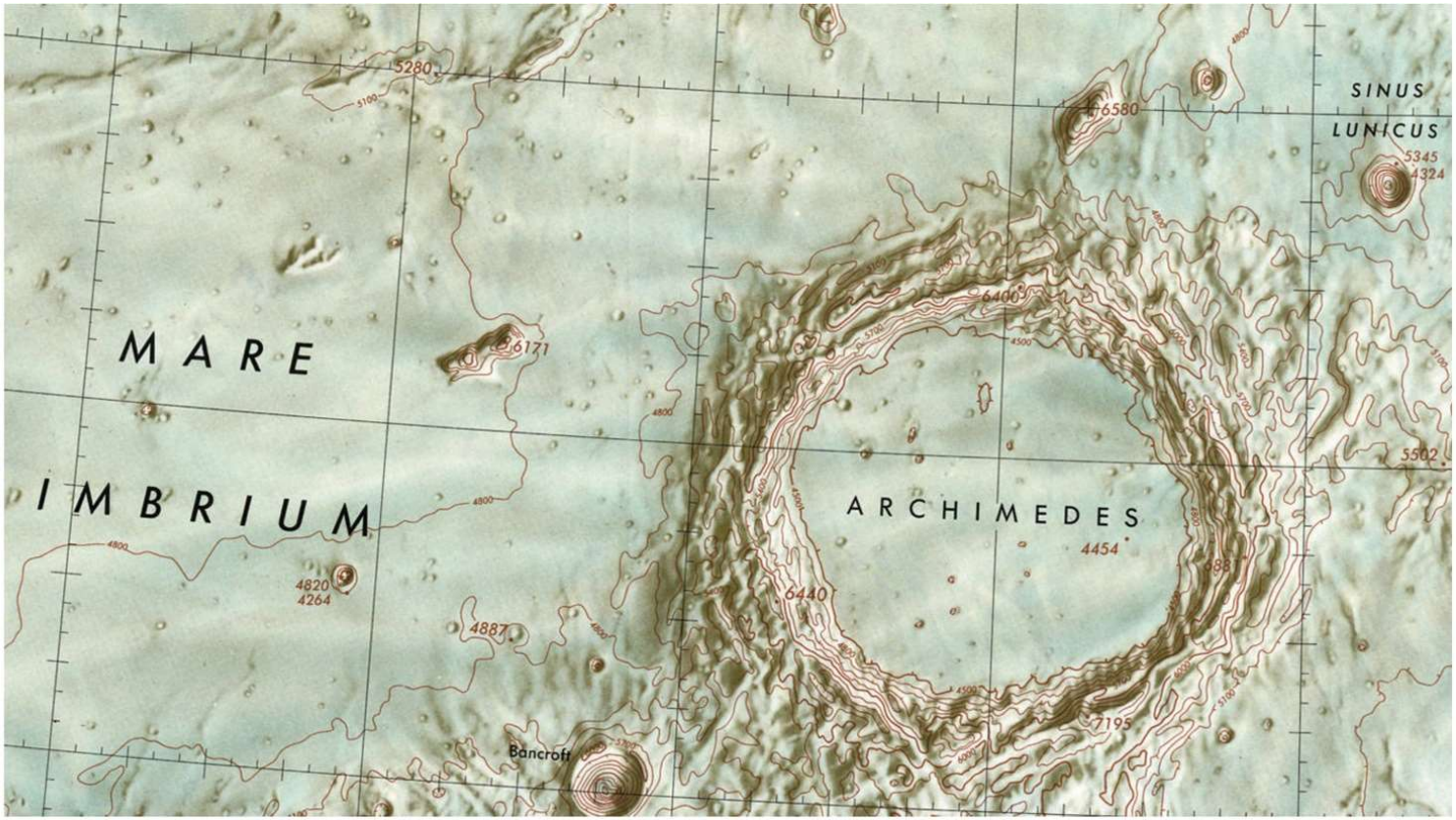


© Ted Timmons

What other uses can you think of for a small GPS unit like this that displays its longitude, latitude, and elevation?

Maps and Map Projections

- Advantages of maps
  - Provide an enormous amount of visual data
  - Geographer's most important tool
- Limitations of maps
  - Inability to capture all properties on a single map
  - Distortion



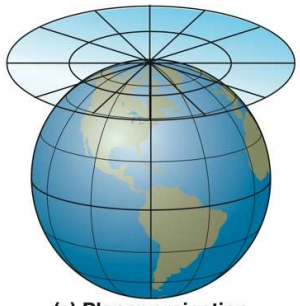
NASA

How were we able to map the moon in such detail?

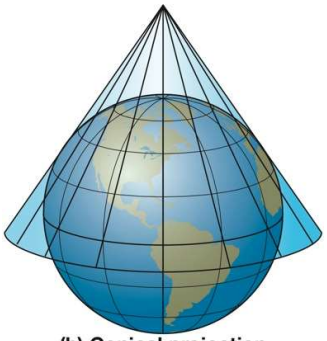
Maps and Map Projections (cont'd.)

- Examples of map projections
  - Planar projection
  - Conic projection
  - Cylindrical projection: e.g., Mercator projection

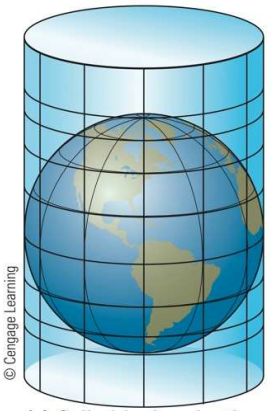
Why do we use different map projections?



(a) Planar projection



(b) Conical projection

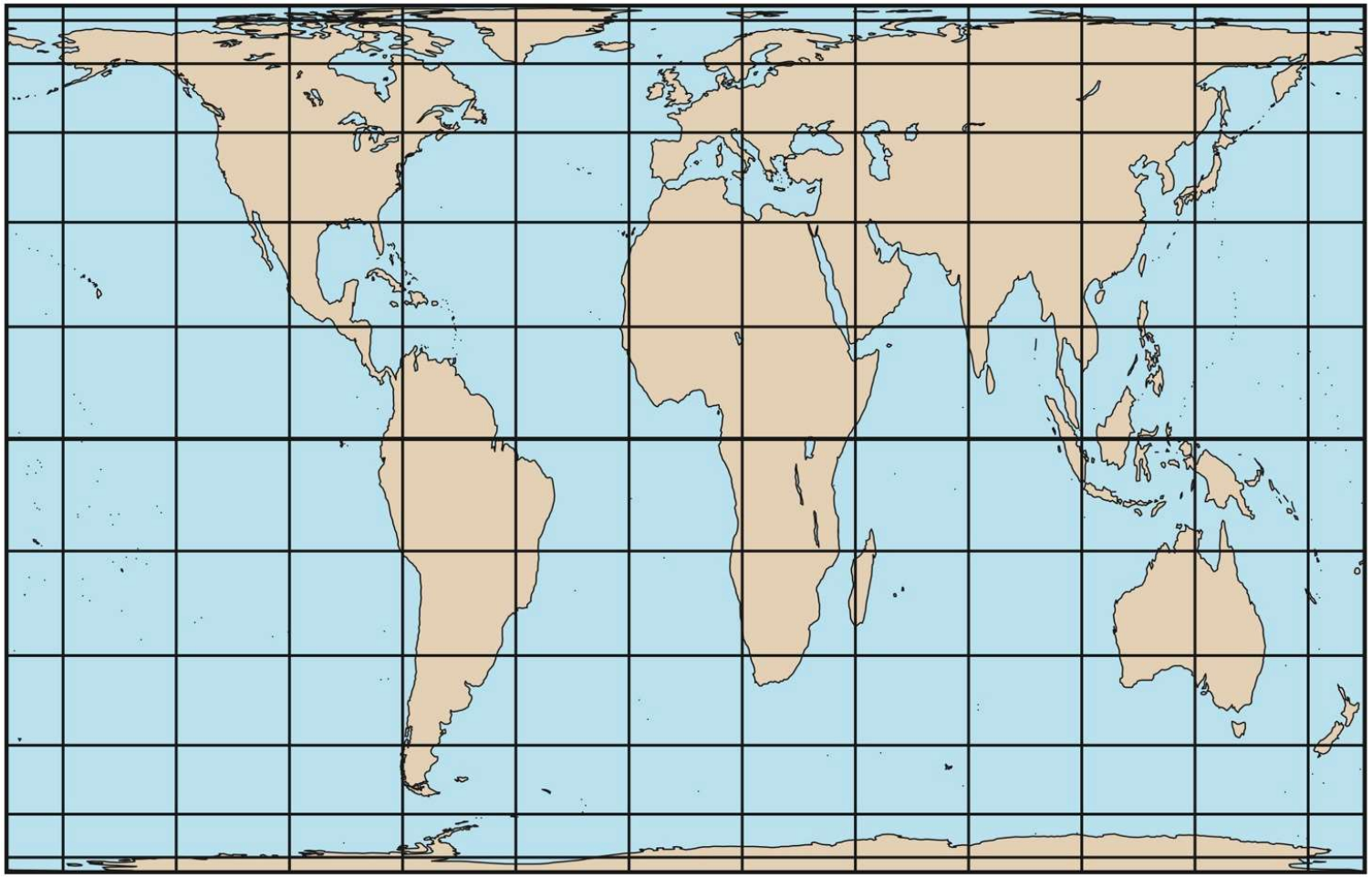


(c) Cylindrical projection

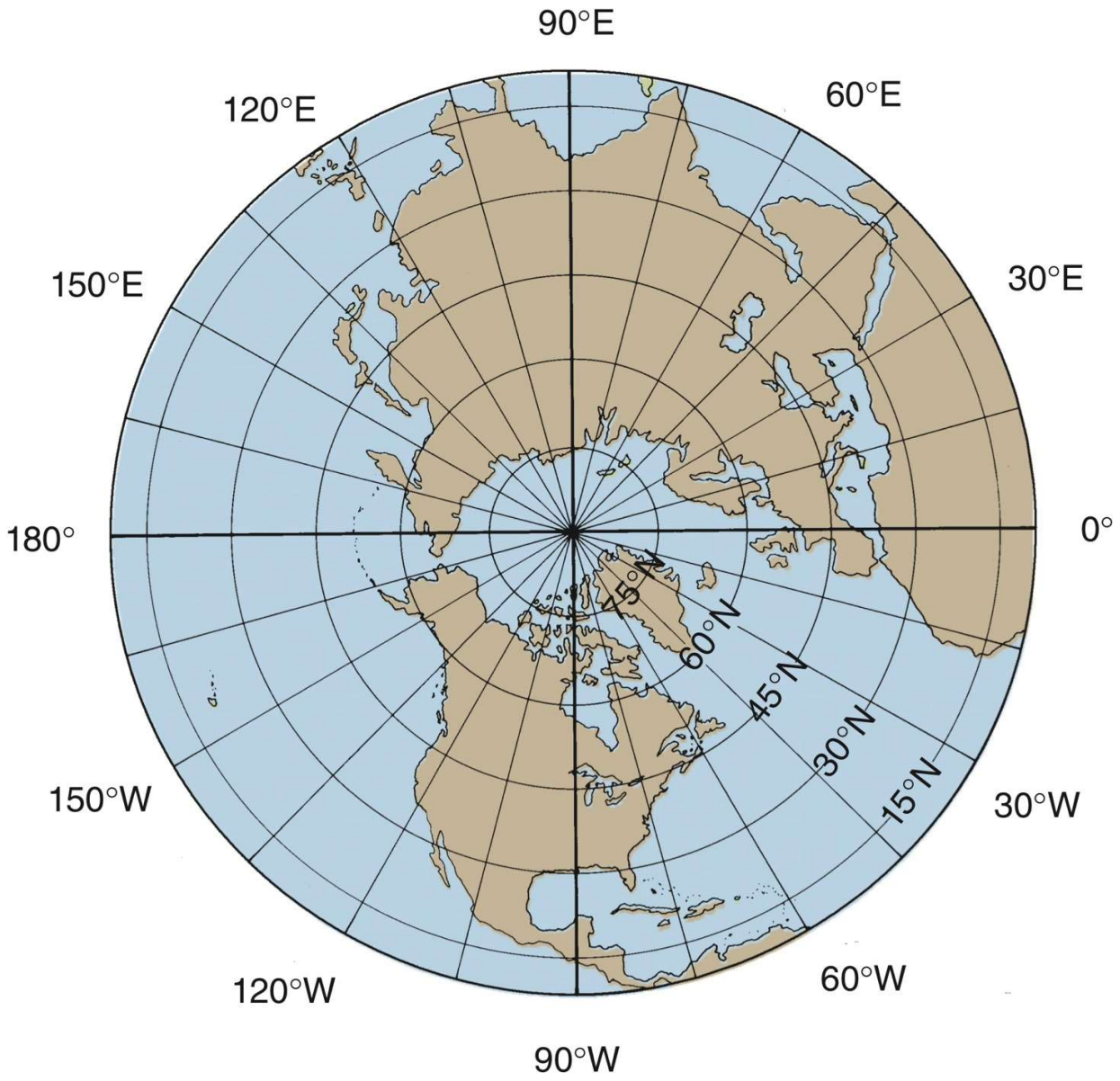
Maps and Map Projections (cont'd.)

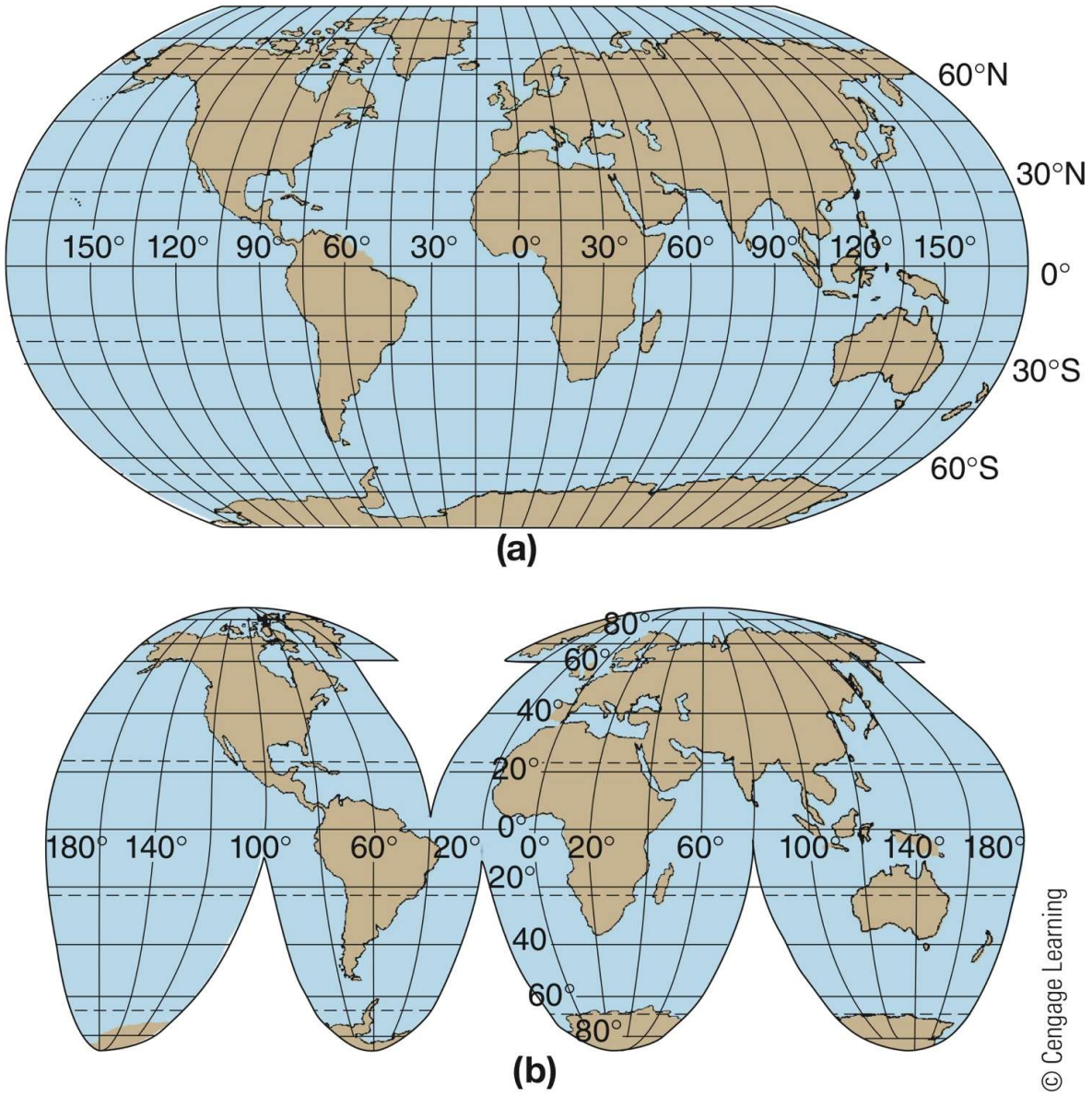
- Properties of map projections
  - Geographic grid has four geometric properties
    1. Parallels: always parallel
    2. Parallels: evenly spaced
    3. Meridians: converge at the poles
    4. Meridians and parallels: always cross at 90°
  - Area: equal-area maps
  - Shape: conformal maps
  - Direction: azimuthal map
  - Compromise projections

Compare the sizes of Greenland and South America on this map to their proportional sizes on a globe. Is the distortion great or small?



Which world map would you prefer, one that preserves area or one that preserves shape, and why?

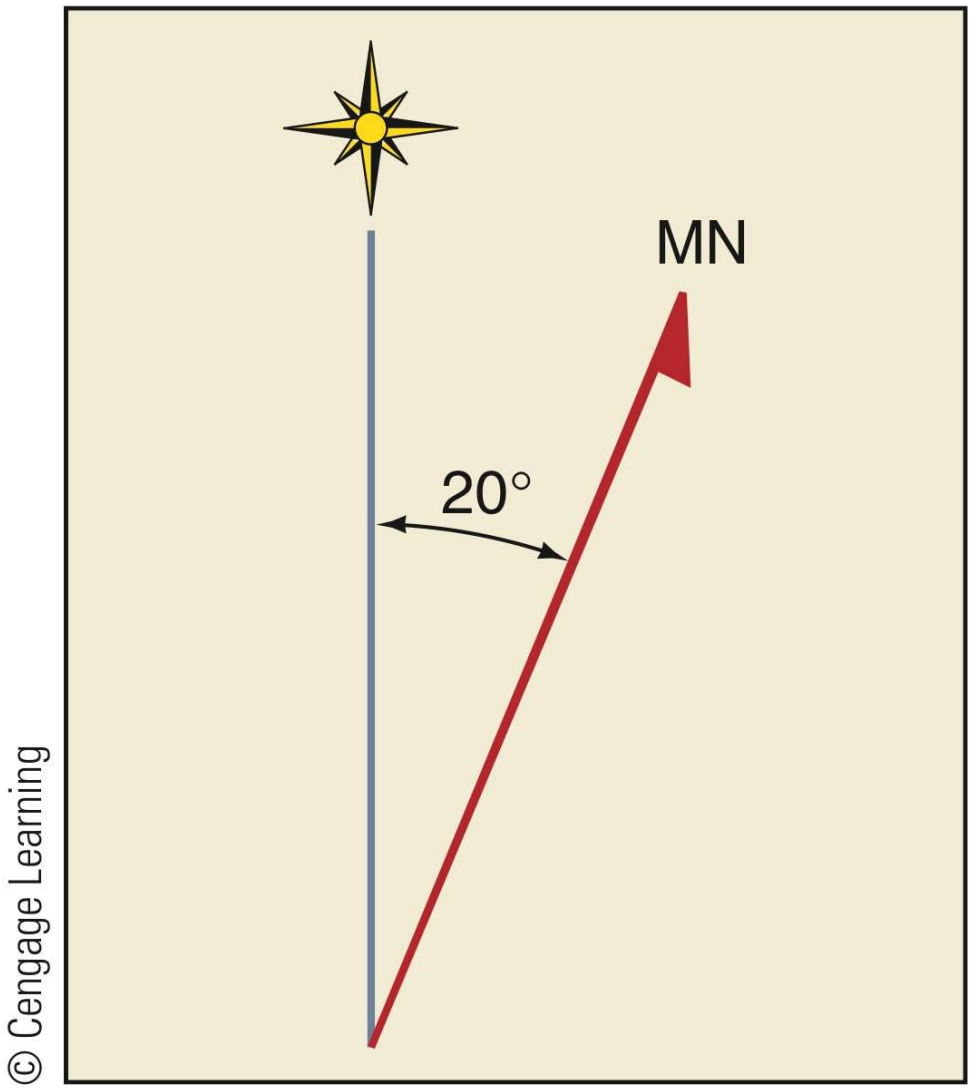




What is a disadvantage of (b) in terms of use?

Maps and Map Projections (cont'd.)

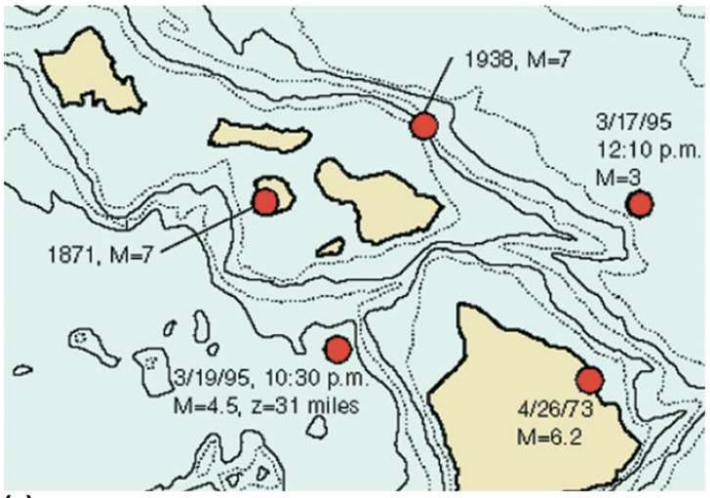
- Map basics
  - Map title
  - Legend
  - Scale
    - Map scale
    - Verbal scale
    - Representative fraction (RF) scale
    - Graphic scale or bar scale
  - Direction
    - Magnetic declination



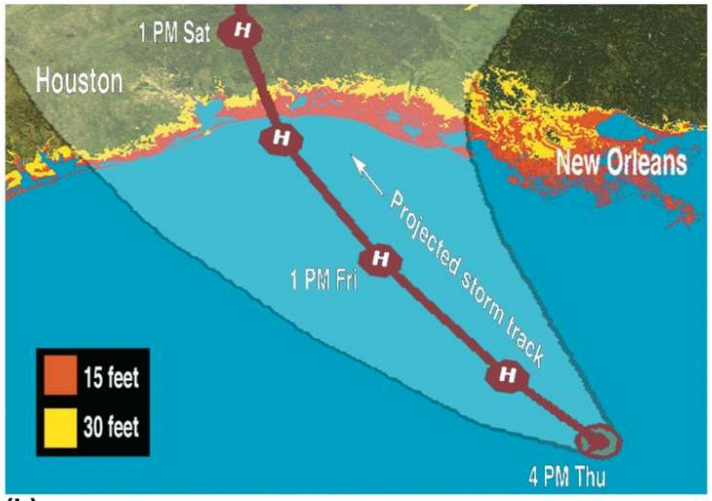
In what circumstances would we need to know the magnetic declination of our location?

Maps and Map Projections (cont'd.)

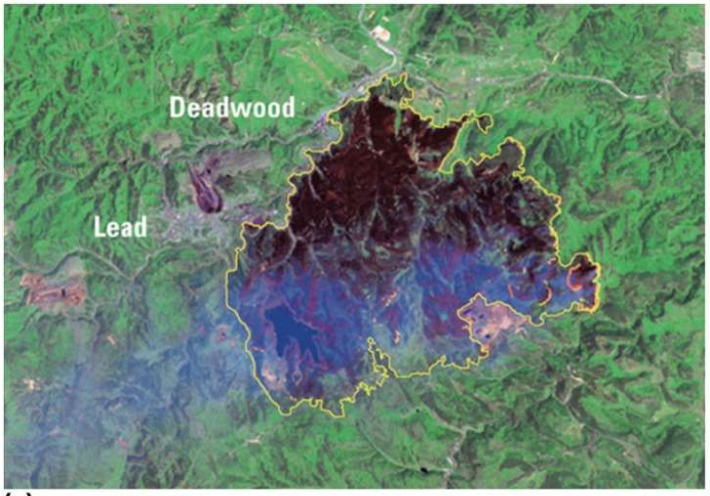
- Thematic maps
  - Discrete data
    - Regions
  - Continuous data
    - Isolines: isotherms, isobars, isobaths, and isohyets



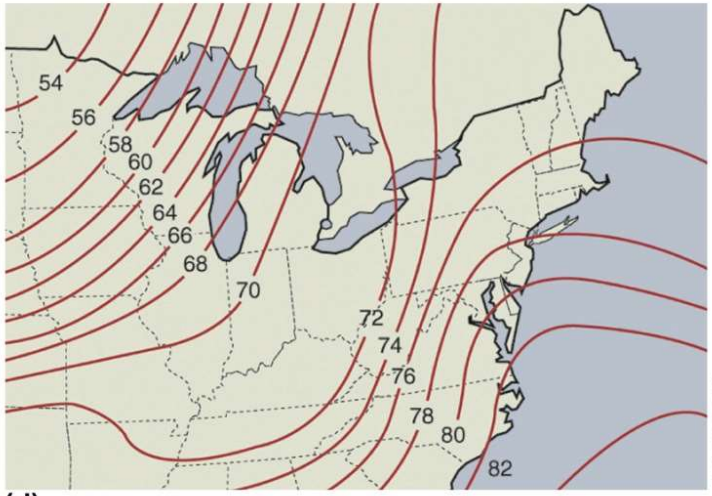
(a)



(b)



(c)



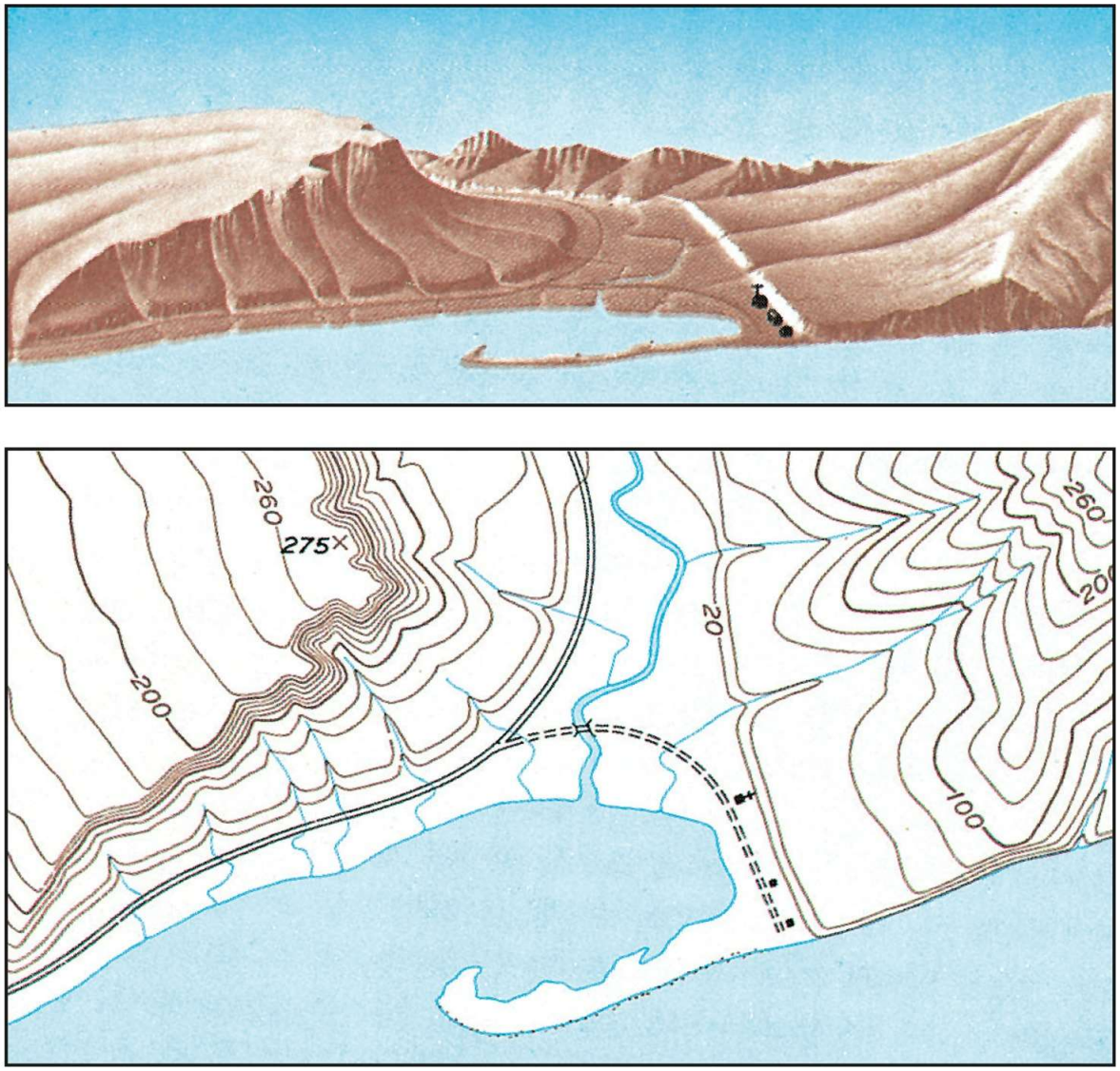
(d)

NASA/JPL/NGA

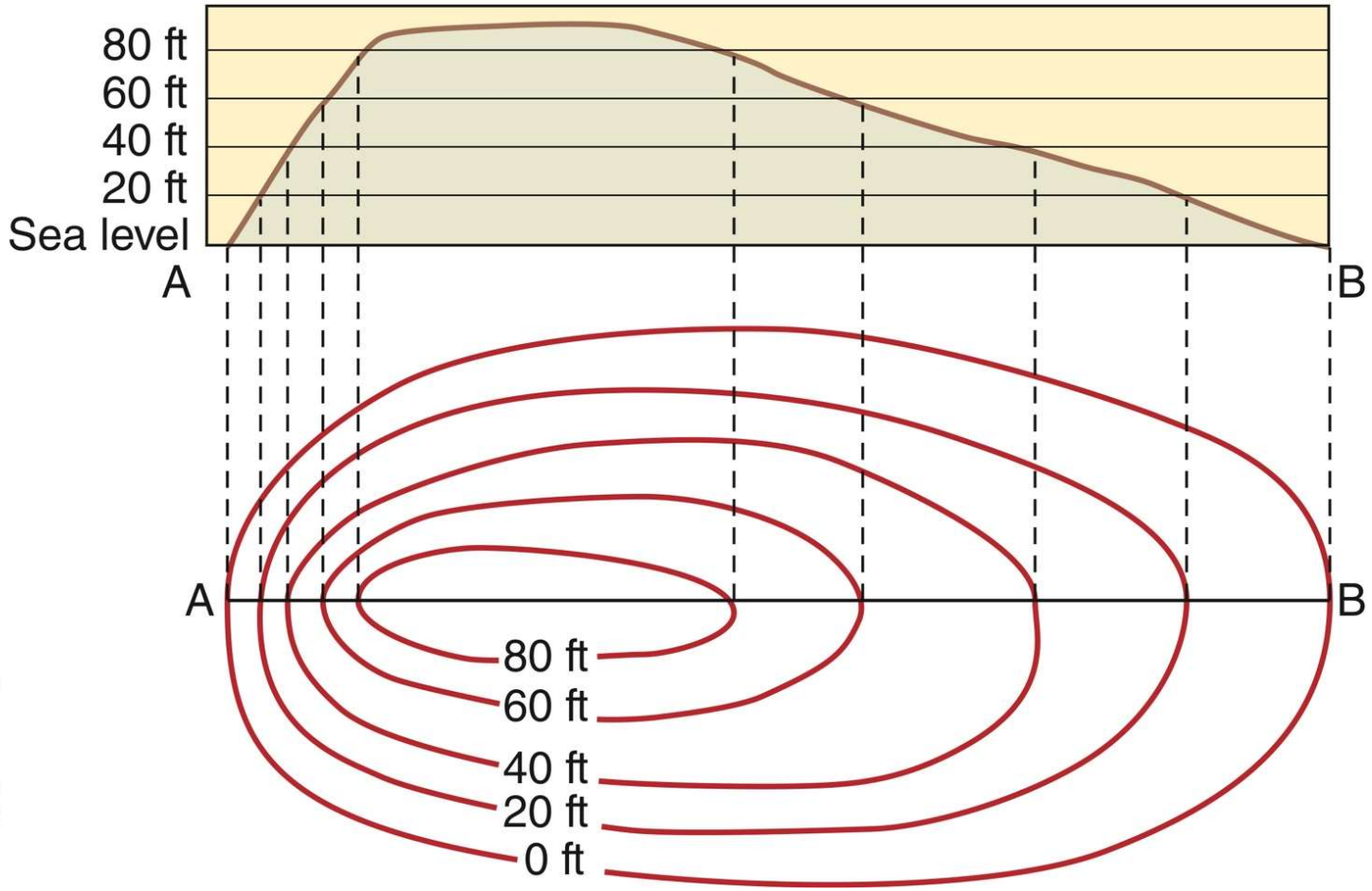
Can you name other environmental examples of discrete and continuous variables?

Maps and Map Projections (cont'd.)

- Topographic maps
  - Topographic contour lines
  - Contour interval
  - Profile
  - Gradient



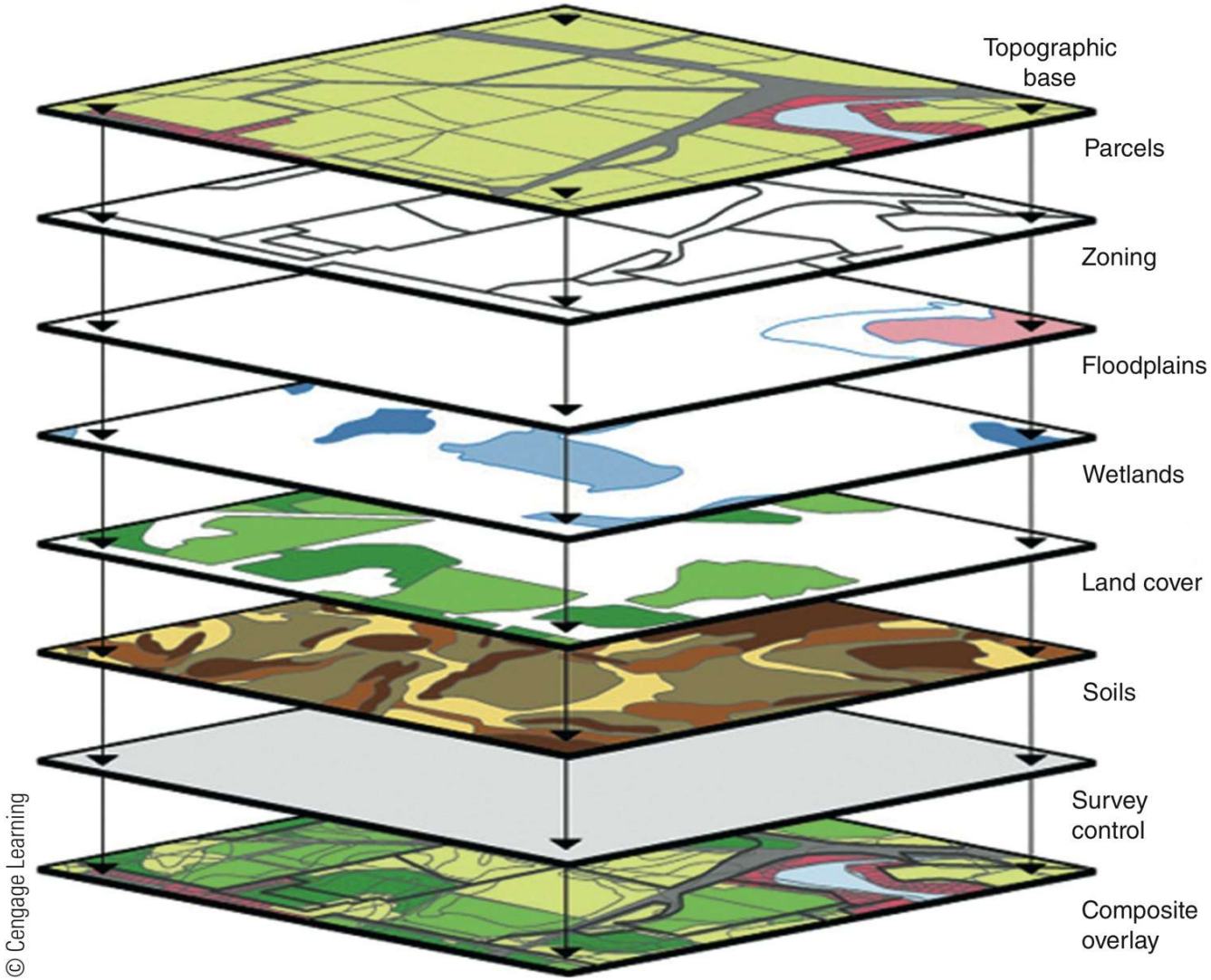
If you only had a topographic map, could you visualize the terrain shown in the shaded-relief diagram?



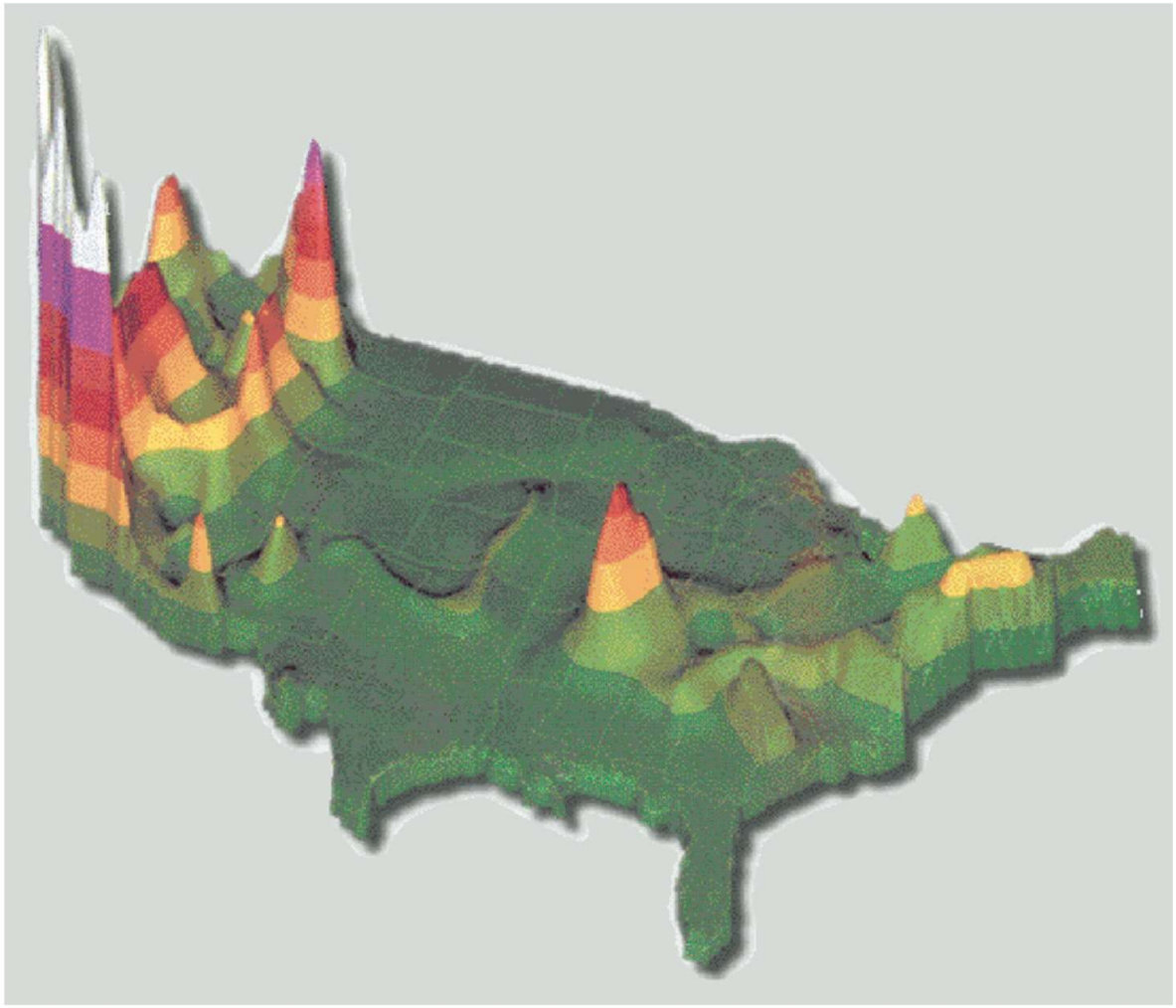
What is the relationship between the spacing of contour lines and steepness of slope?

Modern Mapmaking

- Geographic information systems (GIS)
  - Computer-based technology to enter, analyze, manipulate, and display geographic information
  - What a GIS does
    - Digital overlay of any set of thematic map layers
    - Digital elevation models (DEMs)
    - Visualization models (visualizations)
    - Draping



Can you think of other applications for geographic information systems?

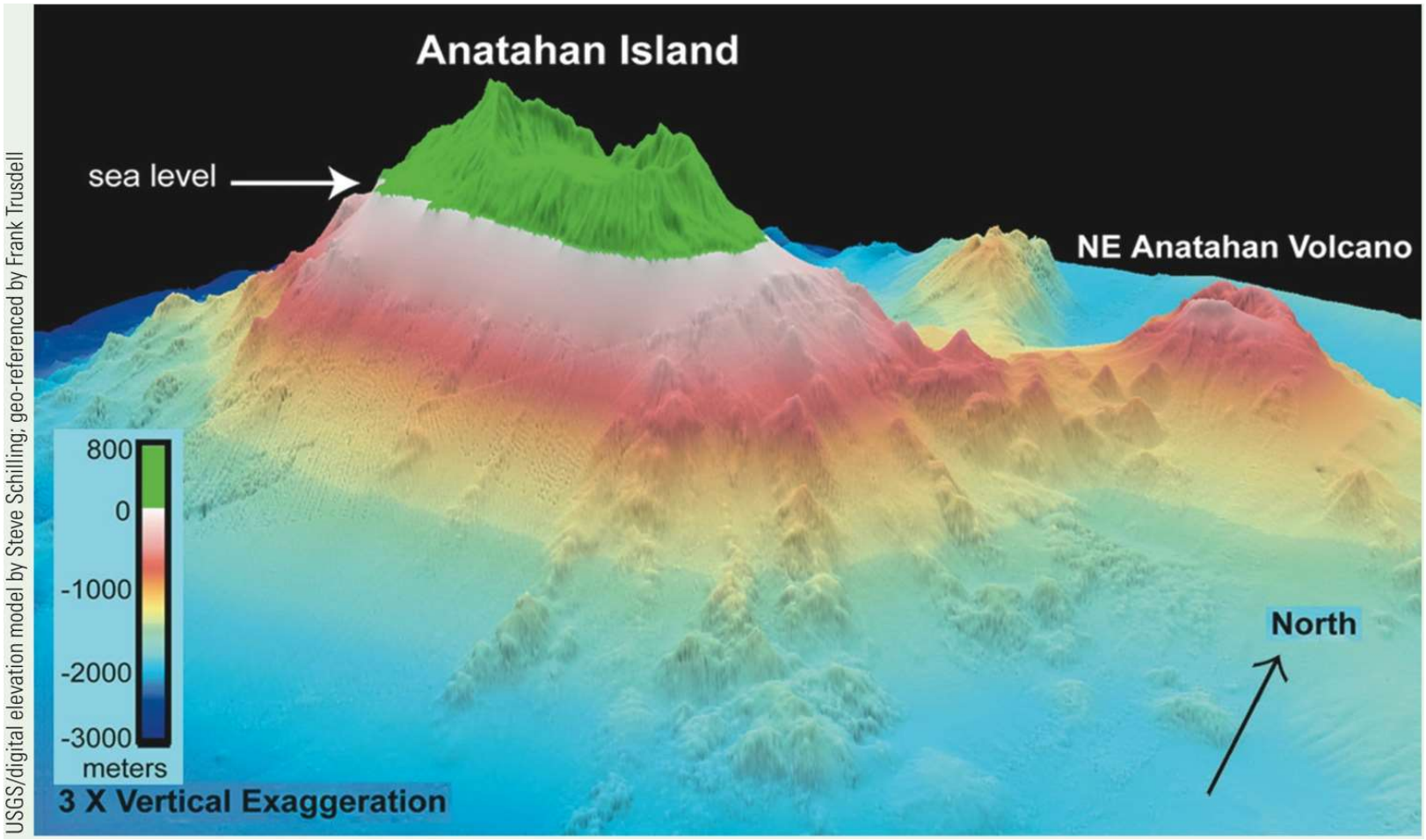


USGS

Other than where you might expect to find a high level of earthquake hazard, are there locations with a level of this characteristic you find surprising?

Modern Mapmaking (cont'd.)

- Using vertical exaggeration to portray topography
  - Apply to block diagrams, profiles and cross sections to enhance elevation changes
    - Subtle terrain changes made more noticeable



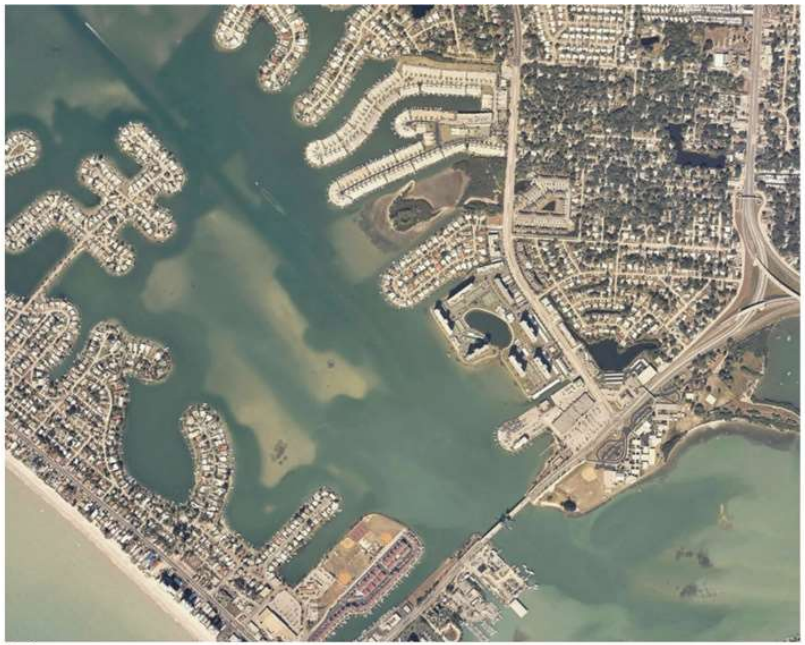
USGS/digital elevation model by Steve Schilling; geo-referenced by Frank Trusdell

Remote Sensing of the Environment

- What is remote sensing?
- Digital imaging and photography
  - Consists of pixels: spatial resolution is a key factor
  - Allows for computer-assisted processing and sharing
  - Near-infrared (NIR) photographs provide clear images from high altitudes or space

USDA

(a)



(b)

USGS

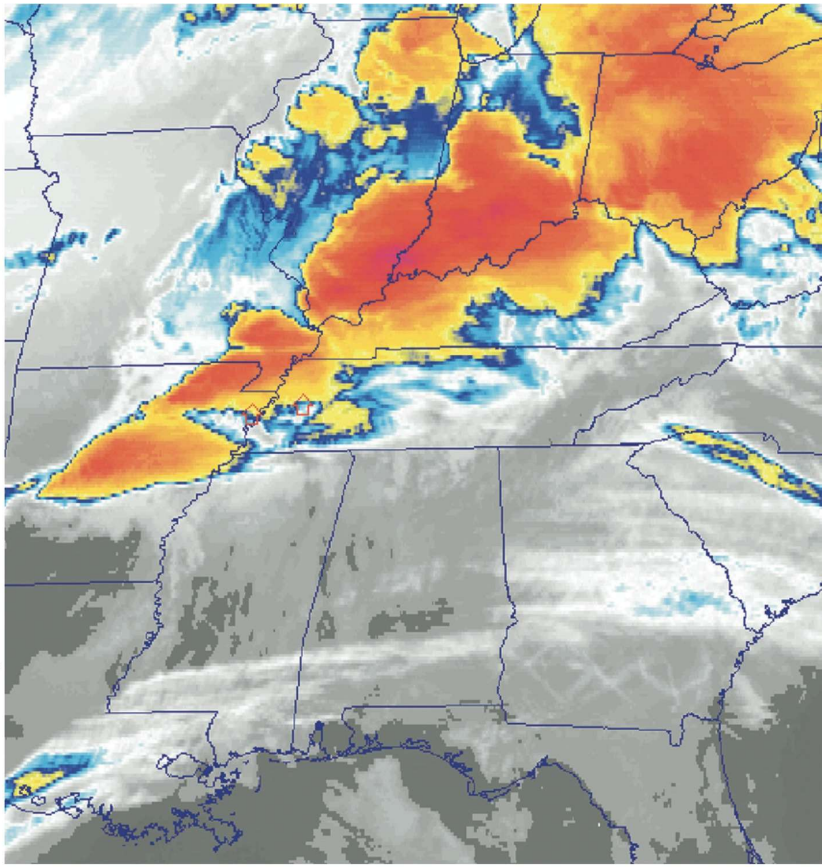
What are the benefits of an oblique view, compared with a vertical view?

NAIP/TNRIS

If you were asked to make a map of vegetation or water features, which image would you prefer to use and why?

Remote Sensing of the Environment (cont'd.)

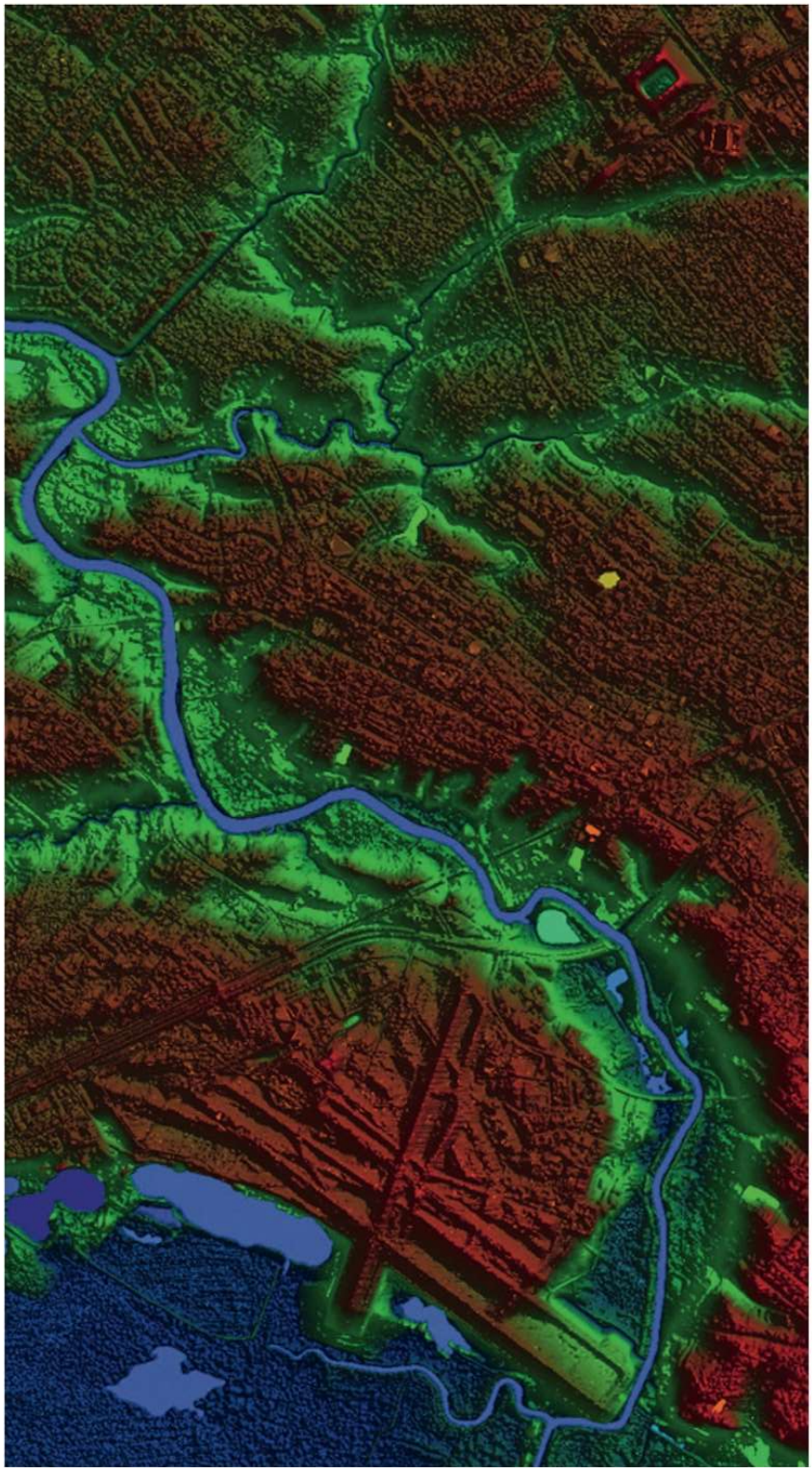
- Specialized remote sensing
  - Thermal infrared (TIR) images
  - Radar (*ra*dio *d*etection *a*nd *r*anging)
  - Lidar (*li*ght *d*etection *a*nd *r*anging)
  - Sonar (*so*und *n*avigation *a*nd *r*anging)
- Multispectral remote sensing: compares same location using multiple image types



NOAA/GOES Satellite Image

Why are the storm patterns on thermal weather images important to us?

Christopher Borst, Center for Advanced Computer Studies,
University of Louisiana at Lafayette



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Representations of Earth

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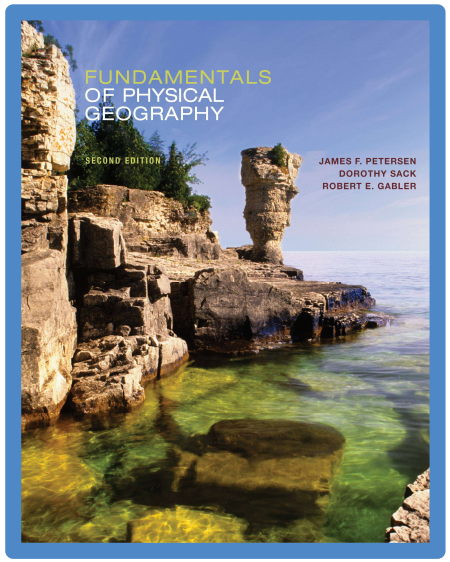

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