Data sources and classification for ecosystem accounting

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Which data source could be useful for mapping ecosystem services?

a. A global land-cover map from an international research consortium — **33%**

b. FAO Forest Resource Assessments — **24%**

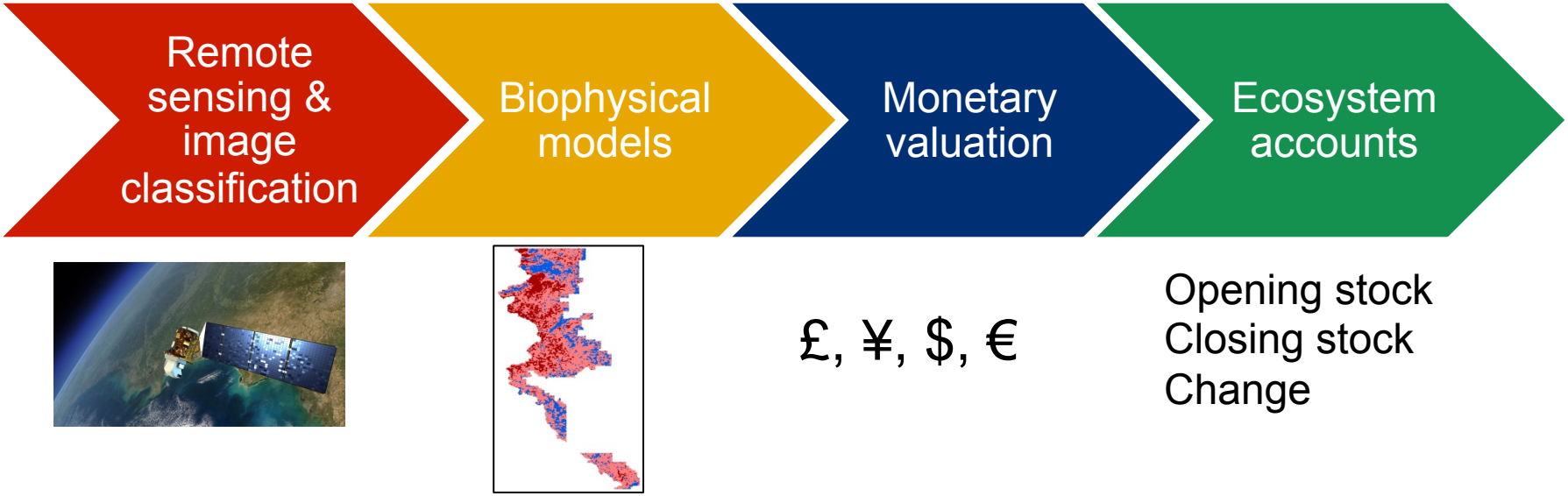
c. Population density and per capita income data from a national census bureau — **5%**

d. Soil survey data from a national mapping agency — **24%**

e. Precipitation data from a university climate research group — **14%**

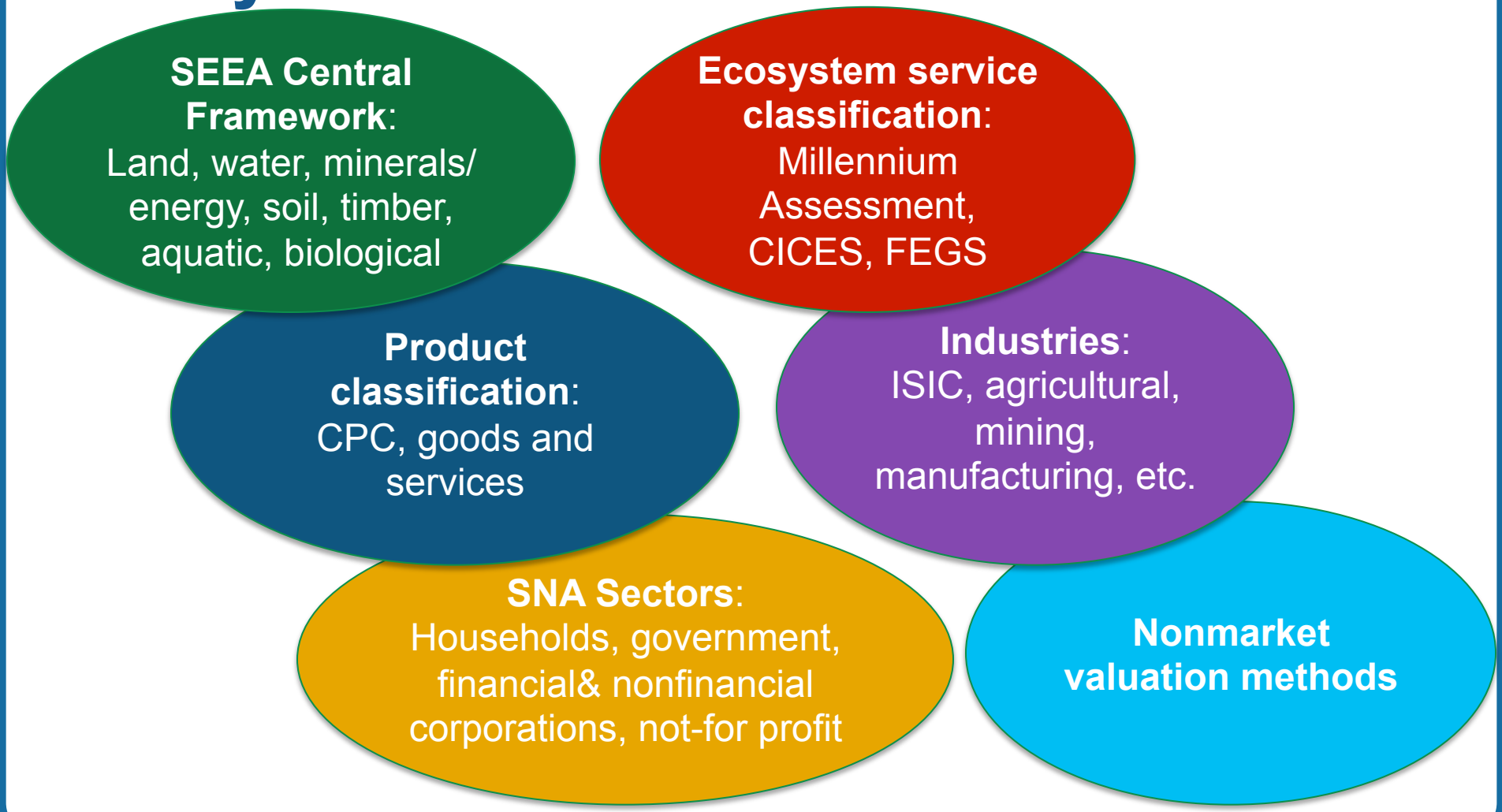
Why classification and data?

Who's done these steps in ecosystem services assessment and accounting?



Classification for ecosystem accounting

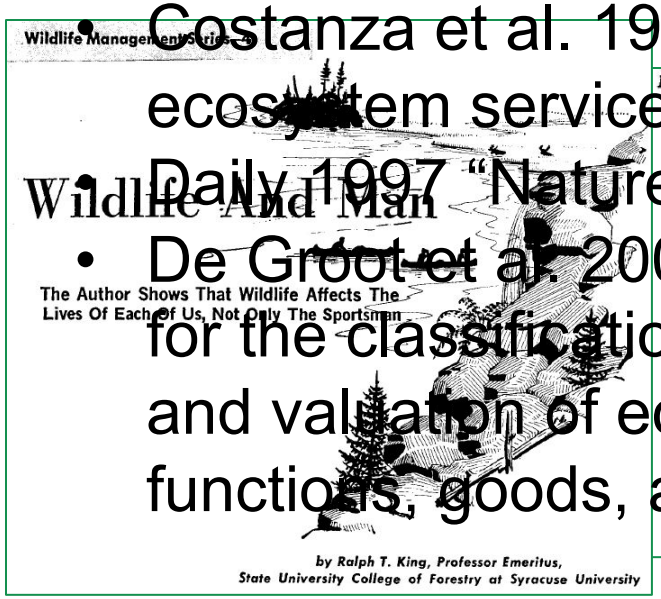
Classifications for accounting & ecosystem services



Classifying ecosystem services

1997-2014: Major compilations of ecosystem services

- Costanza et al. 1997 “The value of the world’s ecosystem services and natural capital”
- Daily 1997 “Nature’s services”
- De Groot et al. 2002 “A typology for the classification, description, and valuation of ecosystem functions, goods, and services”



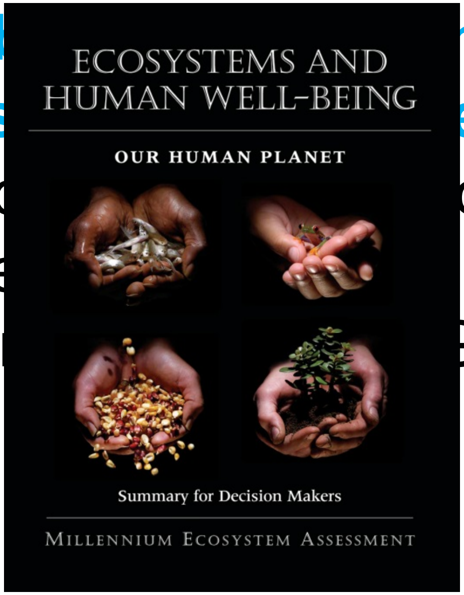
Late 1960s-early 1990s → 1997-2004 → 2005 → 2006-present

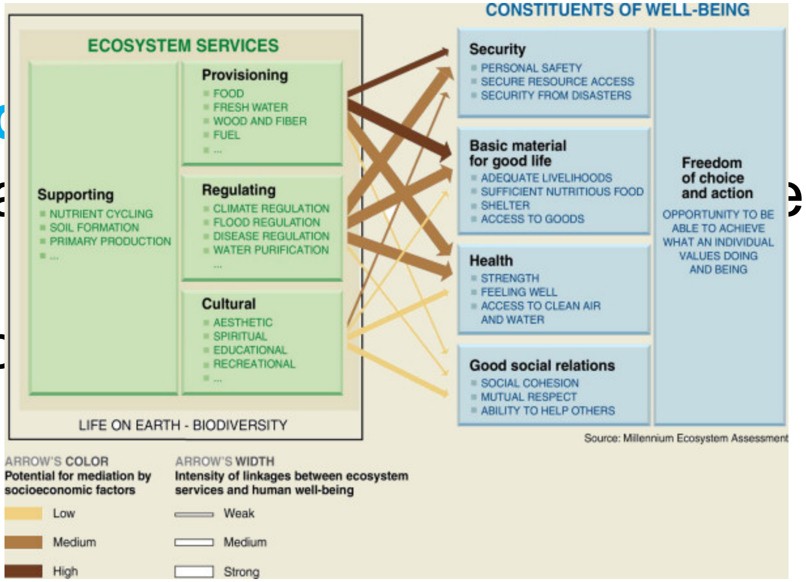
Classifying ecosystem services

2005: Millennium Ecosystem Assessment groups services (supporting, regulating, provisioning and cultural)

2006-present: Efforts to address problem of intermediate ... final ... doub... nd ecos... efic...

- Co... ona... em Se...
- Fi... Goo...





Late 1960s-early 1990s	1997-2004	2005	2006-present

Common International Classification of Ecosystem Services (CICES)

Provisioning services

Nutrition

Food

Cultivated plants and domesticated animals
Wild plants and animals
Aquaculture-raised plants and animals

Water

Surface water for drinking
Groundwater for drinking

Materials

Energy

Regulating services

Provisioning: Water, Food, etc.

Regulating: Flood protection, erosion control, etc.

Cultural: Recreation, Existence, etc.

Data sources for ecosystem accounting

Types of data sources

Statistical data:

Agriculture, Forestry, Fisheries, Other er

Demographics, Resource use

Survey data: point-based, extrapolate

Weather data, soils, biodiversity, etc.

Extrapolate data to make it spatial (e.g., from rain gage data to a precipitation map)

Spatial data: maps generated using imagery and remote sensing

GIS: Software for spatial data

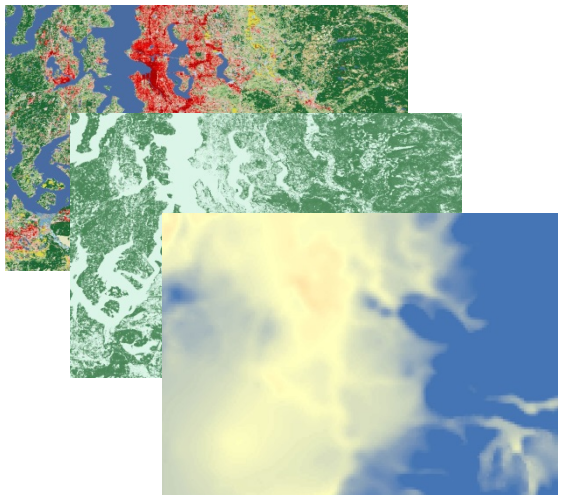
Geographic Information System (GIS) software lets a user:

Overlay and view many GIS layers

Run a wide range of analyses from simple (union, intersection, map algebra) to complex (geospatial modeling, spatial statistics)

Proprietary software: ArcGIS, others

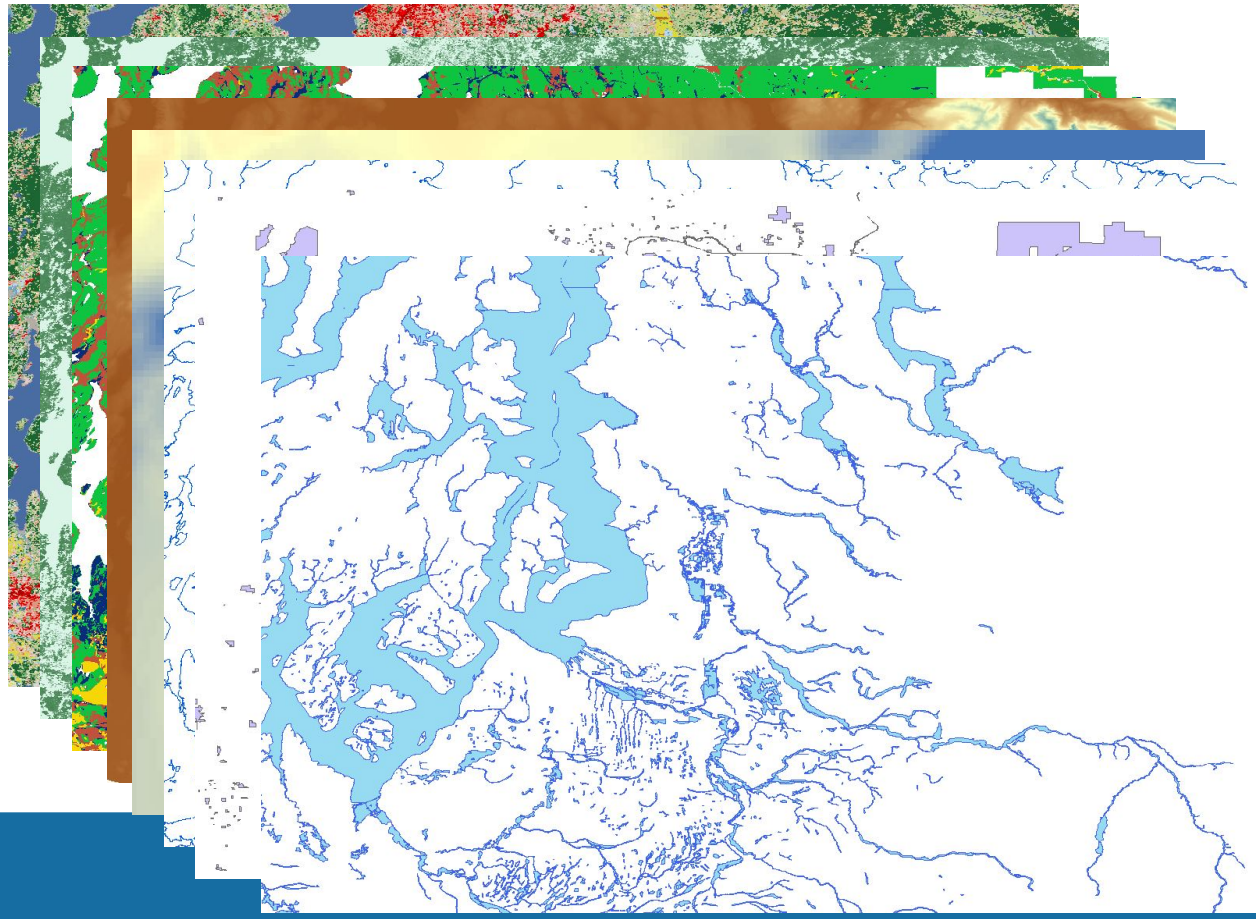
Open-source software: QGIS, GRASS, others



Spatial data themes for ecosystem services mapping

Biophysical and ecological data are often used to map ecosystem service capacity

Land cover
Vegetation
Soils
Elevation/slope
Climate
Streams
Land use
Disturbance



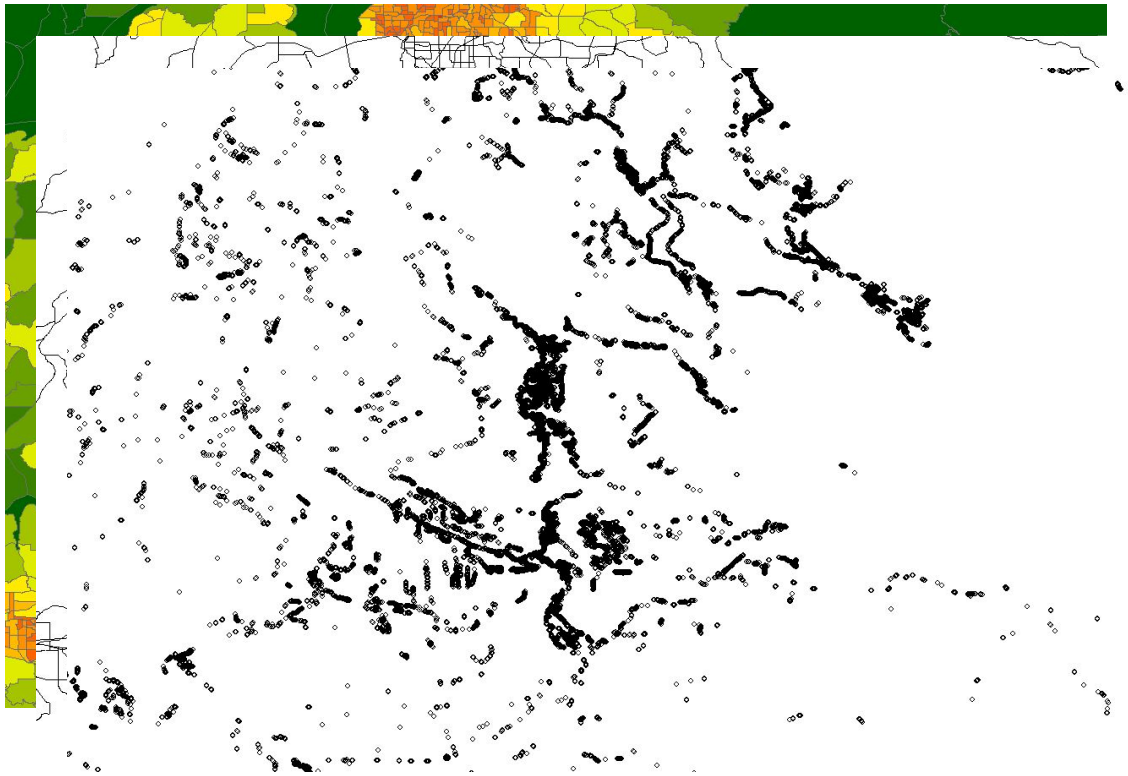
Spatial data themes for ecosystem services mapping

Socioeconomic data are often used to map ecosystem service beneficiaries

Population density

Infrastructure

Other demographic data (e.g., vulnerability)



Where do data come from?

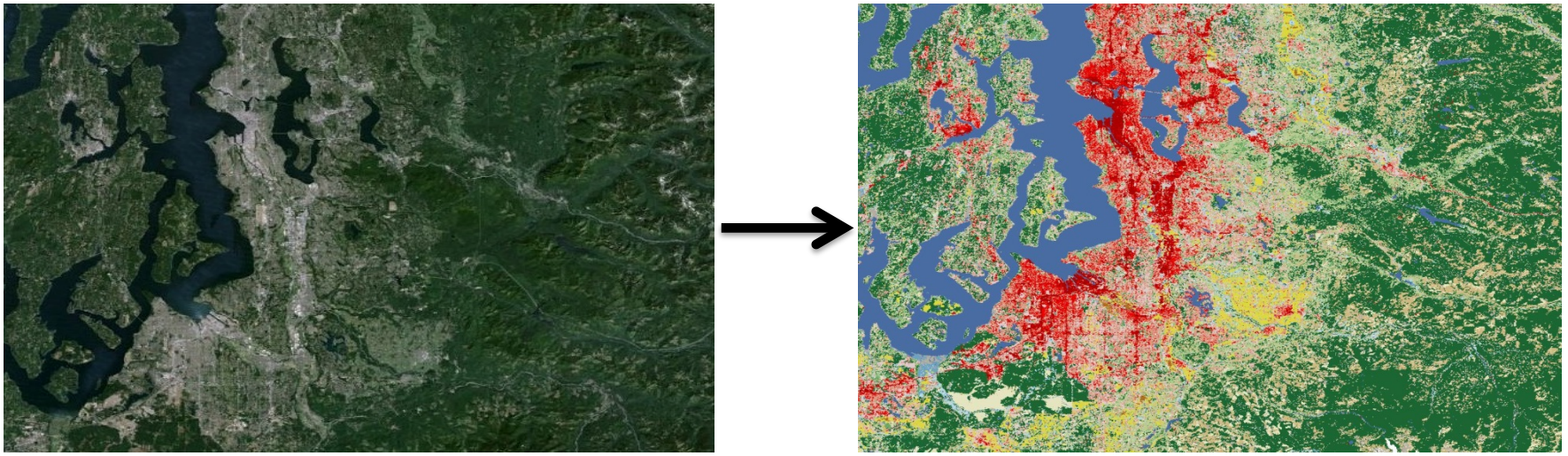
Satellites

Landsat 8, MODIS, European Space Agency Sentinel satellites, many others

Aerial photography (manned/unmanned aircraft)

Remote sensing: From images to datasets

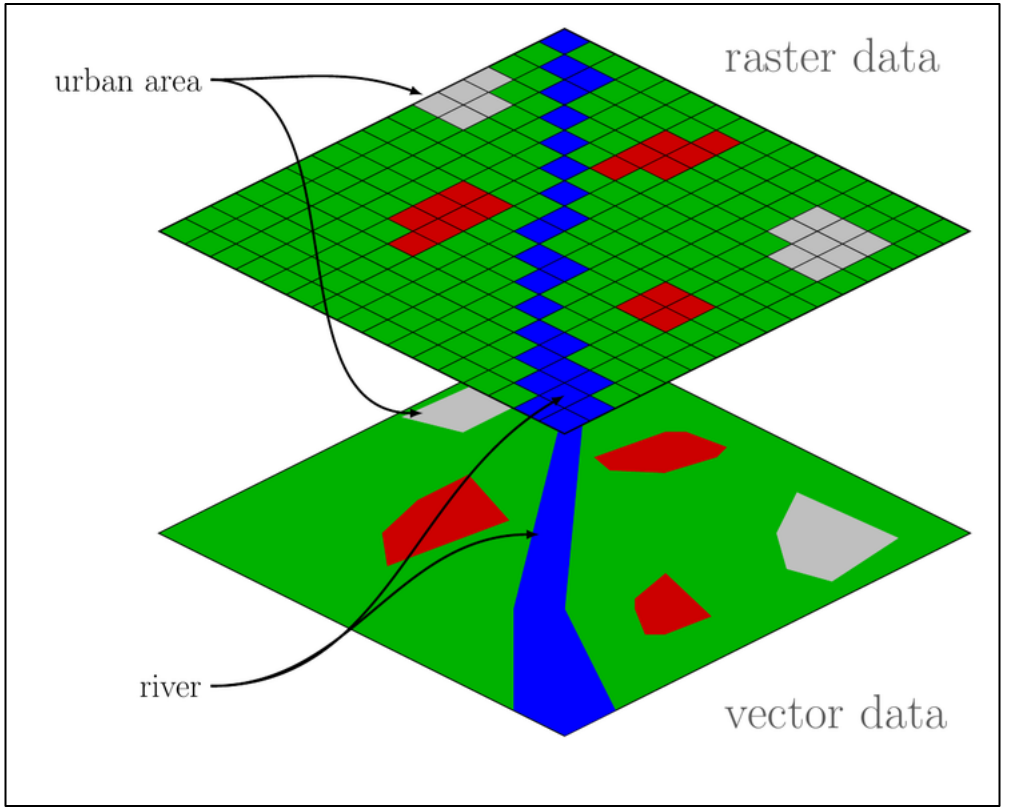
- Manual classification of features from images – slow, differs from observer to observer
- Classification algorithms – fast, but must be well tested
- All methods have some degree of error – misclassification, omission/commission error



Raster and vector data formats

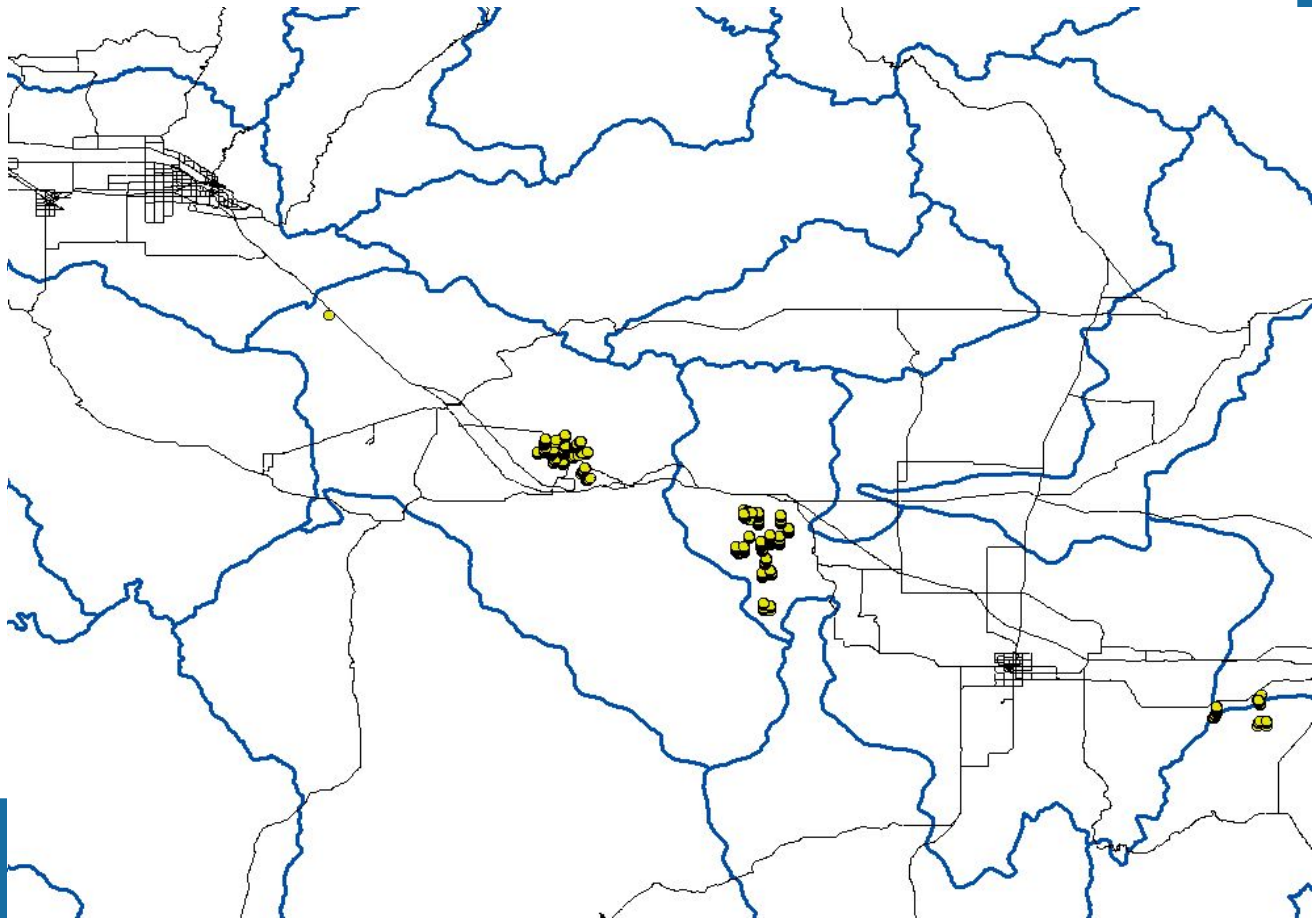
Two data formats:

- Raster data model
  - (grid cells)
- Vector data model
  - Shape (polygon), line, or dot (point); may carry many attributes
- Can convert between the two

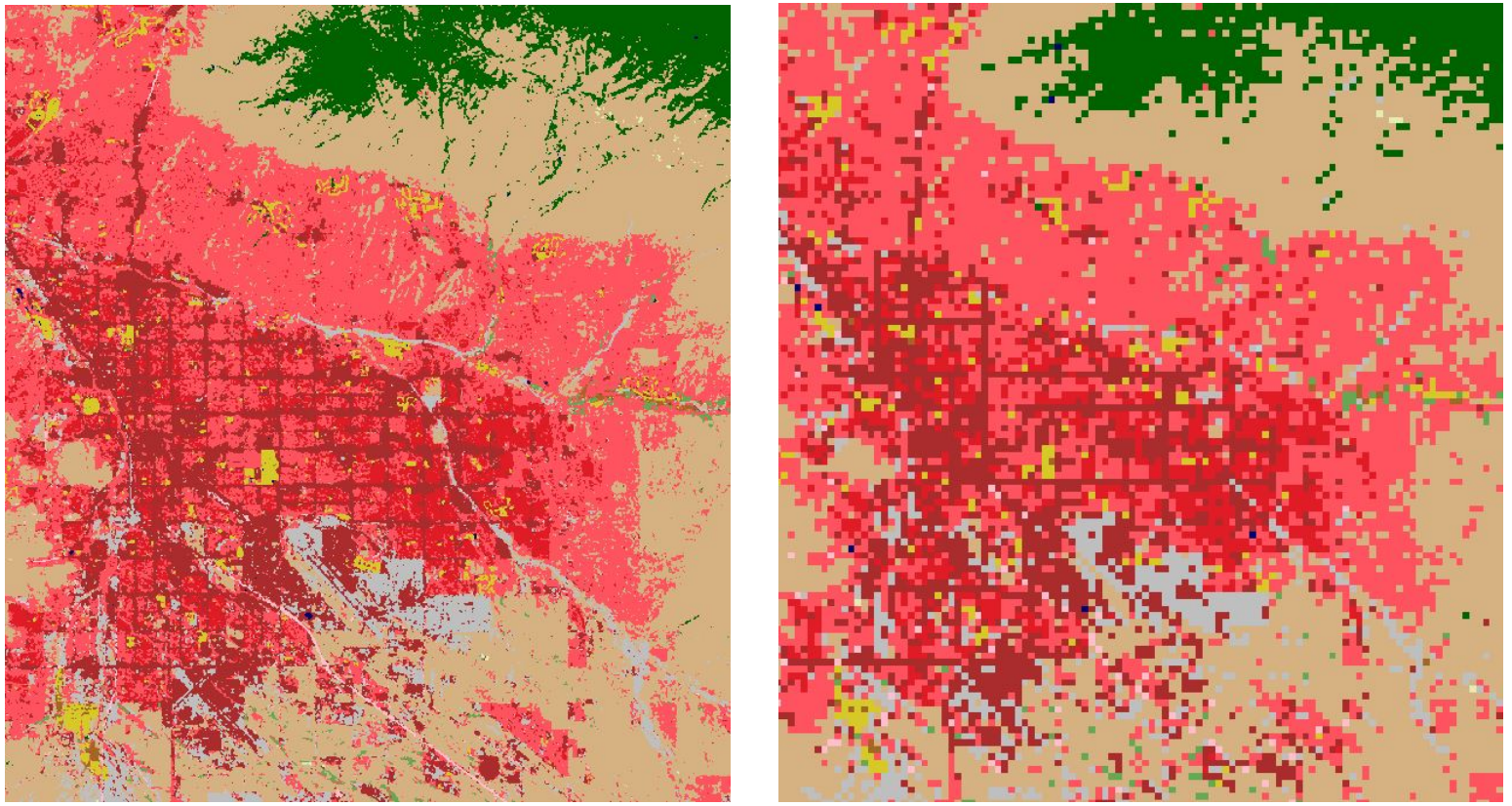


Vector data formats

Vector data types: Polygon (watersheds), Line (roads), Point (wind turbines)

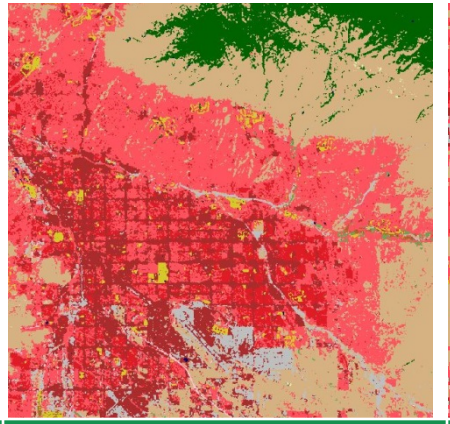


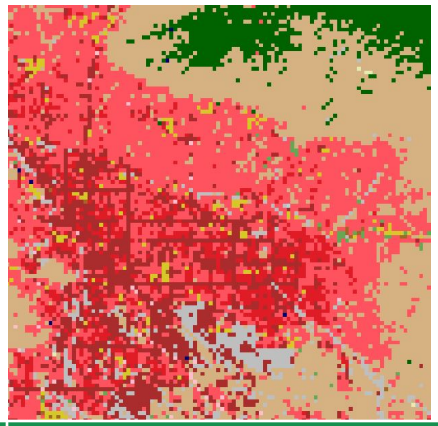
Information gain and loss at varying spatial resolution



U.S. National Land Cover dataset, Tucson Arizona. Native 30 m resolution (left) and resampled to 300 m resolution (right).

Information gain and loss at varying spatial resolution





Land cover	ha, 30 m dataset	ha, resampled 300 m dataset	% difference
Urban	101,203	101,538	0.4%
Forest	141,122	140,733	-0.3%
Wetland	920	909	-1.2%
Open water	315	333	5.6%
Other	672,226	671,724	-0.1%

Data management considerations

Spatial resolution (e.g., 5 m, 30 m, 1 km, 0.5 degrees^2)

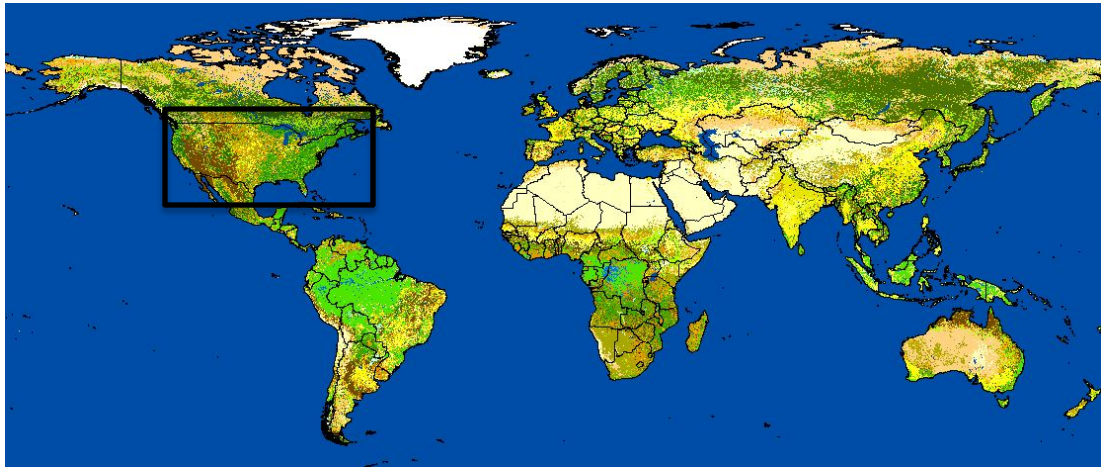
- Greater resolution: greater disk storage needs, slower processing time
- Values change with the size & shape of the units
- Year of data collection (currency) – how comparable is it?

Data quality

Spatial reference system (i.e., datum, projection)

Data sources: Global & subglobal

- Prepared by international organizations (U.N. agencies, international conservation organizations, academic researchers, other research consortia)
- Ensure comparability between nations
- May sacrifice data quality/specificity



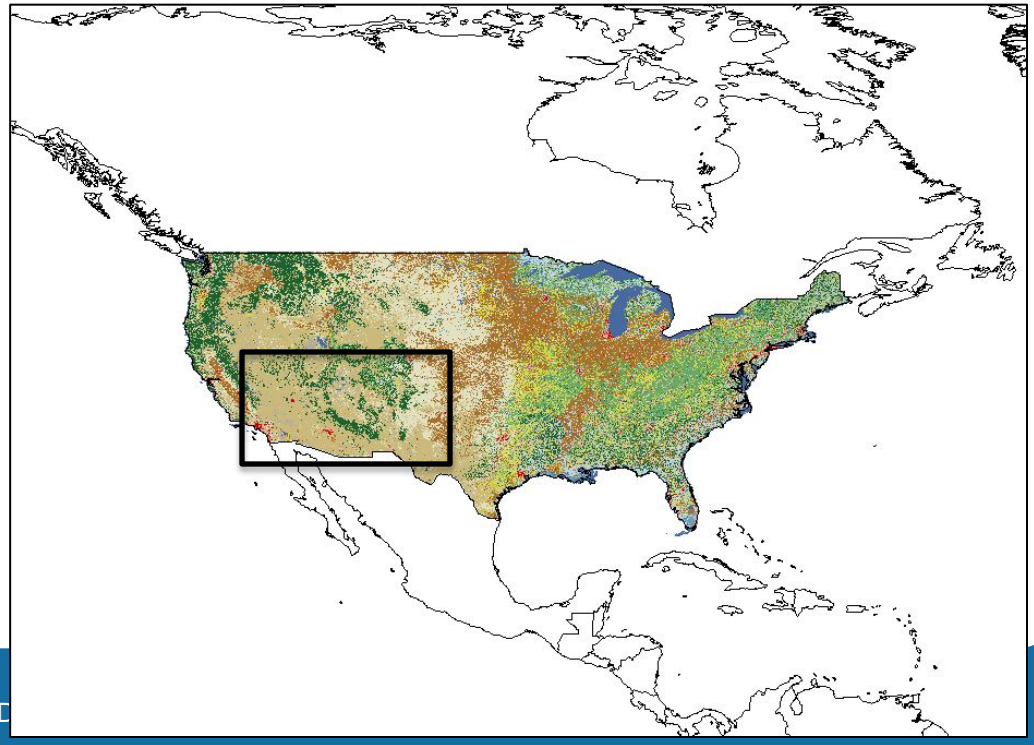
GlobCover land cover dataset

Data sources: National

Often prepared by national mapping agencies

Often highly trusted data sources for the nation

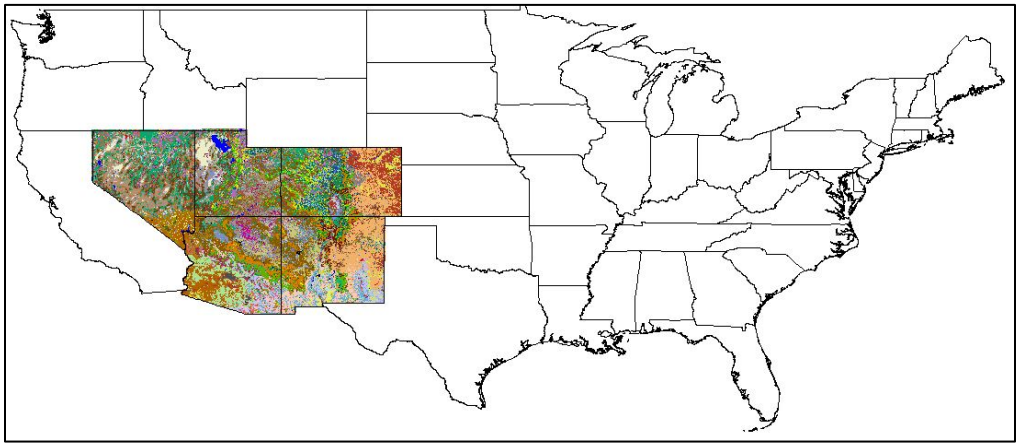
Sacrifice direct international comparability



(US) National Land Cover Dataset

Data sources: Subnational

- Often prepared by national mapping agencies, development aid agencies, and academics
- Cover smaller spatial extents - political subjurisdictions, watersheds, biomes, etc.
- May be of high quality or experimental (i.e., single year only)
- Present "scaling-up" problems when not available for entire nation



Southwest (US) GAP Analysis landcover

Key messages

Global datasets are "standard," allow international comparability, but local data may be better for national/subnational needs

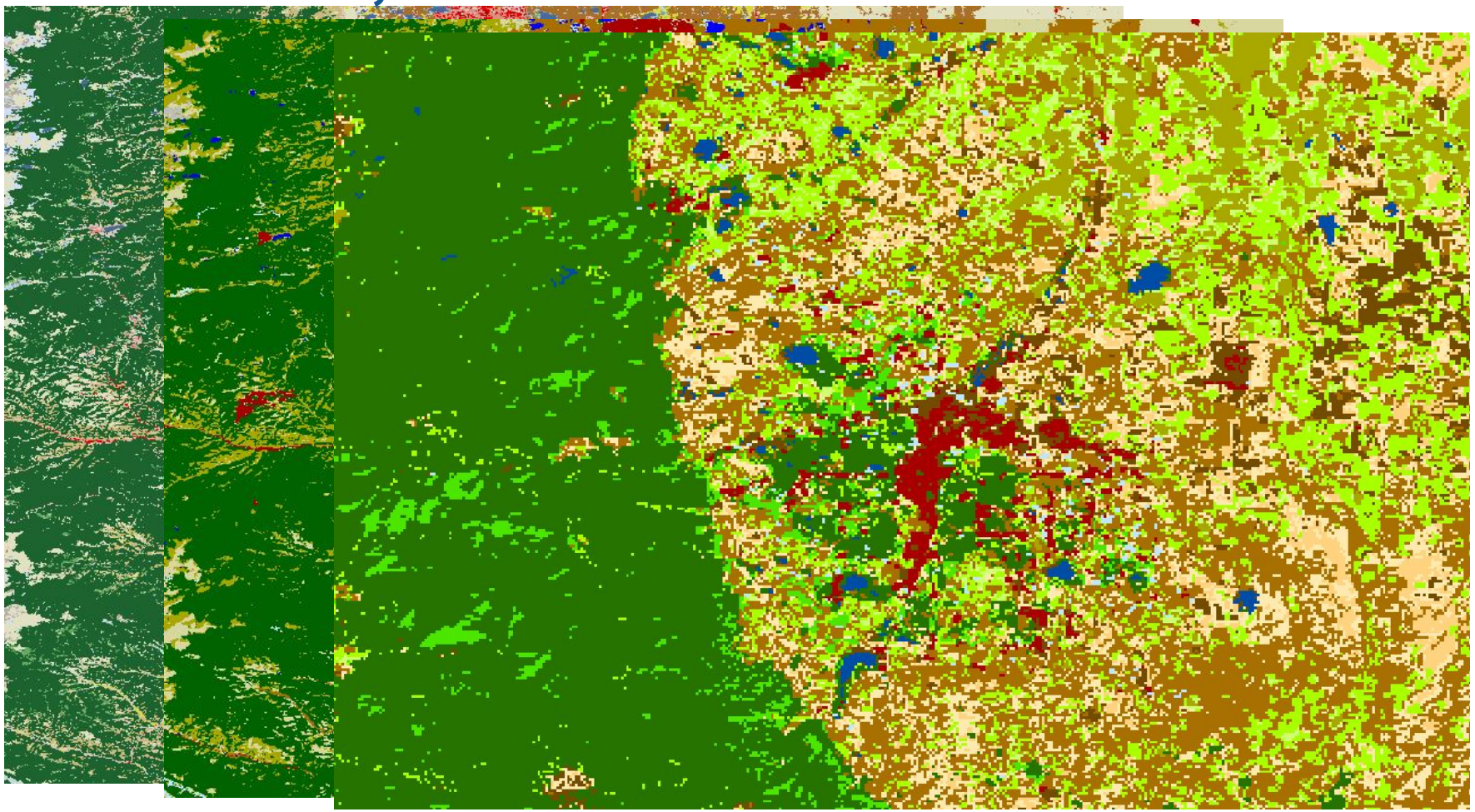
Which data are best trusted by decision makers?

High-resolution data need more storage space and processing time, but often give more accurate "answers"

GIS analysts and modelers must navigate tradeoffs between time period, resolution, accuracy

BUT: don't let the perfect be the enemy of the good

Data tradeoffs example: Denver, Colorado, USA



1. U.S. National Land Cover Dataset, 2011 (30 m) 2. GlobeLand 30, 2010 (30 m)
3. GlobCover, 2009 (300 m)

Exercise: Data for ecosystem service mapping

1. **In small groups, review the CICES ecosystem services classification system and pick 2 class-level ecosystem services of interest.**
2. **For those services, write down 1-2 biophysical and 1-2 socioeconomic datasets needed to map and model that service.**
3. **For each dataset, identify a data source (i.e., national mapping agency, ministry of natural resources), and answer the following:**
    1. Are corresponding global data adequate?
    2. Are national/local data of better quality than corresponding global datasets? Are they substantially better, or only somewhat better?
    3. Is the data source lacking at the national or global scale?
4. **Present your conclusions to the full group for discussion.**

Exercise: Data for ecosystem service mapping

Ecosystem service: Coastal flood regulation

	Biophysical		Socioeconomic	
	Dataset 1	**Dataset 2**	**Dataset 1**	**Dataset 2**
Dataset	Mangrove cover		Population density	
Data source	National mapping agency		Census bureau	
1. Are the corresponding global data adequate?				
2. Are the national/local data of better quality than the global data? Somewhat better or substantially better?				
3. Is the data source lacking at the national or global scale?				