THE UNIVERSITY of NEW MEXICO

GIS Data & Organization

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GIS Data & Organization

What is the purpose of your GIS project(s)?

How will the GIS data be used?

Analysis? Presentation? Decision making?

Resolution? Scale? Accuracy? Metadata?

1. GIS data types

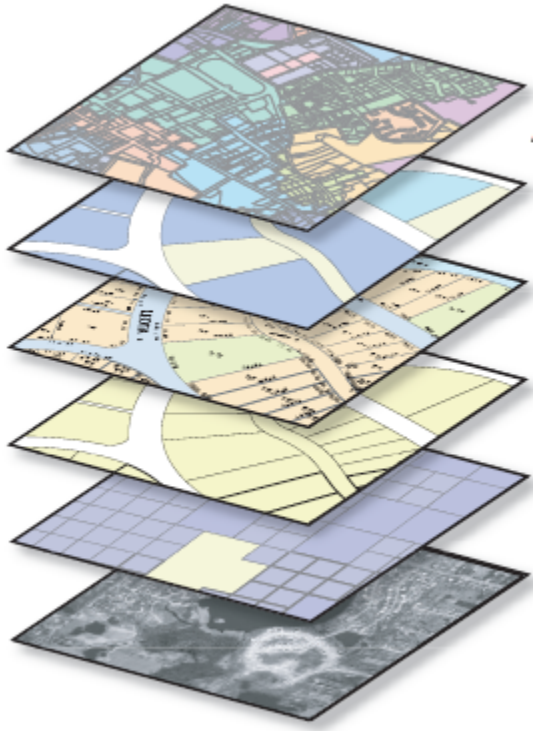
   (vector vs raster)

2. GIS data formats

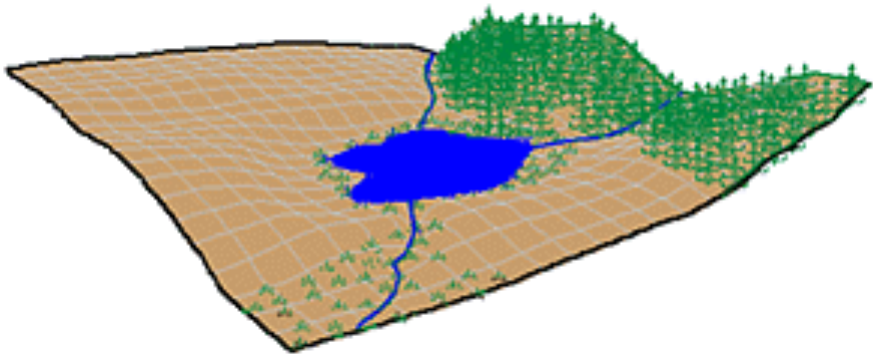
   (shapefile, geodatabase, etc)

3. Organization

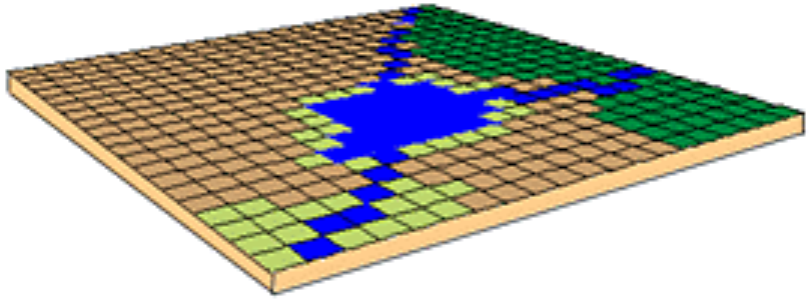
   (data models)



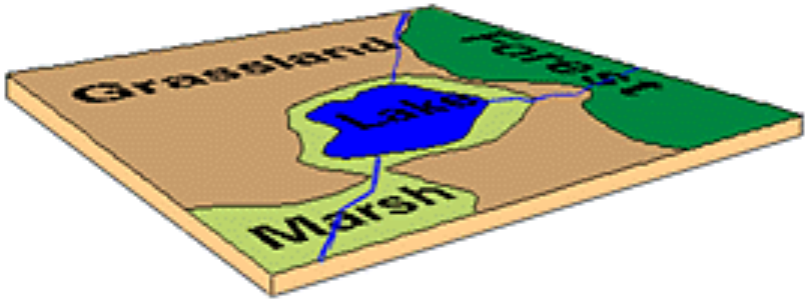
What sort of features do we want to use to represent our area of interest on the earth?



The Real World



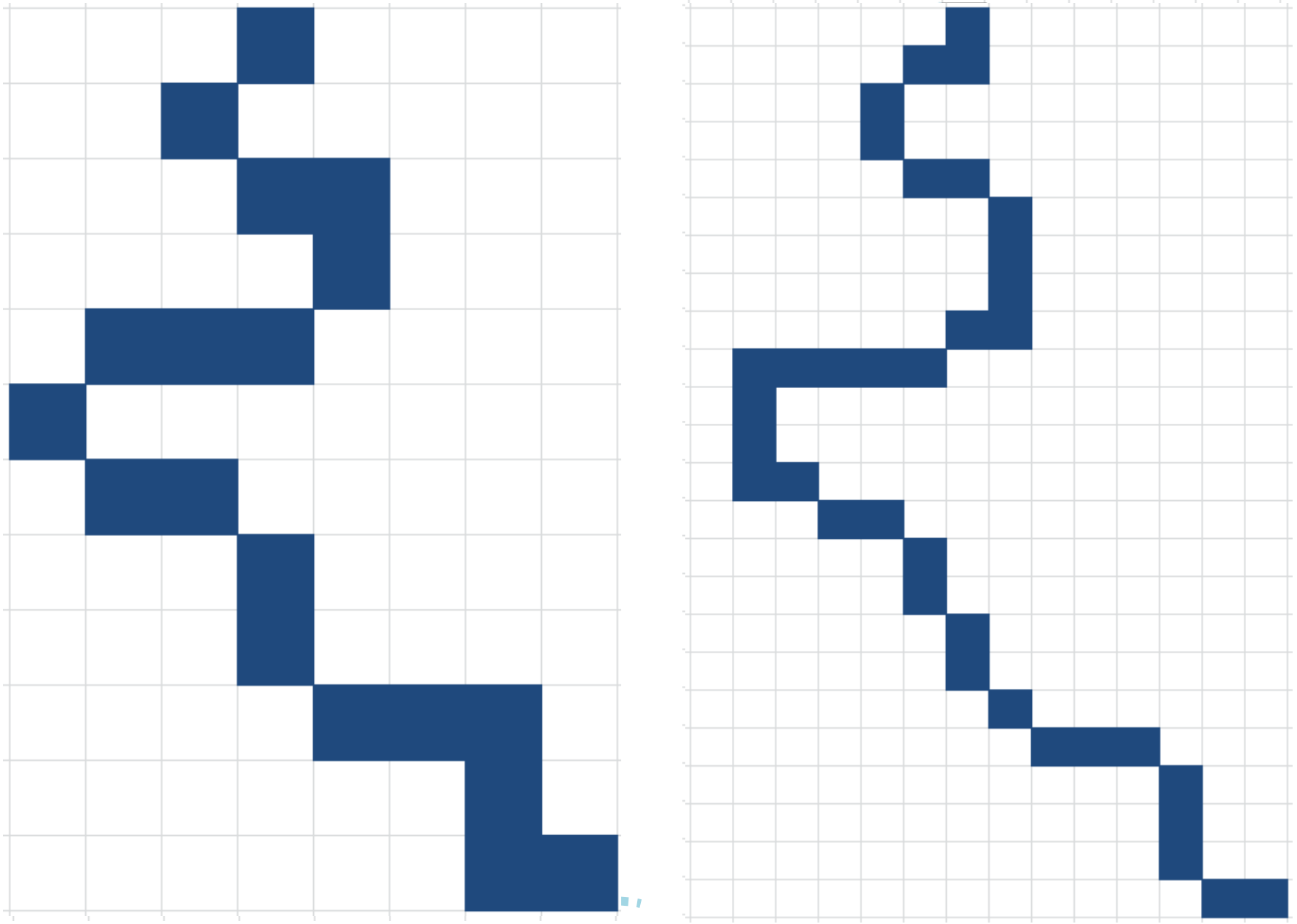
Represented in raster format



Represented in vector format (points, lines, polygons)

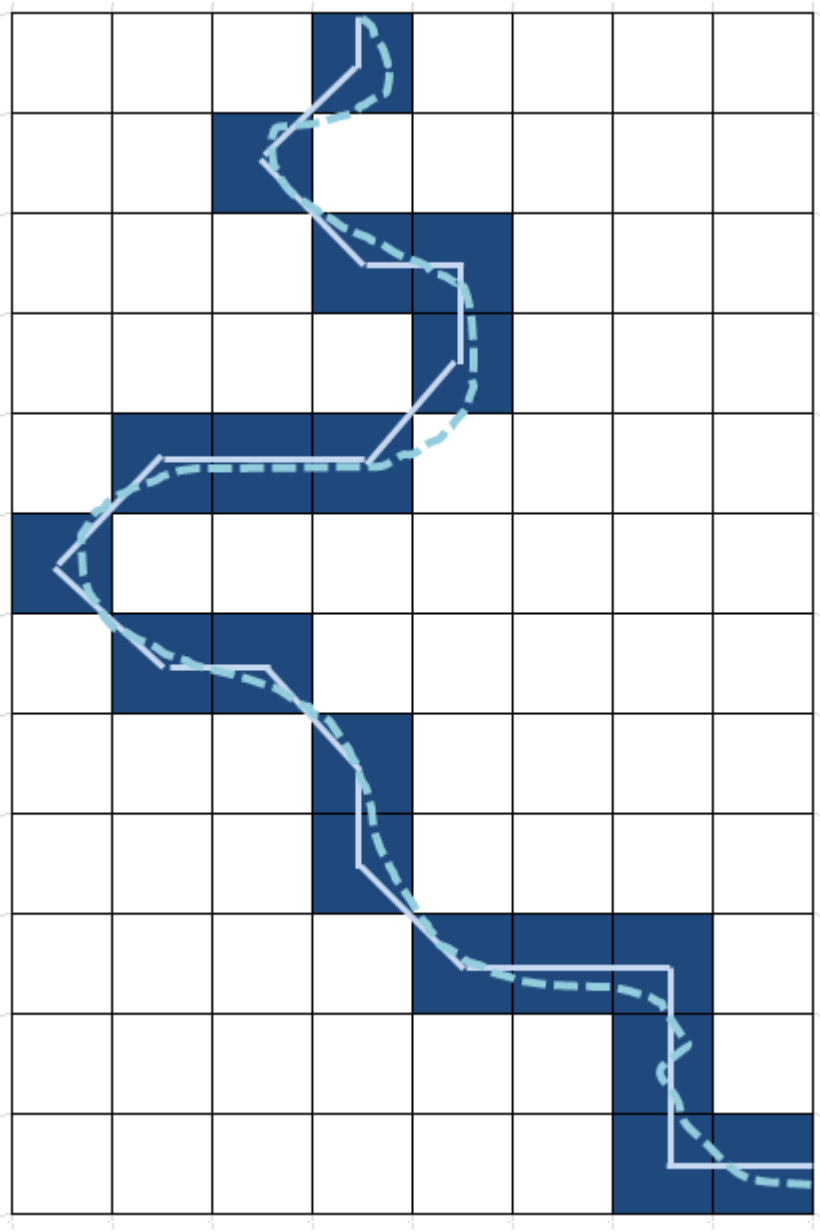
Images from gis.washington.edu

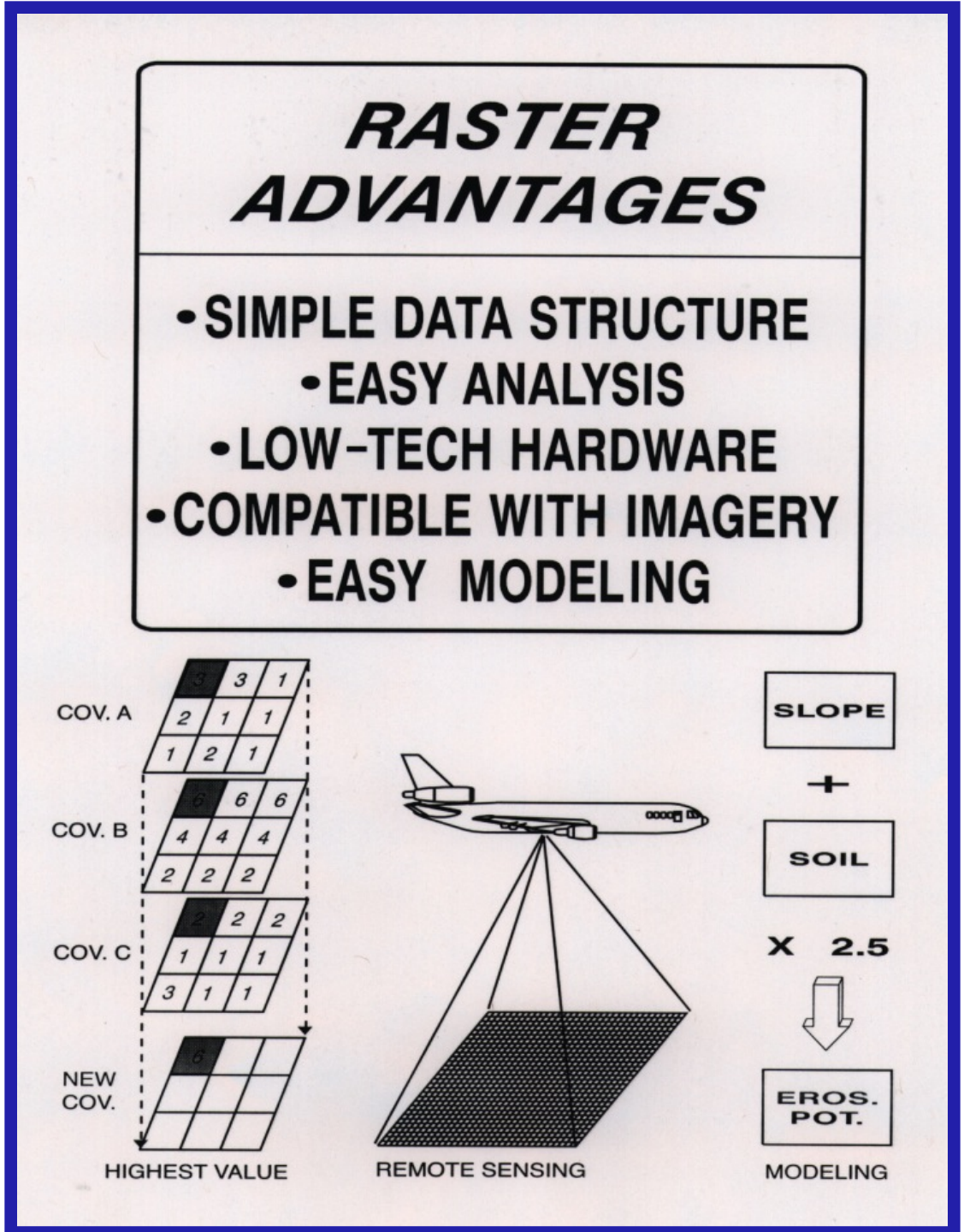
Consider a river represented as a raster



Feature Conversion

Once data is rasterized, it is impossible to simply use the raster and re-create the original vector feature(s)



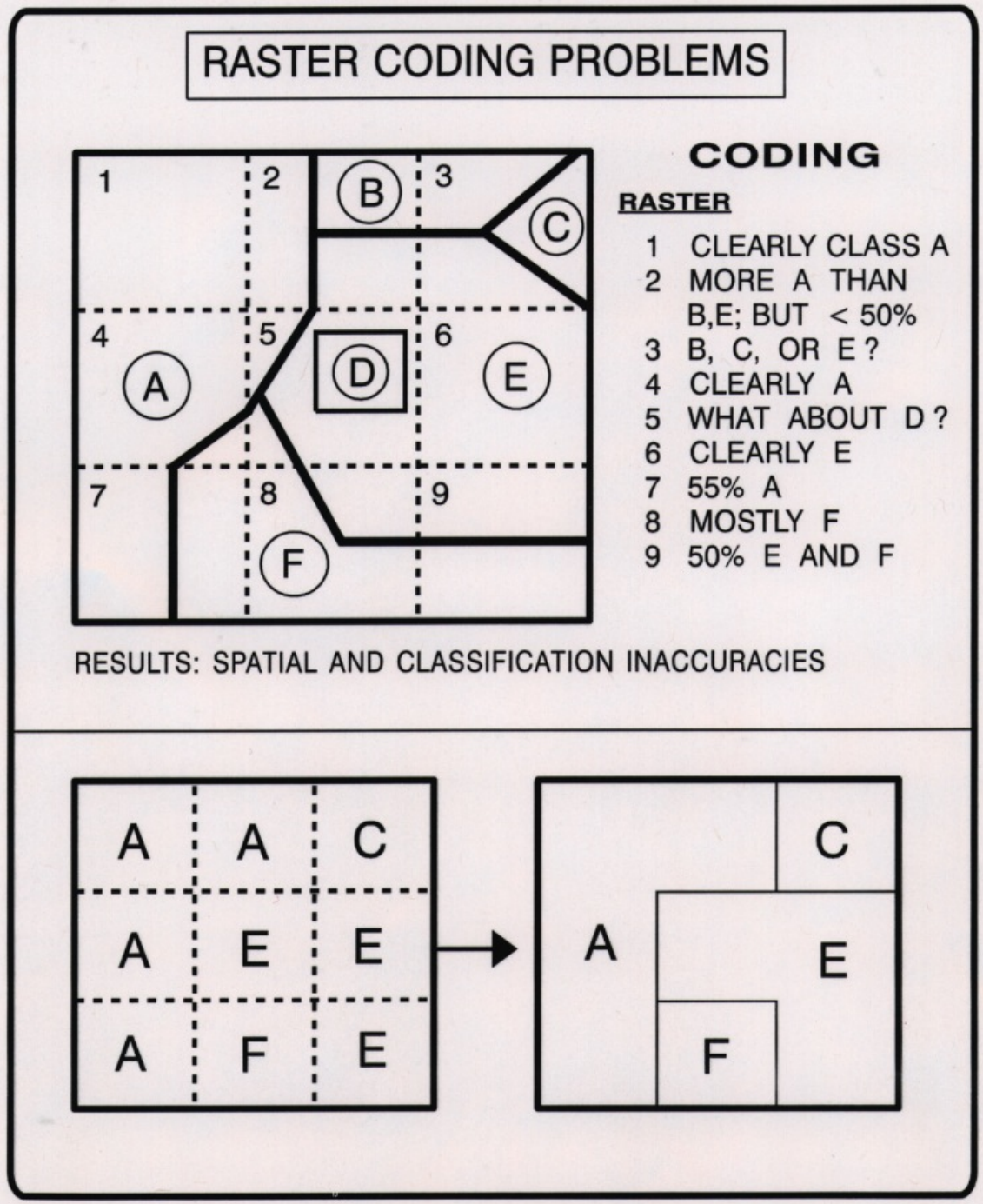


- simple and easy to reference
- map overlays are efficiently processed
- geographic units are consistent in size and shape (spatial relationship is constant)
- better representation of continuous surfaces
- no conversion required for a larger number of data sources

Raster disadvantages

- data redundancy
- topographical relationships are hard to trace and build
- less aesthetically pleasing
- transformation of spatial data coded in a raster structure tends to be distorted
- accuracy in computation and processing is low

Coding Problems

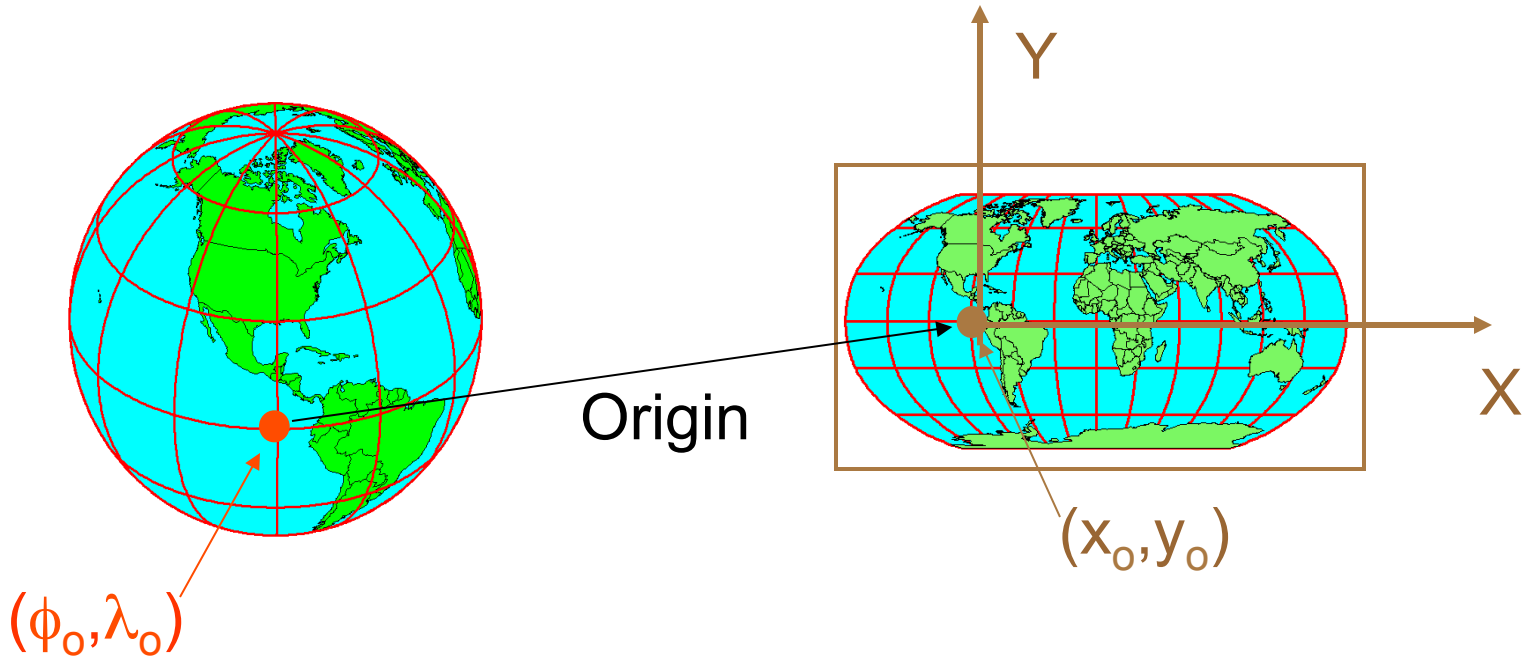


Vector advantages

- less data redundancy
- discrete features are clear & continuous
- topology can be clearly identified
  - topology is the spatial relationship between map features
- greater precision in computation

Coordinate System

A planar coordinate system is defined by a pair of orthogonal (x,y) axes drawn through an origin



Map projections

are distinguished by their suitability for representing a particular portion and amount of the earth's surface, and by their ability to preserve distance, area, shape, or direction.

Data formats

geospatial

• Coverage	ArcInfo
• Shapefile	ArcView
• Geodatabase	ArcGIS
• KML	GoogleEarth

tabular, imagery,
drawings, documents, etc

Coverage or Grid

MyWorkspace

Cover1

Cover2

info

Import/export Interchange files *.e00

OR

Manage in ArcCatalog

Shapefile

Deceiving name → At least three files

shapefile.shp, shapefile.shx, shapefile.dbf

As many as 12 files can make up a shapefile

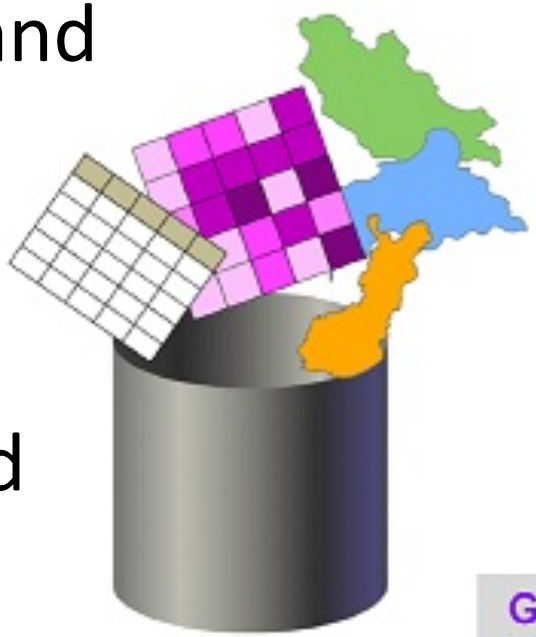
(*.sbn, *.prj, *.ain, *.xml, etc)

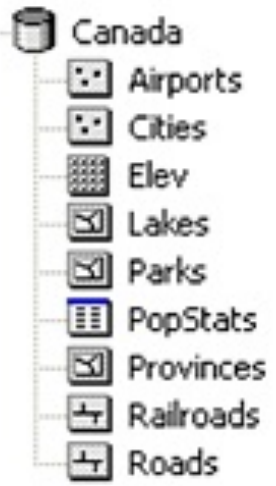
Easy to miss a file using Windows Explorer

Use ArcCatalog

Geodatabase

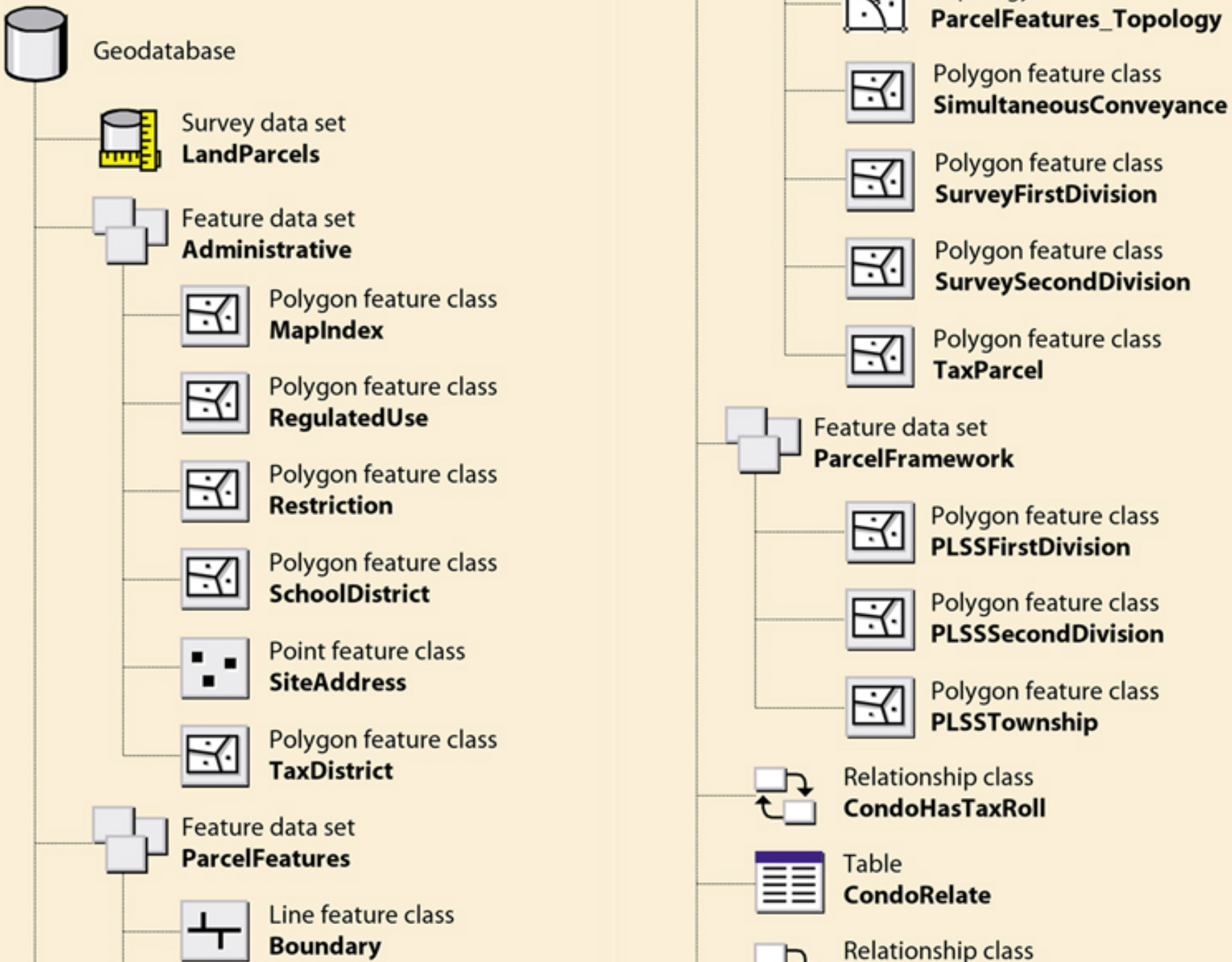
- Store spatial features and their attributes in the same RDBMS
- Feature classes can be stand-alone or grouped in a feature dataset
- Feature datasets model spatial relationships





Geodatabase with feature classes, a raster dataset, and a stand-alone table

www.esri.com


Geodatabase
Survey data set
LandParcels
Feature data set
Administrative
Polygon feature class
MapIndex
Polygon feature class
RegulatedUse
Polygon feature class
Restriction
Polygon feature class
SchoolDistrict
Point feature class
SiteAddress
Polygon feature class
TaxDistrict
Feature data set
ParcelFeatures
Line feature class
Boundary
Topology
ParcelFeatures_Topology
Polygon feature class
SimultaneousConveyance
Polygon feature class
SurveyFirstDivision
Polygon feature class
SurveySecondDivision
Polygon feature class
TaxParcel
Feature data set
ParcelFramework
Polygon feature class
PLSSFirstDivision
Polygon feature class
PLSSSecondDivision
Polygon feature class
PLSSTownship
Relationship class
CondoHasTaxRoll
Table
CondoRelate
Relationship class

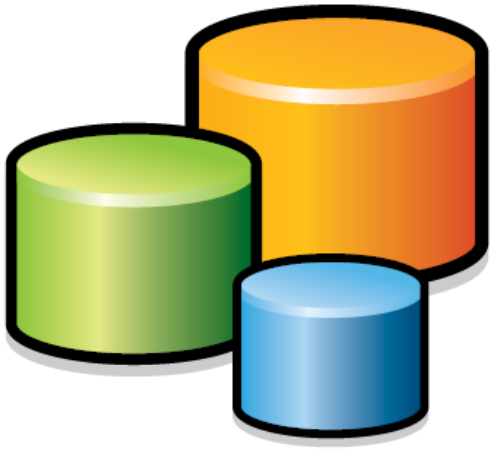
Geodatabase advantages

- Can store multiple feature classes in a single file
- Ability to save labels as annotation feature classes
- Ability to create domains for attributes

Domains

- Define valid values for an attribute field or subtype
- Minimizes data entry mistakes

- *Subtypes are a way to group features of one feature class into subsets based on an attribute value*



The Top Nine Reasons to Use a File Geodatabase

A scalable and speedy choice for single users or small groups

By Colin Childs, ESRI Education Services

http://www.esri.com/news/arcuser/0309/files/9reasons.pdf

Structural	1. Improved versatility and usability 2. Optimized performance 3. Few size limitations
Performance	4. Easy data migration 5. Improved editing model 6. Storing rasters in the geodatabase
Data Management	7. Customizable storage configuration 8. Allows updates to spatial indexes 9. Allows the use of data compression

A quick tour of the Building a geodatabase tutorial

This topic applies to ArcEditor and ArcInfo only.

It is easy to create a geodatabase and add behavior to it, and no programming is required when you use the data management tools in ArcGIS Desktop. When querying and editing the geodatabase in ArcMap, which is the application for editing, analyzing, and creating maps from your data, you can easily take advantage of the data and behavior in your geodatabase without any customization.

This tutorial lets you explore the capabilities of the geodatabase using an ArcEditor or ArcInfo license seat of ArcGIS Desktop. You can complete this tutorial at your own pace without the need for additional assistance. This tutorial includes eight exercises, each of which takes between 10 and 20 minutes to complete. Exercises are cumulative; you must complete them in order.

In this tutorial, you will use ArcCatalog and ArcMap to create a geodatabase that models a water utility network. You will add behavior to the geodatabase by creating subtypes, validation rules, relationships, and a geometric network. You can use ArcMap to take advantage of the behavior by editing some of the existing features in the geodatabase and adding some new features.

The study area for these exercises is a portion of a hypothetical city.

A geodatabase that contains most of the data, a coverage representing water laterals, and an INFO table representing parcel owner data are provided with the software. You will import the coverage ar INFO table into the geodatabase, then modify its properties to give it behavior.

The datasets for the tutorial were created by ESRI using a database schema similar to that of the ci of Montgomery, Alabama. The data is wholly fictitious and has nothing to do with the actual city of Montgomery. This information may be updated, corrected, or otherwise modified without notification.

Related Topics

Exercise 1: Organizing your data in the Catalog

Data models

- Centralized management of a wide variety of geographic information in a DBMS
- Versioning that allows simultaneous editing by multiple editors and transactional views of the geodatabase
- Custom (or intelligent) features that have behavior, editing rules, and relationships

Behavior

- relationships,
- validation rules,
- subtypes, and
- default values

Data Models

- http://www.esri.com/software/arcgis/geodatabase/index.html
- http://www.esri.com/software/arcgis/geodatabase/data-models.html

Download Links

Below is a list of data models that are or will be available for download.

- Address
- Agriculture
- Atmospheric
- Basemap
- Biodiversity
- BroadbandStat
- Building Interior Space
- Carbon Footprint
- Census-Administrative Boundaries
- Defense-Intel
- Energy Utilities (includes ArcGIS MultiSpeak)
- Environmental Regulated Facilities
- Fire Service
- Forest Service
- Forestry
- Geology
- GIS for the Nation
- Groundwater
- Health
- Historic Preservation and Archaeology
- Homeland Security
- Hydro
- International Hydrographic Organization (IHO) S-57 for ENC
- Irrigation
- Land Parcels
- Local Government
- Marine
- National Cadastre
- Petroleum
- Pipeline
- Raster
- Seabed Survey
- Telecommunications
- Transportation
- Water Utilities

Carbon Footprint Data Model

The purpose of the Carbon Footprint data model is to provide a basic starter template to empower GIS users to tackle the basic problems of greenhouse gases that affect Global Climate Change. The data model suggests the feature classes that a GIS manager would build to support issues related to carbon dioxide production and sequestration.

The intent of the model is to be a starting point that can be extended to meet the needs of those whose task is to act on this problem. The model is the starting point for analysis, visualization, tracking change over time and auditing. Consider this as the Mission Data Set to locally address global climate change.

A key part is developing a Carbon Fabric - layers of sources and sinks that aggregate information from more detailed datasets.

This is an early draft of a data model and we are actively looking for projects to collaborate with to establish best practices.

Data Model User Group

Join the data model user group if you are an existing ArcGIS customer and want to learn more about design and architecture of personal or enterprise Geodatabase and become a part of Esri's growing data model community.

User Forums

Visit the Esri data model discussion forum to share your ideas, thoughts, and questions with other users.

Downloads - Design Templates

The Design Templates are the result of the community-based design process. The general concepts and terms for this discipline are described here. Tools and examples to create a template data model are also included for advanced users.

- Design Template .xml, .xls, .txt, .html, .vsd, and .gif - zip format, 410 kb

Forest Service Data Model

The US Forest Service and Esri have teamed on a number of projects to identify and implement geodatabase design standards and appropriate GIS tools and workflows for managing Forest Service spatial data. The data models, tools, and workflows on this site were developed as part of this project work and are made available here to be freely downloaded for review and to be adopted or leveraged by others. The materials on this site are most applicable to units with responsibility for managing natural resources and land management data. For any questions about the materials on this site, please email: forestservice@esri.com

US Forest Service, Southwestern Region (Region 3) Geodatabase Design Template US Forest Service, Southwestern Region, with Esri's support, has developed a geodatabase design built upon the National GIS Data Dictionary. Since the initial data model was completed in 2005, the design has been maintained by the Region and is now in version 2.0. This design has been successfully implemented at each of the Forests in Region 3, and has also been adopted by other Regions. Subsequent work has focused on leveraging the data model to standardize and automate quality control and cartographic processes.

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Key successes include:

- Implementing a geodatabase design that builds on the national standard and supports additional Region requirements.
- Documenting quality standards for the Region's spatial data and configuring a set of ArcGIS Data Reviewer quality control checks to support automated data review.
- Automating cartographic processes to meet the Secondary Base Series map product specification using Esri Production Mapping Visual Specifications.

* **US Forest Service, Southwestern Region (Region 3) Geodatabase Design Template** Version 2.0 xml, pdf, gdb, and rul files - zip format, 1219 kb (submitted 1/1/2011)

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User Community

Visit the Esri data model discussion forum to share your ideas, thoughts, and questions with other users or ask Forest Service Data Model specific questions to forestservice@esri.com

Data Models > Hydro

Hydro Data Model

ESRI has developed models for Water Resources and has focused on surface water with input from key state, national, and international contributors. The ArcGIS Hydro model is available for review and download. We are also supporting a groundwater data model initiative and will eventually consider the full hydrologic cycle as part of the Hydro effort.

ArcHydro Training Classes!

The instructor-led training classes provide an introduction to the Arc Hydro data model and associated software tools supporting hydrologic and hydraulic analysis with GIS. Two courses; ArcHydro GIS for Water Resources, and Hydrologic and Hydraulic Analysis can be found by searching the ESRI Instructor-Led Training site.

If you are interested in downloading the most recent version of the ArcHydro tools please contact ArcHydro.

For more information on the Water Resources data models please contact the Water Resources Consortium. This site is hosted by the Center for Research in Water Resources (CRWR) of the University of Texas at Austin.

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Downloads - Case Studies

These Case Studies are a good starting point to learn about best practices for this discipline. These project examples include sample geodatabases, map documents, and documentation.

- San Marcos Basin Case Study Geodatabase (.mdb) and Map Document (.mxd) - zip format, 28490 kb
- Hydro Data Model Poster ArcGIS Hydro Data Model Visio.pdf - zip format, 17829 kb
- ArcHydro GIS for Water Resources pdf file - zip format, 19 kb
- Hydrologic and Hydraulic Analyses Using ArcGIS - zip format, 24 kb
- Comprehensive Terrain Preprocessing Using Arc Hydro Tools .pdf - zip format, 3756 kb

Downloads - Design Templates

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- Arc Hydro Data Model Template Visio, MS Access - zip format, 18865 kb
- Framework Microsoft Repository Microsoft Access/JET 4 - zip format, 254 kb
- Hydro Microsoft Repository Microsoft Access/JET 4 - zip format, 315 kb
- Visio 2002 Update Visio 2002 - zip format, 1050 kb

Downloads - Tools

These tools have been developed together with the data models to provide new ways to leverage each industry specific model. They are designed to work with the data model templates and case studies, and can be used with the model, or with other data sets. These tools can be found on ArcScripts, and are not supported Esri software.

- Arc Hydro Tools version 1.1 Final for ArcGIS 8.3 pdf, xml, htm, png, jpg, exe, msi, mso, txt - zip format, 19802 kb
- Arc Hydro Tools version 1.1 Final for ArcGIS 9 (9.0 or 9.1) pdf, xml, htm, png, jpg, exe, msi, mso, txt - zip format, 18819 kb
- Arc Hydro Tools version 1.2 Final for ArcGIS 9.2 .pdf, .exe, .msi, and .txt - zip format, 18271 kb
- Arc Hydro Tools version 1.2 Final for ArcGIS 9.0/9.1 .pdf, .exe, .msi, and .txt - zip format, 18277 kb
- Arc Hydro Tools version 1.3 Final for ArcGIS 9.2/9.3 .pdf, .exe, and .txt - zip format, 21157 kb
- Arc Hydro Tools version 1.4 Final for ArcGIS 9.3/9.3.1 .pdf, .exe, and .txt - zip format, 228 MB - URL format

User Community

Oakland county has completed a version of their Hydrography data model that includes design concepts from ESRI's ArcHydro data model and the National Hydrography Dataset (NHD) known as NHDinGEO. The model contains point, line, and polygon geometry as well as a geometric network and two relationship classes. Also included in the model are tables that manage unique IDs across the entire Hydrography dataset. These IDs are helpful when using the ESRI ArcHydro tools, which model hydrologic flow for water resource management. The model can be found at the Oakland County Hydrography Model Website.

For more information on the Hydro Data Model check out the Arc Hydro Book.

Please check Irrigation data model created for Irrigation District user community. Any feedbacks are appreciated in order to enhance the model.

Raster Data Model

Rasters have a new home in the geodatabase since ArcGIS 9.0. They are actually stored on disk and can be accessed through the personal, file, or enterprise geodatabase as either a raster dataset or a raster catalog. A raster catalog can be used to manage tiles of raster data or time series raster datasets. This generally refers to raster data collected at different times in the same geographical extents.

Why do we store rasters in a geodatabase? There are many advantages to working with rasters in a geodatabase:

- Geodatabase solutions for all levels, from personal to enterprise solutions
- Large data holdings that can be easily built, modified, and utilized
- Choice of creating mosaics or raster catalogs
- Fast raster dataset display at any scale
- Enhanced raster catalog functionality
- Raster data extraction easily facilitated
- Raster data compression, for example, lossy or lossless
- To take advantage of the RDBMS, for example, security, multiuser access, user rights, and recoverability

Raster data for many of the earth sciences has an origin that differs from the input requirements of ArcGlobe (-180 to 180). To accommodate this, the ESRI Prototype team has produced a sample and demo with a toolbox model that changes the extents of raster data for use with any of the ArcGIS 9.0 applications. Read more details about rasters in ArcGIS in ArcGIS 9.3 Desktop Help.

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Downloads - Case Studies

These Case Studies are a good starting point to learn about best practices for this discipline. These project examples include sample geodatabases, map documents, and documentation.

- Hurricane Mitch Raster Catalog .idb, .ldb, .mdb, .mxd, .doc - zip format, 38402 kb
- Example raster case studies including the storage decisions ArcGIS 9.2 Desktop Help - URL format

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The Design Templates are the result of the community-based design process. The general concepts and terms for this discipline are described here. Tools and examples to create a template data model are also included for advanced users.

- Raster Twister model builder demo and data Raster Twister Tools Toolbox.tbx file, ArcGlobe.3dd doc, data, Readme.doc - zip format, 1714 kb

Simple database → Advanced applications

Smart database → Simpler applications

Questions