

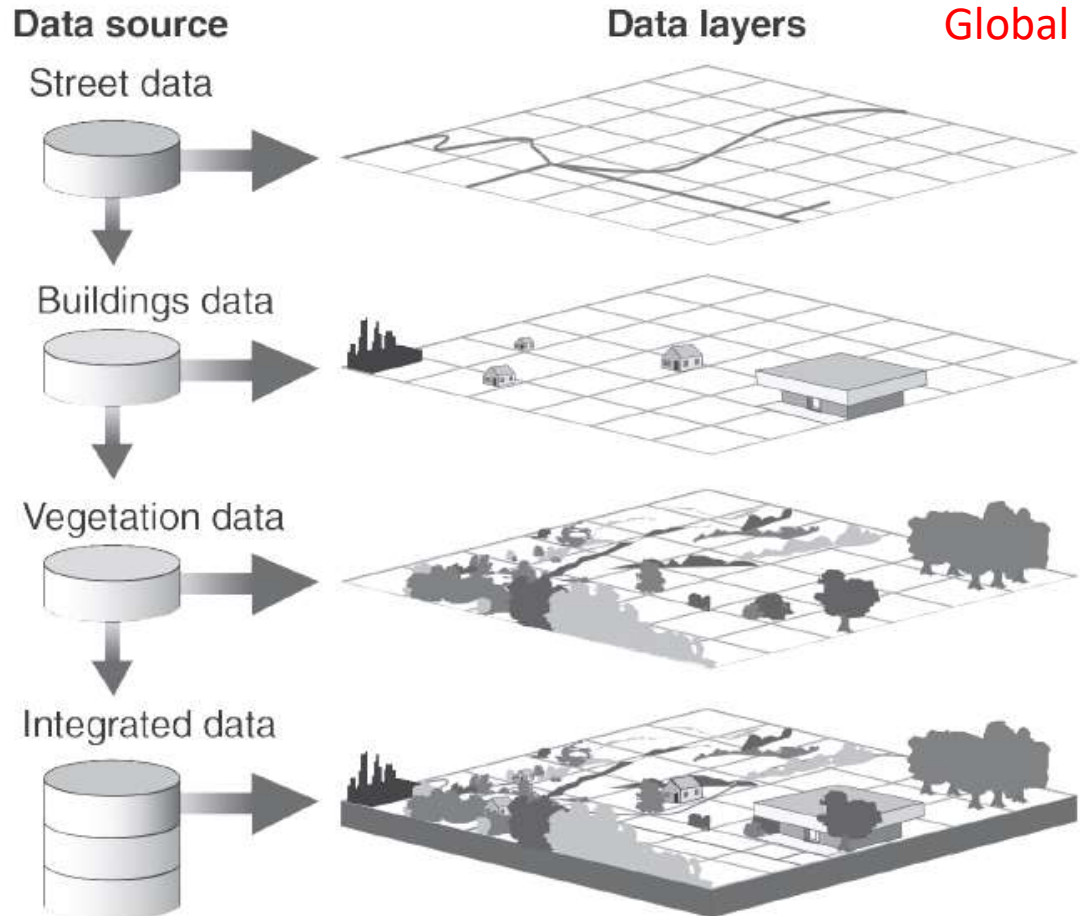
GIS and Earth observation



Geospatial information in the FDES

It adds significant value and utility to environment statistics

Example of GIS data layers or themes¹⁶



Global geospatial information management

Manual on the Basic Set of Environment Statistics of the FDES 2013



Geological and geographical information and statistics (Topic 1.1.1) of the Basic Set of Environment Statistics of the FDES 2013

Draft Version 1.0 31 April 2019

Developed by the Environment Statistics Section of the United Nations Statistics Division, in collaboration with the Expert Group on Environment Statistics

SEEA Ecosystem Accounting

Government Accountability Office (2004). "Geospatial Information: Better Coordination Needed to Identify and Reduce Duplicative Investments", available from www.gao.gov/assets/250/243133.pdf



Geographic and geological statistics in the BSES

Topic 1.1.3: Geological and geographical information	a.	Geological, <u>geographical</u> and geomorphological conditions of terrestrial areas and islands		<ul style="list-style-type: none"> National By location National <ul style="list-style-type: none"> UNSD: Demographic Yearbook Food and Agriculture Organization of the United Nations (FAO) Center for International Earth Science Information Network (CIESIN)
		1. Length of border	Length	
		2. Area of country or region	Area, Location	
		3. Number of islands	Number	
		4. Area of islands	Area	
		5. <i>Main geomorphological characteristics of islands</i>	Description	
		6. <i>Spatial distribution of land relief</i>	Description, Location	
		7. <i>Characteristics of landforms</i> (e.g., plains, hills, plateaus, dunes, volcanoes, mountains, seamounts)	Description, Area, Height	
		8. <i>Area by rock types</i>	Area	
		9. <i>Length of fault lines</i>	Length	
	b.	Coastal waters (including area of coral reefs and mangroves)	Area, Description	
	c.	Length of marine coastline	Length	
	d.	Coastal area	Area	

Topic	Statistics and Related Information (Bold Text - Core Set/Tier 1 ; Regular Text - Tier 2; <i>Italicized Text - Tier 3</i>)		Category of Measurement	Potential Aggregations and Scales	Methodological Guidance
Topic 1.2.1: Land cover	a.	Area under land cover categories	Area	<ul style="list-style-type: none"> By location By type of land cover (e.g., artificial surfaces including urban and associated areas; herbaceous crops; woody crops; multiple or layered crops; grassland; tree-covered areas; mangroves; shrub-covered areas; shrubs and/or herbaceous vegetation, aquatic or regularly flooded; sparsely natural vegetated areas; terrestrial barren land; permanent snow and glaciers; inland water bodies; and coastal water bodies and inter-tidal areas)^(a) National Sub-national 	<ul style="list-style-type: none"> FAO Land Cover Classification System System of Environmental-Economic Accounting (SEEA) Central Framework (2012) land cover categories European Environment Agency (EEA)

About a quarter of all BSES statistics have geospatial element, e.g. 85 statistics measured by area, 5 by length



Geographic and geological statistics in the manual of the BSES

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Manual on the Basic Set of Environment Statistics
of the FDES 2013



Geological and geographical information and
Statistics
(Topic 1.1.3 of the Basic Set of Environment Statistics of the FDES 2013)

Submitted by the Environment Statistics Section
of the Central Agency for Statistics of Latvia,
in collaboration with the
Expert Group on Environment Statistics

Version 1.0
(5 September 2013)

Methodology: FDES of the Basic Set of Environment Statistics of the FDES
Manual on the Basic Set of Environment Statistics of the FDES 2013
http://www.unep.org/statistics



Geographic and geological statistics in the manual of the BSES

- Statistics on geographic and geological characteristics of a country comprise most common and **mostly static properties, such as border length, country area, relief and bedrocks.**
- Yet if rare, any changes either caused by geologic processes or human actions affected these properties, can have **big impacts on the population**, for example: border changes, landslides and earthquakes.
- Even though, not obvious in official statistics, geology and its branches have traditionally been used to develop fundamental national data and information, including **topographic maps, geographic names and geodetic networks of reference points.**
- During the past centuries, this topographic, geographic and geodetic data has been instrumental for the development of most national and international infrastructures such as **national cadastres (property registers), navigation activities**, among others, and in recent decades also for **monitoring sea level rise.**



Geographic and geological statistics in the manual of the BSES

- Geospatial Information - provides the digital and graphical connection between a geographic place, location, its people and their activities, and is used to illustrate what is happening – where, how and why.
- A **National Spatial Data Infrastructure** (NSDI) identifies technology, policies, standards, good practices, and human resources necessary to acquire, process, store, disseminate, and analyse the use of geospatial information. The NSDI concept has been replaced by the IGIF as the overarching framework for strengthening geospatial information.

More related or relevant terms can be consulted in the **Global Statistical Geospatial Framework: Implementation Guide** (<https://unstats.un.org/unsd/statcom/53rd-session/documents/BG-3x-EG-ISGI-GSGF-Implementation-Guide-E.pdf>) and

Glossary of Terms for the Standardization of Geographical Names (https://unstats.un.org/unsd/ungegn/pubs/documents/Glossary_of_terms_rev.pdf).



Examples of definitions

1.1.3.a. Geological, geographical and geomorphological conditions of terrestrial areas and islands.

1.1.3.a.1 Length of border

Length of border is defined as the border line that divides two countries. Total length of the country border and length of segments bordering other countries or entities are relevant. Border or boundary concept is defined as a line marking the limits of a unit of land, often a geographical region, but also of economies or societies, ^[1]**Remarks:**

- This information may be obtained from data or maps in official national/international sources.
- National borders are delimited in accordance with national and international organizations legal backing.
- Statistical information of the length of the border, can be represented by geographical location of border, total length as well as length of separate bordering entities, e.g. countries.

1.1.3.a.2 Area of country or region

An area of land that forms an independent political unit with its own government. ^[2]

Related definitions:

- **Land area** is a country's total area, excluding area under inland water bodies, national claims to continental shelf, and exclusive economic zones. In most cases the definition of inland water bodies includes major rivers and lakes. ^[3]
- **Total surface area** refers to the total area of the country which comprises land area and inland waters. ^[4]

^[1] Oxford dictionary of Geography, <https://ia801908.us.archive.org/34/items/geography-encyclopedia/Oxford%20Dictionary%20of%20Geography.pdf> (accessed 23 September 2022)

^[2] Cambridge dictionary, <https://dictionary.cambridge.org/us/dictionary/english/country> (accessed 23 September 2022)

^[3] The World Bank, data, <https://data.worldbank.org/indicator/AG.LND.TOTL.K2> (accessed 23 September 2022)

^[4] UNSD, Environmental Indicators, <https://unstats.un.org/unsd/environment/totalarea.htm> (accessed 23 September 2022)



Examples of definitions

1.1.3.c. Length of marine coastline

Coastline is not a uniformly defined concept, because of complexities such as fractal dimensions. Coast is generally defined as ‘broad area of land that borders the sea’. Coastal countries may have more specific definitions and official estimates of its length. Because of the many natural and engineering construction impacts affecting the coastline, its length and shape can vary substantially from one point in time to another.

1.1.3.d. Coastal area

Coastal areas are commonly defined as the interface or transition areas between land and sea, including large inland lakes. Coastal areas are diverse in function and form, dynamic and do not lend themselves well to definition by strict spatial boundaries. Unlike watersheds, there are no exact natural boundaries that unambiguously delineate coastal areas.

Encyclopedia Britannica, <https://www.britannica.com/science/coast> (accessed 23 September 2022)



4. International sources and recommendations:

4A. Classifications and groupings

Standard country or area codes for statistical use (M49) - UNSD has developed the UN M49 as the Standard Country or Area Codes for Statistical Use. Standard country or area codes for statistical use (M49), <https://unstats.un.org/unsd/methodology/m49/> (accessed 23 September 2022)

Geographic regions - Based on the M49 coding, UNSD has developed a geographic regions scheme which groups 249 countries and territories in the world into six regional, 17 subregional, and nine sub-subregional groups.

Geographic names - United Nations Group of Experts on Geographical Names (UNGEGN) is one of the nine standing expert bodies of ECOSOC, has a long and rich history, beginning in 1967, of leading national **geographical names standardization in jurisdictions around the world**. United Nations Group of Experts on Geographical Names (UNGEGN), <http://unstats.un.org/unsd/geoinfo/geonames/> (accessed 23 September 2022)

Classifications of Biomes

Classifications of ecoregions and biogeographic regions

Classification of fault lines



4B. Reference to international statistical recommendations, frameworks and standards

- UN-GGIM <https://ggim.un.org/>
- UNESCO <https://en.unesco.org/>
- UN, Oceans and the Law of the Sea, UN Division for Ocean Affairs and Law of the Sea, <https://www.un.org/depts/los/index.htm>
- USGS, United States Geological Survey, <https://www.usgs.gov/>
- GFGS, Global Forum for Geography and Statistics, <https://www.efgs.info/about-efgs/global-forum-for-geography-and-statistics>
- UGI, International Geographic Union, <https://igu-online.org/>
- IGS, International Geoscience Services, <https://www.igsint.com/>
- BGS, British Geological Survey, <https://www.bgs.ac.uk/>

The International Organization for Standardization (ISO) has developed a series of standards and technical specifications on Geographic information and Geomatics.

- ISO 19101-1:2014, Geographic information — Reference model — Part 1: Fundamentals
- ISO 19104:2016, Geographic information — Terminology
- ISO 19112:2019, Geographic information — Spatial referencing by geographic identifiers
- ISO 19115-1:2014, Geographic information — Metadata — Part 1: Fundamentals.

International Organization for Standardization (ISO),

<https://www.iso.org/committee/54904/x/catalogue/#:~:text=ISO%20%2D%20ISO%2F%20TC%2011%20%2D%20Geographic%20information%2FGeomatics>



Ecosystem extent accounts: Ecosystem assets

- *Ecosystem assets (EAs) are contiguous spaces of a specific ecosystem type characterized by a distinct set of biotic and abiotic components and their interactions*
- *Ecosystem assets are classified by ecosystem type (ET)*



Example: Brazil extent account

Ecosystem extent accounts in Brazil (2000-2018)



- The ecosystem extent accounts (2000-2018), by biomes, show that Brazilian terrestrial biomes lost about 500 thousand km² of their natural areas, due to conversion into modified areas such as land used for crops and grazing.

Source: (IBGE 2020), Ecosystem Accounts: Land Use in Brazilian Biomes 2000-2018



SDG indicators that incorporate these statistics

Goal	Target	Indicators	Metadata
Objective 14. Conserve and sustainably use oceans, seas and marine resources for sustainable development.	<p>14.2</p> <p>By 2020, manage and protect in a sustainable way the marine and coastal ecosystems to avoid effects important adversities, including strengthening their resilience, and measures to restore them to improve the health and productivity of the oceans.</p>	<p>14.2.1</p> <p>Proportion of national exclusive economic zones managed through ecosystem-based approaches.</p>	<p>https://unstats.un.org/sdgs/tierIII-indicators/files/Tier3-14-02-01.pdf</p>

15.1.1	Forest area as a proportion of total land area
15.1.2	Proportion of important sites for terrestrial and freshwater biodiversity that are covered by protected areas, by ecosystem type
15.3.1	Proportion of land that is degraded over total land area
15.4.1	Coverage by protected areas of important sites for mountain biodiversity
15.4.2	Mountain Green Cover Index

Additional information

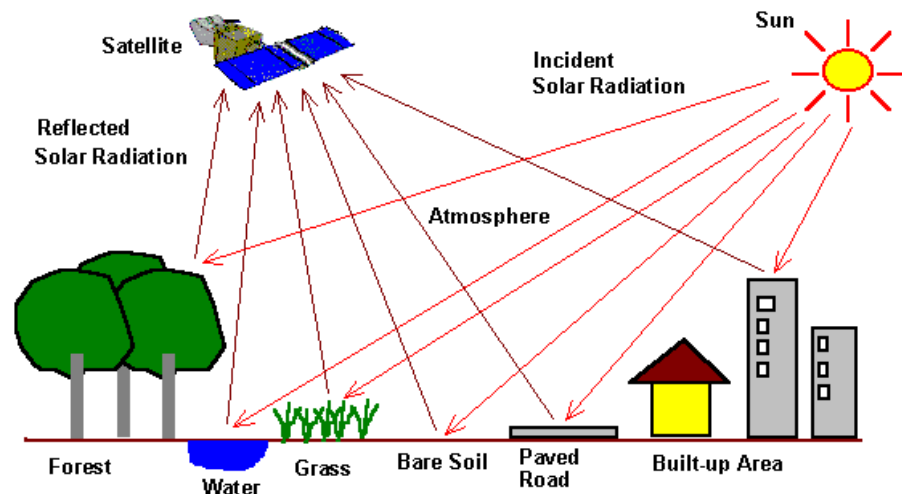


Main concepts and definitions on GIS

- **GIS** is “An integrated collection of computer software and data used to view and manage information about geographic places, analyze spatial relationships, and model spatial processes” Source: ESRI
- The underlying assumption is that any geographic entity can be depicted as a **Feature** (point, line or polygon), or group of **Grid** cells
- A set of feature data representing a concrete theme is called **vector layer**, for example layer of post offices (points), layer of roads, layer of rivers (lines), layer of cadastral properties (polygons). Multiple layers can be overlaid and visualized as composite landscape structures on a single **layout map**.
- A **raster layer** references a raster file as its data source and a raster renderer that defines how the raster data should be rendered and any additional display properties. Source: ESRI
- The single maps are ‘fixed’ as a **Data frame** (containing several layers and grids as separate files) and saved as a **Project**
- **Geodatabase** is a set of shapefiles (either points, lines, polygons) and grids linked in a single structure
- Complete list of terms available from ESRI here:
http://webhelp.esri.com/arcgisserver/9.3/java/geodatabases/definition_frame.htm

Main concepts and definitions on Earth Observation

- 1. Remote sensing: the science and art of identifying, observing, and measuring an object without coming into direct contact with it.** This process involves the detection and measurement of radiation of different wavelengths reflected or emitted from distant objects or materials, by which they may be identified and categorized by class/type, substance, and spatial distribution (NASA).
 - **Measures continuous arrays of reflectance values and the (approximate!) geographic location of pixels or grid-cells**



- 2. Optical remote sensing: Satellite and Aerial: for land cover and use**
- 3. Synthetic Aperture Radar: for biomass, peatlands, elevation**



Satellite instruments

High resolution

- NASA's Landsat
- ESA's Sentinels
- SPOT

Very high resolution

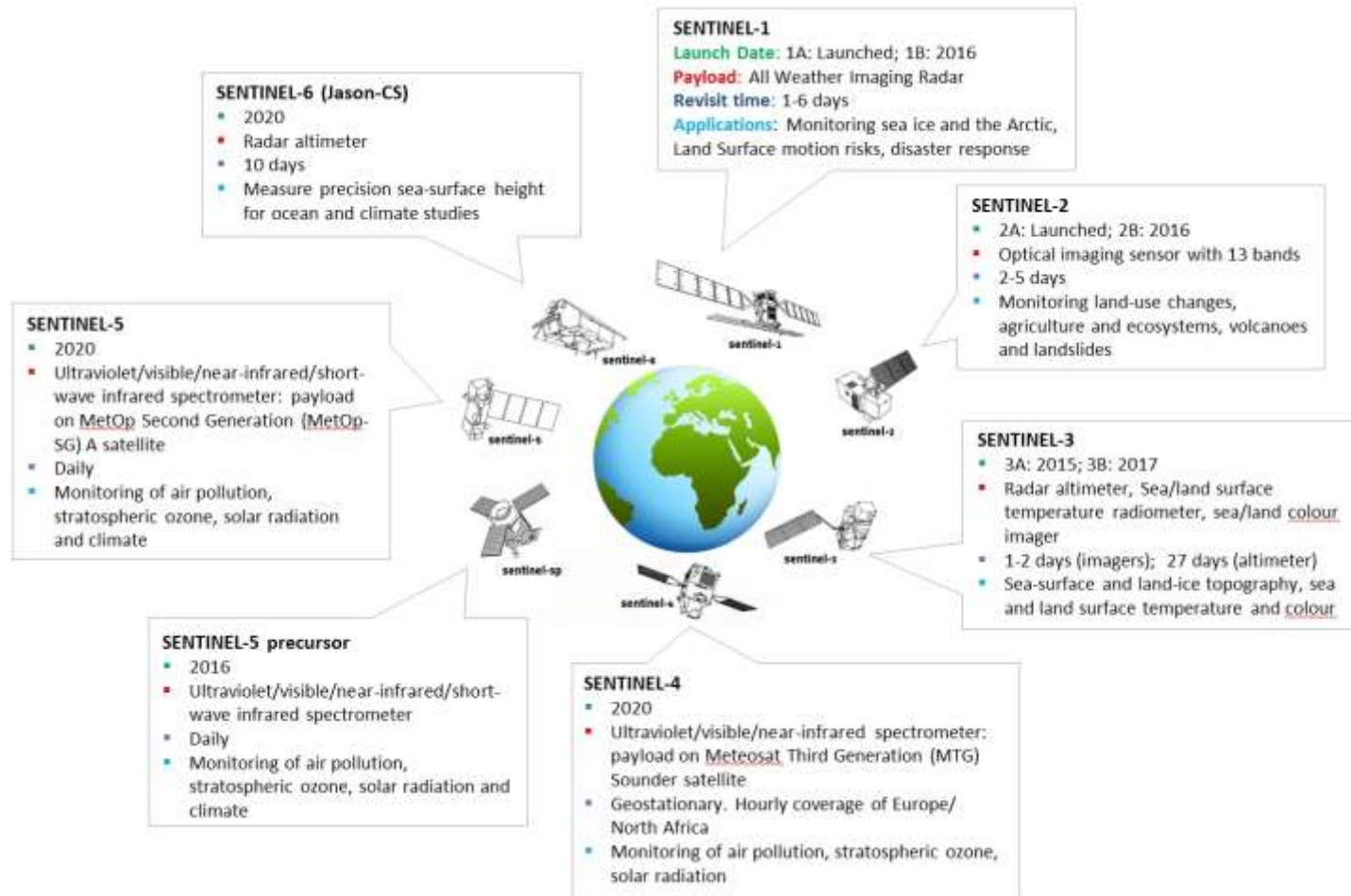
- QuickBird
- Ikonos

Moderate resolution

- NASA's MODIS
- ESA's MERIS

SAR

- ALOS-PALSAR



Interface of ArcMap

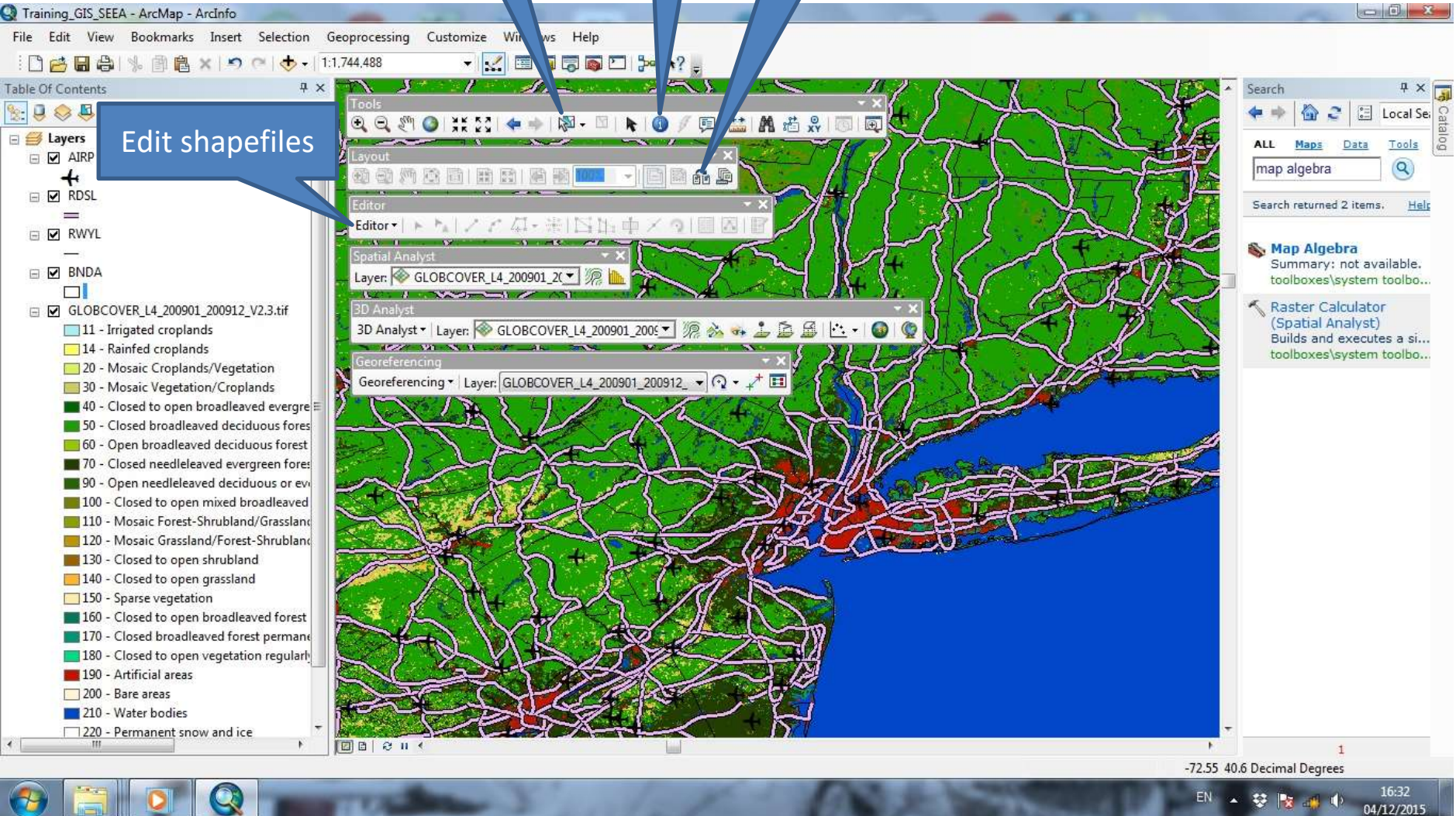
Select feature

Check Value

Change Layout template

Main Toolbars and functions (in menu Customize/Toolbars

Edit shapefiles



Getting Started with GIS (for ArcGIS 10.0)

by Esri

Course Introduction

Before You Start Course Data

Module 1: The Big Picture of GIS

- [-] Six questions about GIS
 - What does GIS stand for?
 - How are paper, digital, and GIS maps different?
 - What are the functions of a GIS?
 - How was GIS used in the past?
 - What is the definition of GIS?
 - What is the geographic approach to solving problems?

GIS maps Evaluation

Module 2: Understanding Geographic Data

- [-] GIS data
 - Understanding vector data
 - Understanding raster data
 - Explore vector and raster data
- [-] Map meets database
 - How is geographic data organized?
 - Explore the feature-attribute relationship
- [-] Thematic mapping
 - What is a thematic map?
 - Classifying features
 - What is a map layout?
 - Create thematic maps

Evaluation

Module 3: Analyzing Geographic Data

- [-] Query
 - What is attribute query?
 - Practice querying attributes
 - Query data based on attribute
 - What is location query?
 - Explore location query
 - Query data based on location
- [-] Analysis
 - What is buffer?
 - Create buffers
 - What is overlay?
 - Create overlays
- [-] Bringing it all together
 - The geographic inquiry process
 - Solve a problem with GIS: Part 1
 - Solve a problem with GIS: Part 2

Evaluation Course Exam

The Big Picture of GIS

In this module, you start your exploration of GIS. You first learn the answers to six questions about GIS. In the second lesson, you learn some fundamental GIS concepts and practice working with GIS maps.

Learning objectives

- A student who completes this module will be able to:
 - Describe the difference between paper, digital, and GIS maps.
 - List the three functions of a GIS.
 - Identify one use of GIS in the past or present.
 - Define GIS.
 - Describe the geographic approach to solving problems.
 - List four components of a feature.
 - Explain the relationship between features and layers.
 - Explain how scale on a GIS map is different from scale on a paper map.

E-learning course designed to introduce thorough conceptual and practical issues in 3 modules.



Thank you for your attention!

For more information please contact the Environment Statistics Section
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