ENV PRO

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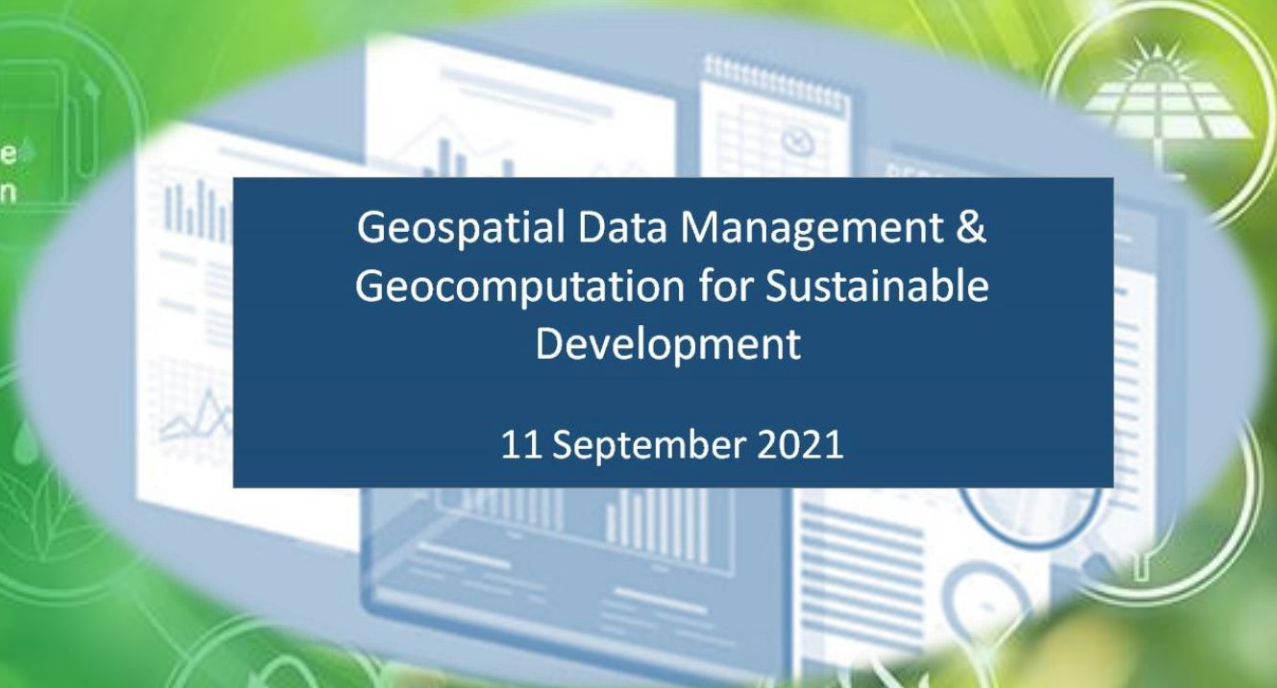

Geospatial Data Management & Geocomputation for Sustainable Development

11 September 2021

The Environmental Science Education for Sustainable Human Health

in commemoration of Professor Armen Saghatelyan

6 – 13 September 2021

UNIVERSITÀ DEGLI STUDI DELLA TUSCIA

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GRENA GEORGIAN RESEARCH AND EDUCATIONAL NETWORKING ASSOCIATION

Co-funded by the
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of the European Union

GEOSPATIAL DATA MANAGEMENT & GEOCOMPUTATION FOR SUSTAINABLE DEVELOPMENT

Dr. Shushanik Asmaryan

The Deputy Director for Science of CENS, Head of GIS and remote sensing department

Lecturer at "Environmental Protection and Nature Management" department of ISEC of NAS RA

UNIVERSITÀ DEGLI STUDI DELLA TUSCIA

E-mail: shushanik.asmaryan@cens.am

ENV PRO

SPATIAL DATA INFRASTRUCTURE AND MANAGEMENT

Modernized by Dr. Shushanik Asmaryan based on courses available in University of Halle (Germany) and University of Tuscia (Italy) University of Geneva (Switzerland)

ECTS: 5 Hours: 150

This course aims at introducing the web-GIS spatial data infrastructures, global spatial data repositories. The students will be introduced to

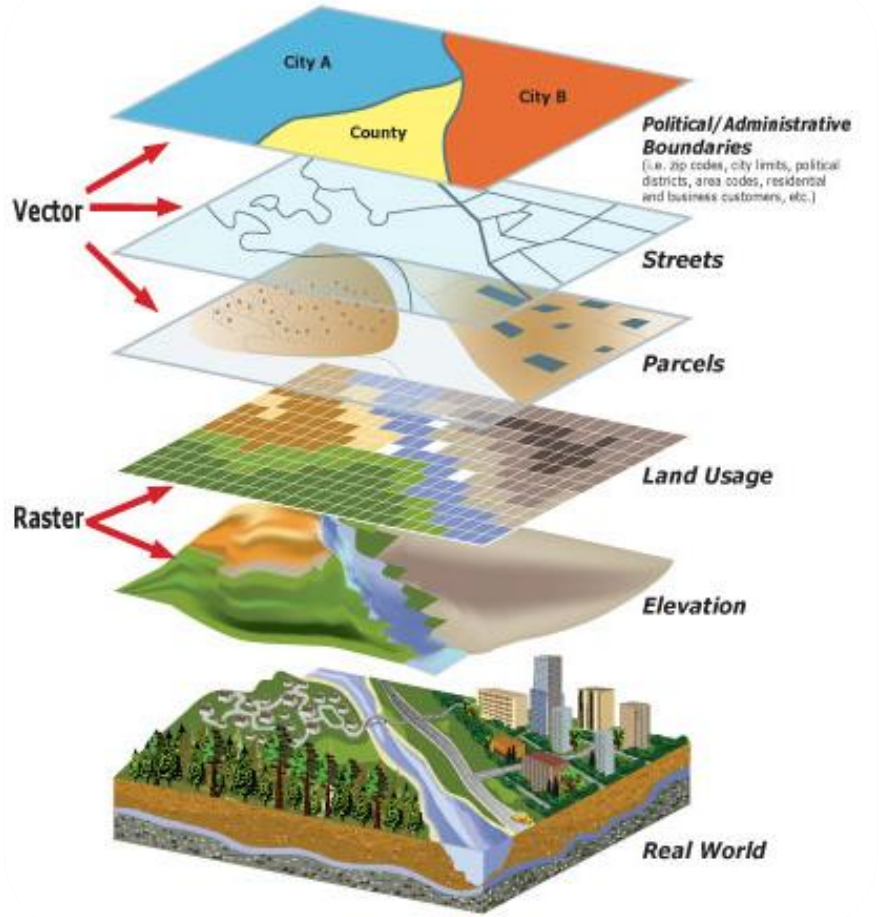
- ***GIS technologies and the skills, methods and principals of the geospatial data processing, maintaining, analyzing, and producing.***
- ***the main structural components of web-GIS (spatial data infrastructures), software, global data repositories and the benefits of their application.***
- ***geospatial standards, the experience of creating the nationally distributed processing capacities for geospatial data in Armenia as well as the benefits of geospatial data and metadata sharing and exchange.***

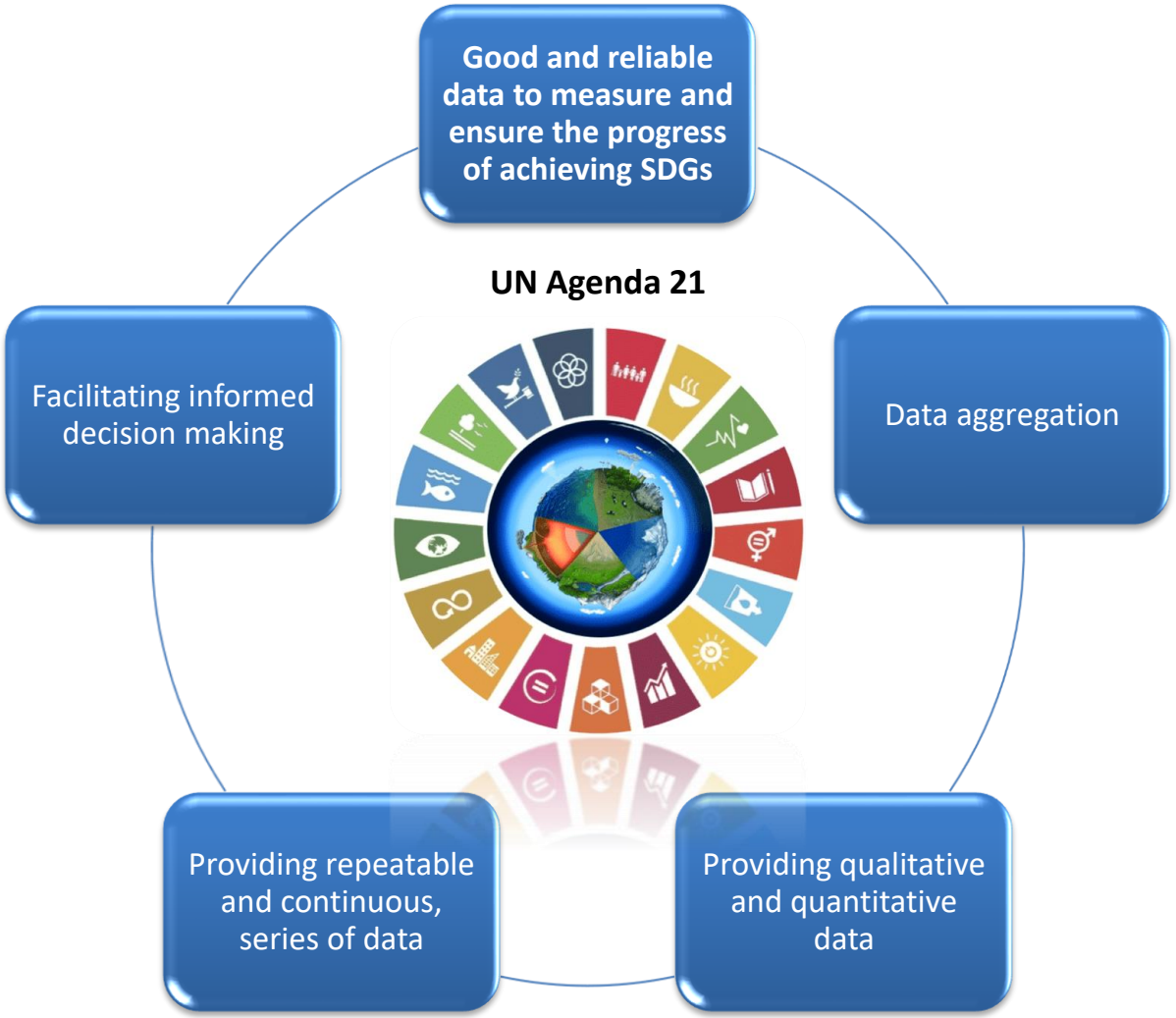
GEOSPATIAL INFORMATION FOR

- Disaster risk management
- Natural resource management
- Connectivity
- Social development
- Energy
- Climate change
- etc. …

https://www.unescap.org/blog/where-are-we-going-geospatial-information-sustainable-development

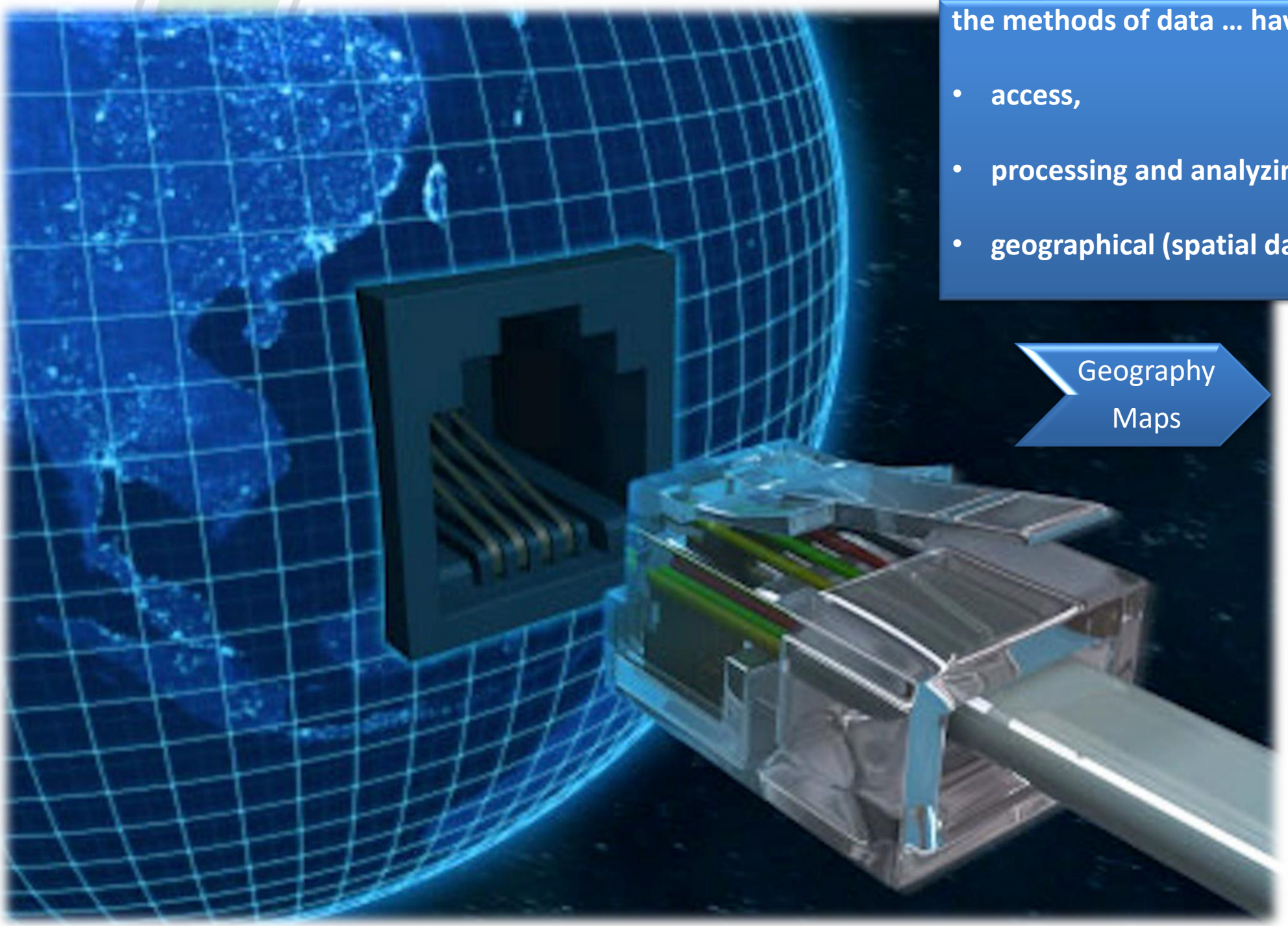
Why We Need Geospatial Information for Sustainable Development ?





SDG Implementation Voluntary National Review (VNR) Armenia; Report for the UN High-level Political Forum on Sustainable Development (9–18 July 2018). Yerevan, Armenia, 2018.

UN in Armenia: News: Armenia's Roadmap for Sustainable Development Goals to Come Forth Soon.

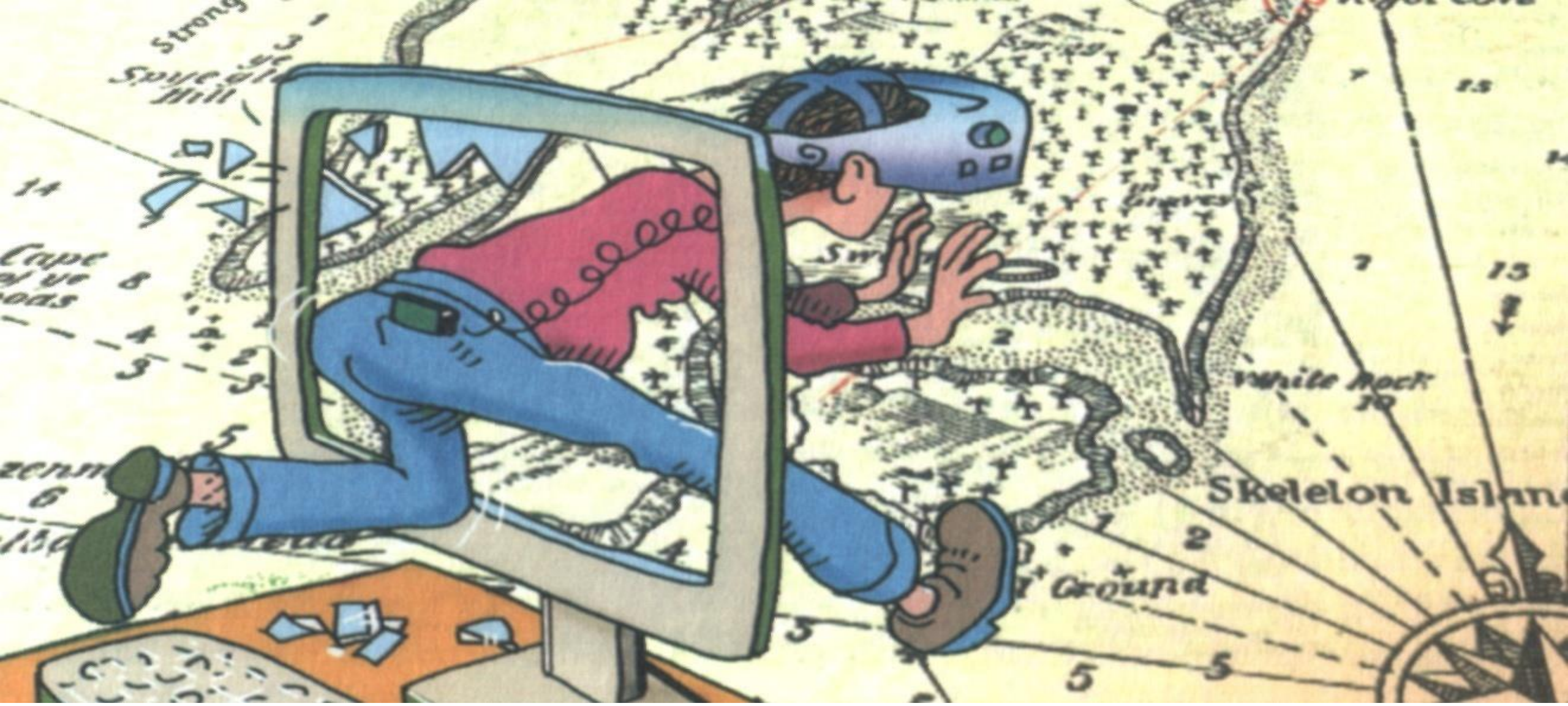


the methods of data … have changed

- **access,**
- **processing and analyzing**
- **geographical (spatial data) visualization,**

Geography
Maps

Geography
Data bases

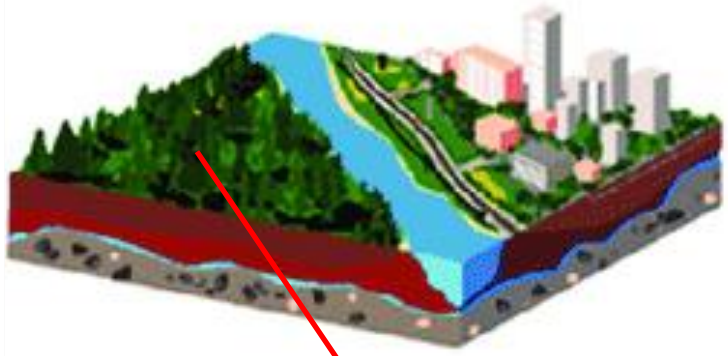


Understanding Earth.

IS Technology Drives a New Relationship Between Humans and the Environment.

Jack Dangermond and Matt Artz, Esri, 2012

The Real World



GIS World Model

Data Slices

Imagery

Elevation

Transportation

Addresses

Boundaries

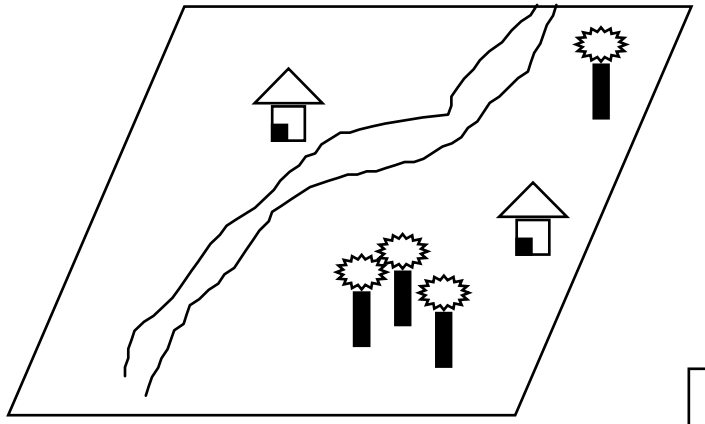
Water Features

Survey Control

Your Data

GIS COMPONENTS

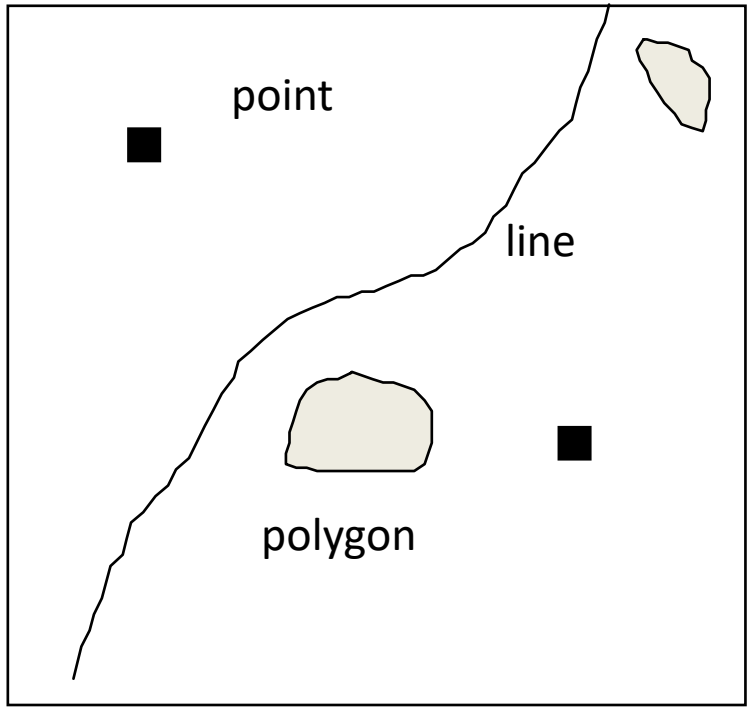
REAL WORLD



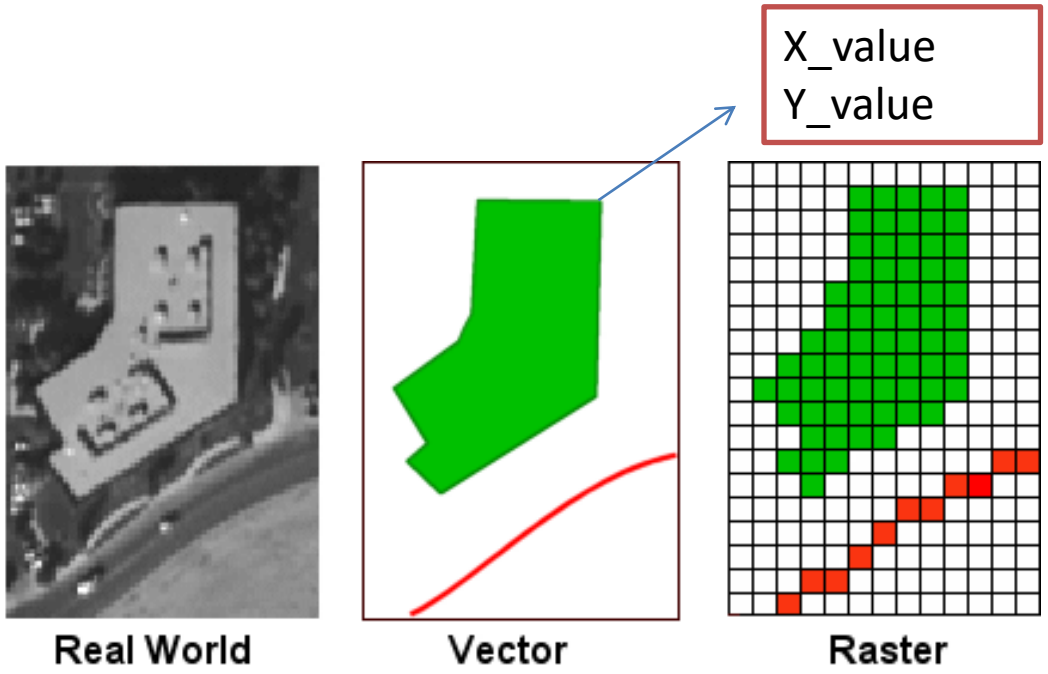
GIS
RASTER MODEL

	0	1	2	3	4	5	6	7	8	9
0								R	T	
1							R			T
2		H					R			
3							R			
4					R	R				
5				R						
6			R		T	T		H		
7			R		T	T				
8		R								
9		R								

GIS
VECTOR MODEL



Which data model should we/you use?

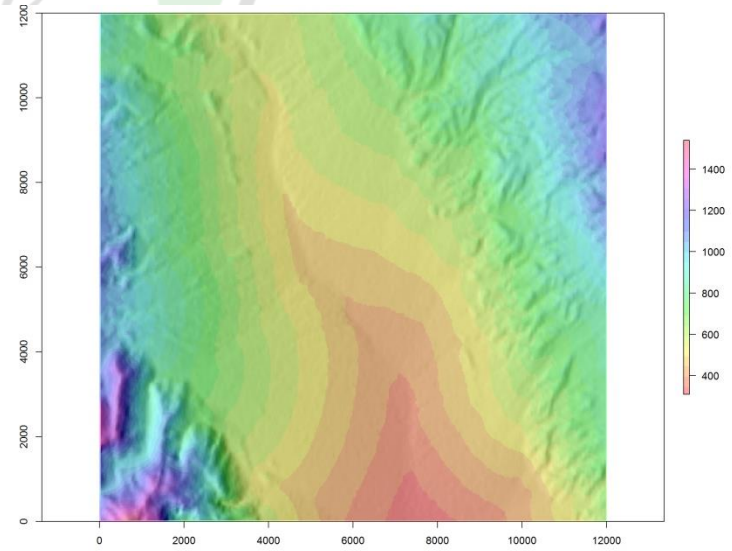


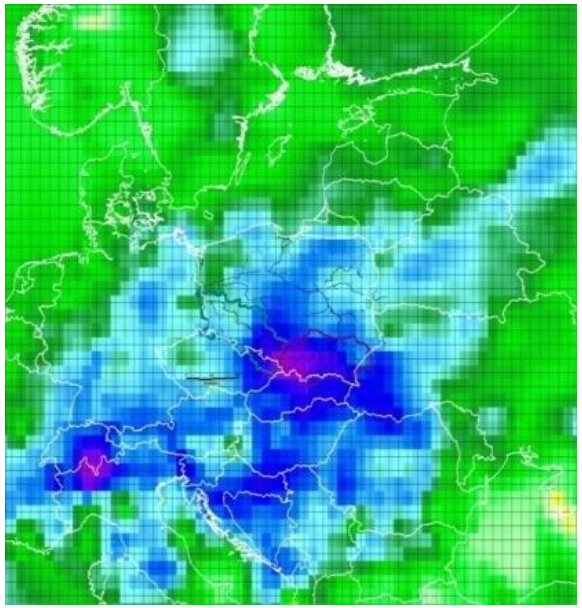
In general, use the ***vector data*** model when you want to represent features that have discrete boundaries.

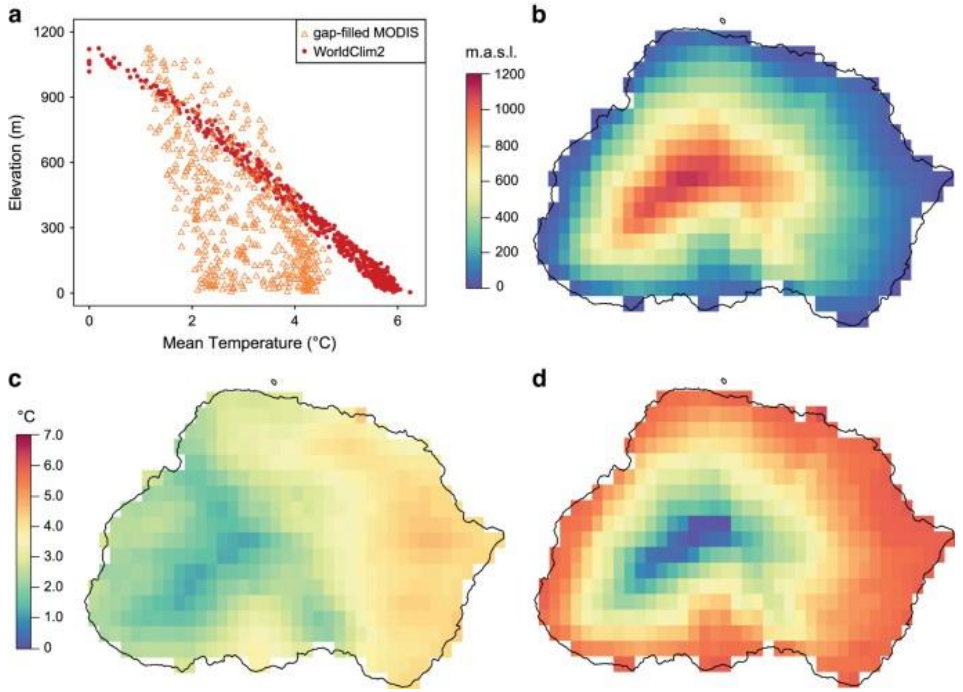
The ***raster data*** model can be used to represent discrete features as well. However, representing discrete features in the raster data model is less accurate.

The ***vector data*** model represents geographic features with exactly defined boundaries, while the raster data model represents them as cells of the same value.

Which data model should you use?

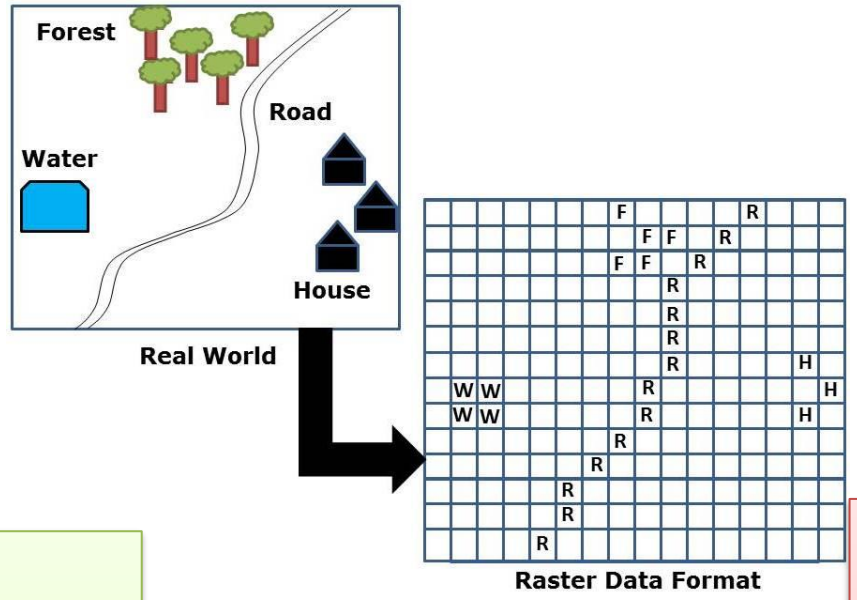






The ***raster data*** model is very useful for representing continuous geographic data; that is, phenomena such as ***elevation, precipitation, and temperature***, which don't have well-defined boundaries and which usually change gradually across a given area.

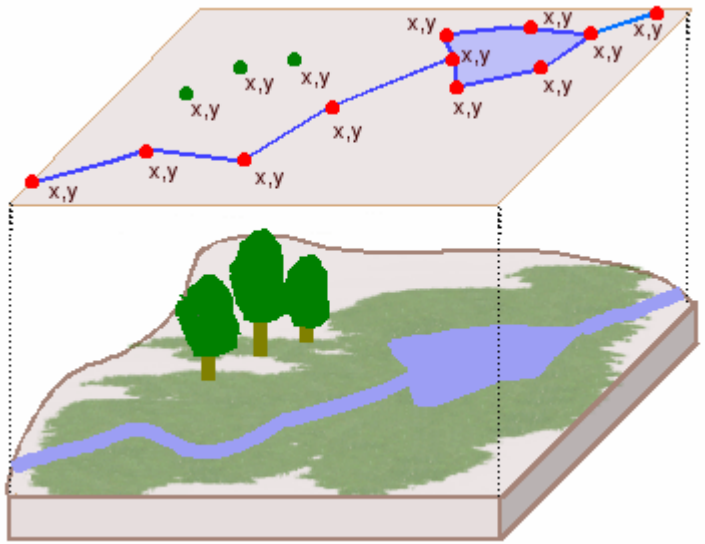
The ***raster data*** model is commonly used for **spatial analysis and modeling**.



- *Simple data structure*
- *Various kinds of spatial analysis*
  Spatial autocorrelation, Spatial interpolation, Spatial interaction, Simulation and modeling, Density mapping etc.)
- *Easy overlay*
- *Uniform size and shape*
- *Cheaper technology*

- *Large amount of data*
- *Less "pretty"*
- *Projection transformation is difficult*
- *Different scales between layers can be a nightmare!!!*
- *May lose information due to generalization*

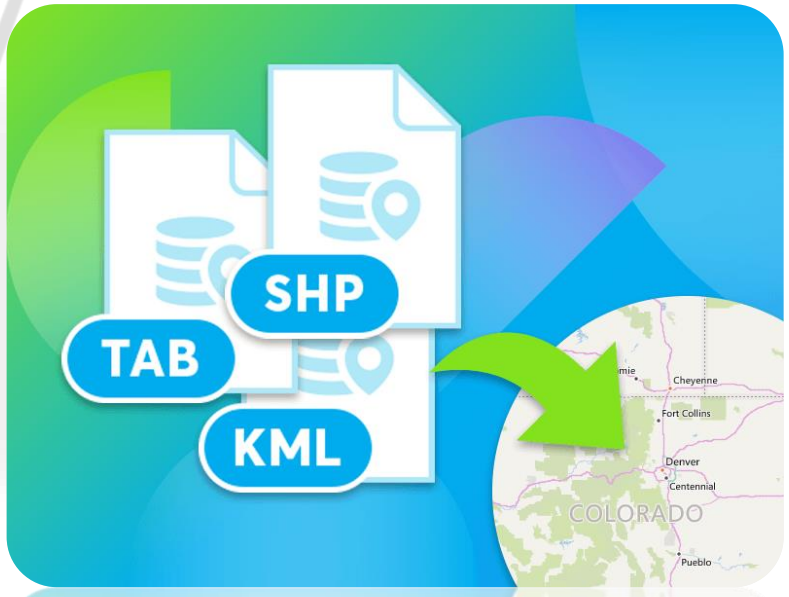
GIS
VECTOR MODEL



- *Good representation of reality*
- *Compact data structure*
- *Topology can be described in a network*
- *Accurate graphics*

- *Complex data structures*
- *Simulation may be difficult*
- *Some spatial analysis is difficult or impossible to perform*

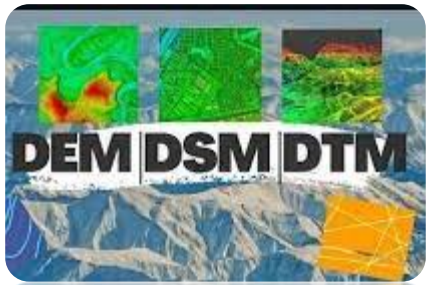
Popular formats (extentions) of GIS data



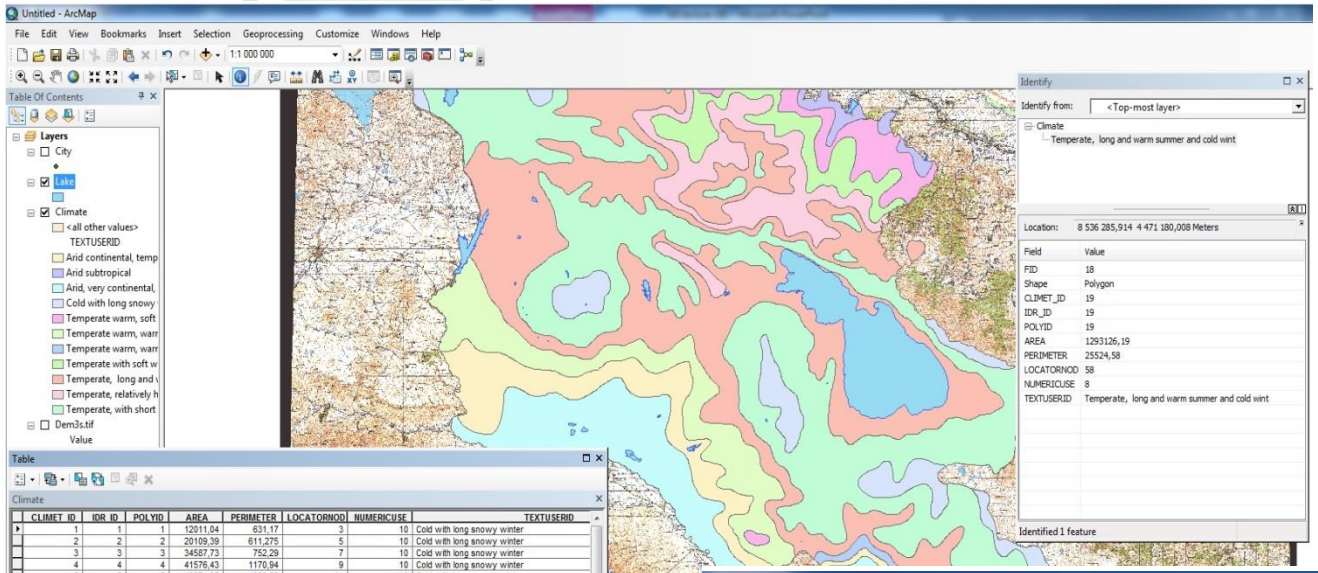
GIS Vector Files - Format Support

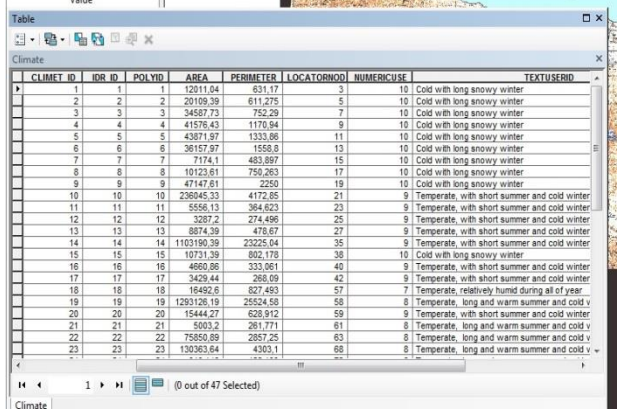
GIS Raster Files - Format support

GRID

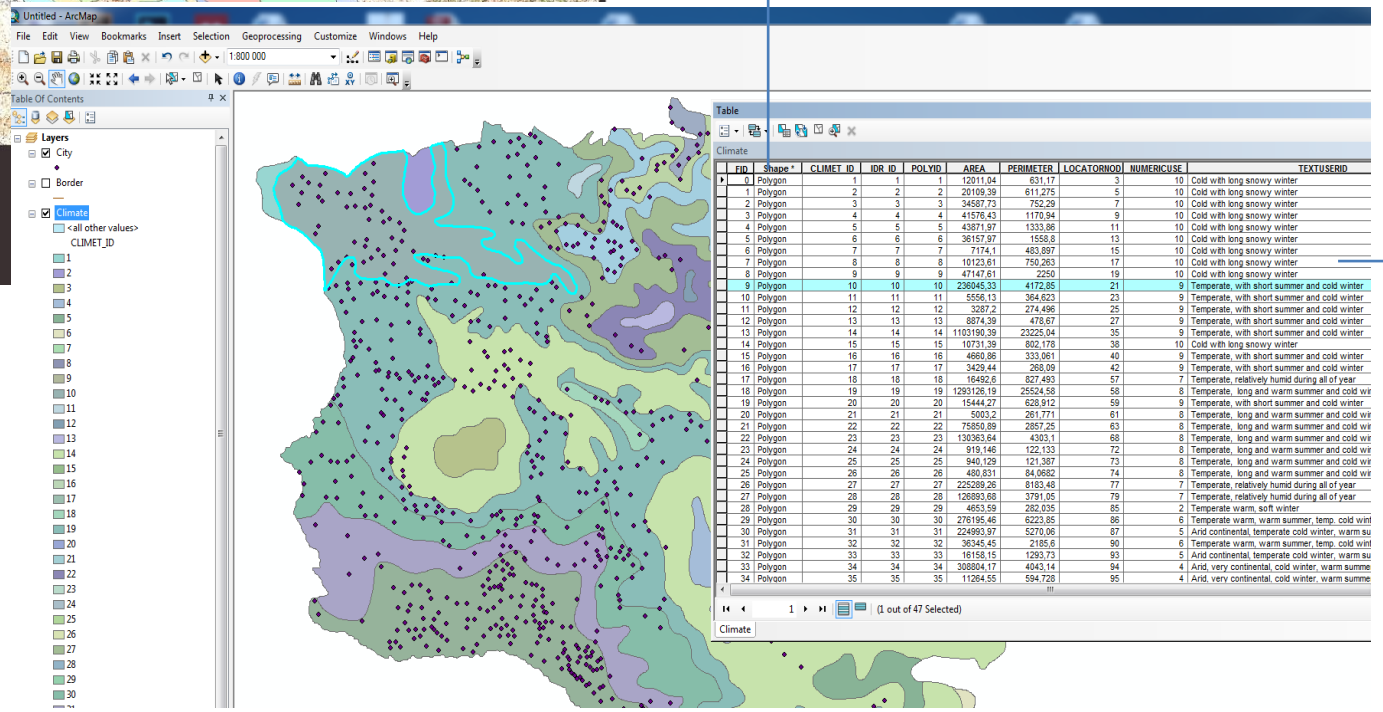


Geospatial and Attribute data





colomns



rows

Spatial data (where)

- specifies location
- stored in geodatabase

Attribute data (what , how much, when)

- Specifies characteristics at that location, natural or human-created
- Stored in a database (tables)

Data are the fuel for scientific analysis and decision-making

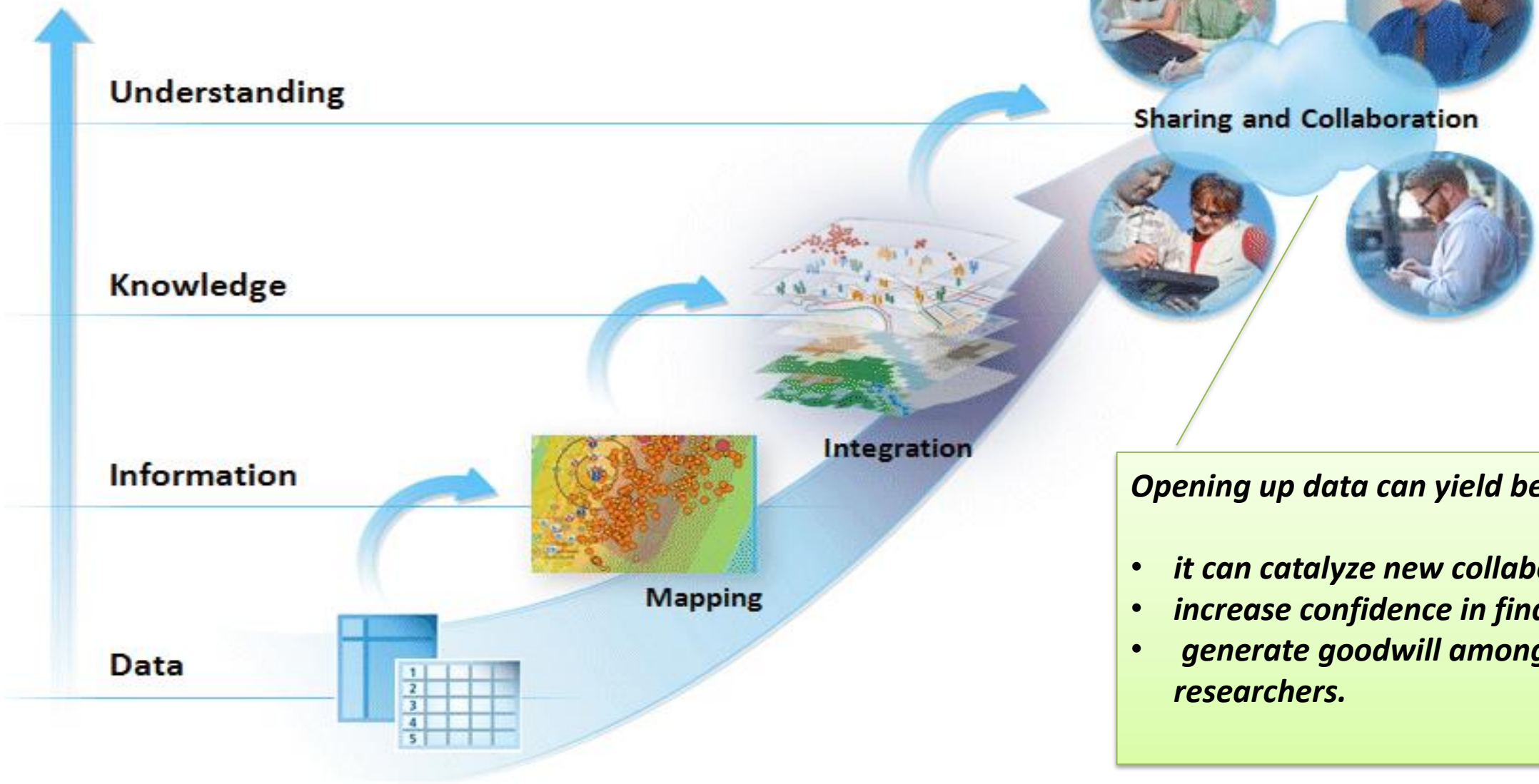
Spatial information affects 60 - 80% of all decisions

Without

data sharing

- **doing science can be difficult ,**
- **taking sound decisions can be problematic**
- **envisioning a sustainable development can be complicated.**

GEOSPATIAL DATA SHARING

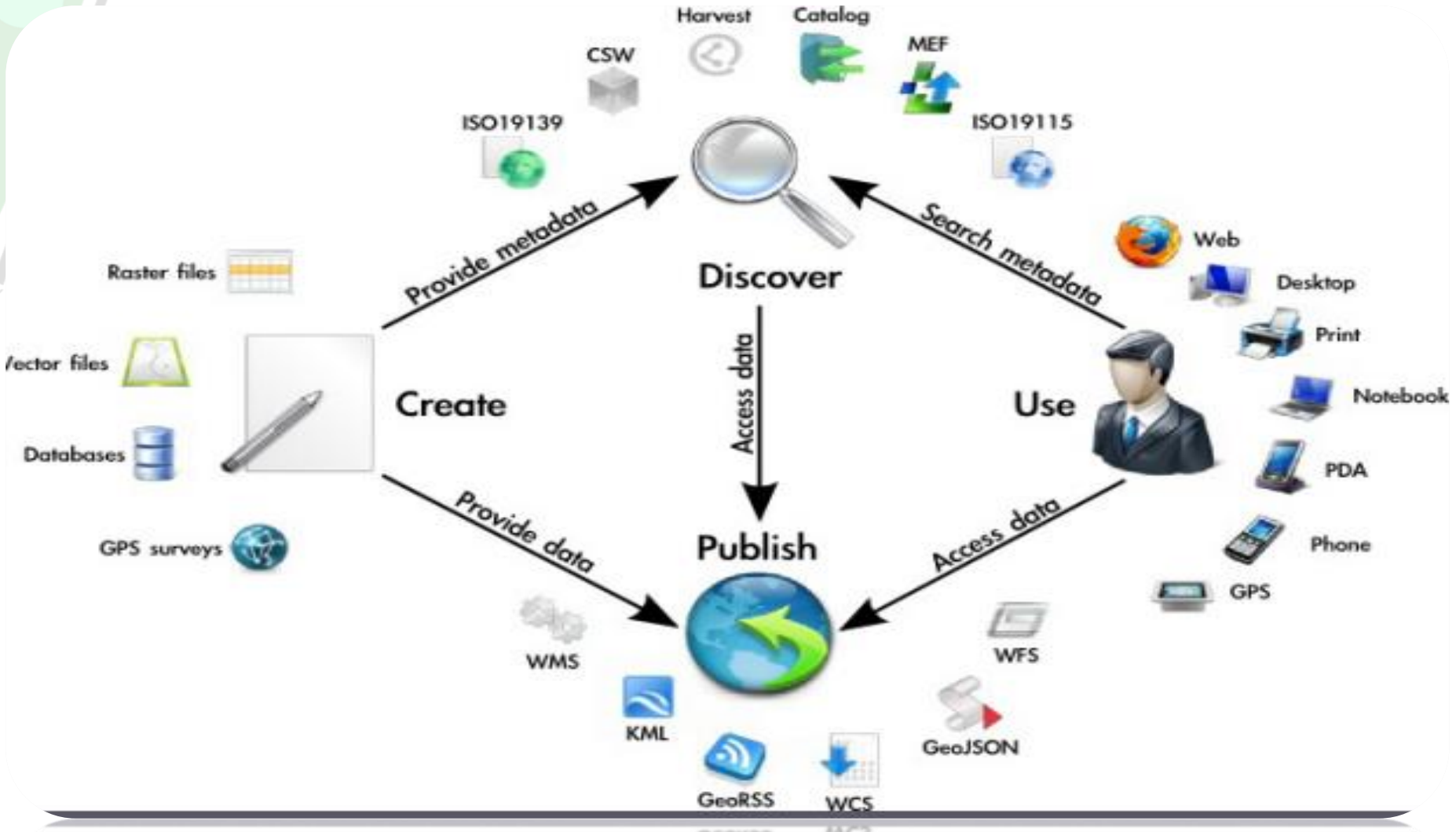


Opening up data can yield benefits:

- ***it can catalyze new collaborations,***
- ***increase confidence in findings***
- ***generate goodwill among researchers.***

SPATIAL DATA INFRASTRUCTURES (SDI)

System of systems that facilitates the discovery, access, management, distribution, reuse, and preservation of digital geospatial resources.

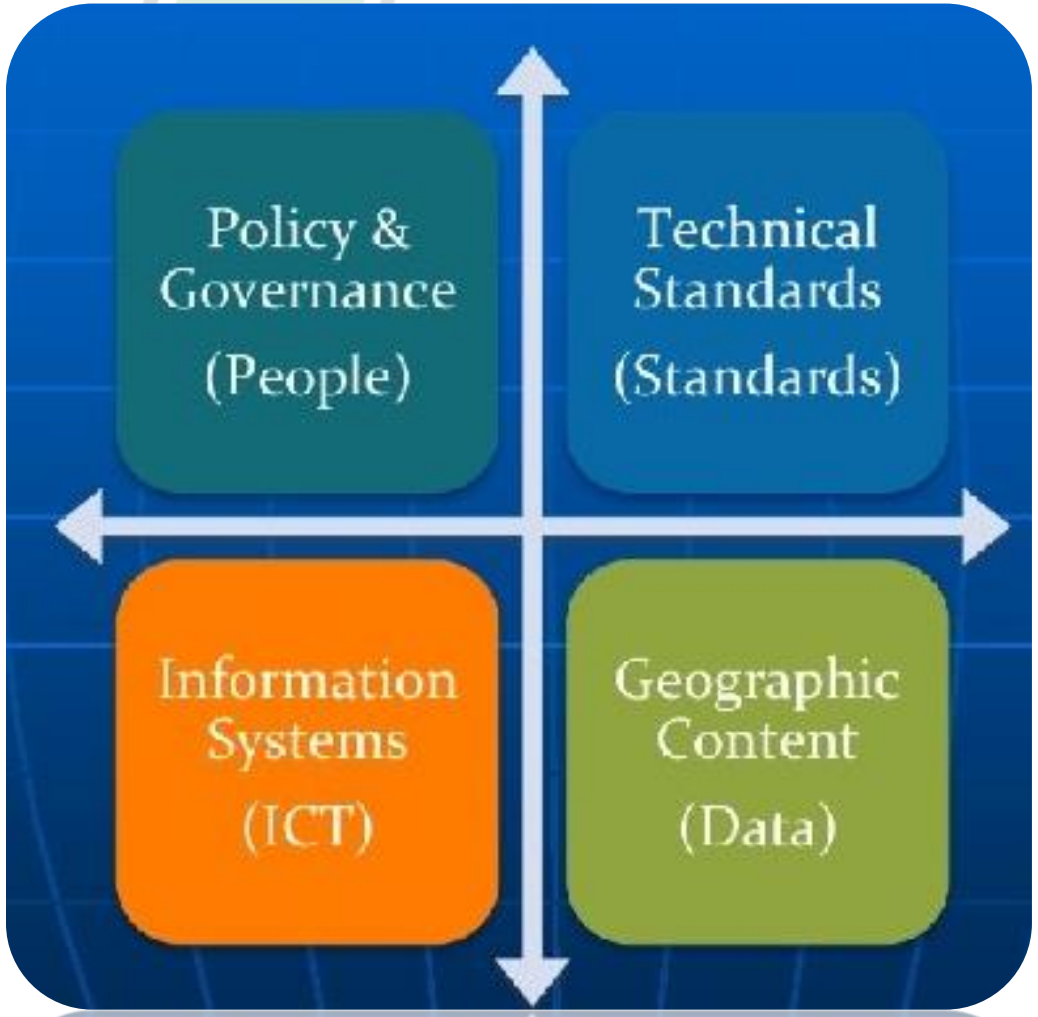


Hu, Y. & Li, W. (2017). "Spatial Data Infrastructures", The Geographic Information Science & Technology Body of Knowledge, John P. Wilson (ed.).
http://dx.doi.org/10.22224/gistbok/2017.2.1

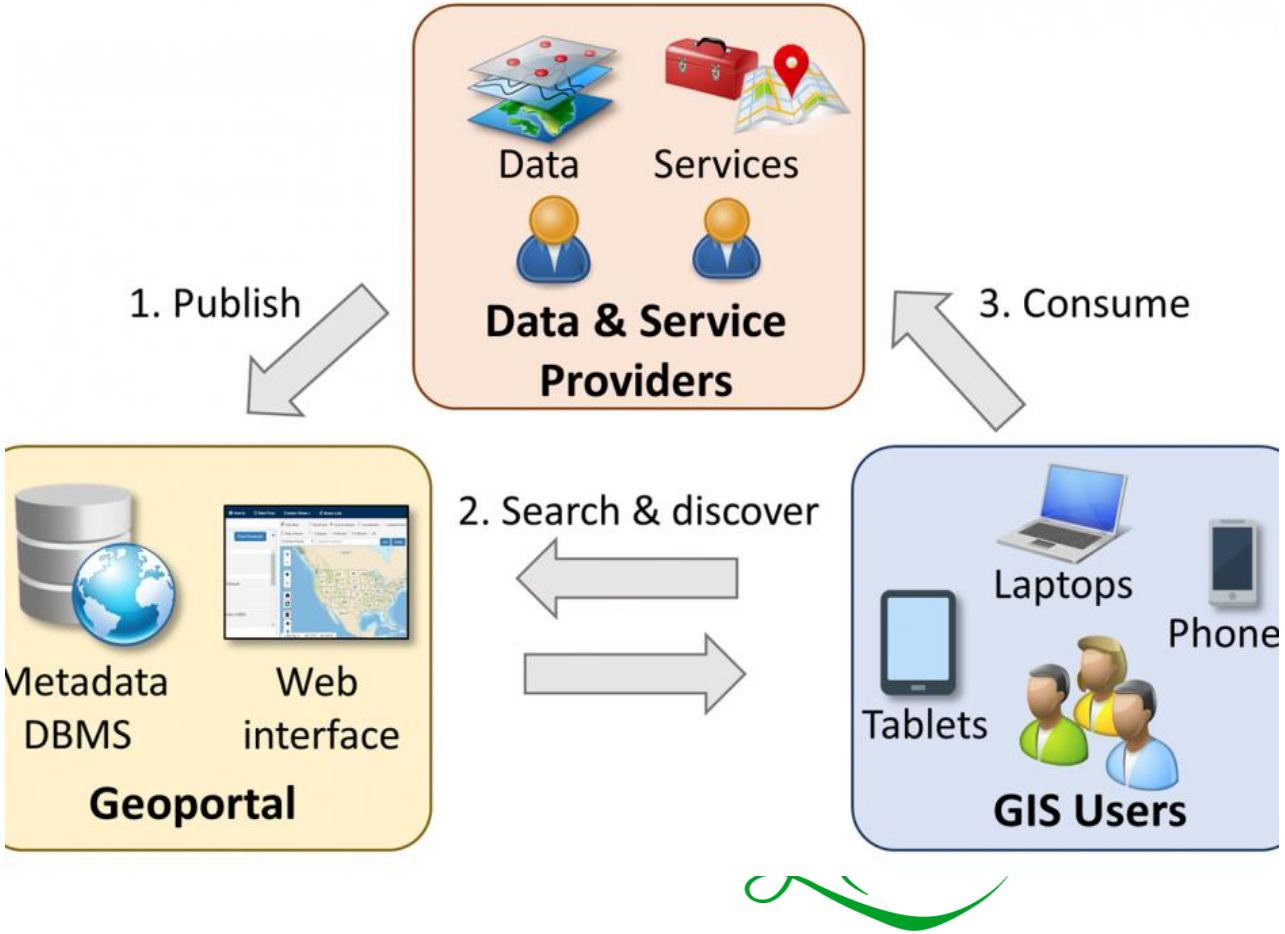
Georgiadou, Y., O. Rodriguez-Pabón & K. T. Lance (2006) Spatial data infrastructure (SDI) and e- governance: A quest for appropriate evaluation approaches. URISA-WASHINGTON DC-, 18, 43.

Key components of the SDI

SDI COMPONENTS - FOUR PILARS



INTERACTION BETWEEN THE COMPONENTS



DEFINITIONS

1. ***Spatial data infrastructure:*** *The technology, policies, standards, and human resources necessary to acquire, process, store, distribute, and improve utilization of geospatial data, services, and other digital resources.*

2. ***Geoportal:*** *A gateway website through which people can search, discover, access, and visualize the geospatial resources within a SDI.*

3. ***Metadata:*** *Documentation about who, when, how, what, why, and many other facets of the data and the data production process. Metadata can be used for describing not only data, but also tools, services, and other geospatial resources.*

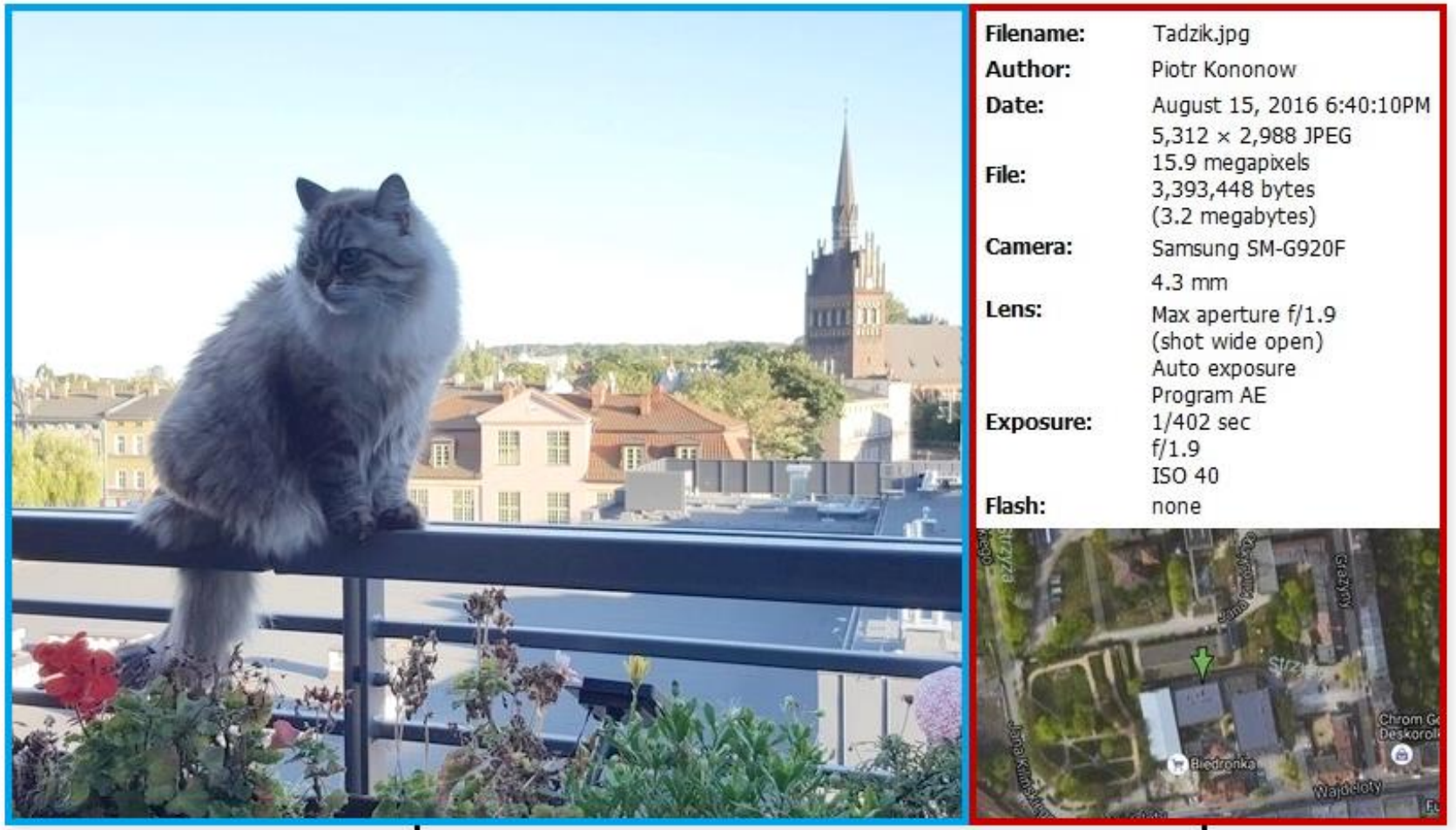
4. ***Data standard:*** *A commonly agreed specification on how data should be recorded and described. A technical document designed to use for operating with geospatial data in order to facilitate developing, sharing and using GIS data, GIS software and GIS services.*

5. ***Geospatial interoperability:*** *The ability of different geographic information systems to share, exchange, and operate (heterogenous) geospatial data and functions.*

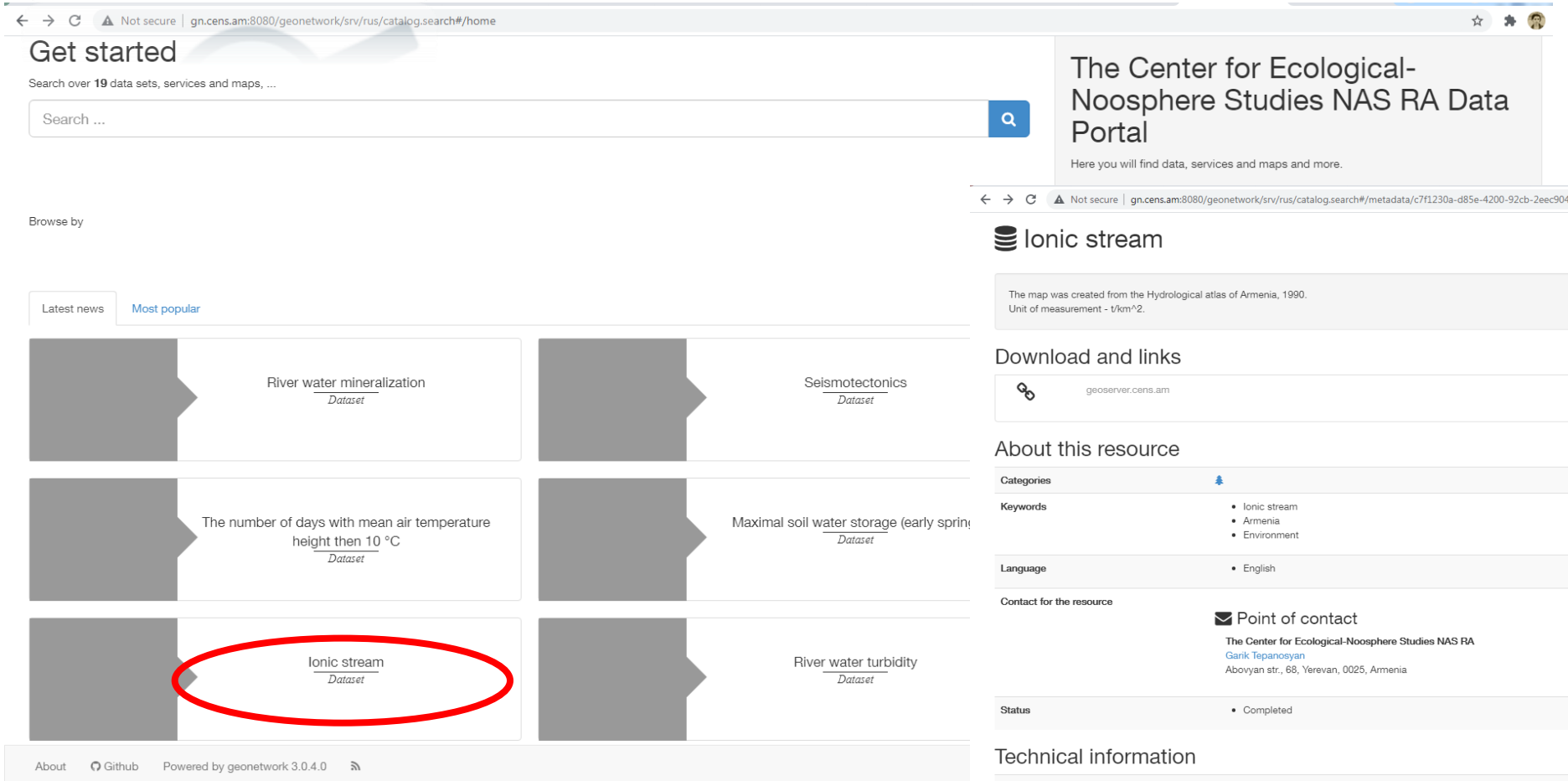
6. ***Web service:*** *A Web application that provides standardized application programming interfaces to allow remote access to data and functions over the Internet.*

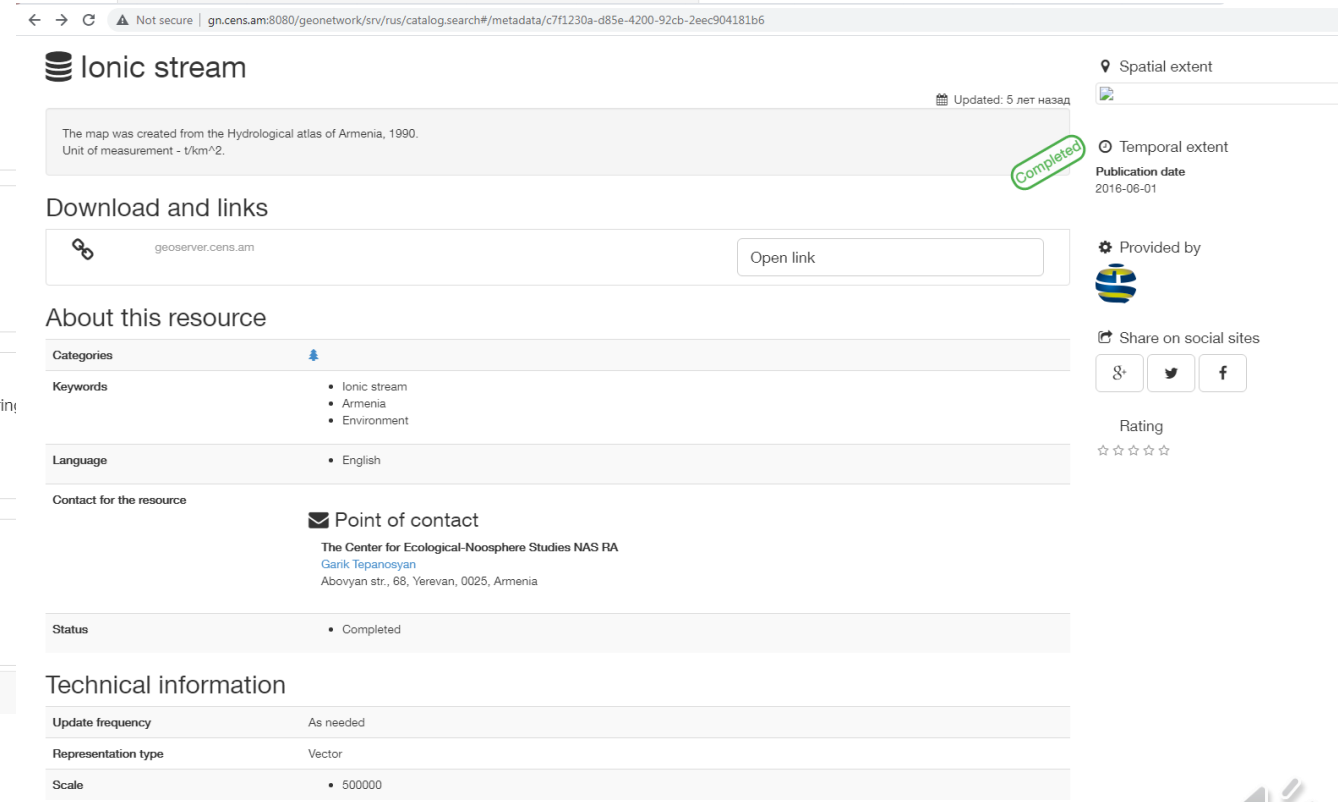
Hu, Y. & Li, W. (2017). "Spatial Data Infrastructures", The Geographic Information Science & Technology Body of Knowledge, John P. Wilson (ed.).
http://dx.doi.org/10.22224/gistbok/2017.2.1

A *DOCUMENTATION ABOUT* ***WHO, WHEN, HOW, WHAT, WHY, AND MANY OTHER FACETS*** *OF THE DATA AND THE DATA PRODUCTION PROCESS.*



A *DOCUMENTATION ABOUT* ***WHO, WHEN, HOW, WHAT, WHY, AND MANY OTHER FACETS*** *OF THE DATA AND THE DATA PRODUCTION PROCESS.18*





Source: http://gn.cens.am:8080/geonetwork/srv/rus/catalog.search#/home

A *DOCUMENTATION ABOUT* ***WHO, WHEN, HOW, WHAT, WHY, AND MANY OTHER FACETS*** *OF THE DATA AND THE DATA PRODUCTION PROCESS.18*

Data Set Attribute	Attribute Value
Landsat Product Identifier	LC08_L1TP_169032_20210824_20210831_01_T1
Landsat Scene Identifier	LC81690322021236LGN00
Acquisition Date	2021/08/24
Collection Category	T1
Collection Number	1

Data Set Attribute	Attribute Value
Landsat Product Identifier	LC08_L1TP_169032_20210824_20210831_01_T1
Landsat Scene Identifier	LC81690322021236LGN00
Acquisition Date	2021/08/24
Collection Category	T1
Collection Number	1
WRS Path	169
WRS Row	032
Target WRS Path	169
Target WRS Row	032
Nadir/Off Nadir	NADIR
Roll Angle	-0.001
Date L-1 Generated	2021/08/31
Start Time	2021:236:07:37:44.0166520
Stop Time	2021:236:07:38:15.7866510
Station Identifier	LGN
Day/Night Indicator	DAY
Land Cloud Cover	17.92
Scene Cloud Cover	17.92
Ground Control Points Model	267

Source: https://earthexplorer.usgs.gov/

Geospatial data are difficult to integrate

incompatibilities
(formats, models, ...)

missing documentation
(metadata)

data fragmentation
data replication

data policies

Key Standards Development Organizations for Geospatial Information

International Organization for Standardization

OGC®
Open Geospatial Consortium, Inc.

Technical committee 211 Geographic information/Geomatics

Both international standards organizations have representative members from government, industry, research, and academia who arrive at decisions through a consensual process. The organizations develop, maintain and make publicly available open standards that enable the ability to publish, discover, access, manage and use geospatial information across a range of applications, systems and business enterprises. These organizations all employ processes and approaches which ensure the development of international open standards that meet the characteristics described above.

Open Geospatial Consortium – http://www.ogc.org
ISO/TC211 - https://www.iso.org/committee/54904.html

OGC®
Open Geospatial Consortium, Inc.

ISO International Organization for Standardization

Web Mapping Service (WMS)
HTTP protocol for publishing a collection of layers as a map (PNG, JPEG)

→ ISO 19128:2005 – Web mapping Service

Data

Web Feature Service (WFS)
HTTP protocol for publishing feature collections that may be queried and updated by clients (features published as GML,…)

→ ISO 19142:2010 - Web Feature Service

Web Coverage Service (WCS)
HTTP protocol for publishing "coverages" (multi-band raster data) that can be accessed by clients (GeoTiff, HDF)

→ ISO 19123:2005 - Schema for coverage geometry and functions

Metadata

Catalog Services for the Web (CS-W)
Defines several web interfaces for data discovery

→ ISO 19115:2003 , ISO/TS 19139:2007 - Geographic information — Metadata

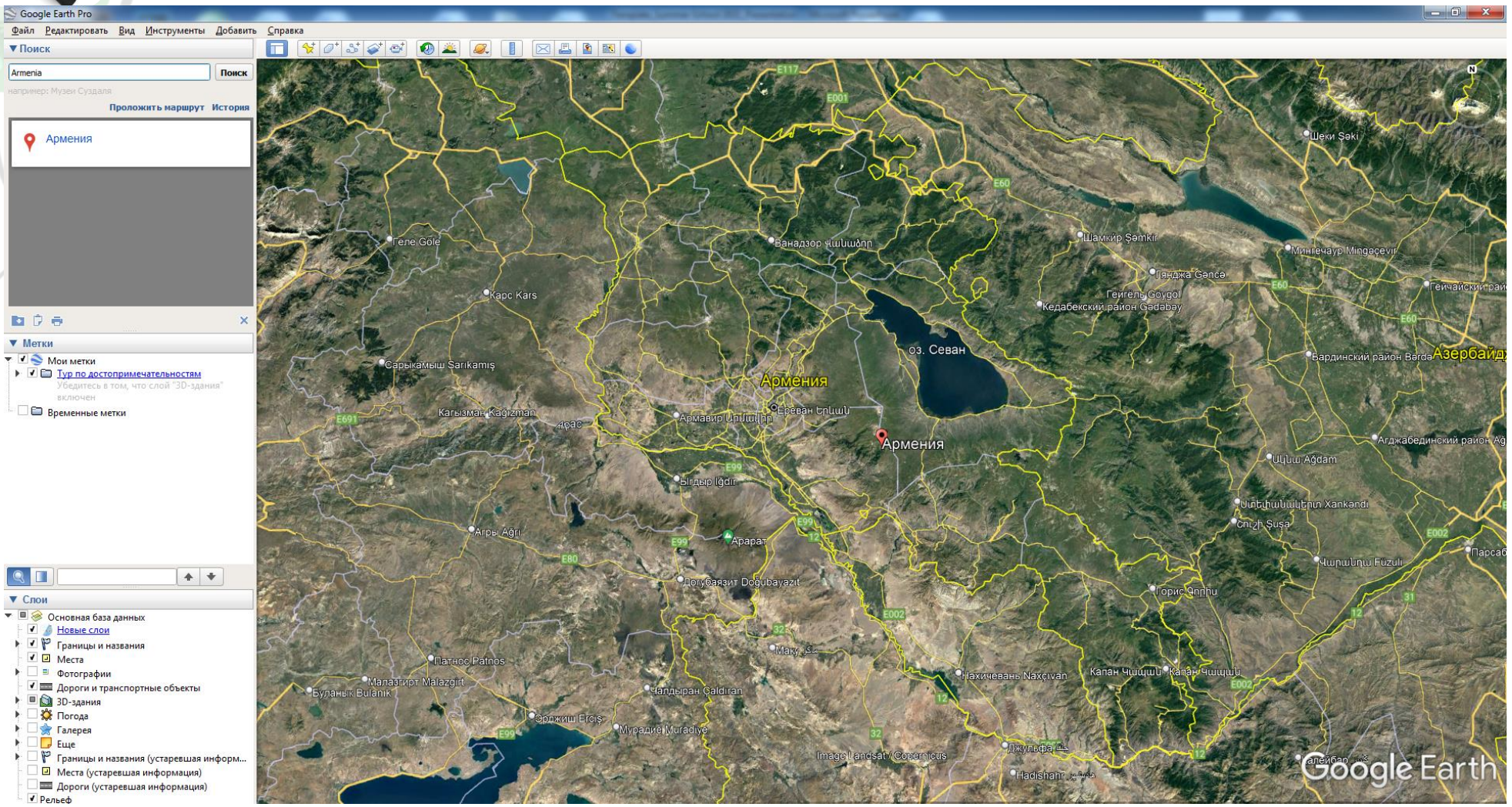
Processing

Web Processing Service (WPS)
Defines an interface to share geoprocessing algorithms

→ ISO 19119:2016(en), Geographic information — Services

GEOPORTAL

A type of web portals used to find and access geographic information and associated services (display, analysis, editing, etc) via the Internet.



Source: Tait, M. G. (2005) Implementing geoportals: applications of distributed GIS. Computers, Environment and Urban Systems, 29, 33-47.

GEOPORTAL

A type of web portals used to find and access geographic information and associated services (display, analysis, editing, etc) via the Internet.

Not secure | gs.cens.am:8081/geoserver/web/?wicket:bookmarkablePage=:org.geoserver.web.demo.MapPreviewPage

GeoServer for OpenGeo Suite

Имя пользователя | Запомнить меня | Войти

Инфа и статус
О GeoServer
Данные
Просмотр слоев
Демо
Powered by Boundless

Просмотр слоев

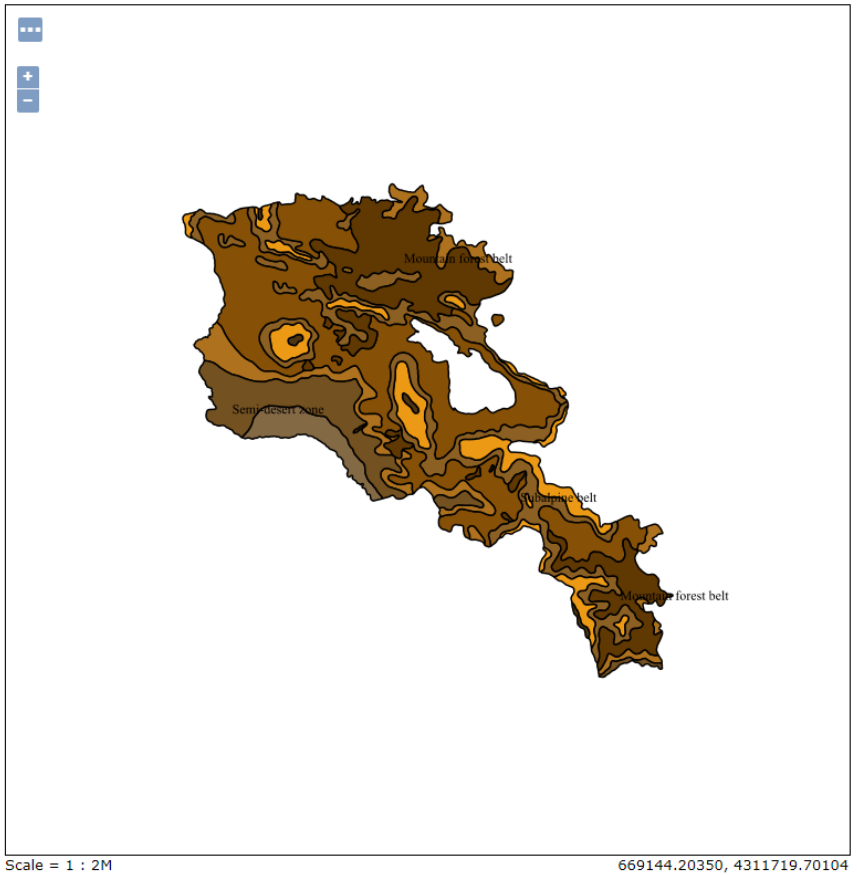
Список всех слоев настроеных в GeoServer и предварительный просмотр в различных форматах для каждого слоя.

<< < 1 2 > >> Показаны с 1 по 25 (из 31 элементов) | Поиск

Тип	Имя	Заголовок	Общие форматы	Все форматы
	Armenia:Absolute air humidity	Absolute air humidity	OpenLayers KML GML	Выберите
	Armenia:Absolute air temperature (max)	Absolute air temperature (max)	OpenLayers KML GML	Выберите
	Armenia:Absolute air temperature (min)	Absolute air temperature (min)	OpenLayers KML GML	Выберите
	Armenia:Administrative divisions of RA	Administrative divisions of RA	OpenLayers KML GML	Выберите
	Armenia:Agroclimatic_zonning	Agroclimatic_zonning	OpenLayers KML GML	Выберите
	Armenia:Annual amount of precipitation	Annual amount of precipitation	OpenLayers KML GML	Выберите
	Armenia:Annual potential evapotranspiration	Annual potential evapotranspiration	OpenLayers KML GML	Выберите
	Armenia:Average_annual_runoff_of_rivers	Average_annual_runoff_of_rivers	OpenLayers KML GML	Выберите
	Armenia:Density of river network	Density of river network	OpenLayers KML GML	
	Armenia:Drought	Drought	OpenLayers KML GML	
	Armenia:Humidification_index	Humidification_index	OpenLayers KML GML	
	Armenia:Ionic stream	Ionic stream	OpenLayers KML GML	
	Armenia:Kaj_bean_pot_sp_2017	Kaj_bean_pot_sp_2017	OpenLayers KML GML	
	Armenia:Maximal soil water storage (early spring)	Maximal soil water storage (early spring)	OpenLayers KML GML	
	Armenia:Medical climatic zonning	Medical climatic zonning	OpenLayers KML GML	
	Armenia:Natural_zones	Natural_zones	OpenLayers KML GML	Выберите
	Armenia:Physico-geographical_regions	Physico-geographical_regions	OpenLayers KML GML	Выберите

WMS
AtomPub
GIF
GeoRSS
GeoTiff
GeoTiff 8 бит
JPEG
KML (обычный)
KML (сетевая ссылка)
KML (сжатый)
MBTiles
OpenLayers
PDF
PNG
PNG 8 бит
SVG
TIFF
Tiff 8 бит
Геопакет

Not secure | gs.cens.am:8081/geoserver/Armenia/wms?service=WMS&version=1.1.0&request=GetMap



Scale = 1 : 2M

669144.20350, 4311719.70104

Natural_zones

fid	OBJECTID	Id	Zones	Shape_Leng	Ô²Õ¸Õ¿Õ«Õ¶	ÐŸÐ¾ÑÑÐ°	Shape_Le_1	Shape_
Natural_zones.16	79	0	Upland steppe belt	1315665.29348	Ô¼Õ¥Õ¼Õ¶Õ¡-Õ¿Õ¡Õ°Õ¡Õ½Õ¿Õ¶Õ¡Õ¶Õ« Õ£Õ¸Õ¿Õ«	ÐÐ²Ð¾ÑÐ¾Ð¼-ÑÑ, ÐµÐ¿Ð¼ÐºÐ¹ Ð¿Ð¾ÑÑ	1315665.29348	6.22042125

Source: http://geoserver.cens.am

GEOPORTAL

A type of web portals used to find and access geographic information and associated services (display, analysis, editing, etc) via the Internet.

sustainable-caucasus.unepgrid.ch/layers/?limit=20&offset=0&fbclid=IwAR1IRP8LGioAFLbw-qdwdZDR-hjslcQgYKHpYKo1u7En1Pv2_EqdNNhzmt4

Data Карты Инфо

Посмотреть слои

Selected Layers

Add layers through the "checkboxes".

Создать карту

Filters Очистить

ТЕКСТ

Search by text

КЛЮЧЕВЫЕ СЛОВА

ТИП

Raster Layers 38

Vector Layers 94

Remote Layer 1

КАТЕГОРИИ

OWNERS

ГРУППЫ

GROUP CATEGORIES

ДАТА

132 Layers found

Data Карты Инфо Поиск Регистрация Подписаться

Global forest height 2019 for Caucasus Ecoregion

Скачать слой

Metadata Detail

View Layer

Скачать метаданные

Легенда

Forest Height 2019 for Caucasus Ecoregion (in meters)

3 m
4 m
5 m
6 m
7 m
8 m
9 m
10 m
11 m
12 m
13 m
14 m
15 m
16 m
17 m
18 m
19 m
20 m
21 m

Информация Атрибуты Поделиться Оценки Комментарии

Заголовок	Global forest height 2019 for Caucasus Ecoregion
Лицензия	Public Domain (PD)
Аннотация	Global 30-m spatial resolution forest canopy height map developed through the integration of the Global Ecosystem Dynamics Investigation (GEDI) lidar forest structure measurements and Landsat analysis-ready data time-series, subsampled within Caucasus Ecoregion boundaries. Pixel values: 0-60 Forest canopy height, meters; 101 Water; 102 Snow/ice; 103 No data. https://glad.umd.edu/dataset/gedi
Publication Дата	8 мая 2021 г. 14:27
Тип	Raster Data
Ключевые слова	Forest_height_2019_NAFR_Caucasus_Ecoregion , GeoTIFF , WCS
Категория	Environment

Source: https://sustainable-caucasus.unepgrid.ch/

GEOPORTAL

A type of web portals used to find and access geographic information and associated services (display, analysis, editing, etc) via the Internet.

ace.aua.am/vector-database-armenia-file-overview/

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Vector Database Armenia – File Overview

Home / Vector Database Armenia – File Overview

Folder	File Name	Description	Type	File Size
Administrative		*Administrative boundaries of Armenia*	*Folder*	*1191kb*
	Aragatsotn_Marz	Shape of Aragatsotn marz (federal state) in Armenia	Polygon	11kb
	Ararat_Marz	Shape of Ararat marz (federal state) in Armenia	Polygon	13kb
	Armavir_Marz	Shape of Armavir marz (federal state) in Armenia	Polygon	13kb
	Armenia_Border_line	Borders of the country of Armenia	Line	200kb
	Armenia_Border_poly	Shape of the country of Armenia	Polygon	201kb

https://ace.aua.am/vector-database-armenia-file-overview/

GEOPORTAL

A type of web portals used to find and access geographic information and associated services (display, analysis, editing, etc) via the Internet.

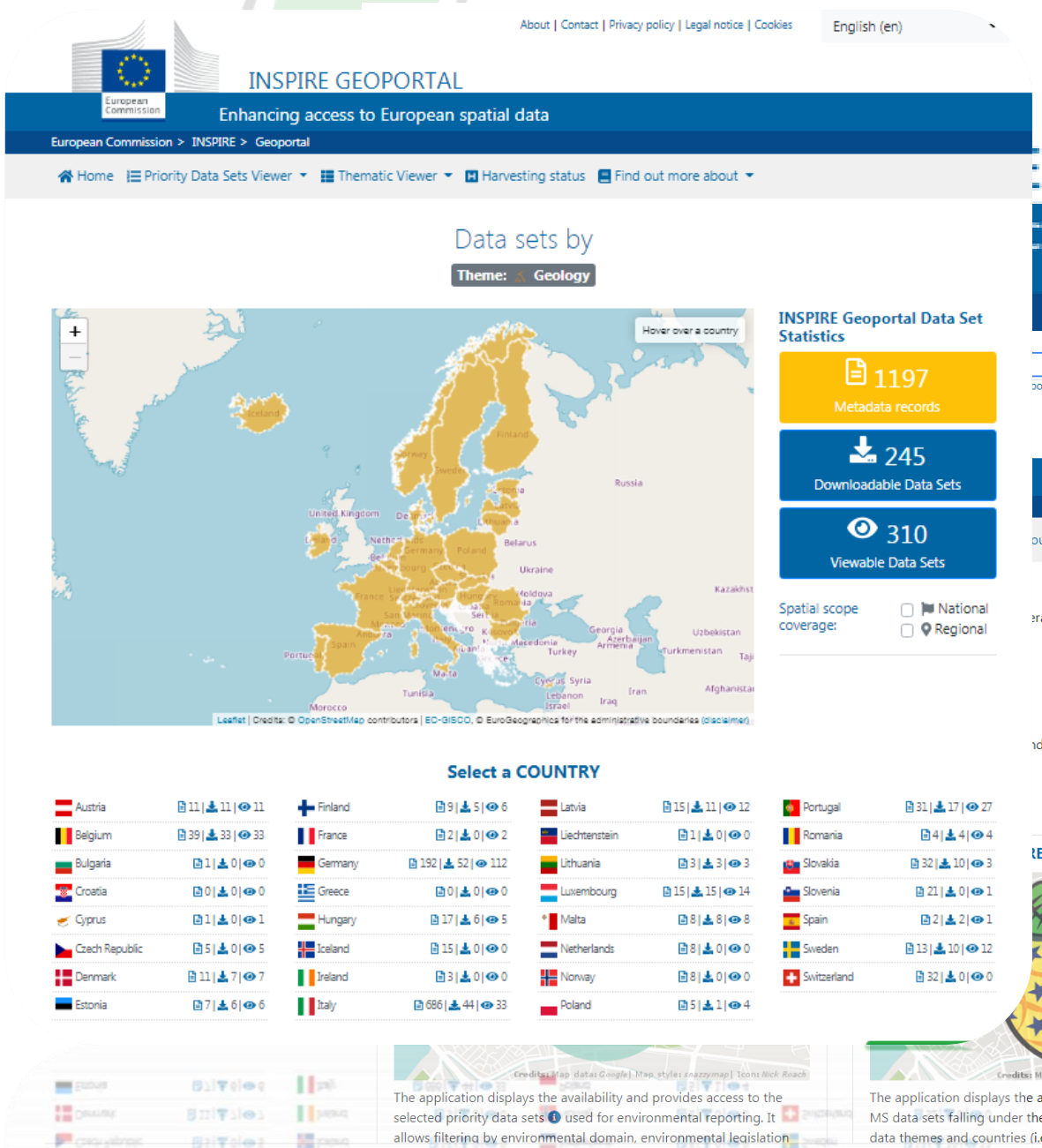
- NSDI of France http://www.geoportail.gouv.fr/actualites
- NSDI of the Poland http://geoportal.gov.pl/
- NSDI of Moldova http://www.geoportal.md/
- NSDI of Nepal http://nationalgeoportal.gov.np/#/

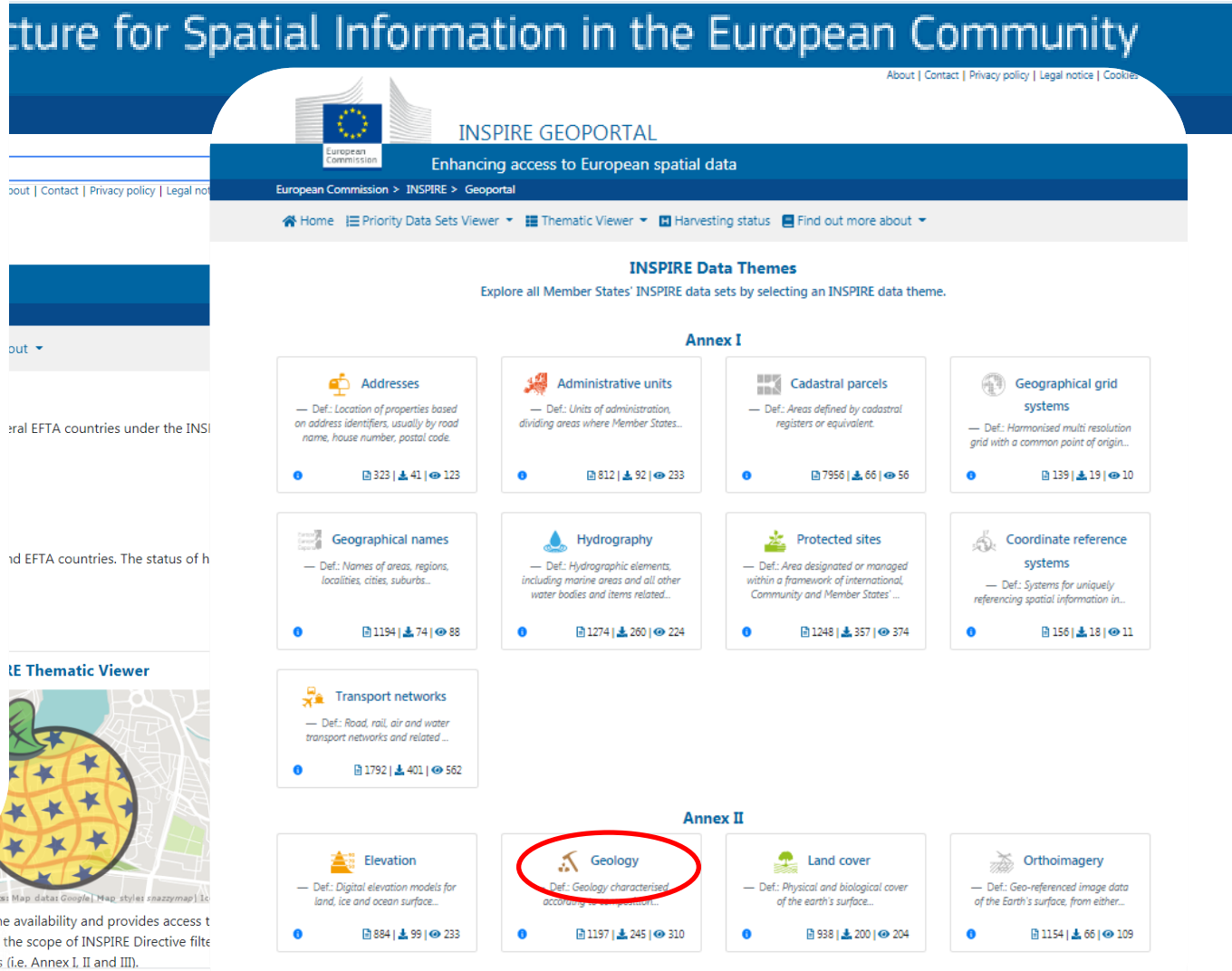
USGS science for a changing world

SDI of US Geological Survey
http://earthexplorer.usgs.gov/
http://www.usgs.gov/pubprod/

https://www.youtube.com/watch?v=xew6qI-6wNk

Source: https://inspire-geoportal.ec.europa.eu/

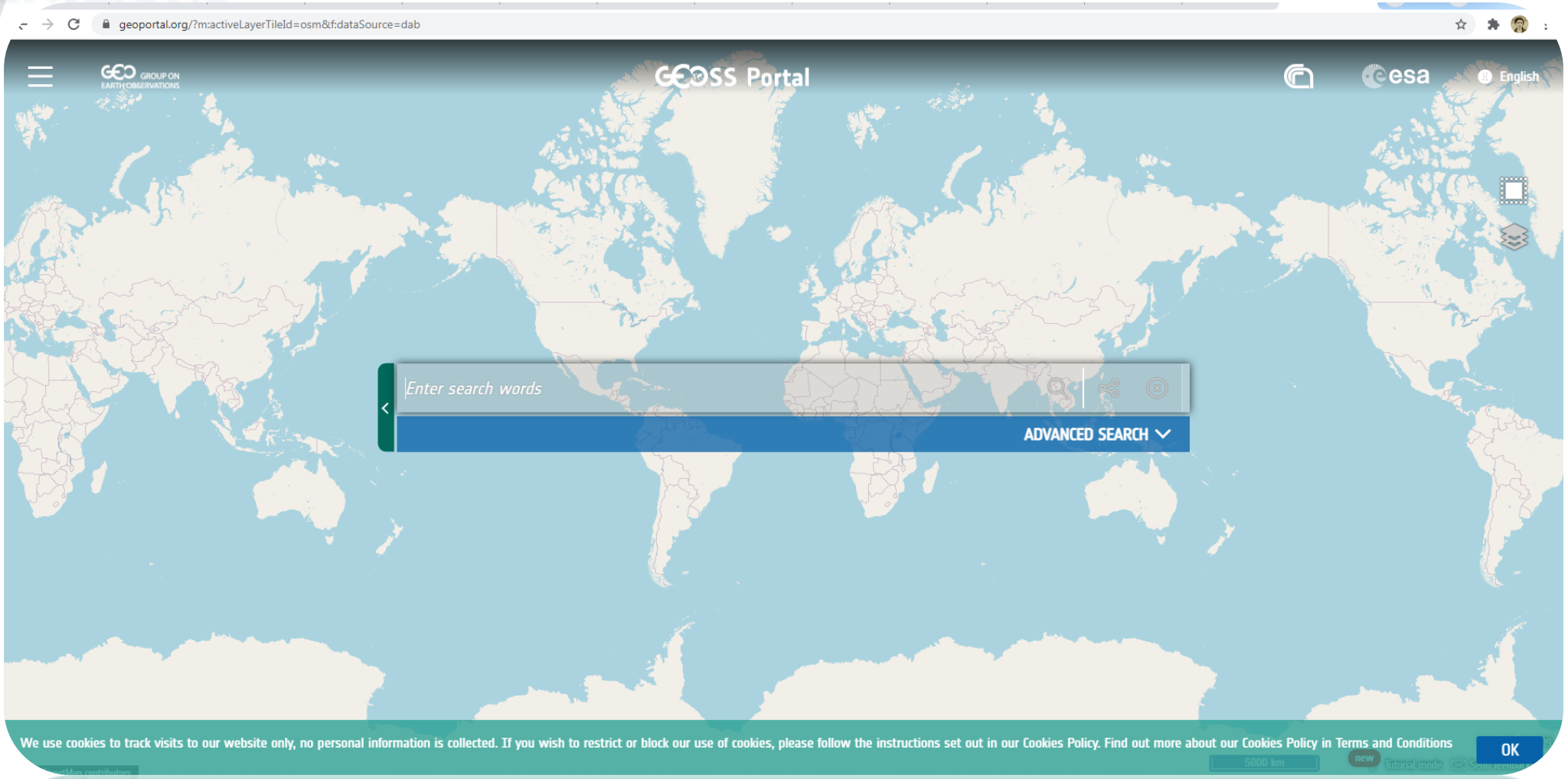




Source: https://inspire-geoportal.ec.europa.eu/

GEO Community

GEO is a partnership of more than 100 national governments and in excess of 100 Participating Organizations that envisions a future where decisions and actions for the benefit of humankind are informed by coordinated, comprehensive and sustained Earth observations.



https://earthobservations.org/geo_community.php; https://www.geoportal.org/

GROUP ON EARTH OBSERVATIONS

GEO Community
GEO is a partnership of more than 100 national governments and in excess of 100 Participating Organizations that envisions a future where decisions and actions for the benefit of humankind are informed by coordinated, comprehensive and sustained Earth observations.

GEO Secretariat Directors

Dr. Barbara Rian
1st Director of the GEO Secretariat
Leading years (…)

Dr. Gilberto Camara
2nd Director of the GEO Secretariat
Leading years (…)

Mrs. Yana Gevorgyan
3rd new appointed
Director of the GEO Secretariat

ARMENIA's engagement to GEO

GROUP ON EARTH OBSERVATIONS

EU FP7 EcoArm2ERA

SNSF SCOPES 2009-2012
International cooperation

Datasets are prepared to register into GEOSS

Official negotiations were started with GEO Secretariat

ARMENIA - full member of GEO in 2014

ARMENIA's engagement to GEO

GROUP ON EARTH OBSERVATIONS

ARMENIA in GEO

Stephen Volz,
Lead GEO Co-Chair
Head of the US National Oceanic and Atmospheric Administration (NOAA) Satellite and Information Service,

"From large member governments like the US, China and the European Commission, to smaller economies like Uganda, Ecuador and Armenia, GEO really is a place where all organizations involved in making or using Earth observations can come together on a level playing field.

It really helps to have the perspective of countries with smaller economies, because they have a different view of what is needed, what the urgency is, and what the solution space might be. It helps keep us grounded, as we need to be responsive to all countries - not just the big ones.

Armenia is a great example of a country that comes in and contributes both financially and programatically to the collective success of GEO.

Their voice is important to the community, and they get a lot out of it because they are heard on a peer basis that might not happen for them in another organization."

Dr. Stephen Volz

Source: https://earthobservations.org/geo_blog_obs.php?id=293

LITERATURE

- Spatial Data Infrastructures and the INSPIRE Directive http://www.intergraph.com/global/uk/government/INSPIRE.aspx.

- *Hu, Y. & Li, W. (2017). "Spatial Data Infrastructures", The Geographic Information Science & Technology Body of Knowledge, John P. Wilson (ed.). http://dx.doi.org/10.22224/gistbok/2017.2.1*

- Arnold BREGT and Joep CROMPVOETS Spatial Data Infrastructures: Hype or Hit? http://www.fig.net/pub/cairo/papers/ts_36/ts36_01_bregt_crompvoets.pdf.

- Steiniger, S., and Hunter, A.J.S. (2012) preprint "Free and open source GIS software for building a spatial data infrastructure". In E. Bocher and M. Neteler (eds): *Geospatial Free and Open Source Software in the 21st Century: Proceedings of the first Open-Source Geospatial Research Symposium*, 2009, LNG&C, Springer, Heidelberg, pp. 247-261.

- Global Spatial Data Infrastructure Organisation - The SDI Cookbook.

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Thank you for your kind attention!

Dr. Shushanik Asmaryan

The deputy Director for Science of CENS,

Head of GIS and remote sensing department

Lecturer at "Environmental Protection and Nature Management" department of ISEC

E-mail: shushanik.asmaryan@cens.am

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