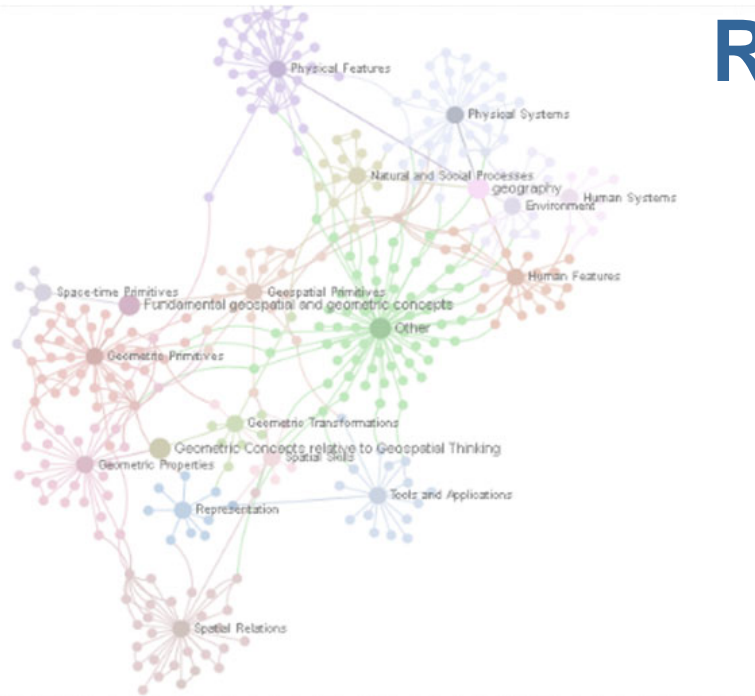




GEOTHNK Summer School
July 5th – July 10th, 2015
Attica Greece

Resources and Tools for Enhancing Spatial Thinking



Margarita Kokla

Lecturer

School of Rural and Surveying Engineering
National Technical University of Athens



Lifelong
Learning
Programme

European Commission
Education, Audiovisual and Culture Executive Agency (EACEA)
Managing programmes and activities on behalf of the European Commission
Unit P1 - Lifelong Learning: Comenius, ICT, Languages and Programme Coordination

Outline

- Spatial thinking and its importance
- Motivation behind the GEOTHNK approach
- Resources for spatial teaching and learning
- Examples of teaching scenarios for enhancing spatial thinking

What is spatial thinking?

(Spatial Literacy Program, University of Redlands)

*“the confident and competent use of **maps, mapping and spatial perspectives** to address **ideas, situations and challenges**. The ability to visualize and interpret **location, distance, direction, relationships, movement and change** through space is fundamental to **content understanding and problem solving**”.*

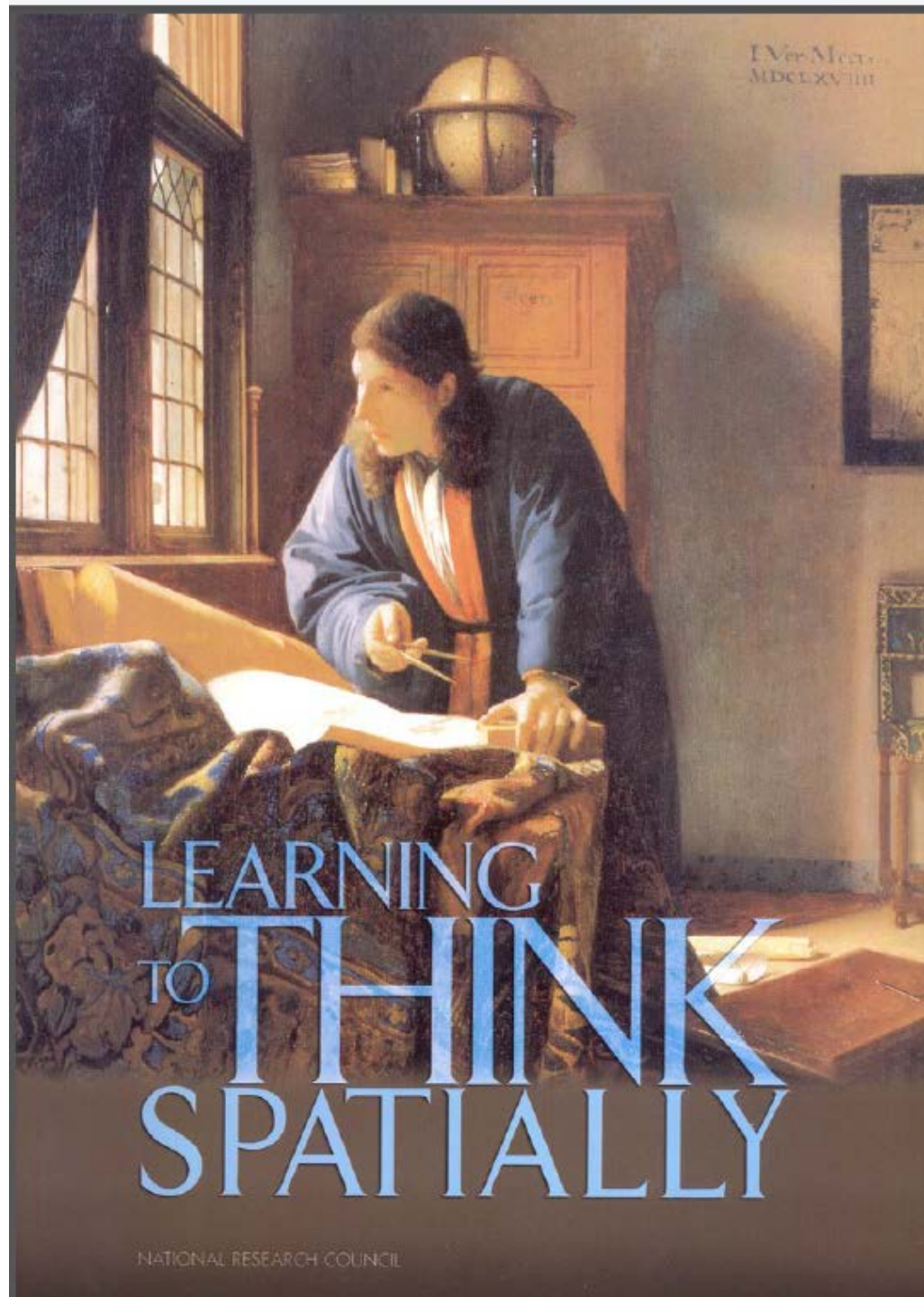
*“**Learning to think spatially is a form of learning how to learn**”*

Spatial thinking

- key ability for the *STEM disciplines*:
 - **increasing the participation in STEM disciplines**
 - **vital talent for achieving STEM innovation**: 90% of STEM doctorate holders scored in the top quartile of spatial ability during adolescence.
- highly relevant to *social sciences and humanities*
- critical for several tasks required in *daily life*, such as giving and following directions, navigating in known and unknown spaces, and interpreting images, graphs, and diagrams.

"without explicit attention to [spatial literacy], we cannot meet our responsibility for equipping the next generation of students for life and work in the 21st century".

National Research Council, 2006.
"Learning to Think Spatially: GIS as a Support System in the K-12 Curriculum",
<http://www.nap.edu/catalog/11019.html>



Components of spatial thinking

(US National Research Council, 2006)

1. **Spatial concepts** (e.g., location, distance / proximity, elevation, etc.)
2. **Representation tools** (e.g., maps and terrain models)
3. **Reasoning processes** (e.g., combining maps and evaluating multiple criteria)

Geospatial thinking in education in Europe

- “At present there is no systematic, European, national or regional, educational agenda to promote GI. *It is rare to find any integration of GI in education or consideration of issues concerned and identified needs*” ...
- “... *most of the activity remains centred largely outside Europe*, developments are very dispersed across different sectors and in different locations” (Donert, 2010).

GEO THINK: why and how

- enhance and integrate the three components of **spatial thinking**: concepts, representation tools, and reasoning tools
- **collect the wealth of resources** available on the web
- provide for their **meaningful, and interdisciplinary association**

GEOTHNK: the result

- over 250 concepts and 770 resources for their explication (provided by GEOTHNK)
- 56 representation tools (provided by GEOTHNK)
- an open set of reasoning tools (provided by users as well)

Concepts

Three types of concepts:

- general concepts
- specific concepts relevant to particular disciplines
- interdisciplinary concepts

Concepts

- general concepts not particularly focused on any specific discipline, such as class, accuracy analysis, and analogy.
- specific concepts relevant to particular disciplines such as Geography, Earth Sciences, Environment, and Mathematics. For example, the concept 'continent' (Fig. 2) is mainly relevant to Geography, the concept 'deforestation' (Fig. 3) to Environment and the concept 'interpolation' to Mathematics (Fig. 4).

General concepts

Concept term

accuracy

Concept definition

the quality of being near to the true value

Resources

[Wikipedia: Accuracy and precision](#)

[MathIsFun: Accuracy and precision](#)

[MathWorld: Accuracy](#)

[NOAA 200th – Surveying: Accuracy vs. Precision](#)

Specific concepts relevant to particular disciplines

Concept term

continent

Concept definition

one of the large landmasses of the earth

Resources

[Encyclopedia Britannica Kids: continent](#)

[Encyclopedia Britannica: continent \(geography\)](#)

[Nations Online Project: Continents of the World](#)

[Wikipedia: continent](#)

Specific concepts relevant to particular disciplines

Concept term

deforestation

Concept definition

the state of being clear of trees

Resources

[eSchoolToday: What is deforestation?](#)

[Kids.mongabay.com: What is deforestation?](#)

[National Geographic: deforestation](#)

[Wikipedia: deforestation](#)

[LiveScience: Deforestation: Facts, Causes & Effects](#)

[University of Michigan - Global Change: Deforestation](#)

Specific concepts relevant to particular disciplines

Concept term

interpolation

Concept definition

(mathematics) calculation of the value of a function between the values already known

Resources

[Encyclopedia Britannica: interpolation](#)

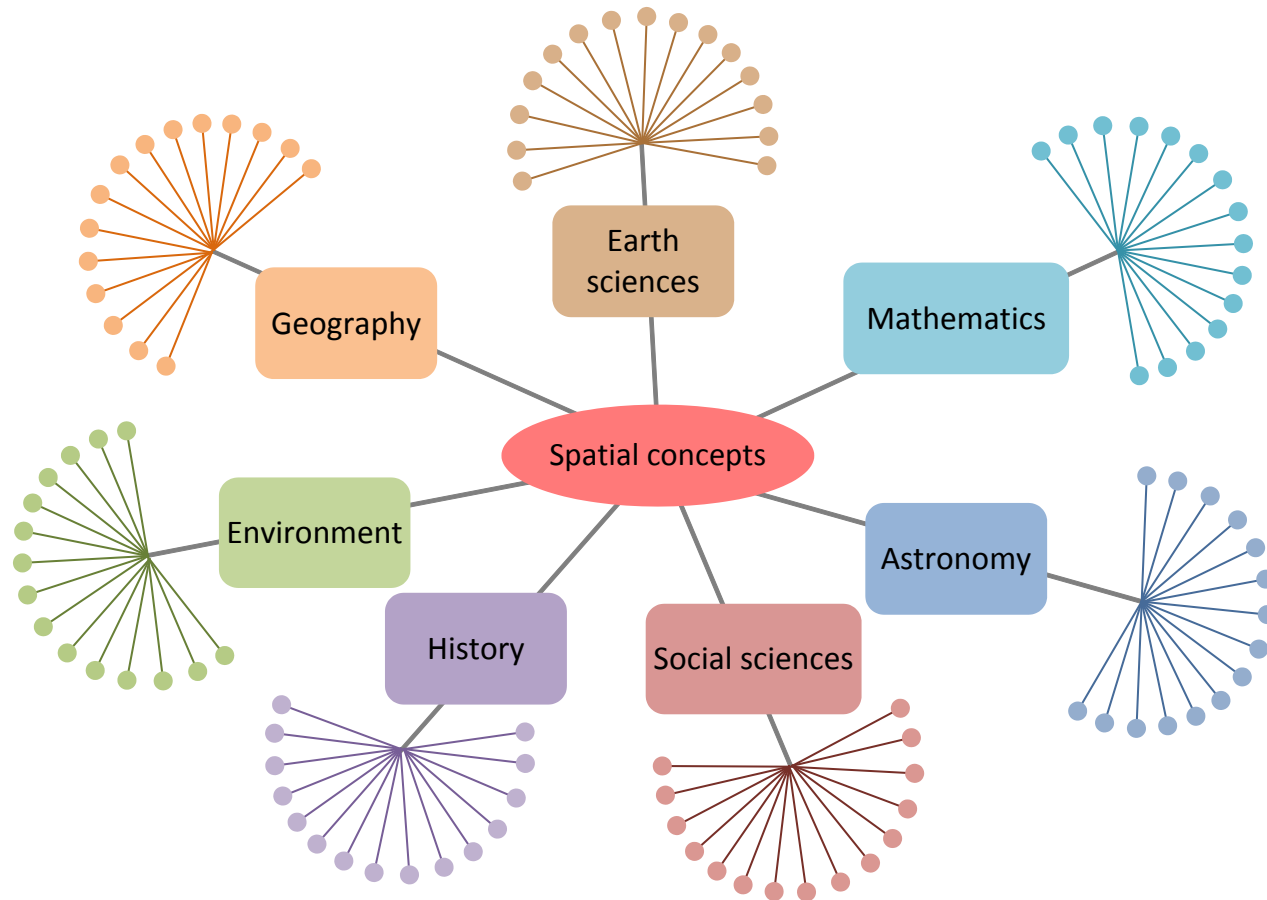
[Encyclopedia of Mathematics: interpolation](#)

[Wolfram MathWorld: interpolation](#)

interdisciplinary concepts

- relevant to several scientific fields that function as a bridge for linking these fields and for developing multifarious scenarios.
- e.g., the concept 'city' may be used for several scenarios dealing with a variety of subjects, such as
 - develop a new city plan,
 - identify major cities and population distribution from satellite images showing night-time lights,
 - study cities in world history and analyze the phenomenon of urban sprawl.

Spatial concepts function as the bridge for linking different disciplines



Resources for Concepts

Concept term

natural resources

Concept definition

resources (actual and potential) supplied by nature

Resources

[Encyclopedia Britannica Kids: Natural Resources](#)

[National Geographic: Natural Resources](#)

[BrainPop: Natural Resources](#)

Resources for Concepts

Concept term

scale

Concept definition

the ratio between the size of something and a representation of it

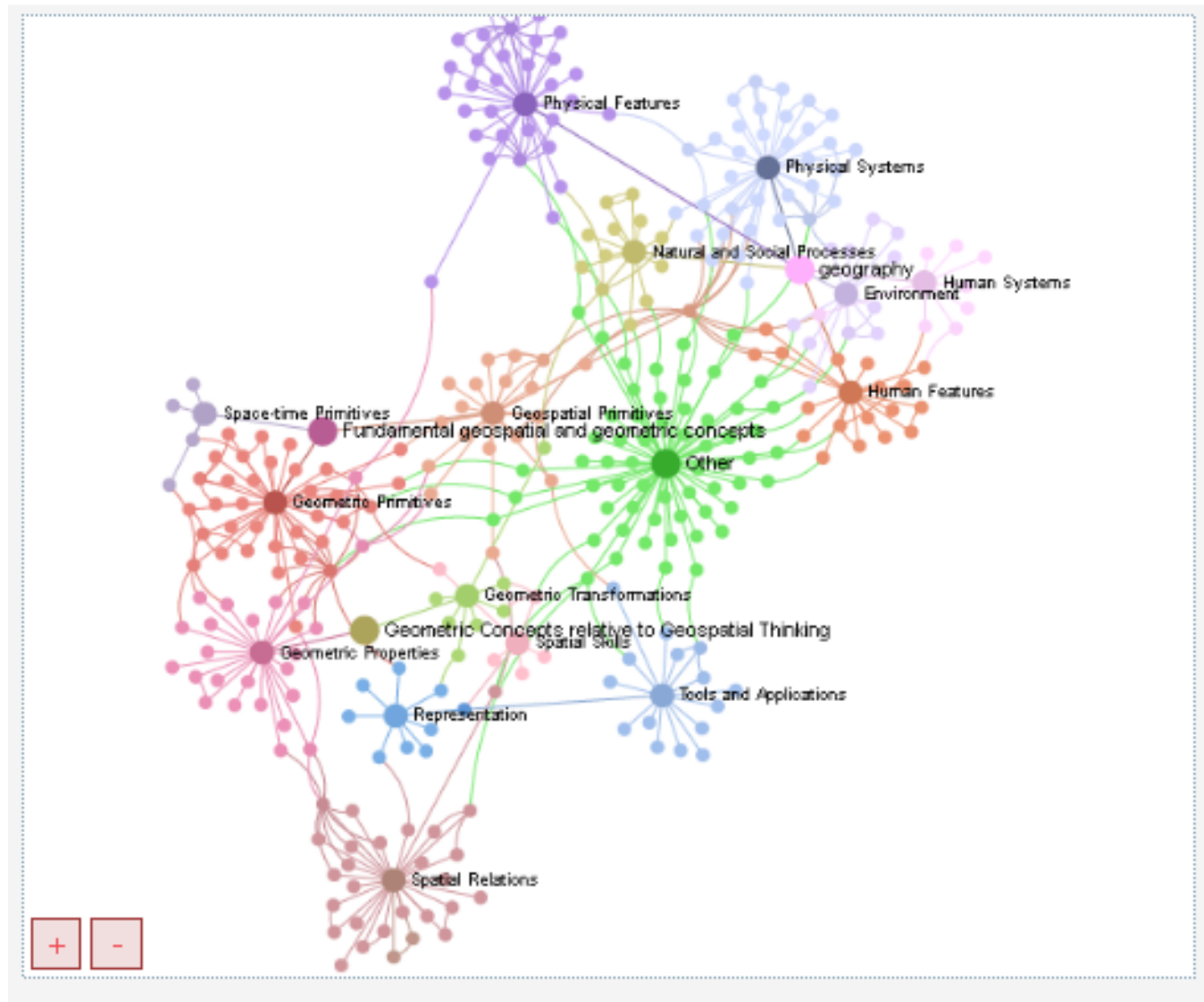
Resources

[KidsGeo – Geography for Kids – Map Scale Types](#)

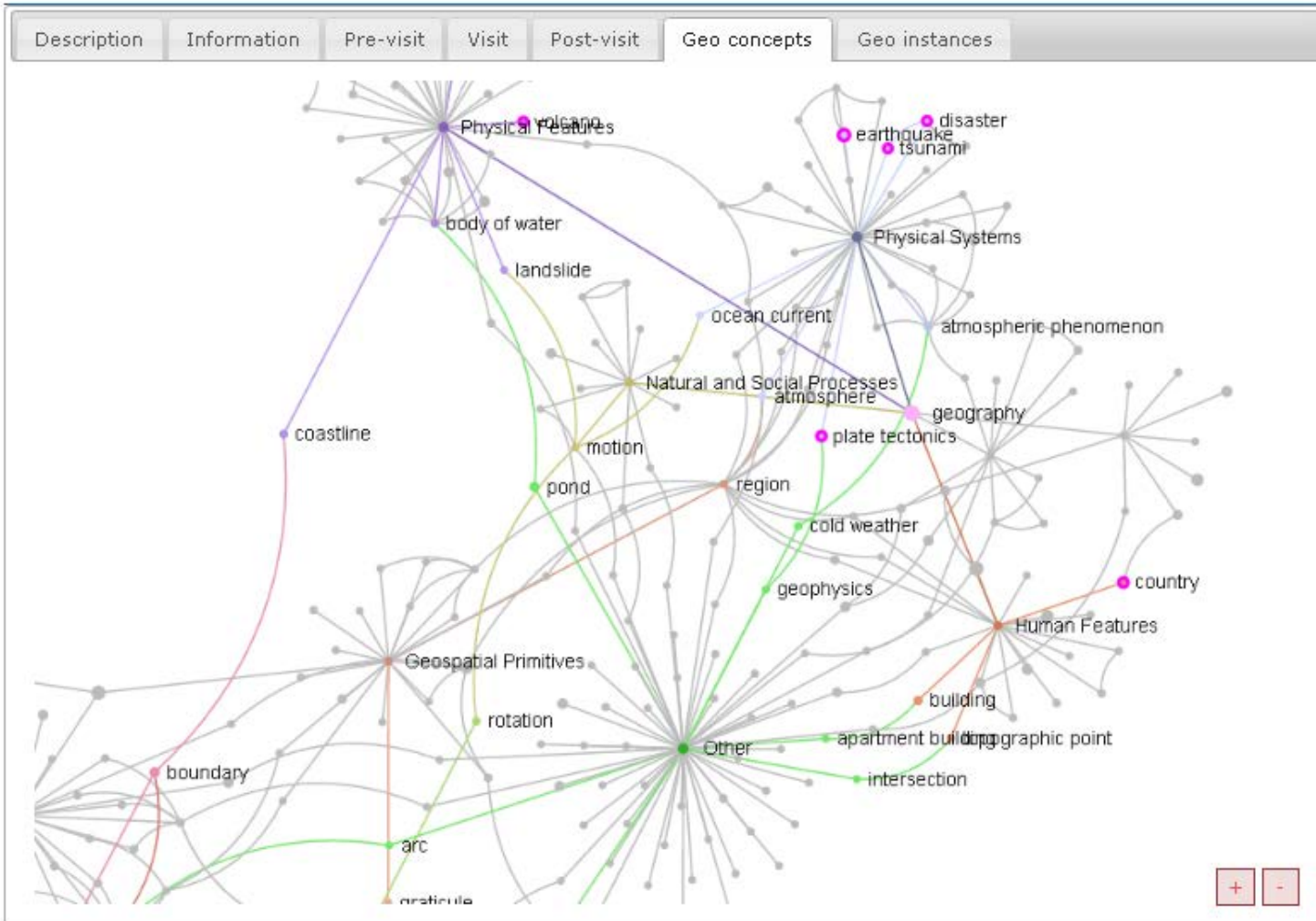
[Ordnance Survey – MapZone – Understanding Scale](#)

[Encyclopedia Britannica: Map scales and classifications](#)

Semantic association of concepts

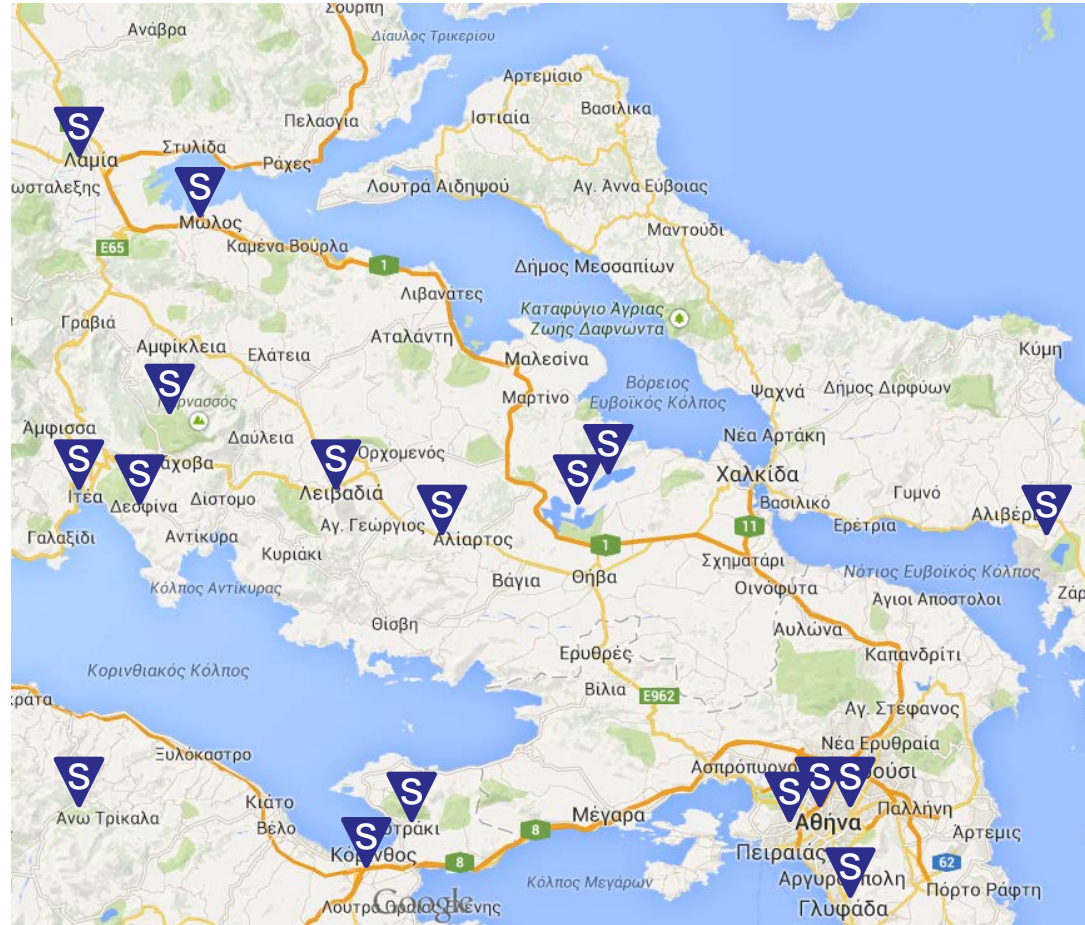


Semantic association of concepts



Instances

- Certain concepts are populated with instances (e.g., cities, rivers, mountains, etc.)
- Gazetteers provide the locations of these instances so as to support the map-based search of the learning pathways: “what scenarios have been created for a specific place or area on a map”?



Example of a gazetteer: geonames

Postal Codes | Download / Webservice | About

Greece ▼

Feature Class:

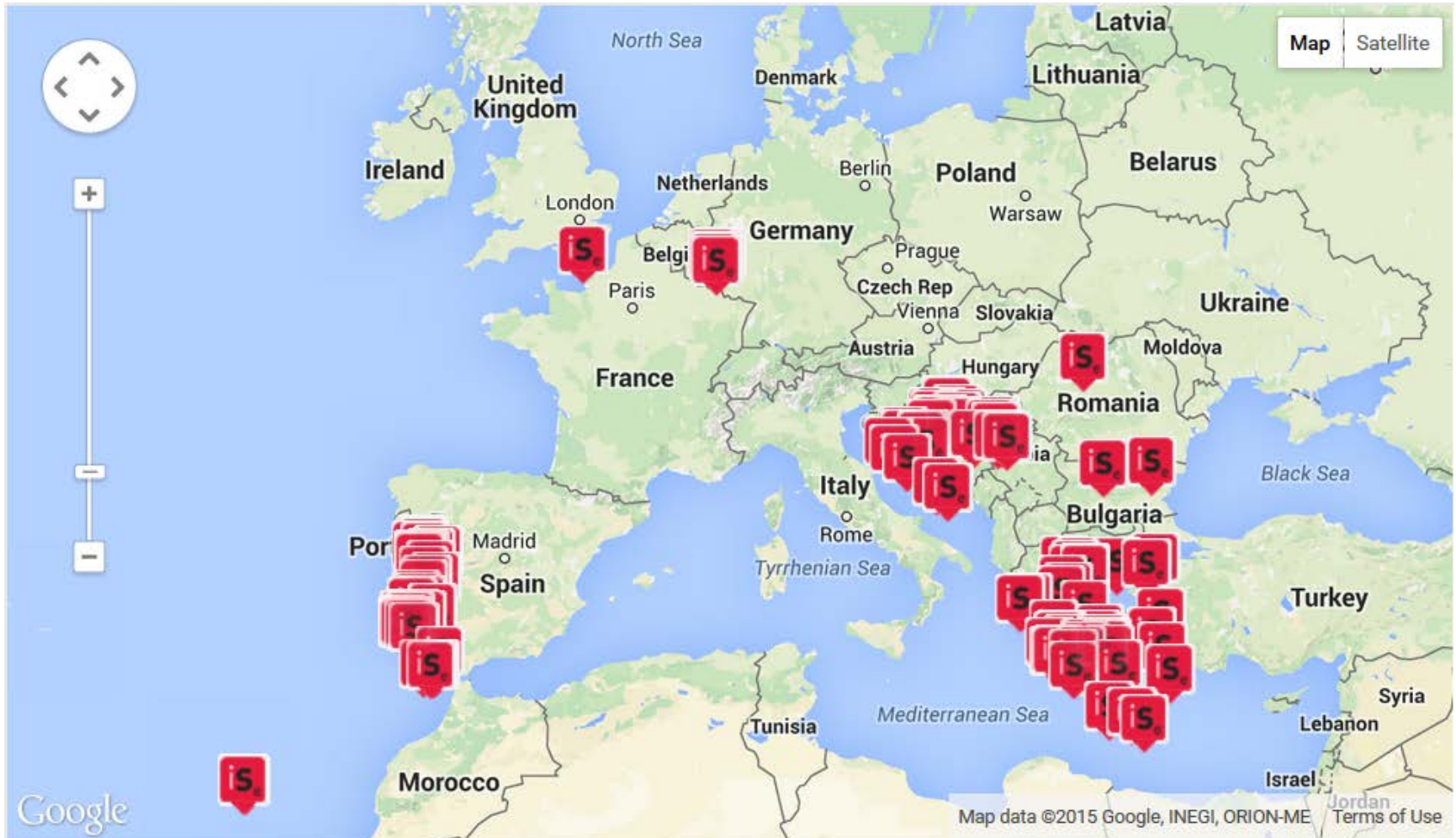
Continent:

fuzzy search :

12916 records found for ""

Name	Country	Feature class	Latitude	Longitude
1 Athens ATH,Afina,Afini,Afiny,An Aithin,Ateena,Atehny,Aten,Atena,Atenai,Atenas,Atenas - Athena,Atenas - Αθήν...	Greece , Attica Nomarchía Athínas > Athens	capital of a political entity population 729,137, elevation 70m	N 37° 58' 46"	E 23° 42' 58"
2 Thessaloniki Ftohomana,Ftohomána,I Protevoussa ton Prosfigon,I Protévoussa ton Prosfígion,Lungsođ ng Thessaloniki,...	Greece , Central Macedonia Thessaloniki > Thessaloniki	seat of a first-order administrative division population 354,290	N 40° 38' 37"	E 22° 55' 51"
3 Piraeus El Pireo,El Pireu,Gorad Pirehj,Il Pireo,Le Piree,Le Pirée,Lo Pireu,Lo Pirèu,O Pireo,Peiraeus,Peiraia...	Greece , Attica Attica	seat of a third-order administrative division population 172,429	N 37° 56' 50"	E 23° 38' 13"
4 Patras Patra,Patrae,Patrai,Patras,Patrasse,Patrasso,Patres,Patrás,Pátra,Pátrai,Pátras,pa te lei,patora,ptrs...	Greece , West Greece Achaea > Patras	seat of a first-order administrative division population 163,360	N 38° 14' 40"	E 21° 44' 4"
5 Heraklion Candia,Candie,Cândia,Erakleion,HER,Heracleum,Heracíaio,Heracليون,Heracião,Heracião,Heracleion,Hera...	Greece , Crete Irákleion > Heraklion	seat of a first-order administrative division population 137,154	N 35° 19' 40"	E 25° 8' 36"
6 Kallithea Kalitea,Kaliteja,Kalitheá,Kalitheá,Kaliteja,Kallifeja,Kalliteja,Kallithea,Kallitheá,kalythya,kalyth...	Greece , Attica Nomarchía Athínas > Kallithea	seat of a third-order administrative division population 107,767	N 37° 57' 0"	E 23° 42' 0"
7 Peristeri Peristeri,Peristeri Attikes,Peristerion,Peristéri,Peristérion,Περιστέρη,Περιστέρη Αττικής,Περιστέριο...	Greece , Attica Nomarchía Athínas > Peristeri	seat of a third-order administrative division population 137,659	N 38° 1' 0"	E 23° 42' 0"
8 Lárisa Larisa,Larissa,Lárisa,Lárisa,Yenisehir,Yenisehir,Λάρισα,Лариса	Greece , Thessaly Lárisa > Larissa	seat of a first-order administrative division population 128,758	N 39° 38' 14"	E 22° 25' 13"
9 Nikaia Nea Kokkinia,Neokokinis,Nikaia,Néa Kokkiniá,Níkaia,Níkaia	Greece , Attica Nomós Piraiós > Nikaia-Agios Ioannis Rentis	seat of a third-order administrative division population 94,608	N 37° 58' 0"	E 23° 39' 0"
10 Kalamaria Kalamaria,Kalamarija,Kalamariá,Kalamaria,Καλαμαριά,Каламария	Greece , Central Macedonia Thessaloniki > Kalamaria	seat of a third-order administrative division population 91,617	N 40° 34' 57"	E 22° 57' 1"
11 Corfu CFU,Corcyra,Corfou,Corfu,Corfú,Corfú,Kerkira,Kerkyra,Korfu,Krf,Kérkira,Kérkyra,kerkira,Kέρκυρα,Κορφυ...	Greece , Ionian Islands Kérkyra > Corfu	seat of a first-order administrative division population 27,003	N 39° 37' 12"	E 19° 55' 11"
12 Ioannina Giannina,IOA,IOaa,Ioanina,Ioannina,Ioánina,Ioánina,Ioáa,Janina,Yanina,Yannina,Yanya,yue a ni na,Iwá...	Greece , Epirus Ioannina > Ioannina	seat of a first-order administrative division population 64,012	N 39° 40' 3"	E 20° 51' 3"
13 Mytilene Kastro,MJT,Metilene,Midilli,Mitilena,Mitilene,Mitileno,Mitilini,Mitilini,Mitiléné,Mitylena,Mitylene,...	Greece , North Aegean Lésvos > Lesbos	seat of a first-order administrative division population 28,322	N 39° 6' 36"	E 26° 33' 17"
14 Komotini Gjumjurdzhina,Guemuelcine,Gumulcine,Gumuljina,Gumuljina,Gümülçine,Komotene,Komotina,Komotinai,Komoti...	Greece , East Macedonia and Thrace Rodópi > Komotini	seat of a first-order administrative division population 45,631	N 41° 7' 9"	E 25° 24' 19"
15 Acharnes Acharnae,Acharnai,Acharne,Acharnes,Akharnai,Akharnai,Menidhi,Menidhion,Menidi,Menidion,Menioi,Menidh...	Greece , Attica Nomarchía Anatolikís Attikís > Acharnes	populated place population 82,376	N 38° 5' 0"	E 23° 44' 0"
16 Chania CHQ,Candia,Canea,Chania,Chanion,Chaniá,Cydonia,Cândia,Hania,Hanio,Hanià,Hanya,Khan'ja,Khania,Khania,...	Greece , Crete Chania > Chania	seat of a second-order administrative division population 54,565	N 35° 30' 40"	E 24° 1' 45"

Map-based search



Representation tools

Categories:

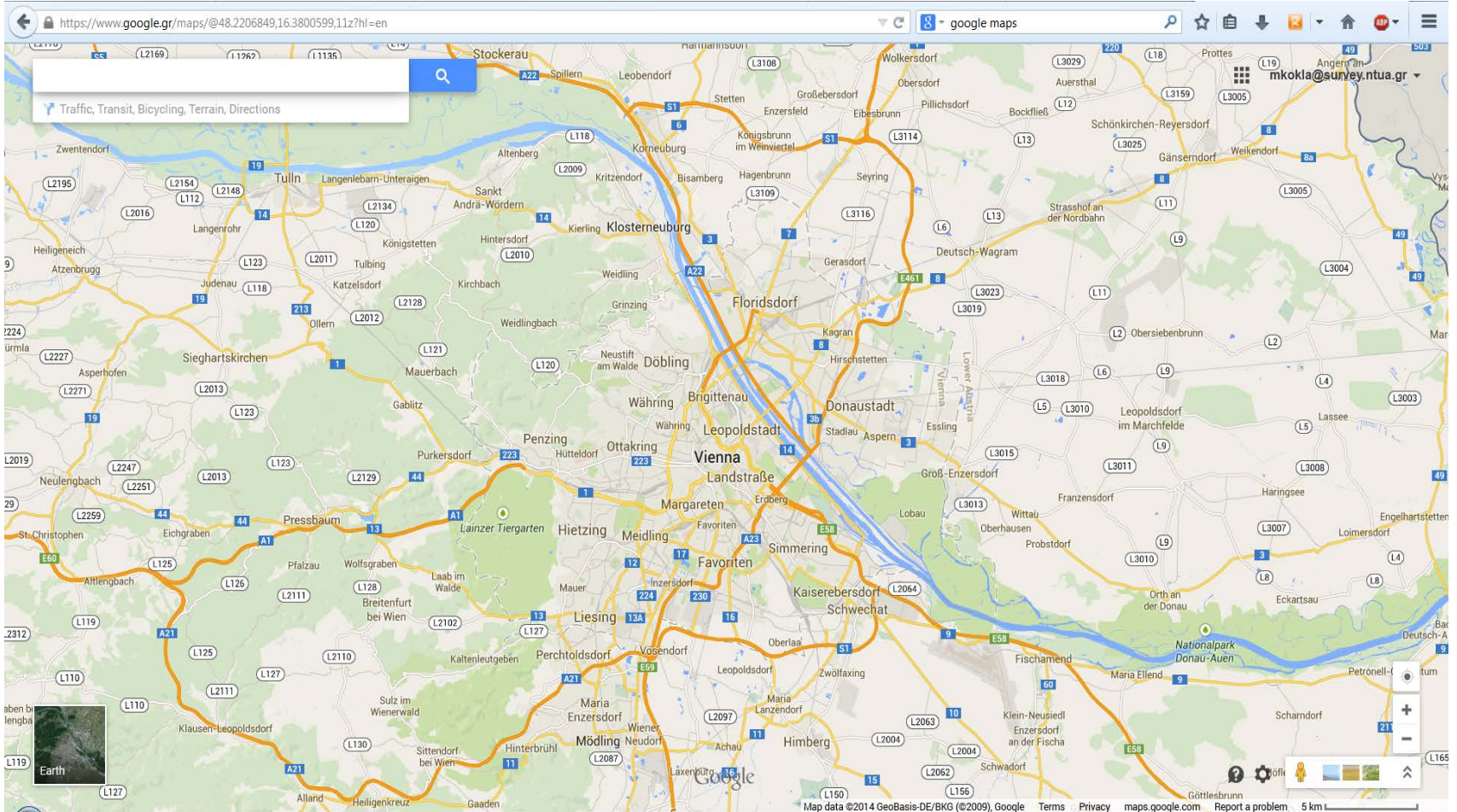
- Maps, Map Viewers, and Map Making
- Country Maps
- Atlases
- Historical maps
- Virtual globes
- Satellite and Areal Imagery
- Data Visualizations
- Models

Maps, Map Viewers, and Map Making

- **online maps and web mapping applications** for:
 - **viewing maps** (e.g., Google Maps, Bing maps, Yahoo! maps, OpenStreetMap, GeoCommons, National Geographic Maps and others) and
 - **making maps** (e.g., MapMaker Interactive)
- **usually offer:**
 - **street maps**
 - **satellite imagery**
 - **3D maps**
 - **street View perspectives**
 - **functions such as a route planning**

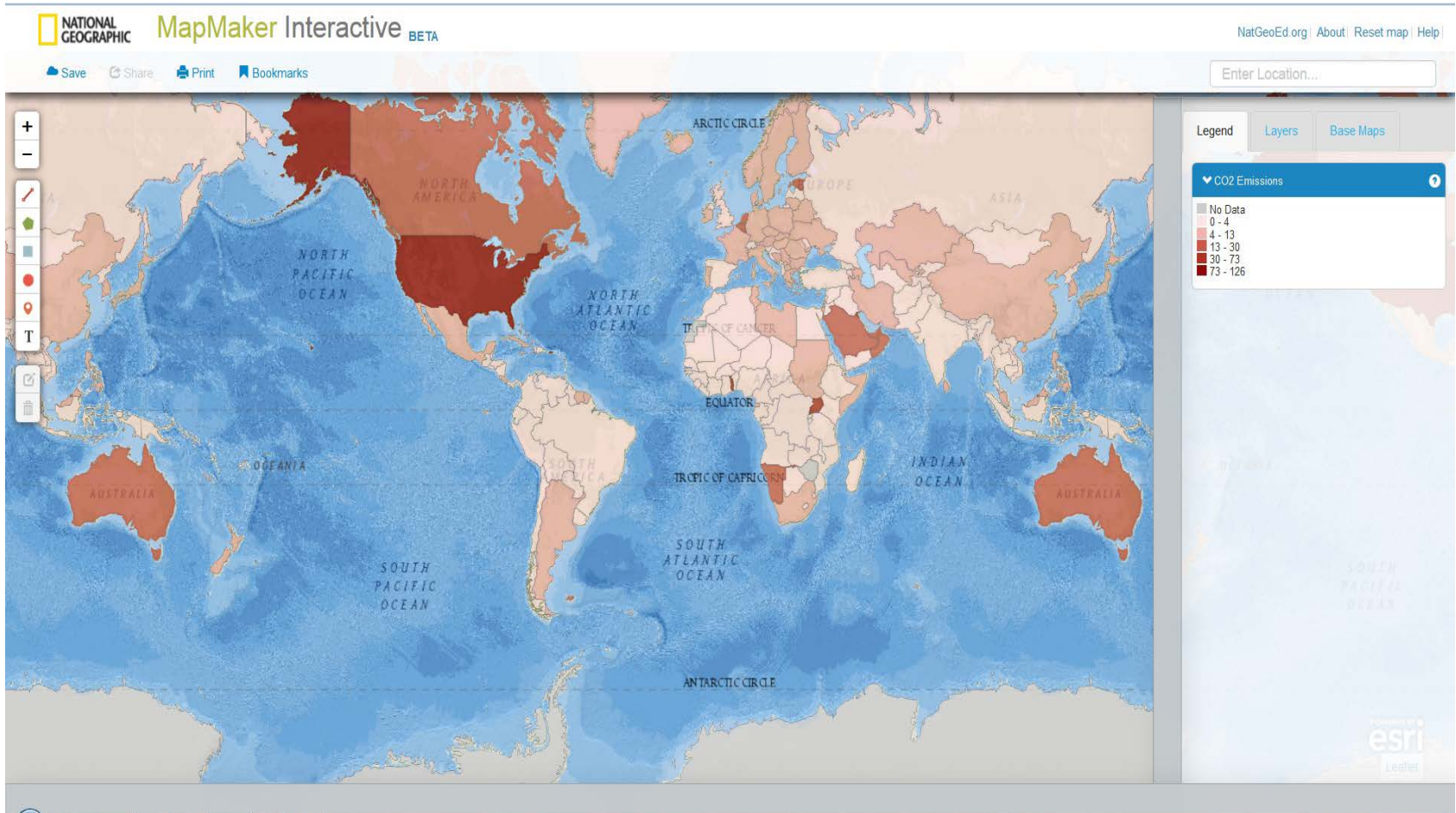
Google maps

<https://maps.google.com/>



MapMaker Interactive showing CO2 Emissions

<http://mapmaker.education.nationalgeographic.com/>



Country Maps

- Includes maps for GEOTHINK partner countries:
 - Austria
 - Bulgaria
 - Greece
 - Romania
 - The Netherlands

Maps of Bulgaria from BGMaps

bgmaps.com Начало Помощ Услуги Реклама Актуално За контакти English Вход Регистрация Защо?

Търсене **Маршрут**

Враца

Намери

Резултати (1) Моят град

[Град Враца](#)
община Враца, област Враца
[детайли](#)

Полезно в Враца

- [Billa](#) (1) [Аптеки](#) (29) [Банкомати \(АТМ\)](#) (51)
- [Зъболекари](#) (54) [Лекари](#) (5) [Магазини](#) (29)
- [Нотариуси](#) (8) [Спорт](#) (12) [Услуги](#) (3)
- [Хотели](#) (10) [Ще...](#)

Враца 19°C [Разпечатай](#)

1. Давид Тогоров
2. Паисий Хилендарски
3. Иван Андриичин

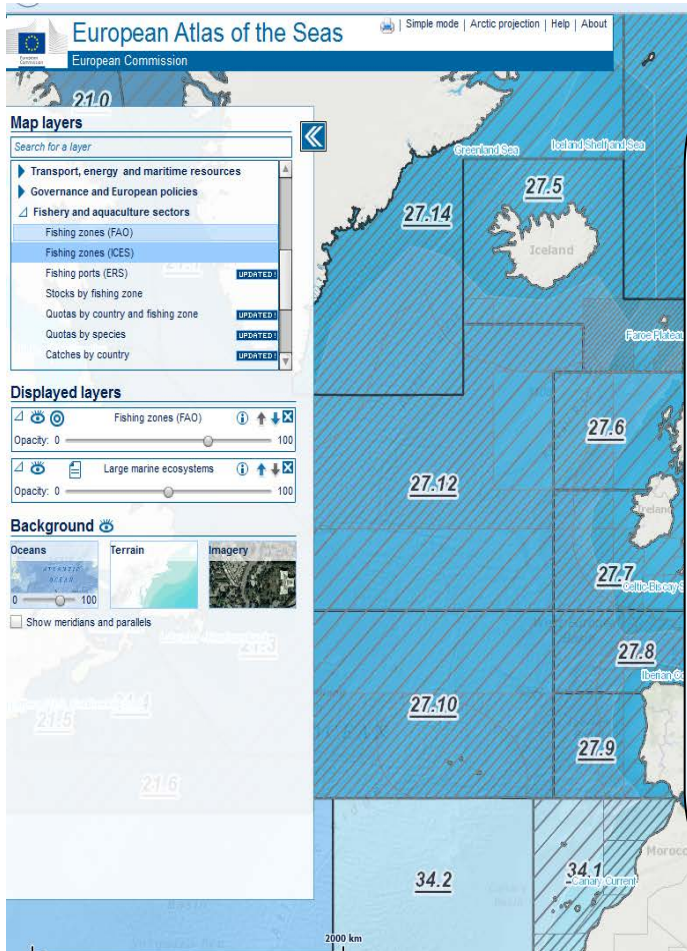
tel vivacom BILLA ОББ ALPHA BANK fuzun ara

Atlases

- educational resources for world maps which are accompanied with other useful information about countries and places on Earth, such as geopolitical, social, religious and economic statistics.

The European Atlas of the Seas

http://ec.europa.eu/maritimeaffairs/atlas/maritime_atlas/#lang=EN;p=w;



The screenshot displays the 'European Atlas of the Seas' web application. The interface includes a header with the European Commission logo and navigation links. A left sidebar contains a 'Map layers' panel with a search bar and a list of categories: 'Transport, energy and maritime resources', 'Governance and European policies', and 'Fishery and aquaculture sectors'. Under the fishery sector, several layers are listed, including 'Fishing zones (FAO)', 'Fishing zones (ICES)', 'Fishing ports (ERS)', 'Stocks by fishing zone', 'Quotas by country and fishing zone', 'Quotas by species', and 'Catches by country'. Below this is a 'Displayed layers' section with two active layers: 'Fishing zones (FAO)' and 'Large marine ecosystems', each with an opacity slider. The 'Background' section offers 'Oceans', 'Terrain', and 'Imagery' options, along with a 'Show meridians and parallels' checkbox. The main map area shows a grid of numbered regions (e.g., 27.14, 27.5, 27.6, 27.12, 27.7, 27.8, 27.10, 27.9, 34.2, 34.1) over a map of the North Atlantic and Mediterranean. A 2000 km scale bar is visible at the bottom left.

provides wealth of information about European seas and coasts, their environment, related human activities and European policies, such as:

- sea depth and underwater features,
- coastal regions geography and statistics,
- blue energies and maritime resources,
- tide amplitude and coastal erosion,
- fishing stocks, quotas and catches,
- European fishing fleet, aquaculture,
- maritime transport and traffic,
- maritime protected areas,
- tourism,
- Etc.

Historical maps

- historical maps provided from Libraries, some of which are georeferenced and may be used for the development of educational scenarios that study the evolution of geospatial entities through time, e.g., the spatiotemporal change of countries and their boundaries due to historical events or the reform of cities due to economic events such as the Industrial Revolution.

OldMapsOnline portal for searching for historical maps

<http://www.oldmapsonline.org/>

The screenshot displays the OldMapsOnline website interface. At the top left is the logo for Old Maps Online, featuring a sun icon. A search bar is located at the top center, with a "Search" button. Below the search bar is a timeline slider ranging from 1000 to 2010, with the year 1370 selected. The main content area shows a map of Athens, Greece, with a red rectangular box highlighting the city center. On the right side, there is a "Instant Search Results" section with a "Fulltext" link. The search results list several historical maps, including one from 1370 titled "<Schedion Athenōn emphainon tēn te néan pólin tō archalon Asty, synoikias, kōmas kai périch dēmos hōs eichon tō pálai kai tous neotérous" and another from 1823 titled "Athēnai kai noikismoι klimax 1800, oiadēpote patryōdis pagoreuetai.>". Other results include a map from 1820 titled "Εκδοτικός αρτογραφικός Οίκος Κ. ρηγουρα = Εκδοτικός χαρτογραφικός Οίκος Κ. ρέγονρα" and a map from 1870 titled "Athènes et ses environs - Imp. Lemercier". At the bottom left, there are logos for JISC, University of Portsmouth, and KLOKAN TECHNOLOGIES. At the bottom right, there is a small inset map of Greece with Athens highlighted.

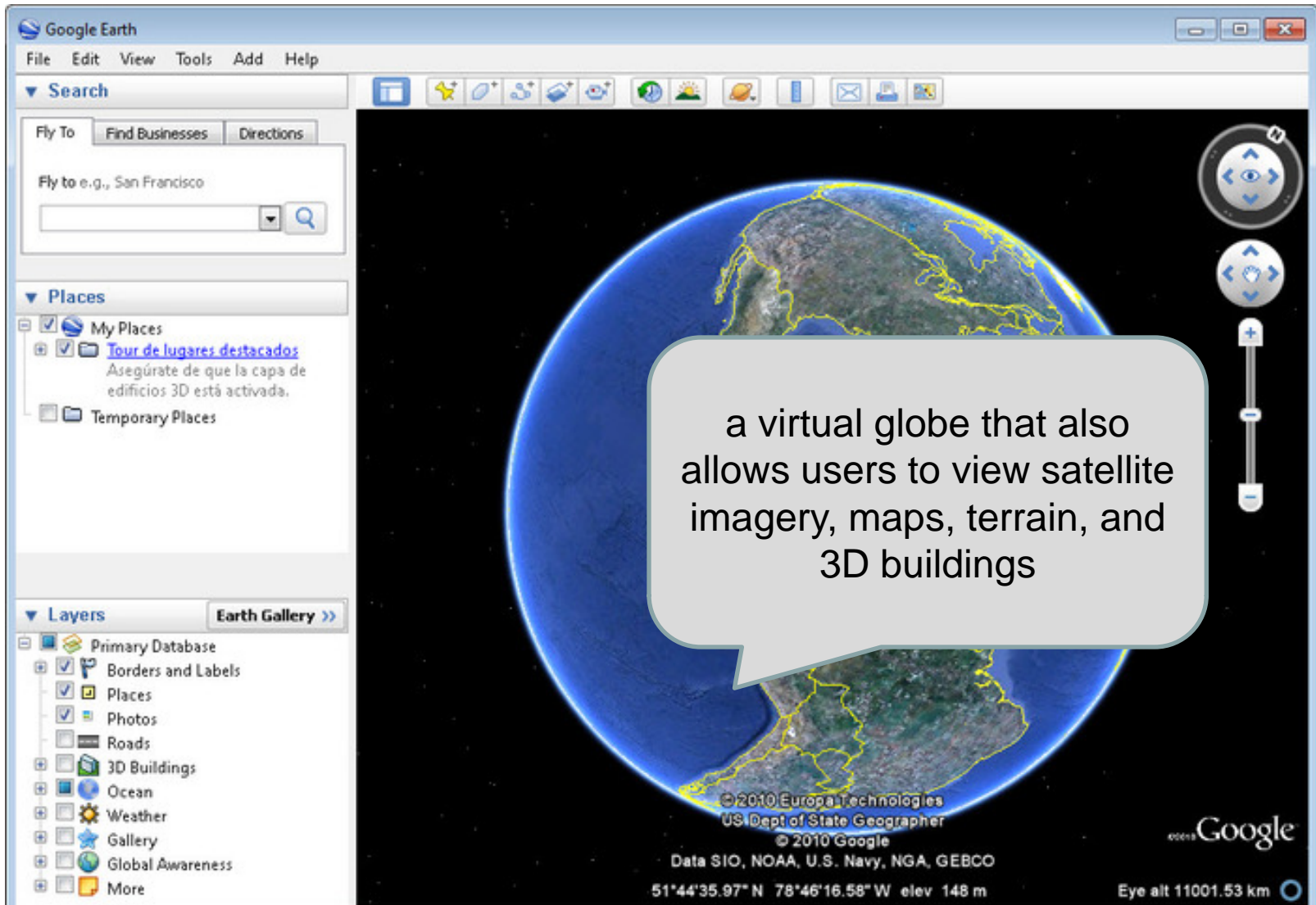
a gateway to historical
maps in libraries
around the world

Virtual globes

- 3D applications that display geographic data on a spherical representation of the Earth

Google Earth

<https://www.google.com/earth/>



Satellite and Areal Imagery

- aerial photographs and satellite images provided mainly for educational purposes. Most of them are categorized according to educational criteria, such as the age, level, resource types, etc

National Geographic Education search for satellite imagery

http://education.nationalgeographic.com/education/topics/satellite-imagery/?ar_a=1

Filter your results further:

Audiences ▾

Grades and Ages ▾

Resource Types ▾

Subjects ▾

Other ▾

Showing results 1 - 30 of 38

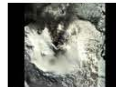
Items per page:



Real-World Geography: Dr. Sarah Parcak
Profile



UNESCO World Heritage Sites
Photos



Montagu Island Volcano
Photo



Volcanoes
Photos



2009 U.S. Presidential Inauguration
Photo



U.S. National Parks - Satellite Images
Photos



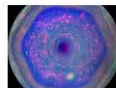
Satellite Imagery and Change Over Time
Activity



Oil Slick Spread Off Gulf Coast
Photo



Eastern Mediterranean Sea
Photos



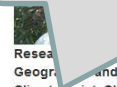
Saturn's Hexagon
Photo



Sarah Parcak
Videos



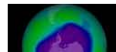
Lakes and Rivers
Photos



Research and Climatologist: Chris Funk
Profile



Mapping the Chesapeake Bay, Past to Present
Activity



provides satellite images for educational purposes offering a functionality to search for satellite images according to criteria such as audiences, grades and ages, resource types, and subjects

NASA Wavelength Digital Library

<http://nasawavelength.org/data-and-images>



Following are sources for NASA Earth and space science data & imagery, which are presented in

Introductory: These NASA science images, animations, and visualizations don't need special software to view and are easy to use. They are ideal for illustrating a concept, to engage students, to develop an educational exhibit, program or product, learn about the latest science, or to share with the public.

Intermediate: Access science data and tools designed for use in the classroom, informal education, or for professional development.

Advanced: Access full scientific datasets and/or analysis tools for conducting research and analysis.

Introductory

NASA science images, animations, and visualizations that don't need special software or tools to view and are easy to use. They are ideal for illustrating a concept, to engage students, to develop an educational exhibit, program or product, learn about the latest science, or to share with the public.

Legend: 🌍 Earth 🌙 Moon ☀️ Sun 🪐 Planets ✨ Universe

Astronaut Views of the Home Planet 🌍 http://earth.jsc.nasa.gov/sseop/efsl/	This online data repository provides access to a wide range of Earth science data and is searchable by city, Earth landscapes, hurricanes and weather, geological features, Earth's water habitats, distinctive features and more.
AstroPix ✨ http://astropix.ipac.caltech.edu/	AstroPix offers access to the collected image libraries of a variety of the leading astronomical observatories, including a range of astronomical observations, illustrations, charts, and photographs spanning the field of Astronomy. The site automatically pulls in the latest imagery as soon as it becomes available. Initial partners include Spitzer, Chandra, Hubble, Galax, WISE, and ESO, with more coming soon.
Earth Observatory 🌍 http://earthobservatory.nasa.gov	Shares the images, stories and discoveries that emerge from NASA Earth science research, including its satellite missions, in-the-field research and climate models. View global maps of NASA data , check out the Image of the

provides NASA Earth and space science data and imagery, which are classified in three categories: introductory, intermediate, and advanced

USGS Earth Explorer

<http://earthexplorer.usgs.gov/>



USGS
science for a changing world

EarthExplorer

USGS Home
Contact USGS
Search USGS

Page Expires In 1:54:03

Home 1 New System Message Login Register **USGS** Feedback Help

Search Criteria Data Sets Additional Criteria Results

1. Enter Search Criteria

To narrow your search area: type in an address or place name, enter coordinates or click the map to define your search area (for advanced map tools, view the [help documentation](#)), and/or choose a date range.

Address/Place Path/Row Feature Circle

Show Clear

Coordinates Predefined Area Shapefile KML

Degree/Minute/Second Decimal

No coordinates selected.

Use Map Add Coordinate Clear Coordinates

Date Range Result Options

Search from: 01/01/1920 to: 10/10/2014

Search months: (all)

Data Sets » Additional Criteria » Results »

Search Criteria Summary (Show) Clear Criteria

(72° 07' 40" N, 155° 44' 31" W) Options Overlays Map Satellite

Google

Map data ©2014 Google, INEGI Imagery ©2014 NASA, TerraMetrics 1000 km Terms of Use

The up-to-date Google map is not for purchase or for download; it is to be used as a guide for reference and search purposes only.

web application that provides users the ability to search and view satellite images, aerial photographs, and cartographic products from several sources.

Data Visualizations

- includes tools and resources for viewing, exploring, and creating data visualizations, i.e. presentations of data in a graphical format

Models

- includes 2D and 3D geometrical models which are commonly used for supporting STEM (Science, Technology, Engineering and Mathematics) education

GeoGebra

<http://www.geogebra.org/>

Voronoi Diagram Animation

Move the points
Press "Go"
Be amazed!



a dynamic
mathematics software
that provides
interactive 2D and 3D
geometry models.

Reasoning tools

- Any kind of tool (educational game, learning activity, interactive application, etc.) that may facilitate the understanding of a concept or scenario and prompt reasoning processes.
- All partners (and end-users) will be able to add reasoning tools relative to their scenarios to the GEOTHNK platform.

Make a Chart for Safe Boaters

- Tool that allows young learners to create their own nautical charts for safer navigation!
- Owner: National Ocean Service, National Oceanic and Atmospheric Administration, Department of Commerce, USA.gov
- **Links:** [NOAA's National Ocean Service Education: Nautical Charts](#)

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION NOS NOAA search

noaa ocean service education

Edu Home Students Teachers For Fun NOS Home

◀ Prev | Nautical Charts HOME | Next ▶

Make a Chart for Safe Boaters

CLICK ON THE BUTTONS TO CREATE A SYMBOL: TOWER BUOY MARKS Lighthouse SHIPWRECK PENCIL: OFF ? RESTART

DIRECTIONS

Click and Drag Objects:	Click on the Pencil:
1 Lighthouse 2 Shipwrecks 1 Tower 1 Buoy marker	1. Write in numbers for soundings 2. Write in names: <ul style="list-style-type: none">• Cape Point• Hatteras Island• Diamond Shoals

Great job on making a nautical chart!
[CLICK to FINISH!](#)

Safe boaters

- Always wear a life preserver on a boat.
- Have charts onboard a boat.
- Know how to read a chart.

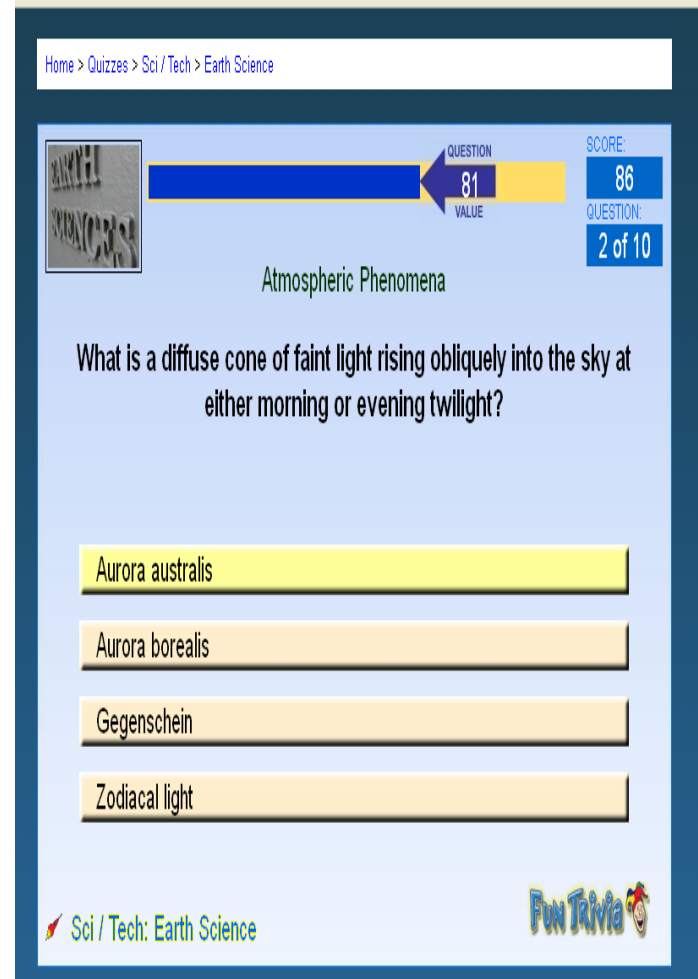
Comparison of earthquakes' magnitude

- The tool allows learners to compare between two earthquakes of different magnitudes so that they realise how bigger an earthquake really is compared to another of lower magnitude.
- Owner: U.S. Geological Survey
- **Links:** ["How Much Bigger...?" Calculator](#)

The screenshot shows the USGS Earthquake Hazards Program website. The page title is "'How Much Bigger...?' Calculator". It features two input fields for earthquake magnitudes: "Larger Magnitude:" with a value of 8.7 and "Smaller Magnitude:" with a value of 5.8. Both fields have a range of -3. to 10. Below the inputs are "Calculate" and "Reset" buttons. The result shows a "Magnitude Difference:" of 2.9. A summary text states: "A magnitude 8.7 earthquake is 794.328 times bigger than a magnitude 5.8 earthquake on a seismogram, but is 22387.211 times stronger (energy release)." The USGS logo and navigation menu are visible at the top.

Atmospheric Phenomena Quiz

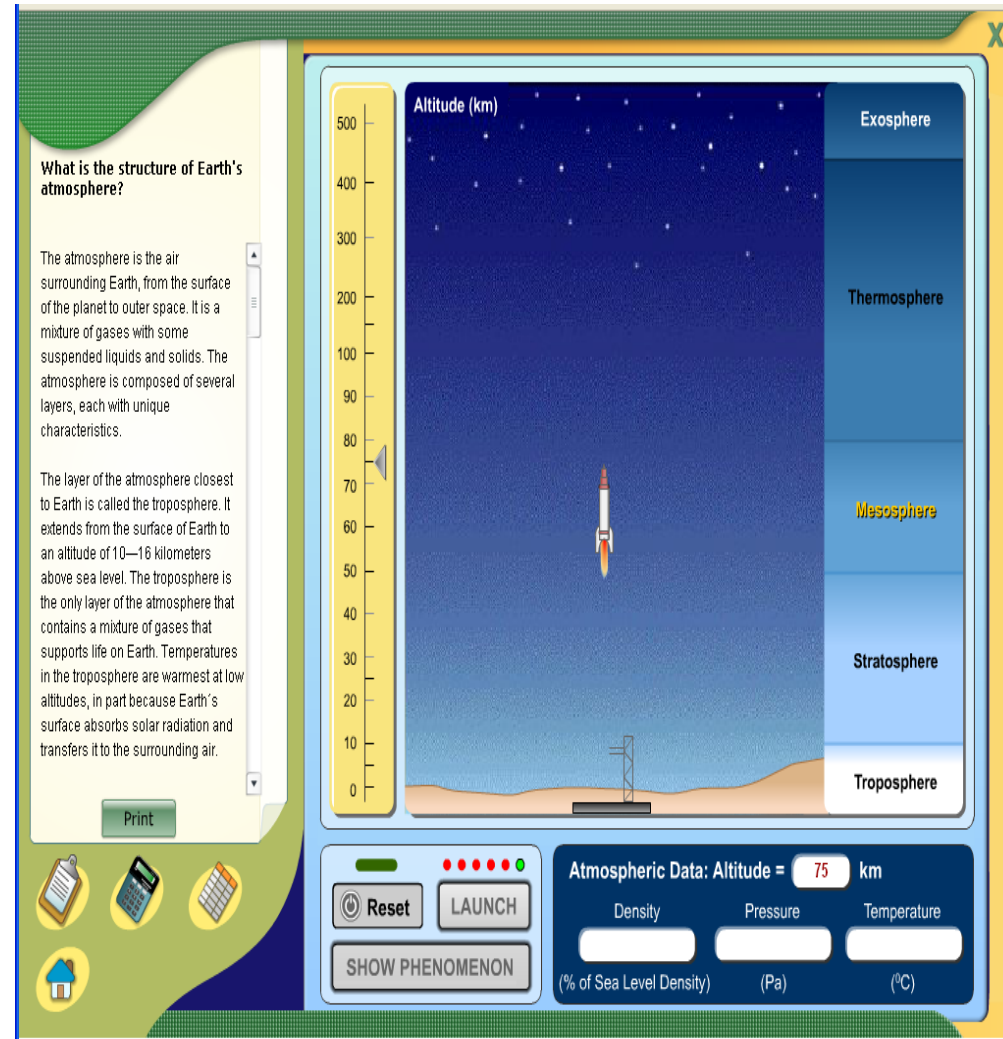
- Atmospheric Phenomena quiz gives a description of some type of atmospheric phenomenon and the learner determines the answer (author: almach)
- Owner:
- FunTrivia.com, the World's Largest Trivia Website (<http://www.funtrivia.com>)
- **Links:** [Atmospheric Phenomena - A time quiz game](#)



The screenshot shows a quiz interface on FunTrivia. At the top, a breadcrumb trail reads "Home > Quizzes > Sci / Tech > Earth Science". Below this is a progress bar with a blue arrow pointing left, labeled "QUESTION" and "VALUE" with the number "81". To the right of the bar, a "SCORE:" box shows "86" and a "QUESTION:" box shows "2 of 10". The quiz title "Atmospheric Phenomena" is centered. The question text is: "What is a diffuse cone of faint light rising obliquely into the sky at either morning or evening twilight?". Below the question are four answer options in yellow boxes: "Aurora australis", "Aurora borealis", "Gegenschein", and "Zodiacal light". At the bottom left, there is a navigation link "Sci / Tech: Earth Science" and at the bottom right is the FunTrivia logo.

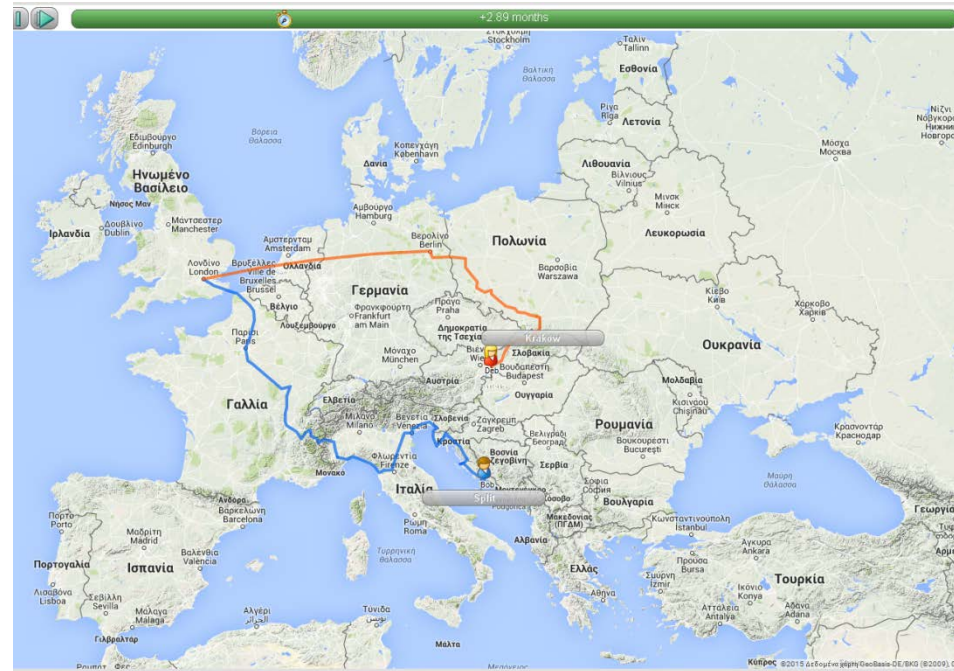
Layers of the Atmosphere virtual lab

- Interactive virtual lab tool that shows the structure (different layers) of the Earth's atmosphere, provides information on atmospheric data (e.g. pressure, temperature, density) at different altitudes, and shows meteorological and astronomical phenomena of the different layers.
- Owner: McGraw-Hill Education
- **Links:** [Earth's Atmosphere Structure](#)



Animaps

- "Animaps extends the My Maps feature of Google Maps by letting you create maps with markers that move, images and text that pop up on cue, and lines and shapes that change over time."
- Owner: Animaps
- Links:
<http://www.animaps.com/>



Example Scenario 1:

BUILD YOUR OWN CITY PLAN

Build your own city plan

- Description: build the plan of an ideal city
- Objectives:
 - The world in spatial terms
 - Human systems
 - Uses of geography
 - Understanding space and environment
 - Understanding urban space and interactions
- Target group: primary and secondary school teachers

Concepts

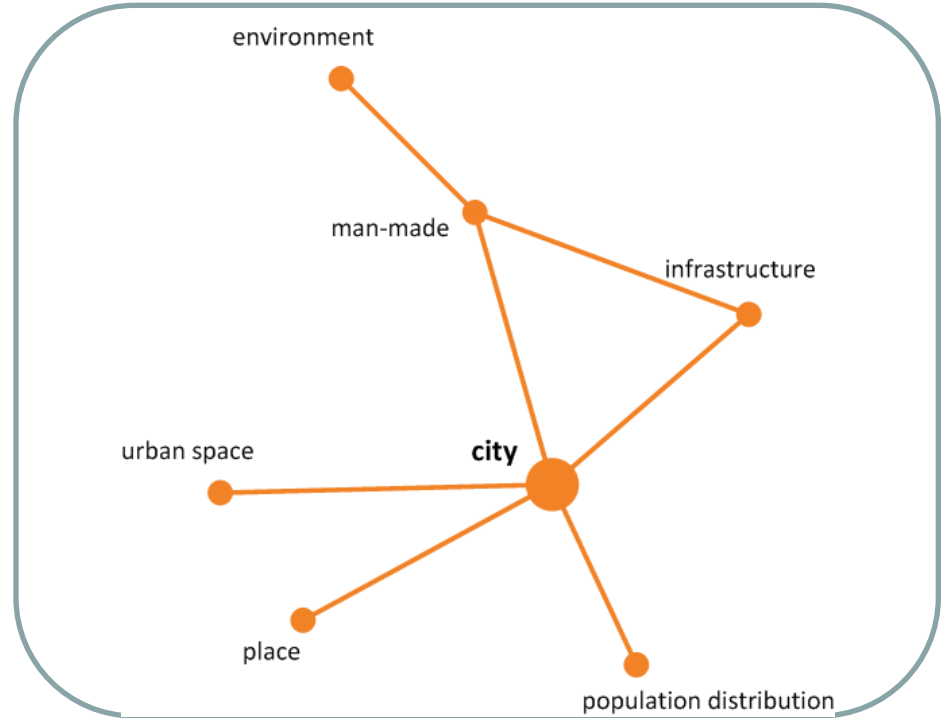
Instances

Representation tools

Reasoning tools

city

- City
- Urban space
- Place
- Infrastructure
- Population distribution
- Environment
- Man-made
-



Concepts

Instances

Representation tools

Reasoning tools

Concept term

city

Concept definition:

a large and densely populated urban area; may include several independent administrative districts

Links

[United Nations Cyberschoolbus: What is a city?](#)

[UK Cities: What is a city?](#)

[Cities In Europe: The New OECD-EC Definition](#)

Concepts

Instances

Representation
tools

Reasoning tools

Concept term

natural resources

Concept definition:

resources (actual and potential) supplied by nature

Links

[National Geographic: Natural Resources](#)
[BrainPop: Natural Resources](#)

The screenshot shows the BrainPOP website interface. At the top, there is a navigation bar with a search bar, an 'ENTER CODE' button, and a 'LOG IN' button. Below this is a dark grey login form with a text input field, a 'Password' label, another text input field, and an orange 'LOG IN' button. A link for 'Need help logging in?' is located below the button. The main content area features the BrainPOP logo, a 'SCIENCE' icon, and a 'NATURAL RESOURCES' section. This section includes a video player with a 'play' button and a 'QUIZ' button. The video player shows three recycling bins (red, green, blue) with icons of a bottle, a newspaper, and a can. Below the video player, there are buttons for 'LESSON IDEAS', 'FREE STUFF', 'SUBSCRIBE', and 'TOUR'. At the bottom, there is a footer with 'Related Topics: Water Pollution | Gas and Oil | Fossil Fuels | Air Pollution' and a list of links: 'Tour | About | Subscribe | Funding | Help | Jr (K-3) | Español | More...'. A small link 'See a Full List of Topics' is also present.

Concepts

Instances

Representation
tools

Reasoning tools

Concept:

City

Instance:

Athens

Instance:

Amsterdam

Concepts

Instances

Representation tools

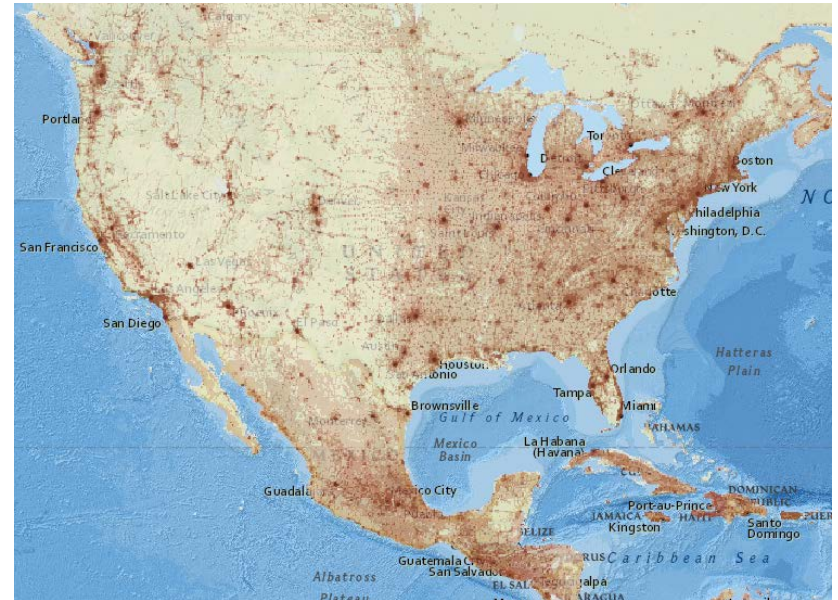
Reasoning tools

Category:

Map

Tool:

MapMaker Interactive



Category:

Satellite image

Tool:

NASA Earth Observatory/NOAA
NGDC



Concepts

Instances

Representation
tools

Reasoning tools

Title:

Plan It Green

Short Description:

Educational game for building a sustainable city

Age range:

14+

Time:

1 hour

Link:

<http://www.planitgreenlive.com/en/build-your-own-city>



Example Scenario 2:

COASTLINE PARADOX

Coastline Paradox

- Description: measure the length of a coastline at different scales
- Objectives:
 - understand spatial concepts such as measurement, scale and length as well as mathematical concepts such as fractals
 - link knowledge components from different disciplines.
- Target group: university students



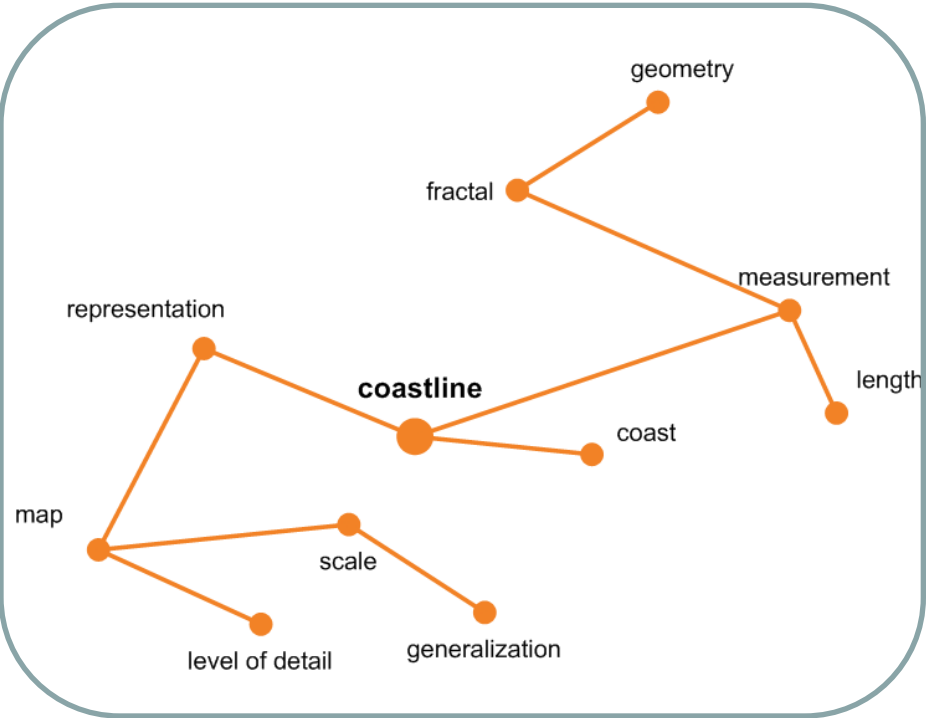
Concepts

Instances

Representation tools

Reasoning tools

Coastline
Coast
Length
Measurement
Scale
Generalization
Fractal



Concepts

Instances

Representation
tools

Reasoning tools

Concept term

coastline

Concept definition:

the outline of a coast

Links

<http://www.bbc.co.uk/learningzone/clips/an-introduction-to-the-coastline/8429.html>

<http://science.nationalgeographic.com/science/earth/surface-of-the-earth/coastlines-article/>

Concept term

scale

Concept definition:

the ratio between the size of something and a representation of it: *"the scale of the map"; "the scale of the model"*

Links

<http://www.kidsgeo.com/geography-for-kids/0028-map-scale-types.php>

<http://www.slideshare.net/tbonnar/social-studies-geography-skills-scale>

<http://mapzone.ordnancesurvey.co.uk/mapzone/PagesHomeworkHelp/mapability/understandingscale/>



Concepts

Instances

Representation tools

Reasoning tools

Concept term

fractal

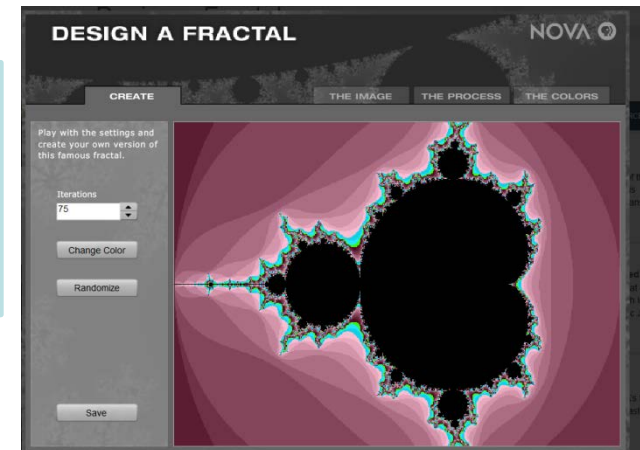
Concept definition:

(mathematics) a geometric pattern that is repeated at every scale and so cannot be represented by classical geometry

Links

http://www.pbs.org/wgbh/nova/education/activities/3514_fractals.html

<http://www.pbs.org/wgbh/nova/physics/fractal-generator.html>



Concepts

Instances

Representation
tools

Reasoning tools

Concept:

Coast

Instance:

[Côte d'Azur](#)

Instance:

[Costa Smeralda](#)

Concepts

Instances

Representation
tools

Reasoning tools

Category:

Satellite image

Tool:

Google maps



Title:

Fractal Dimension of a Coastline

Short Description:

Students learn that measuring the length of a natural shape such as a coastline depends on the scale of the ruler with which they measure it.

Age range:

18+

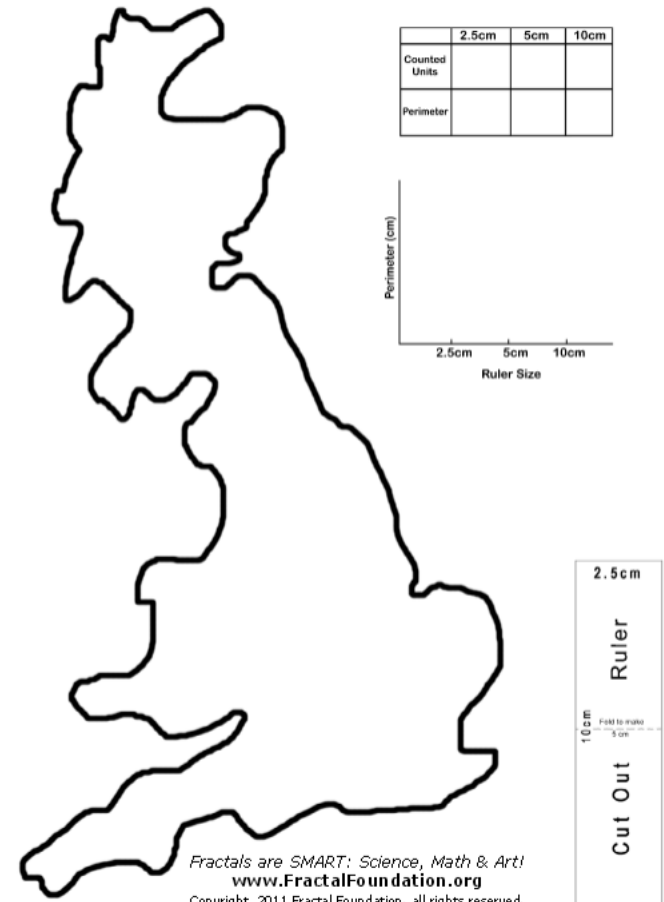
Time:

1 hour

Link:

<http://www.sfafs.org/pdfs/coastlinedimension.pdf>

Fractal Dimension of a Coastline



Concepts

Instances

Representation tools

Reasoning tools

Title:

Measure the length of a coastline using Google Earth

Short Description:

Use Google Earth to measure the length of a coastline at 3 different levels of detail (scale)

Age range:

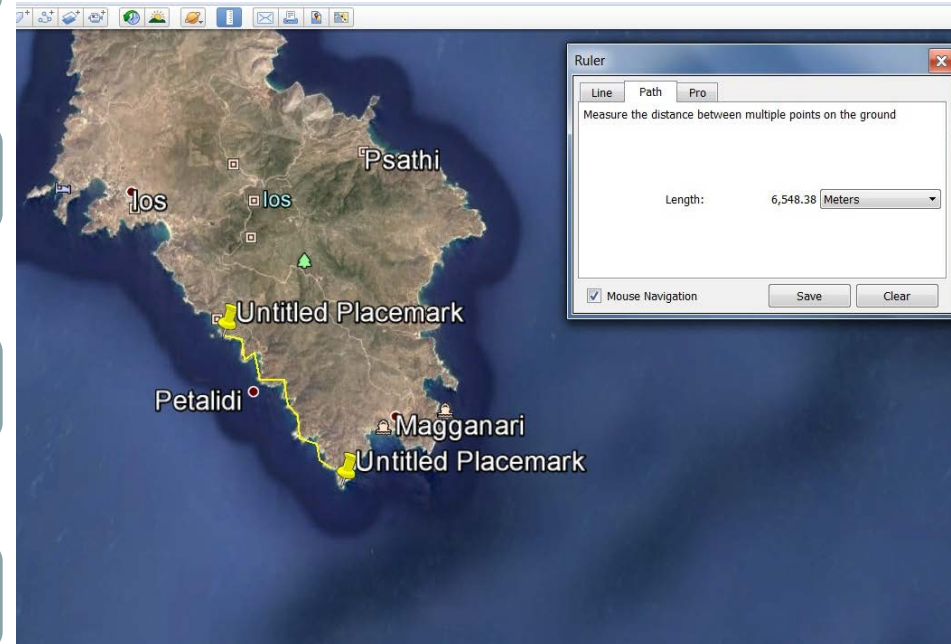
18+

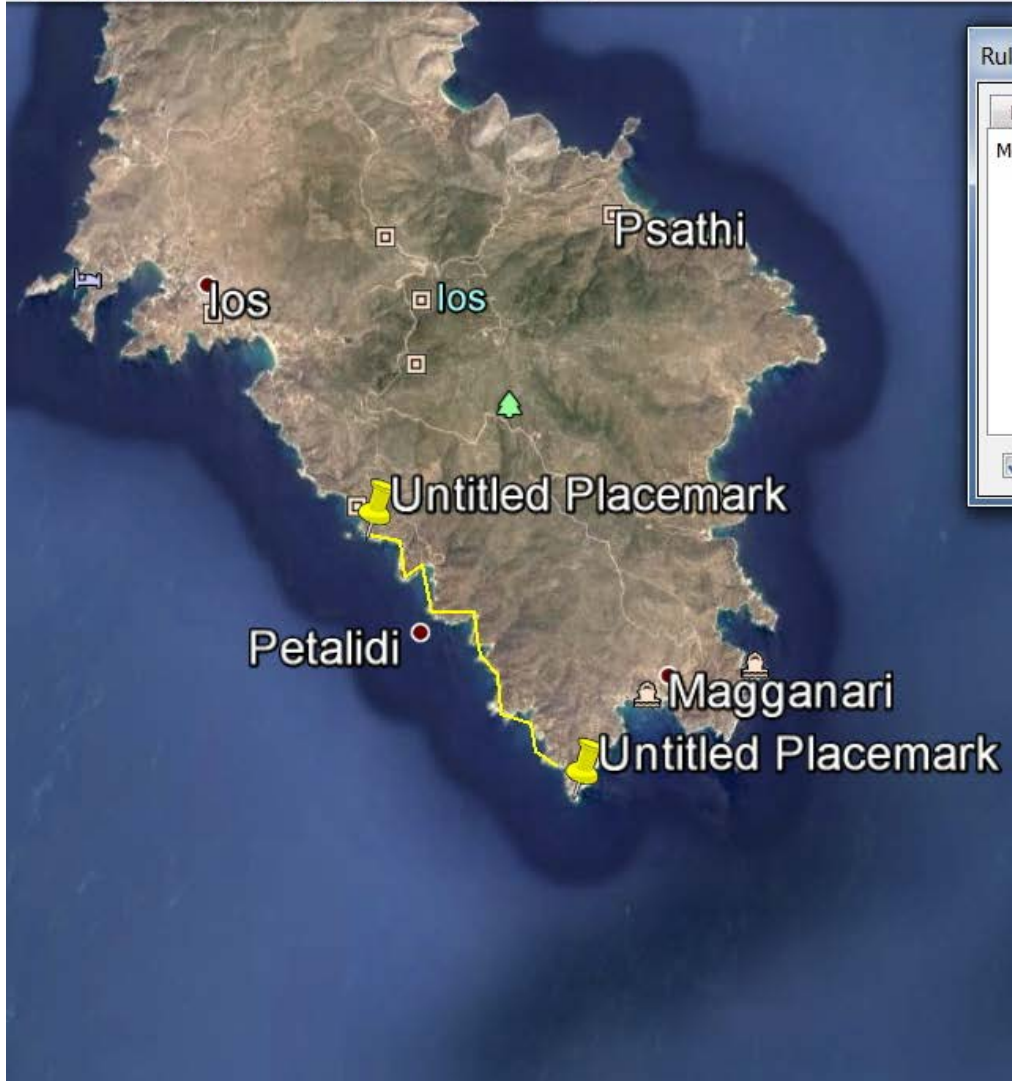
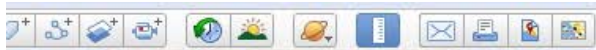
Time:

1 hour

Link:

earth.google.com/





Ruler [Close]

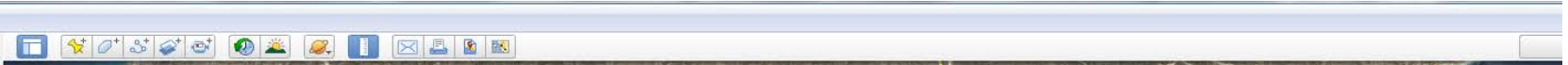
Line Path Pro

Measure the distance between multiple points on the ground

Length: 6,548.38 Meters

Mouse Navigation

Save Clear



Untitled Placemark

Petalidi

Magganari

Ruler

Line Path Pro

Measure the distance between multiple points on the ground

Length: 9,877.76 Meters

Mouse Navigation Save Clear

Data SIO, NOAA, U.S. Navy, NGA, GEBCO © 2014 Google

Untitled Placemark

Google

Image © 2014 CNES / Astrium

36°39'01.29" N 25°20'13.35" E elev 0 m eye a



San Francisco sea level rise at 1.5 m. and 4 m.

<http://www.storagefront.com/therentersbent/what-will-sea-level-rise-look-like-west-coast-edition>

Example Scenario 3:

**WHICH CITIES WILL BE
COMPLETELY UNDERWATER IN
LESS THAN 100 YEARS?**

Which Cities Will Be Completely Underwater In Less Than 100 Years?

- Description: identify areas vulnerable to flooding due to a sea level rise
- Objectives:
 - understand spatial concepts such as location, elevation, proximity as well as environmental concepts such as global warming, greenhouse effect, etc.
 - semantically link knowledge components from different disciplines.
 - raise awareness on the environmental consequences of human activities
- Target group: teachers, university students, adults

Concepts

- Spatial: location, distance, proximity, elevation, city, sea, ocean, sea level, etc.
- Non-spatial: flooding, global warming, climate change, greenhouse effect, etc.

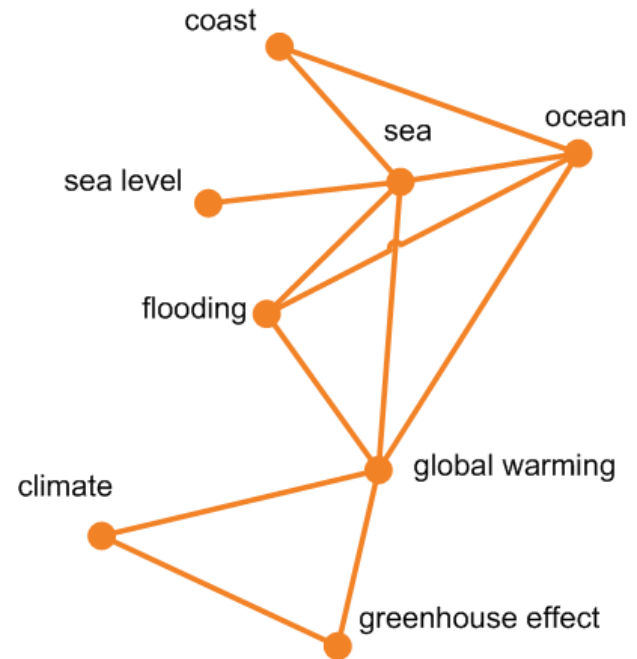
Concepts

Location
Distance
Proximity
Elevation
Sea
Ocean
Sea level
Flooding
Global warming
Climate change
Greenhouse effect

Instances

Representation tools

Reasoning tools



Concepts

Instances

Representation
tools

Reasoning tools

Concept term

location

Concept definition:

a point or extent in space

Links

<http://www.teachspatial.org/concept-browser/location>

<http://vocabulary.curriculum.edu.au/scot/2315.html>

[http://dbpedia.org/resource/Location_\(geography\)](http://dbpedia.org/resource/Location_(geography))

The screenshot shows the Kids Geo Go website. At the top, there is a navigation bar with links for HOME, GEOGRAPHY, and GEOGRAPHY GAMES. Below this is a search bar and a list of categories including Anatomy, Biology, Chemistry, Geography, History, Math, Music, and Science. The main content area features a large map of the world with a red box labeled "Παίξτε" (Play). Below the map, there is a section titled "Latitude And Longitude Map Match Game" with a score of 0 and a timer of 100. The game interface includes a grid of latitude and longitude coordinates and a small map showing the current location of a character named Hannah. The text below the game reads: "Welcome to Hannah's world. Sometimes Hannah gets lost. Fortunately..."

Concepts

Instances

Representation tools

Reasoning tools

Concept term

Global warming

Concept definition:

an increase in the average temperature of the earth's atmosphere (especially a sustained increase that causes climatic changes)

Links

<http://www.c2es.org/science-impacts/basics/faqs/climate-science>

http://en.wikipedia.org/wiki/Global_warming

<http://earthobservatory.nasa.gov/Features/GlobalWarming/>



Concepts

Instances

Representation
tools

Reasoning tools

Concept:

City

Instance:

Venice

Instance:

San Francisco

Representation tools

- Maps
- Digital elevation models
- Interactive applications
- Diagrams
- Images

Concepts

Instances

Representation tools

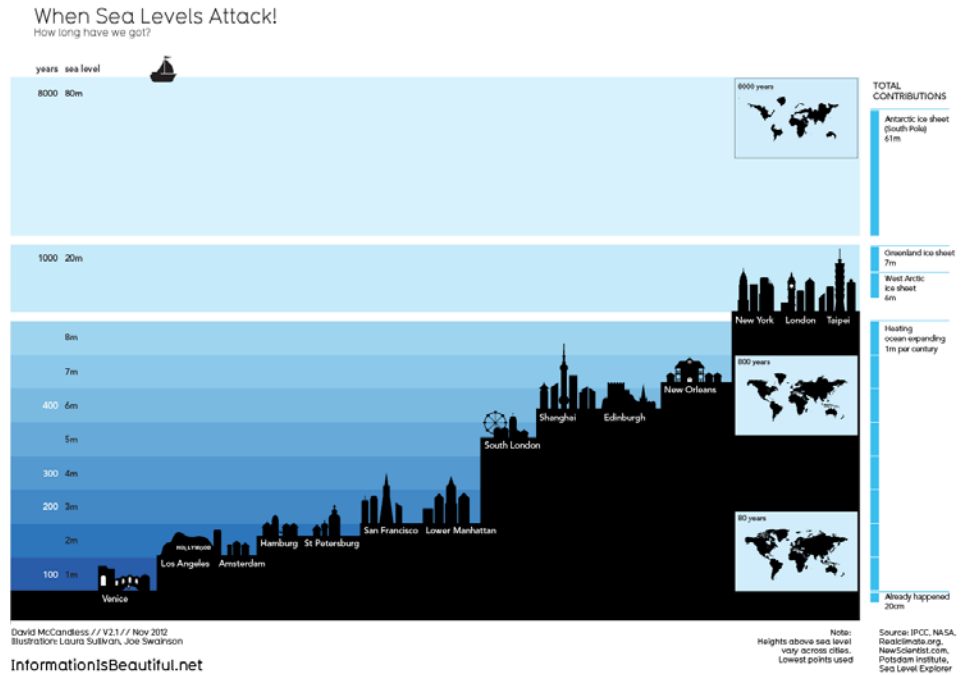
Reasoning tools

Category:

Diagram

Tool:

When sea levels attack!



Concepts

Instances

Representation tools

Reasoning tools

Title:

The New York Times: What Could Disappear

Short Description:

Maps show coastal and low-lying areas that would be permanently flooded, without engineered protection, in three levels of higher seas.

Age range:

14+

Time:

30 minutes

Link:

http://www.nytimes.com/interactive/2012/11/24/opinion/sunday/what-could-disappear.html?_r=0

Select sea level rise over current level:

25 feet: Potential level in coming centuries, based on historical climate data.

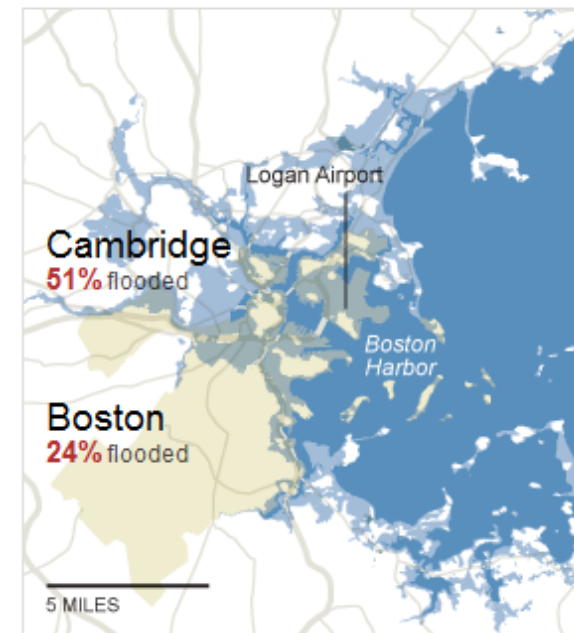
12 feet: Potential level in about 2300 if nations make only moderate pollution cuts.

5 feet: Probable level in about 100 to 300 years.

0 feet: Today's sea levels and land area.

[Notes on sea level estimates](#)

Boston



Back Bay, the South End and the airport are permanently submerged. What's left of downtown is an island.

Concepts

Instances

Representation tools

Reasoning tools

Title:

Geology.com: Global Sea Level Rise Map

Short Description:

The map shows areas that would be flooded at various stages of sea level rise. You can select a value of sea level rise using the dropdown box in the upper left corner of the map.

Age range:

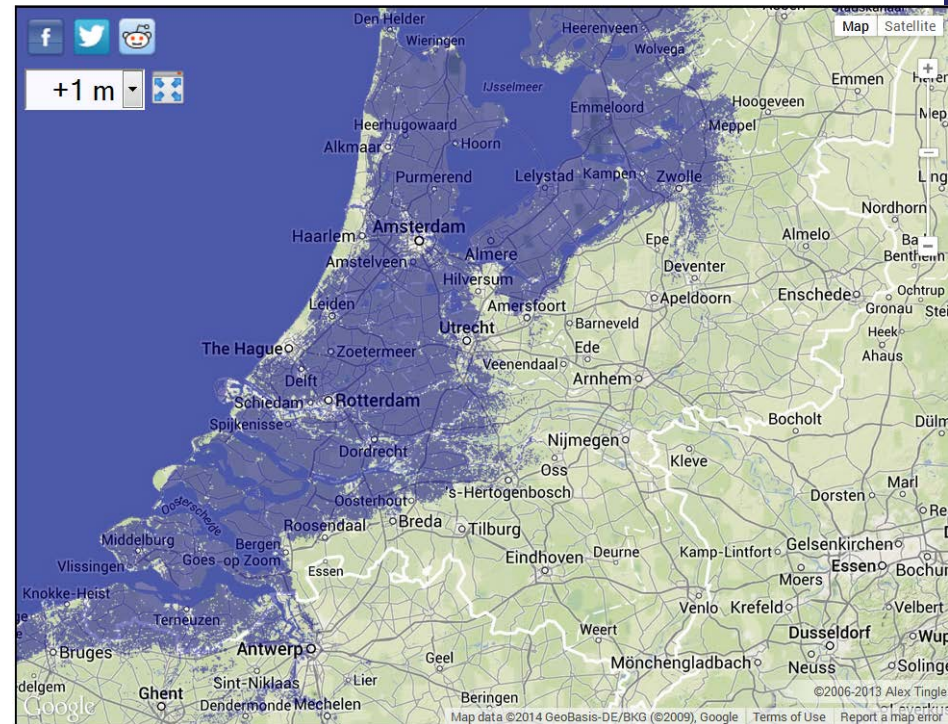
14+

Time:

30 minutes

Link:

<http://geology.com/sea-level-rise/>



Geology.com: Global Sea Level Rise Map



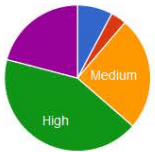
<http://geology.com/sea-level-rise/>

Map & Chart Controls

Map Inundation Increment:
2m

Chart Inundation Increment (m):
1

National Social Vulnerability Index

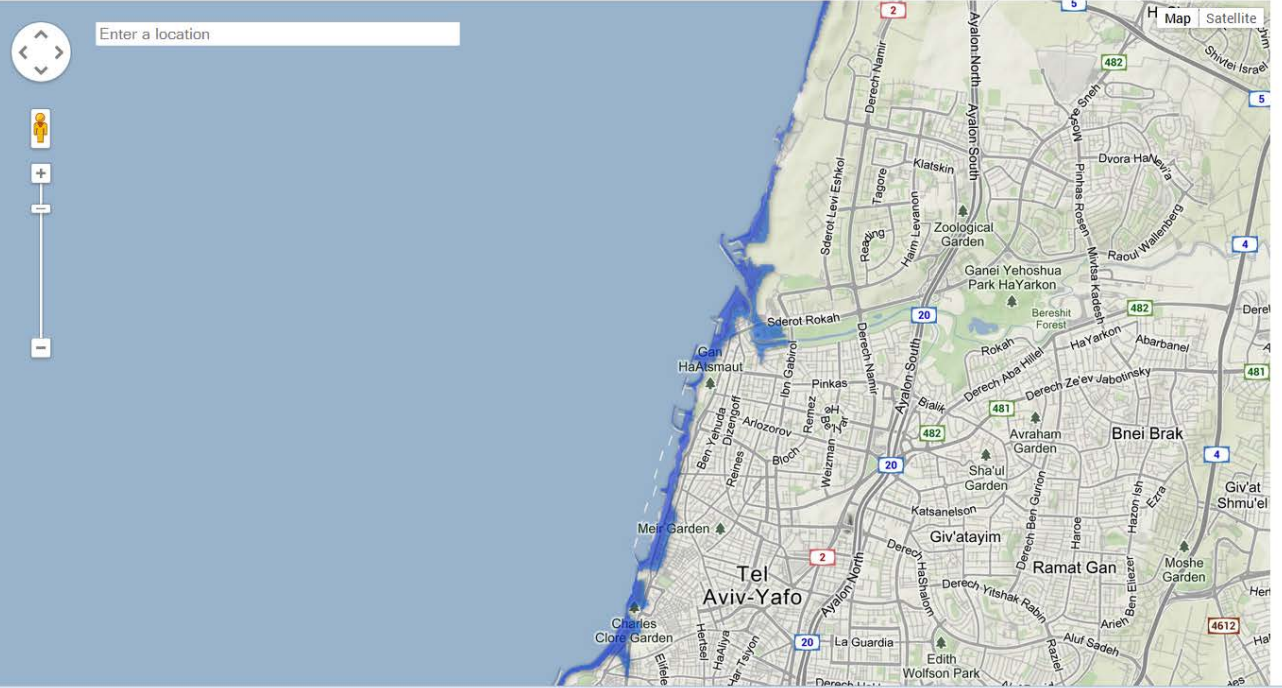


Vulnerability	Inhabitants
Very Low	338
Low	150
Medium	1087

How to use this map

About

Acknowledgement: This research is partially based on work



Learning activity

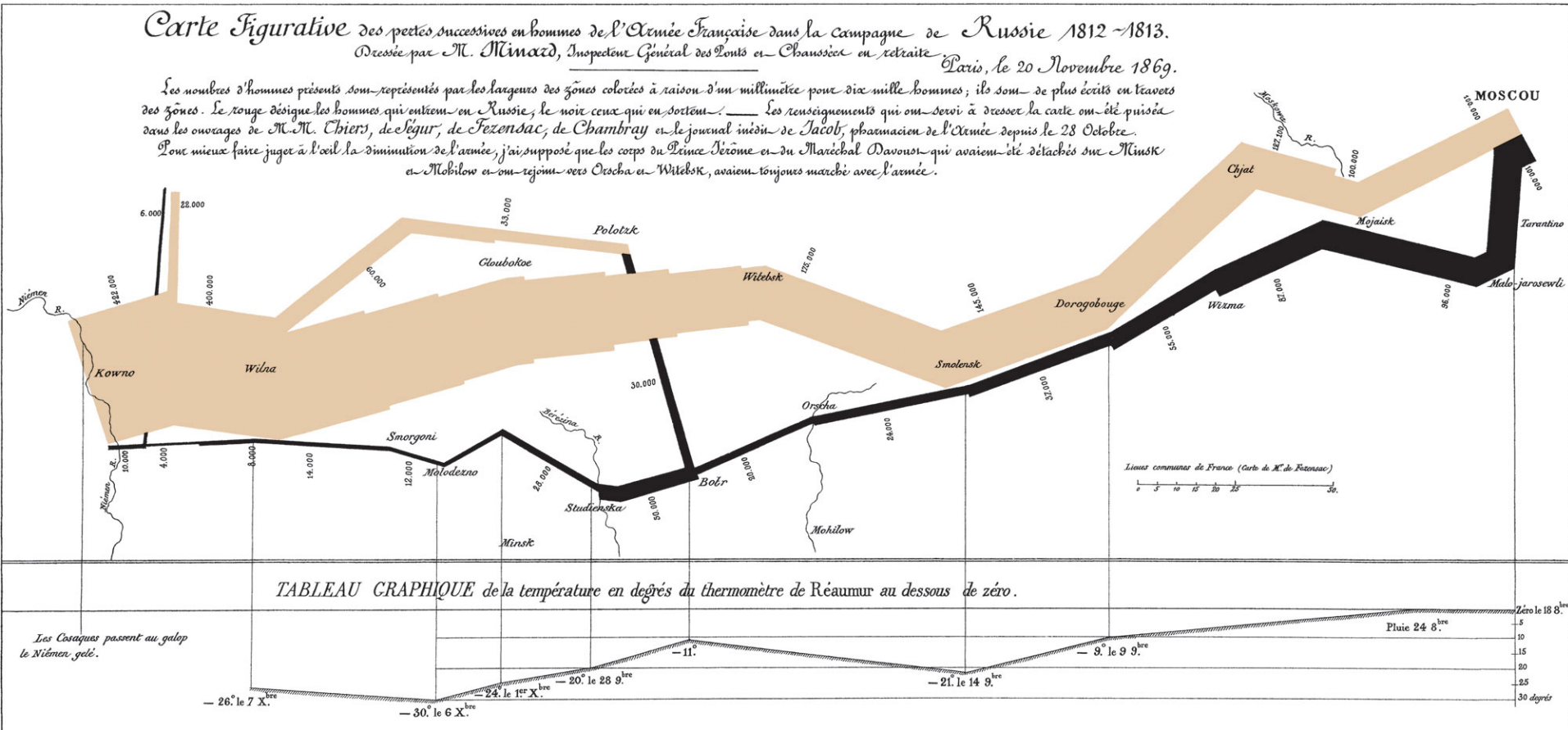
- Combine a map and a digital elevation model using a free GIS software, evaluating multiple criteria (e.g., the location of settlements and other socioeconomic activities) and making inferences about environmental consequences

What about social sciences and
humanities?

Minard's Map of Napoleon's March on Moscow

Carte Figurative des pertes successives en hommes de l'Armée Française dans la campagne de Russie 1812-1813.
 Dressée par M. Minard, Inspecteur Général des Ponts et Chaussées en retraite. Paris, le 20 Novembre 1869.

Les nombres d'hommes présents sont représentés par les largeurs des zones colorées à raison d'un millimètre pour dix mille hommes; ils sont de plus écrits en travers des zones. Le rouge désigne les hommes qui entrent en Russie, le noir ceux qui en sortent. Les renseignements qui ont servi à dresser la carte ont été puisés dans les ouvrages de M. M. Chiers, de Légar, de Fezensac, de Chambrey et le journal inédit de Jacob, pharmacien de l'Armée depuis le 28 Octobre. Pour mieux faire juger à l'œil la diminution de l'armée, j'ai supposé que les corps du Prince Jérôme et du Maréchal Davout qui avaient été détachés sur Minsk et Mohilow et ont rejoint vers Orscha et Witebsk, avaient toujours marché avec l'armée.



Storymaps

<http://storymaps.esri.com/templates/development/stable/geoblog/?appid=42459c24c8a44f328e55c9043bf26208>

Napoleon's March on Moscow 1812-1813

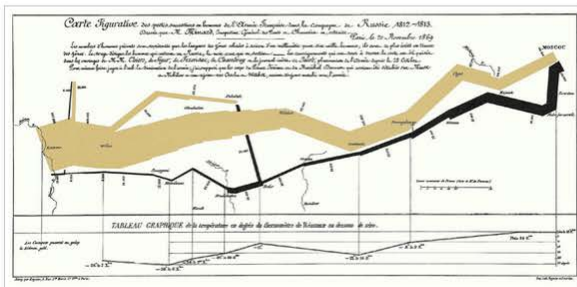
A new look at an old classic

A story map



Re-imagining Minard's map of Napoleon's March on Moscow

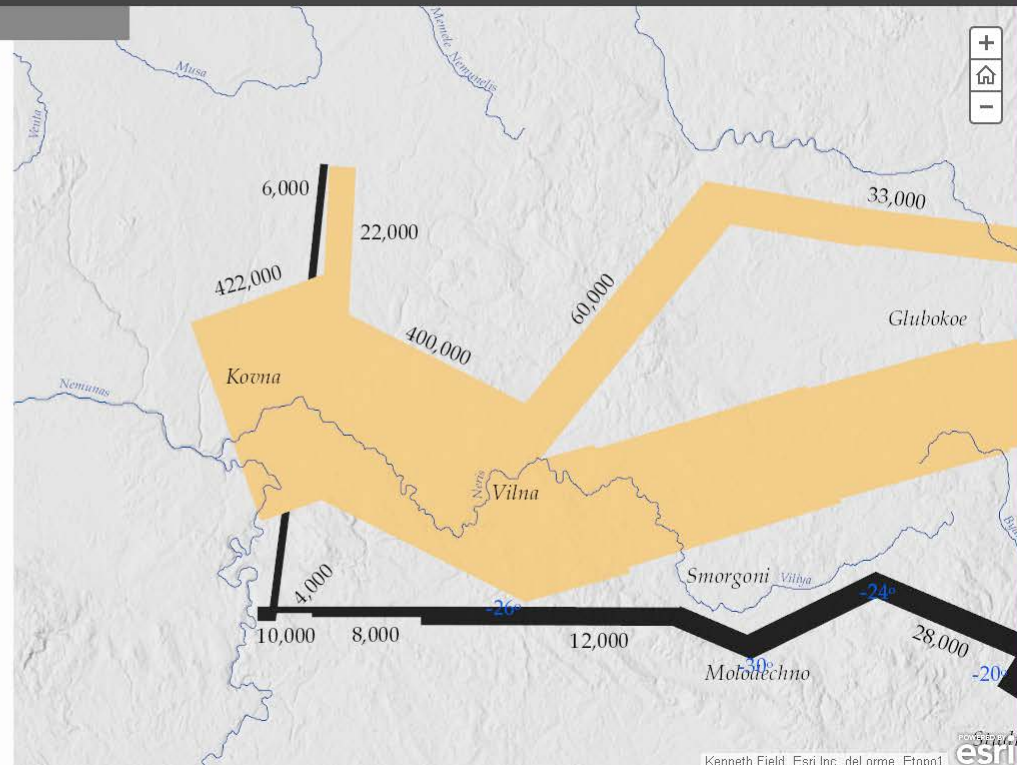
Harvard scholar and graphics guru Edward Tufte suggested that the famous Minard map of Napoleon's tragic march to Moscow 1812-13 map 'may well be the best statistical graphic ever drawn' (Tufte, 2001). Here, we present a 2D version created in ArcGIS, a narrative geoblog as well as a 3D space-time cube which allows us to re-imagine the map in new ways and to tell an even richer story than Minard's original.



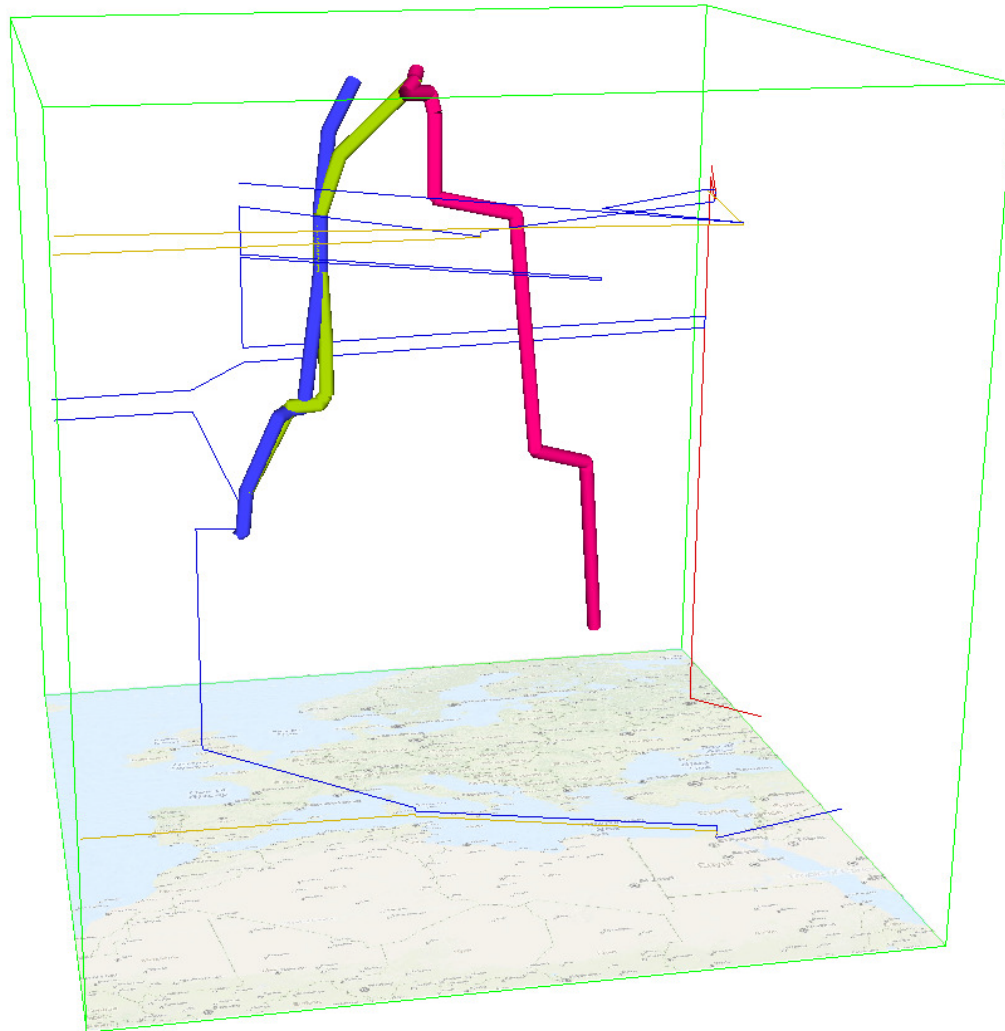
Figurative map of the successive loss of French troops during Napoleon's Russian Campaign (1812-1813); Charles Minard 1869

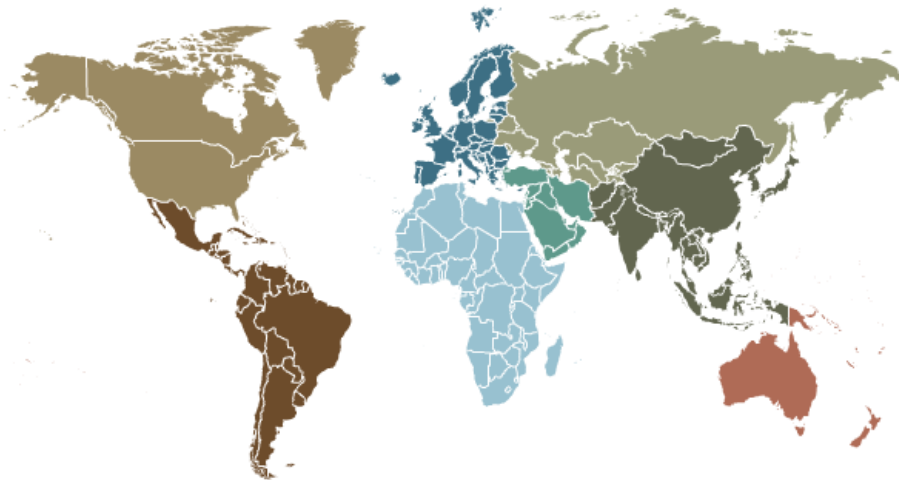
The original map is multivariate and shows movement in space and time. The subtlety of the multivariate complexity has been expertly integrated into the graphic by Charles Minard in 1869 who combined the data map and time-series to show the devastating losses of Napoleon's French troops. The Grand Army started its march with some 422,000 troops. The map

LEGEND ▼



Space time cube depicting the movement of leaders and troops during the Second World War





change the world,
one map at a time

SELECT a subject from the top menu and watch the countries on the map change their size. Instead of land mass, the size of each country will represent the data for that subject--both its share of the total and absolute value.

NEW ADDITIONS

- > BUDDHISM
- > CATHOLICISM
- > ISLAM
- > JUDAISM

DATA PROVIDERS



THE WORLD BANK

