

EXCELSIOR

GIS day for EXCELSIOR

Trends, challenges and perspectives in GIS

Prof. Marinos Kavouras

National Technical University of Athens



17 Nov. 2021

11:00 EET

CONSORTIUM



Cyprus University of Technology



DEC

GEOSPATIAL KNOWLEDGE

IN ACTION

Trends, challenges
and perspectives in GIS



MARINOS KAVOURAS

CONTEXT:
THE SPATIAL TURN OF THE WORLD

“What is special about spatial ?”

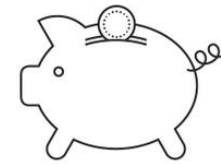
CONTEXT:
THE SPATIAL TURN OF THE WORLD

*“What is **so** special about spatial ?”*

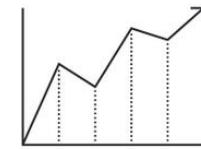
CONTEXT:

THE SPATIAL TURN OF THE WORLD

- Economic impact of geospatial services
- Renaissance of Geography and Mapping



Digital maps have supported more than **\$1 trillion** in sales for businesses.



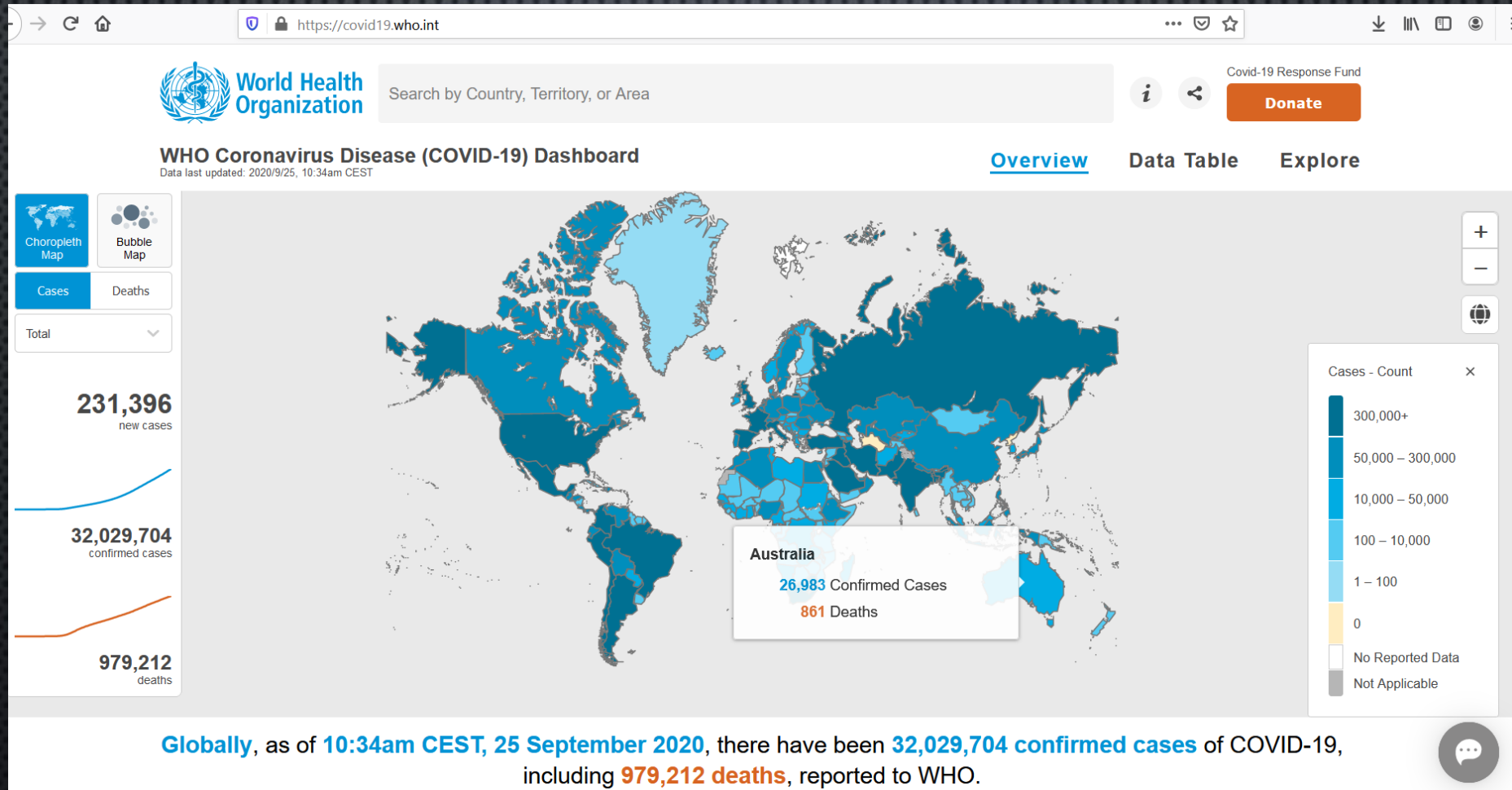
Geospatial services help companies raise revenue and diminish costs by more than **5%**.

<https://www.blog.google/products/maps/economic-impact-geospatial-services/>

A big comeback with a whole new role

**ALMOST EVERYTHING IS SPATIAL
AND MAPS ARE EVERYWHERE**

MAPS EVERYWHERE



Latest Situation of Coronavirus Disease (COVID-19) in Hong Kong

Confirmed/Probable

5,059

▲ 2

Discharged

4,765

▲ 7

Hospitalized

160

▲ 0

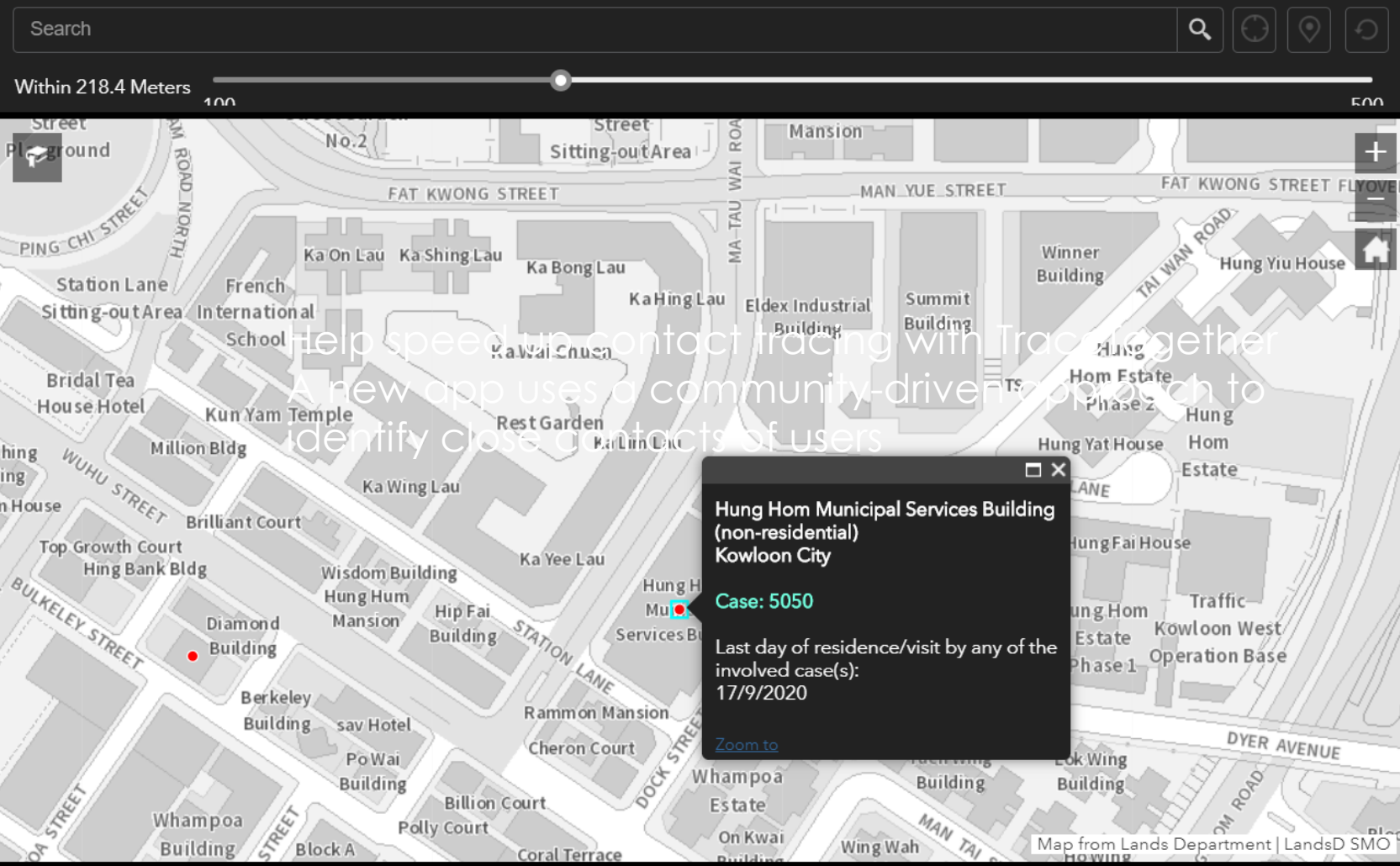
Critical

12

Death

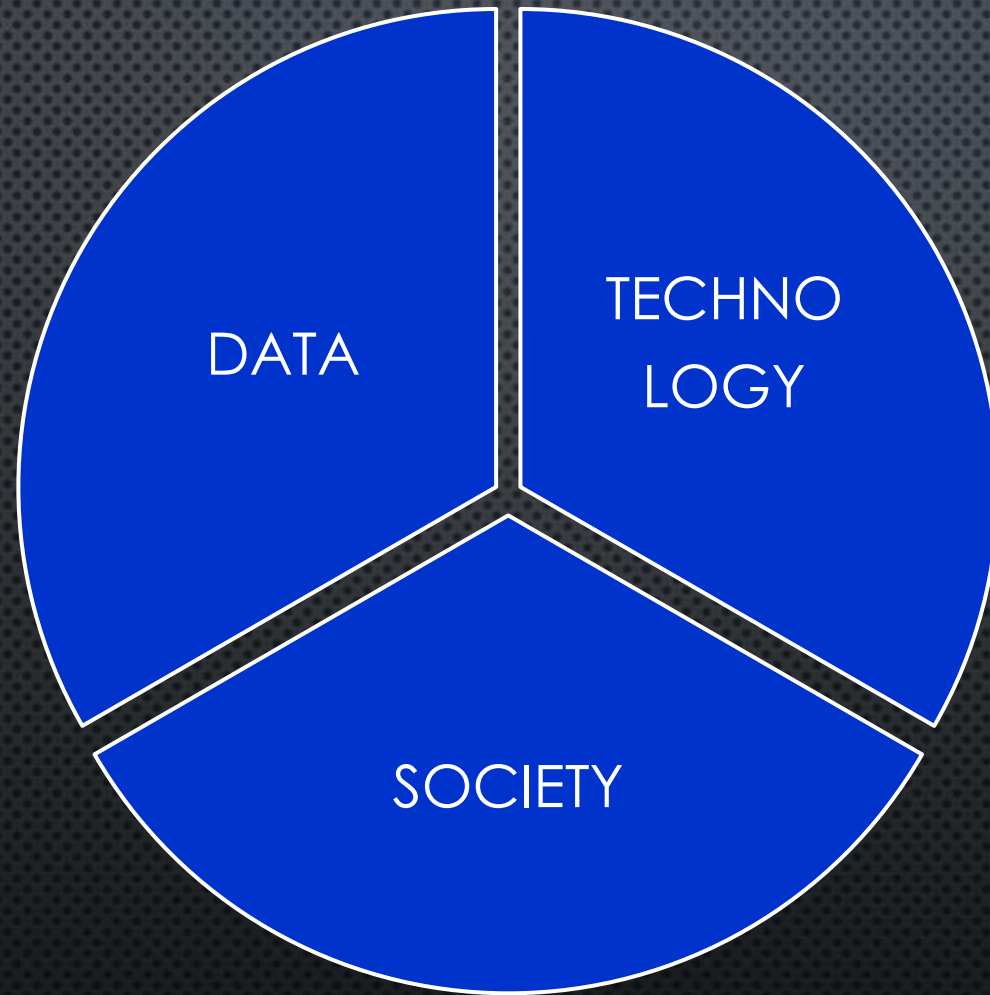
105

▲ 1



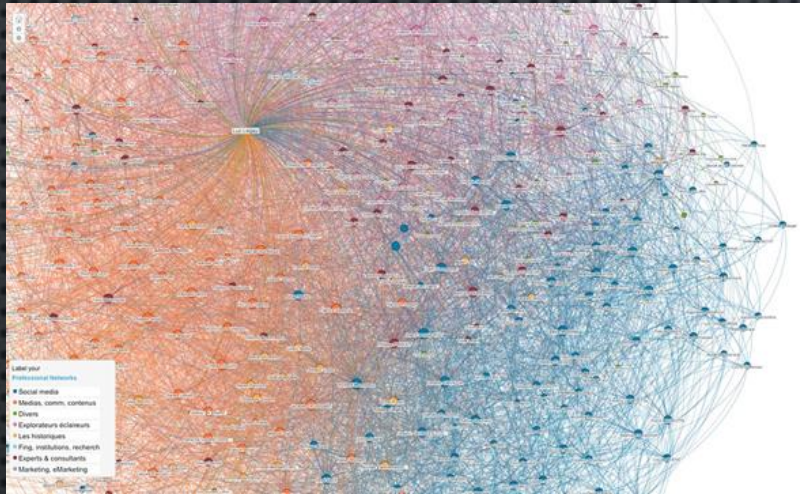
- Buildings with cases in the past 14 days (28 days if with cluster)
- Related Case(s): 5057
Tuen Mun Tai Sang House, Kin Sang Estate
- Related Case(s): 5056
Yuen Long Block 7, Kenswood Court, Kingswood Villas
- Related Case(s): 5054
Yau Tsim Mong Silka Seaview Hotel
- Related Case(s): 5053
Wan Chai Dorsett Wanchai
- Related Case(s): 5052
Wan Chai Dorsett Wanchai
- Related Case(s): 5051
Islands Hong Kong Skycity Marriott Hotel
- Related Case(s): 5050
Kowloon City Hung Hom Municipal Services Building (non-residential) 17/9/2020
- Related Case(s): 5050
Kowloon City Po Sun Mansion (non-residential) 20/9/2020
- Related Case(s): 5050
Kowloon City Block A, Fok Lin Building

SPATIAL ERA:



- **GREAT AMOUNTS**
- **RAPID CHANGE**
- **NO LIMITATIONS**

SPATIAL ERA:



• DATA, APPLICATIONS, SERVICES

- Abundance
- Finer spatiotemporal resolution
- Real-time
- Interoperable

- Location-based real-time monitoring applications are the fastest growing geospatial services
- Expected to be the biggest drivers of the Earth Observation field in coming years.
- This will create an unprecedented amount of data at an exponential scale.

- **Massive amount of resources**

- Provide knowledge about places, events, phenomena, geospatial concepts
- Come as unstructured or semi-structured - natural language
- Need support for semantic annotation and search

SPATIAL ERA:

- **TECHNOLOGY**

- Positioning & Navigation
- Real-time sensors
- High definition maps (AV)
- Open Cloud
- Spatial Analytics
- AI – ML - DL
- Interaction – mixed realities
- Digital twins
- Cybercartography

SPATIAL ERA:

- **SOCIETY**

- Neogeography
- Education
- Language and cognition
- Story mapping
- fakeGEO – misinformation and truth
- Ethics
- Inclusion - empathy

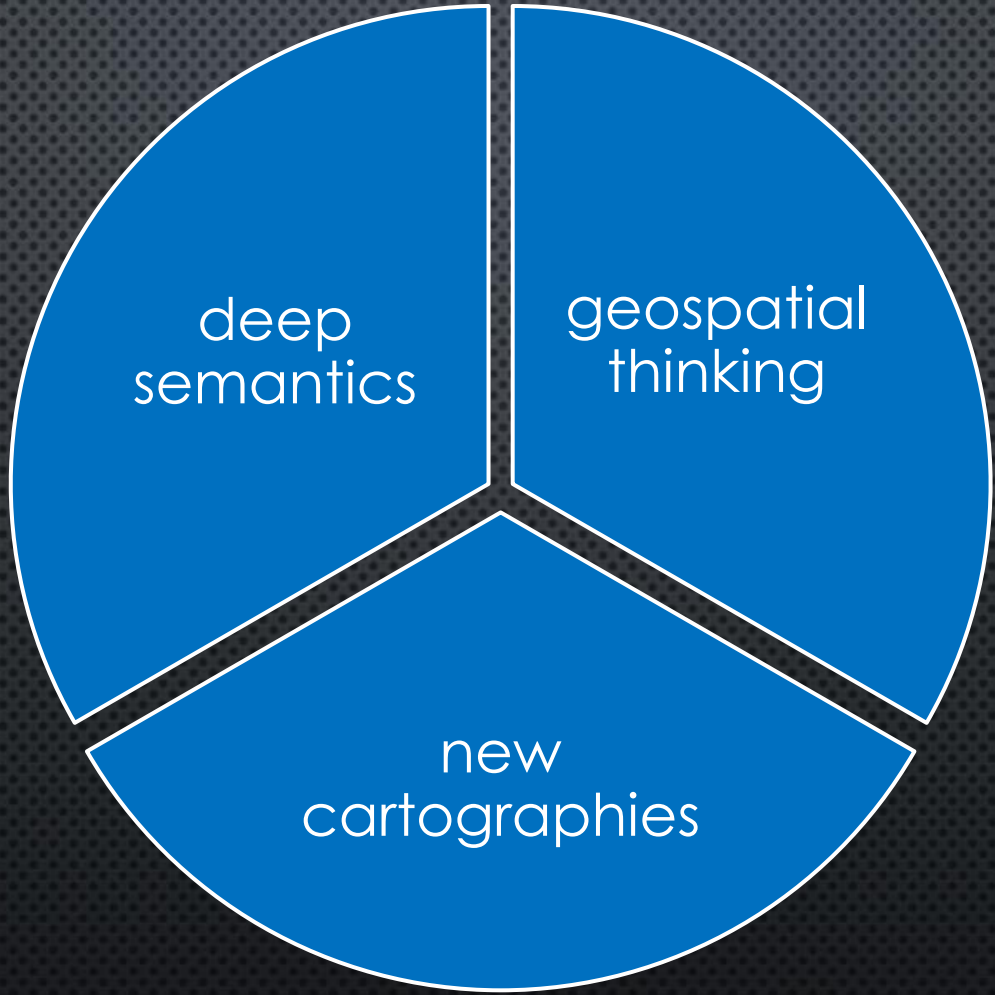
SPATIAL ERA:
UNCERTAIN KNOWLEDGE
IT IS SO (IF YOU THINK SO)

- Lots of data – uncertain meaning
- New cartographers - questionable content
- Spatial Literacy
- Expert vs. common sense views
- Misconception of sharing common concepts/truth/world
- Conflicting versions of the truth (Luigi Pirandello)
- Living in individual constructed Truman realities
- Fake maps

DEVELOPING THE SPATIAL CITIZEN

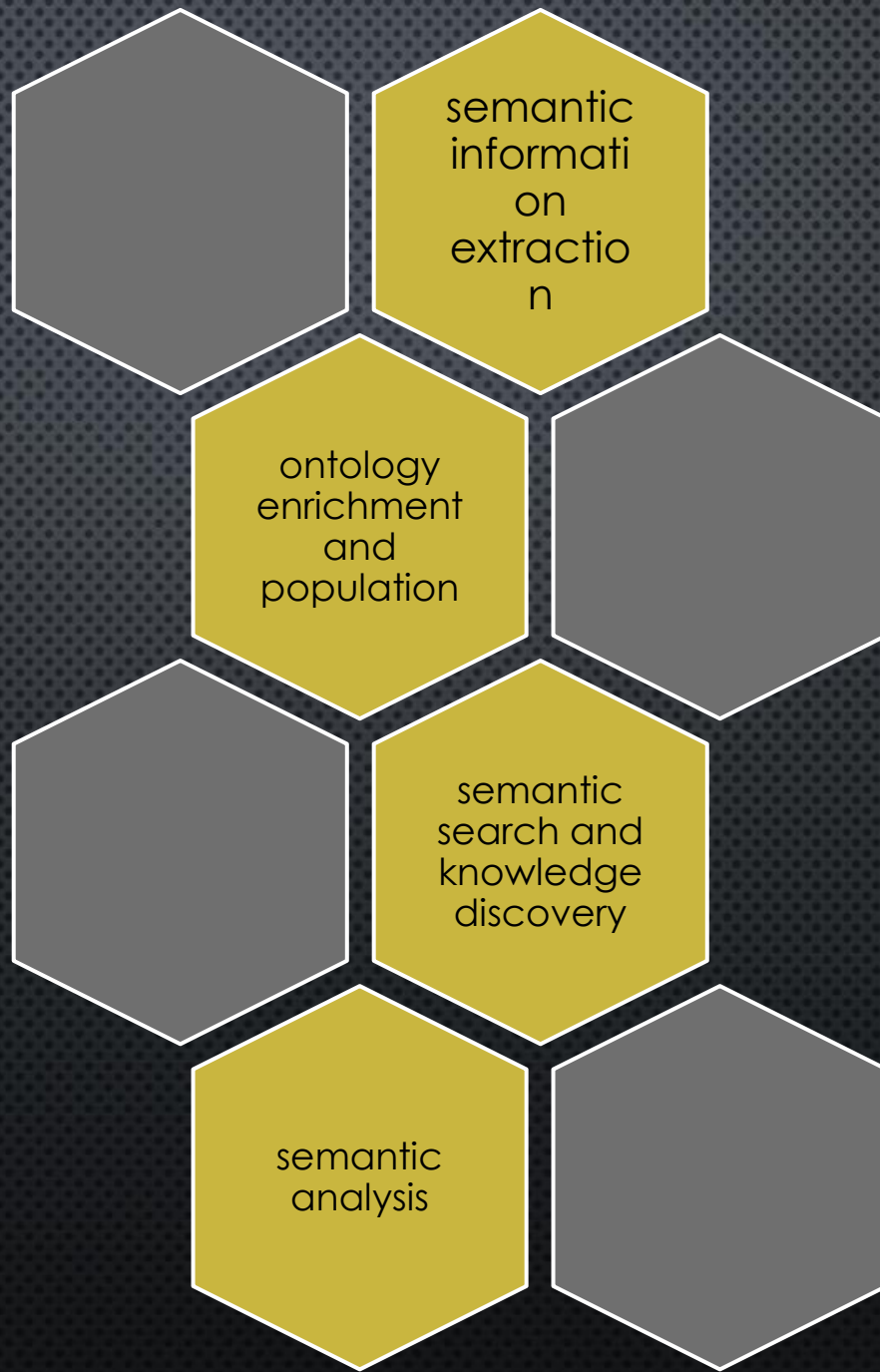
FACTS ABOUT SPATIAL SKILLS

- SPATIAL SKILLS CAN BE IMPROVED
- TRAINING MATTERS
- IMPROVEMENTS TO COGNITIVE SPATIAL ABILITY ARE DURABLE
- THERE IS A RELATIONSHIP OF PERFORMANCE ON TESTS OF SPATIAL SKILLS AND THE CHOICE OF CAREERS



(GEO) SEMANTICS

- Semantics-meaning-knowledge
- The importance of formalizing meaning
- Expert's vs. common sense
- Semantic interoperability
- Essential properties and meaning
- Dealing with scale and detail
- Spatial Knowledge elicitation from text



SEMANTIC INFORMATION EXTRACTION

Is sea level rising?

Yes, sea level is **rising at an increasing rate**.



With continued ocean and atmospheric warming, sea levels will likely rise for many centuries at rates higher than that of the current century. In the United States, almost 40 percent of the population lives in relatively high-population-density coastal areas, where sea level plays a role in flooding, shoreline erosion, and hazards from storms. Globally, eight of the world's 10 largest cities are near a coast, according to the U.N. Atlas of the Oceans.

*(US National Ocean Service, **Is sea level rising?**)*

Is sea level rising?

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*(US National Ocean Service, **Is sea level rising?**)*

EXAMPLE

Atolls and low-lying coastal areas on islands are particularly vulnerable to **sea level rise**. Possible impacts include **coastal erosion and flooding**. **Low-lying countries** such as **Maldives** and **Tuvalu** are among the **areas** that are at the highest level of risk.

Spatial concept

Spatial entity

Spatial relation

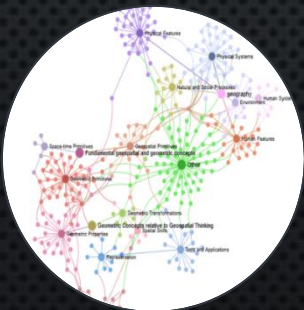
Instance of relation

SEMANTIC ENRICHMENT OF
USER-GENERATED CONTENT
WITH SPATIAL CONCEPTS AND ENTITIES

map-based
search and
visualization



semantic
search and
visualization



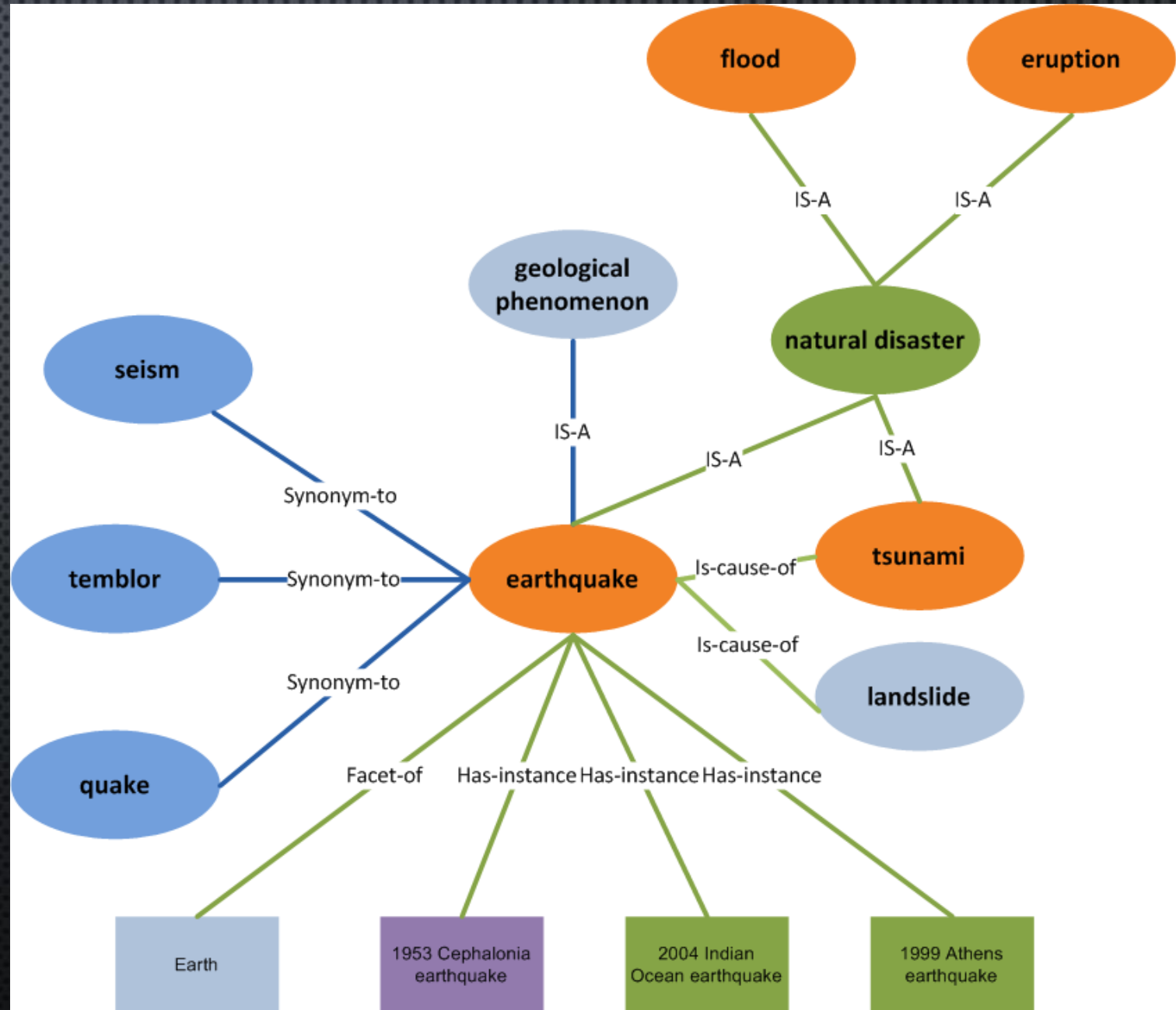
SEMANTIC SEARCH AND KNOWLEDGE DISCOVERY

SEMANTIC-BASED SEARCH

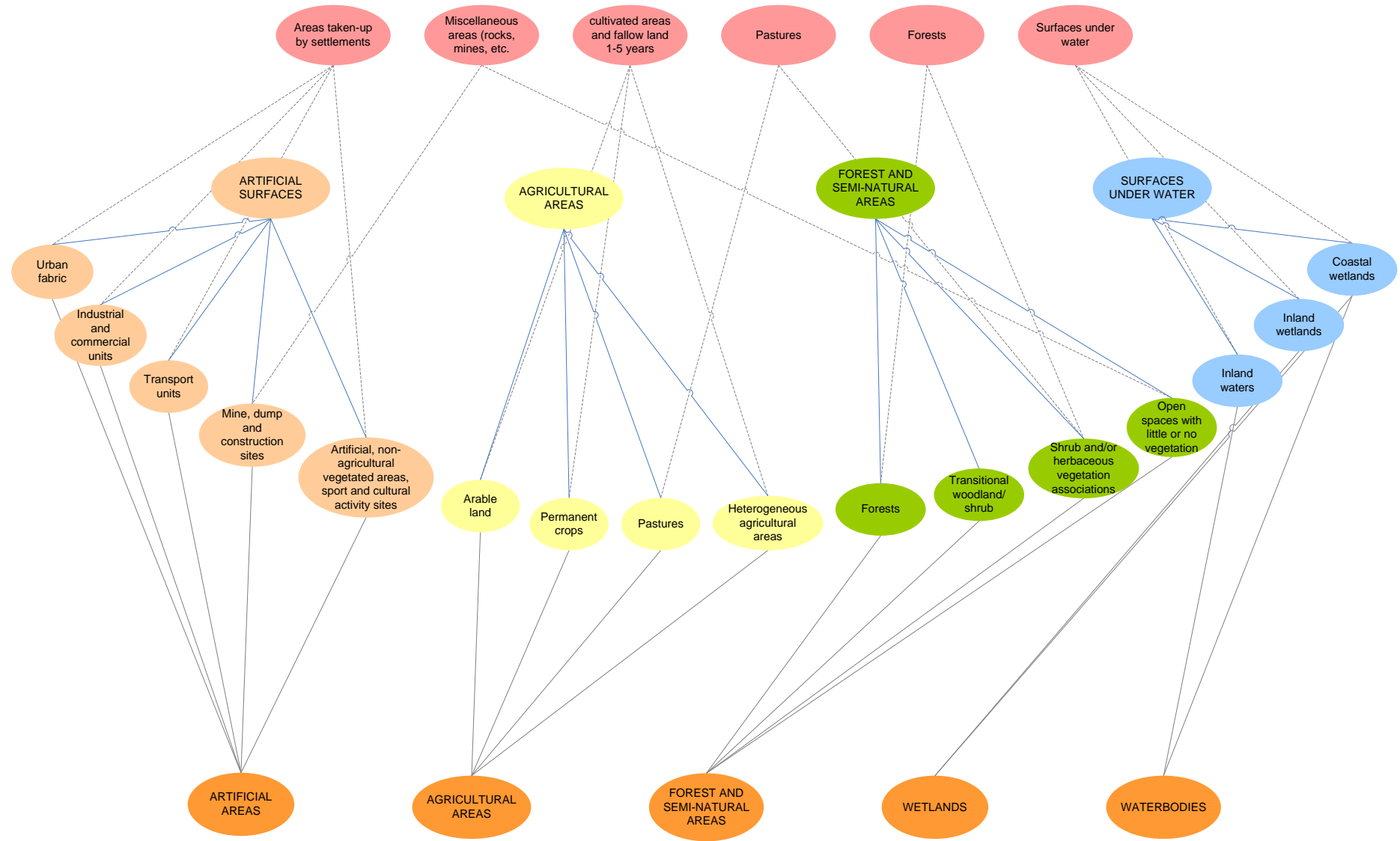
- MAY IDENTIFY RELEVANT SOURCES THAT **DO NOT NECESSARILY CONTAIN THE KEYWORD USED IN THE QUERY**.
- FOR EXAMPLE: **“GEOLOGICAL PHENOMENA IN THE MEDITERRANEAN”** WOULD IDEALLY RETURN RESOURCES INCLUDING:
 - “EARTHQUAKES IN IONIAN ISLANDS”,
 - “VOLCANIC ERUPTION OF MOUNT VESUVIUS” AND
 - “SOIL EROSION IN SPAIN”
- ALTHOUGH THESE RESOURCES **MAY NOT EXPLICITLY MENTION THE TERMS “GEOLOGICAL PHENOMENA” OR “MEDITERRANEAN”**.

Semantic search

- **SEMANTIC RELATIONS** BETWEEN CONCEPTS AND **SPATIAL RELATIONS** BETWEEN PLACES ARE STORED IN ORDER TO ENABLE SEMANTIC SEARCH OF THE CONTENT.



Semantic Interoperability - Ontology Integration



NEW CARTOGRAPHIES

interactive, inclusive, ubiquitous
and metaphorical

mapping

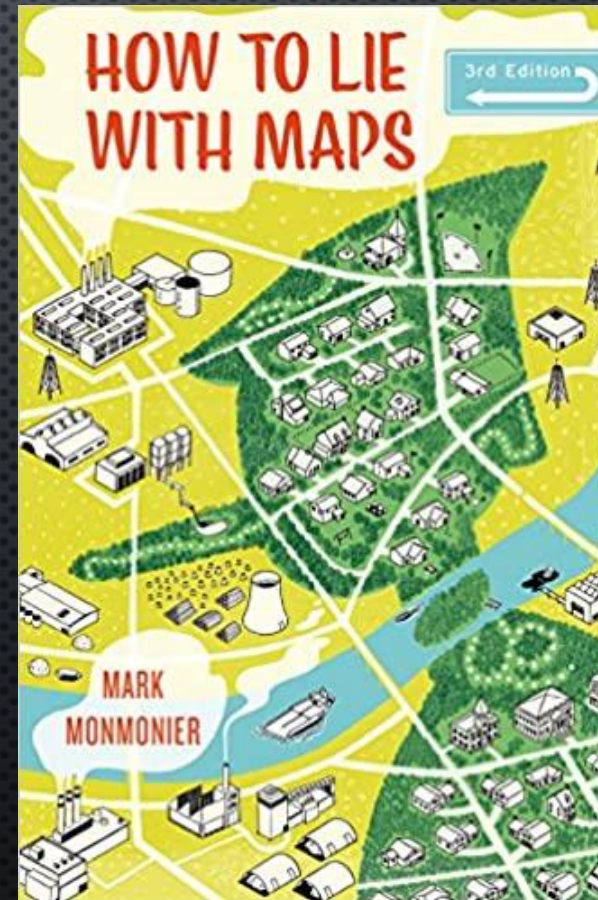
everything (geo or non-geo)

NEW CARTOGRAPHIES

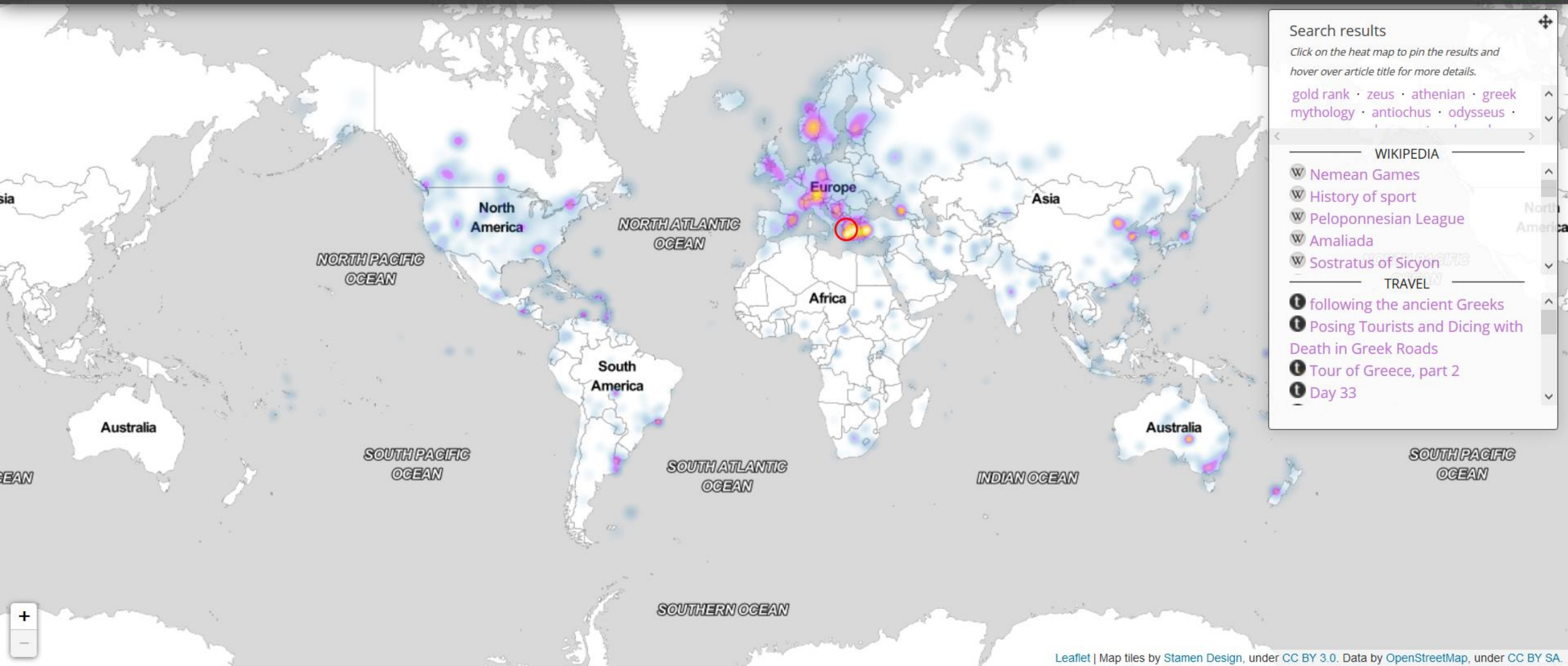
- Spatialization
- Conceptual graphs
- Exploiting the authoritative power of maps
- Maps from everyone
- From serving personalized content to serving personalized maps
- Our “objective maps” are not that objective!
- Cartography is the next generation of language for the world

GOOD MAPS – TERRIBLE MAPS

The authoritative character of maps is that strong and easily trusted, that it can be easily exploited to convey fake information



INTERACTIVE THEMATIC MAP ENGINES



Search results

Click on the heat map to pin the results and hover over article title for more details.

gold rank · zeus · athenian · greek mythology · antiochus · odysseus ·

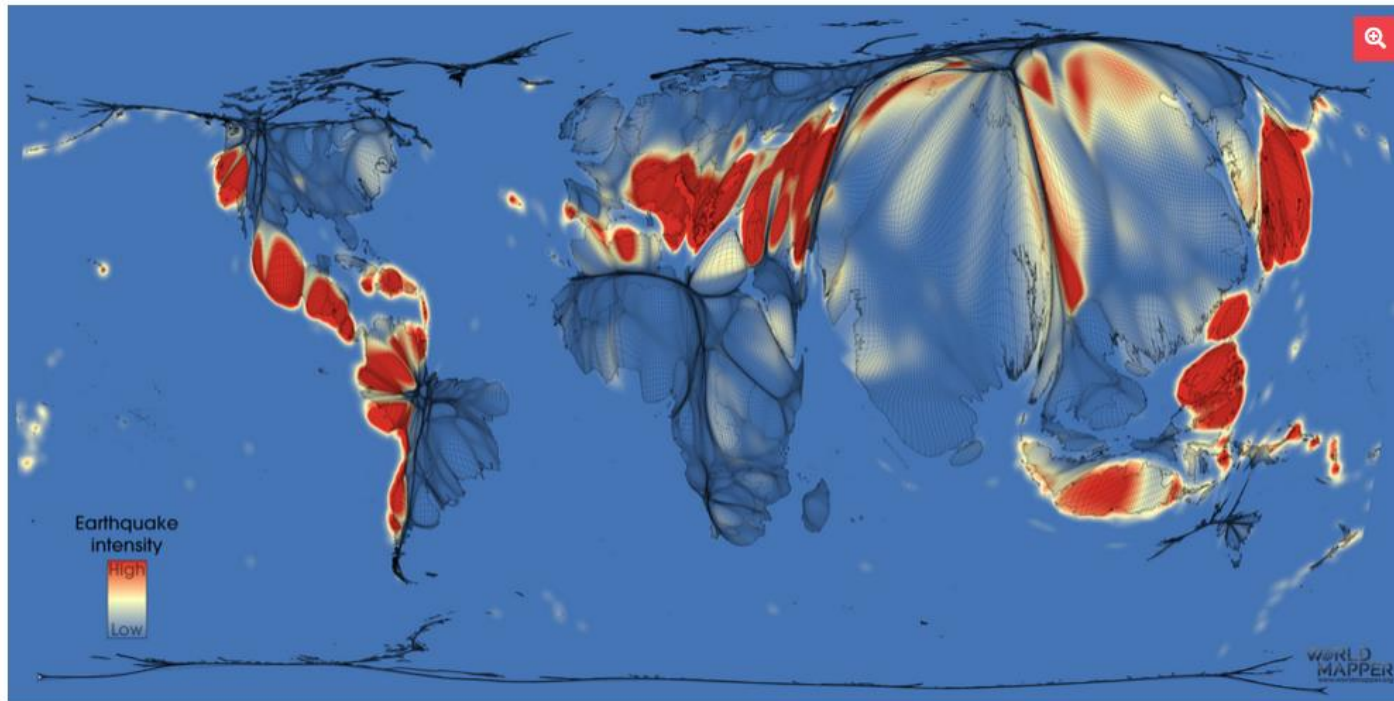
WIKIPEDIA

- W Nemean Games
- W History of sport
- W Peloponnesian League
- W Amaliada
- W Sostratus of Sicyon

TRAVEL

- I following the ancient Greeks
- I Posing Tourists and Dicing with Death in Greek Roads
- I Tour of Greece, part 2
- I Day 33

Earthquake Risk



MAP NO.

175

TOPIC(S)

Environment - Hazard

SHARE



RELATED

- Earthquakes Deaths 2001-2017
- Earthquakes Damages 2001-2017
- Earthquakes 2001-2017

TECHNICAL NOTES

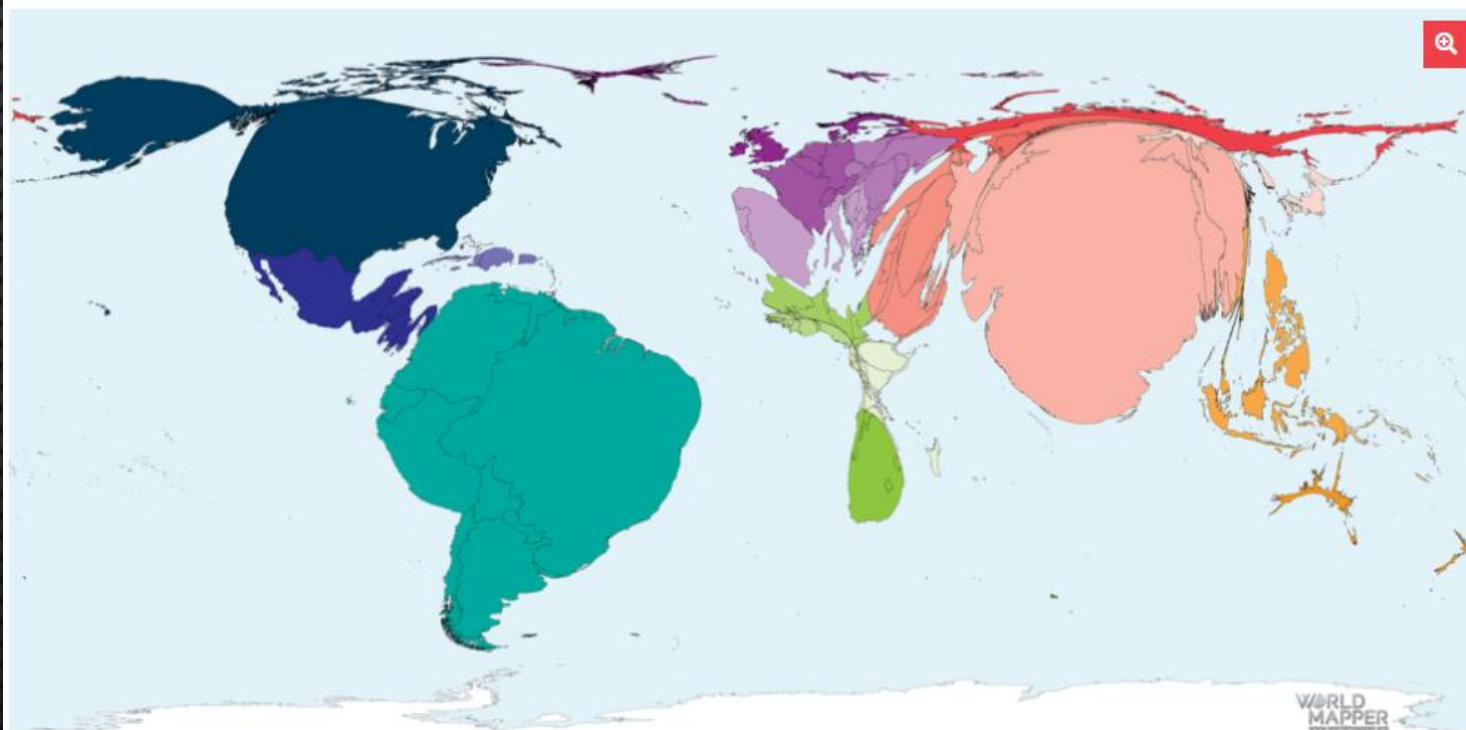
This map shows the land surface resized by its population overlaid with data about earthquake intensity records from a global listing of over 5,700 earthquakes from 2150 BC to the present. Each transformed grid cell in the map is proportional to the total number of people living in that area.

Data sources

This map uses population estimates for the year 2020 based on data from the [Gridded Population of the World \(GPW\), v4](#) at 0.25 degree resolution, released by SEDAC (Socioeconomic Data and Applications Center). The map overlay is a kernel density estimate using data derived from the Global Significant Earthquake database created by NOAA's National Geophysical Data Center ([doi:10.7289/V5TD9V7K](#)). The database "contains information on destructive earthquakes from 2150 B.C. to the present that meet at least one of the following criteria: Moderate damage (approximately \$1 million

|| A bad earthquake at once destroys the oldest associations: the world, the very emblem of all that is solid, has moved beneath our feet like a crust over a fluid; one second of time has conveyed to the mind a strange idea of insecurity,

Covid-19/Coronavirus deaths August 2020



MAP NO.

1135

TOPIC(S)

Health - Disease

SHARE



RELATED

- [Covid-19/Coronavirus cases \(rates / per capita\)](#)
- [Covid-19/Coronavirus mortality \(rates\)](#)
- [Covid-19/Coronavirus deaths \(January-August 2020\)](#)
- [Covid-19/Coronavirus cases \(January-August 2020\)](#)

TECHNICAL NOTES

This map shows the proportion of new confirmed deaths of Covid-19 (coronavirus) in August 2020.

Data sources

This map uses data by WHO (accessed 04. September 2020). We aim to map as complete data as possible and therefore estimate data for missing values. In some cases, missing data for very small territories is not used in the cartogram and that area is therefore omitted in the map.

Further notes on the data, as well as all modification to the original data source are noted in our data sheets.

[Download data file](#)

COLOUR KEY



It's going away. It'll go away. Things go away. No question in my mind that it will go away.

Donald Trump, President of the USA on 5 August 2020

Information Extraction (IE)

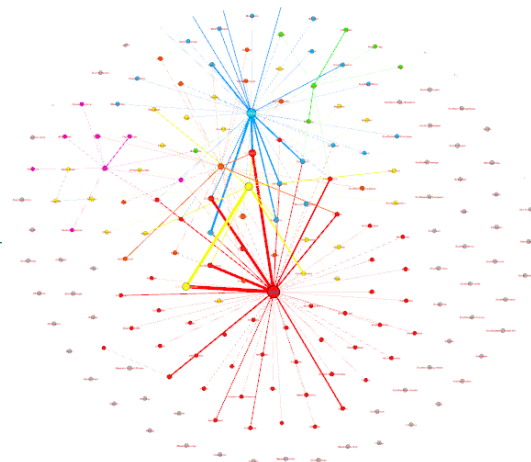
Sentiment Analysis (SA)

Texts in NL

Information

Environmental terms

Locations



Sentiment

Polarity

Negative Positive Neutral

anger joy

disgust surprise

fear cheeky

sadness happy

swearing cute

bad good

Emotions

To conclude,

- Everything is spatial
- The rapid increase of data, resources, technological changes and the involvement of people, pose new challenges for GIS
- Location-based real-time monitoring applications
- Real-time and data driven visualization
- As everybody becomes a cartographer, people's data contribute to knowledge creation and the empowerment of spatial citizens
- Misconception of sharing common concepts/truth/world
- Semantic instruments are essential to information extraction, comparison and integration, but also validation.
- Cartography will become story-telling language for the next generation
- Many ethical issues to tackle