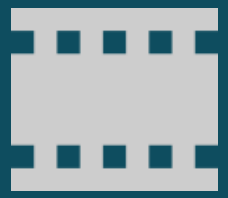
Thank you for joining us!

We will start shortly.



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ELISE action
Webinar Series

Geospatial Data and Artificial Intelligence: a deep dive into GeoAI

Sebastiaan VAN DER PEIJL, Deloitte
Dhananjay IPPARTHI, Deloitte
Lea YTREHUS, Deloitte
Lorena HERNANDEZ, European Commission JRC
Simon VREČAR, European Commission JRC (consultant)
Uroš KOSTIĆ, European Commission JRC (consultant)

09/07/2020 14.00 -15.00

European Location Interoperability Solutions for e-Government

Enabling Digital Government through Geospatial and Location Intelligence

ISA²

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Cross-Border *and* ***Cross-Sector*** *Interoperability Solutions*

For ***Public Administrations, Businesses*** *and* ***Citizens***

54 different actions tackling **interoperability** from different angles

ELISE action is the **only** action focusing on the **location dimension**

European Location Interoperability Solutions for e-Government

Enabling Digital Government through Geospatial and Location Intelligence

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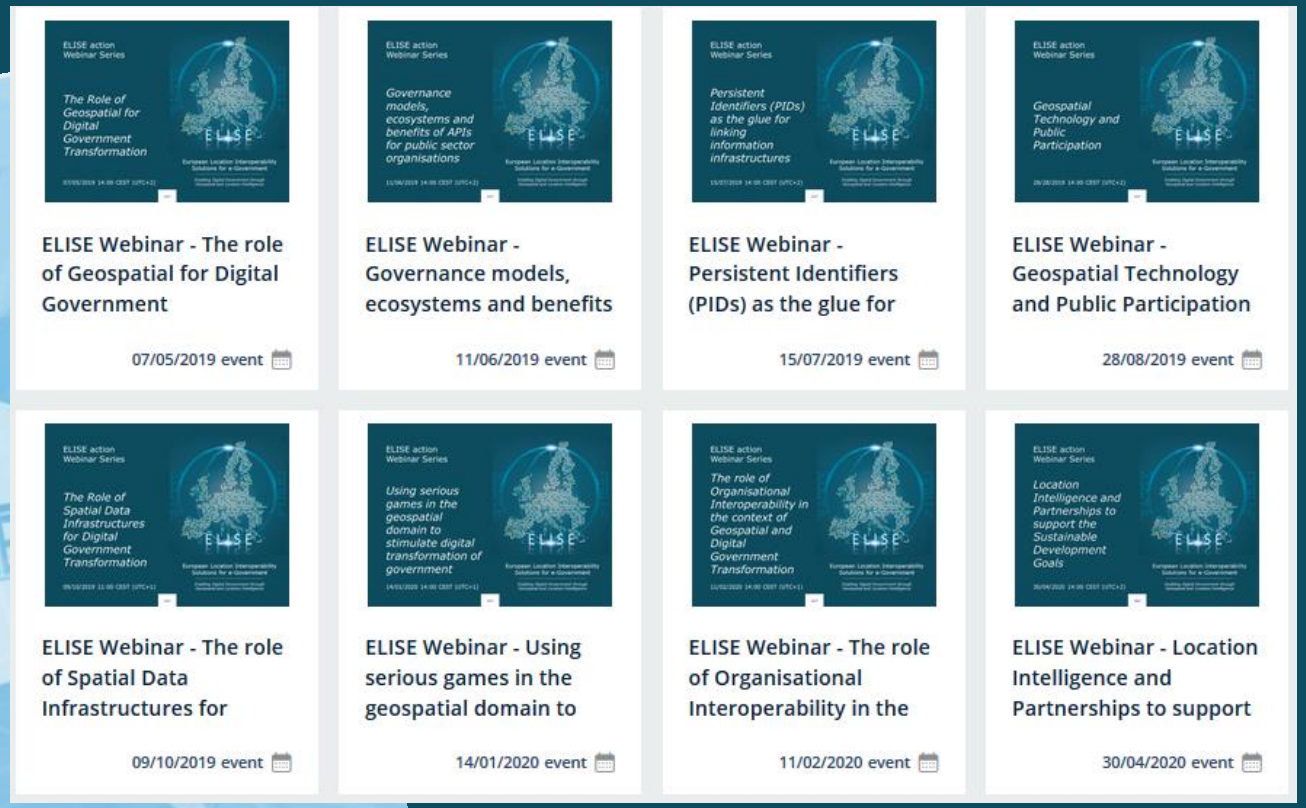
Welcome to the ELISE webinar series



ELISE **Knowledge Transfer** activities

Purpose:

- engage in **an agile way**
- with **topics** of relevance to the **Digital Transformation**
- **by harnessing the use of spatial data and technology**.

https://europa.eu/!nP74ph

About our speakers

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The views expressed are purely those of the authors and may not in any circumstances be regarded as stating an official position of the European Commission.

Deloitte. ISA² KU LEUVEN

What we will cover today

1. Introduction – Setting the scene & key terms
2. *GeoAI* - Origins, present & future trends – research areas and applications
3. Enabling GeoAI - Converging political & technical environments
4. GeoAI applied - Demonstrating mounting relevance in key public policy areas
5. Interoperability efforts and challenges
6. Key take-away messages and conclusions
7. Q&A

1

Introduction: Setting the scene & key terms

> *Artificial Intelligence is developing fast. It will change our lives by improving healthcare (..), increasing the efficiency of farming, contributing to climate change mitigation and adaptation, improving the efficiency of production systems through predictive maintenance, increasing the security of Europeans, and in many other ways that we can only begin to imagine.*

European Commission, White Paper on Artificial Intelligence, A European approach to excellence and trust (2020)

Setting the scene:
What is AI and what is its potential for *geospatial thinking*?

Artificial Intelligence (AI) is the field of computing where intelligent machines **augment human cognitive capabilities and experiences.**

Increased availability of geospatial data + Advancement of AI + Availability of massive computing power = A momentum for the mounting relevance and potential of GeoAI

This has led to:

1. the opportunity of digital exploitation of geo-located data
2. implementation of geospatial analytics and
3. development of location-based services

JRC, Exploring Digital Government Transformation in the EU, (2019)

Key definitions for this webinar 1/3

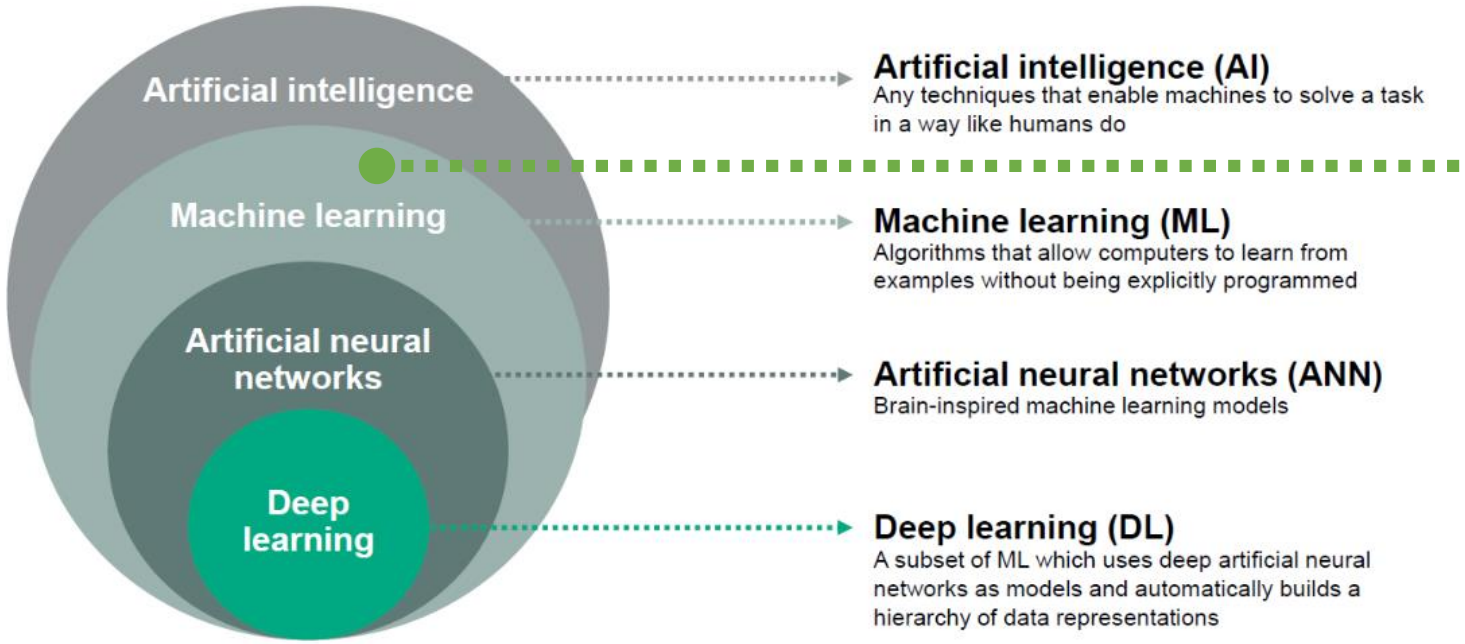
"Artificial intelligence (AI) systems are software (and possibly also hardware) systems designed by humans that, given a complex goal, act in the physical or digital dimension by perceiving their environment through data acquisition, interpreting the collected structured or unstructured data, reasoning on the knowledge, or processing the information, derived from this data and deciding the best action(s) to take to achieve the given goal. AI systems can either use symbolic rules or learn a numeric model, and they can also adapt their behaviour by analysing how the environment is affected by their previous actions."

EU High Level Expert Group on AI

Photo by Joshua Hoehne on Unsplash

Key definitions for this webinar 2/3

AI intra-relationships



Hewlett Packard Enterprise

"Geospatial Artificial Intelligence (GeoAI) is a sub-discipline of Artificial Intelligence that uses machine learning to extract knowledge from spatial data"

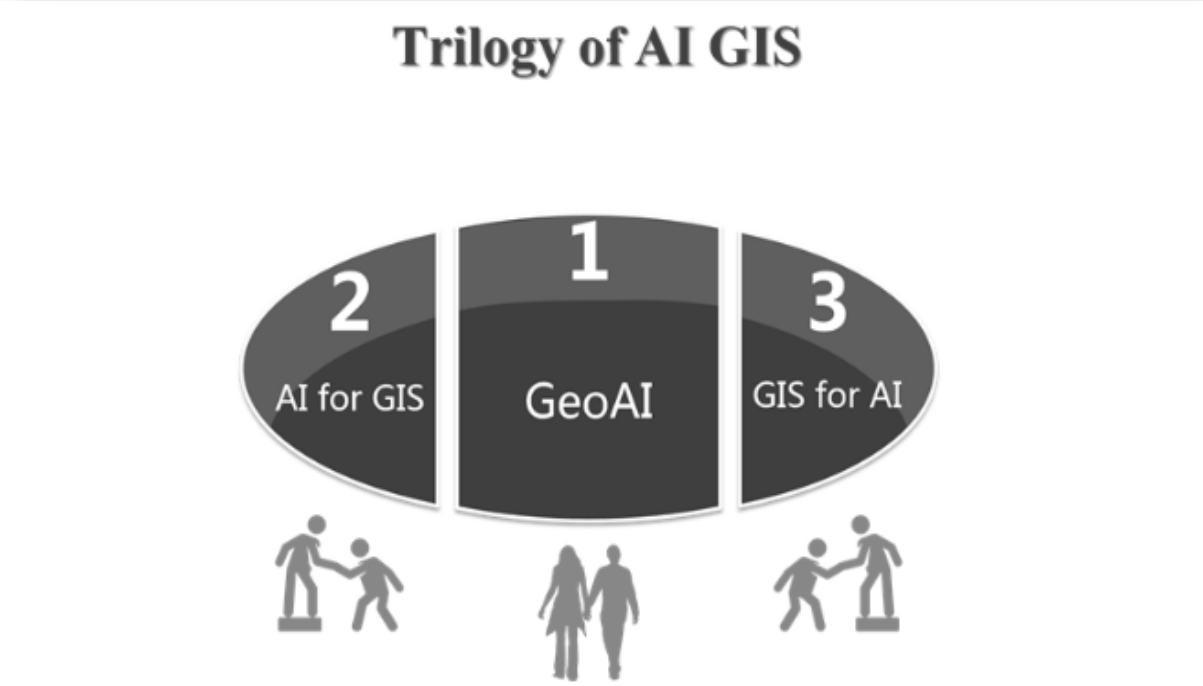
UNGGIM Future Trends Report (2020)

Source: Hewlett Packard

Key definitions for this webinar 3/3

" Geospatial artificial intelligence (GeoAI) is an emerging scientific discipline that combines innovations in spatial science, artificial intelligence methods in machine learning (e.g., deep learning), data mining, and high-performance computing to extract knowledge from spatial big data. "

Vopham, Trang & Hart, Jaime & Laden, Francine & Chiang, Yao-Yi. (2018)



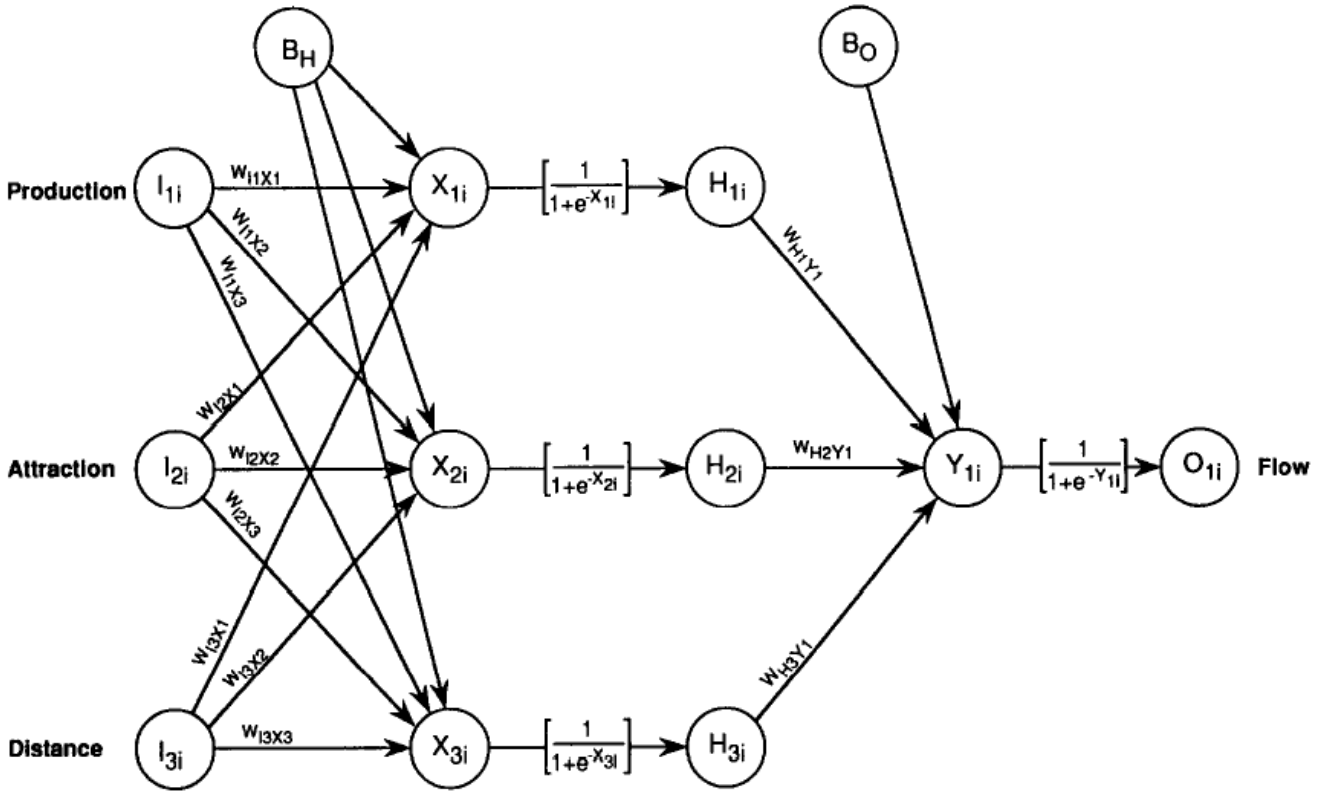
Source: Supermap

2

GeoAI:
Origins, present & future trends –
research areas and applications

GeoAI: a concept that dates back

- GeoAI is a not a new concept. It was first mentioned in the literature in the late-1980s.
- Black (1995) highlights how **artificial neural networks** using traditional gravity model components were proposed as an alternative to the fully constrained gravity model.
- This would in turn facilitate **spatial interaction modelling** and initiated spatial data processing and analysis.

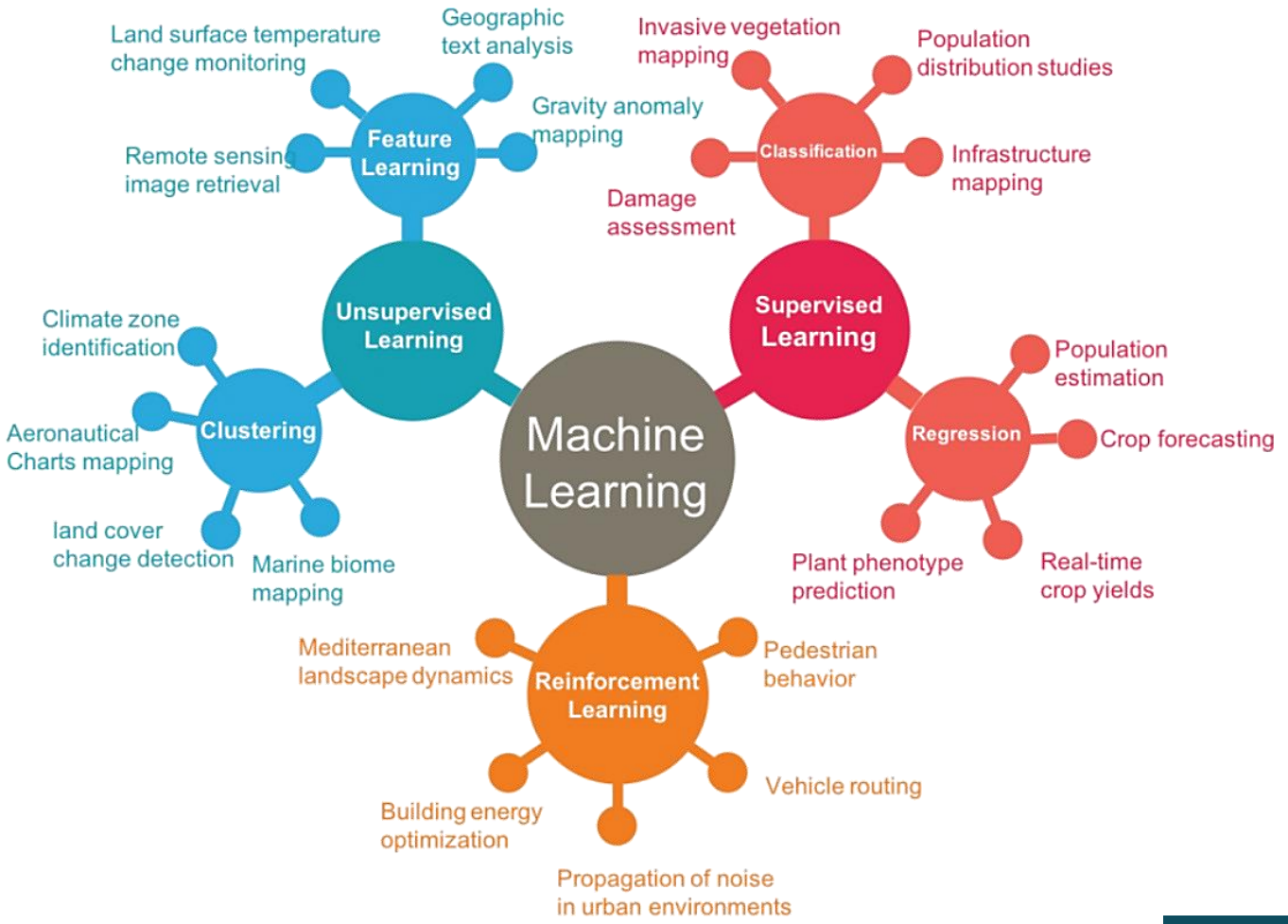


Source: Black (1995)

Diving deeper:
Why is GeoAI a field in itself?

GeoAI, i.e., the integration of geography and AI, provides novel approaches for addressing a variety of problems in the natural environment and our human society.

GeoAI is unique, as it has the **ability to handle time and space features** and equally or more importantly **spatial relationships** .



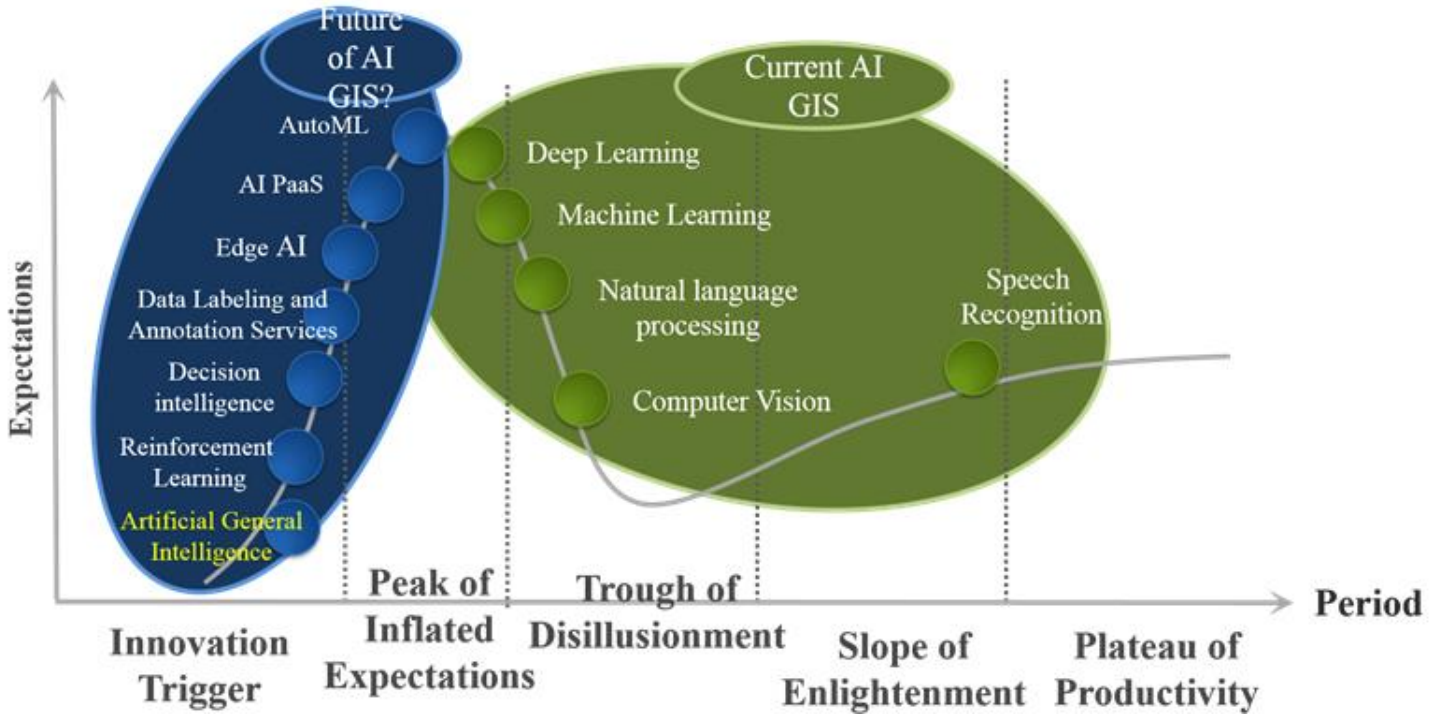
Source: GISTBOK

GeoAI: what is new and what are the future trends?

As AI is increasingly accessible in economic, skills and technical terms, the use of GeoAI is in turn greater for powered services.

What is the future outlook?

AI, cloud technology and infrastructure, geospatial analytics and visualisation will continue to be brought together to help create more powerful and intelligent applications (e.g. *Esri*, *Azure*)



Source: SuperMap

3

Enabling GeoAI:
Converging political & technical environments

European policy and initiatives: Creating an enabling environment for the uptake of GeoAI

- The Declaration of Cooperation on AI (2018) and the Communication on AI for Europe (2018) set the direction to ensure Europe's role in research and deployment of AI.
- The EC Whitepaper on Artificial Intelligence reflecting a coordinated European approach.
- AI Watch, the Commission's Knowledge Service, was set up to monitor the development, uptake and impact of AI for Europe.

…but the uptake of GeoAI touches upon a multitude of policy areas:

1. The need for urban digital ecosystems
2. The need for interoperability between systems and services
3. The need for coherent and commonly agreed upon standards

Source: JRC (2020)

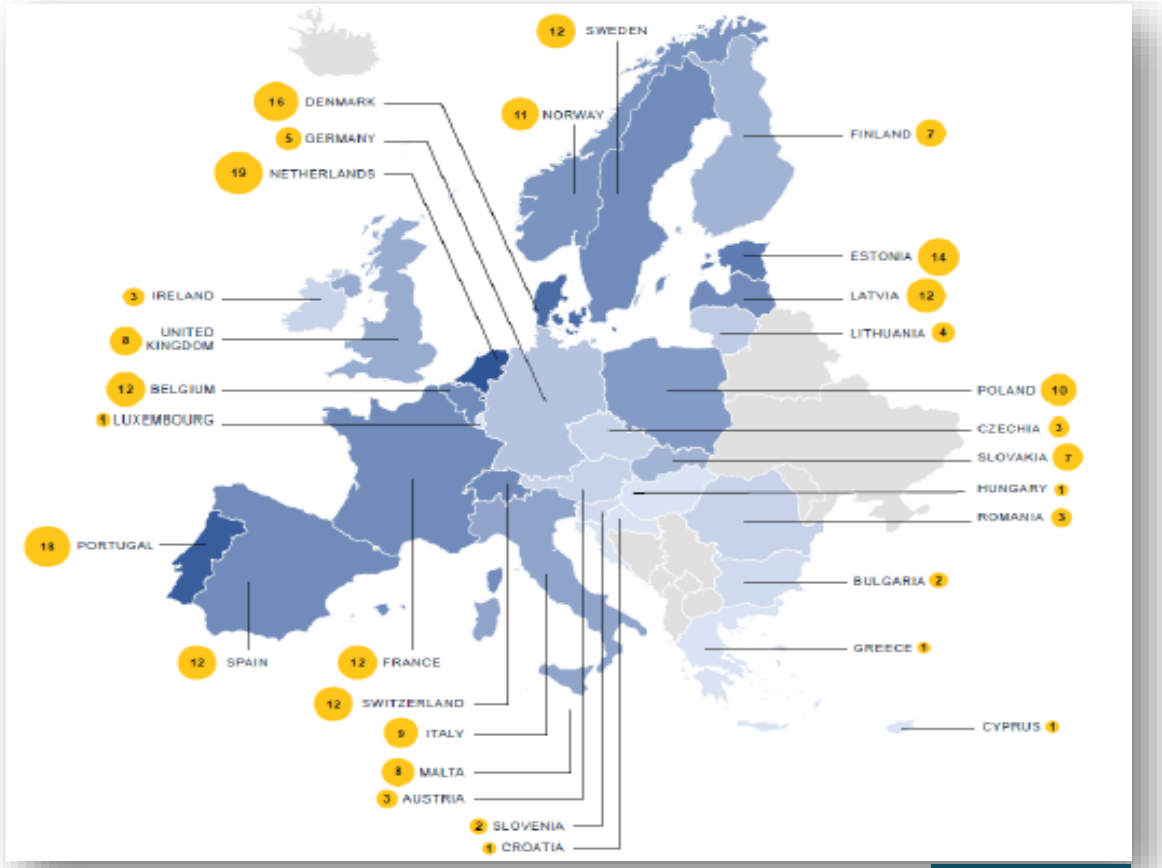
Source: JRC (2018)

Demonstrating mounting relevance in key public policy areas

AI Watch, the EC Knowledge Service to monitor AI in for Europe, has found:

- There is **growing use of AI within governments**
- The **policy sectors** in which AI is most used are: General Public Services (33%), Health (18%) and Economic Affairs (17%) with 30% of cases at local/municipal level

Section 4 will provide concrete examples of GeoAI systems and applications that have the potential to significantly impact key public policy areas.



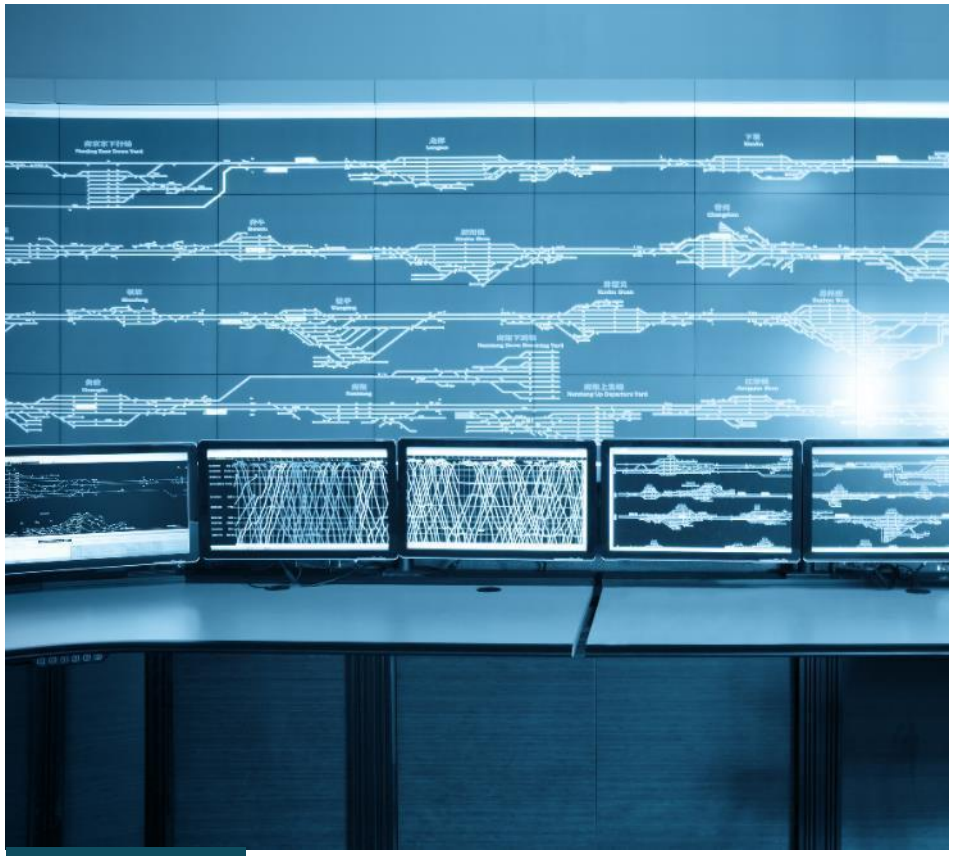
Source: JRC (2020)

Data availability, synthesis and advancements in AI technologies as a momentum for GeoAI

1 - (Big) Data & Analytics

2 - Massive Computing power

3 - Human-System Integration



Source: Deloitte (2020)

Technological deep dive 1: (Big) Data & Analytics

Big Data is voluminous, high velocity and highly variable that is not amenable to "traditional" analysis.

Big Data can be used for..

- Advanced prediction
- Pattern recognition
- Classification
- Enhanced customer experience
- Deep learning

Source: Simplilearn

What is the future outlook?

Big Data will evolve into: (1) new domains, (2) get more connected, (3) more personalised and (4) more accurate predictions at a (5) higher velocity.

However, there is a need for: (1) quality, (3) privacy, (4) security, (5) trust, and preventing (6) discrimination/bias.

What does it mean for GeoAI?

Advanced gathering, flow and storing of larger volumes and different forms of GeoData, will provide better insights and predictions.

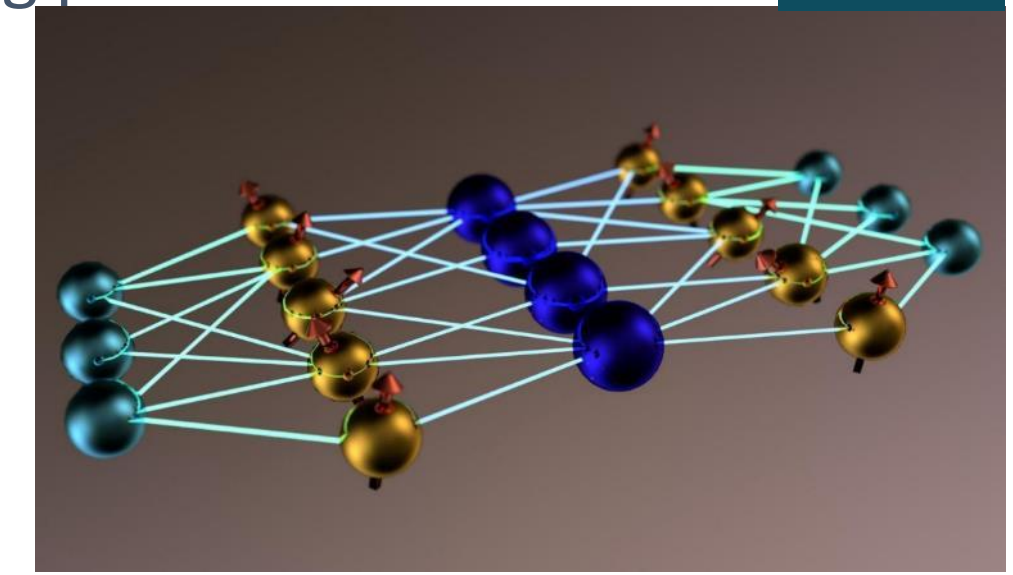
Technological deep dive 2: Massive Computing power

Computing power is a function of three parameters:

1. speed,
2. volume and,
3. type of computations which a processor computes.

Application of advanced or complex **theoretical concepts** rely heavily on the computing power. Better computing power **implies more complex problems can be solved faster**.

Source: Medium.com



What is the future outlook?

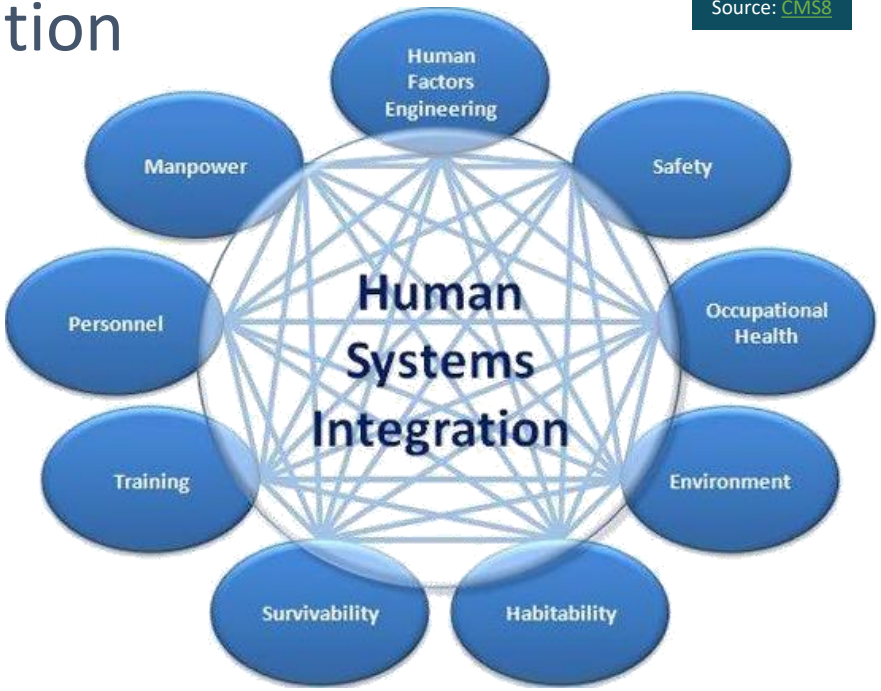
Computing power is currently growing. As per Moore's law: the power of chips, bandwidth and computers doubles approximately every 18 months.

What does it mean for GeoAI?

As geospatial data becomes more accessible for advanced analytical tools, increased computing power will provide **deeper** and **faster** insights on **large volumes** of **complex** geospatial data.

Technological Deep Dive 3: Human-System Integration

Source: CMS8



Human-System Integration is a field of expertise that pertains to how humans interact with AI systems.

It can be applied to a variety of areas: (1) interaction with apps on smartphones, (2) guiding swarms of robots, (3) immersive virtual/augmented/mixed reality.

→ E.g.: the effectiveness study of chatbots in the public administrations of Latvia, Vienna and Bonn.

What is the future outlook?

E.g.: (1) Physical realities could be mixed with virtual/augment/mixed aspects, (2) Personalised virtual worlds, (3) Public services flexible in time and space.

What does it mean for GeoAI?

Novel ways to interact with and gain insight from geospatial systems. Virtual reality systems for research, remote robotic systems to test and learn from unfavourable environments.

4

GeoAI applied: Demonstrating mounting relevance in key public policy areas

GeoAI to close the map gap: Facebook and OSM' Map with AI and RapiD

AI Geospatial

Why?

Creating maps remains a **manually burdensome, time-consuming process,** even with satellite imagery and mapping software. Moreover, **many parts of the world remain unmapped** which is an obstacle for development, disaster response and more.

What?

Map with AI and RapiD uses **deep learning** and weakly supervised training to **predict road networks** from **satellite imagery** and **Open Street Map**, and create new maps based on cooperation with OSM.

Map with AI takes the deep learning outputs and makes **them compatible with geospatial databases**, i.e. Open Street Map.

In extracting roads from satellite imagery, they use fully **convolutional neural networks** for **semantic segmentation** in conjunction with large-scale weakly **supervised learning**.

Source: Facebook Artificial Intelligence

GeoAI in health and environment: Tackling pollution with AI-enabled tracking

Why?

Air pollution is the cause of around **400 000 premature deaths** per year in the EU (EEA)

What?

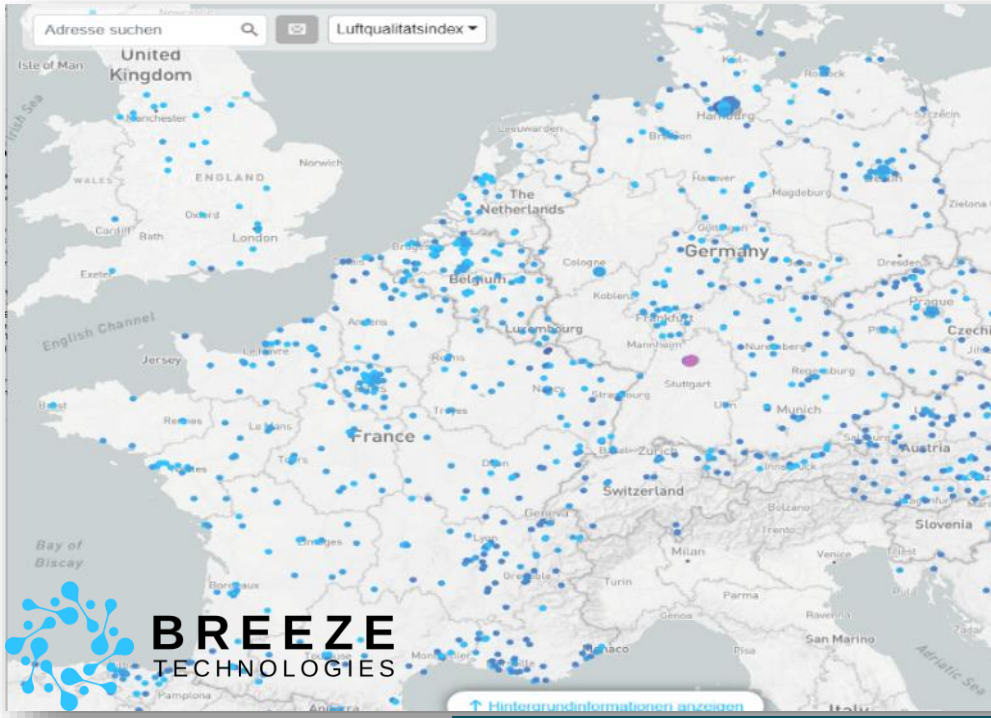
Breeze Technologies is a German IT start-up that helps cities design more efficient **clean air action plans**, by developing small-scale air quality sensors that measure pollutants, combining **real-time data** from sensors and satellites, and processing this in their platform using **machine learning** and **big data technology**.

Geospatial

Gathering **location and earth observation data to map pollution** in urban environments and renewable energy initiatives.

AI

Parameter estimation approaches to accurately provide measurements based on sensed data. The air quality **sensor** is said to be **intelligent** and **recalibrates** itself based on what it has learnt. Based on its learning, it also **predicts** necessary **maintenance.**



Source: Breeze Technologies Citizen Portal for Air Quality

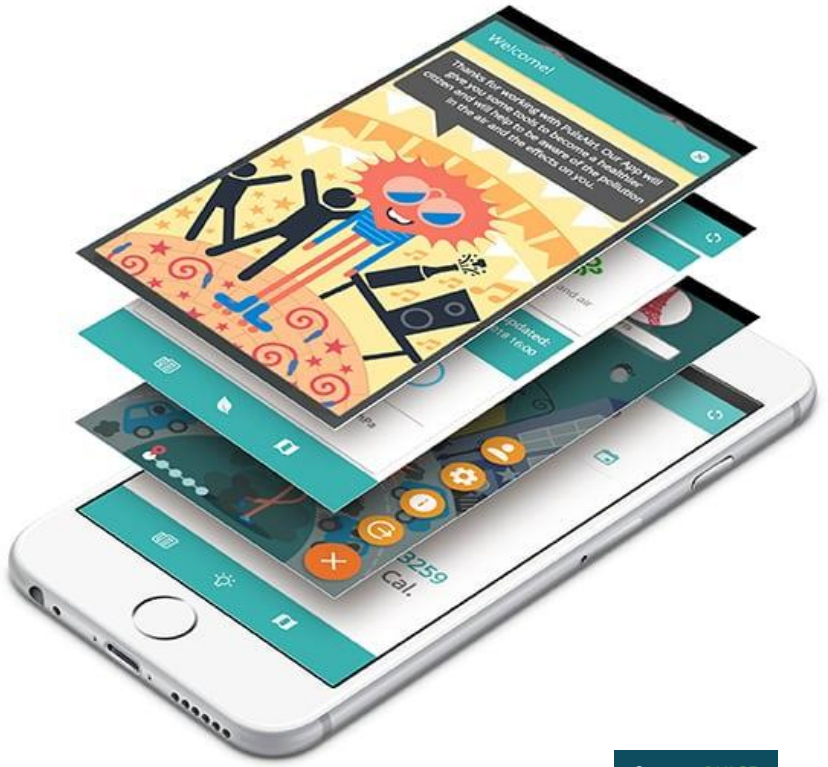
GeoAI in public health and environment: the PULSE project and its mHealth application Pulsair

Why? There are large potential benefits in moving public health **from a reactive to a predictive system.**

What? **PULSE** engaged with a range of stakeholders across **7 smart cities** in response to the **EU Urban Agenda** and current drivers of public health risks. The project created the **mHealth app Pulsair** and a **Public Health Observatory** with a visual dashboard for policy makers.

Geospatial AI Pulsair shows exposure to air pollutants by combining **location information** and data from sensors. The visual dashboard employs **WebGIS** for spatial analytics.

PULSE uses analytical tools to formulate tailored policy interventions, powered by **data mining**, **simulations** leveraging spatial-temporal **geolocated data** and **knowledge driven analyses**



Source: PULSE

GeoAI in mobility: Using AI to ensure co-modal freight transport

Why?

Freight transport currently suffers from from **low quality** and **reliability** due to lack of traffic management and planning of infrastructure works.

What?

Co-modal transport aims to achieve an **optimum in the transport system** by an efficient use of all modes. This would increase lead times, reduce inventory management costs and freight costs, and generate a smaller carbon footprint.

Geospatial

Conundra, a Belgian logistics company, uses **satellite image** to help optimise distribution of transport modes in the supply chain.

AI

The approach makes use of **data mining** and **probabilistic predictions** to recognise patterns and predict which routes should be taken and which mode of transport to support the distribution.

Source: Conundra

GeoAI in agriculture: Use of satellite data for tracking fields

Why?

Inspectors spent excessive time and resources on driving to every farm in Estonia to carry out compliance audits to see whether farmers mowed their fields with the frequency to qualify for EU Structural funds.

What?

KrattAI is a national AI strategy for 2019-2021, which is an **interoperable network** of public and private sector AI applications that work from the user perspective as a single, united channel for accessing public direct and informational services.

Geospatial

Gathering **location and earth observation data** to determine whether farmers have mowed their fields and qualify for EU Structural funds

AI

The satellite images uses **machine learning** and **big data technologies** to increase data reliability and accuracy. Currently the accuracy of the AI solution lies at around 90%.

Source: EqualOcean

GeoAI in agriculture: Optimising Production of Sugar Beet With Geospatial Data Analytics

Why?

During the procurement planning phase, **processors need visibility of historical crop rotations** for every field in the catchment areas around their production facilities.

Geospatial What?

Rezatec ensures that **processors** are able to **identify the fields that are planted with sugar beet** and **monitor** the sugar beet crops throughout the growing season for compliance to recipes/guidance.

Rezatec's solution uses **satellite images** to improve visibility over sugar crops to ensure better crop volume and harvest time estimates earlier in the planning process.

AI

Satellite data coupled with **crop modelling** and **machine learning** to **predict** procurement needs and **optimise** production based on a large set of input parameters.

Source: Rezatec

GeoAI in security and defence: Data-driven predictive policing

Why?

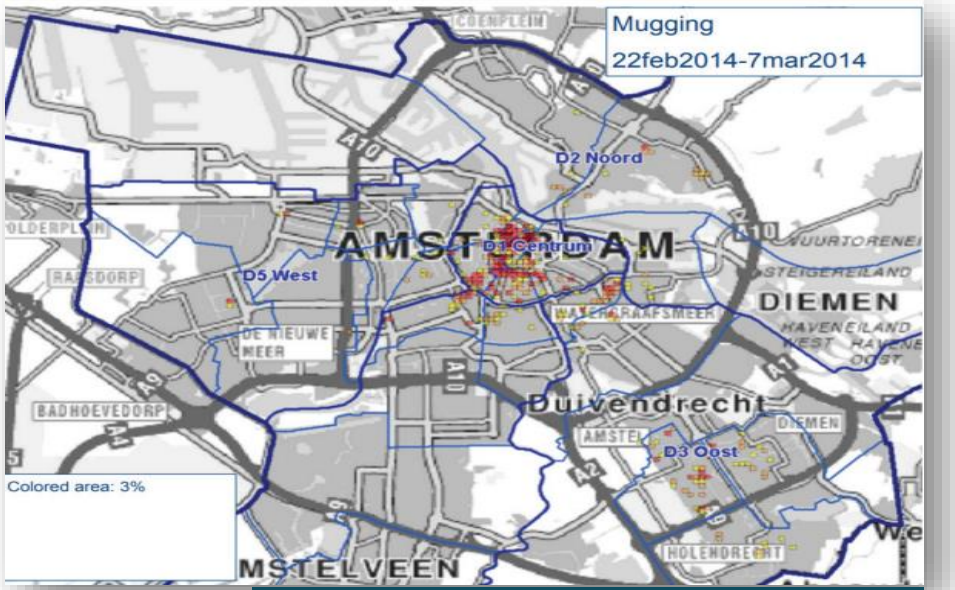
Predictive policing has the potential of decreasing public spending by contributing to the **efficient allocation of police resources**. A EUCPN report stated that already in 2016, a number of Member States were implementing predictive policing models (NL, UK, DE, AT, BE)

AI Geospatial What?

The Dutch **Crime Anticipation System** (CAS) performs **predictive policing**, an approach that uses big data to feed into an algorithmic model to predict **where crime is most likely to occur** in the future and at **what time**.

The system uses **geo-data** from the municipal administration, as well as **geo-tagged historical crime data** to make predictions.

The approach makes use of data mining and probabilistic predictions to recognise patterns and predict time, place and nature of crimes.



Source: Willems, D (2014) Presentation: 'CAS: Crime Anticipation System

5

Interoperability efforts and challenges

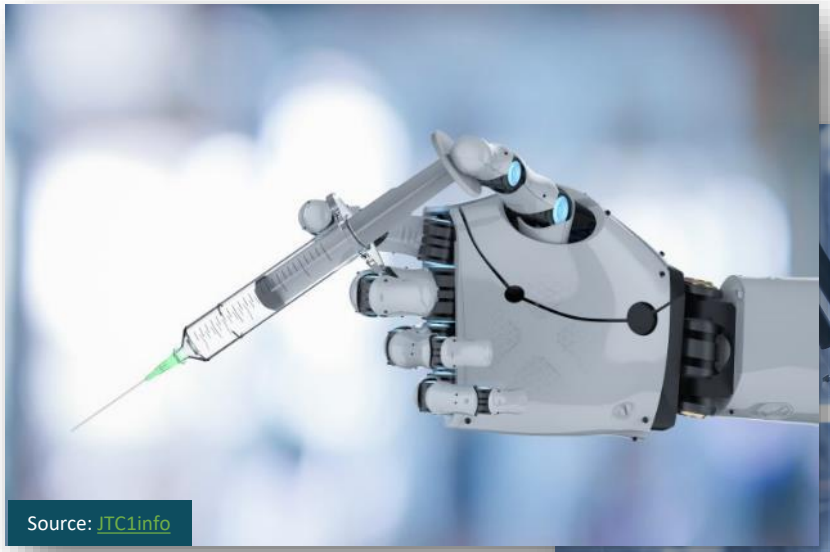
Enabling AI made in Europe: State of play on standards and interoperability

"Quality assurance and standards are still in their infancy, and we are likely to see an increased activity in this space as government bodies and businesses move away from feasibility studies and adopt machine learning into the geospatial production cycle."

UNGGIM (2020).

Bodies and institutions are working to address societal and ethical issues, governance and privacy policies and principles through standardisation and interoperability:

- ✓ ISO Standardisation committees
- ✓ OGC GeoAI DWG
- ✓ National standardisation bodies
- ✓ Industry and open standards



Source: JTC1info

Source: Deloitte (2020)

AI and the importance of semantic interoperability

In order to achieve semantic interoperability, human-annotated data sets are necessary to train machine learning models.

- ✓ **Challenge:** Data in AI systems have become increasingly complex
- ✓ **Opportunity:** Semantic interoperability in action means hundreds of thousands of data points in different systems are seamlessly interoperable.

Some **key elements** to mention are:

1. Tackling a disjointed ecosystem
2. Ensuring interpretability and transparency

GeoAI challenge: potential for spatial and temporal bias.

"Semantic interoperability is the ability of computer systems to exchange data with unambiguous, shared meaning."
Appen, (2019)

Source: Appen

6

Key take-away messages and conclusions

What's next? Opportunities and challenges for the uptake of AI for geospatial in short

Opportunities

- Deeper, new and more accurate findings, due to availability and volume of data (80% of data sets are composed of geospatial data (Transerve, 2020).
- Expected growth of the global Geospatial Analytics AI Market at a CAGR of 23% by 2023 (SB WIRE, 2018).
- Digital technologies are key in accelerating progress towards a European Circular Economy.
- GeoAI solutions present transformative opportunities to address global challenges.

Challenges

- Interoperability for public services.
- Common standards (OGC GEOAI DWG).
- Regulation issues of data protection, privacy, liability and discrimination coupled with large variances in adoption and use in EU countries remain pertinent.
- The human dimension of trust "Trustworthiness is a key prerequisite for AI uptake,"(EC, White Paper on AI).

Key messages and conclusions

Increased availability of geospatial data, the advancement of AI and availability of massive computing power has created a momentum for digital exploitation of geospatial data.

AI technology is presenting new opportunities to integrate, exploit and make use of geospatial data for geospatially-informed insights and predictions.

Through the examples given, we see that the GeoAI techniques employed can further public sector capabilities in moving from reactive to predictive, and therein produce new and innovative solutions.

While GeoAI can be a tool for increased growth, efficiency, security and more, challenges related to regulation, interoperability and standards

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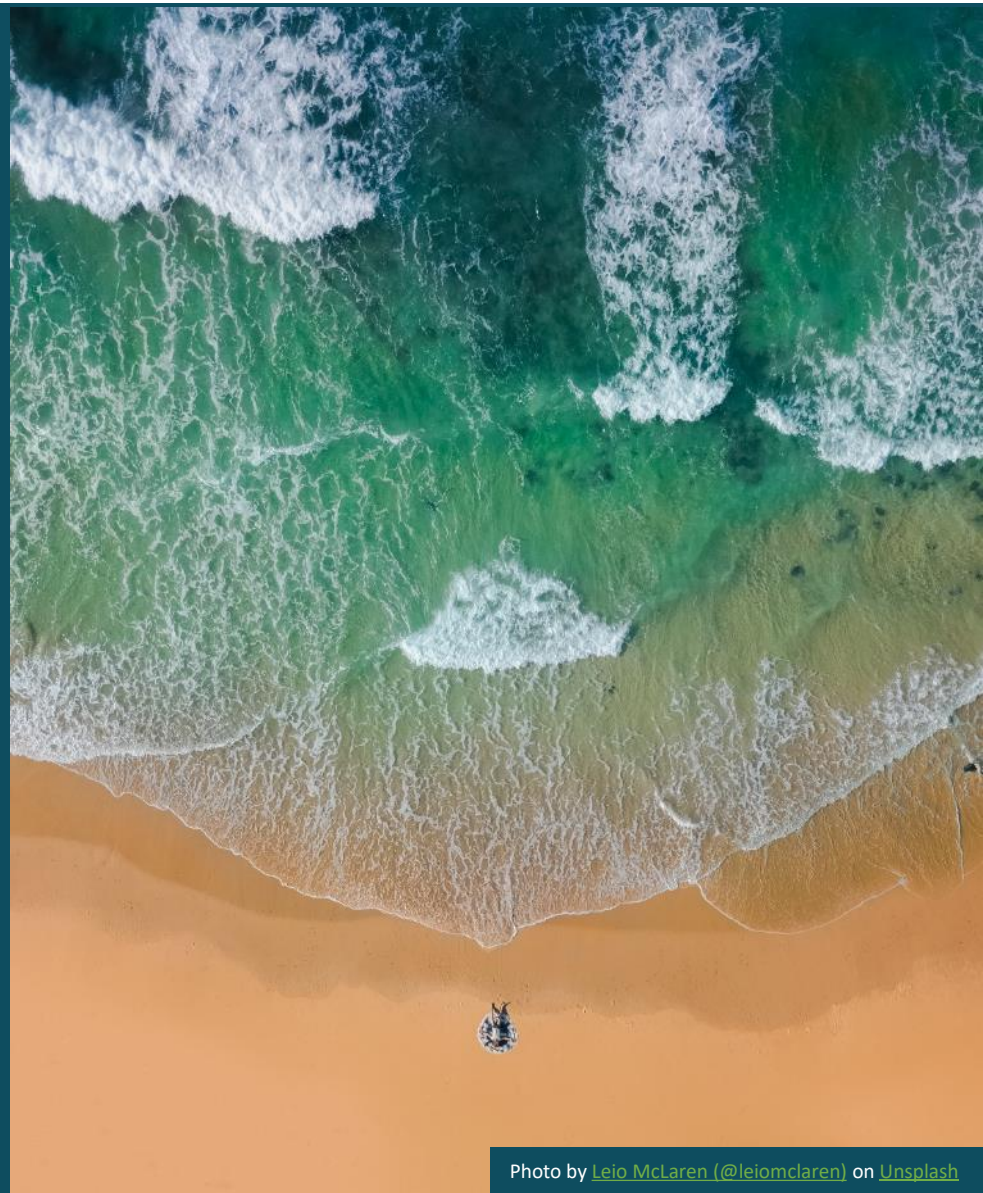
Next topics after the summer break…

- Smartcities
- Emerging technologies
- Geospatially enabled public services



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ELISE playlist

Thank you

Q&A

A

GeoAI applied:

Demonstrating mounting relevance in key public policy areas- Appendix