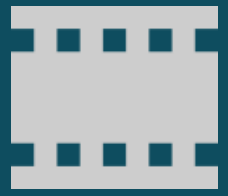
Thank you for joining us!

We will start shortly.



The presentation will be recorded

Mute your microphone

Turn off your camera

Use the chatbox to ask or comment

ELISE action
Webinar Series

Immersive realities and location for better public services

European Location Interoperability Solutions for e-Government

Enabling Digital Government through Geospatial and Location Intelligence

Danny VANDENBROUCKE, KU Leuven
Vincente BAYARRI, GIM Geomatics (Guest Speaker)
Lorena HERNANDEZ, European Commission JRC
Simon VREČAR, European Commission JRC (consultant)
Lily PANIAGUA, European Commission JRC (consultant)

15/04/2021 14:00 CEST (UTC+2)

ISA²

European Commission

WHAT?

ELISE stands for **E**uropean **L**ocation **I**nteroperability **S**olutions for e-Government. It is one of the more than 50 actions in the European Interoperability Programme ISA².

WHAT FOR?

To support Digital Government Transformation by making the best use of location data and technologies in an interoperable manner

FOR WHOM?

For all: citizens, businesses and public administrations

ISA²

ISA²

European Commission

Policy support

Supporting different policy initiatives at European and national levels

Emerging trends and technologies

Discovering how emerging trends and technologies enable more effective use of location data for policy and digital public services

Interoperable frameworks and solutions

Providing reusable interoperable cross-border and cross-sector frameworks and for public administrations, business and citizens

Building a Knowledge base

Building a Geo-Knowledge base inform and train stakeholders and promote the adoption of good practices and innovations in location data

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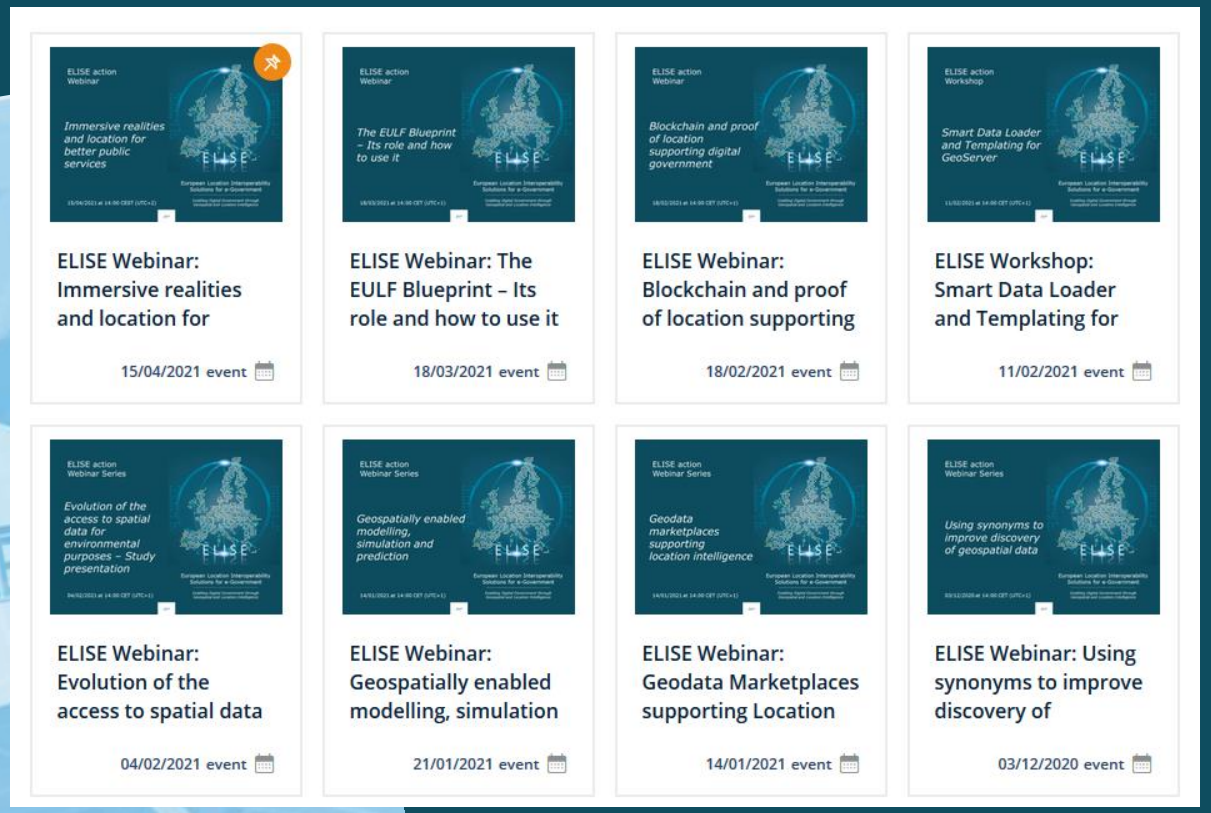
European Location Interoperability Solutions for e-Government

Enabling Digital Government through Geospatial and Location Intelligence

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.**
- **Share the results of ELISE activities.**

https://europa.eu/!nP74ph

Immersive realities and location for better public services

Our speakers

Danny VANDENBROUCKE

Senior Researcher
KU Leuven

Vicente BAYARRI (guest speaker)

GIM Geomatics

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.

What we will cover today

1. Introduction
2. Virtual, Augmented, Mixed and Extended Realities: What are they?
3. Immersive visualisation techniques for public services
4. Case studies: VR for cultural heritage and AR for underground management
5. Interoperability efforts and challenges
6. Key take-away messages and conclusions
7. Q&A

Key messages

1. Immersive visualisations exist for some time: first VR, then AR and more and more MR. They have very often a **location component**

2. **VR, AR, MR…** are based on technological developments, both **hardware- and data-related developments**

3. There is a rising number of applications, including in the **public sector**, more opportunities lie ahead

Various applications of immersive visualisation exist, in **different sectors**: security, health, tourism, transport, spatial planning, emergency, education … although few are really operational

1

Virtual, Augmented, Mixed and Extended Realities

What are they?

Virtual Reality

Virtual Reality (VR) refers to a **computer-generated simulation** in which a person can interact within an **artificial three-dimensional environment** using electronic **devices**, such as special goggles with a screen or gloves fitted with **sensors**. In this simulated artificial environment, the user is able to have a **realistic-feeling** experience.

Mitchell (2020)

Flight simulators

simulationflight.co

Entertainment

quytech.com

Military

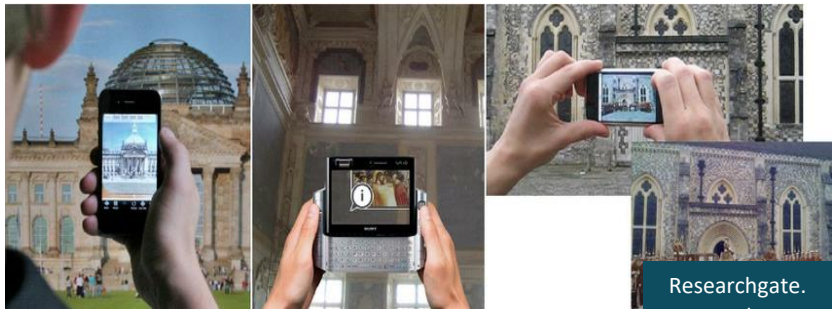
affinityvr.com

Commercial (DOVY kitchens)

dovykeukens.be

Augmented Reality

Cultural Heritage



Military

Entertainment

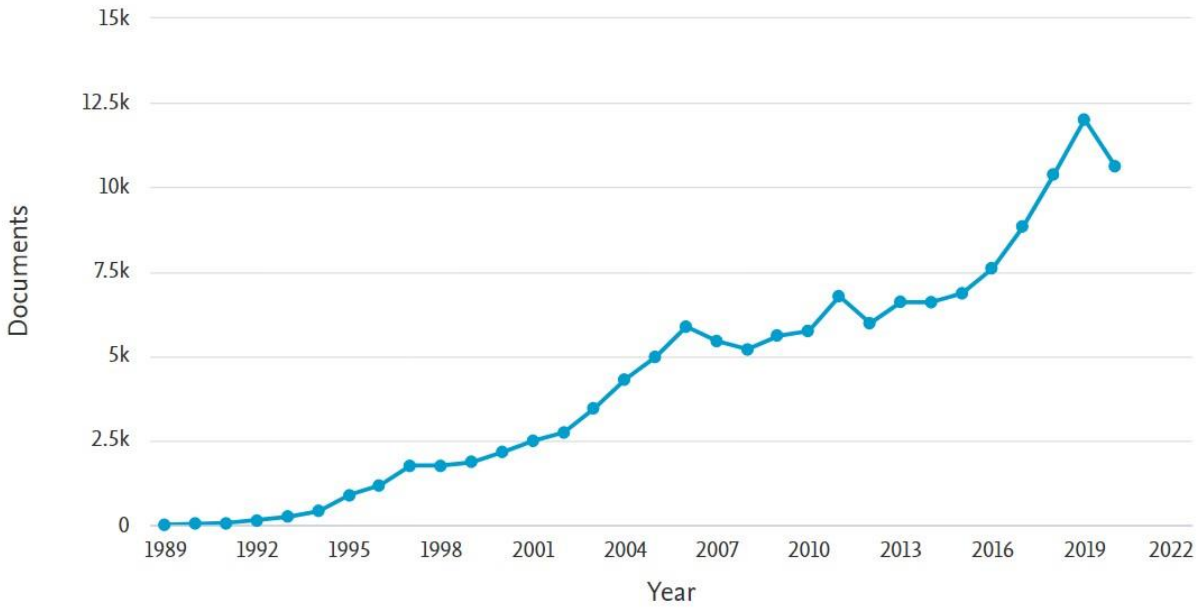
Tourism

Augmented reality (AR) is an **interactive** experience of a **real-world environment** where the objects that reside in the real world are **enhanced by computer-generated perceptual information**, sometimes across multiple sensory modalities including visual, audio …

Huffington Post (2016), Schueffel (2017)

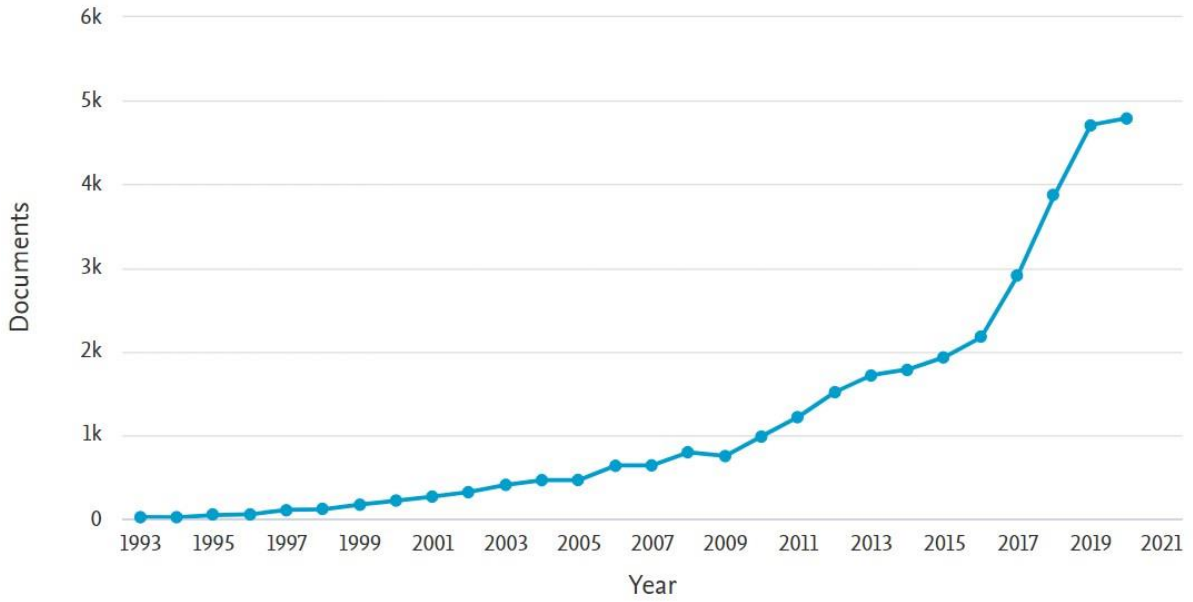
Virtual Reality

Coined by Jaron Lanier, CEO VPL Research in 1989
140.979 papers, first mentioned in 1955



Augmented Reality

Coined by Tom Caudell, Boeing researcher in 1990
34.067 papers, first mentioned in 1950



Scopus (2021)

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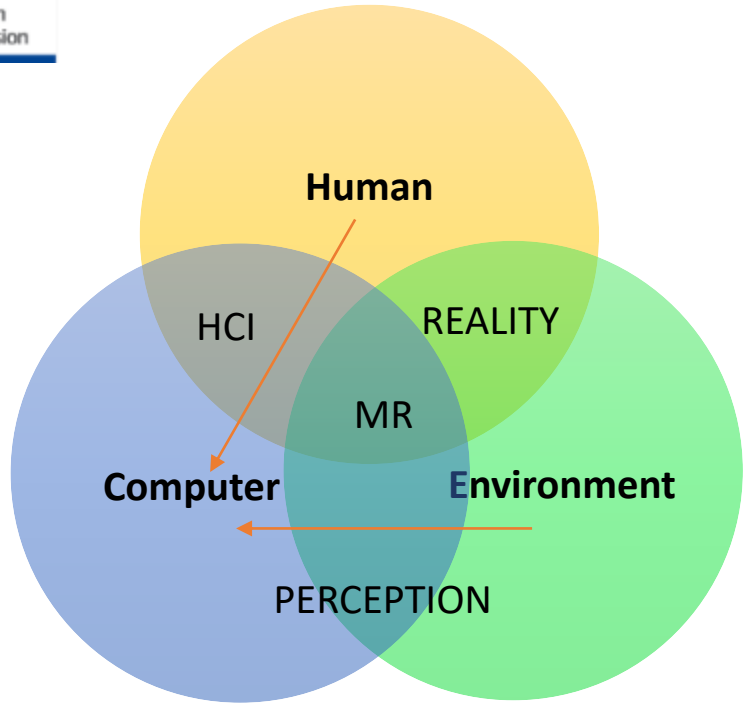
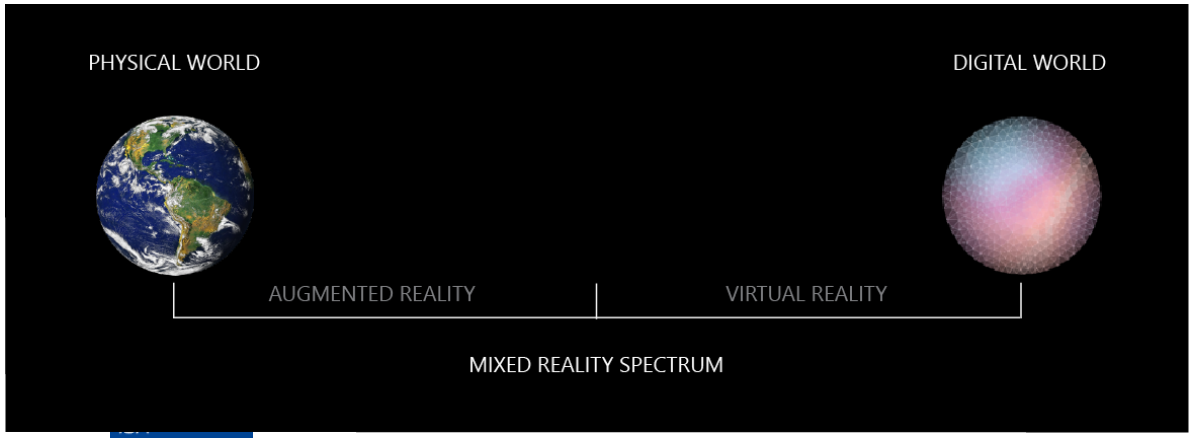
Mixed Reality

Mixed Reality is a **blend of physical and digital worlds**, unlocking the links between human, computer, and environment interaction. This new reality is based on advancements in **computer vision, graphical processing** power, **display** technology, and **input systems**.

Microsoft (2020)



Lighting
Sound
Boundaries
Scenes
Object recognition
Location



REAL ENVIRONMENT

MIXED REALITY (MR)

VIRTUAL ENVIRONMENT

Tangible User Interfaces (TUI)

A TUI uses real physical objects to both represent and interact with computer-generated information (Ishii & Ullmer, 2001).

Augmented Reality (AR)

AR 'adds' computer-generated information to the real world (Azuma, et al. 2001).

Augmented Virtuality (AV)

AV 'adds' real information to a computer-generated environment (Regenbrecht, et al. 2004).

Virtual Reality (VR)

VR refers to completely computer-generated environments (Ni, Schmidt, Staadt, Livingston, Ball, & May, 2006; Burdea & Coffet 2003)

Projection Augmented models (PA model) are a type of Spatial AR display, and are closely related to TUIs

Spatial AR

Spatial AR displays project computer-generated information directly into a user's environment (Bimber & Raskar, 2005).

'See-through' AR (either optical or video)

A user wears a head-mounted display, through which they can see the real world with computer-generated information superimposed on top (Cakmakci, Ha & Rolland, 2005; Billinghurst, Grasset & Looser, 2005).

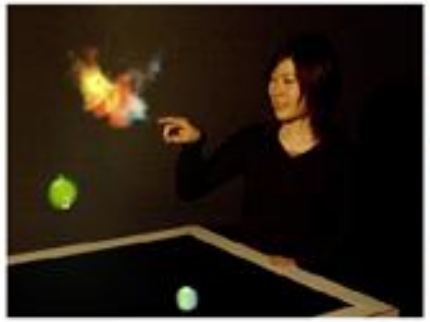
Semi-immersive VR

A semi-immersive VR display fills a limited area of a user's field-of-view.

Immersive VR

Immersive VR, which uses either a head-mounted-display or a projection-based system, completely fills the user's field-of-view.

Using physical objects to create a virtual model (Ichida, Itoh, & Kitamur, 2004). As a user adds a physical 'ActiveCube' to the construction, the equivalent virtual model is automatically updated.



The 'Bubble Cosmos' – 'Emerging Technology' at SIGGRAPH'06. The paths of the smoke-filled bubbles are tracked, and an image is projected into them as they rise.

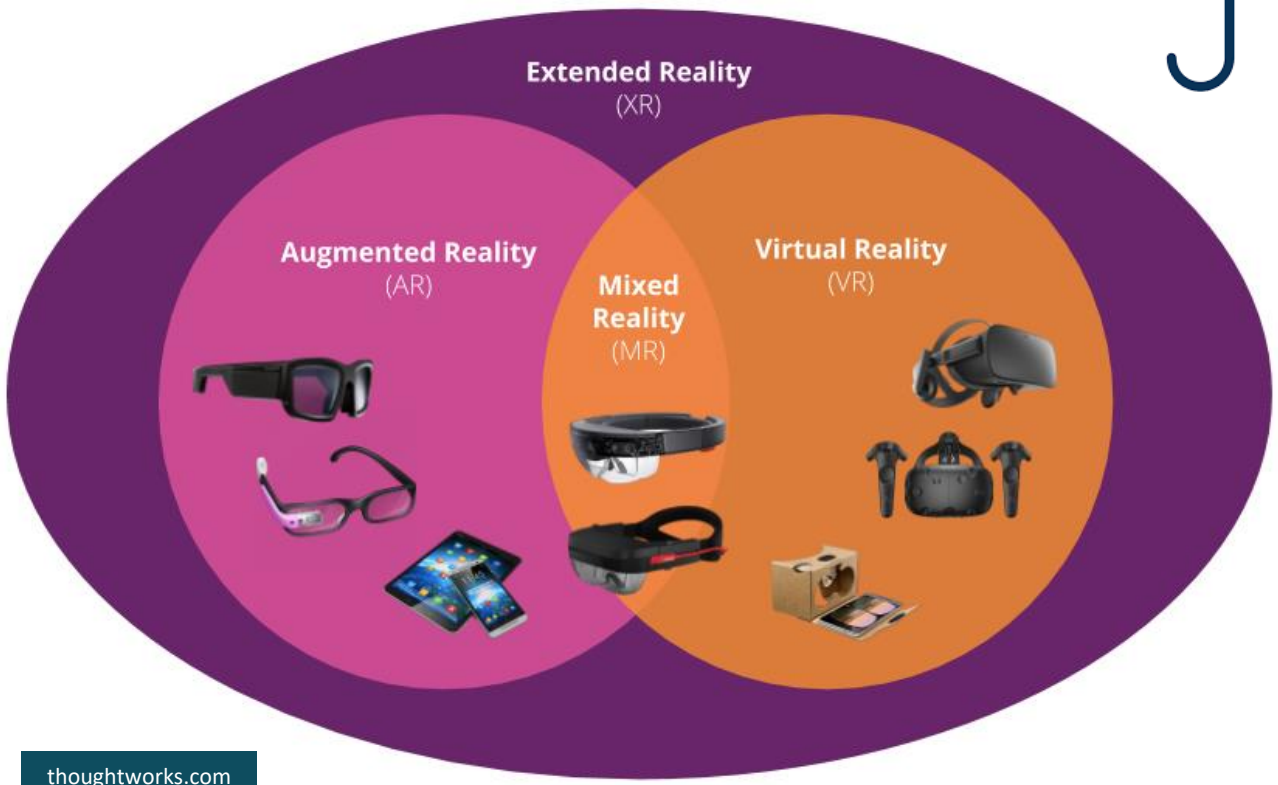
See-through AR: the butterfly is computer-generated, and everything else is real (Fischer, Bartz & Straßer, 2006; Kölsch, Bane, Höllerer, & Turk, 2006).

Semi-immersive VR using the Barco Baron workbench (Drettakis, Roussou, Tsingos, Reche & Gallo, 2004).

Projection-based immersive VR. The users are fully immersed in the 'CAVE' (FakeSpace, 2006; Cruz-Neira, Sandin & DeFanti, 1993).

Electricbadger (2007), based on Milgram and Kishino (1994)

Extended Reality



thoughtworks.com

Extended reality (XR) is a term referring to all **real – and - virtual combined environments and human-machine interactions** generated by computer technology and wearables.

The '**X**' represents a variable for any current or future spatial computing technologies.

Greenwold (2003)

mouser.be

VR, AR and MR: based on evolving technologies

Hardware developments

1. More powerful computers and Computer graphics
2. Gaming consoles
3. Mobile developments (smart phones …)
4. Sensors
5. Holographic, immersive devices
6. Eyewear …


superhuman.se


microsoft.com


virtualspeach.com


microsoft.com


forbes.com


iter.org

VR, AR and MR: based on evolving technologies

Soft developments

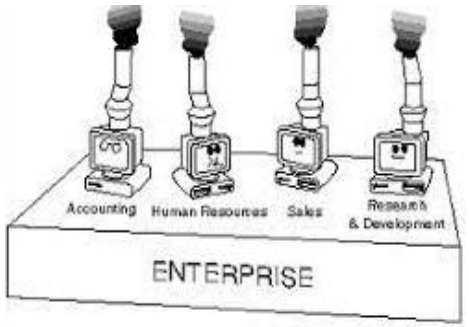
1. Modelling, simulation, prediction
2. Gaming industry
3. 3D visualisation, BIM
4. Digital Twins
5. Integrated applications
6. Dynamic data flows & big data


palamir.com


logdna.com

safety4sea.com


new.siemens.com



Polarising.com

OGC.org

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2

Immersive visualisation for public services

Immersive visualisation for public sector services

Spatial Planning

Military

Management of utilities

City tourism

Preserving cultural heritage

Environmental management & monitoring

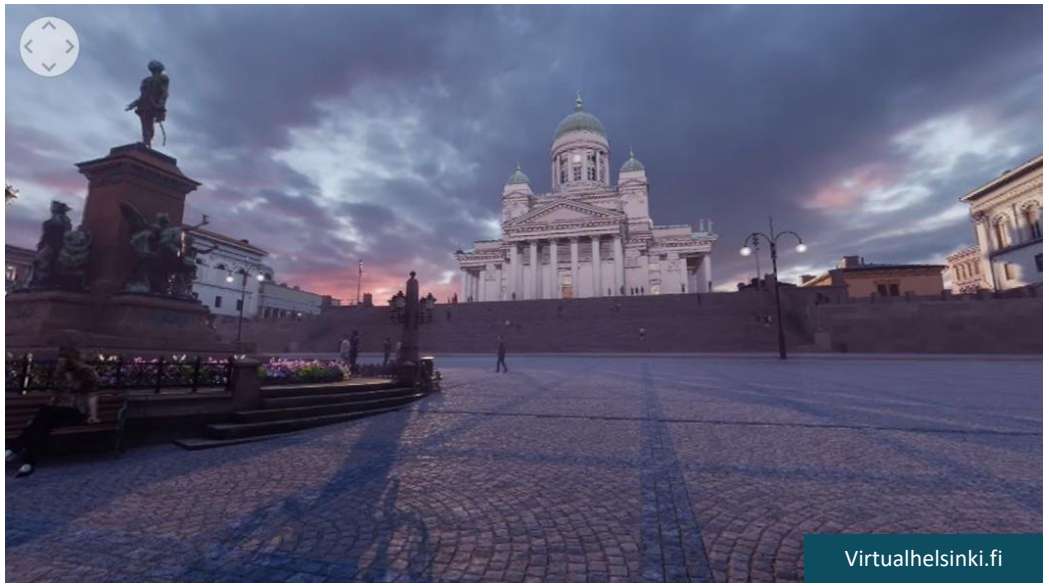
Healthcare

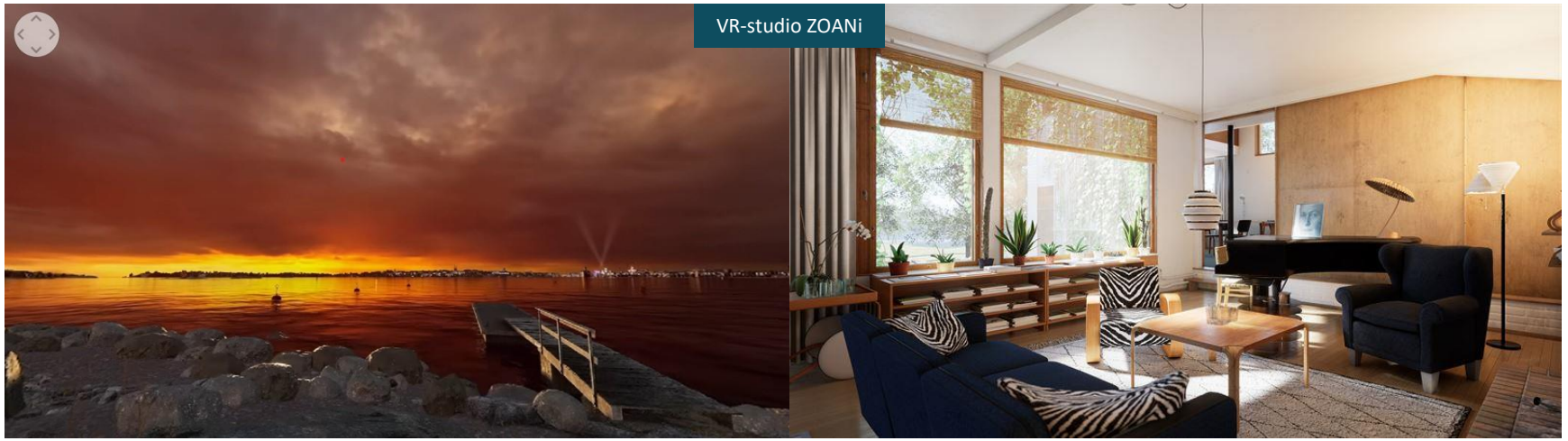
More…

City tourism: promoting Helsinki

Virtual Helsinki is **digital twin** of the Helsinki City centre, created in high-quality **3D** for **VR**.

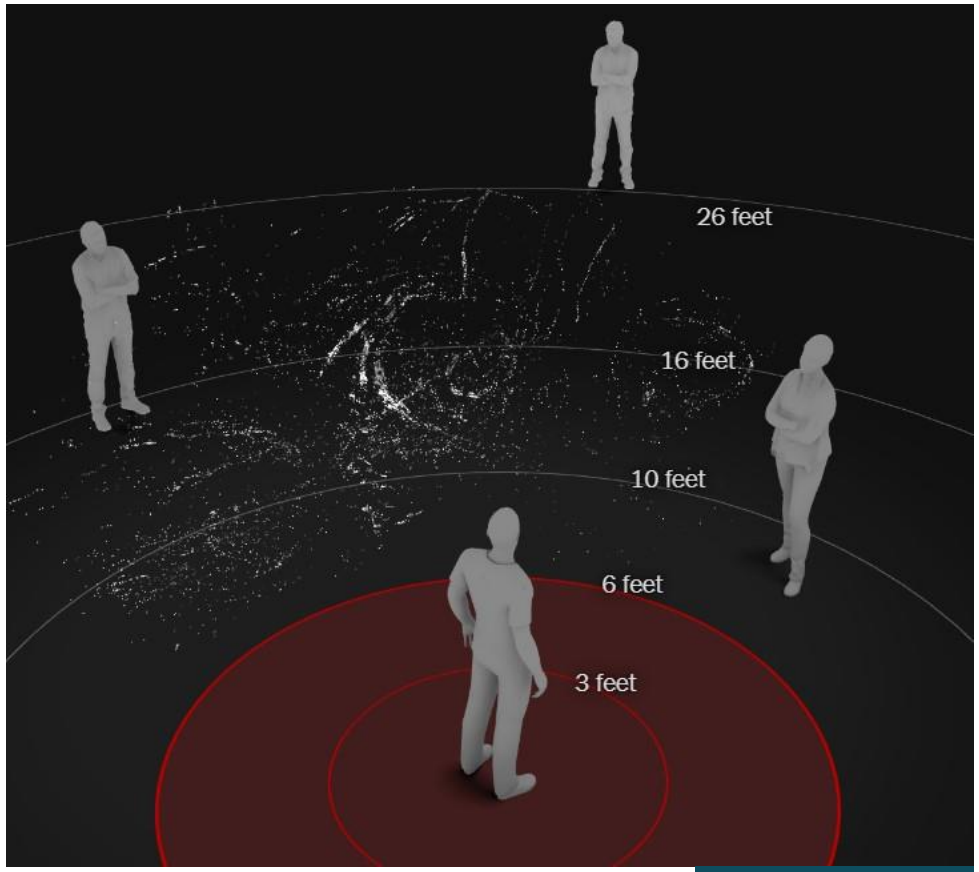
- **Outdoor** & **Indoor**
- Viewing from **different angles**
- Covering **different seasons**


Virtualhelsinki.fi


VR-studio ZOANi

Become a virtual tourist in Virtual Helsinki
Target 1,0 million virtual tourists
Supporting sustainability goals
Other potential usages (planning, shopping, citizens involvement)

Healthcare & policy: COVID-19



New York Times (2020)

theguardian.com

bronkhorst.com

Joint effort:

Scientists

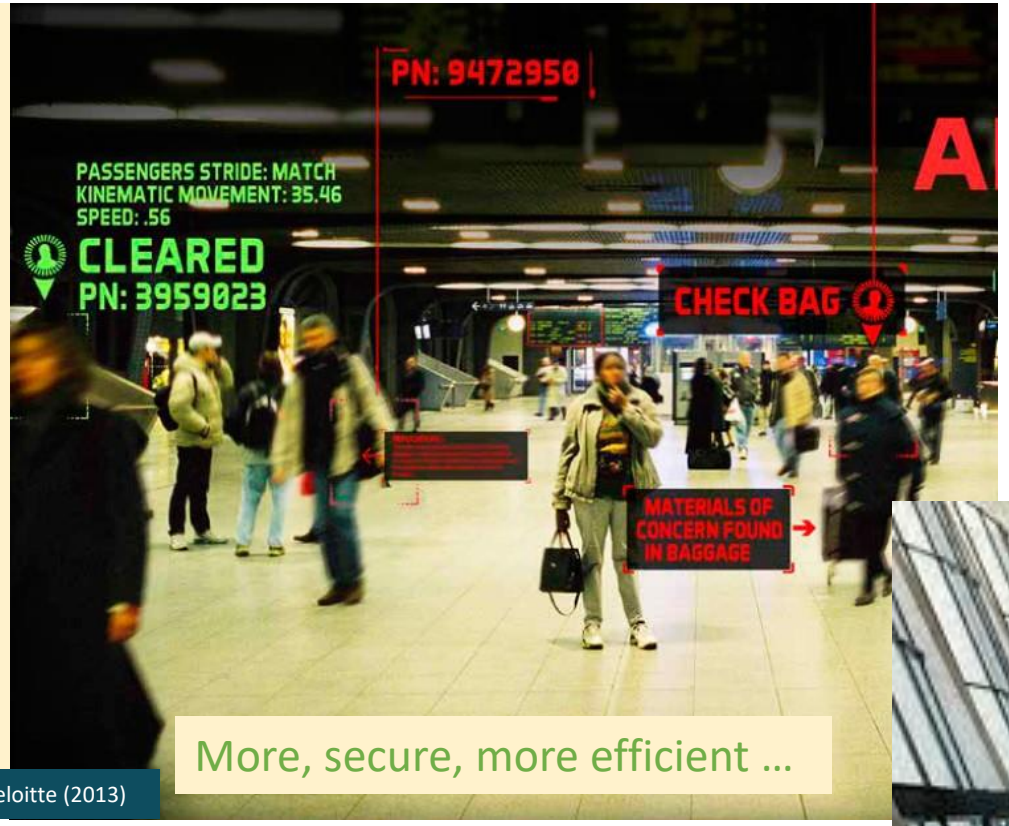
NYT

Public Authorities

How nose-drops can spread and masks can help to prevent it …
Creation of awareness using AR
Educating the concept of social distancing (location)
3D simulations and visualisation
Operational app on iPhone/iPad

Transport: security @airports

*"Just 10 years before, the **Transportation and Security Administration** (TSA) identity verification process at the **Dulles** International airport (Washington DC) had been a long exercise, requiring security agents to **compare each passenger's face with their ID, and the name with the boarding pass**, thousand of times each day"*



Deloitte (2013)

More, secure, more efficient …

New screening programme using AR
Passengers get a random PN
AR glasses to monitor passengers speed, behavior, check ID …
Contextual overlays with security officers' vision

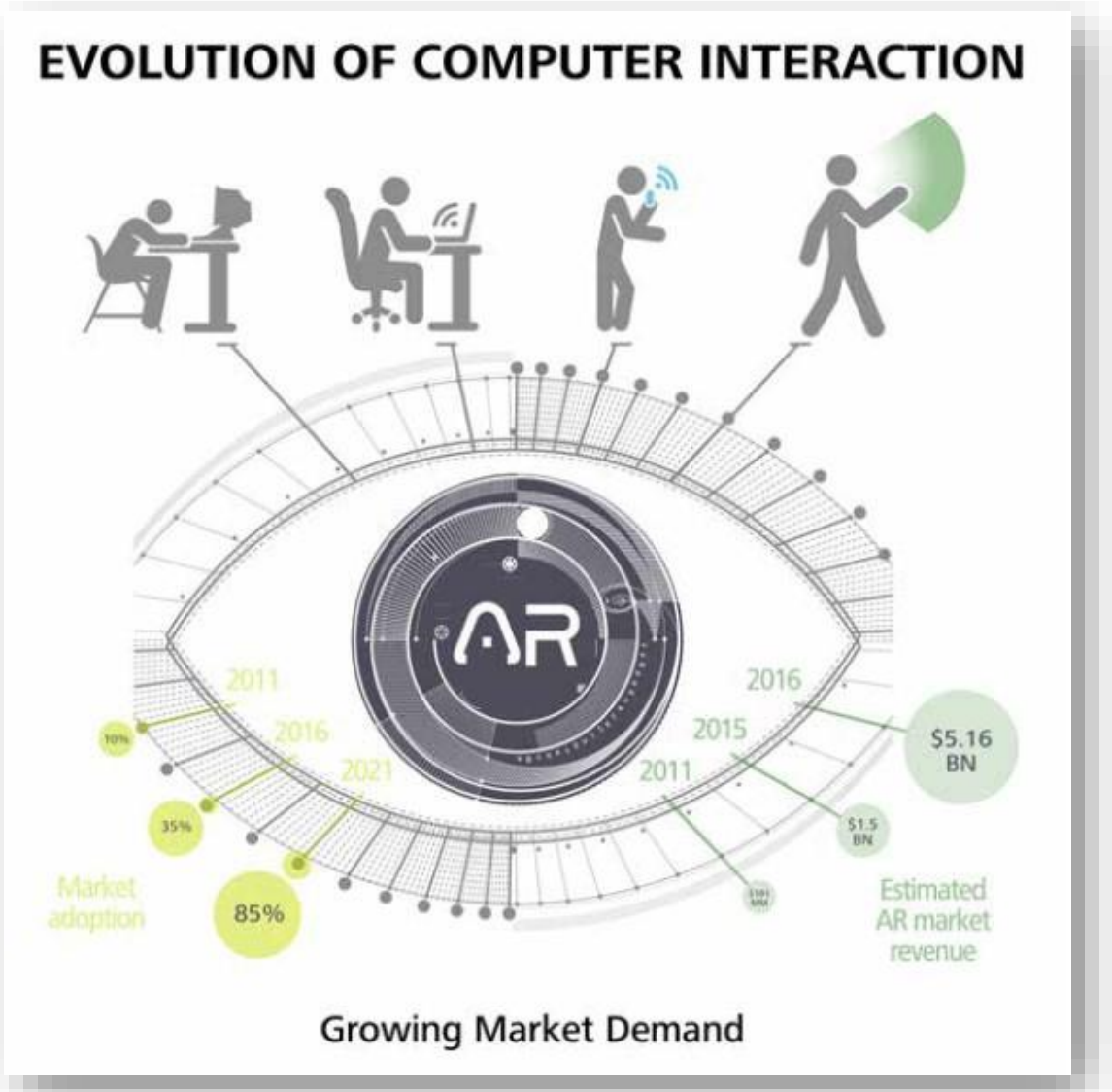
iJETairportconcierge.com

Preparing for AR, MR, VR …

Readiness questions

1. **Who** in the organisation requires real-time information?
2. What are the **technology and data** requirements, do we have these?
3. What are the **human resources** required?
4. What are the **risks** for my organisation in using AR, VR …
5. What **impact** will the technology have on my mission-critical activities

Based on Deloitte (2013)



3

Case studies:

- Cultural heritage &
- Underground asset management

Case Study #1

Underground asset management

Managing our underground: ARinfuse

ARinfuse (Erasmus+) aims to **infuse skills** on **Augmented Reality** for geospatial information management in the context of **utility underground infrastructures**.

ICT in fusion with **GNSS**, **GIS** and **geodatabases**, and **AR/VR** are offering the possibility to convert the geospatial information of the underground utilities into a powerful **tool for field workers**, engineers and managers.

Training packages on utility management, GI and AR … ARinfuse Tool

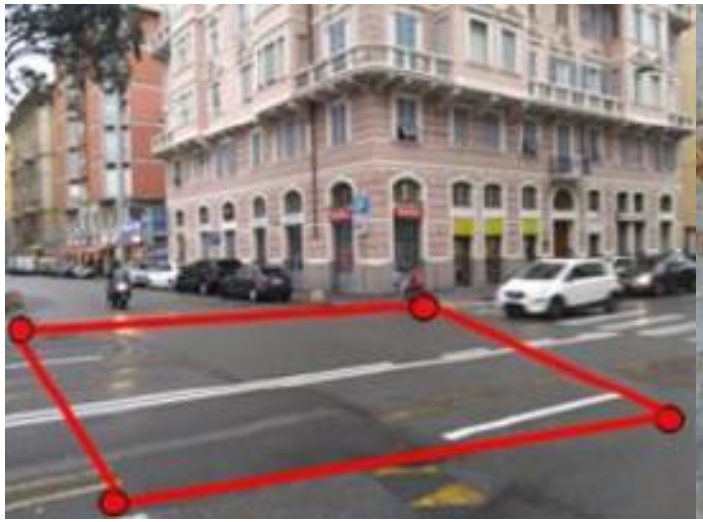
https://www.arinfuse.eu/

Managing our underground: ARinfuse

Data challenges

- Data not always publicly available, security concerns
- Precision, some parameters not known (e.g. Z)
- Network is underground

Minaskan (2020)



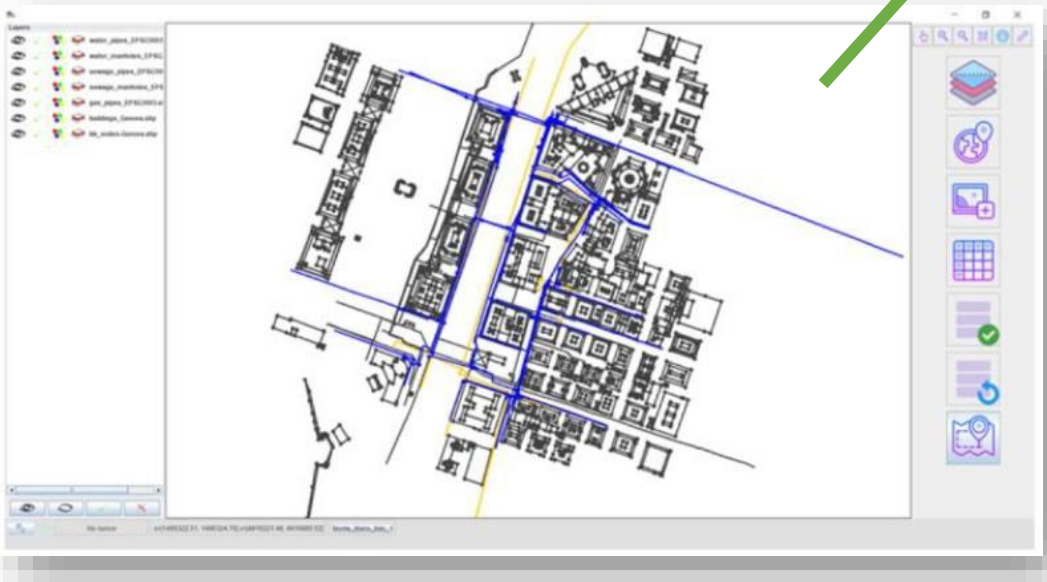
Technical challenges

- Camera callibration (checker board, vanishing points)
- Pose of the camera for tracking features, link to CRS utility network
- Fixed images or real-time (requires GNSS)

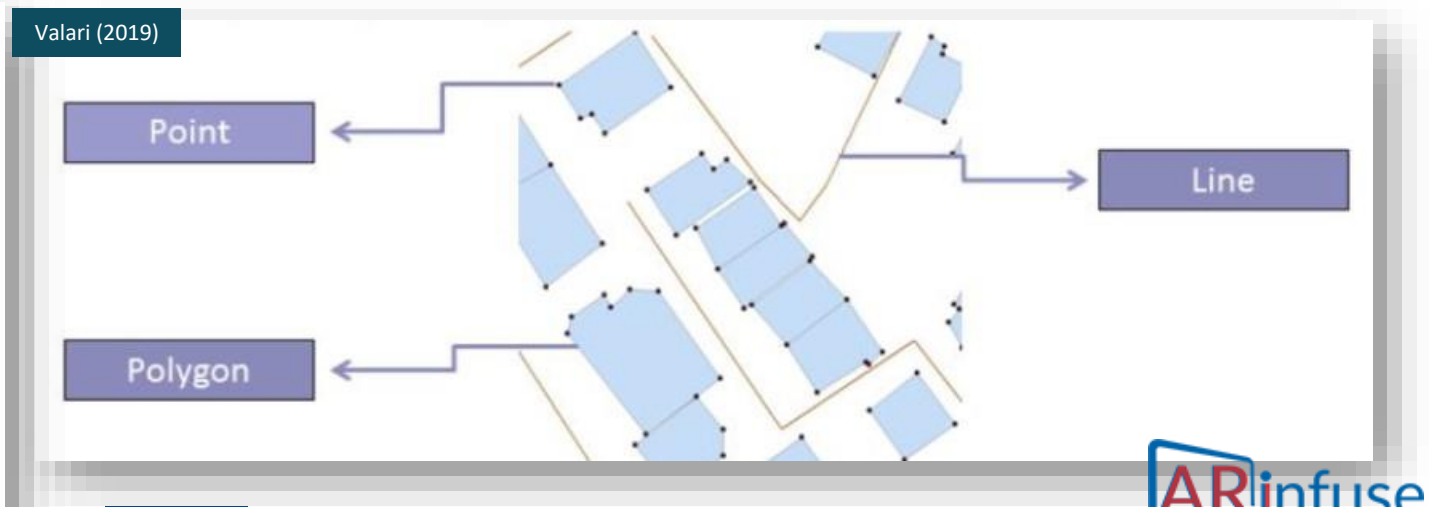
Managing our underground: ARinfuse

Data preparation is key
AR depends on data quality
GML file prepared

VMM, IREN, …



Valari (2019)



Data requirements

- Vector data & geometries (SHP, GML, KML …)
- Minimal data features and attributes
  - Pipelines: Z ground values, Z values, diameter
  - Manholes:: Z ground values, diameter
  - Optional: buildings

ISA²

ARinfuse

Managing our underground: ARinfuse

Visualisation

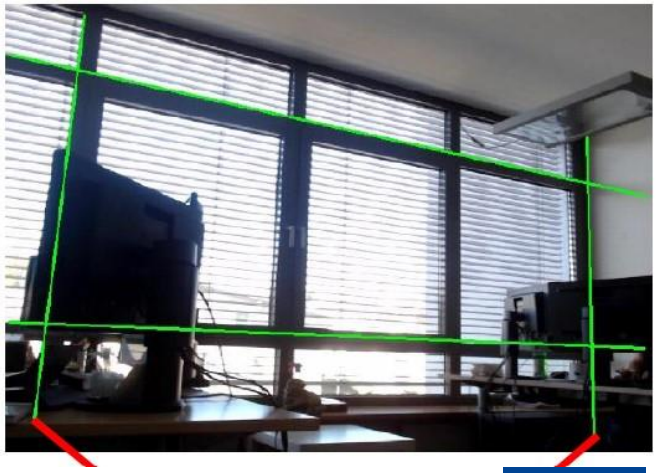
GI & AR environments

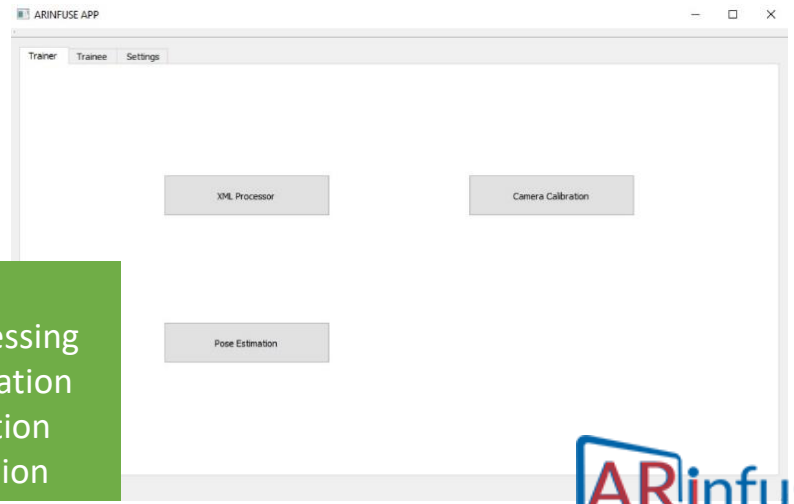
- GI environment is open and based on PostGIS, PostgreSQL, GeoTools
- Installation and user guidelines available

Positioning

Valari & Minaskan (2019)

Calibration





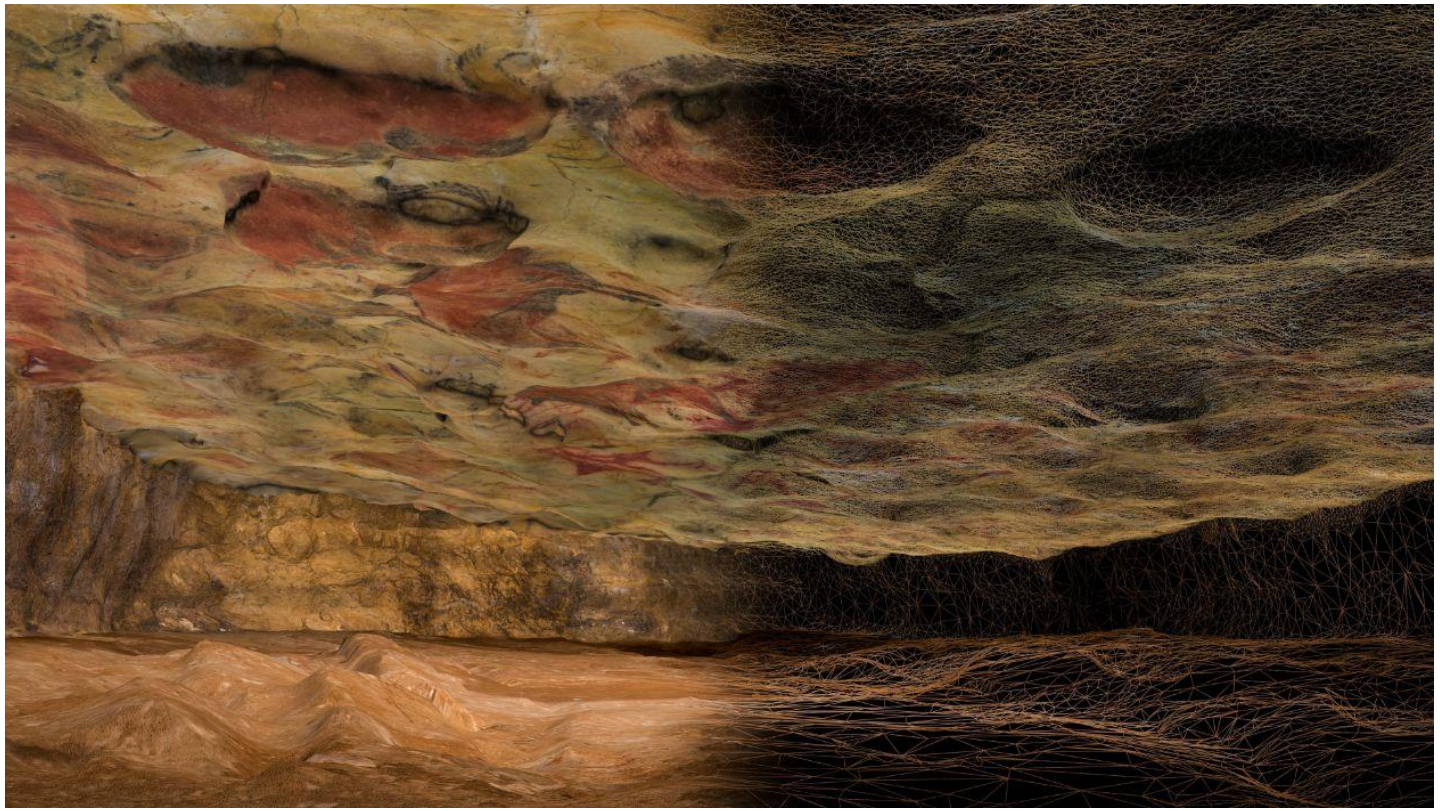
AR Tool:
XML pre-processing
Camera calibration
Pose estimation
3D visualisation

Managing our underground

https://www.youtube.com/watch?v=Wg6jN-audEM

Case Study #2
Cultural heritage

“The past in the future: Virtual reality to know the Altamira of the past”



GIM Geomatics:

- Founded in 2005
- Most innovative company in Cantabria (2018)
- Spanish finalists in Quality Innovation Awards (2019).
- Projects in 10 countries in Europe, America, Africa and Asia.
- Several R&D projects in geospatial data integration
- Dozens of projects in Virtual Reality, Augmented Reality, smart-cities, digital twins, etc.

Museo de Altamira:

- The cave of Altamira was discovered in 1868
- First decorated cave to be discovered
- The museum was founded in 1924
- 250.000 visitors / year
- Its mission is to manage the cave of Altamira and its art, conserving it and making it accessible to the public.

Strategy of the Management System: “Altamira 8D”

3D: Current Conditions	4D: Evolution	5D: Parallelisms	6D: Estimates	7D: Sustainability of the cave	8D: Maintenance
3d Karst Model: GNSS, TTS, LE3D (cave model) and GPR. **Thematic information (art & conservation)**: photogrammetry, micro-photogrammetry and Hyperspectral remote Sensing	**Climate monitoring** Weather station data **Water Monitoring** Drip and flow data **Biodeterioration Monitoring** Microphotogrammetry for evolution of fungi and bacteria	**Analysis of historical scenarios:** Archaeological data - Present-day cave - **Palaeolithic Cave** - Discovery Cave **Simulation of parameters in the scenario**	***What-if* estimates:** When is the dew point reached under these conditions? Where does it condense? **Visualisations** **Extraction of quantities**	**Conceptual analysis of sustainability** **Analysis of optimal and current conditions** **Monitoring of sustainable elements**	Operational and maintenance model *As-Is* model Life Cycle

https://www.youtube.com/watch?v=5xvy8FEBrt0

GOBIERNO DE ESPAÑA
MINISTERIO DE CULTURA Y DEPORTE

MUSEO DE ALTAMIRA

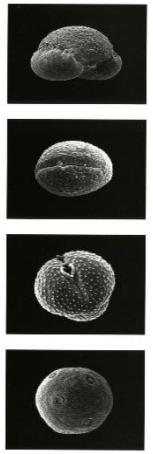
ISA²

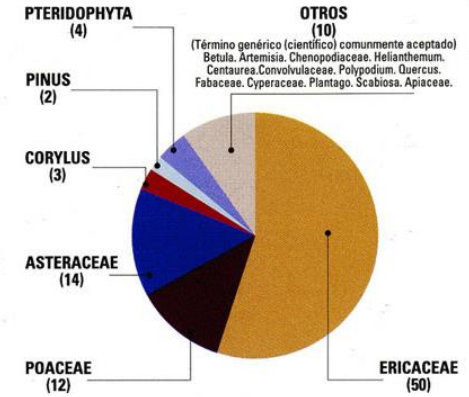
GIM GEOMATICS
servicios geomáticos especializados

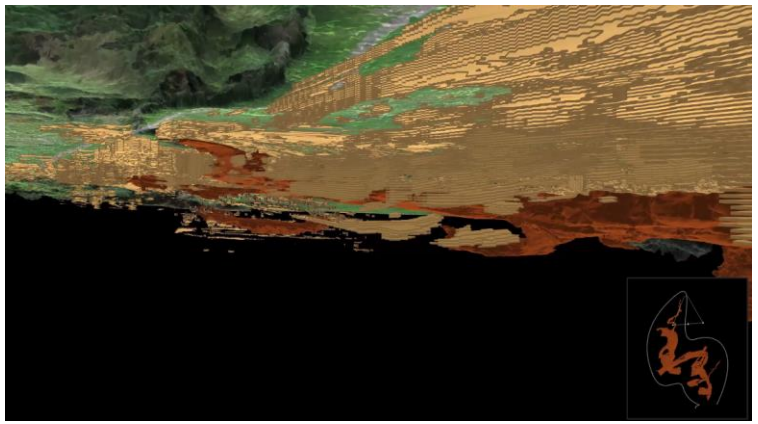
United Nations Educational, Scientific and Cultural Organization
Cave of Altamira and Paleolithic Cave Art of Northern Spain inscribed on the World Heritage List in 1985

Data Integration

- GNSS + ETT Reference Frame: 2013
- 3D information: 3D Terrestrial laser scanner: 2013
- Photogrammetry:
  - New Ceiling orthoimage (200 microns): 2013
  - Watersheds: 2017
- Texture of the cave: High resolution photos
  - Cudón Cave: 2017
  - El Pendo Cave: 2017
- Topographic survey of the exterior. 2013
- Ground Penetrating Radar: : 2017-2019
- Drone Flight: 2019
- Old Cartographies (20's, 50's, 70's 90's)
- Archaeological studies: Excavation remains, historical pictures, pollen studies, etc
- Weather historical series
- Hyperspectral remote Sensing: Art and biodegradation studies (2018 -)







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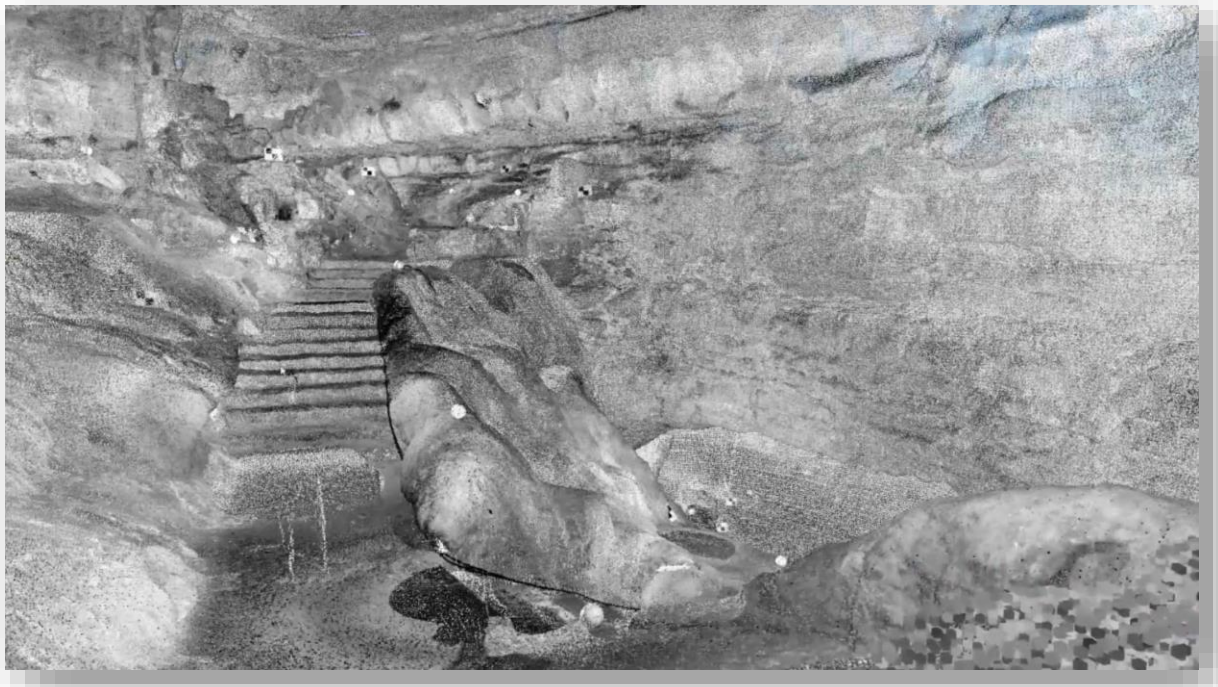
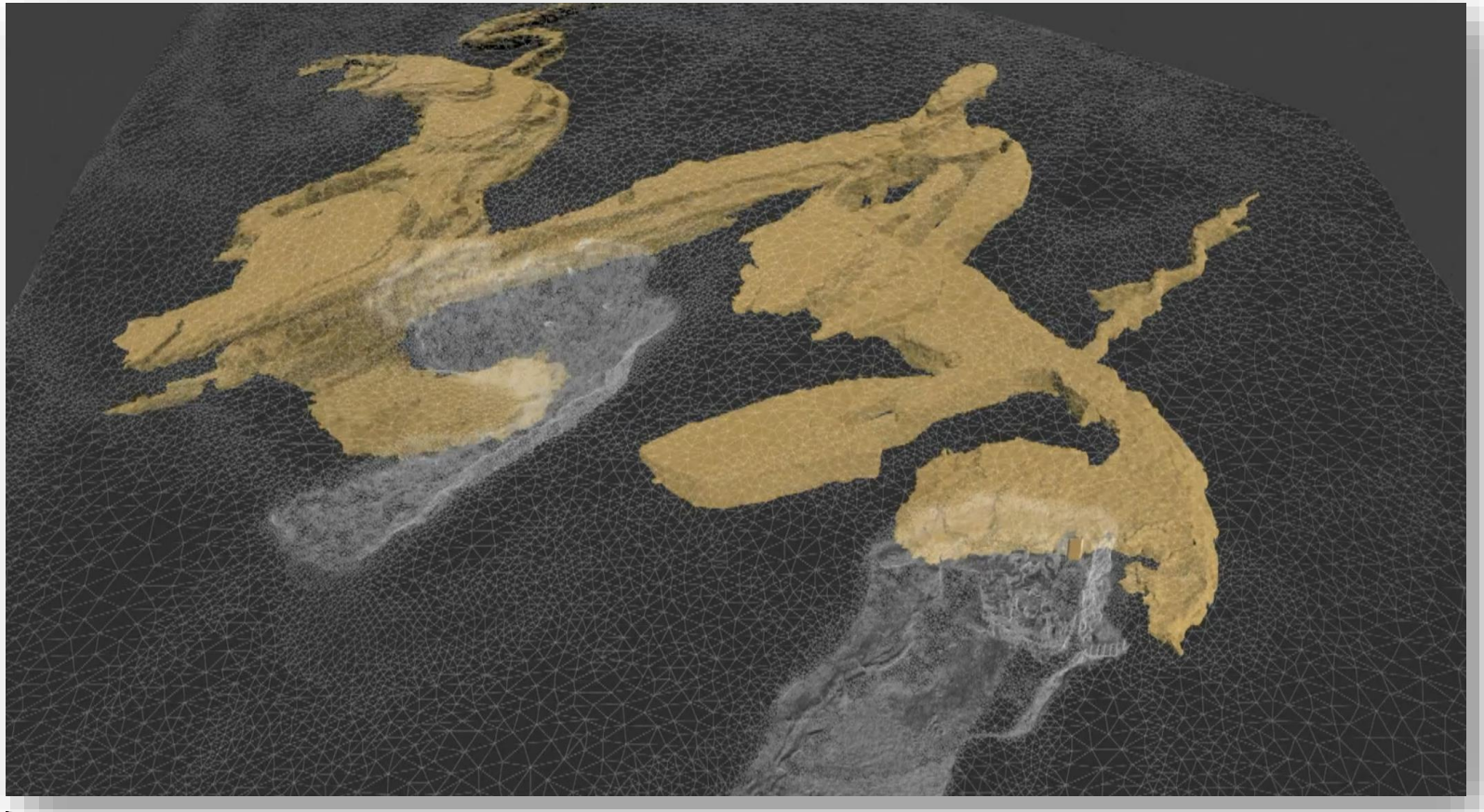
2. 3D data processing

- Registration and georeferencing of scans
- Creation of a point cloud for the whole cave



3. Creation of a 3D model of the current state

Partial models of about 4 million that are merged into one complete model



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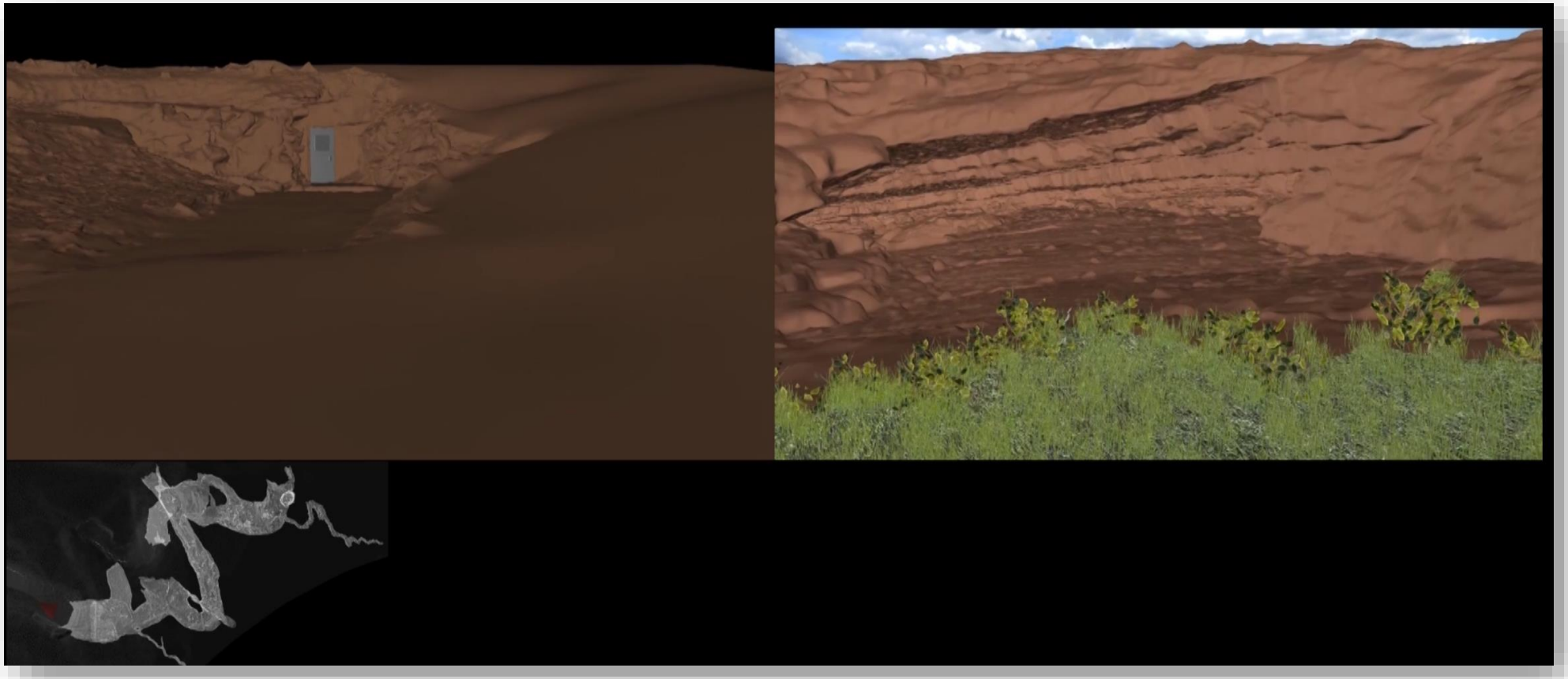
United Nations Educational, Scientific and Cultural Organization

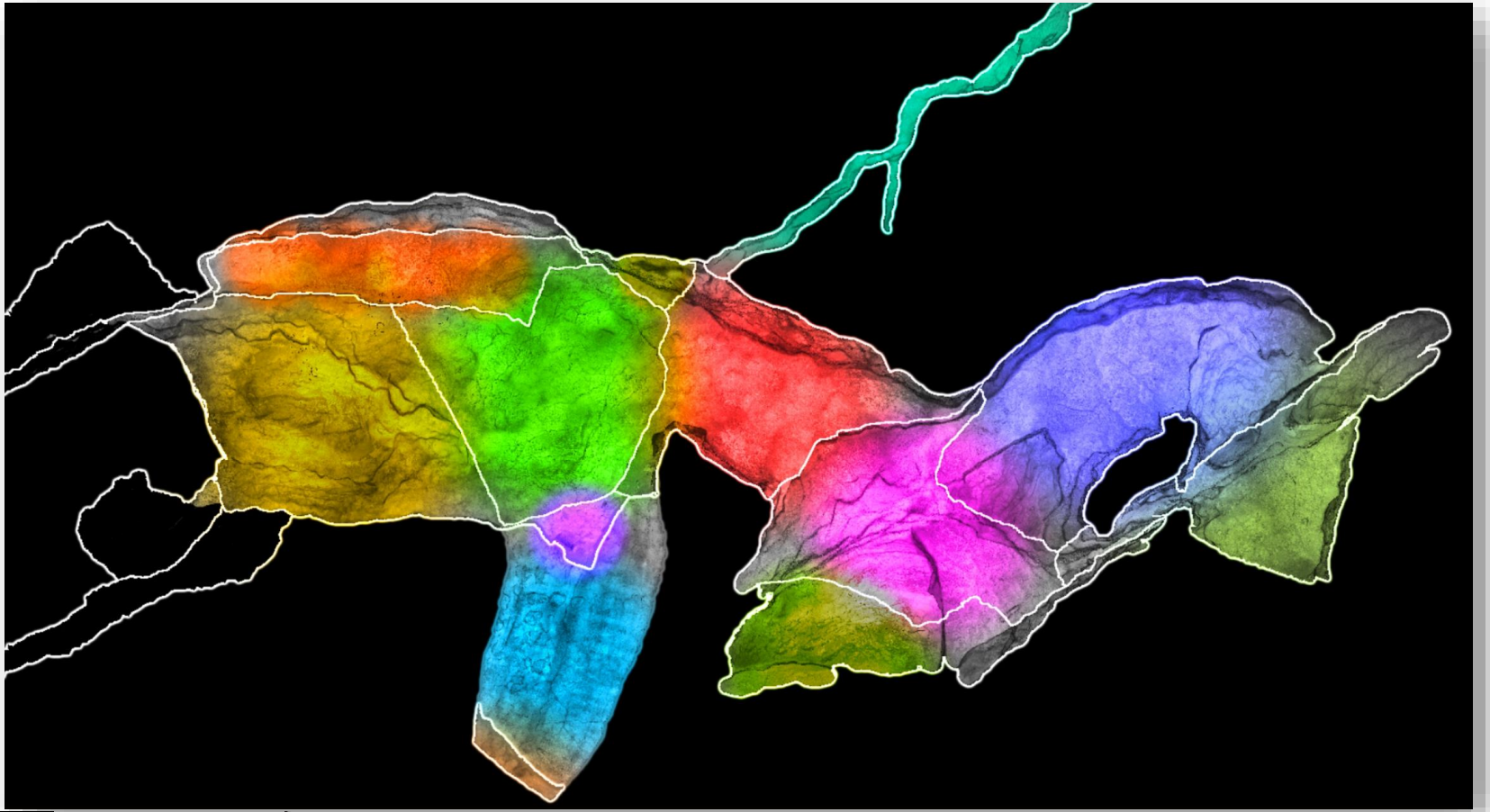
Cave of Altamira and Paleolithic Cave Art of Northern Spain inscribed on the World Heritage List in 1985

4. Reconstruction of the Palaeolithic cave

- Opening the mouth of the cave
- Polychrome room open to the rest of the cave
- Elevation of the floor of the Polychrome Room
- Living area at the entrance



5. Subdivision of the model



6. Texturing the cave

- UV creation
- Texturing from more than 600 real high-resolution photographs

7. Model creation of the polychrome ceiling

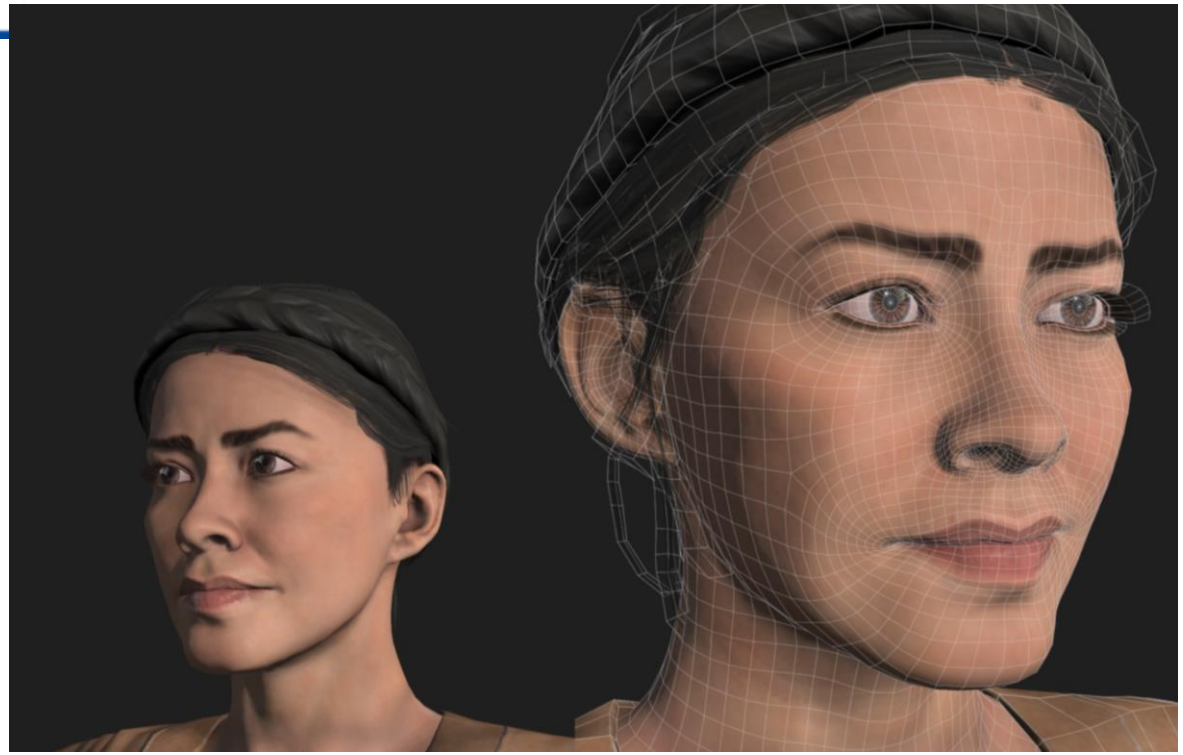
- Photogrammetry: 2314 photographs
- 500,000 polygon model

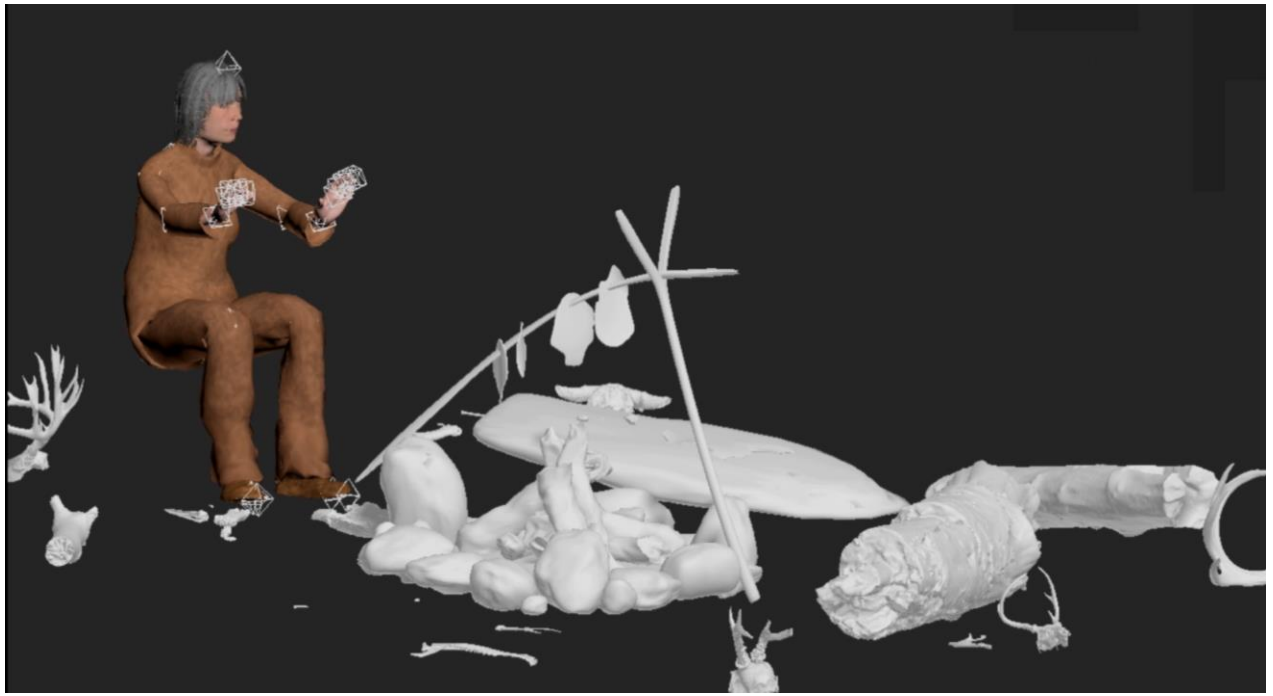
8. Recreation of living area, passage and utility areas

- Home
- Fauna bones
- Antlers
- Patellas
- Marrow lamps
- Chestnuts
- Conch shells
- Teeth
- Skins..

9. Character creation and animation

- Five characters
- A child
- Artist protagonist





GOBIERNO DE ESPAÑA
MINISTERIO DE CULTURA Y DEPORTE

MUSEO DE ALTAMIRA

ISA²

GIM GEOMATICS
servicios geomáticos especializados

UNESCO
United Nations Educational, Scientific and Cultural Organization

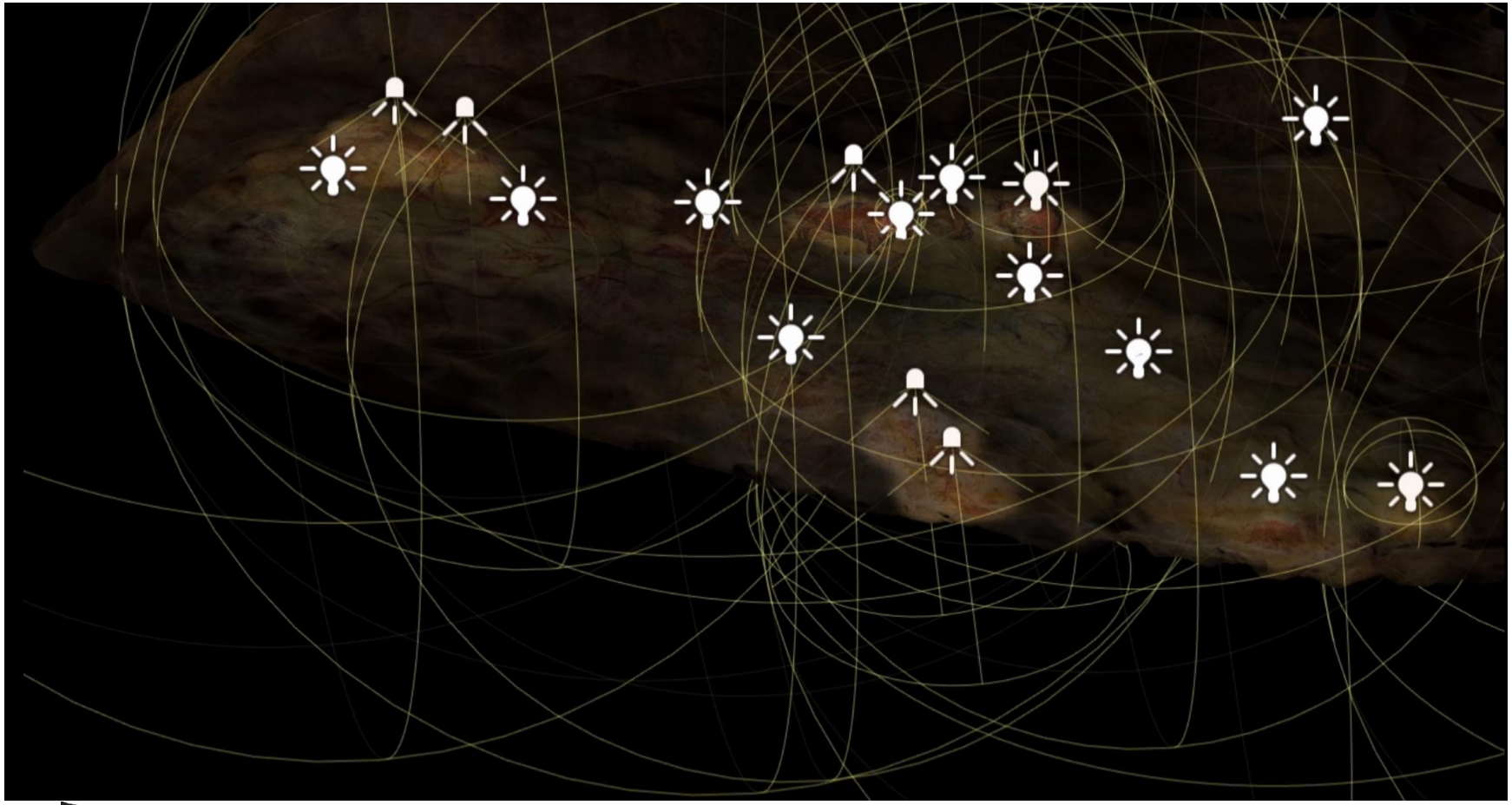
Cave of Altamira and Paleolithic Cave Art of Northern Spain inscribed on the World Heritage List in 1985

10.Recreation of the natural environment

- Vegetation consisting of birch, hazel, dogwood, holm oak, juniper, ash, elm, pine, oak and linden trees.
- Cold and humid climate

11.Treatment of lighting

- Marrow lamps
- Colour temperature and dimming adjustment

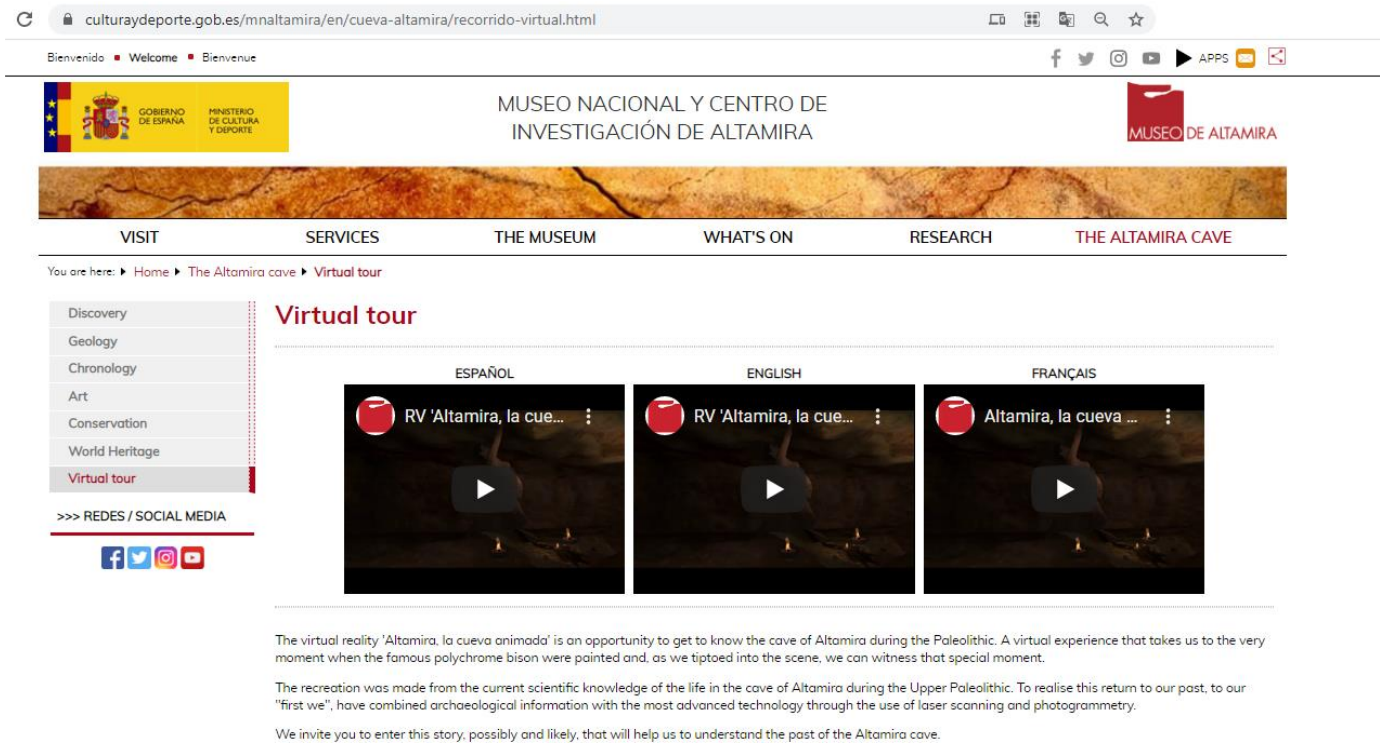


12.Editing and post-production

- Sequence plan
- Creation of introduction, credits and countdown
- Voice-over in English, Spanish and French
- 4K resolution

The result is available on:

https://www.culturaydeporte.gob.es/mnaltamira/en/cueva-altamira/recorrido-virtual.html



Premiere in the temporal exposition
"The art of reproducing Art":
December 2018
100.000 visitors

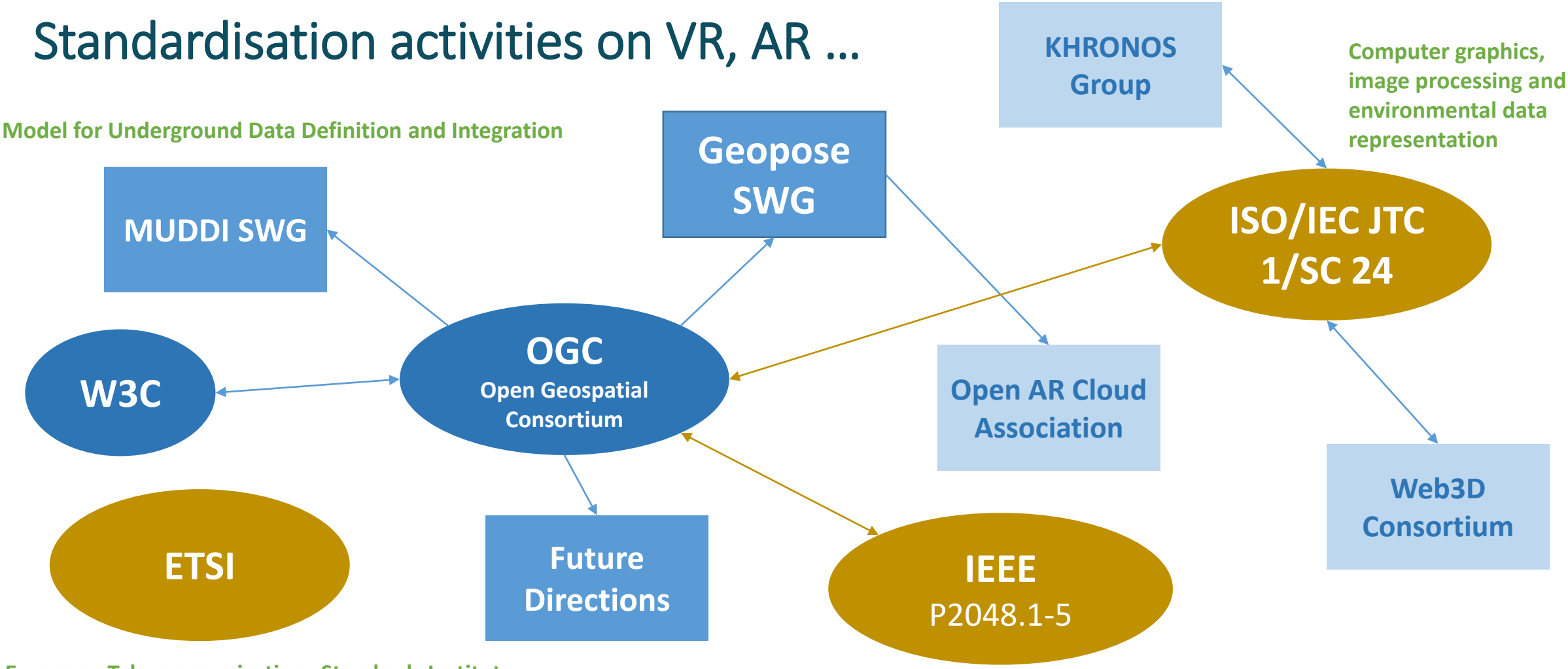
Internet
Available from 11th February 2020:
Spanish: 64.500 visualisations
English: 7.900 visualisations
French: 2.300 visualisations
Total: 74.700 visualisations

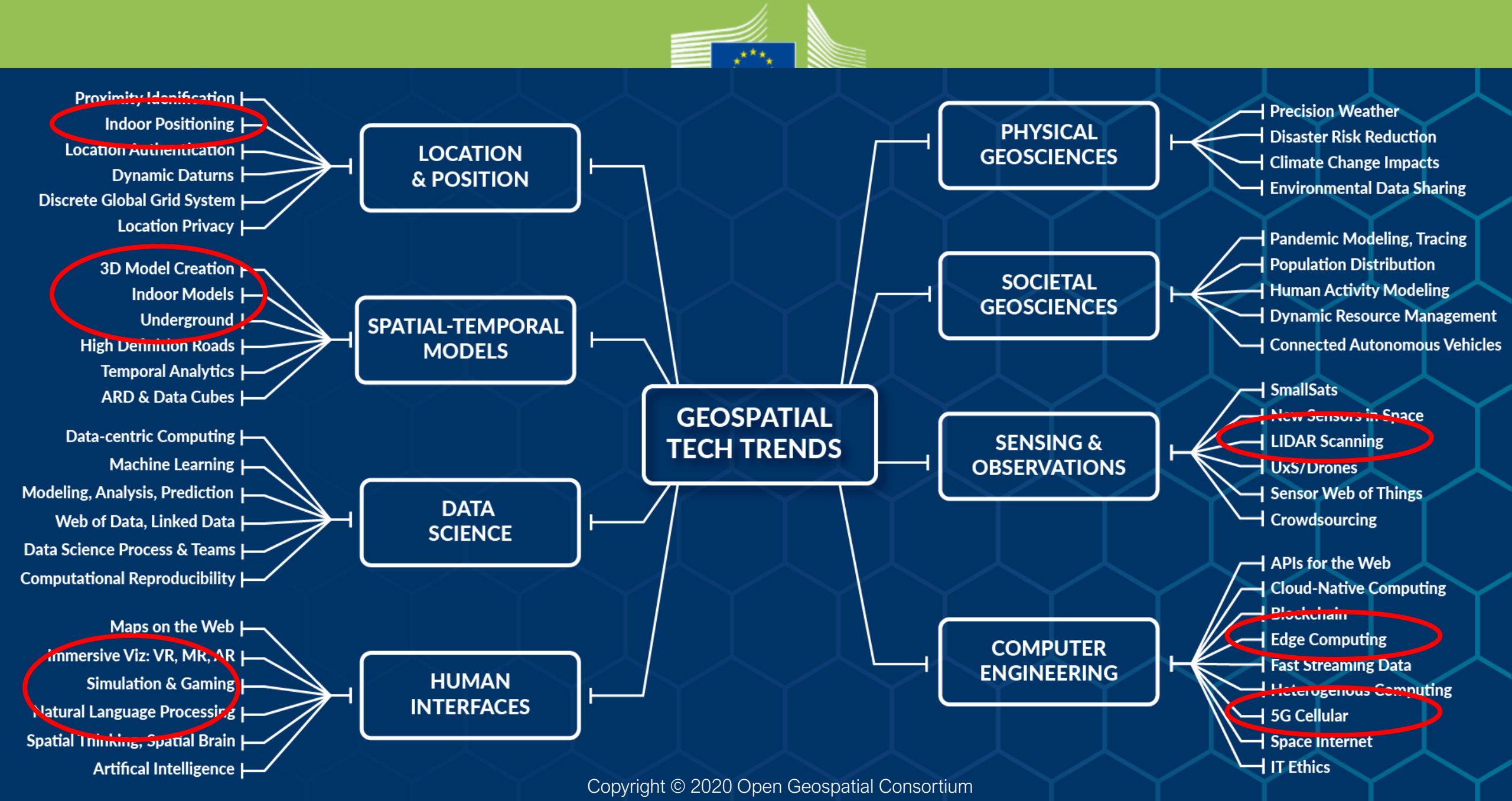
"Zero impact" in the cave: Data recorded for research and management has been used for educational and touristic purposes.

4

Interoperability efforts and challenges

Standardisation activities on VR, AR …





OGC activities

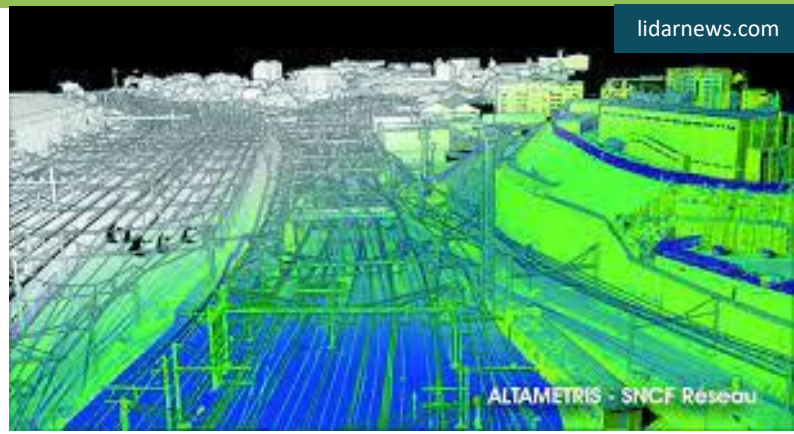
Tech Trends Relevant to Cluster:

- Immersive Viz: VR, MR, AR
- LIDAR Scanning
- Edge Computing
- 5G Cellular
- Indoor Positioning

Immersive Geo

OGC (2020)

- 3D Model Creation
- Indoor models
- Underground
- Simulation and Gaming
- Web of Data, Linked Data



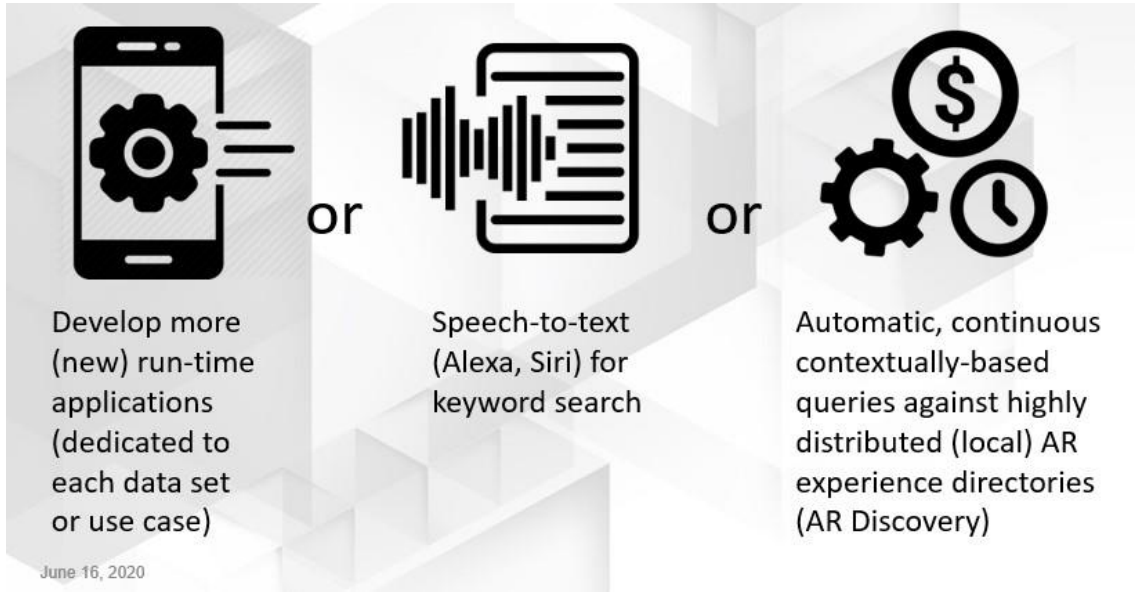
OGC®
Making location count.

Immersive Geo:
Technical Readiness Level (TRL): 9
Interoperability Readiness: 4
"OGC Mixed Reality to the Edge Concept Development Study"

Interoperability challenges

AR-enabled content and its usage are limited. There are still **barriers**, among others **discoverability**. So called **"content-pumps"** will improve the creation and uptake of AR-enabled content. But **standardisation** is required in order not to create new technological silos

Perey (2020)



shutterstock.com

- Emerging Technologies
  - Real World Capture
  - Lower friction for distribution (WebXR)
  - Faster networks (e.g., 5G)
  - Powerful "nearby" processing (Edge)

WebXR Website A-Frame is a web framework for building 3D/AR/VR experiences using a combination of HTML and Javascript

immersiveweb.dev

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5

Key take-away messages & conclusions

Concluding remarks

Immersive visualisation techniques exist for some time and can take **different forms**: from entirely virtual (VR) to forms that are closer to the real world (AR). Mixed Realities (MR) seem to be most promising

VR, AR, MR can be exploited fully when **dedicated hardware devices** such as specialized eyewear is used. However, also **more common devices** such as smartphones bring immersive visualisation technology usable by all

Public Authorities and Governments can use the technologies to enhance existing **public services** or create new innovative services for citizens in many domains

Challenges & priorities

VR, AR, MR require **high quality** base **data** of which a lot is location-based. **3D** is a must, while the right attributes must be available to create ‘real-world’ user experiences.

Implementing immersive visualisation technology requires good multidisciplinary **collaboration** and expertise in the field of **ICT**, **computer vision** (VR, AR, MR), **location data and technologies**, etc.

There are still **barriers** that impede the use of VR, AR, MR based content, among others: the **discoverability** of such content. There is a clear need for standardization as well, with several SDO’s involved.

Q&A

European Commission

European Commission

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DigitALL Public conference

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20, 21 and 22 April 2021

22 April 12:30-14:00 CEST, ELISE Workshop

ELISE enabling the interoperability of digital government from a location perspective

https://digitallpublic.eu

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Photo by Simon Abrams on Unsplash

Next ELISE webinars…

- 3 ELISE webinars giving an overview on ELISE outputs by the 'objective areas', **4, 5, 6 May**

- May/June
  - Energy efficiency and location
  - Re3gistry
  - Reference Validator

Photo by Simon Abrams on Unsplash

Thank you

Stay tuned

Join the *ELISE* community in JoinUp

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eu-location@ec.europa.eu

ELISE channel