



**Barcelona
Supercomputing
Center**
Centro Nacional de Supercomputación



BSC-CNS Technologies Catalogue

Innovating the future together

Connect with the future through all the technologies developed by the research projects coordinated by the Barcelona Supercomputing Center – Centro Nacional de Supercomputación. The centre is committed to extending the boundaries of research and offering new horizons where technologies play a key role.

In this catalogue, BSC-CNS technologies are presented according to their impact on society and contribute to business competitiveness. These impact categories include high-technologies, such as hardware developments and research focused on processors, extreme computing and other initiatives. Health technologies that exploit digital twins and health cloud platforms. Climate technologies that facilitate the understanding and predictability of atmosphere and weather phenomenon, and AI technologies that focus on safety, traceability, open data and their application in language technologies.

These technologies and the research behind them are boosting innovation to shape the future.

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New Processors and Advanced Computing

BSC is a pioneer institution in processors, and extreme and high performance computing research. Its latest developments focus on the design and development of hardware and software that strength European technology and contribute to mobile, automotive, health and other Industries competitiveness.

European Open-source ecosystem with an out-of-order processor and accelerators

Pioneering the future of HPC systems and computing innovation, our open-source out-of-order processor aims to establish the first entirely open-source European full-stack ecosystem. Emphasizing software hardware co-design for peak performance and energy efficiency, it caters to HPC, embedded systems, and High Performance Data Analytics. Join the future of open-source computing.

TECHNOLOGY



RISC-V



High Performance Computing



Emphasizing Software



Artificial Intelligence



Bioinformatics



Deep Learning



Towards European open-source hardware

The Barcelona Zettascale Lab is pioneering the development of Zettascale 1000x faster supercomputers. Dedicated to advancing European technology, the laboratory focuses on designing microprocessors or chips using open-source RISC-V hardware, that will serve applications ranging from supercomputers to autonomous cars and AI devices, positioning the laboratory at the forefront of technological innovation and fostering advancements in diverse sectors.

TECHNOLOGY



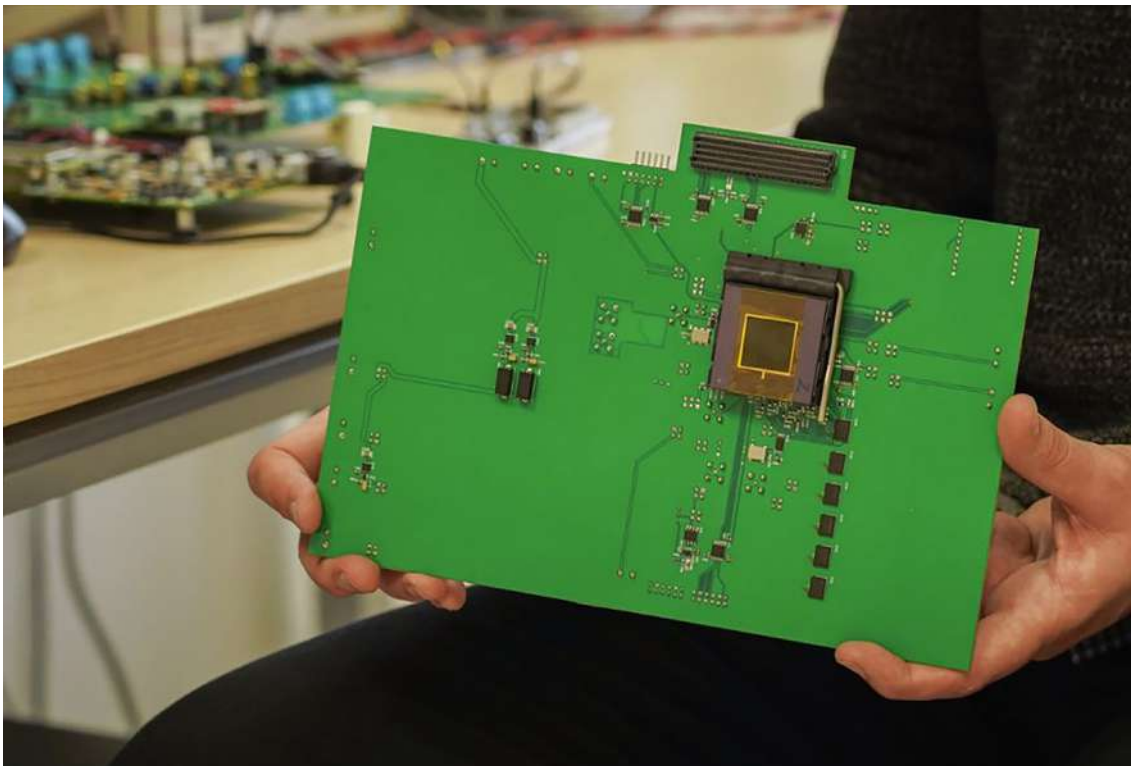
RISC-V



Mobile Manufacturers
Tech



High Performance
Computing



EUPILOT: European AI/ML and HPC Accelerator System



Pilot using Independent Local & Open Technologies

EUPILOT is an ambitious project aiming to establish a robust European computer system for high performance tasks and artificial intelligence. It's set to design, build, and validate the first EU-based accelerator platform for HPC, covering a wide spectrum of compute-intensive AI applications.

TARGET INDUSTRIES

Sector AI, HPC, RISC-V, machine learning, semiconductors, VLSI, chips, liquid cooling, cloud computing, edge computing, genomics, molecular dynamics, datacentre computing, supercomputing, datacentre deployments, big data, data analytics, parallel computing, earth sciences, climate modeling.

Why EUPILOT produces accelerator chips in advanced manufacturing technologies based on innovative RISC-V technologies and its associated software stack, achieving high levels of integration, efficiency, aiming to achieve a more independent technology supply chain.

- Uses**
- High performance computing.
 - Artificial Intelligence.
 - Machine Learning.
 - Genomics.
 - Molecular Dynamics.

European, Extendable, Energy-Efficient, Extreme-Scale, Extensible, Processor Ecosystem



The eProcessor project aims to create an open-source European ecosystem with an out-of-order processor and accelerators. It's designed for high performance, low power, and versatility in HPC and embedded applications. Based on the RISC-V ISA, the project combines existing and new IP for future HPC systems. Emphasis is on software/hardware co-design for better performance and energy efficiency, targeting HPC and HPDA applications. The project involves architectural simulations, FPGA emulation, and two ASIC tapeouts for single-core and multi-core processors.

TARGET INDUSTRIES

Sector **High Performance Computing (HPC):** The project aims to deliver technology suitable for HPC applications, emphasizing high performance and efficiency.

Embedded Systems: The technology is designed to be suitable for embedded applications, indicating versatility and applicability in various embedded systems.

High Performance Data Analytics (HPDA): With a focus on software/hardware co-design, the project is relevant for applications in high-performance data analytics, including AI/ML/DL (Artificial Intelligence/Machine Learning/Deep Learning) and bioinformatics.

Why The eProcessor project disrupts the computing landscape by creating an open-source European ecosystem with an out-of-order processor based on the versatile RISC-V ISA. Prioritizing energy efficiency and high performance, the project combines software/hardware co-design, leveraging existing IP and extending it for future HPC systems. Its focus on both High Performance Computing (HPC) and embedded systems, along with comprehensive testing through simulations, FPGA emulation, and ASIC tapeouts, reflects a holistic approach that challenges traditional architectures and promotes innovation in computing.

Uses NAS Parallel Benchmarks:

- Widely used benchmark suite to evaluate HPC systems.
- Traditional HPC algorithms.
- Diverse data structures, including dense and sparse 3D matrices with different block sizes.

Bioinformatics algorithms found in secondary analysis:

- Sequence alignment.
- Smith-Waterman-Gotoh (SWG).
- Banded SWG.

Enhancing Workflow Lifecycle in Distributed Computing Infrastructures

PyCOMPSs and the eFlows4HPC software stack provide tools for developing and managing complex parallel workflows in distributed computing infrastructures. PyCOMPSs simplifies parallel workflow development by annotating Python scripts, auto-converting them into parallel workflows. eFlows4HPC automates deployment on distributed platforms, reducing time-to-market for computing solutions with HPC-ready container images.

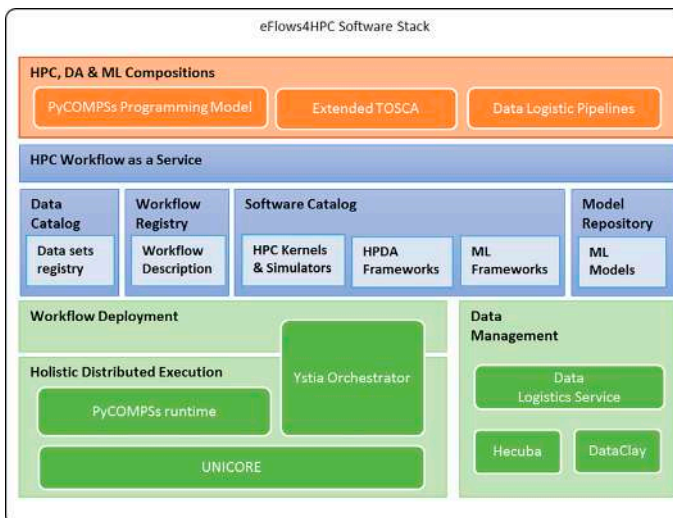


TARGET INDUSTRIES

- Sector** Engineering, bioinformatics, climate forecast, machine learning and software companies.
- Why** Reduce the development and management time of complex workflows in distributed computing platforms.
- Uses** Programming parallel complex workflows for distributed computing platforms. Facilitate the development of complex workflows through HPC ready container images.

TECHNOLOGY

- Software Stack Provider
- Industries Target
- Machine Learning
- Bioinformatics
- Programming
- AI Platform



Empowering data-driven decision-making with extreme data mining



A distributed data-mining software platform for extreme data across the compute continuum

The EXTRACT platform delivers seamless data mining workflows across edge, cloud, and high performance computing technologies. It streamlines complex processes, ensuring efficient and secure data processing. Designed for sectors reliant on AI-driven decision-making, such as Industry 4.0 and smart cities, EXTRACT empowers data-driven choices. Real-life testing in Venice will validate its capabilities by providing personalized emergency escape routes, showcasing its practical applications in critical scenarios.

TARGET INDUSTRIES

Sector Industry 4.0, Smart City, Crisis management, Research, Automotive, Healthcare- bioinformatics.

Why The EXTRACT platform offers a scalable, fast, and distributed processing mechanisms capable of efficiently handling massive datasets to accelerate acquisition of actionable knowledge. It reduces costs for developing data mining workflows for extreme data, allows for a 50% faster implementation of data mining workflows, 60% less data transfers, 30% increase in security ML model attack detections and reduces energy use by leveraging edge computing with minimum performance impact.

Uses AI-big data analytics, data mining, Digital twin modelling, Smart mobility, Emergency response - real-time personalized instructions in a crisis, Cybersecurity, Astronomy, High-energy physics, AI-driven decision-making, e.g., bioinformatics.

TECHNOLOGY



Data-mining Software Platform



Digital Twins



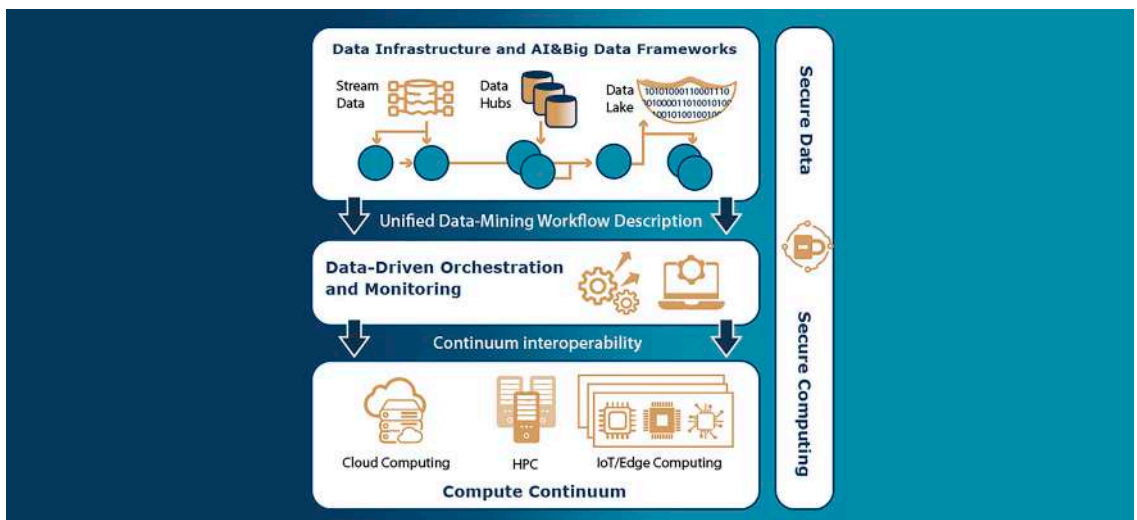
Workflows across edge, cloud and HPC tech



AI Platform



5G



Designing large simulation workflows with integrated analysis and visualization



Horus, an innovative multi-platform GUI, empowers scientists in molecular modeling. With cutting-edge technology, it serves as a local app or centralized server, enhancing collaborative teamwork. Featuring an integrated 2D infinite canvas, Horus excels as a modular workflow designer across environments. Autonomous blocks allow seamless linking, enabling customizable workflows via an accessible API. As a desktop app, it facilitates workflow design, result visualization, and offers an extensive API for custom flows, blocks, and visualizations. Targeting pharmaceutical, biotechnology, and AI industries, Horus heralds a new era of efficiency and adaptability in scientific pursuits.

TARGET INDUSTRIES

Sector **Pharmaceutical and Biotechnology Research.**

Why Horus disrupts by revolutionizing drug discovery and biomolecular design processes. It streamlines and enhances collaboration among scientists, expediting research and development.

Uses Hit identification, High throughput virtual screening, Molecular Visualization, Hit to lead optimization, Structure prediction.

Sector **Artificial Intelligence Development.**

Why Horus disrupts AI development by providing a user-friendly GUI and modular workflow design, boosting efficiency in algorithm creation and testing.

Uses Algorithm Prototyping, Model Training, Collaborative AI Development.

Sector **Scientific Research and Collaboration.**

Why Horus disrupts traditional research methods, offering a centralized platform for scientists to collaborate, design workflows, and share insights seamlessly.

Uses Centralized Collaboration, Workflow Customization, Data Integration.

TECHNOLOGY



Large Simulation Workflows



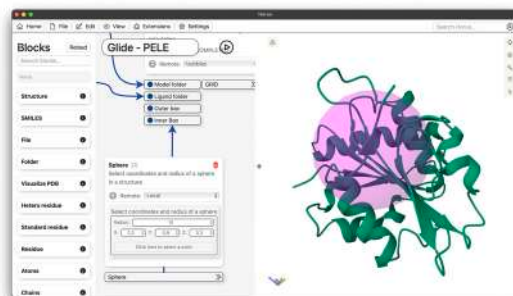
Pharmaceutical and biotechnology research



Scientific Research



Artificial Intelligence Development



AI-Optimized Serverless Deployment Environment



ASDE provides a framework for optimizing omics workload deployment in serverless environments. Enhanced by an AI engine, it continuously monitors deployment telemetry, refining future deployments. This technology streamlines automated, flexible foundational infrastructure deployment through AI and real-time telemetry, ensuring optimal performance for similar workloads.

TARGET INDUSTRIES

Sector Cloud provides, specifically those with serverless environments.

Why It is disrupting in the sense that allows for an automated and adaptive deployment of the underlying infrastructure using AI and real-time telemetry.

To be licensed under Apache License 2.0.

Uses Genomics, metabolomics and surgery.

TECHNOLOGY



Artificial Intelligence



Cloud Providers



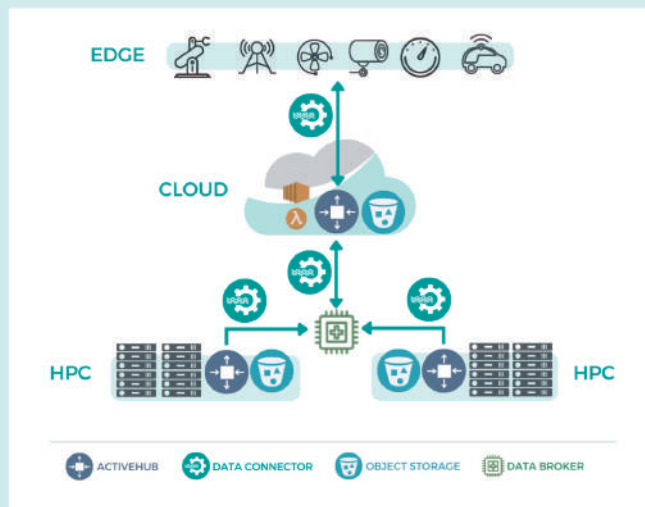
5G



Data connector



AI Platform





A vertical strip on the left side of the page shows a microscopic view of biological cells, likely neurons or similar structures, with glowing blue and green filaments and nodes against a dark background.

Health

Personalised medicine and drug synergies research has radically evolved during the recent years. Through technologies such as digital twins, BSC is setting up innovative approaches to increasing diagnostic precision and the scope for designing tailored treatment strategies.

Personalized stroke risk assessment using AI and wearables for a healthier society



Stroke, the 2nd leading global cause of death, is often underdiagnosed in women. OneCareAI addresses this by leveraging wearables and AI models developed in HPC environments. Pilot studies with hospitals reveal enhanced predictive accuracy and the discovery of non-trivial data patterns. This breakthrough technology, part of the AI-SPRINT project, utilizes wearables for data collection, making disease prevention accessible to the general population. OneCareAI strives to revolutionize stroke risk prediction, bridging the gap between advanced AI, HPC techniques, and wearable technology for the greater good of public health.

TARGET INDUSTRIES

Sector Digital healthcare.

Why The application of state-of-the-art AI and distributed computing techniques to a widespread technology as wearables devices, thus engaging general population in health monitoring and reducing healthcare system burden.

Uses Telecardiology operators could benefit from an advanced analysis of patient's data to early detect stroke risks.

Hospitals that could integrate it among their portfolio of patients monitoring services.

Wearables manufacturers for the proposition of an added value service on top of the basic fitness functionalities.

Insurance companies that offer the service to the customers and monitor their health to reduce costs.

TECHNOLOGY



Medical Assistance



Stroke Risk Assessment



Citizens Healthcare



Wearable Devices

Giving universal access to medical decision support

Aloe Vera, a cutting-edge AI healthcare solution, comprehends medical images and text to provide precise responses. It supports practitioners in diagnosis and treatment planning while offering accessible health insights to individuals, showcasing its versatile capabilities in medical query handling.



TARGET INDUSTRIES

Sector Healthcare domain.

Why Aloe Vera is a foundational medical model, which can be directly applied or fine-tuned for specific medical use cases.

- Uses**
- Health education.
 - Assistance to clinicians.
 - Report summarization.
 - Document Classification.
 - Medical image classification.

TECHNOLOGY



Medical
Universal access



Citizens
Healthcare

Aloe Vera in action

Is this lung healthy?



No, the lung is not healthy, there is a nodule here...



TRY
IT
HERE



Precision medicine for healthy cities

MePreCiSa provides innovative urban health management with a cloud-based platform, a flexible and scalable solution for the integrated analysis and management of Health issues in cities. It integrates epidemic simulation for real-time scenario assessment and decision-making, emphasizing environmental risk factors' impact on well-being. This scalable solution represents a significant leap in proactive public health management for cities.

TARGET INDUSTRIES

Sector Policy makers, healthcare authorities and researchers.

Why The platform will include a simulation environment for epidemic processes, serving as a tool for scenario evaluation and decision-making in real situations. This solution represents a unique advancement towards precision management of public health in cities.

Uses Integrated management of health problems in cities, with special emphasis on the study of exposure to environmental risk factors and their impact on the well-being and health of citizens along with the control of the spread of infectious diseases.

TECHNOLOGY



Sustainable Cities



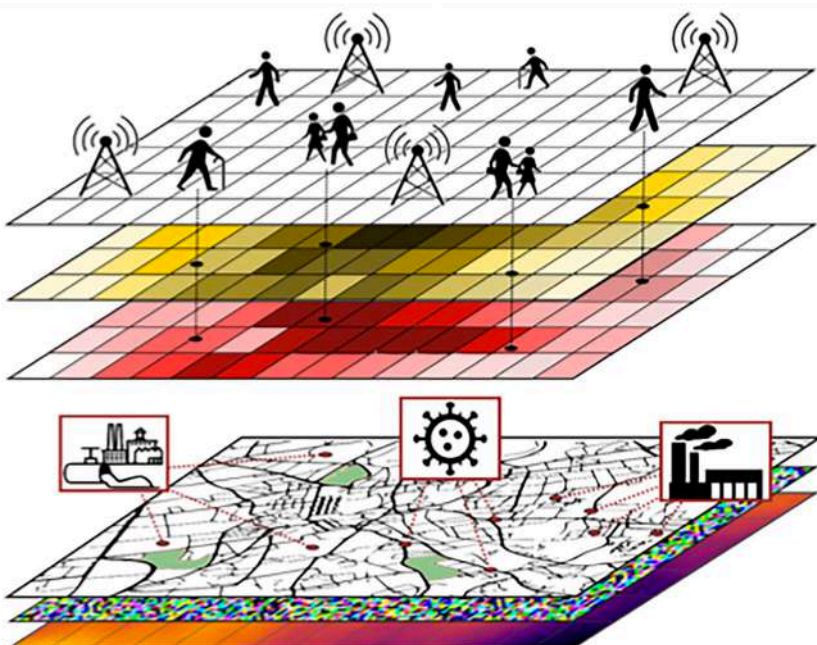
Healthcare Tech



Public Administrations



Software Platform



Generating synthetic data for health

In response to the growing demand for large-scale health data, SynthHealth introduces a deep learning approach to generate synthetic data mirroring existing Electronic Health Records (EHRs). This innovative technology ensures privacy protection, minimizes data biases, and fosters seamless data sharing. Enabling data-driven decision-making, supporting health technology development, and facilitating large-scale epidemiological studies. In pharma, it expedites clinical trials with synthetic control arms, reducing costs, while Health AI benefits from enhanced data access for model training.

TARGET INDUSTRIES

Sector Pharma companies/CROs.

Why Synthetic control arms for clinical trials to speed up and lower the cost.

Sector Health AI companies.

Why Access to data to train their models.

TECHNOLOGY



Databases
Tech



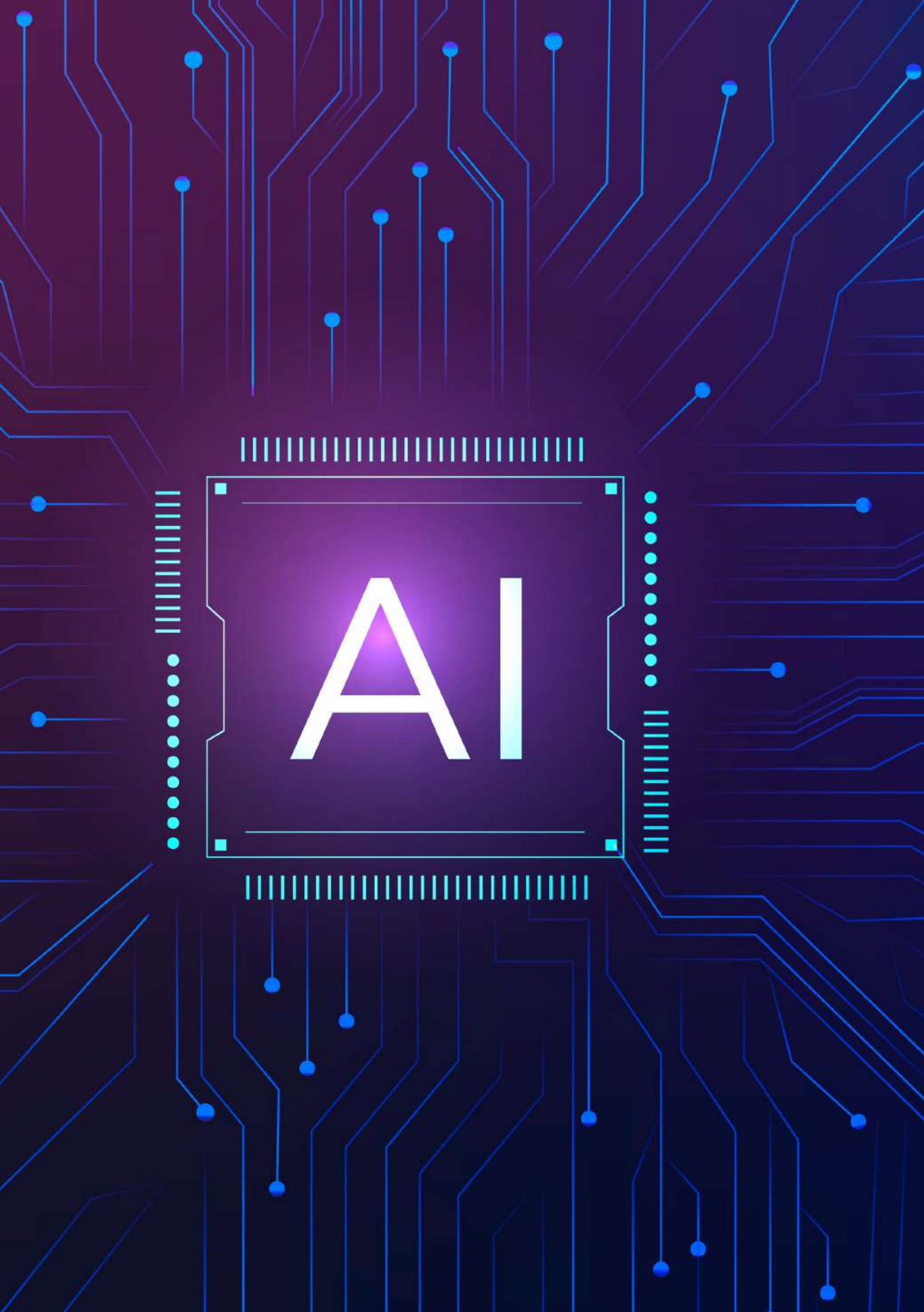
Artificial
Intelligence



Medical
Tech



Medical data-driven
decision-making



AI



Artificial Intelligence

At the same time, Artificial Intelligence (AI) technologies are increasingly able to learning by themselves in a wide range of spheres, such as data processing and software automatization. Language models in generative AI are also changing industrial, educational and social processes with a huge impact on the everyday lives.

Enabling the safe use of AI in automotive, space and railway



Safexplain ensures safe AI integration in automotive, space, and railway systems. It uniquely certifies solutions, addressing explainability, supervision, traceability, and real-time compliance. Following industrial best practices, it facilitates building safety-critical AI systems for autonomous navigation of cars, space shuttles and trains.

TARGET INDUSTRIES

Sector Applications with safety requirements (Automotive, Railway, Space, avionics, Robotics, Industry, health, etc.).

Why So far AI-based solutions have only focused on increased quality without ensuring compliance with domain-specific safety standards. SAFEXPLAIN solutions reconcile AI-based solutions with safety-relevant development processes to enable the use of AI in safety-critical applications.

- Uses**
- Autonomous navigation.
 - Safe object detection.
 - Safe classification.

TECHNOLOGY



Artificial intelligence



AI integration in automotive



AI integration in space



AI integration in railway systems

Providing forecasts, estimations and recommendations to wine makers to optimise vineyard management

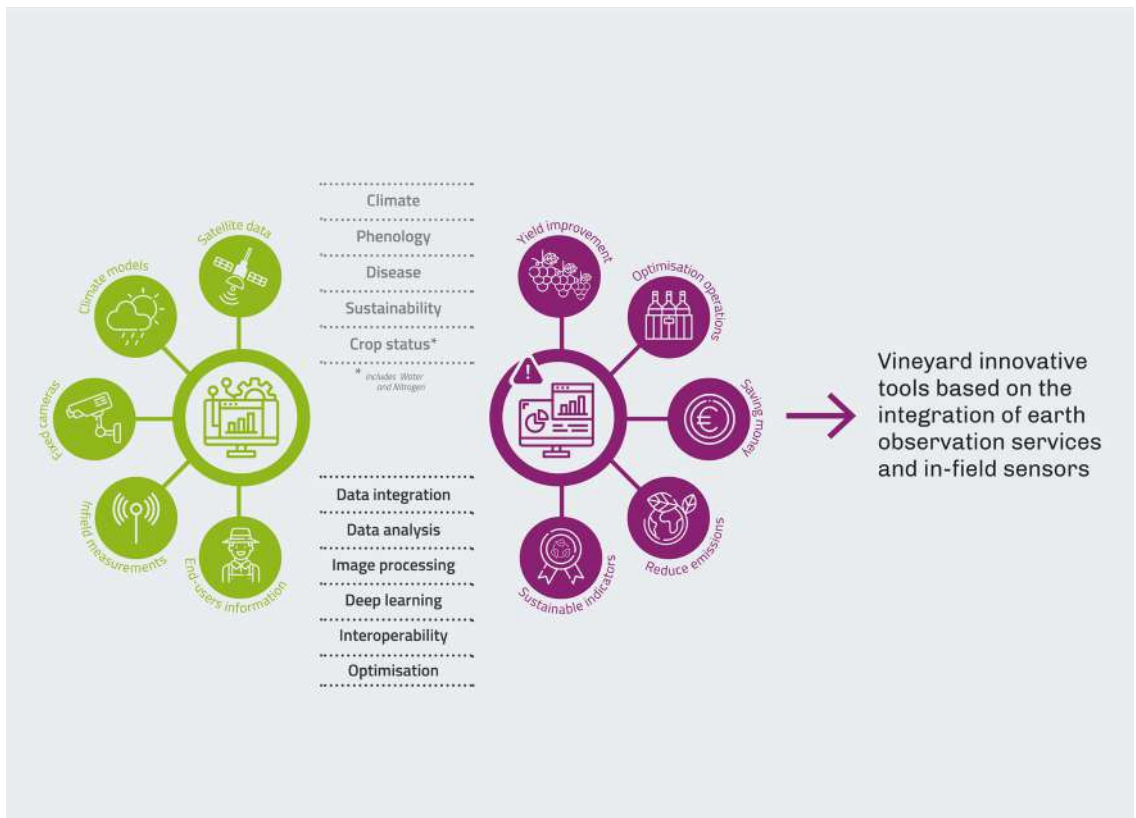


VITIGEOSS is a single entry-point solution for wine producers, aiming to boost vineyards' sustainability. Integrating Earth observation services and in-field sensors, it optimizes grapevine cultivation through decision support systems. Enhance sustainability, minimize resource usage, and make informed decisions with accurate forecasting, mapping, and novel production indicators. VITIGEOSS empowers wine producers for responsible and efficient vineyard management.

TECHNOLOGY



Providing Forecast Technology



Assisted living solution for elderly people living alone



DOMOBOI provides an assisted living solution for seniors living independently. Through a single measurement point, it observes electrical appliance usage, learns daily routines, and identifies real-time anomalies without active intervention. This advanced technology offers non-intrusive, low-cost monitoring for accident prevention and early detection of chronic diseases, ensuring the well-being of elderly individuals at home.

TARGET INDUSTRIES

Sector Home assistance.

Why Non-intrusive, low cost, low maintenance solution for home monitoring.

TECHNOLOGY



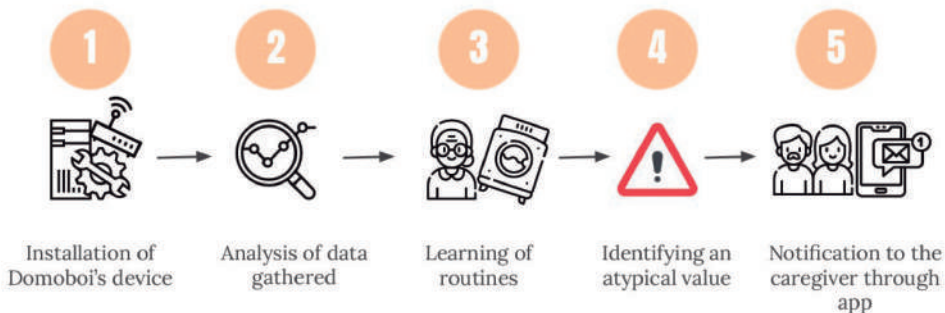
Artificial Intelligence



Medical Assistance



Elderly people



Smart City Software Architecture Framework for smart and safe mobility



Smart City Software Architecture Framework is a robust solution for developing and orchestrating AI-enabled cloud-native applications across the edge-to-cloud spectrum. Integrated with 5G network services, it ensures rapid, reliable connectivity for diverse applications, emphasizing real-time components with low response time guarantees. Ideal for complex workflows, it finds applications in domains such as smarter and safer mobility and real-time air quality monitoring, shaping the future of intelligent urban living.

TARGET INDUSTRIES

Sector Smart City, Research, Automotive and smart mobility, Healthcare, Industry 4.0.

Why The approach provides a software solution to describe complex workflows that can run seamlessly over heterogeneous edge and cloud computing infrastructures.

These specifically target services with real-time components, which require very low response time guarantees. Integration with 5G networking services is also a key enabling factor.

- Uses**
- Smart and safe mobility.
 - Real-time air quality prediction.
 - AI-driven decision-making.

TECHNOLOGY



Smart City



Artificial Intelligence



Software architecture framework



Edge cloud tech for air quality



5G



Smart Mobility

Digitalizing the use of Catalan

AINA is at the forefront of digitalizing the use of Catalan in AI and Language Technologies. By creating multilingual large language models, it enriches AI applications, encompassing text and voice. AINA's impact extends to public administrations, chatbots, and audio-guides, unlocking diverse benefits for seamless language integration in the digital landscape.



TARGET INDUSTRIES

Sector Developers/integrators of AI applications.

Why There are a few LLM that are multilingual and open. We provide resources for Catalan (data + models, both text and speech).

Uses Any AI application involving language, including text (chatbots, document classification, summarization, question answering, semantic search, etc.) and voice (TTS, STT, diarization, etc.).

TECHNOLOGY



Translation Tech



Artificial Intelligence



Chatbot



Audio-guide



Public Administrations



Multilingual large models software

Digitalizing the use of Spanish co-official languages







ILENIA ensures the use of minority languages in AI by developing linguistic infrastructure. Leading scientific centers generate multilingual large language models. As part of the PERTE Strategic Project, it promotes the new digital economy based on natural language in Spain. ILENIA, a coordinated effort among BSC-CNS, CENID, HiTZ, and the University of Santiago de Compostela, generates digital resources for developing multilingual applications in various Spanish languages.



TARGET INDUSTRIES

- Sector** Developers/integrators of AI applications.
- Why** ILENIA acts as a platform for boosting the digital presence of the Spanish languages through a common project. The technologies developed through ILENIA, aim at answering the social demands and the multilingual requirements.
- Uses** Any AI application involving language, including text (chatbots, document classification, summarization, question answering, semantic search, etc.) and voice (TTS, STT, diarization, etc.).

TECHNOLOGY

-  Translation Tech
-  Artificial Intelligence
-  Chatbot
-  Audio-guide
-  Public Administrations
-  Multilingual large models software

Helping AI be compliant with the new European law

The imminent AI Act is the first big regulation on Artificial Intelligence. It promotes trustworthy AI but will introduce complex requisites for AI developers. Mocca is a software platform that helps researchers compile documentation, track metrics, etc. to satisfy all requirements introduced by the AI Act.



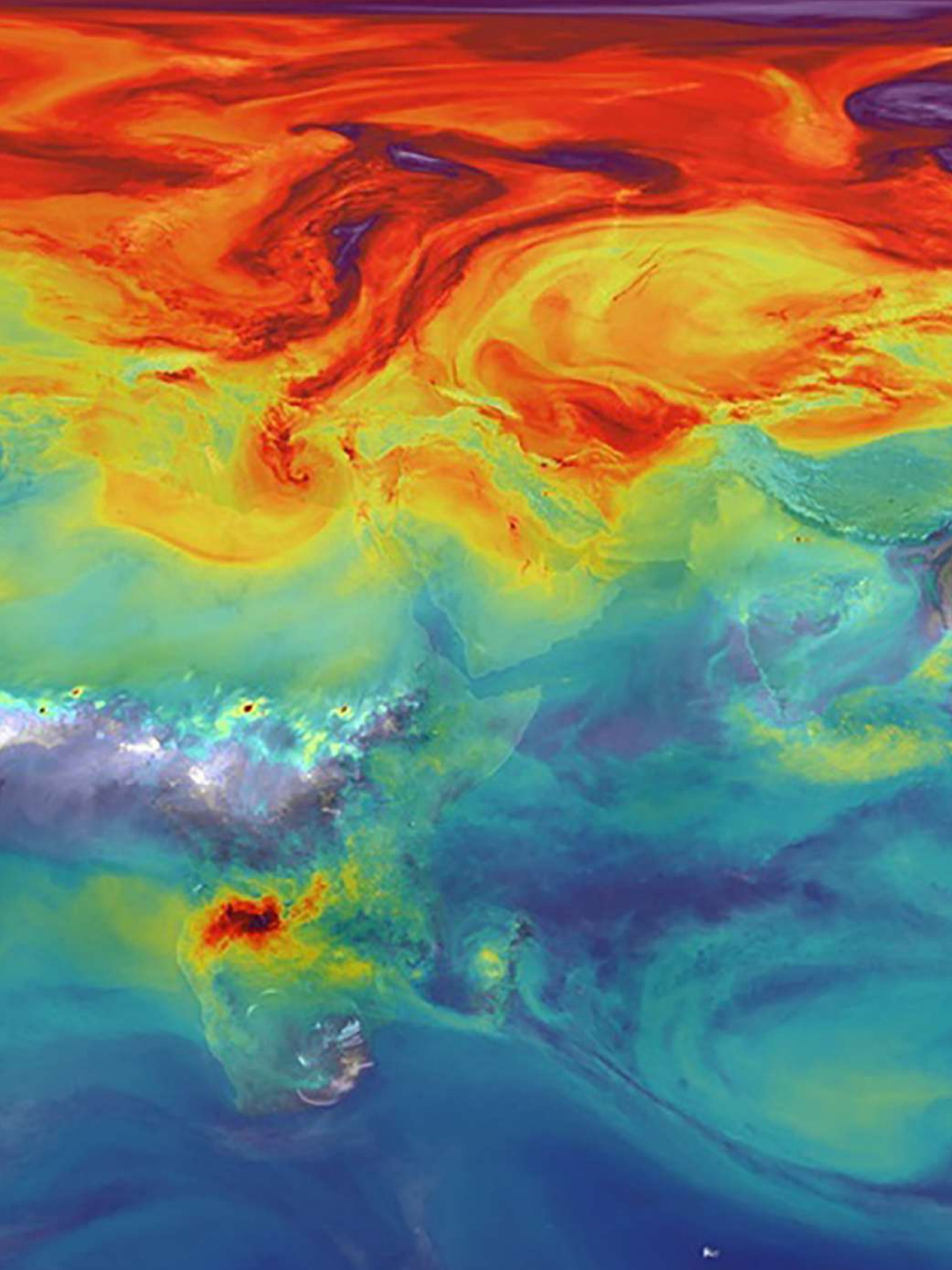
TARGET INDUSTRIES

Sector Mocca targets small to medium research groups and private SMEs and start-ups developing AI systems.

Why Mocca is the first software that aids you in compiling and generating documentation and in making your AI systems compliant with the new European regulation.

Uses

- Generating AI model documentation.
- Tracking AI Act requisites.



NASA-produced simulation of the current distribution of carbon dioxide in the atmosphere | NASA

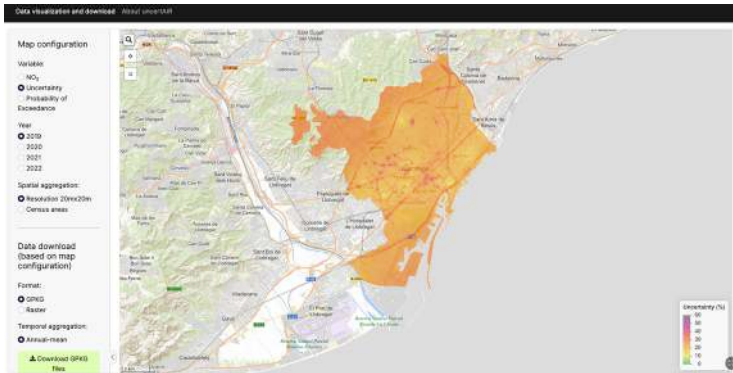


Climate

BSC leverages its expertise to create and execute models that are able to predict and examine future events or patterns that will negatively affect the ecosystem and life on earth.

Reporting uncertainty in air quality simulations

UncertAIR collaboratively designs and develops an interactive platform for data visualization and download, empowering users to compute and communicate air quality model uncertainty in Barcelona city. The urban planning sector and air quality-related companies gain valuable probabilistic information for designing the future cityscape.



TECHNOLOGY



Air Quality Model

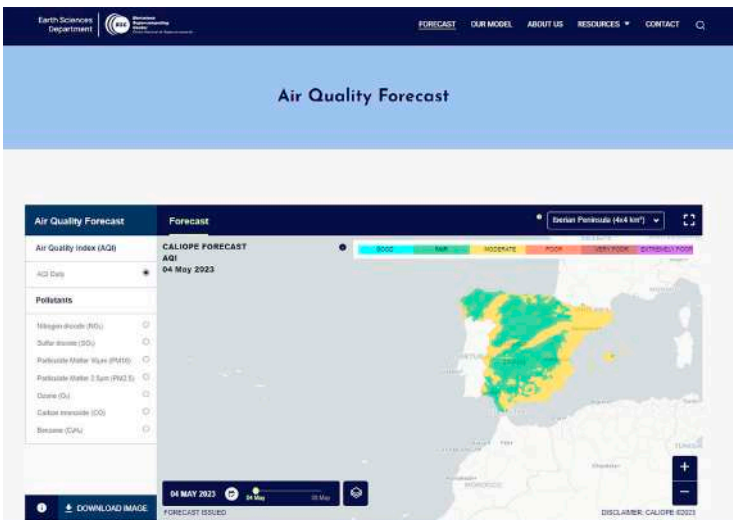
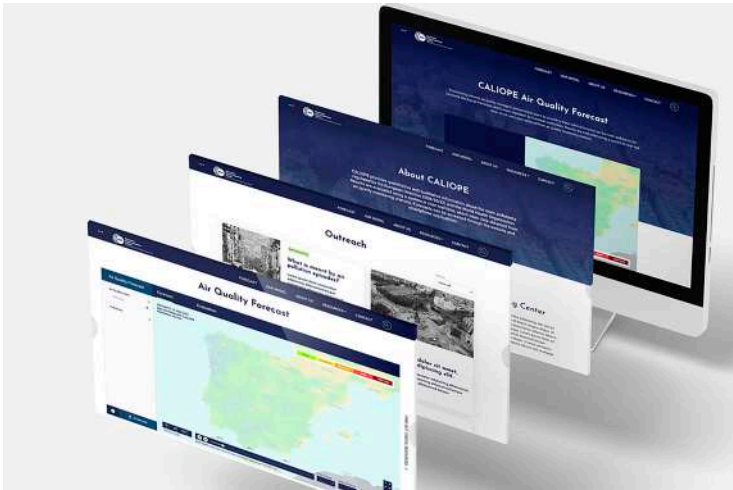
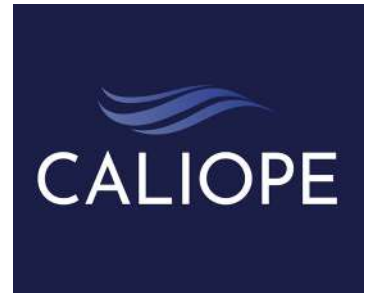


Sustainable Cities



Operational air quality forecast system

CALIOPE system delivers operational air quality forecasts for Europe, the Iberian Peninsula, and Canary Islands, utilizing nesting techniques for 24h and 48h predictions. The System serves to inform the population about upcoming air quality episodes, enabling proactive implementation of mitigation measures and timely warnings for adverse air quality situations.



TECHNOLOGY

 Air Quality Forecast

 Sustainable Cities

 Citizens Healthcare

 Software System

Barcelona Dust Regional Center

The Barcelona Dust Regional Center oversees the World Meteorological Organization Sand and Dust Storms Warning Advisory and Assessment System (WMO SDS-WAS) in Northern Africa, the Middle East, and Europe. Providing timely and high-quality forecasts, observations, and knowledge, it plays a crucial role in supporting the development of early warning systems and mitigation plans for sand and dust storms.



Barcelona Dust
Regional Center

Products

Overview

The WMO Barcelona Dust Regional Center provides access to high-quality dust information for the benefit of society. This information is useful to predict the occurrence of Sand and Dust Storms (SDS), as well as to manage their effects and impacts. In this context, the Center offers a wide range of dust products, both models and observations, that serve the need for detailed dust information on a regional scale. A detailed description of all the products offered on the Center's website can be found in the User Guide.

[USER GUIDE](#)



Daily Dust Products

Dust forecasts and dust-related observational products

[EXPLORE PRODUCT](#)



Dust Products Catalogue

Inventory of available dust observational and modelling products

[EXPLORE PRODUCT](#)



Data Download

Access and download the numerical data of dust forecasts

[EXPLORE PRODUCT](#)

TECHNOLOGY



Air Quality
Forecast



Scientific Researcher
Target



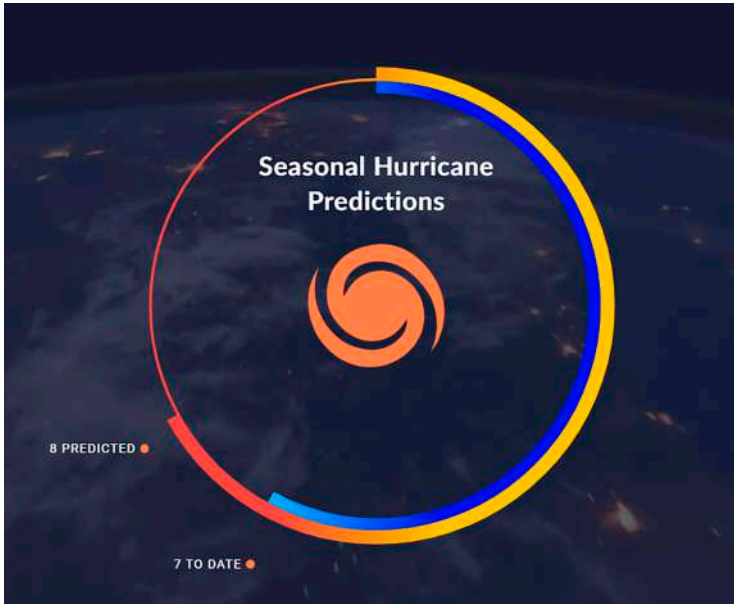
Citizens
Healthcare



Sustainable
Cities

Seasonal Hurricane Predictions

The Seasonal Hurricane Predictions platform offers free access to global forecasts from universities, private entities, and government agencies for the upcoming North Atlantic hurricane season. Available in April 2024, these predictions estimate basinwide hurricane activity based on the atmospheric and oceanic system's current and projected state, facilitating informed preparedness.



TECHNOLOGY



Hurricane Predictions



Software Platform



5G

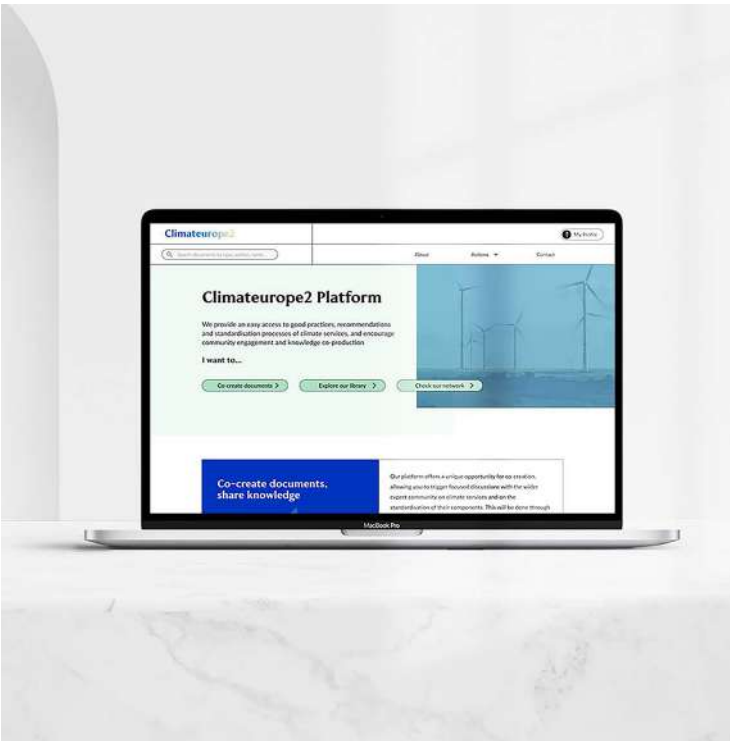


Citizens Healthcare

Supporting and standardizing climate services in Europe

Climateurope2

Climate information is pivotal for achieving a green recovery and climate neutrality in Europe. The demand for climate information has seen substantial growth and is anticipated to continue. Coordinated by the Barcelona Supercomputing Center, Climateurope2 focuses on developing standardization procedures and recommendations for climate services. This project actively supports and unifies the European climate services community, playing a crucial role in meeting the evolving market needs for climate information.



TECHNOLOGY



Climate Services



Software Platform



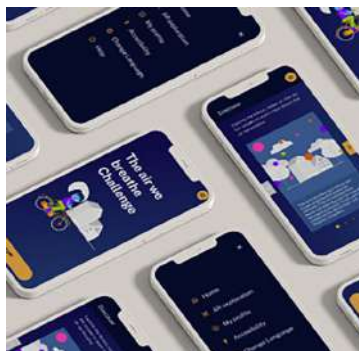
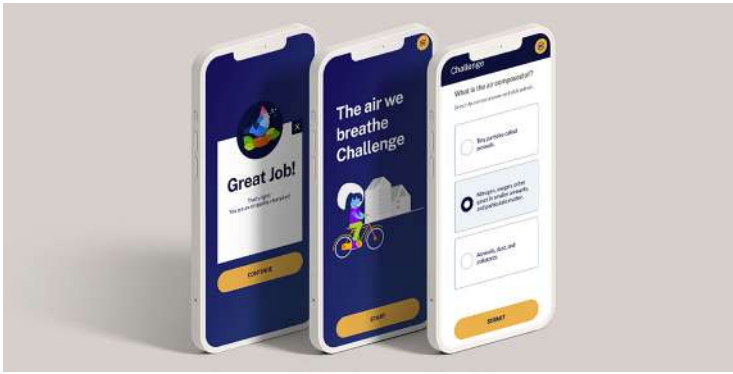
AI platform



Sustainable Cities

Shaping a green future and inspiring environmental leaders

The GreenSCENT AR e-learning app is designed to empower European citizens, fostering empathy for the planet and encouraging positive environmental behavior change. Offering a comprehensive educational experience, it covers topics from the composition of the atmosphere to the impact of pollutants. By bringing air quality education to life, the app aims to nurture a stronger sense of environmental awareness, encouraging individuals to make informed decisions for a more sustainable future.

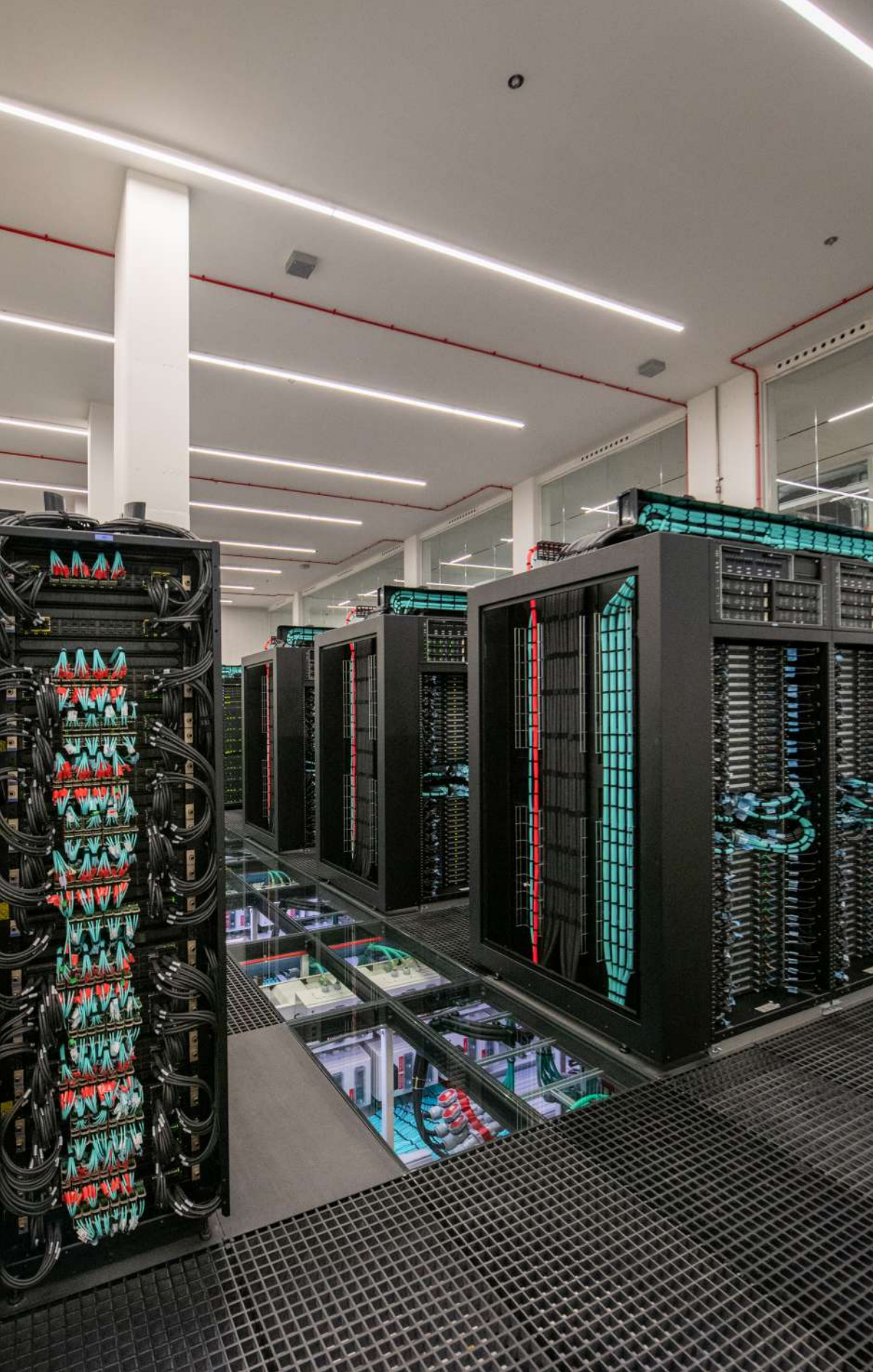


TECHNOLOGY



**Download
GreenSCENT
AR App
to be an
environmental
leader!**





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HR EXCELLENCE IN RESEARCH



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**Barcelona
Supercomputing
Center**

Centro Nacional de Supercomputación