



AIR CENTRE
ATLANTIC INTERNATIONAL RESEARCH CENTRE

High-level panel on Science, Technology, and Innovation for Sustainable Urban Development in a post-Covid19 world

AIR Centre for 25th CSTD
Miguel Belló Mora (CEO)
March 2022





- **Introduction to AIR Centre:**
 - **Mission and Vision**
 - **Earth Observation Laboratory**
- **Space Data System for Sustainable Urban Development:**
 - **System overall description**
 - **Space Data Component**
 - **In-situ Data Component**
 - **Data Center Module**
 - **Applications Module**
 - **Capacitation and Training**
- **Conclusions**



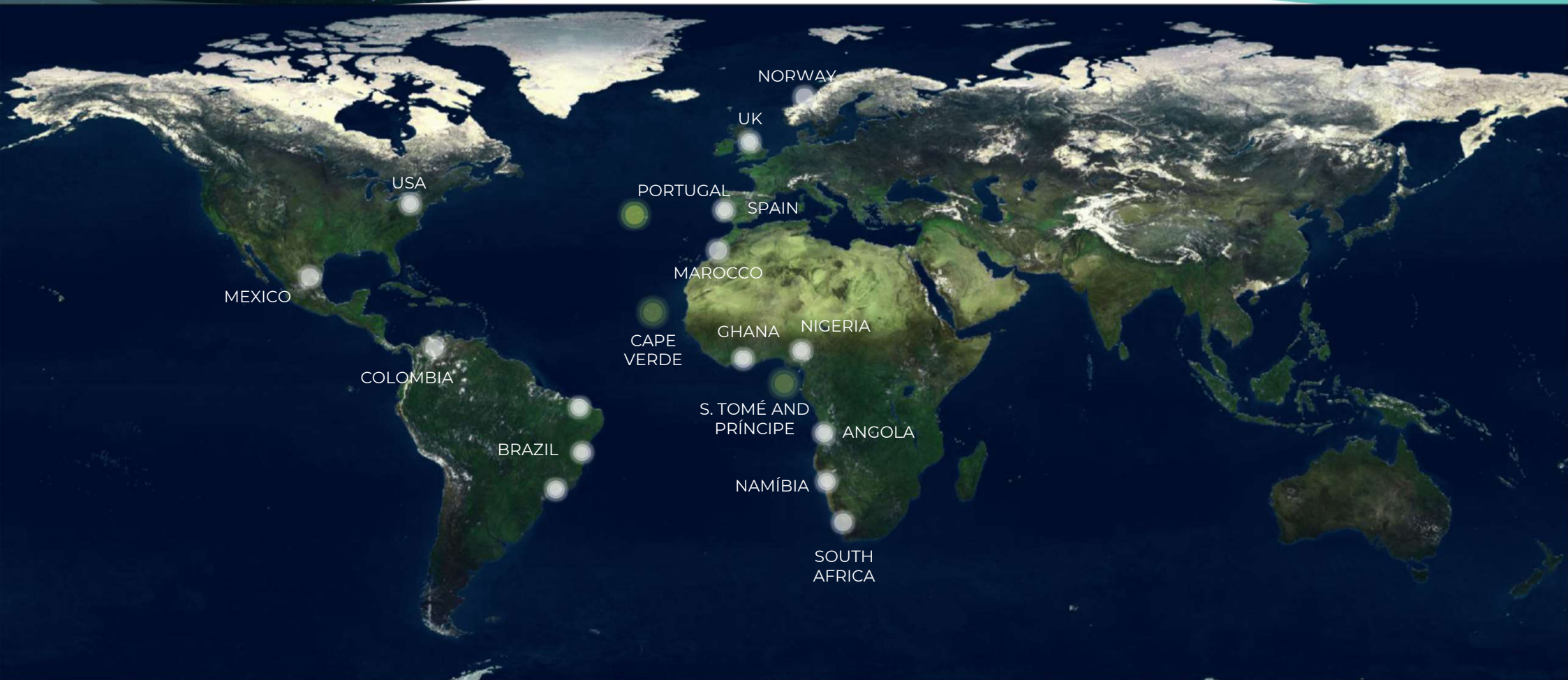
AIR CENTRE: MISSION AND VISION

- International non-profit organization with a distributed and collaborative network
- To foster **job creation** and **knowledge driven economic development** in Atlantic regions
- Based in **scientific excellence** and providing services to the scientific community
- To monitor and decisively contribute to reach the UN sustainable development goals
- It integrates space, climate, earth, ocean, energy and data sciences
- To promote South-North/North-South cooperation
- With main actions oriented towards selected **main thematic missions**





AIR CENTRE NETWORK STATUS: AIR CENTRE OFFICES





AIR CENTRE NETWORK STATUS: AZORES HEADQUARTERS



AIR CENTRE NETWORK STATUS: LISBON OFFICE

Central office – Palácio das Laranjeiras,
Lisboa



Headquarters – Terinov, Terceira Island
Earth Observation Laboratory
Marine Biodiversity Observation Network



AIR CENTRE EARTH OBSERVATION LABORATORY





The graphic features a large lightbulb on the left and a circular, multi-layered design on the right. The circular design has a central image of Earth, surrounded by concentric rings of various colors. The text "ESA_Lab@" is prominently displayed in white at the top left of the circular area, and "space 4.0" is in the center. The ESA logo is in the top right corner. The circular design is surrounded by various words in different languages, including "innovate", "inform", "inspire", and "interact". At the bottom, there is a row of flags representing various European countries, and the text "European Space Agency" is on the right.

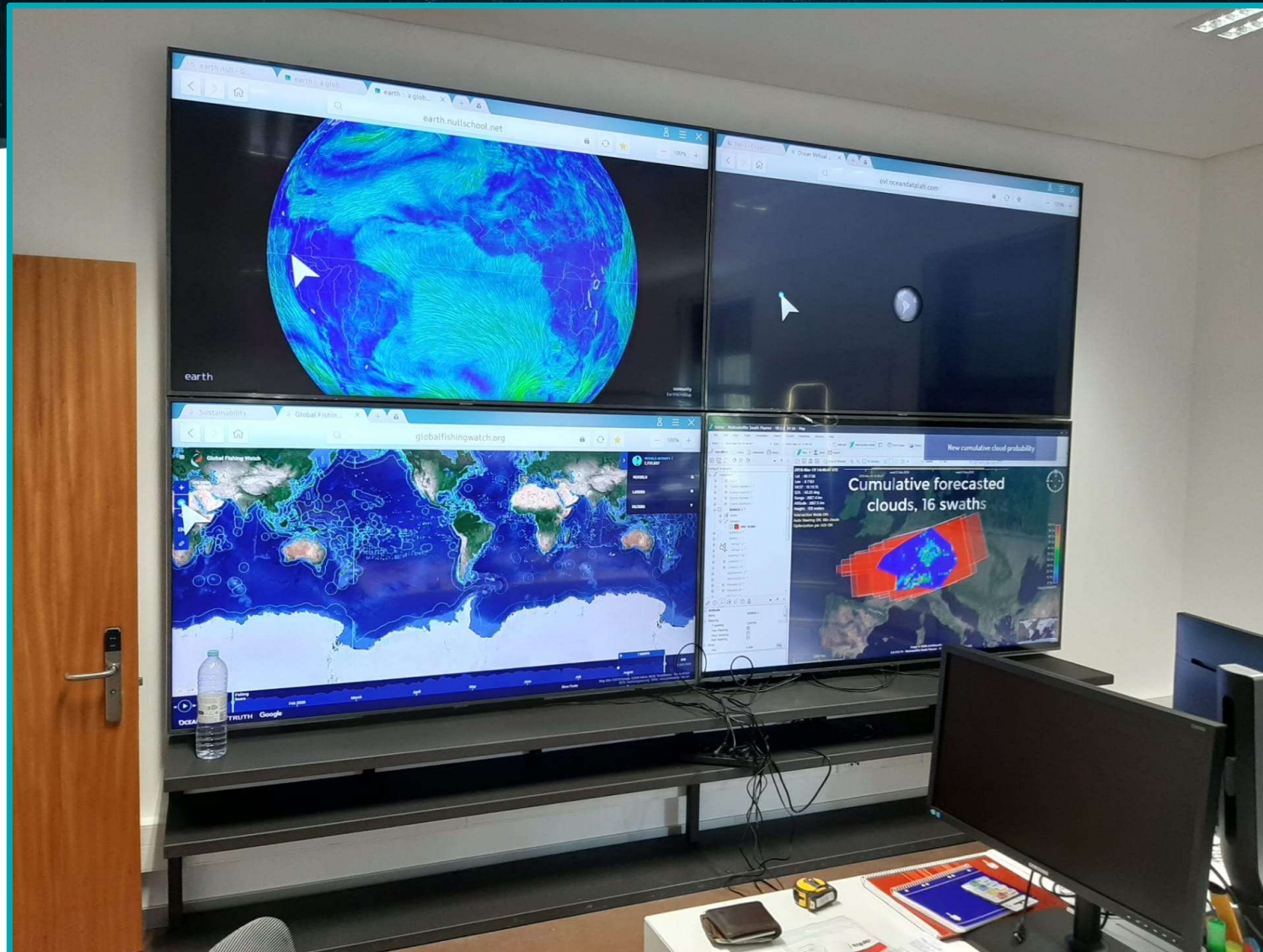
ESA_Lab@

space 4.0

esa

European Space Agency

EARTH OBSERVATION LABORATORY & ESA_Lab

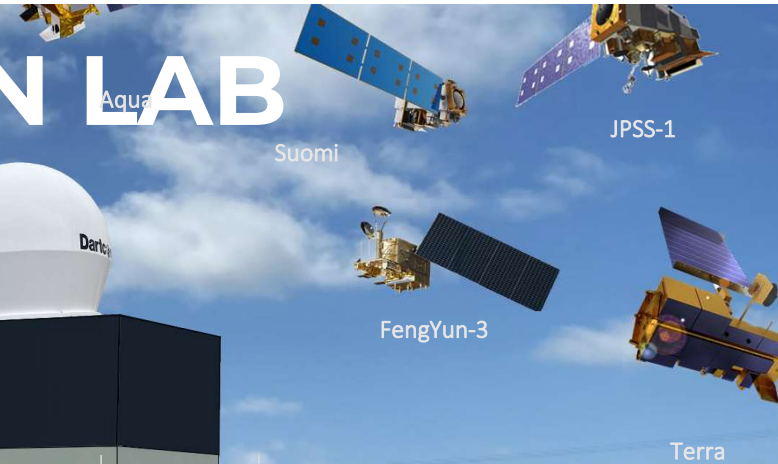




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EARTH OBSERVATION LAB

DIRECT RECEIVING STATION



Estimated External Data Usage 10 Years (error +/- 10%)

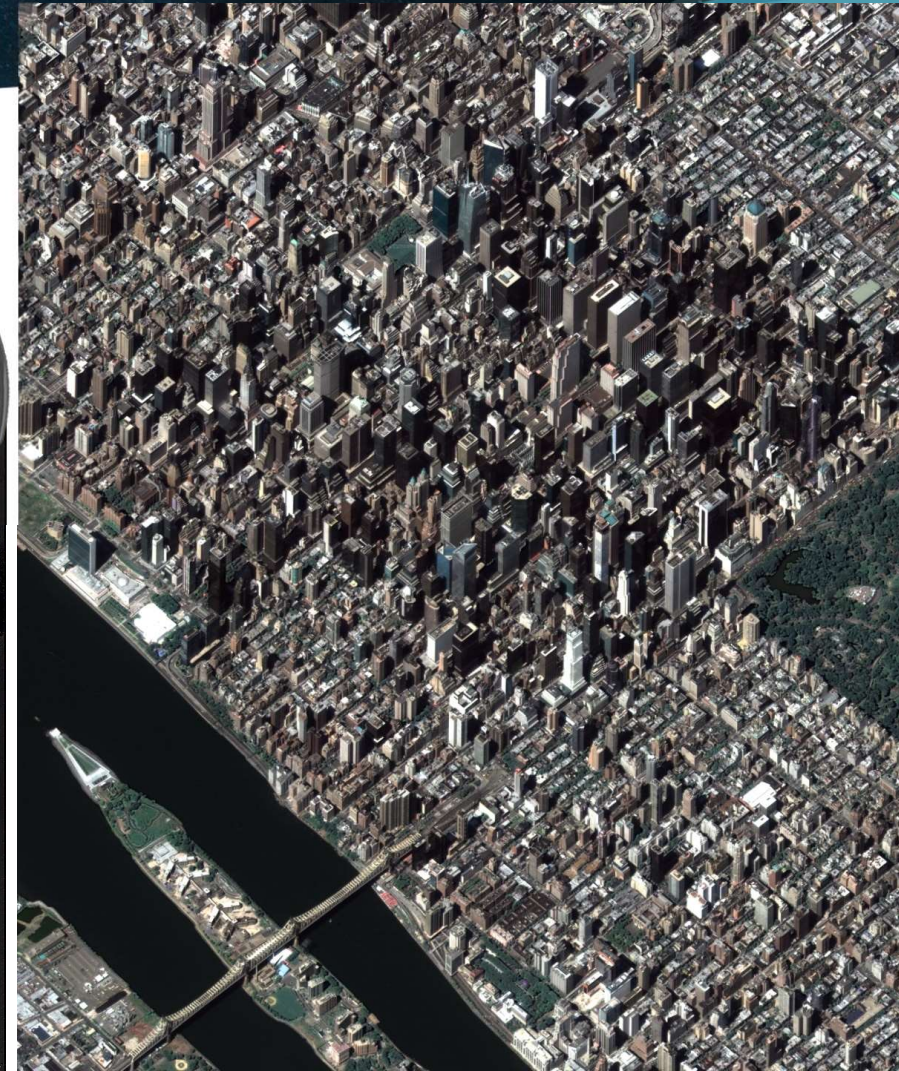
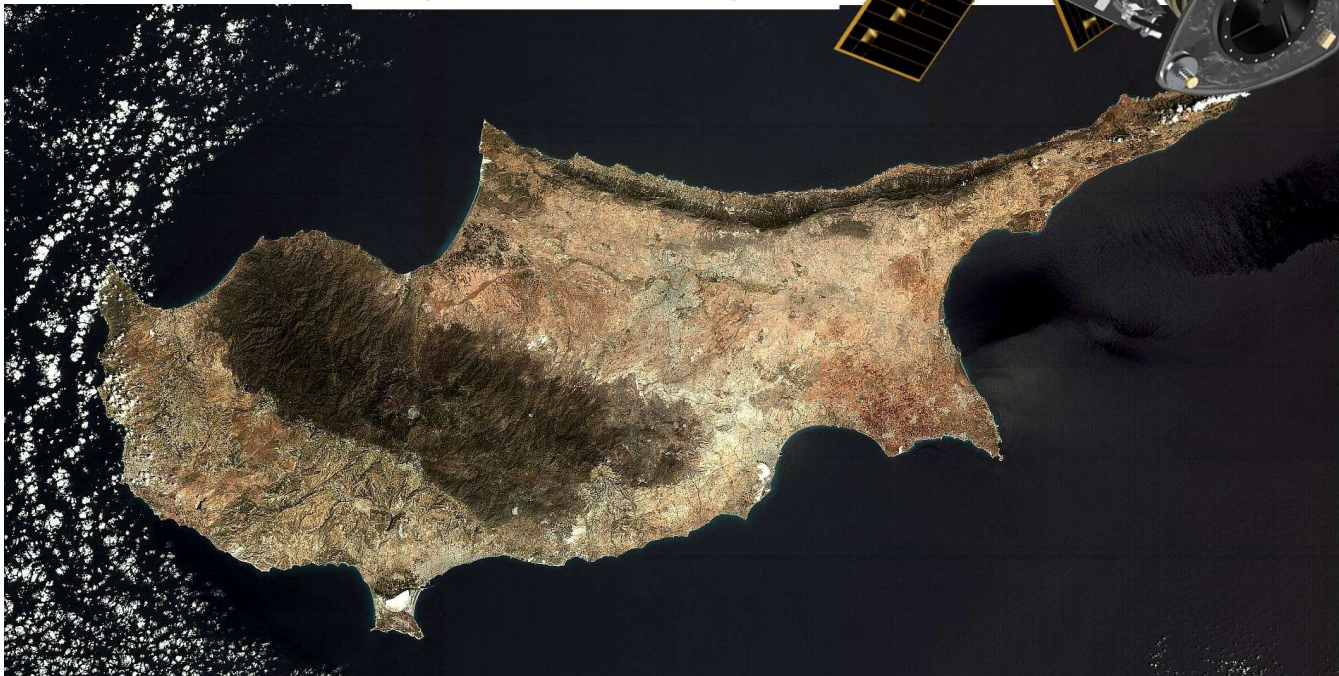
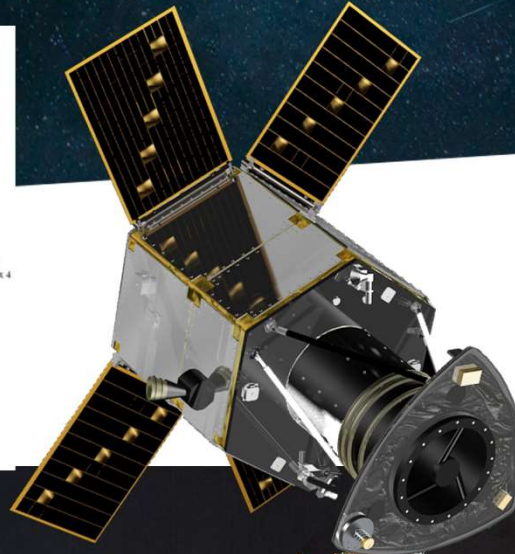
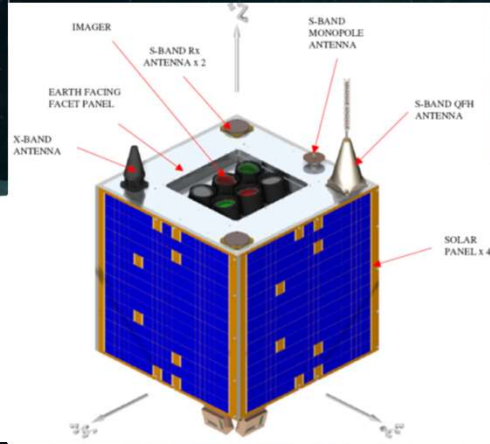


buildprint

Taerabyte



AIR CENTRE PARTNER SATELLITES: GEOSAT-1, GEOSAT-2





GEOSAT
Global Earth Observation Satellites

LA PALMA VOLCANO



GEOSAT 1, La Palma, Canary Island, Spain



GEOSAT 2, Cumbre vieja Volcano, La Palma, Spain



FIRE MONITORING



SPACE DATA SYSTEM FOR SUSTAINABLE URBAN DEVELOPMENT



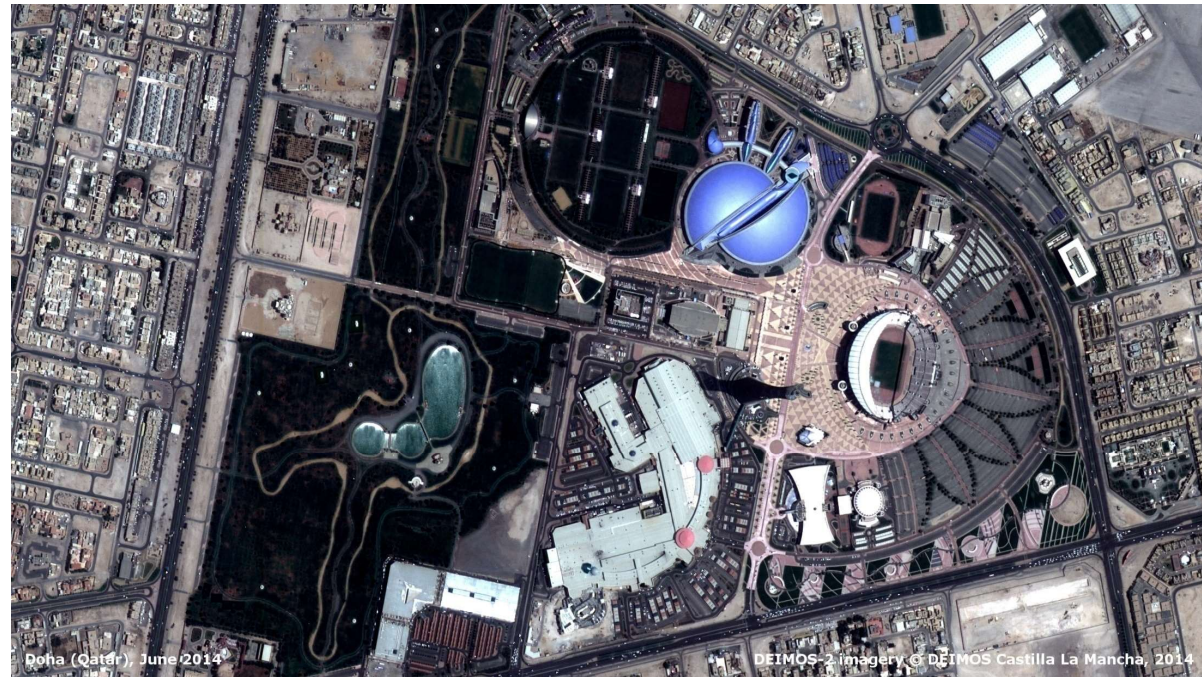
Sustainable urban development, SDG 11, faces important challenges today:

- **Inefficient and polluting energy systems**
- **Unsustainable production and consumption patterns**
- **Water scarcity**
- **Traffic congestion and vehicle emissions**
- **Limited access to decent employment**
- **Unaffordable and poor-quality housing**
- **Gender-based inequalities and violence against women and girls**
- **Inadequate planning practices**
- **Violence and insecurity**
- **Vulnerability to natural disasters**



SUSTAINABLE URBAN DEVELOPMENT

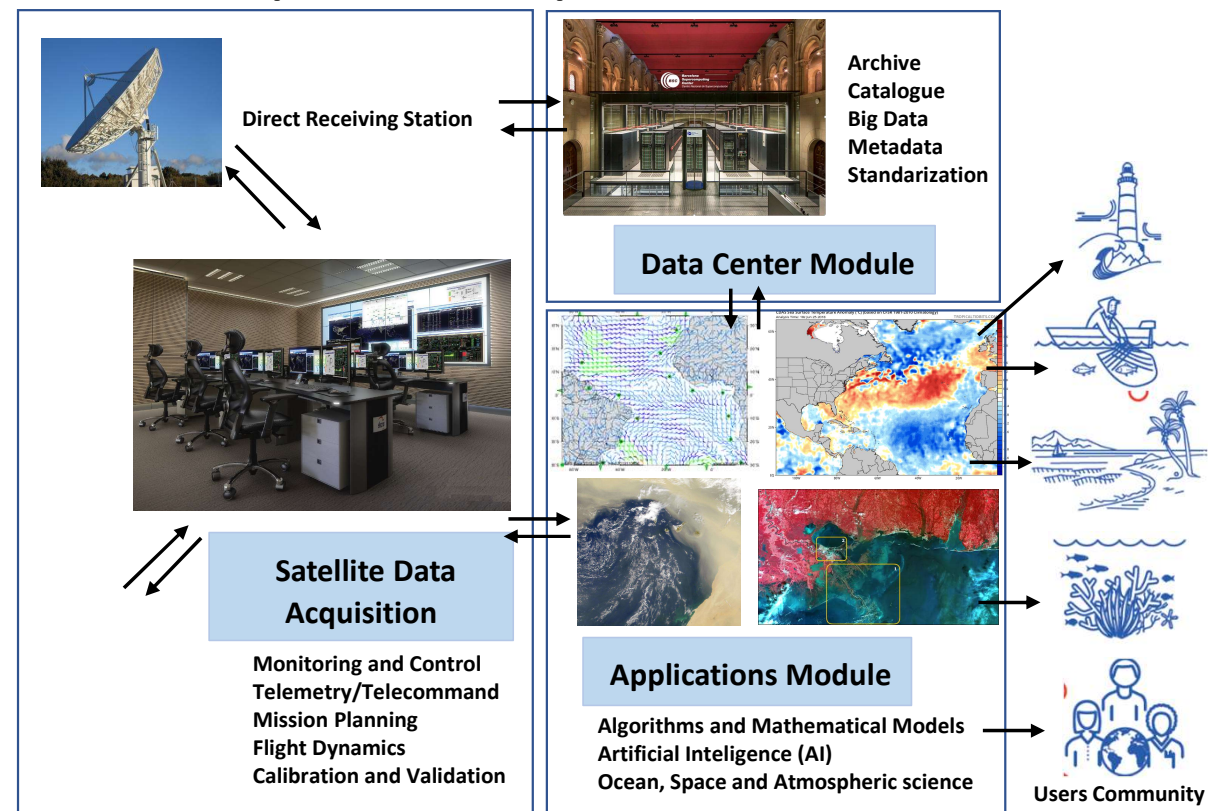
- Urban sustainability challenges requires the access to and the sharing of knowledge of science, technology and innovation.
- In this line, the AIR Centre proposes to the UN Commission on Science and Technology for Development (CSTD) the implementation of a technological system based on Earth Observation data from the space
- This system shall help to achieve the sustainability goals for urban development by using data provided by several satellites combined with in-situ measurements, Artificial Intelligence algorithms and Big Data Science
- The main components of this “Space Data System for Sustainable Urban development” are presented in the next slides



SYSTEM OVERALL DESCRIPTION

The “Space Data System for Sustainable Urban Development” is composed of the following five elements:

- Satellite Data Acquisition Module
- In-situ Data Acquisition Module
- Data Center Module
- Applications Module
- Capacitation and Training Module



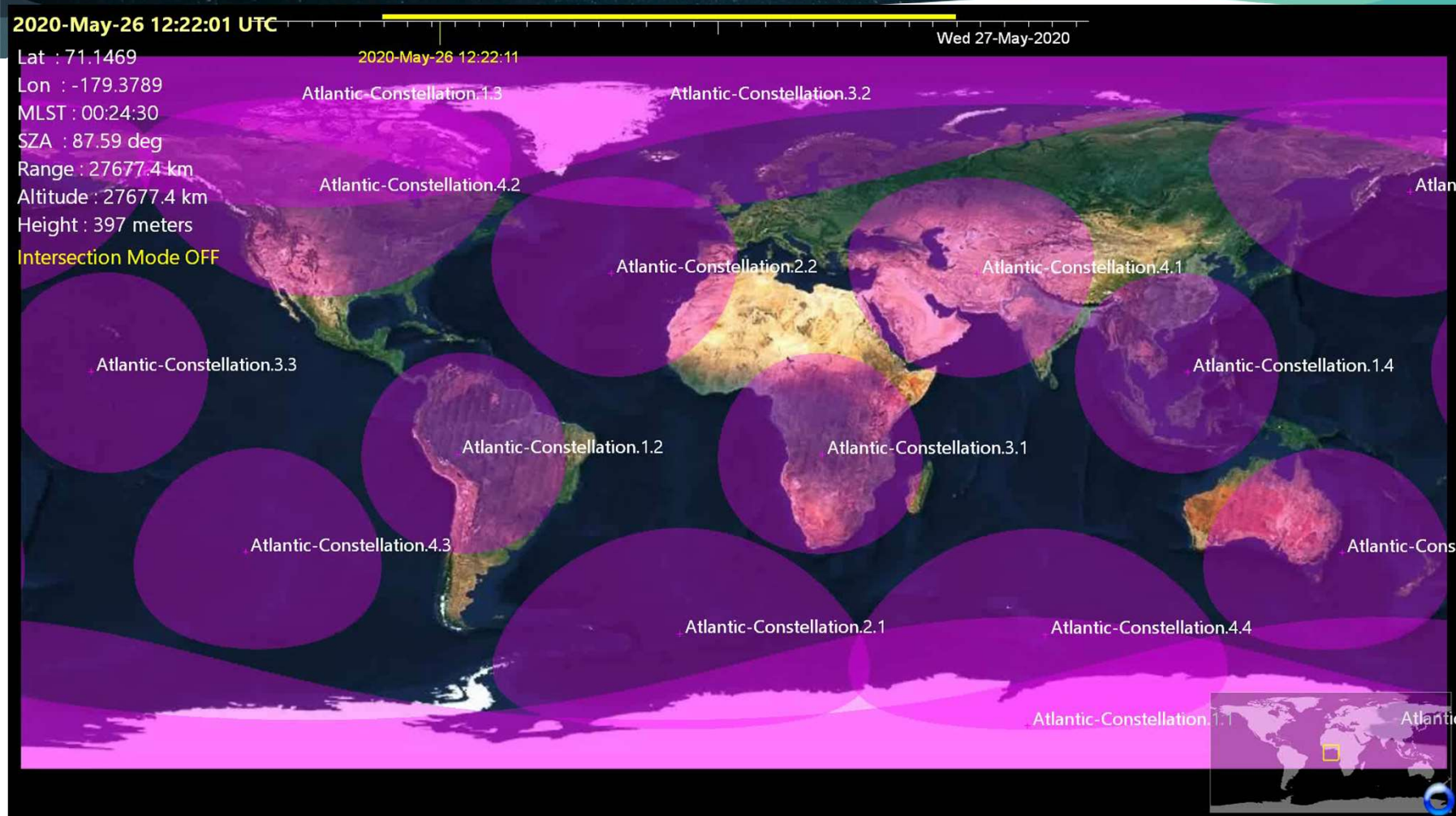
SATELLITE DATA ACQUISITION MODULE

The Satellite Data Acquisition Module is able to provide data from four different type of satellites using the following components:

- Through the local installation of a “Direct Receiving Antenna” DRS the system is able to get “real time” data from up to 6 direct broadcast satellites (from NOAA, NASA in USA and Fenyung from China), this is important data for urgent urban extreme weather events
- With a specific software module, access to the free data generated by the Sentinels satellites of the European Copernicus program, those are optical and radar satellites with mid resolution
- An additional software package shall get access to the very high resolution data provided by the commercial Geosat 1 and Geosat 2 satellites, down up to 75 cm resolution. This is of paramount importance for urban cartography and urban planning in high resolution
- In the next future, from 2025, another additional software module shall be implemented to access the new Atlantic Constellation, which is able to provide data with an unprecedented frequency (every 2-3 hours).



ATLANTIC CONSTELLATION DESIGN: 2D VIDEO



- 2D graphical animation of the Atlantic Constellation with visibility of the cone of coverage of each satellite
- The image on the poles are distorted due to the projection used in this video



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ATLANTIC CONSTELLATION DESIGN: 3D VIDEO

2020-May-26 15:36:39 UTC

Lat :

Lon :

MLST :

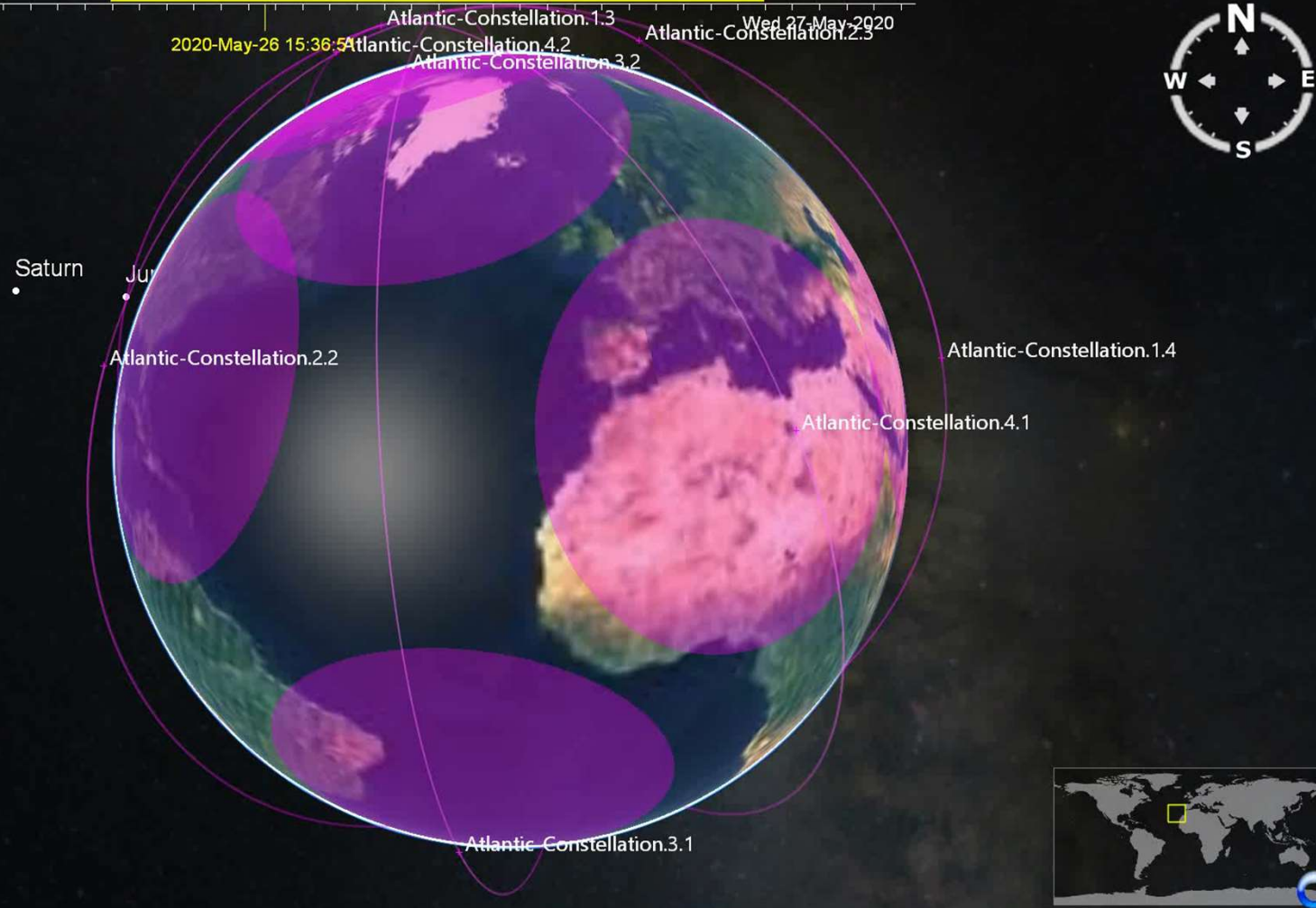
SZA :

Range : 12756.3 km

Altitude : 12756.3 km

Height : 0 meters

Intersection Mode OFF



- 3D graphical animation of the Atlantic Constellation with visibility of the cone of coverage of each satellite
- Some gaps of coverage appears on the video, but they are closed always in a few minutes

IN-SITU DATA ACQUISITION MODULE

The In-situ Data Acquisition Module is able to acquire data from different urban sensors to be combined with satellite data:

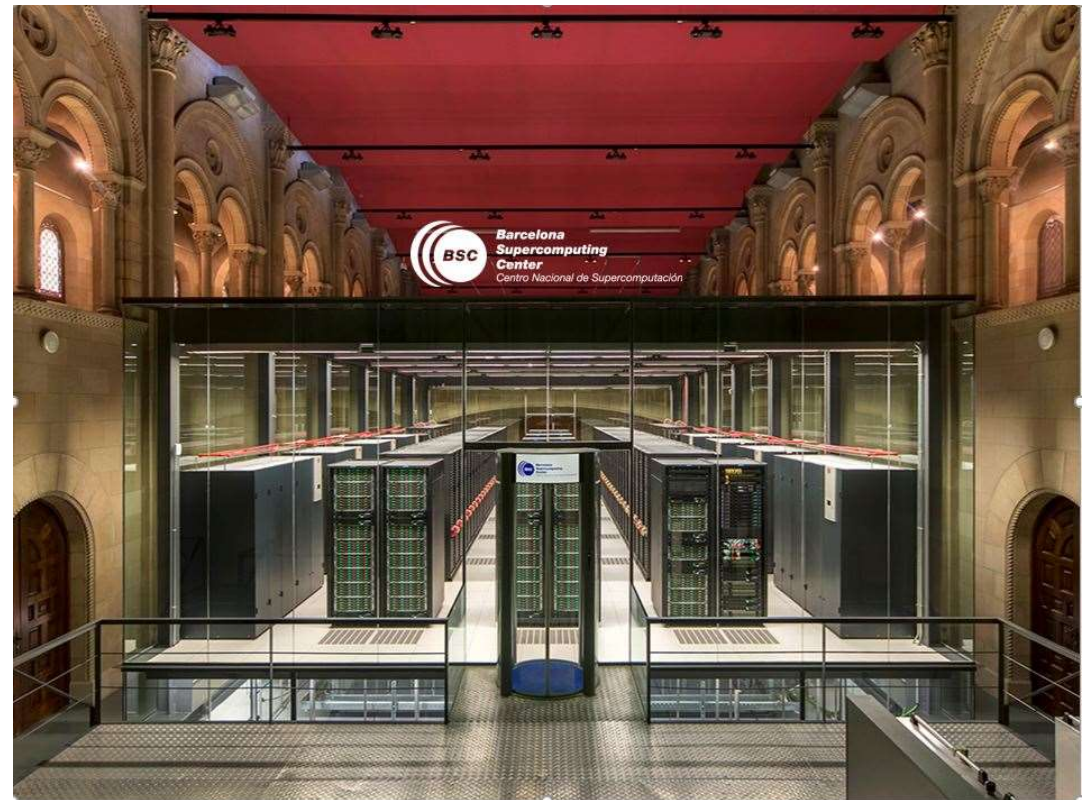
- Meteorological stations to provide urban meteo data
- Atmospheric stations to provide air and atmospheric data
- Sensors under water (urban water bodies, rivers, sea side) to provide water parameters (water level)
- Soil sensors to provide soil parameters like humidity
- Traffic sensor data



DATA CENTRE MODULE

The Data Centre Module shall archive all data (space and in-situ) in different formats (raw and processed) and make it available to all users for different applications, it must include:

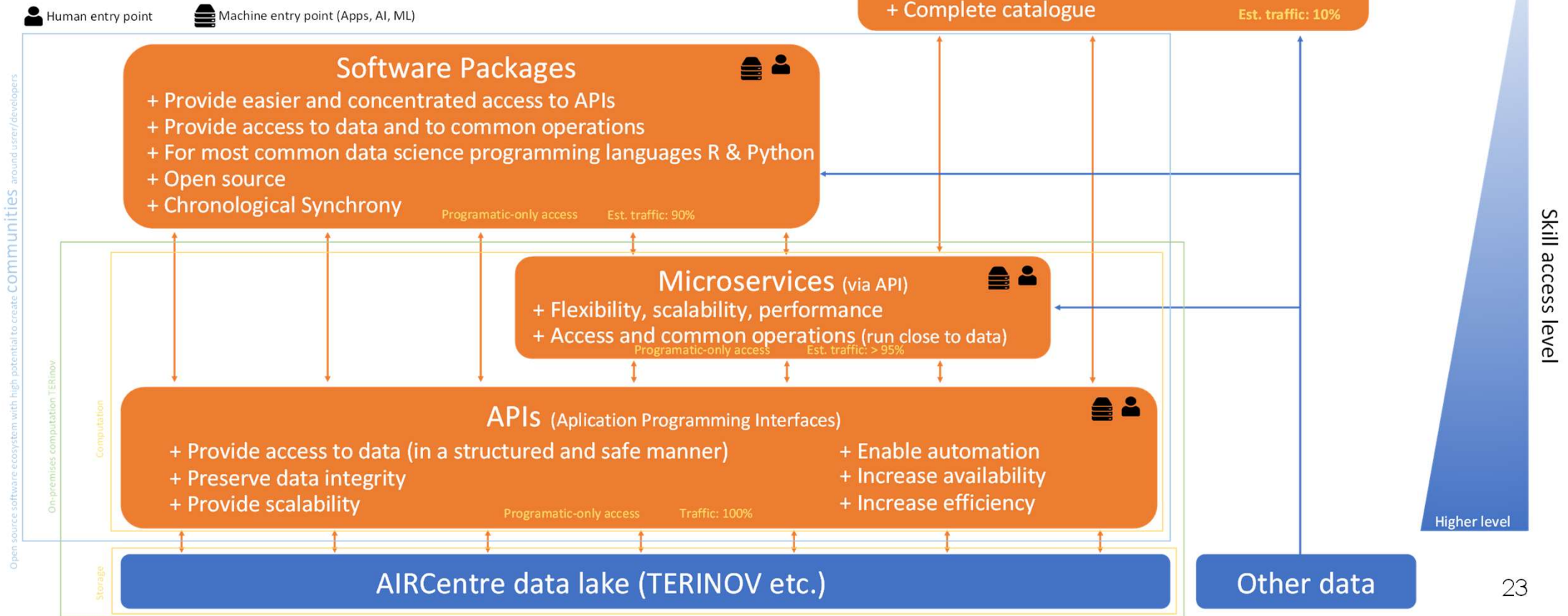
- Well defined data models (data cubes)
- Storage servers to archive all data with enough room for several years of operations
- All type of API's (Application Programming Interfaces) to access the data for users with diferente degree of sophistication



DATA CENTRE MODULE: DATA ARCHITECTURE

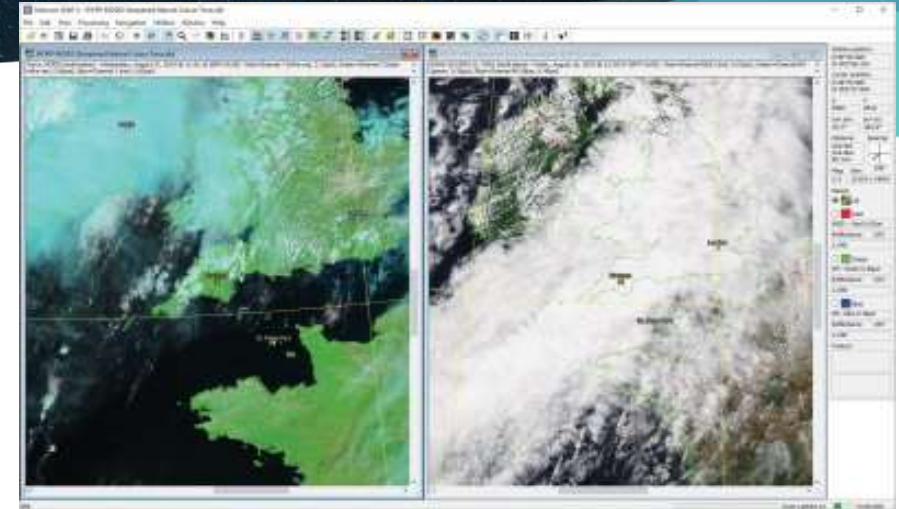
Data Architecture

Microservices-based (API-first approach)



The Application Module is a set of software tools that processes all space and in-situ data with mathematical models, Artificial Intelligence algorithms and Big Data Science to produce the required output for services in the following five domains:

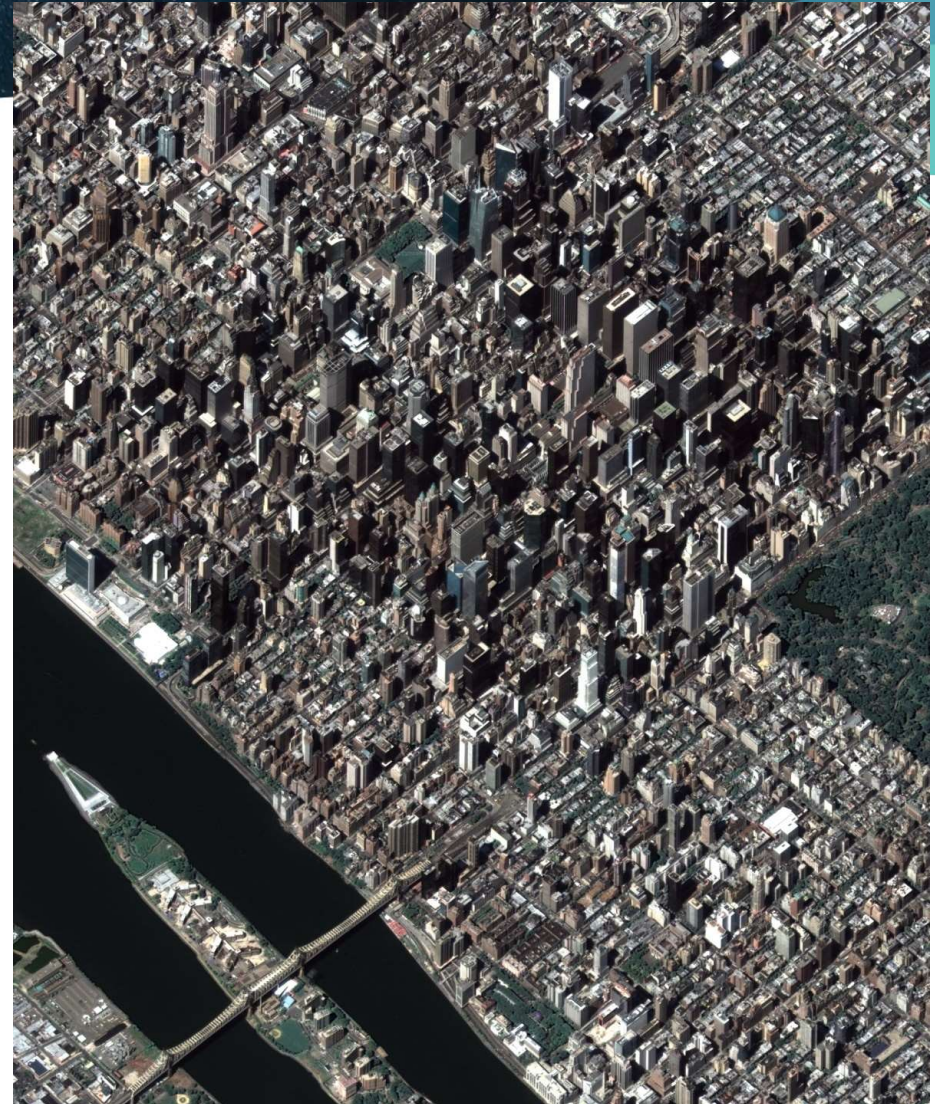
- Urban Planning
- Water Quality and Scarcity Monitoring
- Urban Air Quality Monitoring
- Waste Management (detection and control of garbage dumps)
- Vulnerability to Natural Disasters



URBAN PLANNING APPLICATION

The Urban Planning Application shall be able to provide as minimum the following services:

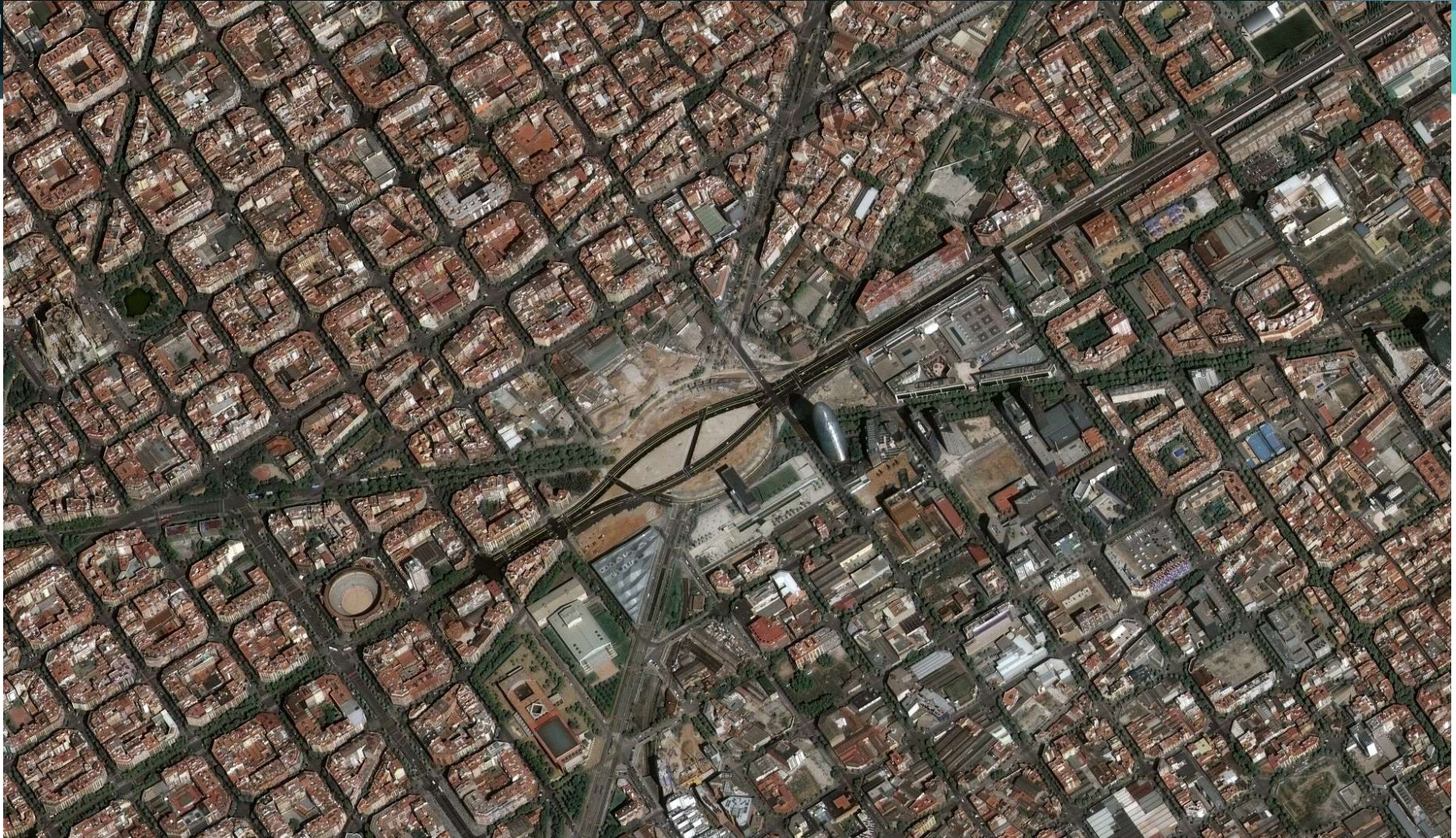
- Monitor urban sprawl and peri-urbanization processes
- Support updated urban cartography
- Detect ilegal construction
- Identify risks in new populated areas
- Identify new settlements
- Report land-use activities
- Management of urban green areas
- Management of urban water bodies





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URBAN PLANNING: BARCELONA WITH GEOSAT 2





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URBAN PLANNING: BEIJING WITH GEOSAT 2



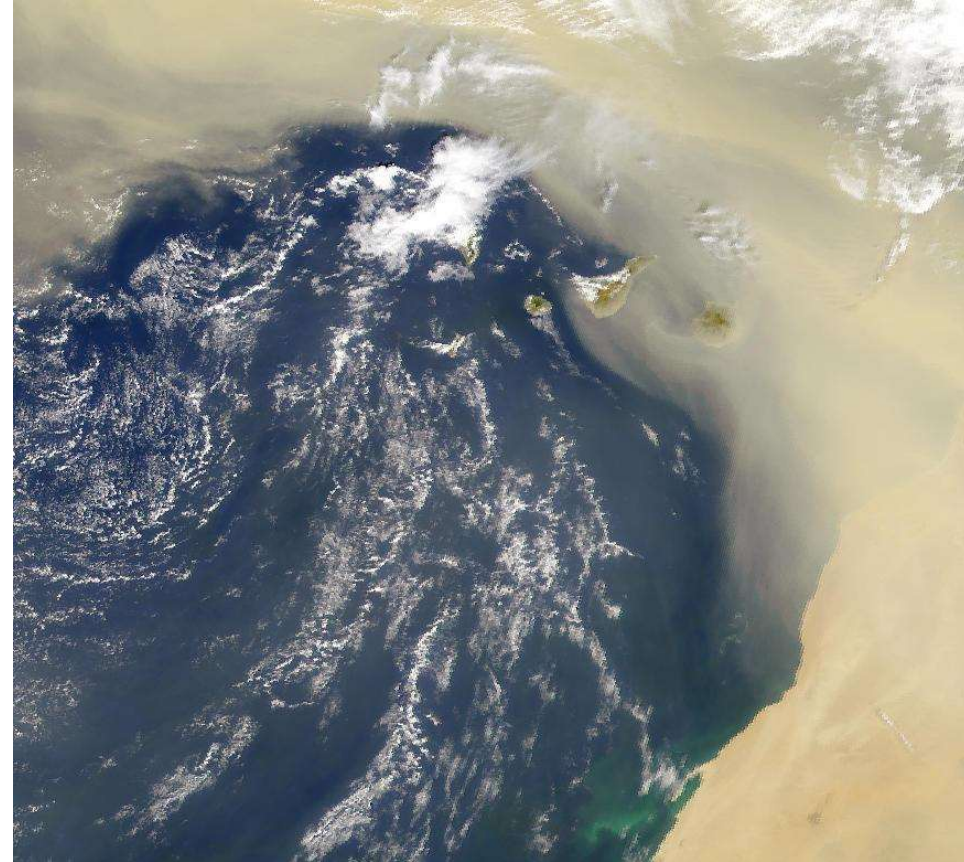
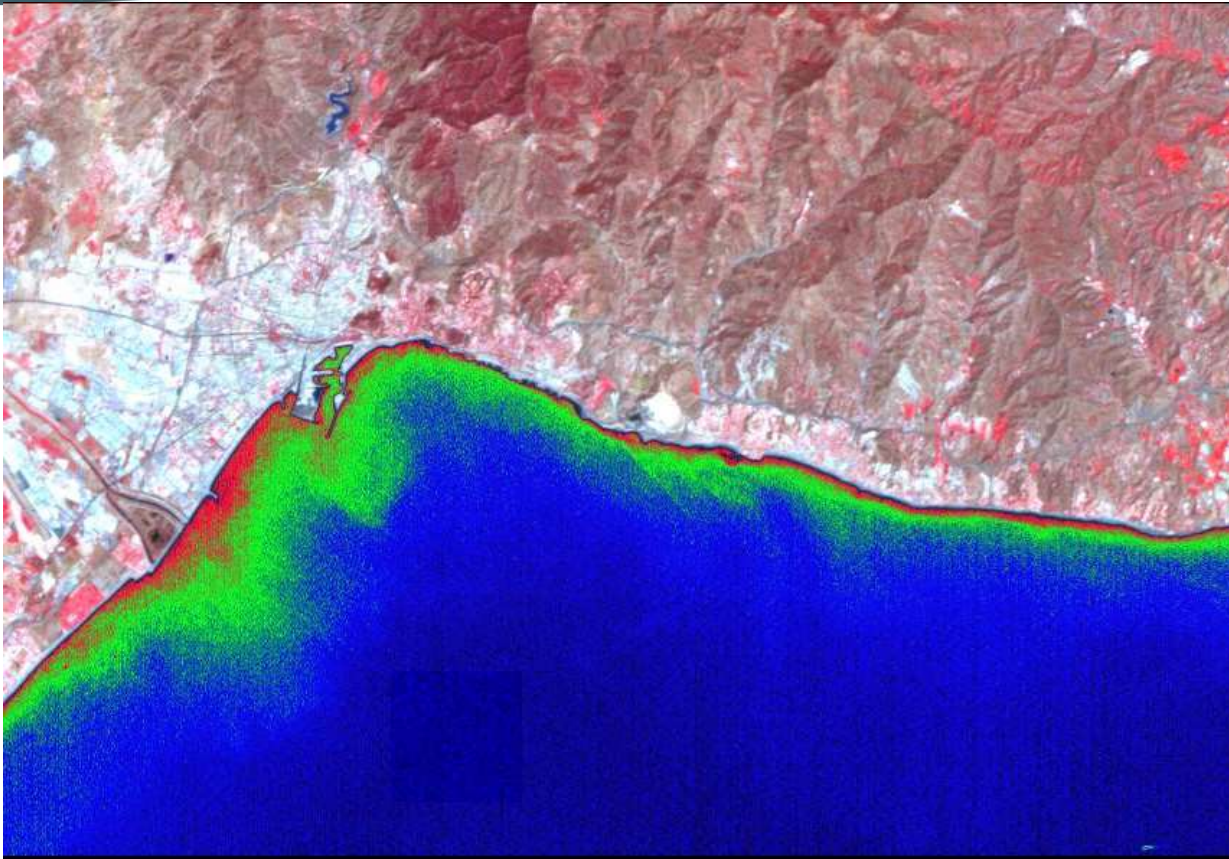


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URBAN PLANNING: MOSCOW WITH GEOSAT 2



URBAN WATER AND AIR QUALITY (MALAGA, CANARY ISLANDS)



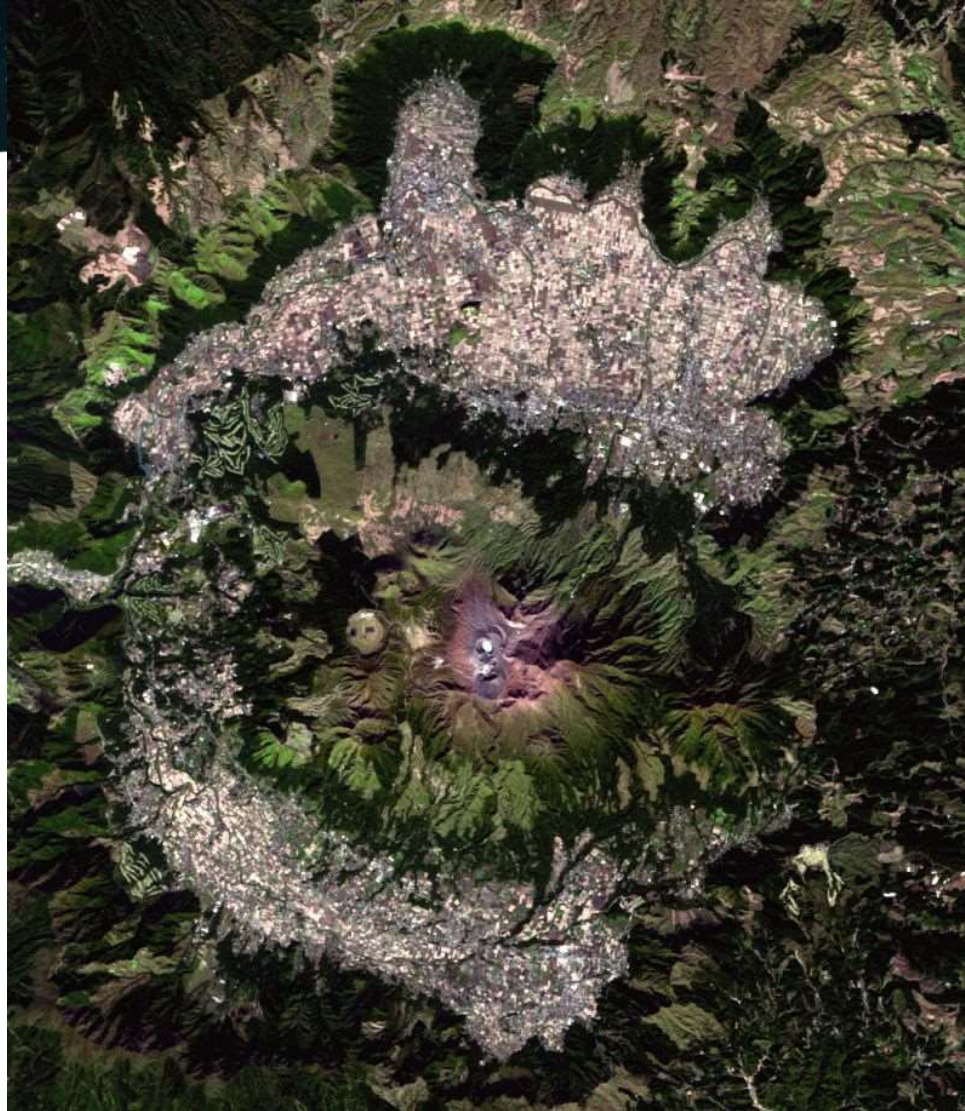
VULNERABILITY TO NATURAL DISASTERS APPLICATION

The Vulnerability to Natural Disasters Application shall be able to provide as minimum the following services:

- Detection of areas vulnerable to flooding, sea level rise or other natural hazards
- Alert of extreme weather events (storms, hurricanes, typhoons, ...)
- Detection, monitoring and evaluation of:
 - Fires
 - Tsunamis
 - Volcanoes eruptions
 - Earthquakes



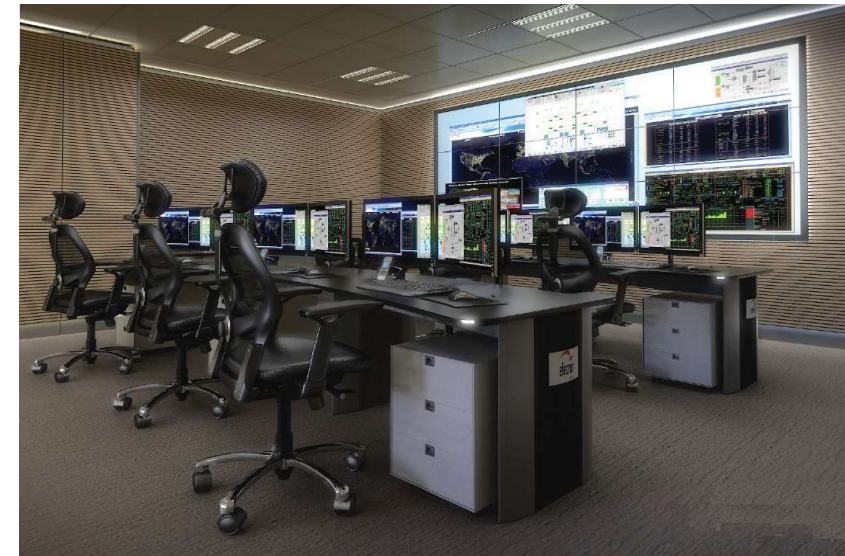
URBAN VULNERABILITY TO VOLCANOES (JAPAN)



CAPACITATION AND TRAINING MODULE

The Capacitation and Training Module shall provide the following functionalities:

- Training Course to the operators of the Direct Receiving Antenna such that they can be autonomous in the reception of satellite data (5 to 10 operators)
- Capacitation Course to a set of selected analysts in the use of data from Earth Observation satellites and the techniques of Remote Sensing (20 experts)
- Training Course to several experts in each of the selected application domains such that they can autonomously generate the final products and services (25 experts)



Conclusions and Proposals



CONCLUSIONS AND PROPOSALS

- **Sustainable urban development (SDG 11) presents important challenges that can be mitigated by using new scientific and technological tools**
- **The AIR Centre proposes to the UN CSTD the development of a pilot project called “Space Data System for Sustainable Urban Development” to help achieving the sustainability goals by using data from four different type of satellites combined with in-situ data, Artificial Intelligence algorithms and Big Data Science.**
- **This project requires the development of five different modules, from the construction of a Direct Receiving Antenna down to the capacitation and training program to deliver products and services for five different type of applications: Urban Planning, Water Quality and Scarcity, Urban Air Quality Monitoring, Waste Management and Vulnerability to Natural Disasters**

