The FIRE-RES project: overview of innovations and end-users needs in the field of remote sensing and wildfires

Andrea Duane

andrea.duane@ctfc.cat

Earth Observation Products for Wildfires Monitoring and Forecast 2022

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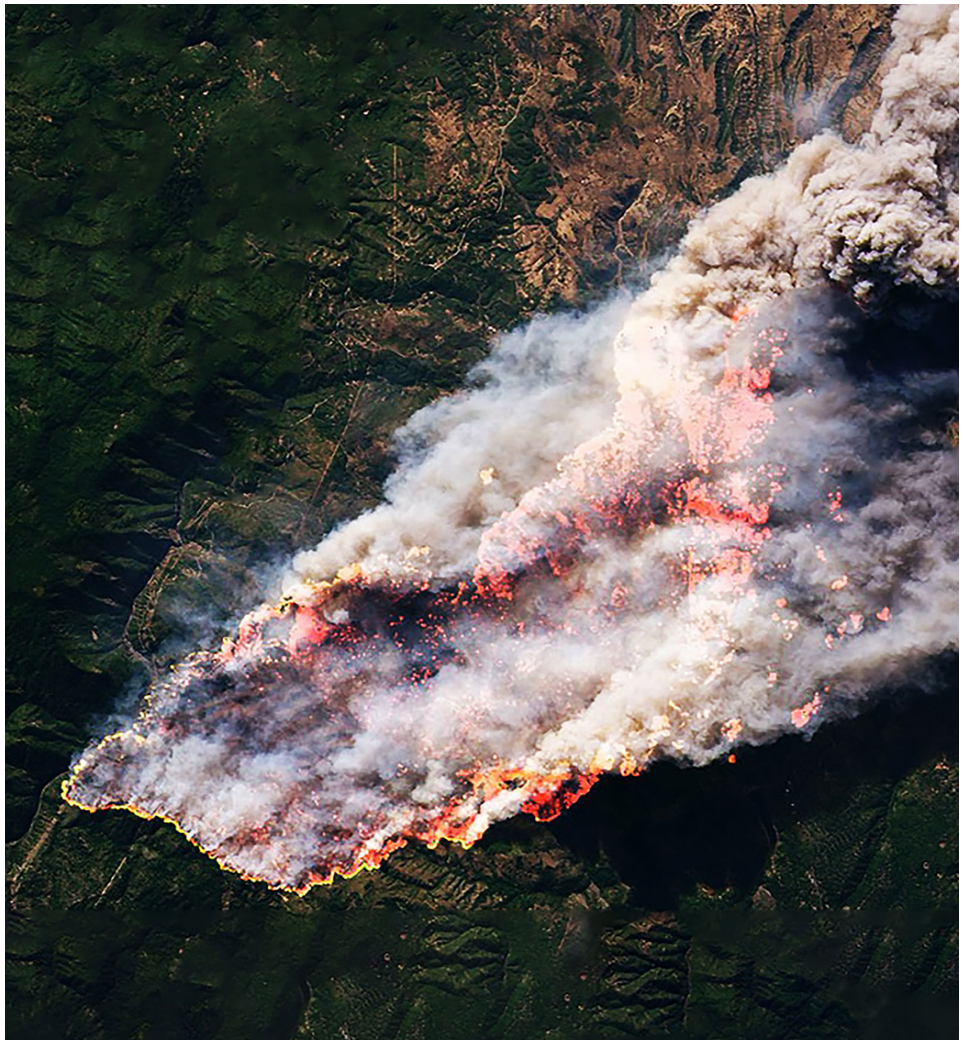
Overview of the presentation

1. FIRE-RES presentation
2. Innovations in the Earth Observation field in FIRE-RES
3. Interesting works for the Earth Observation community
4. End-user priorities in the Earth Observation field within the FIRE-RES consortium

1) The FIRE-RES project



FIRE-RES is a 4 years project coordinated by the Forest Science and Technology Centre of Catalonia in Spain.

H2020 Innovation Action

Dec 2021 - Nov 2025

34 partners

21,5 total budget

Extreme Wildfire Events exceeding control capacity are becoming a major environmental, economic and social threat across the world.

The FIRE-RES project aims to implement an Integrated Fire Management approach and support the transition toward more resilient landscapes and communities to Extreme Wildfire Events in Europe.

34 Innovation Actions

Extreme Wildfires' behaviour and drivers

Landscape and economy

Emergency management

Governance, society, communication and risk awareness

Based on the four pillars, FIRE-RES will develop **34 Innovation Actions** that will allow the integration of the fire management measures for:

Detection and Response

Prevention and Preparedness

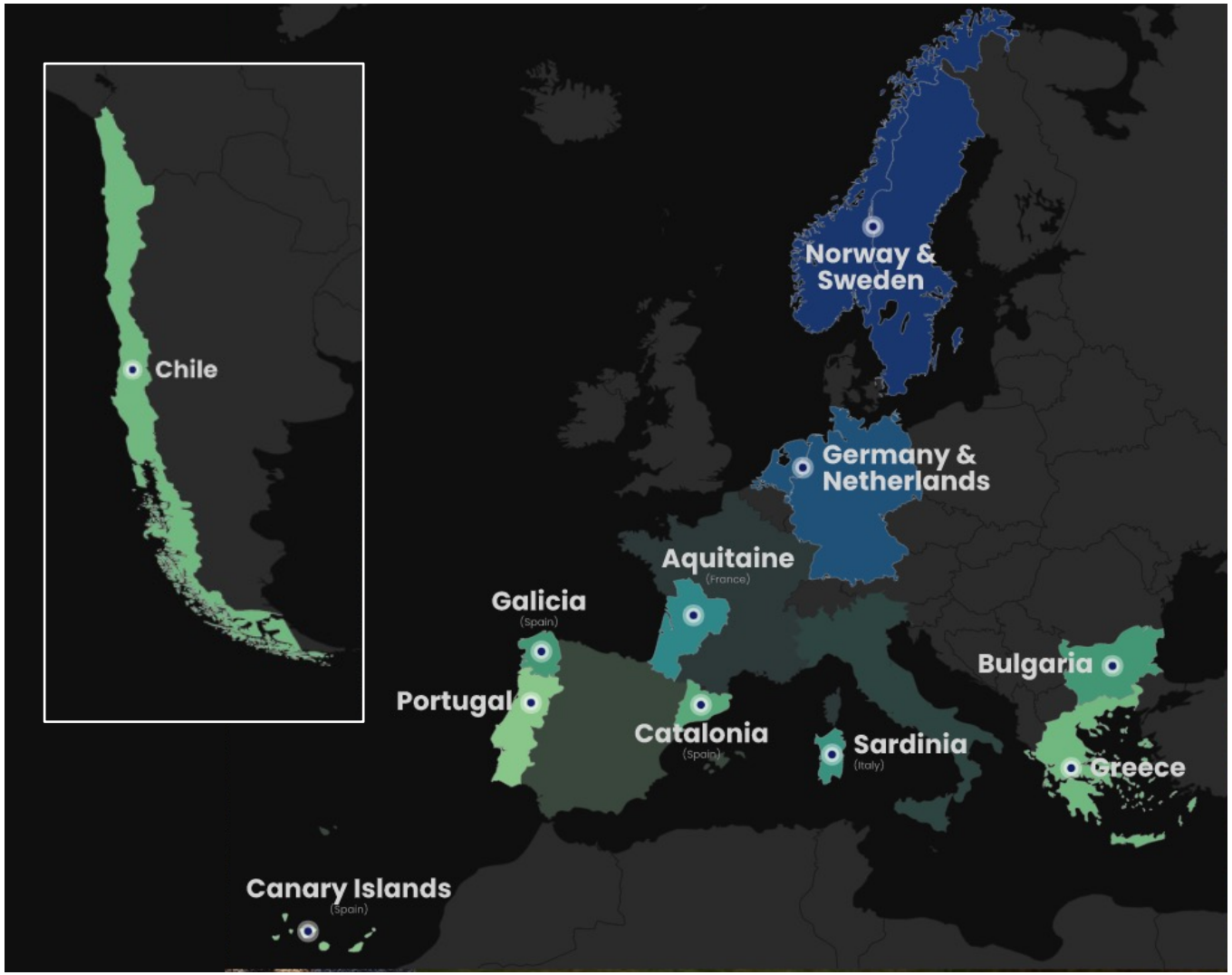
Restoration and Adaptation

11 Living labs

Your logo here

Living Labs are **open innovation ecosystems** dedicated to the demonstration and deployment of innovative solutions, through collaboration with local actors:

- **Public sector**
- **Scientific communities**
- **Private companies**
- **Citizen associations**



Partners

- 14 RESEARCH AND INNOVATION CENTERS
- 3 INTERNATIONAL NETWORKS
- 8 TECHNOLOGICAL ENTERPRISES
- 1 INDUSTRY
- 6 EMERGENCY-RESPONSE BODIES
- 2 REGIONAL GOVERMENTS
- 1 ASSOCIATION FORESTRY OWNERS

FIRE-RES Sister projects

FIRE-RES does not operate alone in the field of forest fires in EU.

It is necessary to collaborate with other projects to maximize results and face challenges!

This is why FIRE-RES is engaged in a group of sister projects (Firelogue, SILVANUS, TREEADS, and firEUrisk).

Firelogue

SILVANUS

TREEADS

firEUrisk

2) Innovations in the field of Earth Observation in FIRE-RES

- AIRBUS new HAPS for wildfire monitoring:
  - Zephyr (HAPS Platform)
  - OPAZ (HAPS Sensor)
  - HAPS complementing Satellites to fight Forest Fires
  - Zephyr & OPAZ – FIRE-RES Operational example
  - Real use case from OPAZ

- SPIRE new satellite constellation for atmospheric profiles
  - GNSS-Based Earth Observations
  - Radio Occultation Observations
  - Measurements for Soil Moisture
  - Truly global reach

Meet Zephyr, the Airbus HAPS

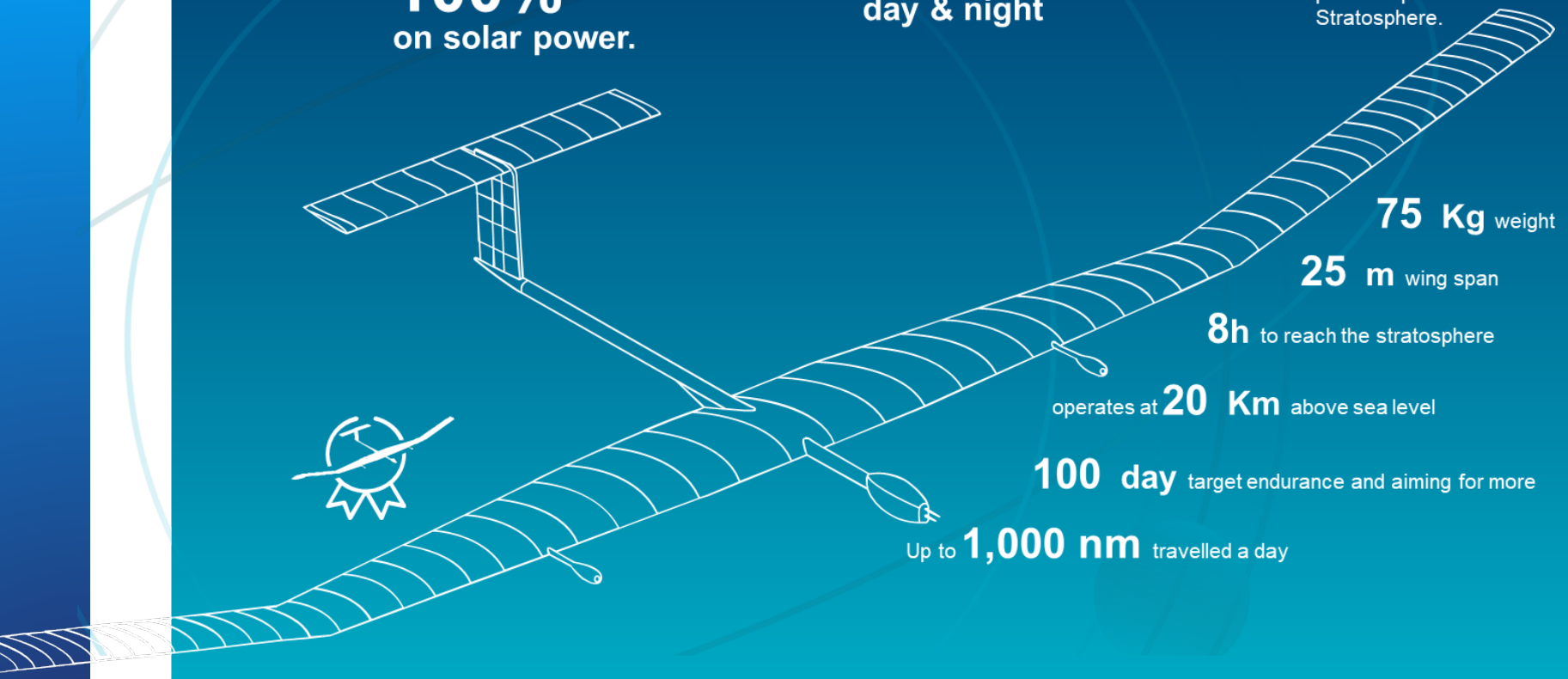
Facts Figures

Sustainable,
Relies
100%
on solar power.

Electrical,
Uses sunlight to fly and recharge its batteries to continue operating
day & night

Autonomous,
Has demonstrated
64 days of continued, precise operations in the Stratosphere.

Connected,
Provides Earth Observation and Connectivity:
See, Sense & Connect



75 Kg weight

25 m wing span

8h to reach the stratosphere

operates at **20 Km** above sea level

100 day target endurance and aiming for more

Up to **1,000 nm** travelled a day

10 years
of research, **design, prototyping and flying** development activities.

AIRBUS

DEFENCE AND SPACE

HAPS

OPAZ

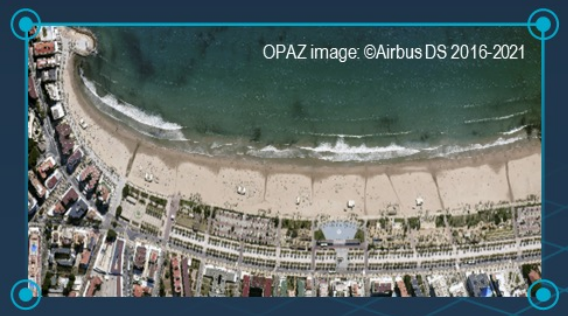
The Airbus stratospheric Earth Observation payload

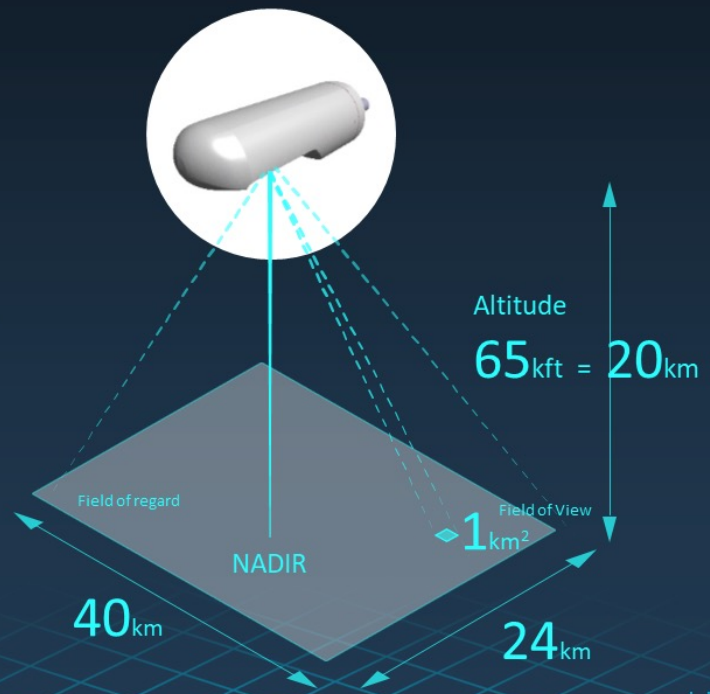
OPAZ: The Airbus stratospheric Earth Observation payload has been successfully used with both Zephyr and Balloons

Both Balloons and Zephyr are environmentally sustainable, and rely on **100% Solar power**

OPAZ can host visible and IR sensors oriented to Forest Fire Fighting

Complementary: Balloons and fixed wings can compose a mixed fleet to better serve customer needs





Live video & imagery

Main sensor (steerable)

Electro-optical RGB resolution ..... @ 18 cm

Medium Wave Infra-red resolution ..... @ 70 cm

Secondary sensors (fixed)

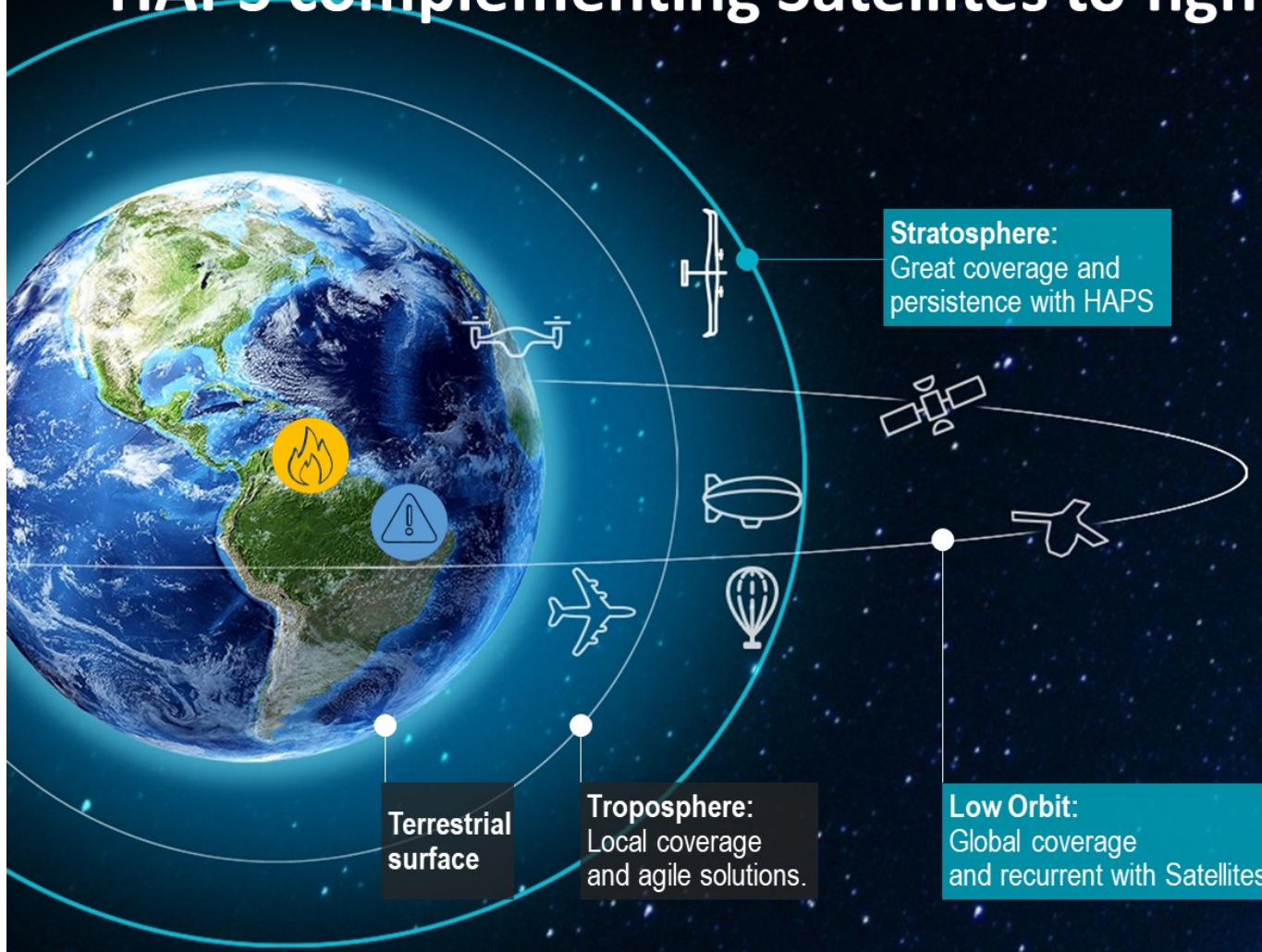
100 km² RGB resolution ..... @ 2 m

AIS sensor

AIRBUS

DEFENCE AND SPACE

HAPS complementing Satellites to fight Forest Fires



Adding a new Earth Observation layer
(with multi-domain solutions)

Persistence on the same location 24/7
(during all fire season)

Offers new services for Forest Fires:
- ✓ Fire detection (before)
- ✓ Monitoring & Connectivity (during)
- ✓ Hot-spot monitoring (after)

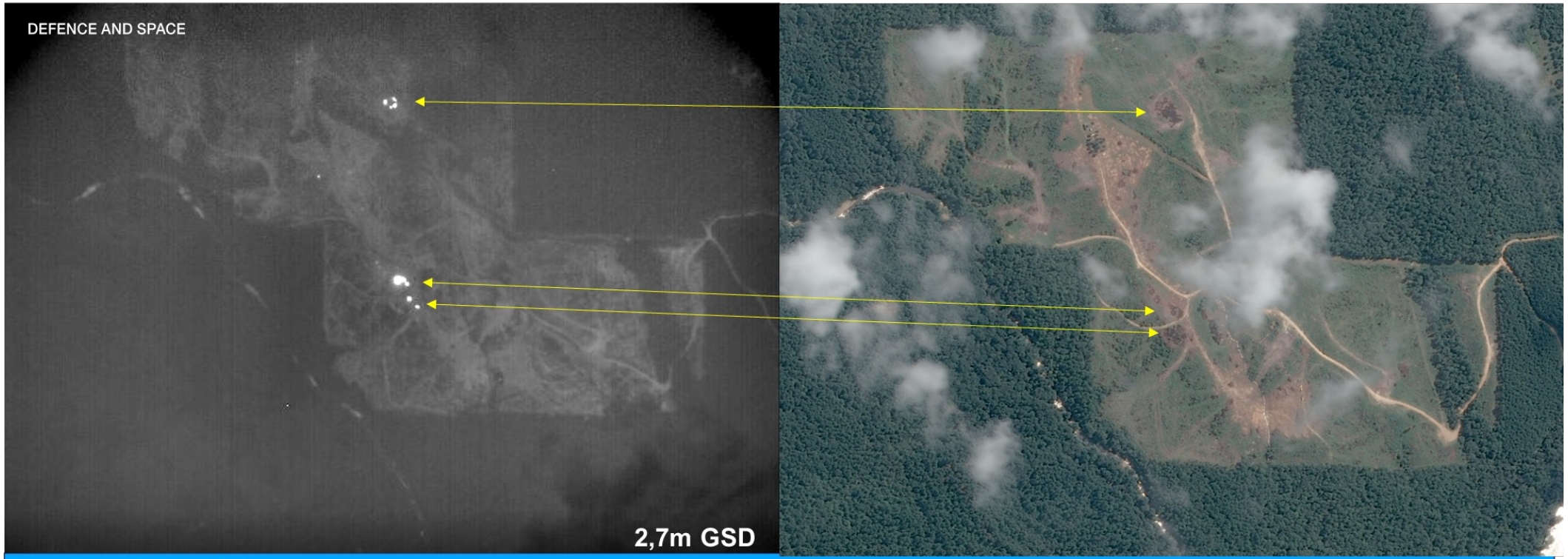
The HAPS platform does not interfere with the aerial traffic of fire extinction.

OPAZ - Zephyr is a fully operational solution

AIRBUS


DEFENCE AND SPACE
European Commission
FIRE-RES
Lightning events
EFFIS Extreme and Very high danger of wildfire
Potentially large fire
Protected natural area
Drought, wind and high temperature forecast
EU HAPS Wildfire Service
AIRBUS

Real use case from OPAZ



OPAZ images © Airbus DS 2020

Pléiades images © Airbus DS 2020

- Still image extracted from a 5 fps video.
  - GSD = 2.7m
  - 1730 x 1300m

Two hot spots detected from the Stratosphere
in a forest area

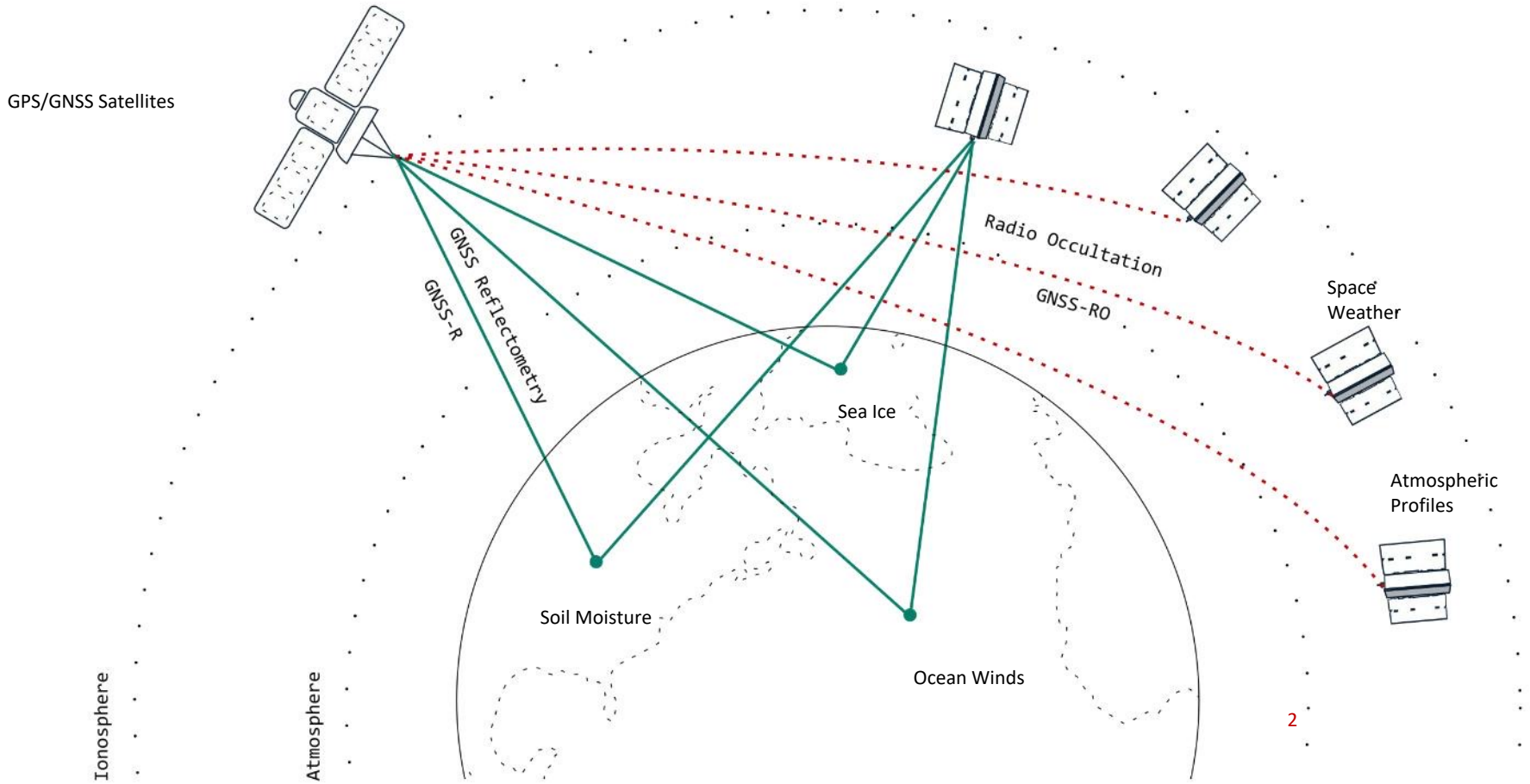
- MWIR sensor
- Equipped with zoom:
  - 0.7m 336x448m
  - 17m 9x11km

Spire Satellites

Scanning Earth 24/7

- Data services provider that owns its own satellite infrastructure
- One of the largest private satellite constellations in the world

Spire GNSS-Based Earth Observations



GNSS-Reflectometry (GNSS-R)

- Surface measurements of: soil moisture, sea ice and ocean roughness

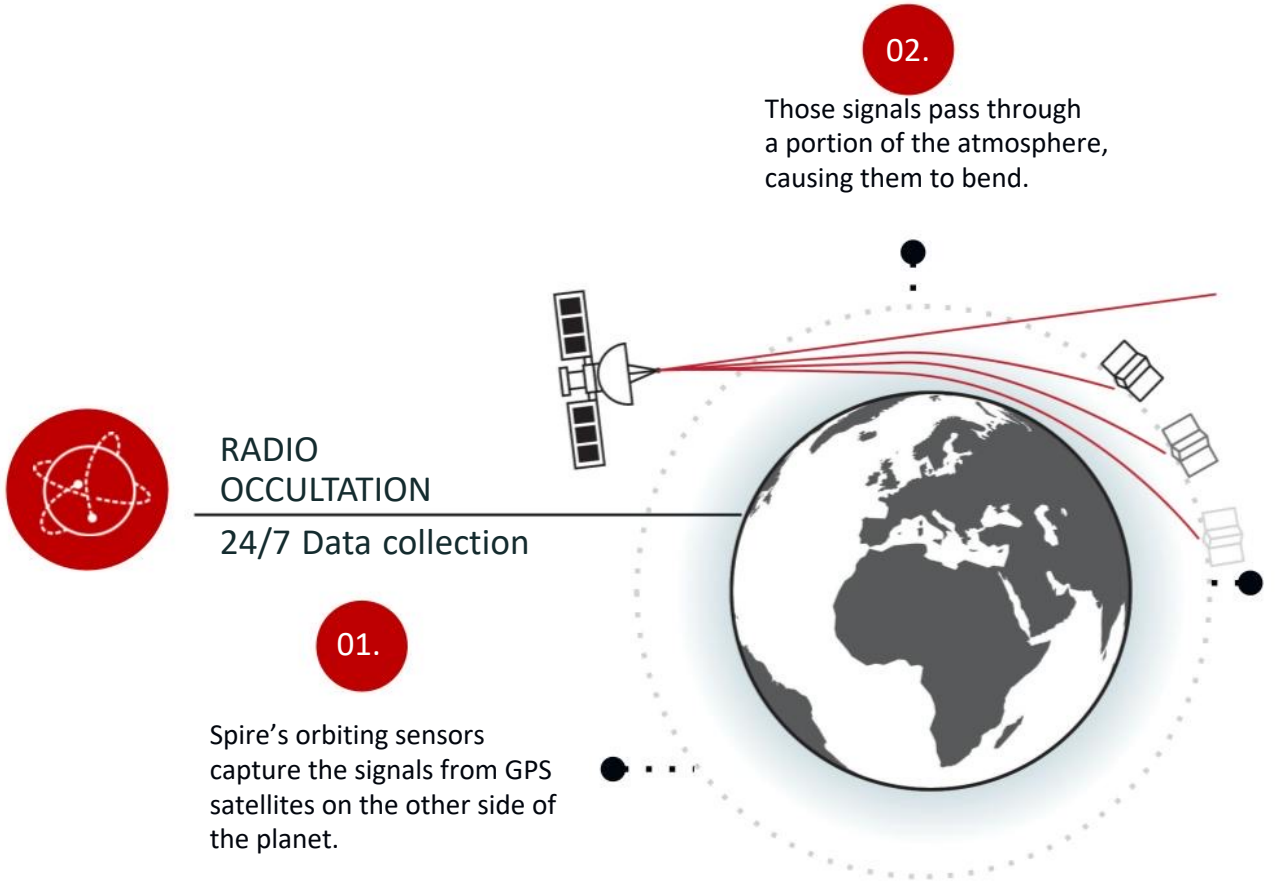
GNSS-Radio Occultation (GNSS-RO)

- Atmospheric sounding for NWP, climate
- Ionospheric sounding for space weather monitoring

RO - An unbiased weather measurement

Spire Radio Occultation Observations:

- Our satellites can measure temperature, pressure and humidity through RO observations
- Spire collects more RO profiles than any company in the world
- Continuous scan of the atmosphere creates a unique unbiased global weather observation dataset



GNSS-R - Measurements for Soil Moisture

GNSS-R data can be processed to monitor multiple earth properties, including, but not limited to:

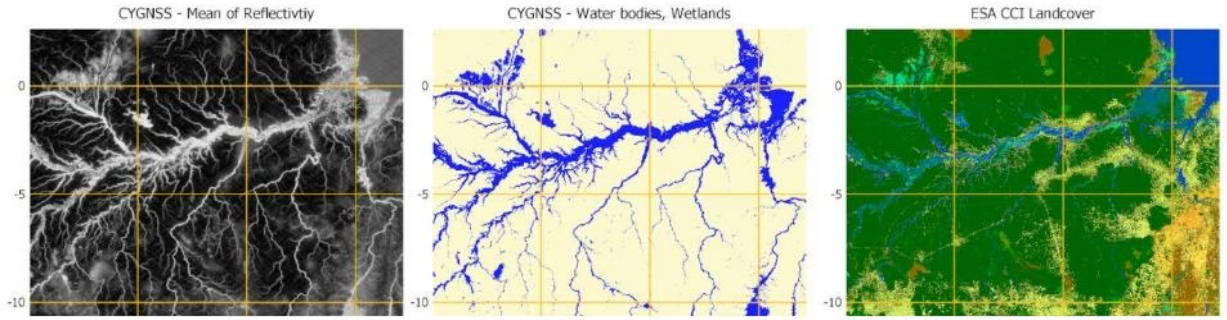
- Water bodies & flood mapping
- Soil moisture
- Soil freeze/thaw
- Biomass
- Sea ice
- Ocean winds & waves
- Phase-delay altimetry

One of the major advantages of using GNSS-R is its penetration through vegetation and clouds, where optical sensors and monostatic radar have limited capabilities.

Using GNSS-R data from the CYGNSS constellation - while Spire satellites were being developed - Spire acquired promising processing capabilities that confirmed the potential of GNSS-R:

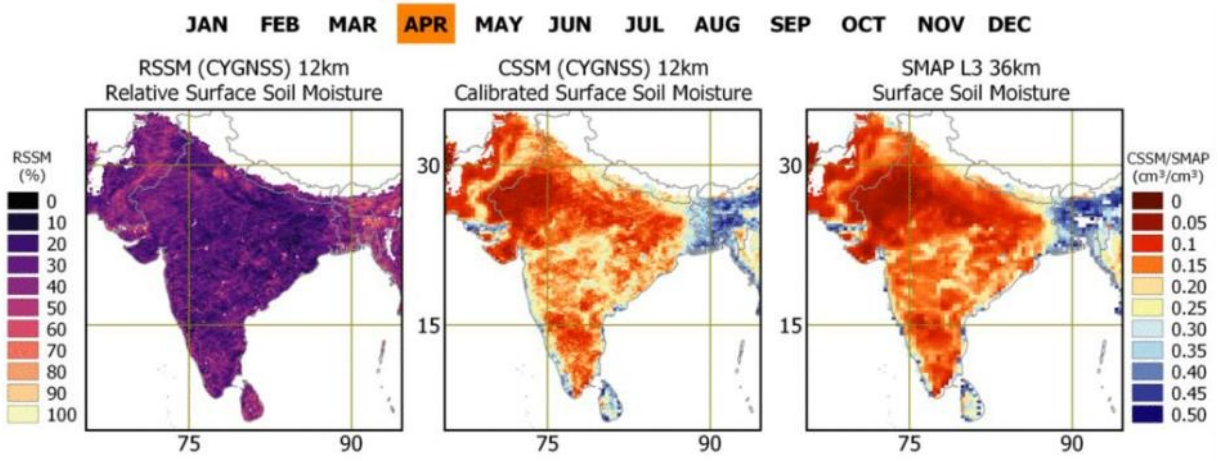
Water Bodies

Spire analysis of the Congo River Basin using GNSS-R



Soil Moisture

Spire analysis of India using GNSS-R

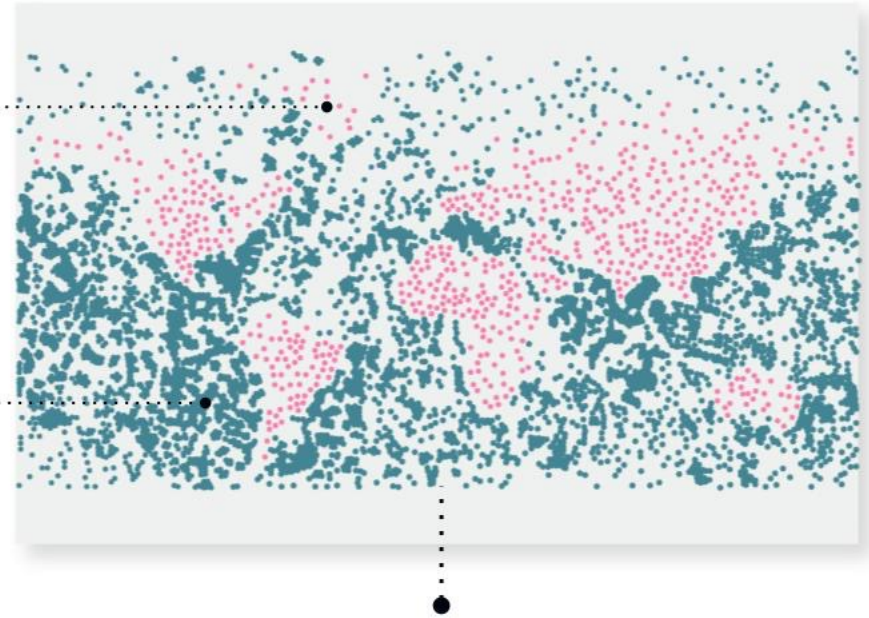


A truly global reach

Compared to the traditional weather observation devices, Spire's satellites collect weather data on the entire planet

Land Coverage

Sea Coverage



SPIRE'S GLOBAL WEATHER DATA COVERAGE

WEATHER BALLOON RECEIVING STATIONS

3) Interesting works for the EO community

- Smoke monitoring:
  - Smoke plume progression and impacts on air quality (ambient and indoor) during new fires occurring during the project's lifetime
  - Modelling of smoke plume progression and impacts on ambient air quality during new fires occurring during the project's lifetime by means of an atmospheric dispersion model
  - Impact of fires (prescribed burns or wildfires) occurring during the project's lifetime on human exposure (firefighters but also in indoor air in populations affected by wildfires)

- LIDAR use of data:
  - High-resolution (10 point /squared meter) flights
  - GEDI use and calibration

4) End-user priorities within the FIRE-RES consortium

- Research entities:
  - INRAE, ICGC, CTFC
- Emergency-response bodies:
  - ANEPC, CFRS

Research entity priorities:

- Estimation of fuel moisture content (live!)
- Real time fire monitoring at high temporal resolution (hours or less).
- Access to the data
- Resolution of geostationary data
- Fuel Maps with optical, radar, lidar…

Emergency-body priorities:

- **!!** Hourly (or more frequent) reading system that allows automatic progressions
- Validation of FWI products produced by EUMETSAT with the observed data
- Having the services on a more permanent basis/early in the **summer**
- Ease the management of available data (download, visualize, convert, etc.) to operational bodies
- Increase the information of fuel loads at higher temporal and spatial scales
- Increase the information knowlesdge and Access about soil moisture and atmospheric variables

FIRE-RES

Thank you!

www.fire-res.eu

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CTFC
Andrea.duane@ctf.cat

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