QUASAR
SCIENCE RESOURCES, S.L.

QUASAR
Scientific
Exploitation
Platform

# SATELLITE IMAGERY PRODUCTS AND APPLICATIONS CATALOGUE 2022

# SIMBAD

BOAT DETECTION

MARINE ECOSYSTEMS

WATER QUALITY

WILDFIRE

PRECISION AGRICULTURE

*Enhance your Research*

SIMBAD

SATELLITE IMAGERY
PRODUCTS AND APPLICATIONS CATALOGUE 2022

# ÍNDICE


1. SIMBAD 4
2. SIMBAD PRODUCTS 9
   - 2.1 MARITIME MONITORING 11
   - 2.2 MARINE ECOSYSTEMS MONITORING 25
   - 2.3 WATER QUALITY MONITORING 37
   - 2.4 WILDFIRE MONITORING 49
   - 2.5 PRECISION AGRICULTURE 61
3. SERVICE DESCRIPTION 73
4. QUASAR CAPABILITIES 77

# Earth Observations

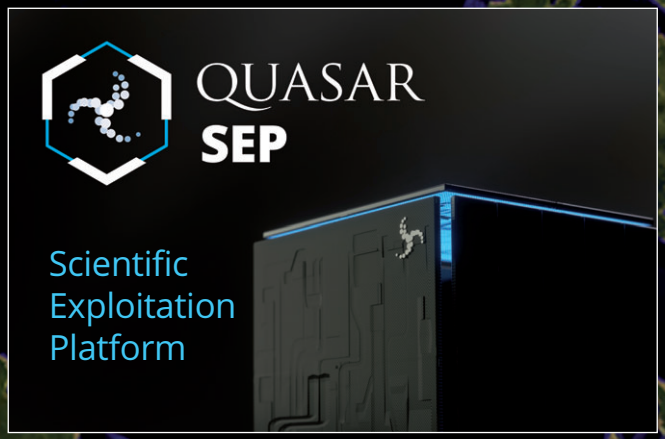
## An Opportunity for Service Providers

Earth Observation (EO) applications and services are rapidly increasing. Sentinel missions are being developed by the European Space Agency (ESA) for the Copernicus Programme, a European effort to monitor the Earth and its different habitats. Each Sentinel mission is based on a constellation of two satellites to fulfil revisit and coverage requirements, providing robust datasets for Copernicus Services. These missions (from Sentinel-1 through Sentinel-6) carry a range of technologies, such as radar and multi-spectral imaging instruments for land, ocean and atmospheric monitoring; and are providing massive EO data collections on a global scale, and the data generation rate is rapidly increasing. In addition, advances in Information Technology (IT) infrastructures have enabled new ways of accessing and exploiting EO data. This rapid evolution provides an opportunity for added value service providers of EO applications and services. Quasar Science Resources is taking advantage of this opportunity and is developing products and custom services based on Sentinel data.

# Quasar Science Resources

## Scientific Exploitation Platform

The Scientific Exploitation Platform (SEP) for Sentinel Data is a Quasar Science Resources initiative for the transformation of raw Sentinel data into useful final scientific products to be used in day-to-day applications. At present, there are ESA/Copernicus tools that promote and facilitate access to EO data, but not so much to facilitate its final applicability to the general public. It is because of this, that SEPs are gaining prominence over the past few years. We consider our SEP as one more layer over existing tools to take the EO data exploitation a step further. This is achieved by introducing an innovative hardware and software infrastructure for the development, implementation and operation of scientific algorithms, which applied to EO data, can help tackle daily-life common problems. Our SEP will help our customers to carry out their activities in a sustainable way and be respectful of natural resources.




**SEPs follow the paradigm of bringing the code to the data, instead of the old-fashioned paradigm of bringing the data to the code (users).**

**SEPs hide from the user the complexity of accessing the data by wrapping around it a friendly user interface.**

**SEPs offer the capability to embed and execute predefined data processing algorithms to exploit scientific data, as well as the possibility to upload new code to be executed at the SEP.**

**SEPs can give access to computer power and resources otherwise unavailable to the end user.**

Photo: Siberia, 9 May 2018. Contains modified Copernicus Sentinel data 2018, processed by ESA.

# SENTINEL IMAGERY MULTIBAND ANALYSIS AND DISSEMINATION

The vast amounts of data produced by the constellation of Sentinel satellites are a great opportunity to develop EO-based products, applications and services. However, handling an ever-increasing volume of EO data is one of the main challenges faced. It becomes crucial to use the adequate tools to manage these data including, data storage, integrated data processing chains, analysis and preservation. SIMBAD (Sentinel Imagery MultiBand Analysis and Dissemination), is a module of our SEP dedicated to the processing of Sentinel imagery and the extraction of EO-based products. SIMBAD integrates the hardware/software infrastructures able to supply the computing and storage resources needed for the exploitation and provision of the tools needed to manage the EO datasets in a distributed environment.

SIMBAD

SIMBAD facilitates the exploitation of EO data by developing applications to address societal challenges, enabling policymakers, authorities, and environmental agencies to develop long-term strategies as well as to react efficiently to sudden critical situations.

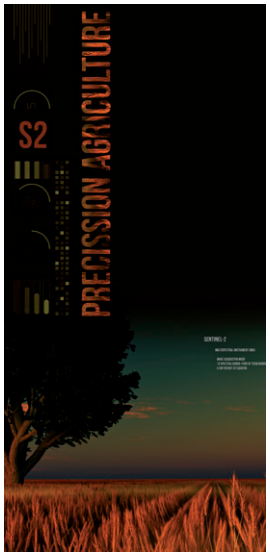
Boat Detection SIMBAD

Posidonia SIMBAD

Water Quality SIMBAD

Wildfire SIMBAD

Agriculture SIMBAD




esa business incubation centre Madrid Region

fundación para el conocimiento madrid

Comunidad de Madrid

FUNDACIÓN Parque Científico de Madrid

QUASAR SCIENCE RESOURCES S.L. PARTICIPATES IN THE ESA BUSINESS INCUBATION CENTRE MADRID REGION

ENHANCE YOUR RESEARCH

**ESA is developing the Sentinel missions as part of the Copernicus programme, the European Union's Earth Observation Programme. Each Sentinel mission is based on a constellation of two satellites to fulfil revisit and coverage requirements, providing robust datasets for Copernicus services. These missions carry from radar to multi-spectral imaging instruments. Quasar Science Resources develops services for, public authorities, private enterprises and other international organizations, and cover land, ocean and atmospheric applications.**

# Sentinel-1

The Sentinel-1 (S1) mission is designed as a two-satellite constellation. Sentinel-1 is an imaging radar mission where each satellite carries an advanced radar instrument to provide an all-weather, day-and-night supply of imagery of the Earth's surface.

## S1 Launch

- **Date:** 03 April 2014 - Sentinel-1A
  25 April 2016 - Sentinel-1B
- **Site:** Kourou, French Guiana
- **Rocket:** Soyuz rocket

Sentinel-1 Technical Guide

https://sentinels.copernicus.eu/web/sentinel/technical-guides/sentinel-1-sar

Sentinel-1 User Guide

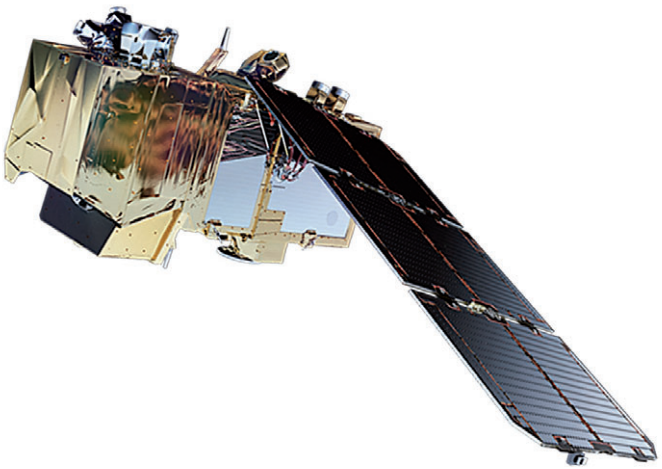
https://sentinels.copernicus.eu/web/sentinel/user-guides/sentinel-1-sar

## S1 Facts

- Two satellites in a 12-day orbit. The two-satellite constellation offers a 6-day exact repeat cycle at the equator (revisit rate is significantly greater at higher latitudes than at the equator).
- Sentinel-1 carries a Synthetic Aperture Radar (SAR) instrument.
- **Repeat Frequency:** 6 days.
- **Revisit Frequency:** 3 days at equator (Europe ~ 2 days).
- **4 Acquisition Modes:** Stripmap (SM), Interferometric Wide swath (IW), Extra-Wide swath (EW) and Wave (WV). WV mode is the operational mode used over open sea.

# Sentinel-2

Sentinel-2 (S2) is a wide-swath, high resolution (up to 10 m), and multi-spectral imaging. It is composed of two identical satellites, Sentinel 2A and Sentinel 2B, which provide imagery every 5 days or less. The S2 spectral bands enable the development of detailed land and marine ecosystems maps through the analysis of surface reflectance data under cloud-free conditions.



## S2 Launch

- **Date:** 23 June 2015 - Sentinel-2A
  07 March 2017 - Sentinel-2B
- **Site:** Kourou, French Guiana
- **Rocket:** Vega rocket

Sentinel-2 Technical Guide

https://sentinels.copernicus.eu/web/sentinel/technical-guides/sentinel-2-msi

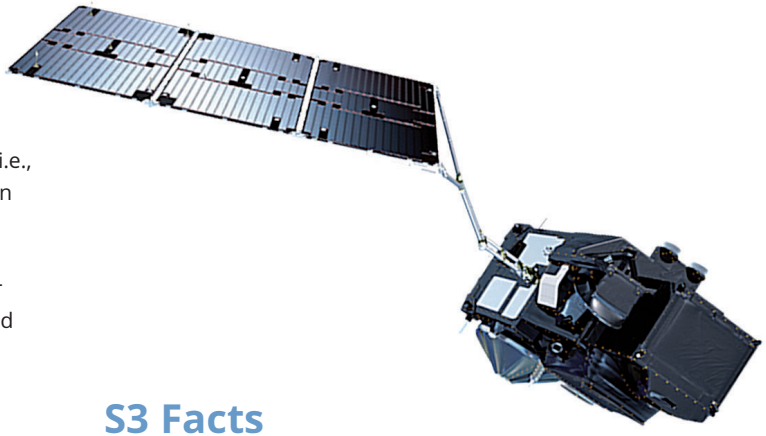
Sentinel-2 User Guide

https://sentinels.copernicus.eu/web/sentinel/user-guides/sentinel-2-msi

## S2 Facts

- The two-satellite constellation offers a 5-day revisit cycle at the equator under cloud-free conditions which results in 2-3 days at mid latitudes.
- Sentinel-2 carries a MultiSpectrum Instrument (MSI) with 13 spectral bands.
- **Repeat Frequency:** 16 days at equator.
- **Revisit Frequency:** 5 days at equator (2-3 days at mid latitude).
- **Spectral bands:** 13, ranging from 10 to 60-meter pixel size. Its blue (B2), green (B3), red (B4), and near-infrared (B8) channels have a 10-meter resolution. Its red edge (B5), near-infrared NIR (B6, B7 and B8A) and short-wave infrared SWIR (B11 and B12) have a ground sampling distance of 20 meters. Finally, its coastal aerosol (B1) and cirrus band (B10) have a 60-meter pixel size.

# Sentinel-3



The Copernicus Sentinel-3 (S3) mission is designed as a two-satellite constellation. It carries multiple sensing instruments i.e., Sea and Land Surface Temperature Radiometer (SLSTR), Ocean and Land Colour Instrument (OLCI), and Synthetic Aperture Radar ALtimeter (SRAL) etc. The mission objectives are to measure topography, temperature, marine ecosystems, water quality, pollution, and other features for ocean forecasting and environmental monitoring.

## S3 Launch

- **Date:** 16 February 2016 - Sentinel-3A
  25 April 2018 - Sentinel-3B
- **Site:** Plesetsk Cosmodrome, Northern Russia
- **Rocket:** Vega rocket

### Sentinel-3 Technical Guide

https://sentinels.copernicus.eu/web/sentinel/technical-guides/sentinel-3-olci

https://sentinels.copernicus.eu/web/sentinel/technical-guides/sentinel-3-slstr

https://sentinels.copernicus.eu/web/sentinel/technical-guides/sentinel-3-altimetry

https://sentinels.copernicus.eu/web/sentinel/technical-guides/sentinel-3-synergy

### Sentinel-3 User Guide

https://sentinels.copernicus.eu/web/sentinel/user-guides/sentinel-3-olci

https://sentinels.copernicus.eu/web/sentinel/user-guides/sentinel-3-slstr

https://sentinels.copernicus.eu/web/sentinel/user-guides/sentinel-3-altimetry

https://sentinels.copernicus.eu/web/sentinel/user-guides/sentinel-3-synergy

## S3 Facts

- The OLCI instrument has a 300-meter spatial resolution and 21 spectral bands with wavelengths ranging from the optical to the near infrared, allowing global coverage in less than 4 days. It provides information about water quality.
- SLSTR is the main topographic instrument that provides topography measurements over sea ice, ice sheets, rivers and lakes. It uses dual-frequency Ku and C band with a 300-meter spatial resolution.
- The SAR altimeter and the microwave radiometer can detect changes in sea-surface height and sea-ice.

## SATELLITE DATA PROVIDERS: COMMERCIAL IMAGERY

Quasar Science Resources is working on adapting its products to commercial satellite data for those applications that would benefit from additional data or better spatial or time resolution. We work with several commercial satellite data providers and with them, Quasar will find the best solution to your application. This kind of service can be requested and will be studied on a one-by-one basis before providing a solution to potential users.

2022

QUASAR
SCIENCE RESOURCES, S.L.

# SIMBAD PRODUCTS


MARITIME MONITORING 11

MARINE ECOSYSTEMS MONITORING 25

WATER QUALITY MONITORING 37

WILDFIRE MONITORING 49

PRECISION AGRICULTURE 61

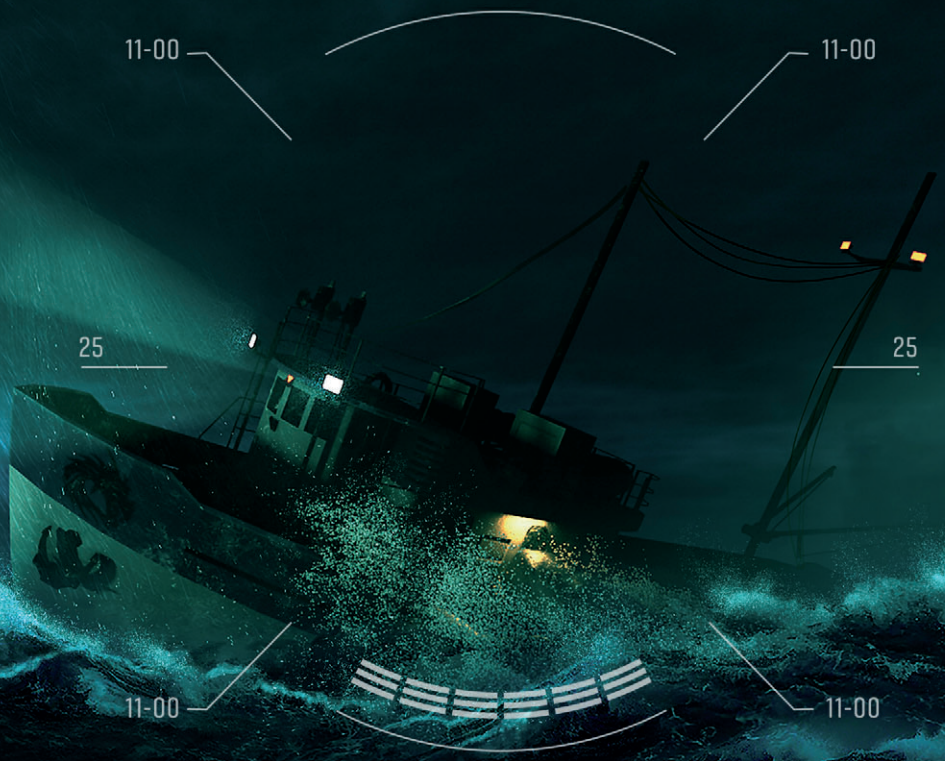
2022

# Remote Sensing for Maritime Monitoring

QUASAR
SCIENCE RESOURCES, S.L.

# MARITIME MONITORING

## S1



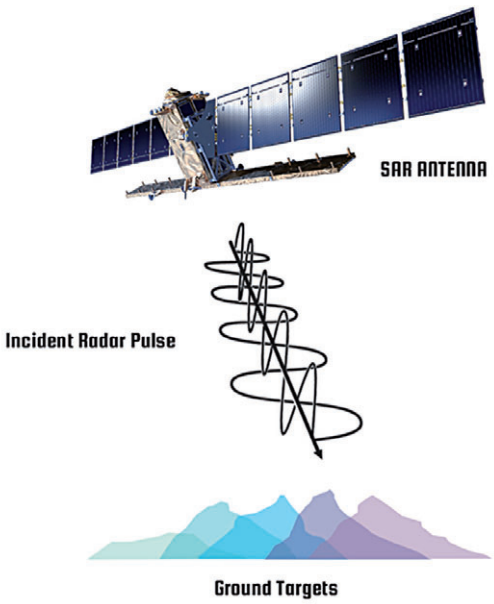

### SENTINEL-1

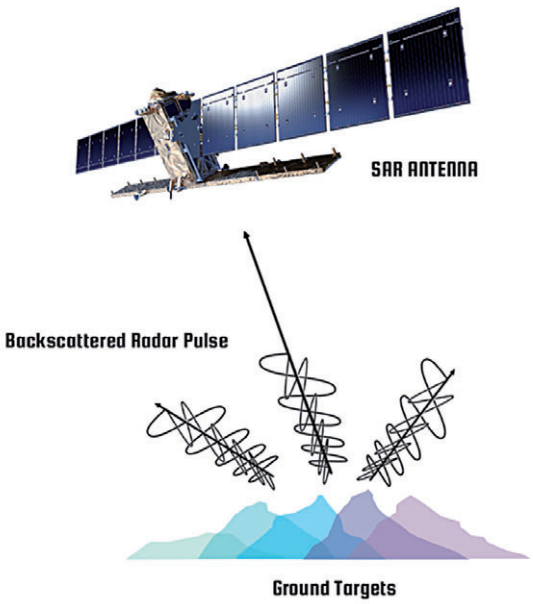
SYNTHETIC APERTURE RADAR (SAR)

WAVE ACQUISITION MODE
20 KM BY 20 KM AT 5M SPATIAL RESOLUTION
6 DAY REVISIT AT EQUATOR

# S1
## MARITIME MONITORING

Sentinel-1 provides global, regular and repeated coverage of coastal and open sea waters. With its Synthetic Aperture Radar (SAR), Sentinel-1 has the advantage of operating under cloud cover or a lack of illumination and can acquire data over a site during day or night time under all weather conditions. One of the many applications of Sentinel-1 SAR data is for Maritime Monitoring, making it suitable for vessel detection.




By monitoring ship behavior, it is possible to alert of potential illegal activities, like border crossings, infringements of maritime traffic separation schemes, and illegal fishing. Maritime surveillance is also useful to assess the use and management of the maritime space.

Sentinel-1 routinely collects large amounts of images which are made freely available. The vast amounts of data produced by the constellation of satellites are a great opportunity to develop systems for Maritime Monitoring. To become fully operational, these processing systems must be entirely automatic with a controlled level of reliability and robustness.

Boat Detection
SIMBAD

# S1
# MARITIME MONITORING

The system developed by Quasar provides a fully automatic ship detection algorithm for Sentinel-1 SAR images, providing a long-term, wide-area monitoring of vessel traffic along with vessel location and size estimators and classification. Automatic vessel detection, without human intervention, requires reliable results in order to remove false alarms which are not due to vessels.

The behavior of the vessel detection pipeline developed by Quasar, in terms of success rate as a function of boat size, is summarized in the following table:

| Vessel Detection Processing Pipeline Summary | | |
|---|---|---|
| **Vessel size >10 m** | **Vessel size >20 m** | **Vessel size >30 m** |
| Precision: 0.55<br>Recall: 0.5625<br>Accuracy: 0.68<br>FScore: 0.56 | Precision: 0.61<br>Recall: 0.8055<br>Accuracy: 0.74<br>FScore: 0.69 | Precision: 0.75<br>Recall: 0.9167<br>Accuracy: 0.86<br>FScore: 0.83 |

(1) The Precision tells us to what percentage one is sure that what is being detected is a vessel or not.

(2) The Recall tells us what percentage of all ships are being detected in a given scene.

(3) Accuracy and FScore are two ways of combining Precision and Recall. Either one of these two values can be used as a global value to estimate the success rate.

As an example, from the table above, for boats larger than 30 meters in length, the success rate is more than 80%, a fairly good value according to other studies (*).

(*) It is important to notice that these numbers depend on many factors. Amongst them, it depends largely on the analysis window size chosen, the type of pre-processing, the probability of false alarms, the type of image, whether the area is prone to have a lot of noise, such as areas near permanent radars, the minimum size of vessels of interest to be detected, etc .....These factors should be taken into consideration since the detection capabilities of the vessel processing pipeline depends largely on the problem at hand. For example, weight can be given to detecting the maximum number of vessels in a given scene versus how reliable each single detection is. Or the opposite, fewer vessel detections in favor of a higher reliability for single detections.

# S1
## MARITIME MONITORING

# S1
# MARITIME MONITORING

## Maritime Monitoring Products

- **Sentinel-1 SAR Processed Image**
- **Vessel Detection Shapefile**
  - Vessel location and size estimators
- **Oil Spill Detection Shapefile**
  - Characterization of Oil Spills

## Maritime Monitoring Applications

The Maritime Monitoring Products can be used for different applications. Some examples are:

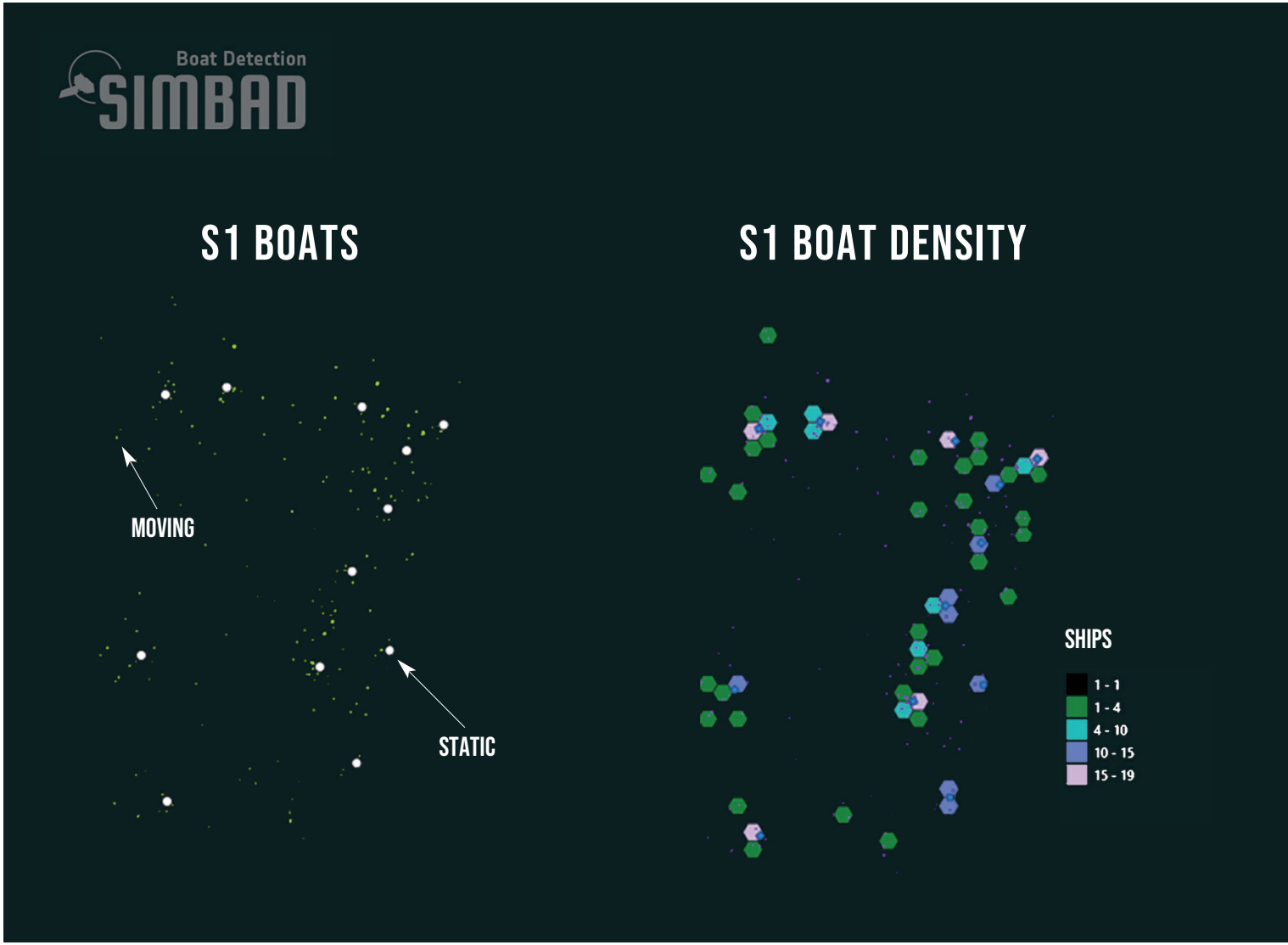
- **Vessel and vessel traffic spatial density and distribution**
- **Derivation of most likely vessel routes**
- **Identification of static and mobile maritime objects**
- **Hotspot identification and their temporal and spatial evolution**
- **Autocorrelation analysis to characterize the behavior of different spatial zones**
- **Temporal analysis for the extraction of trends on different time scales**
- **Cross-correlation with AIS or other external sources of data**
- **Cross-correlation with location of Marine Ecosystems**
- **Follow the route of single large vessels over time (cruises, tankers, ...) ***

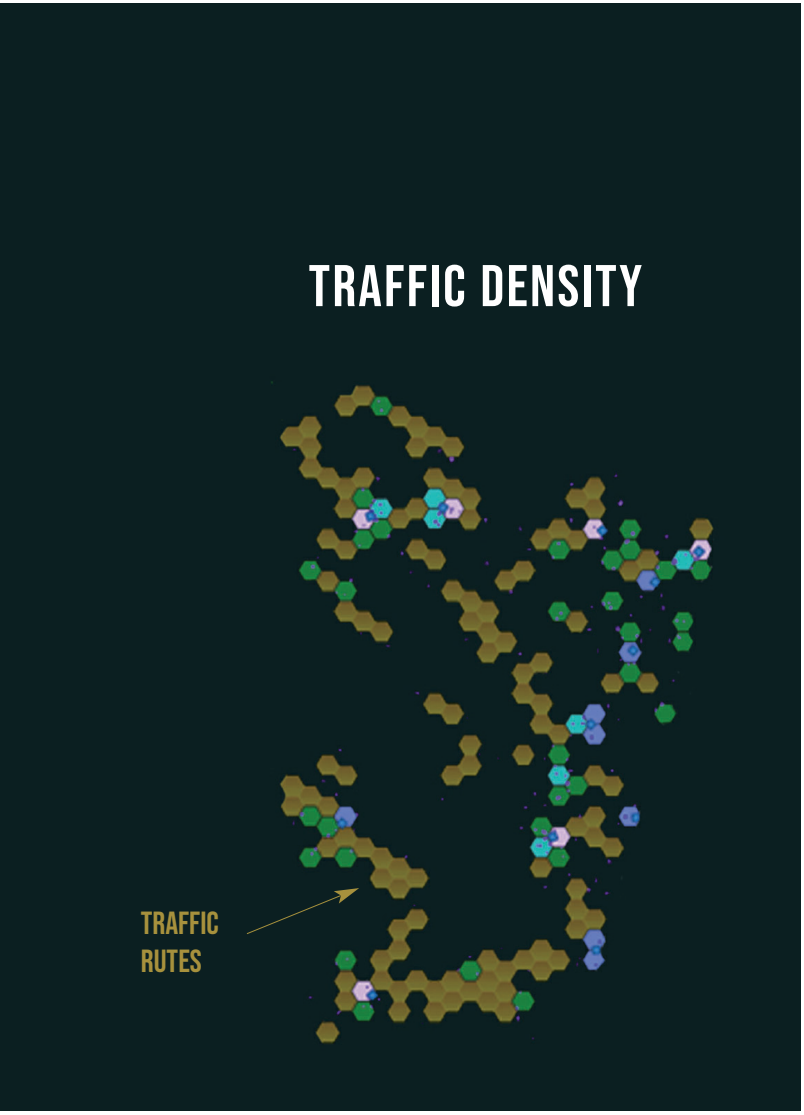
* Non time continuous coverage. Dependent on revisit time

## Maritime Monitoring Services

- Dedicated tailor-made solutions for Sentinel-1 SAR applications
- Consulting services about Sentinel-1 data, products and applications
- Support the integration of Sentinel-1 data into your solution
- Support the integration of auxiliary non-EO data into your EO solution
- Participation in R&D projects at national and European levels with experience leading projects and working within large collaborations

## Application Examples






# BOAT AND TRAFFIC DENSITY

S1 boat detections give location and estimated boat size.

Using a tessellated field (World reference tessellated (UBER H3)) density maps can be derived at any desired scale.

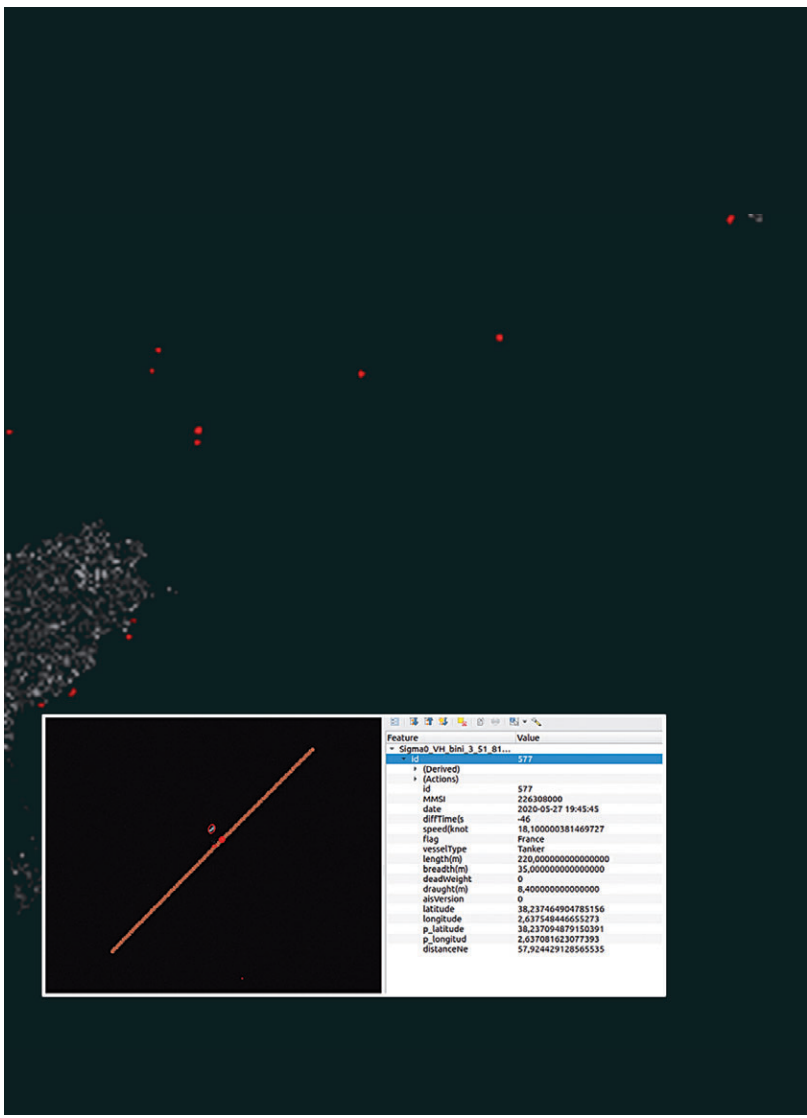
Multi temporal analysis allows to derive most likely traffic routes together with a classification of objects as moving or static.

sentinel-1

# S1/AIS CORRELATION

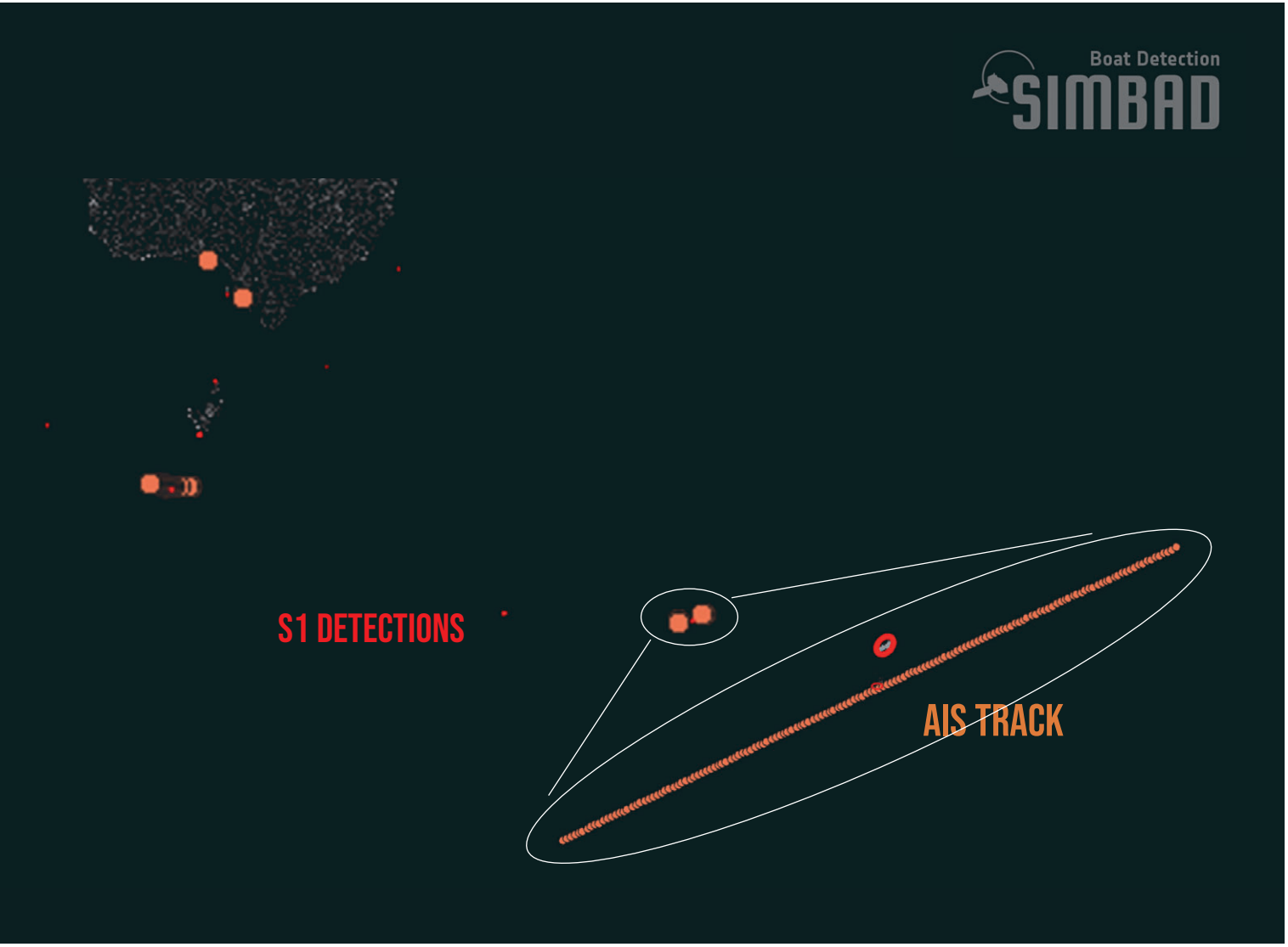
S1 and AIS data comparison can provide vital information.

S1 and AIS hotspot comparison and their spatial evolution with time can help identify illegal activities and to manage and monitor marine areas.




sentinel-1

# S1
## MARITIME MONITORING

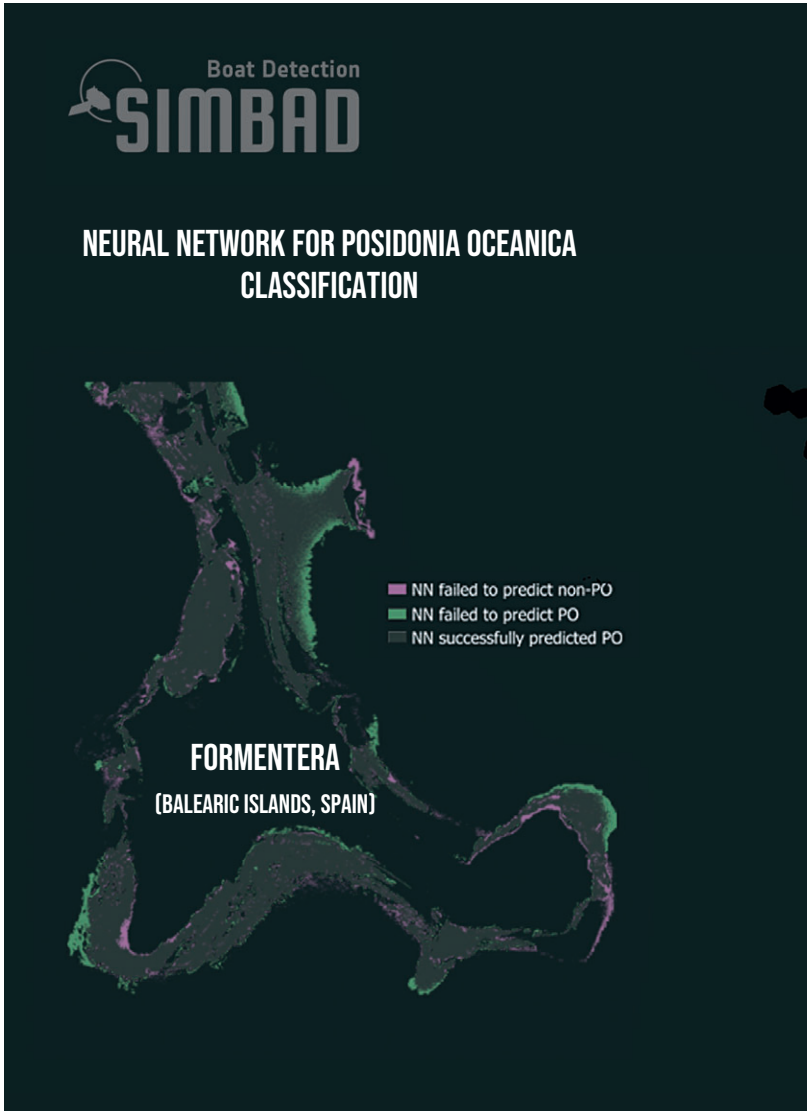


# MARINE ECOSYSTEMS MONITORING

S1 detections can be used to assess boat pressure over marine ecosystems.

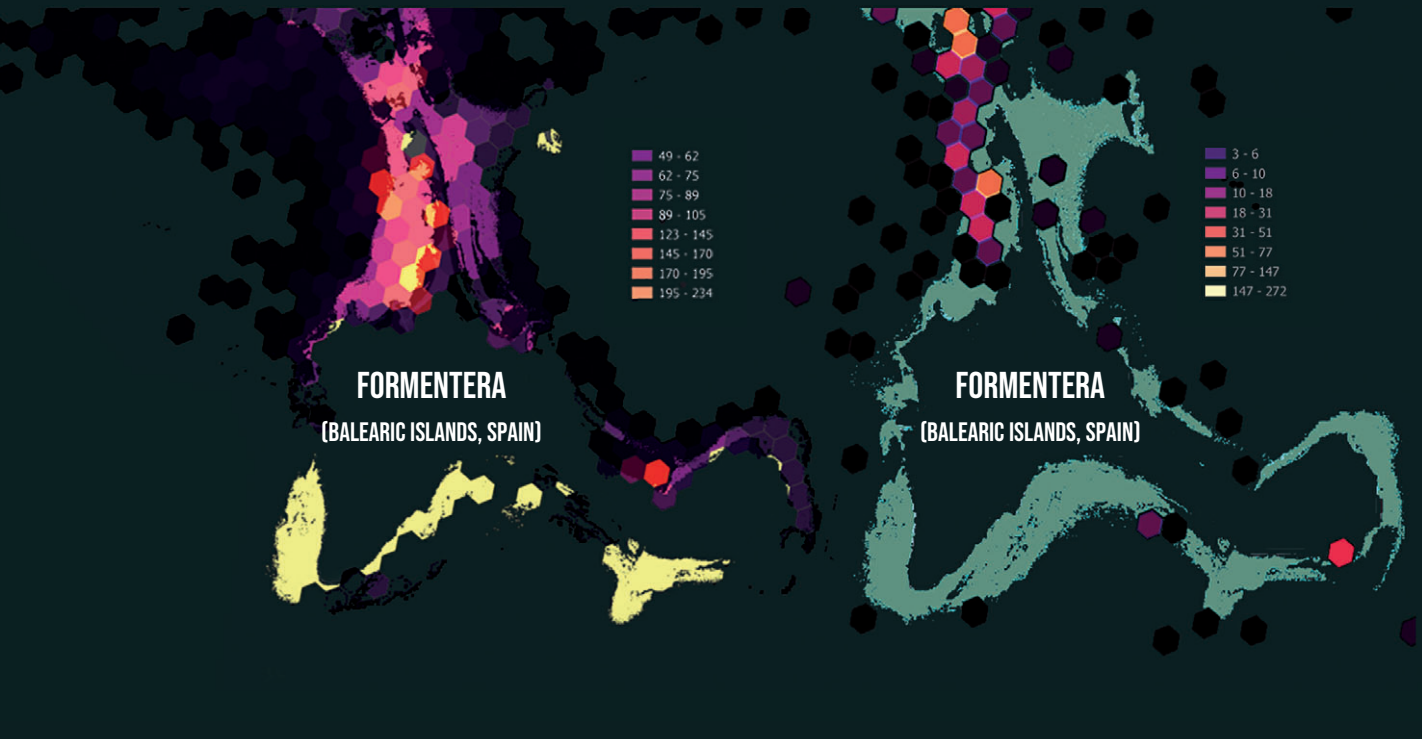
Temporal analysis of these pressure points can be used to monitor seasonal boat activity and help in putting measures in place to protect marine ecosystems.

Autocorrelation studies can help to characterize the behaviour of different spatial zones.




sentinel-1

## BOAT PRESSURE OVER MARINE ECOSYSTEMS (AIS AND SENTINEL-1 SAR DATA)



2022

# Marine Ecosystems monitoring

QUASAR
SCIENCE RESOURCES, S.L.

# MARINE ECOSYSTEMS MONITORING

S2

## SENTINEL-2

MULTISPECTRAL INSTRUMENT (MSI)

13 SPECTRAL BANDS: FOUR OF THEM AT 10 M SPATIAL RESOLUTION
5 DAY REVISIT AT EQUATOR

Posidonia SIMBAD

Sentinel-2 (MSI) provides global, regular and repeated coverage of inland, coastal and open sea waters under cloud-free sky. One of the many applications of Sentinel-2 data is for marine ecosystem monitoring in shallow coastal waters.

In particular, Quasar can provide customized Sentinel image services specifically designed to map the meadows of *Posidonia oceanica* in the Mediterranean Sea. *Posidonia oceanica* is a seagrass species that is endemic to the Mediterranean Sea, and it constitutes one of the most important ecosystems of the sea. Posidonia is one of the main sources of oxygen in the sea and it is considered to be a good bioindicator of the quality of the water.

S2 routinely collects large amounts of images which are made freely available. The vast amounts of data produced by the constellation of satellites are a great opportunity to develop systems for marine ecosystem monitoring in shallow coastal waters. To become fully operational, these processing systems must be entirely automatic with a controlled level of reliability and robustness.

Quasar's system provides *Posidonia oceanica* maps with a 10 m spatial resolution and at different temporal scales, being the recommended one, but not limited to, yearly cartography. A seasonal and yearly scale cartography should be enough for decision-making on conservation measures. Our classification technique is able to recover from S2 images the detailed spatial shape of the seagrass meadows with a correct recall rate of 84% for Posidonia pixels. These results prove accurate up to depths close to 30 meters in depth. Our classification method can provide an extremely cost-effective way to monitor variations of *Posidonia oceanica* meadows using the S2 archive (2015-present). Another advantage of the system designed is the ability to replicate results.

## BIOINDICATOR OF THE QUALITY OF THE COASTAL WATERS

Scientific name: ***Posidonia Oceanica***

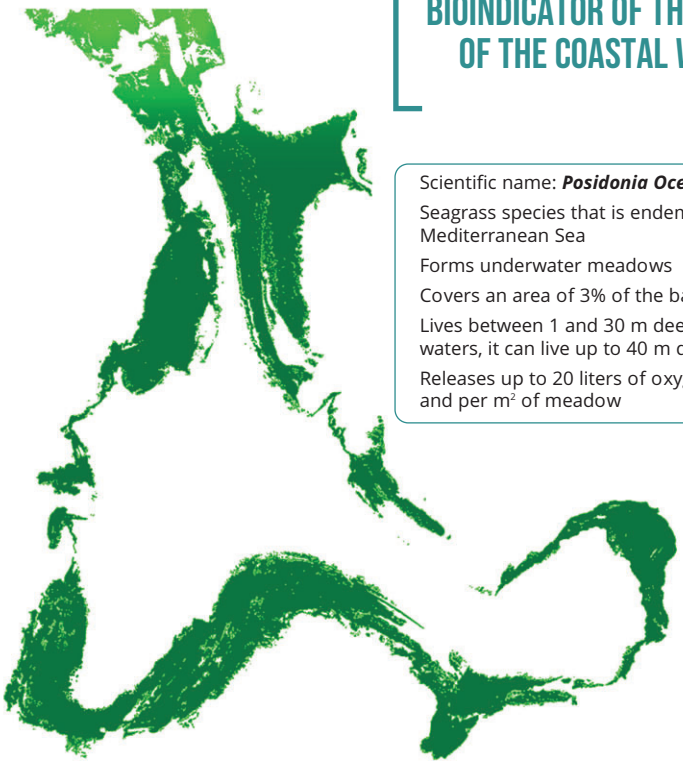
Seagrass species that is endemic to the Mediterranean Sea

Forms underwater meadows

Covers an area of 3% of the basin

Lives between 1 and 30 m deep in clear waters, it can live up to 40 m deep

Releases up to 20 liters of oxygen per day and per $m^2$ of meadow



**Formentera, Balearic Islands (Spain)**
**Posidonia Oceanica meadows**
**SIMBAD 2020 cartography**

# S2
# MARINE ECOSYSTEMS MONITORING

## Marine Ecosystems Products

- *Posidonia oceanica* maps (shapefiles) at a 10 m spatial resolution
- *Posidonia oceanica* maps (shapefiles) at different temporal scales, like yearly or seasonal

## Marine Ecosystems Applications

The Marine Ecosystems Products can be used for different applications. Some examples are:

- Time-series analysis of *Posidonia oceanica* cartography for the provision of evidence to support the development of better coastal laws and regulations addressing identified issues
- Allow for spatial and temporal evolution studies to monitor degradation as a result of natural causes or coastal development
- Evaluation of ecosystem status by comparing the before and after natural events or coastal human activity, like infrastructure development
- Determine the spatial extent covered by marine ecosystem over a range of depths (down not more than 30 meters)
- Distinguish different seagrass species, in the Mediterranean Sea, mainly *Posidonia oceanica* and *Cymodocea nodosa*
- Cross-correlation of marine ecosystems with maritime activities (vessel traffic, tourism, fishing, etc ...), like, the location of maritime objects extracted from Sentinel-1 SAR data or external sources of data (ex. AIS data)

## Marine Ecosystems Services

- Dedicated tailor-made solutions for satellite and model-based Marine Ecosystems applications
- Participation in R&D projects at national and European levels
- Consulting services about Sentinel-2 and applications
- Support the integration of Sentinel-2 data into your solution
- Support the integration of Copernicus Marine Service products into your solution

## Application Examples

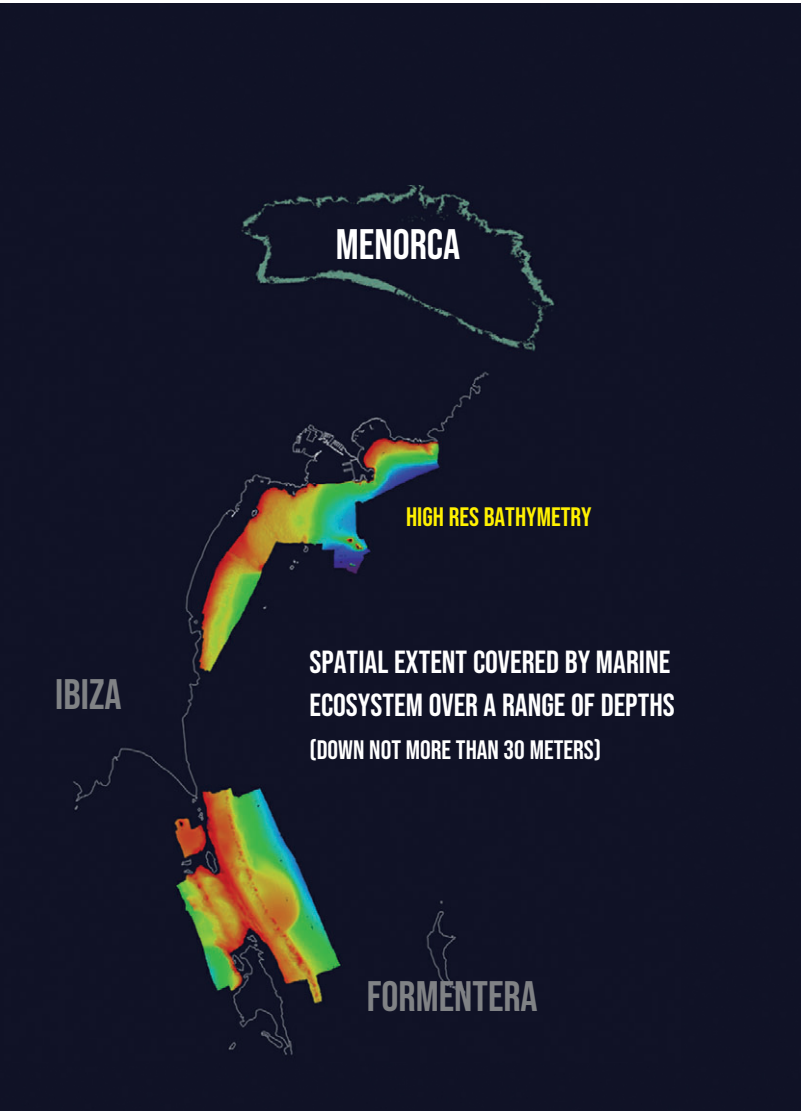
Posidonia SIMBAD

### POSIDONIA OCEANICA AROUND THE BALEARIC ISLANDS (SPAIN)

10 METERS SPATIAL RESOLUTION
SEASONAL AND YEARLY TEMPORAL SCALES

CLASSIFICATION TECHNIQUE ABLE TO RECOVER THE DETAILED SPATIAL SHAPE OF THE SEAGRASS MEADOWS FROM THE SENTINEL-2 IMAGES WITH A CORRECT RECALL RATE OF:

**84%**




# MARINE ECOSYSTEM SPATIAL COVERAGE

PO cartography allows to estimate the spatial coverage of marine ecosystems and stablish their correlation with maritime activities like, vessel traffic, tourism, fishing, etc...

Spatial studies can support the development of better coastal laws and aid in the decision making progress on conservation measures.

sentinel-2

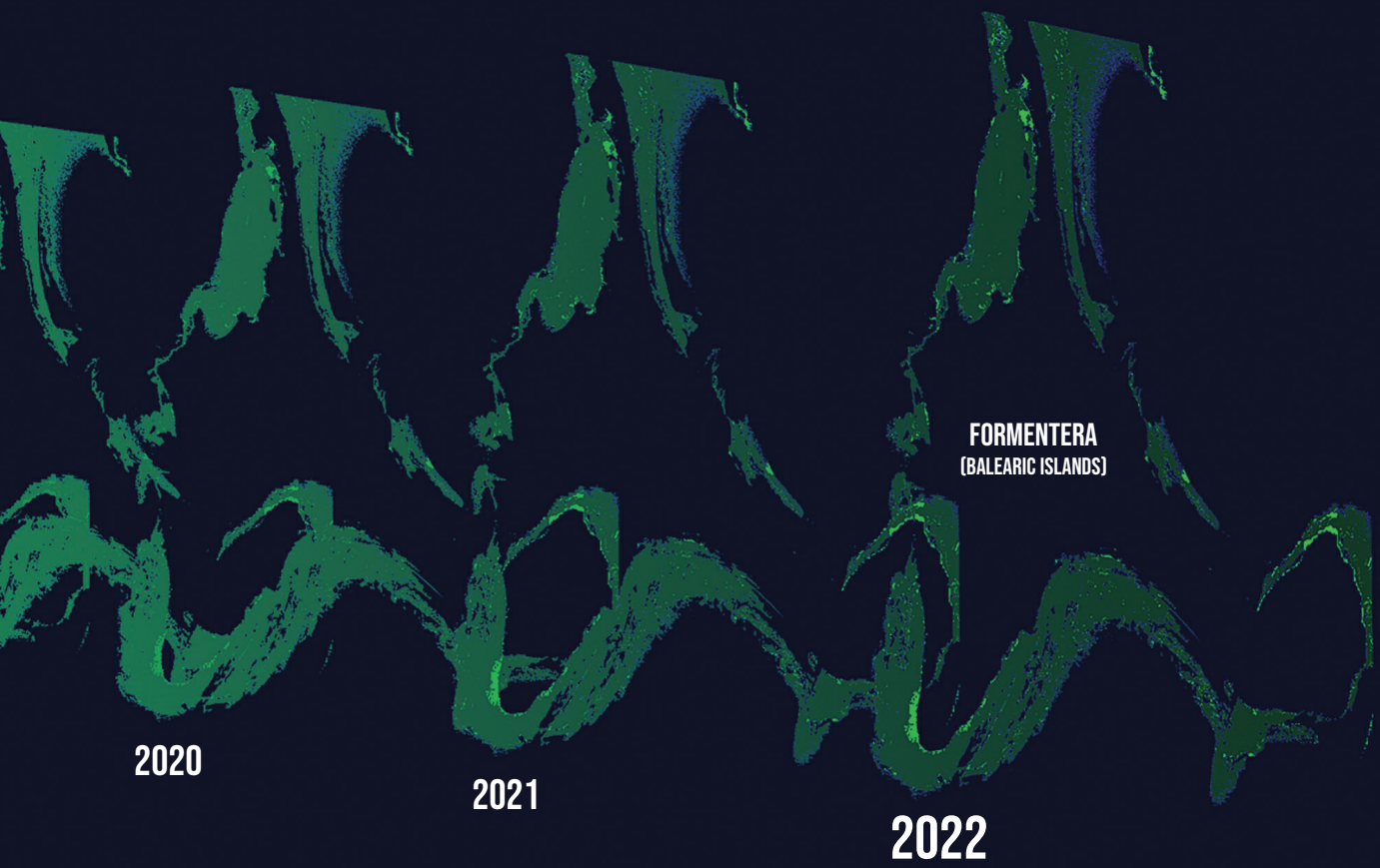
# MARINE ECOSYSTEM TEMPORAL COVERAGE

Temporal evolution studies of marine ecosystems can be used to monitor ecosystem degradation as a result of natural causes or coastal development.

It is possible to evaluate the status of the ecosystem by comparing the before and after natural events or anthropogenic activities.

sentinel-2

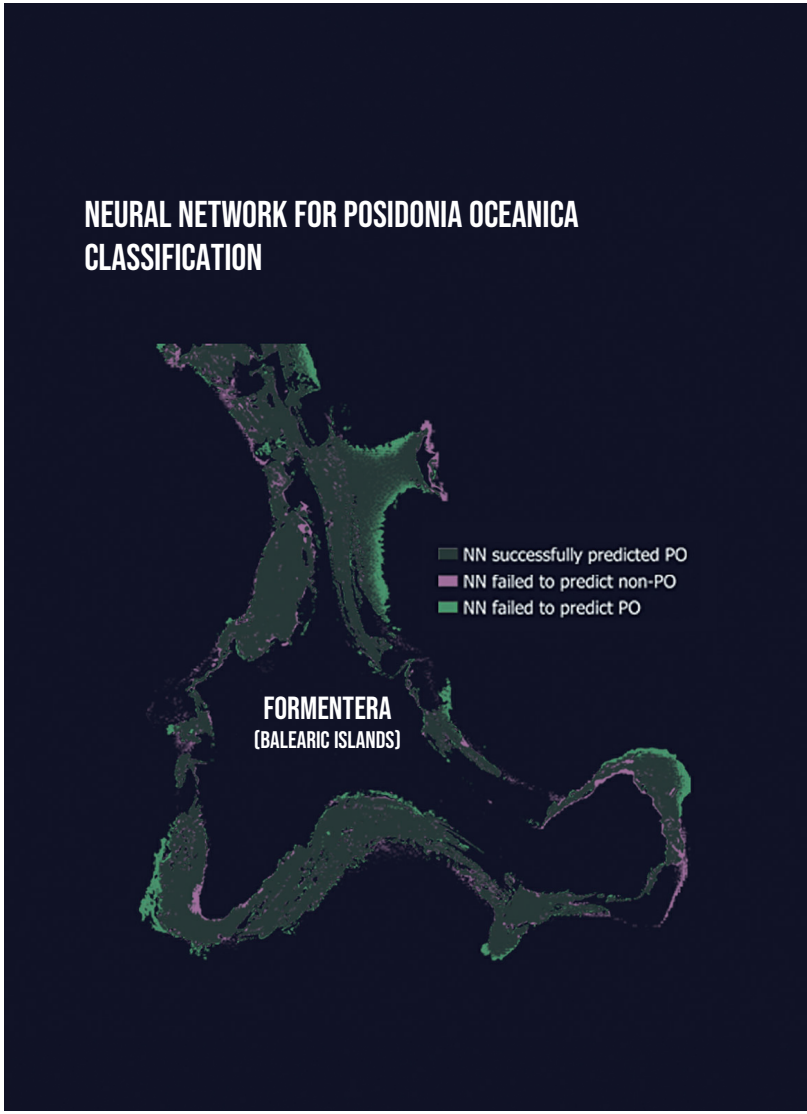
## TIME-SERIES ANALYSIS OF POSIDONIA OCEANICA CARTOGRAPHY FOR THE PROVISION OF EVIDENCE TO SUPPORT THE DEVELOPMENT OF BETTER COASTAL LAWS AND REGULATIONS



# BOAT PRESURE OVER MARINE ECOSYSTEMS

S1 boat detections can be used in combination with meadow location to assess boat pressure over marine ecosystems.

The temporal analysis of these pressure points can be used to monitor seasonal boat activity and help in putting measures in place to protect marine ecosystems.

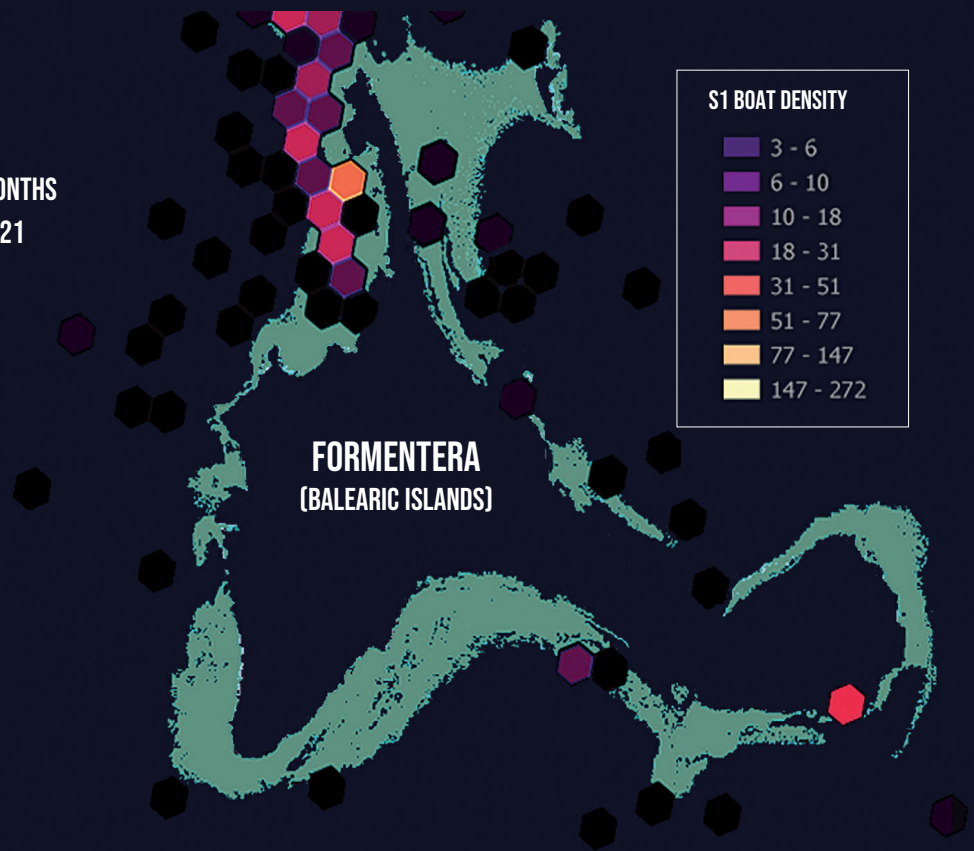



sentinel-2

## BOAT PRESSURE OVER MARINE ECOSYSTEMS (SENTINEL-1 SAR DATA)

Posidonia SIMBAD

S1 SAR DATA FROM MONTHS OF JUNE TO AUGUST 2021



2022

# Remote Sensing for Water Quality Monitoring

QUASAR
SCIENCE RESOURCES, S.L.

# WATER QUALITY MONITORING

## S2 S3

### SENTINEL-2

MULTISPECTRAL INSTRUMENT (MSI)

13 SPECTRAL BANDS: FOUR OF THEM AT 10 M SPATIAL RESOLUTION
5 DAY REVISIT AT EQUATOR

### SENTINEL-3

SEA AND LAND SURFACE TEMPERATURE RADIOMETER (SLSTR)
OCEAN AND LAND COLOUR INSTRUMENT (OLCI)
SYNTHETIC APERTURE RADAR ALTIMETER (SRAL)

SLSTR, KU AND C BAND WITH A 300 M SPATIAL RESOLUTION
OLCI, A 300 M SPATIAL RESOLUTION AND 21 SPECTRAL BANDS
SRAL, SAR ALTIMETER AND THE MICROWAVE RADIOMETER

# S2 S3
## WATER QUALITY MONITORING

Sentinel-2 (MSI) and Sentinel-3 (OLCI) provide global, regular and repeated coverage of inland, coastal and open sea waters under cloud-free sky. One of the many applications of both these satellites data is for water quality monitoring, making it suitable to measure and monitor different water quality parameters i.e., Chlorophyll (Chl-a) as a proxy of primary productivity, Turbidity (T), Total Suspended Matter (TSM), Coloured Dissolved Organic Matter (CDOM), and Sea Surface Temperature (SST).

By measuring different physical and chemical parameters of the lakes, rivers, coastal areas, estuaries, and open sea waters, it is possible to monitor the water quality status as well as the eutrophication of the respective water bodies, assess ecosystem productivity, and identify, for example, potential sites for fish farming. Also, turbidity and sediment load measurements are useful in dealing with coastal problems like delta growth and retreat, beach erosion, and modification of harbor basins.

S2 and S3 routinely collects large amounts of images which are made freely available. The vast amounts of data produced by the constellation of satellites are a great opportunity to develop systems for Water Quality Monitoring.

To become fully operational, these processing systems must be entirely automatic with a controlled level of reliability and robustness.

SIMBAD can provide current and time series maps of different water quality estimators for a wide range of areas, including European and Global coastal and open seawaters. SIMBAD also provides water quality monitoring systems by developing region-specific algorithms.

Water Quality SIMBAD

# S2 S3
## WATER QUALITY MONITORING

## Water Quality Monitoring Products

Water quality parameter maps.

- **Maps of Harmful Algae Blooms (HABs)**
- **Maps of Chlorophyll-a (Chl-a) concentrations**
- **Maps of Total Suspended Matter (TSM) concentrations**
- **Maps of Turbidity level**
- **Maps of Coloured Dissolved Organic Matter (CDOM) concentrations**
- **Maps of Sea Surface Temperature (SST)**

Quasar provides Water Quality Monitoring services for the above-mentioned parameters. On special requests or demands, Quasar also provides region-based monitoring systems by developing specific regional algorithms.

Besides, Quasar also provides a package of satellite and model derived environmental forces data i.e., Salinity, Ocean Currents, Photosynthetic Active Radiation (PAR), and wind mixing index (WMI), along with the water quality products (HABs, Chl-a, TSM, Turbidity, and SST), providing useful information for decision making in the management of coastal natural resources.

## Water Quality Monitoring Applications

Different Water Quality Monitoring products can be used for different applications. Some example applications are:

- **Harmful Algae Bloom (HABs) monitoring**
- **Eutrophication monitoring**
- **Ecosystem monitoring**
- **Aquaculture site selection**
- **Identification of delta growth and retreat**
- **Identification of beach erosion**
- **Sediment load estimation**
- **Water quality monitoring**

# S2 S3
## WATER QUALITY MONITORING

## Water Quality Monitoring Services

- Dedicated tailor-made solutions for satellite and model-based Water Quality applications
- Consulting services about Sentinel-2, Sentinel-3 and their applications
- Support the integration of Sentinel-2 and Sentinel-3 data into your solution
- Support the integration of Copernicus Marine Service products into your solution
- Participation in R&D projects at national and European levels with experience leading projects and working within large collaborations

## Application Examples

# MAPPING WATER QUALITY

S2 water quality maps of Chl-a, CDOM, and TSM at 10 metre spatial resolution.

Water quality maps help to identify point sources of pollution. It also provides the spatial and temporal distribution of the pollutants which are not readily available from in-situ measurements. These type of information is helpful for accurate assessment or management of the water bodies.

sentinel-2 sentinel-3

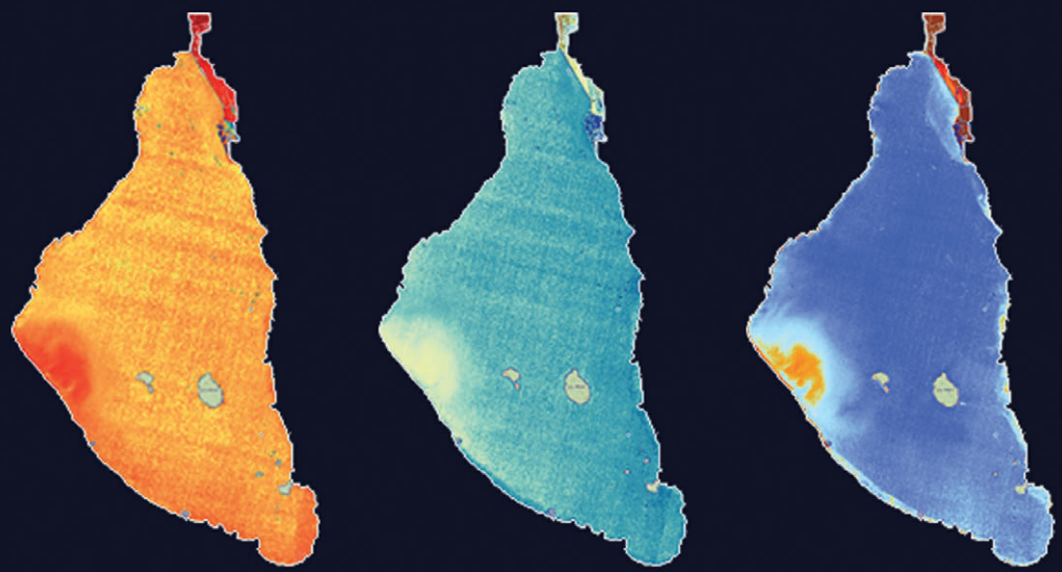
# S2 S3
## WATER QUALITY MONITORING

### MAR MENOR (SPAIN) ENVIRONMENTAL COLLAPSE (AUGUST 2021)

Water Quality SIMBAD

**MAPS OF:**

CHLOROPHILL | CDOM ABSORPTION COEFFICIENT | SUSPENDED MATTER



MAR MENOR (SPAIN) SUMMER 2021

**OTHER MAPS:**

- TEMPERATURE
- TURBIDITY
- WIND VELOCITY
- OCEAN CIRCULATION

**APPLICATIONS:**

MONITORING,

- HARMFULL ALGAL BLOOMS
- PRIMARY PRODUCTION
- SEDIMENT TRANSPORTATION

# TURBIDITY AND ALGAL BLOOM

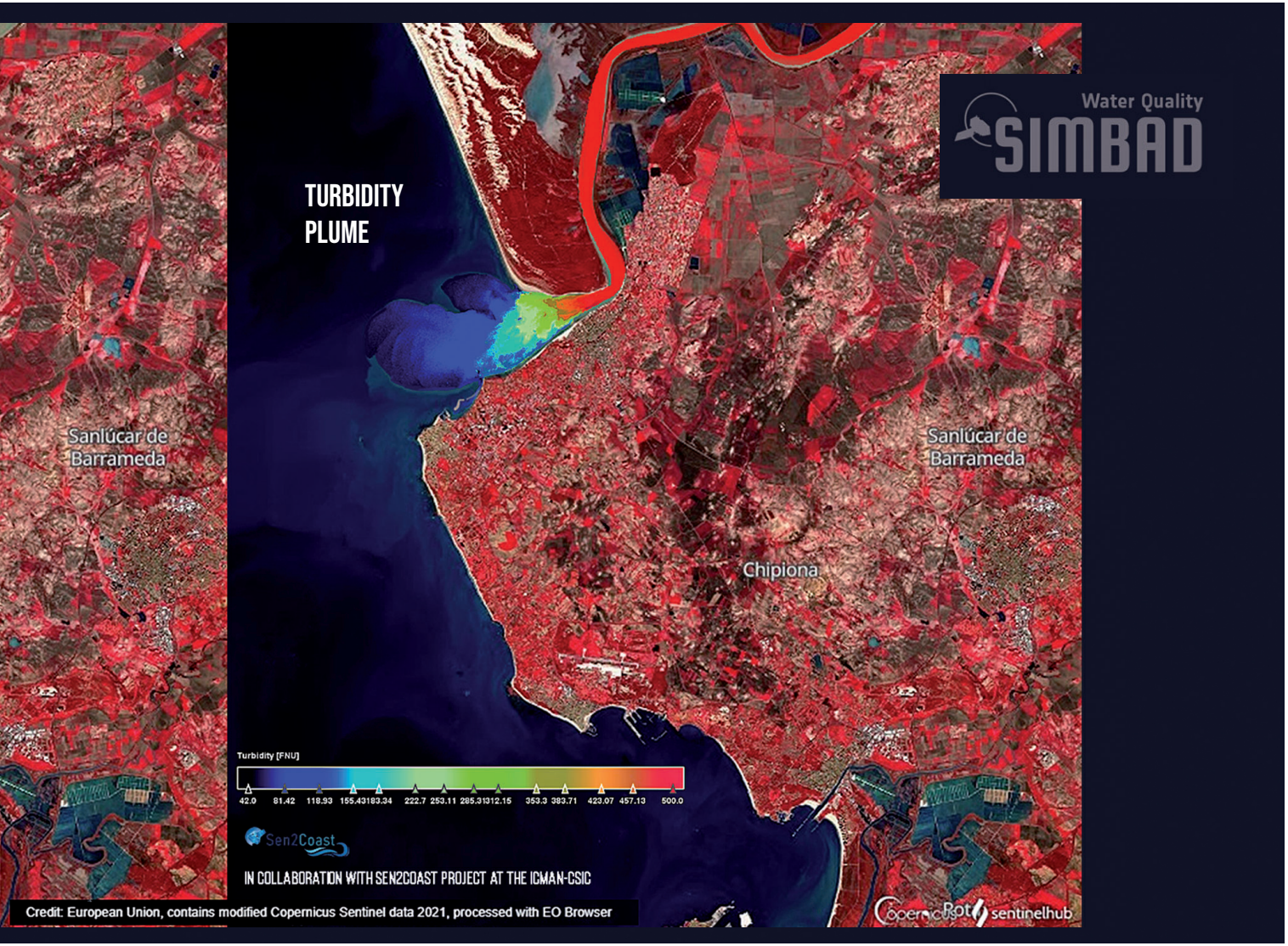
Prolonged turbidity episodes can cause hypoxia and inhibit the growth of phytoplankton in coastal regions, thus negatively affecting the productivity of the aquatic ecosystem. Examining the turbidity levels can assists coastal managers and policy makers to control the challenging issue of water quality monitoring.

HABs can represent a potential health risk.

GUADALQUIVIR ESTUARY (SPAIN)

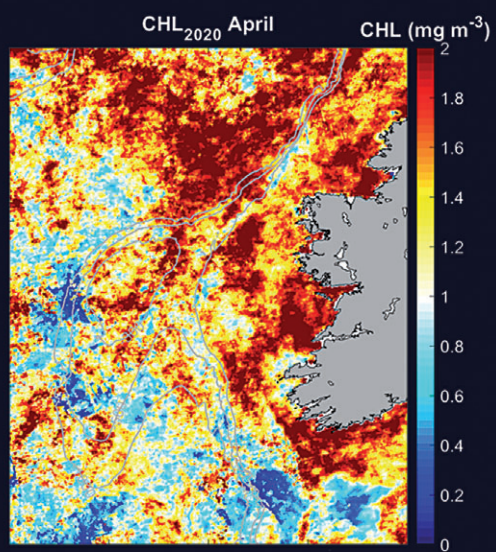
sentinel-2 sentinel-3

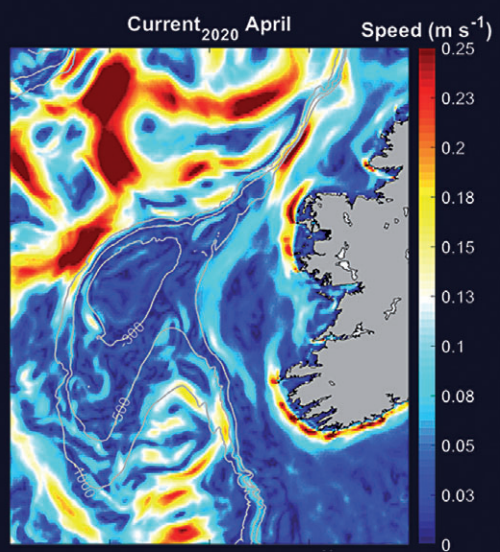
# S2 S3
## WATER QUALITY MONITORING

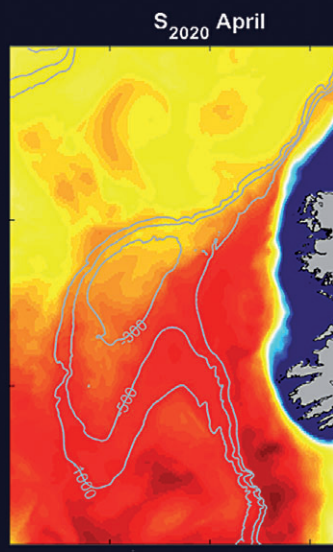


## OPTIMAL ENVIRONMENTAL CONDITIONS DURING THE SPAWNING SEASON COULD IMPROVE AND ENHANCE THE LARVAL SURVIVAL RATES OF FISH SPECIES

THE CONCENTRATION OF CHL IN THE OCEAN IS CONSIDERED AS A PROXY OF PHYTOPLANKTON BIOMASS THAT CAN BE RELATED TO FISH PRODUCTION.



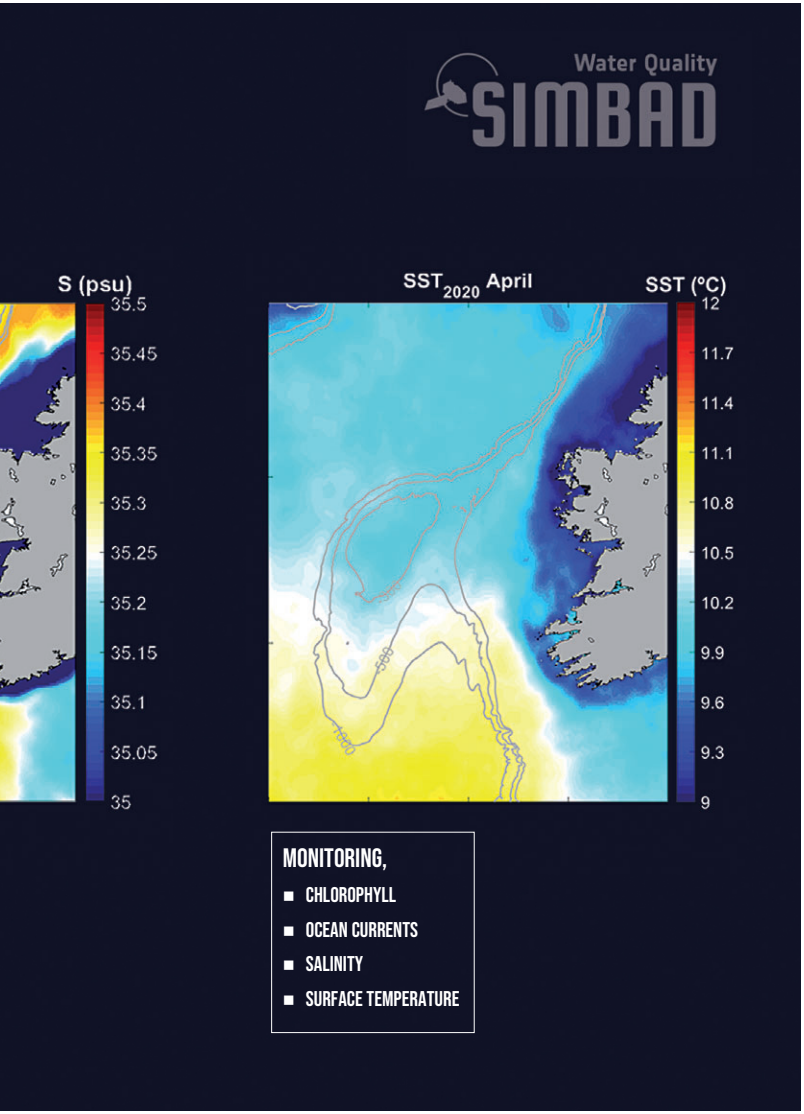




## THE PORCUPINE BANK, IRELAND

A MAJOR SPAWNING AREA FOR BLUE WHITING

*ENVIRONMENTAL FORCING ON BLUE WHITING YEAR-CLASS STRENGTH IN THE PORCUPINE BANK (NE ATLANTIC)* - MASUMA CHOWDHURY ET AL 2022




# AQUACULTURE SITE SELECTION

By examining different physical and biochemical parameters derived from a combination of satellite products, it is possible to identify potential regions for specific fish farming.

Different products from a combination of different satellites and modeled data can be used as a proxy of ecosystem productivity.

sentinel-2 sentinel-3

2022

# Remote Sensing for Wildfire Monitoring

QUASAR
SCIENCE RESOURCES, S.L.

# WILD FIRE MONITORING

## SENTINEL-2

MULTISPECTRAL INSTRUMENT (MSI)

- 13 SPECTRAL BANDS: FOUR OF THEM AT 10 M.SPATIAL RESOLUTION
- 5 DAY REVISIT AT EQUATOR

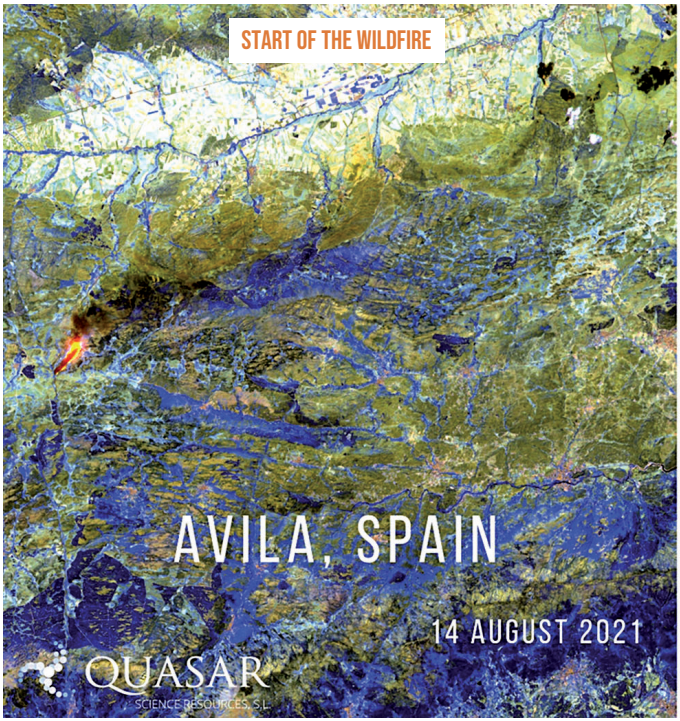
# S2
# WILDFIRE MONITORING

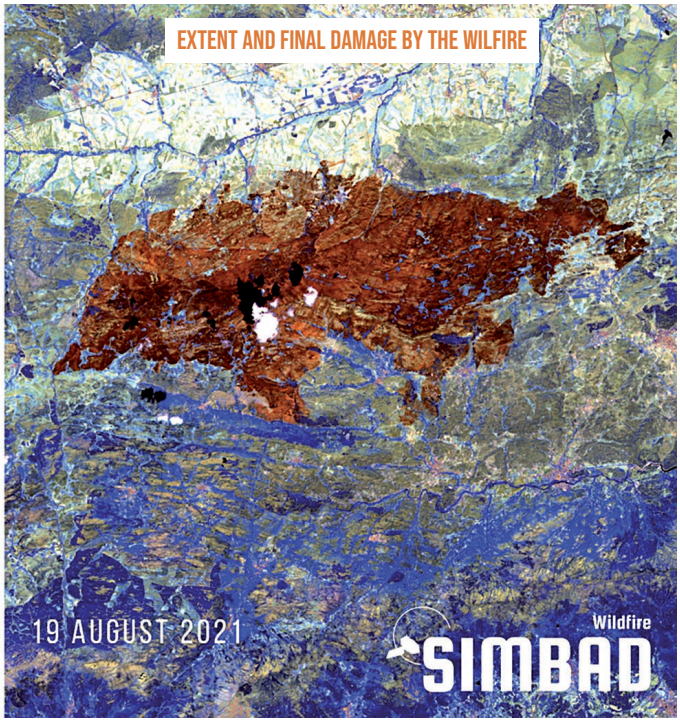
Sentinel-2 offers global, regular, and repeated coverage of terrestrial surfaces under cloud-free sky, which is ideal to map and monitor wildfires and their evolution over time by using the top-of-canopy surface reflectance. Based on these data, it is possible to develop systems to provide up-to-date and timeseries maps of Wildfires that can be used for monitoring purposes worldwide.

Wildfires affect thousands of people all over the world every year, destroy natural environments, and cause huge economic losses. The frequency and severity of these natural hazards are expected to increase as a consequence of climate change. It is therefore essential to develop monitoring tools to analyze the post-fire landscape evolution, to manage burnt areas, and to prevent the breakout of a fire in the future.

Wildfire SIMBAD

Sentinel-2 routinely collects large amounts of images which are made freely available. The vast amounts of data produced by the constellation of satellites are a great opportunity to develop systems for Wildfire Monitoring. To become fully operational, these processing systems must be entirely automatic with a controlled level of reliability and robustness.



## Wildfire Monitoring Products

- S2 RGB and false color maps
- Wildfire burn severity maps
- External data enhancement maps
- Fire perimeter delineation
- Land use land cover (LULC) change maps
- Wildfire vulnerability maps
- Wildfire risk maps
- Recovery maps

## Wildfire Monitoring Applications

The Wildfire Monitoring Products can be used for different applications. Some examples are:

- Categorization of burn severity levels applying spectral indices
- Delineation of the wildfire extent to support the decision-making process
- Valuation of economic losses through the analysis of the impacted surfaces over different land designations (such as municipalities, plots, etc...)
- Environmental impact assessment after a wildfire-event (analysis of landslides, flooding, and erosion)
- Analysis of the vegetation cover evolution to asses and evaluate restoration plans
- Control land use changes after a wildfire-event
- Wildfire prevention, analysis of wildfire risk, exposure and vulnerability to avoid future wildfires in fire-prone areas
- Identification of priority forest restoration areas
- Prioritize wildfire surveillance and monitoring according to the level of risk areas
- Data-support for wildfire restoration plans

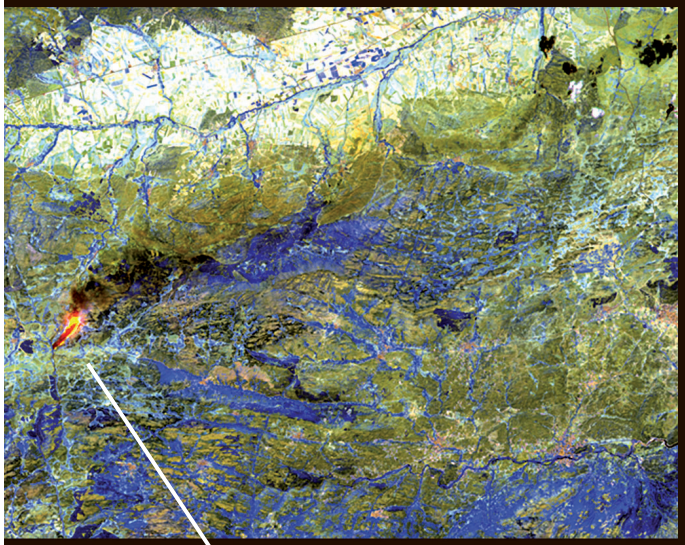
## Wildfire Monitoring Services

- Dedicated tailor-made solutions for satellite and model-based Wildfire applications
- Transfer Wildfire analysis to diverse locations and Wildfire types
- Provide near real-time fire monitoring at a spatial resolution of 10 m
- Consulting services about Sentinel-2 data, products and applications
- Support the integration of Sentinel-2 data into your solution
- Support the integration of auxiliary non-EO data into your EO solution
- Support the integration of Copernicus Land Monitoring Service data into your solution
- Participation in R&D projects at national and European levels with experience leading projects and working within large collaborations

## Application Examples

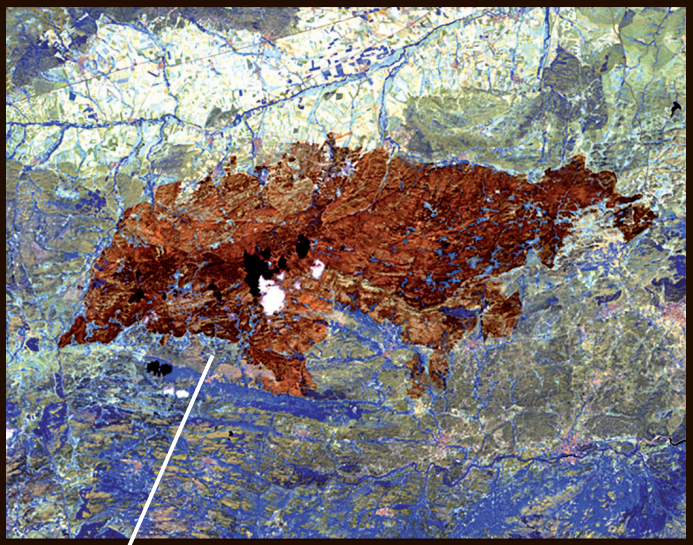
ON THE 14TH OF AUGUST 2021, A WILDFIRE STARTED ON NAVALACRUZ ÁVILA PROVINCE (SPAIN)

14TH AUGUST



FIRE STARTS

19TH AUGUST



BURNT AREA

# WILDFIRE BURNT AREA

S2 imagery can be used to follow the recovery of affected burnt areas.

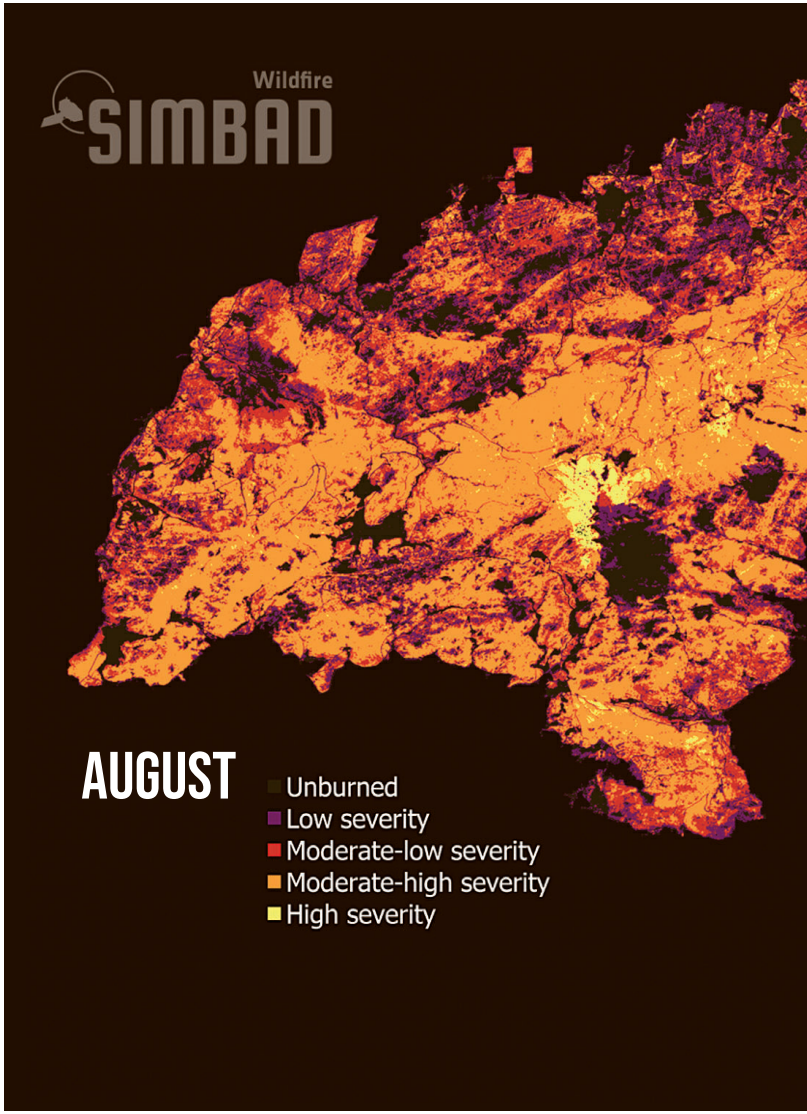
In the case of the Ávila fire, the affected area were mostly occupied by forests and seminatural areas. Although Wildfires are common in Spain, this is the largest fire that Castilla and Leon has suffered in the last 40 years and the most serious of the year in the whole country.

sentinel-2

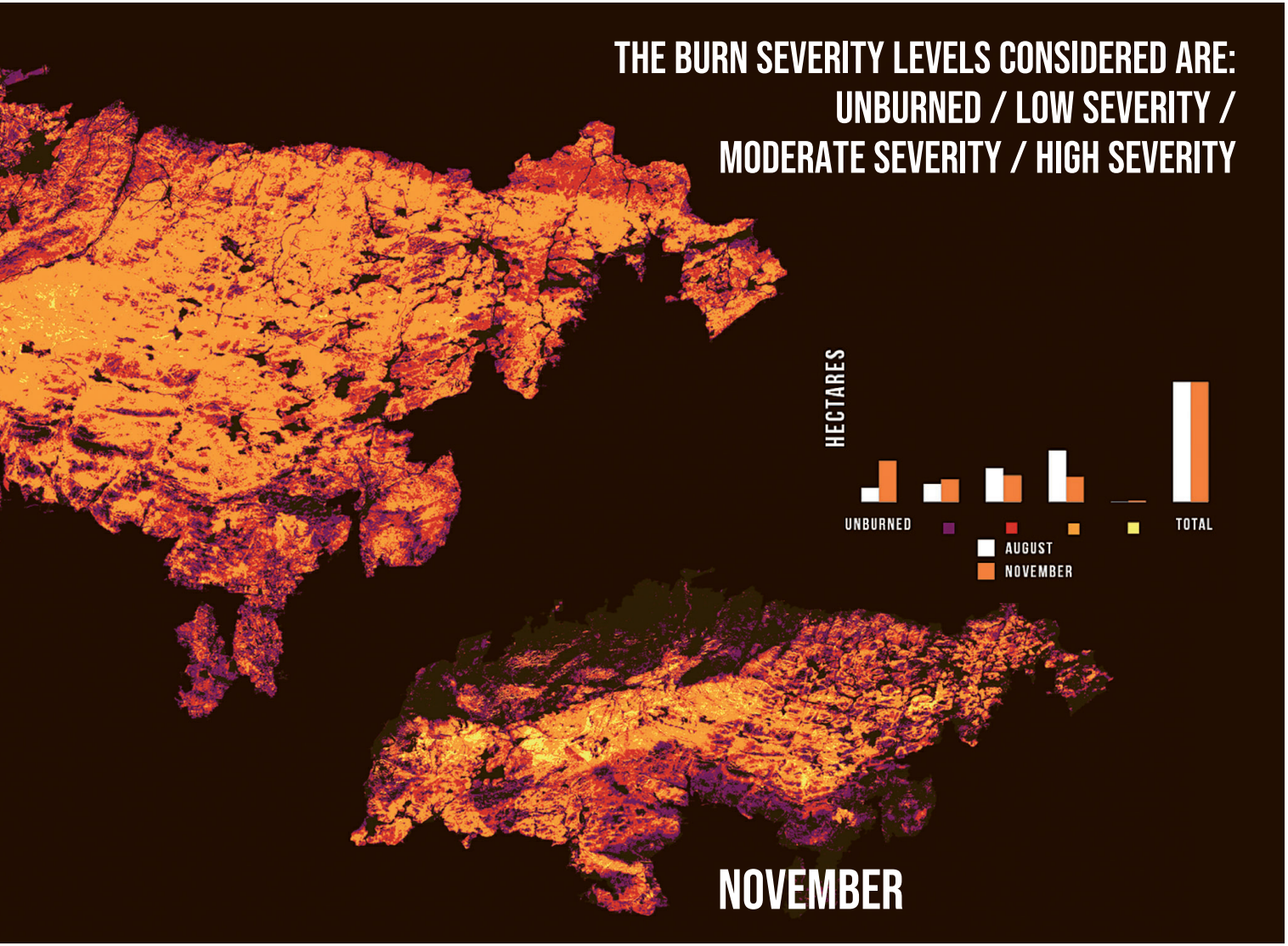
# WILDFIRE SEVERITY

After a Wildfire, it is crucial to assess the severity of the impacted area.

The burnt severity is calculated through the comparison of pre-fire and post-fire S2 imagery.The temporal analysis of the burnt severity is paramount for the identification of priority forest restoration areas and the assessment of restoration measures.

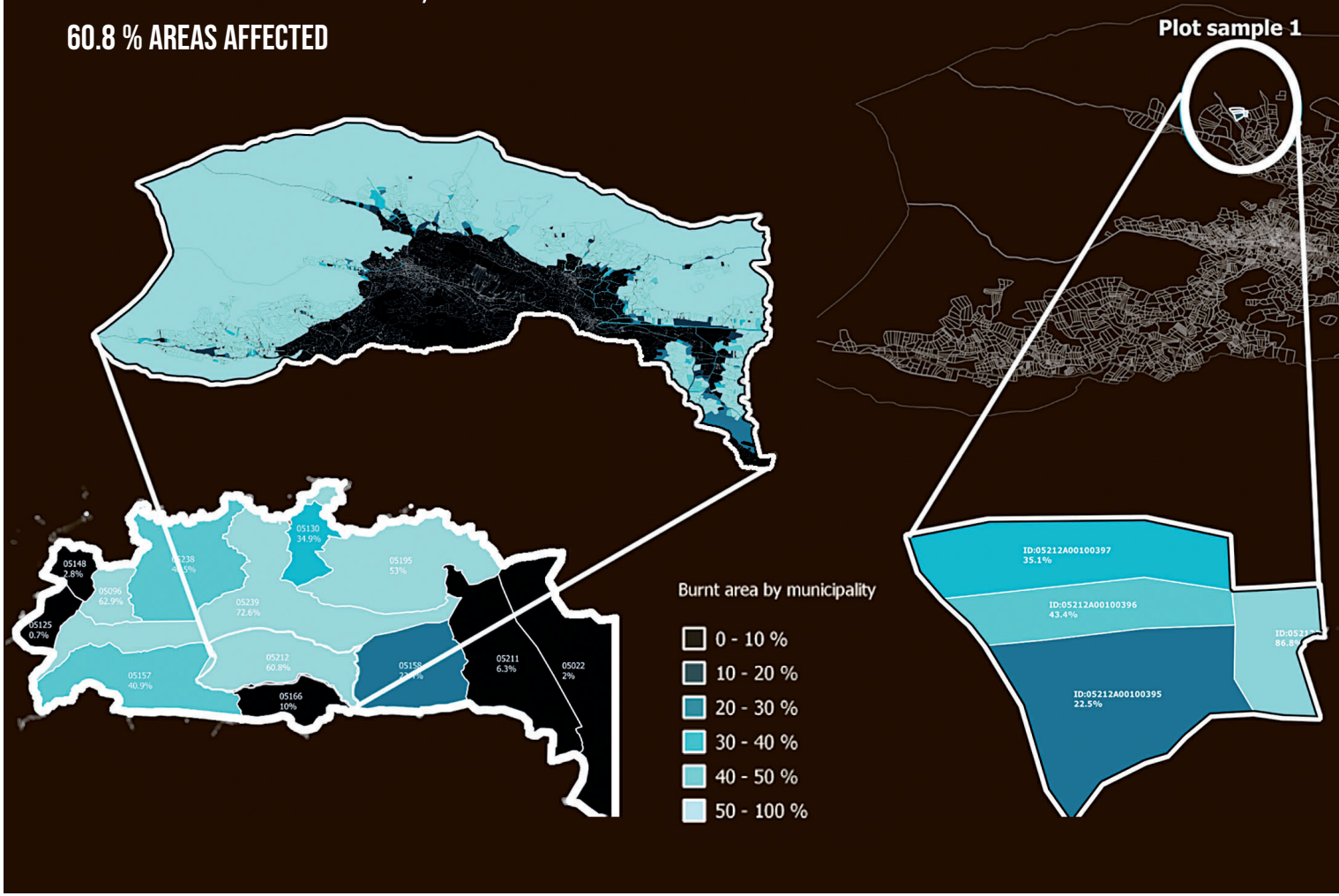



sentinel-2


THE BURN SEVERITY LEVELS CONSIDERED ARE:
UNBURNED / LOW SEVERITY /
MODERATE SEVERITY / HIGH SEVERITY
HECTARES
UNBURNED
TOTAL
AUGUST
NOVEMBER
NOVEMBER

## SAN JUAN DEL MOLINILLO, ÁVILA

### 60.8 % AREAS AFFECTED



# WILDFIRE LAND DESIGNATION

With governmental legal land divisions, subdivisions and designations, the burnt area can be estimated as a percentage for each individual plot of land.

This information can be useful for the evaluation of the economic losses caused by the Wildfire, including the estimation of economic compensation for land owners.

sentinel-2

2022

# Remote Sensing for Precision Agriculture

QUASAR
SCIENCE RESOURCES, S.L.

# PRECISION AGRICULTURE

## S1 S2

### SENTINEL-1

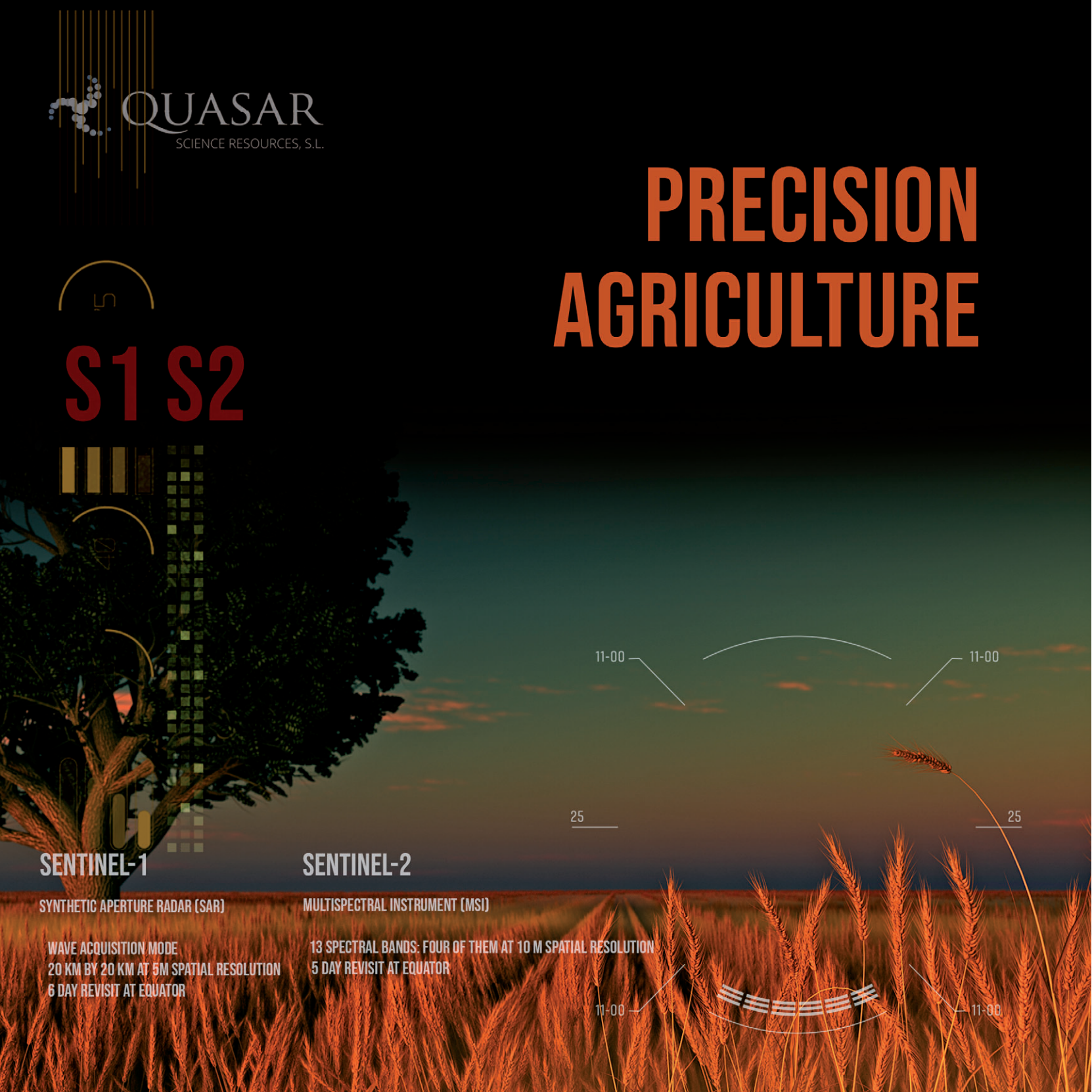
SYNTHETIC APERTURE RADAR (SAR)

WAVE ACQUISITION MODE
20 KM BY 20 KM AT 5M SPATIAL RESOLUTION
6 DAY REVISIT AT EQUATOR

### SENTINEL-2

MULTISPECTRAL INSTRUMENT (MSI)

13 SPECTRAL BANDS: FOUR OF THEM AT 10 M SPATIAL RESOLUTION
5 DAY REVISIT AT EQUATOR



# S1 S2
## PRECISION AGRICULTURE

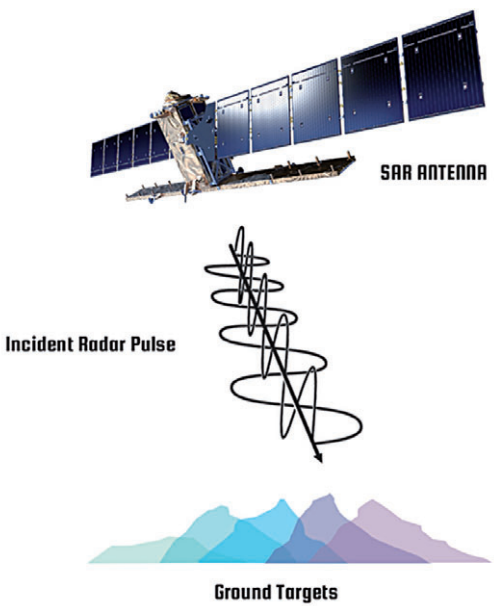
There is currently a wide range of passive and active sensors located both in situ as well as remotely, mounted on land, water, aerial or satellite platforms to monitor the conditions of the vegetation. Remote sensing from satellite platforms uses both active and passive sensors for data acquisition, capturing data from one or multiple parts of the electromagnetic spectrum.

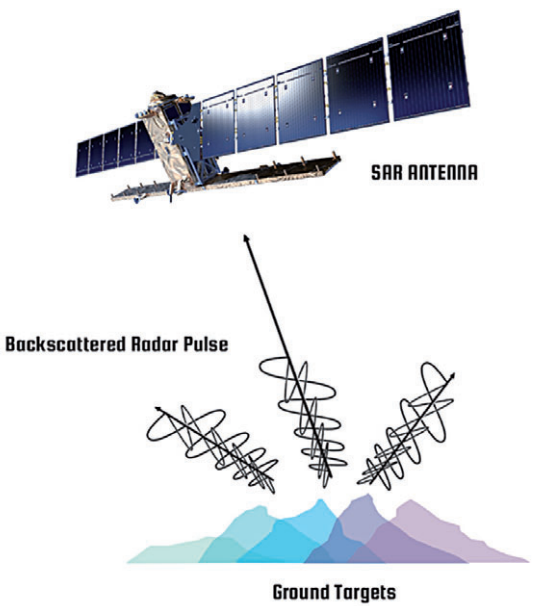
The information contained in these data sets can only be exploited using advanced image and signal processing techniques, which frequently makes its access difficult for people, businesses, and institutions.

Among the multiple applications of remote sensing, there are numerous uses for agriculture, such as crop type identification, land cover and land use mapping, monitoring change and phenology, identification of pest and disease, crop stress and droughts, yield forecasts, phenotyping, soil moisture, evapotranspiration, etc.

Sentinel-1 (S1) and Sentinel-2 (S2) provide global, regular and repeated coverage of land regions. Among the many applications of S1 Synthetic Aperture Radar (SAR) and S2 optical data, Precision Agriculture can benefit from both missions used in conjunction to maximize their output. While optical data from S2 are intuitive and related with vegetation vigor status, S1 SAR has the advantage of operating under cloud cover or lack of illumination, acquiring useful data during day and night under all weather conditions.

**Passive sensors detect radiation emitted or reflected by the observed objects, whilst active sensors emit a signal and collect the part reflected by the target objects**



## Precision Agriculture Products

- Vegetation indices (NDVI, SAVI, NDWI, DVI, ...)
- Soil moisture maps
- Crop classification maps
- Crop rotation maps
- Vegetation parameters
- Time series of indices and parameters

On request, Quasar provides user-based monitoring systems of key indicators by developing user-adapted algorithms for the detection and warning of vegetation changes. These systems, allow users to accurately assess the state of the crops and define the most appropriate actions for the mitigation of the impacts to maximize performance with the lowest environmental impact.

## Precision Agriculture Applications

The Precision Agriculture Products can be used for different applications. Some examples are:

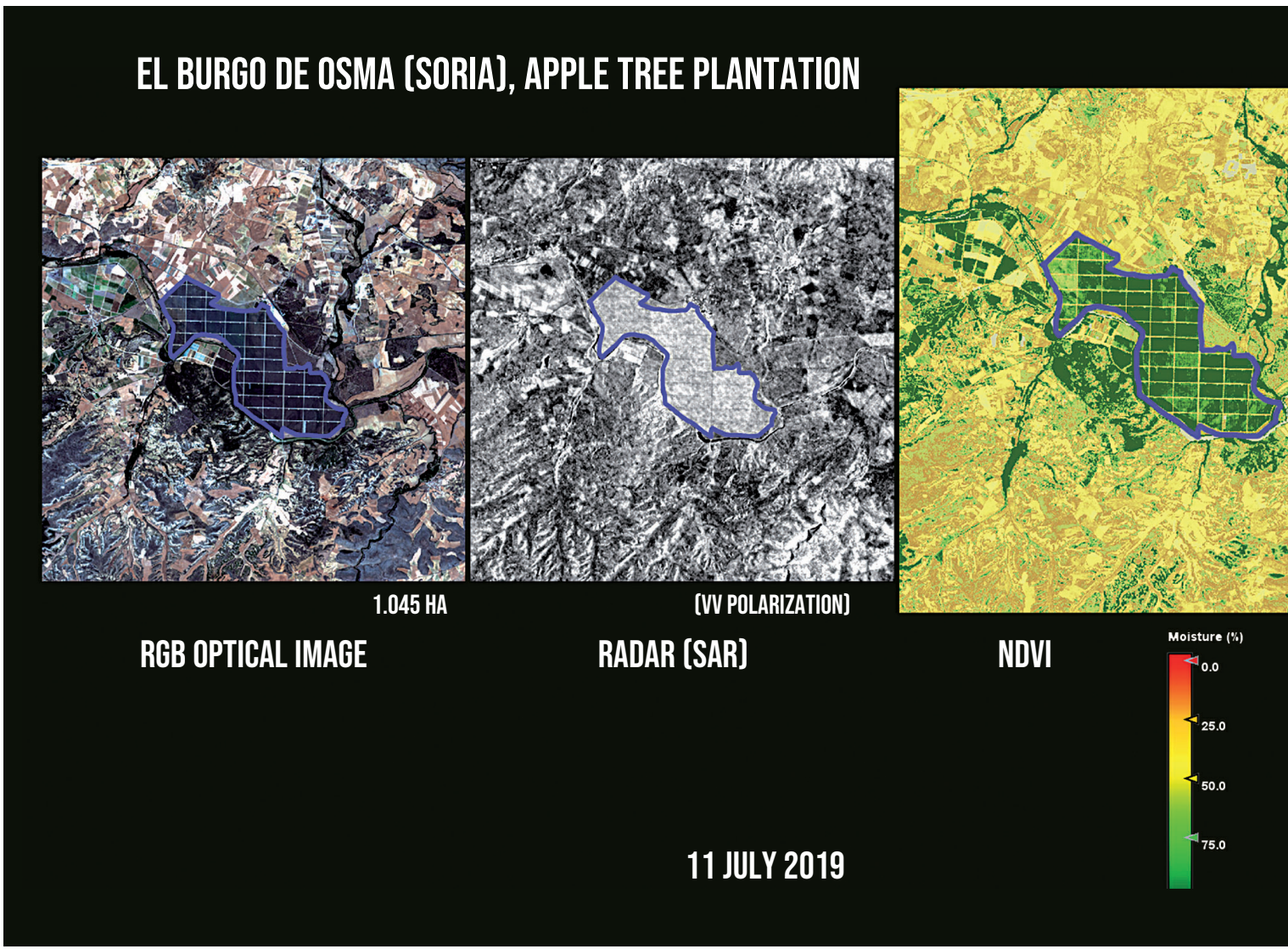
- Remote crop monitoring with high spatial detail (10 m)
- Vegetation indices, when used correctly, can provide information on the phytosanitary status of the vegetation, phenology, water stress, etc ...
- Estimations of parameters such as height, volume and biomass using bistatic interferometry techniques with data from commercial satellites
- Analysis of crop dynamics with vegetation indices using time series *
- Identification of crop rotation
- Generation of anomalies and prediction models for crop management
- Generation of operational models to correlate phenological cycle with production
- Development and application of different time series filtering, which when applied to an image can improve its quality
- Monitoring key indicators, including, change and phenology detection, pest and disease identification, crop stress and droughts, and soil moisture and evapotranspiration

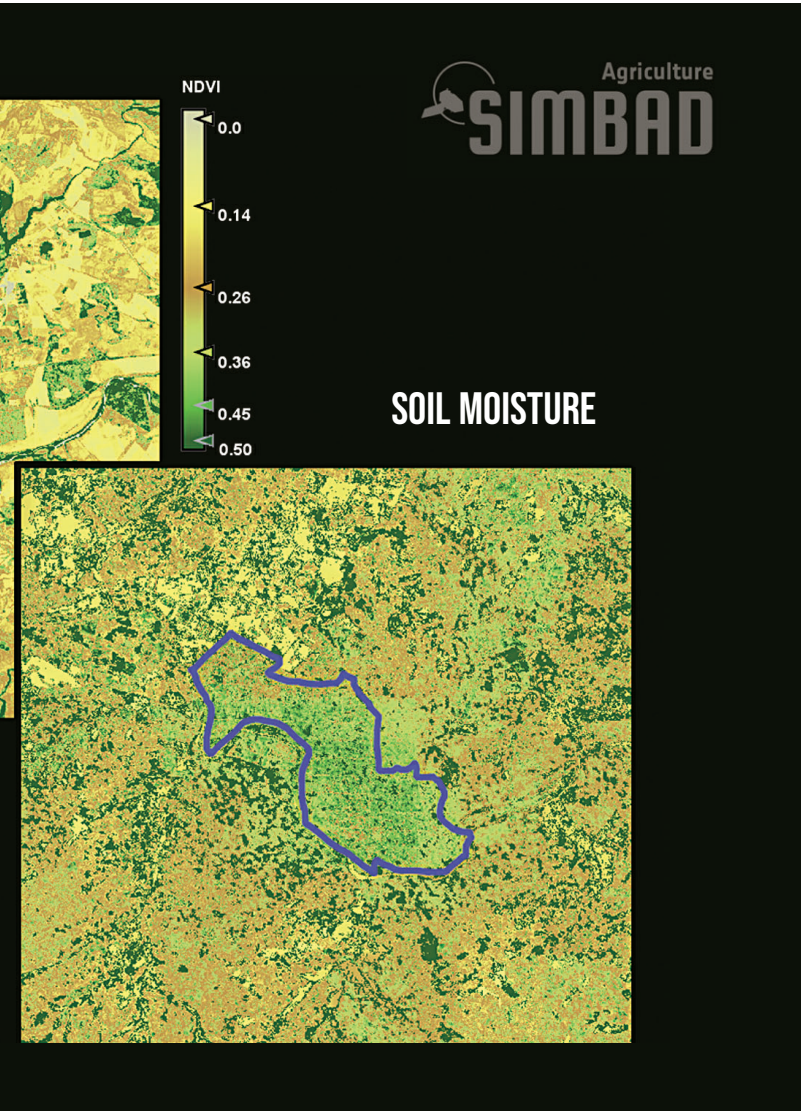
* Since 2017

## Precision Agriculture Services

- Dedicated tailor-made solutions for Sentinel-1 SAR and Sentinel-2 optical applications
- Consulting services about Sentinel-1 and Sentinel-2 data, products and applications
- Support the integration of Sentinel-1 and Sentinel-2 data into your solution
- Support the integration of auxiliary non-EO data into your EO solution
- Participation in R&D projects at national and European levels with experience leading projects and working within large collaborations

## Application Examples






# S1 & S2 FOR SOIL MOISTURE

S1 SAR and S2 imaging, can be combined to recover soil moisture for agriculture applications.

An operational system for soil moisture mapping at the high spatial resolution offered by S1 is important for agriculture applications, management and risk assessment. The approach can serve as a solution that works over bare soils, as well as soils with vegetation cover.

sentinel-1 sentinel-2

# SOIL MOISTURE MONITORING

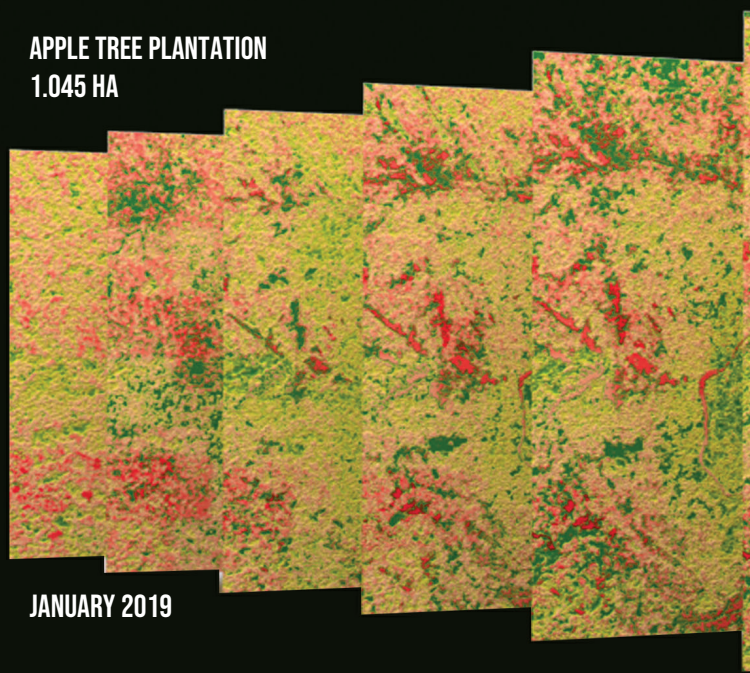
One of the most important factors in the characterization of the properties of the agricultural soil is its water content and its evolution over time.

For the same vegetation cover and structure, one can assume that changes in the radar signal are due to changes in the soil moisture.

## EL BURGO DE OSMA (SORIA)

### TOOLS AND METHODOLOGIES TO MONITOR THE EVOLUTION OF SOIL MOISTURE OVER TIME

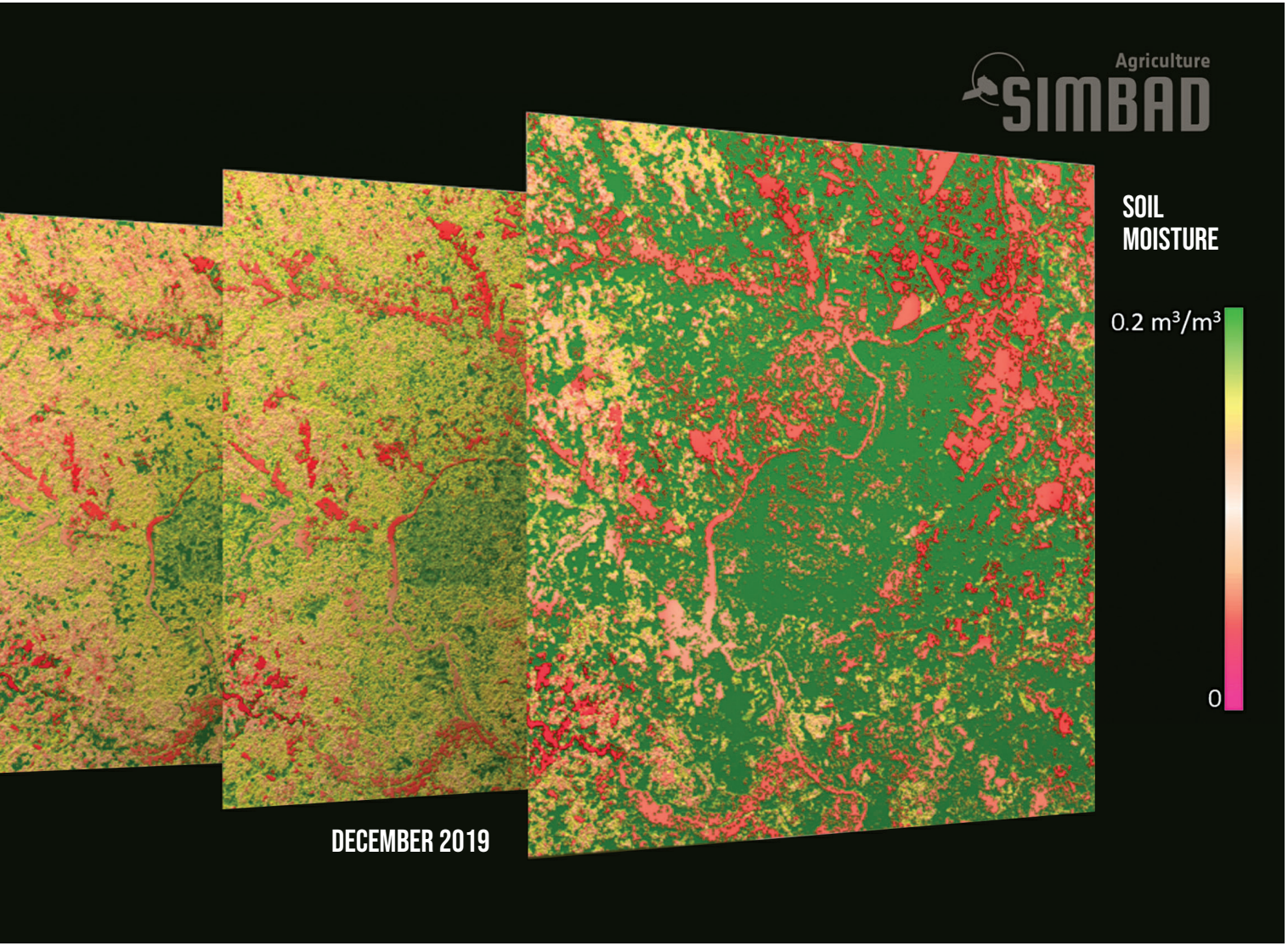
APPLE TREE PLANTATION
1.045 HA

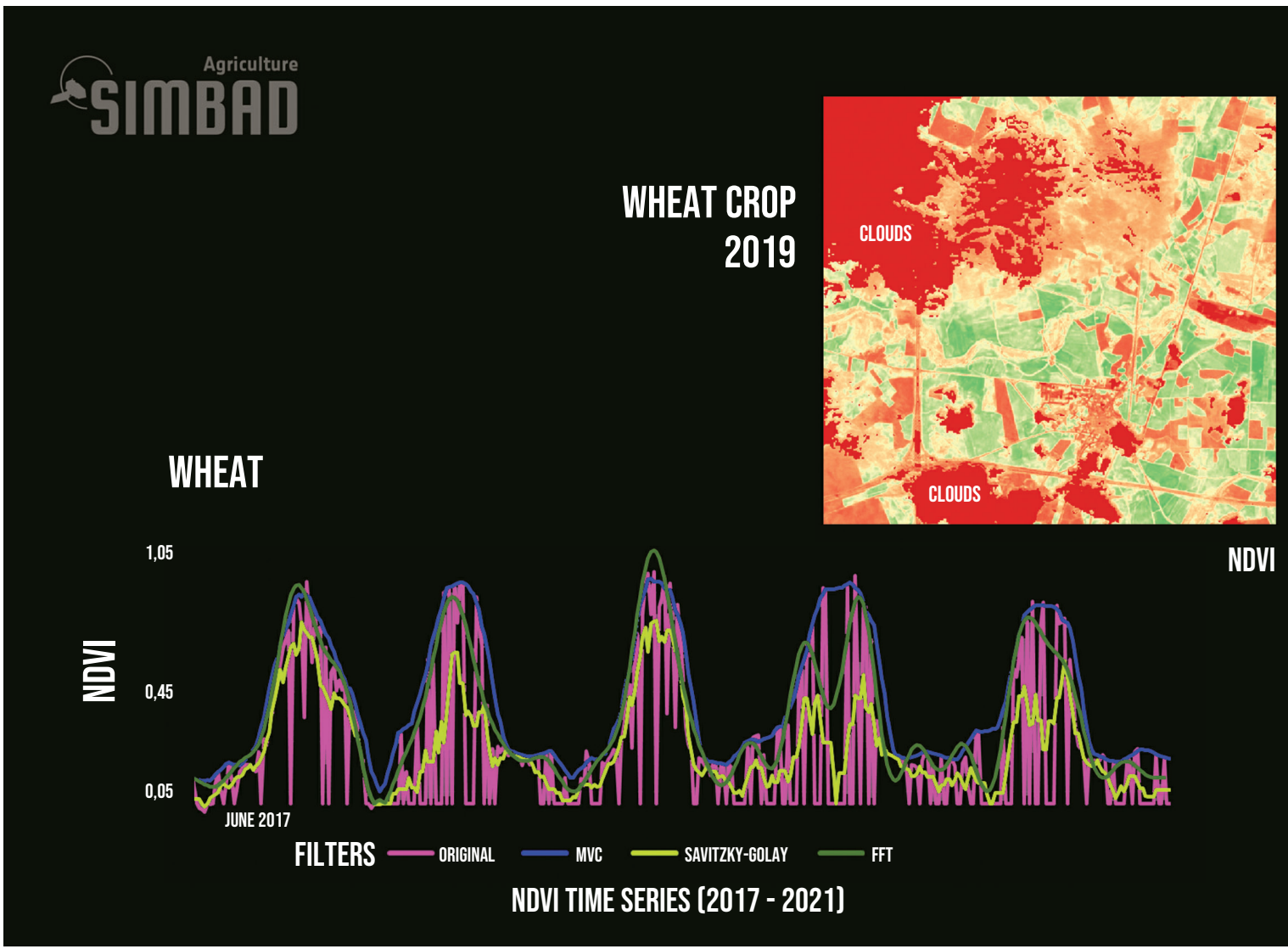


JANUARY 2019

ONE SOIL MOISTURE MAP EVERY 5-6 DAYS SINCE 2016

sentinel-1 sentinel-2


Agriculture
SIMBAD
SOIL
MOISTURE
0.2 m³/m³
0
DECEMBER 2019


Agriculture
SIMBAD
WHEAT CROP
2019
CLOUDS
CLOUDS
NDVI
WHEAT
1,05
0,45
0,05
NDVI
JUNE 2017
FILTERS
ORIGINAL
MVC
SAVITZKY-GOLAY
FFT
NDVI TIME SERIES (2017 - 2021)

NDVI AFTER FILTERING
AND CLOUD INTERPOLATION

# TIME SERIES FOR CROP EVALUATION

Analysis of crop dynamics with vegetation indexes using time series can provide important information about crop rotation.

Different filters applied to the time series can be developed and used to, for example, obtain cleaner images and improve their quality, as well as, to develop anomalies and prediction models.

sentinel-1 sentinel-2

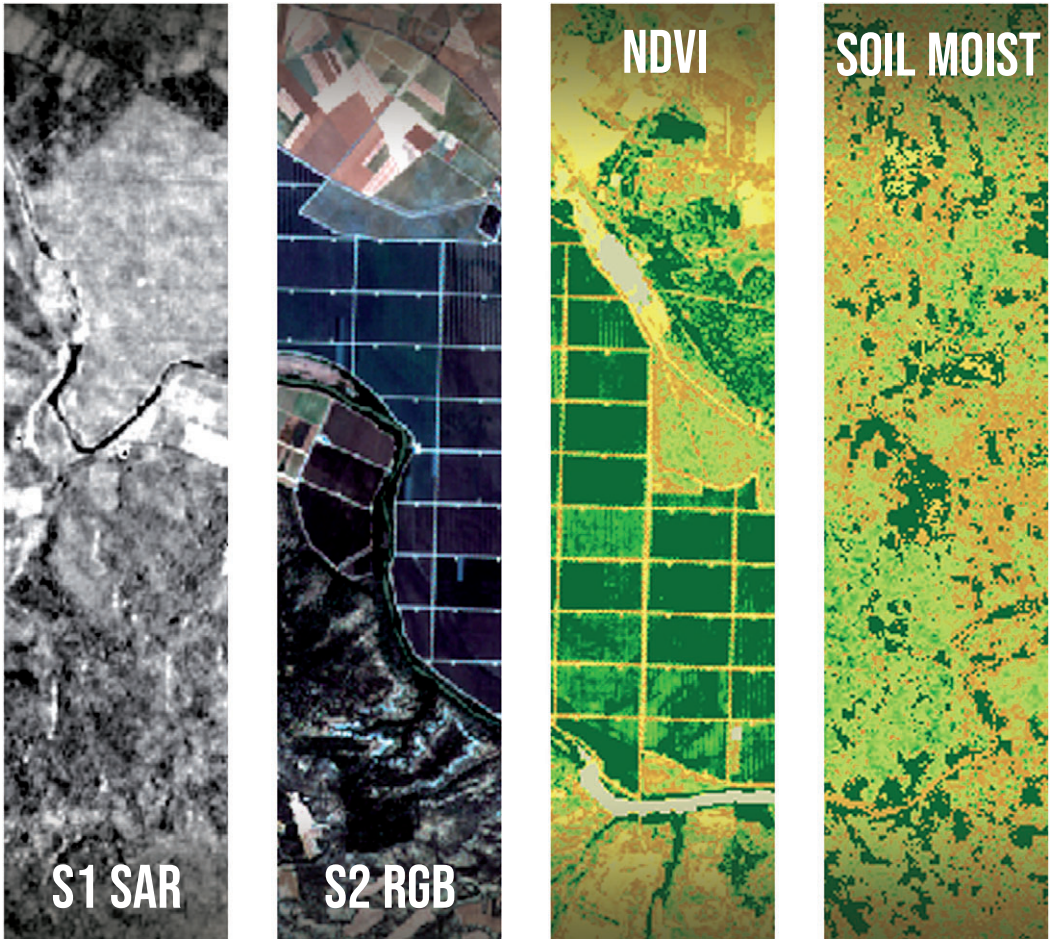
# S1 S2
## PRECISION AGRICULTURE

Sentinel-1 and Sentinel-2 routinely collect large amounts of images which are made freely available. The vast amounts of data produced by the two constellations of satellites are a great opportunity to develop systems for Precision Agriculture. To become fully operational, these processing systems must be entirely automatic with a controlled level of reliability and robustness.

Agriculture SIMBAD

**EL BURGO DE OSMA, SORIA (SPAIN)**

**APPLE TREE PLANTATION 11TH JULY 2019**



2022

QUASAR
SCIENCE RESOURCES, S.L.

# Service Description

## Quality Control and Image Delivery

The SIMBAD processed data will be assessed during the Quality Control process. A Quasar Data Scientist and Image Analyst will verify that the Sentinel images and products derived contain the customer's target application and information, that it complies to the product specifications and that it does not contain any problems that could render the product invalid. Upon request, a Quality Report will be delivered together with the Sentinel images and products.

Orders are delivered to customers via a number of services,

- Bucket Storage (Cloud storage: Google, Amazon, ...)
- Access through: API, GeoServer, SFTP
- QGIS, ArcGIS Plugin

Notification (via email) will be sent every time a new product is available for download or ready to be delivered.

Product delivery times will vary and will be agreed with the customer. Fast delivery times for customers that require near-real-time data can be arranged. Sentinel imagery is available within 24 hours of satellite passage, so this is the minimum overhead we work with. Our data processing and preparation of target products could take up to an extra 12 hours.

## Unforeseen Circumstances

Quasar personnel are committed to our customers and believe that the key to success is by working towards building a good reputation and to establish long term relationships with our customers and clients.

SIMBAD products are mainly derived from Sentinel images obtained directly from the Copernicus Open Access Hub. Quasar believes that our work and knowledge is of the highest quality, and we will work to overcome any unforeseen circumstances that could prevent us from delivering high-quality SIMBAD products to our customers. But most of all, we believe in treating our customers with respect and good faith. In the event of unforeseen circumstances, we will analyze the impact and work together with our customers to provide the best solution for mitigation.

## Orders and Requests

Quasar can be contacted at **contact_simbad@quasarsr.com** for any enquires related to SIMBAD products and applications. Include your contact details and we will contact you back to arrange a meeting to assess the feasibility of your request.

## Helpdesk

Quasar can be contacted at **helpdesk_simbad@quasarsr.com** for any enquires about purchased SIMBAD products and applications. We will contact you within 2 working days.

## Orders Cancellation and Return Policy

Quasar supports a user-friendly order cancellation policy. Based on the type of SIMBAD product, application or service, we will follow simple Cancellation Policy conditions.

If you are not satisfied with your purchase, please contact us at **helpdesk_simbad@quasarsr.com** within 30 days of receiving your products. Your satisfaction is our priority, so we will work quickly to resolve your concerns.

## Invoicing

SIMBAD users can pay for orders in a range of different ways in order to be as flexible as possible and we will work out a payment plan before any work commences. The payment plan will be custom made according to the needs of the customers and based on the product, application or service requested.

## Pricing and Revenue

Due to the nature of the products and applications developed, combined with the number of users and their needs, makes us feel that's its fairer on the users to keep an adaptable pricing system. We will discuss with potential clients, based on their needs, what is the best price scheme that will suit us both.

We also contemplate revenue through participation in R&D projects at National or European level. We have ample experience participating and managing large consortium at both levels, working together with public and private bodies.

Revenue through participation in Pilot projects is also an option we offer. This gives clients the opportunity to test the products and gives us the chance to tailor the application to the user's needs.

2022

QUASAR
SCIENCE RESOURCES, S.L.

# Company Capabilities

**Quasar Science Resources** is a team of highly qualified experts covering a wide variety of backgrounds that offers new concepts and approaches in the IT Management, Development and Services area. We provide consulting on Software and System Engineering services for Research and Development projects providing high quality tailor-made services targeted at Research Centres, Universities and Private Companies looking to expand their activity domain.

Quasar has strong expertise in scientific software development and data reduction techniques, handling and exploitation of scientific databases, archive engineering and data mining, computer systems engineering, including virtual machine infrastructure, network, data storage and backup.

## Software Engineering

Our Software Engineers have experience in the design, development, deployment and maintenance of new code, as well as the maintenance and improvement of legacy code that is already up and running. With our scientific background, we can provide software architectural solutions developed by scientist for scientists. Our expertise also includes the design and development of web applications (back-end and client layers) oriented for data processing in grid or cloud environments.

- **Software life cycle, architectural design and standards**
- **Implementation, testing and maintenance of software tools and systems**
- **Software Configuration Control techniques**
- **Scientific software engineering and requirements analysis**
- **Development of Data Processing Pipelines**
- **Development of Scientific Data Archives and interfacing with external tools and systems**
- **Development of User Interfaces, based on Web Services**
- **Development of data layers, including databases, data distribution subsystems and data repositories that allows easy and protected access to the data**
- **Development of server layers that minimise the data to be exposed into the user interfaces**

## Computer System Engineering

Our aim is to improve business efficiency and productivity by providing new IT design solutions for scientific environments, as well as to modify, enhance or adapt existing systems and integrate new features or improvements.

- **Analysis of hardware and software requirements**
- **Installation, configuration and Maintenance of application software**
- **Installation, configuration and maintenance of computer systems**
- **Deployment, configuration and maintenance of Virtual Infrastructure**
- **Configuration and maintenance of large storage infrastructure**
- **Deployment of web servers**
- **Databases installation and configuration**
- **System deployments and monitoring**
- **Installation and configuration of system monitoring tools and load balancers**
- **GRID and Cloud Computing Infrastructures**
- **Handling of system backup, disk storage and recovery procedures**
- **Implementation of system security standards and procedures**

## Data Archive Engineering

Our team of Data Archive Engineers has experience in data management, exploitation and archiving for large international research projects. Their expertise includes access, manipulation, distribution and maintenance of real-time and archive data.

- **Archive data products repositories**
- **Archive databases, including ingestion and metadata extraction systems**
- **Archive graphical user interfaces and web pages**
- **Archive data distribution systems**
- **Archive administration services**
- **Archive data products on-line visualisation and analysis services**

## Data Analysts

Our scientists have doctorates in several scientific areas and have ample experience working in international research projects and centres. We understand that scientists or R&D departments conduct research, and do not develop software or build IT infrastructure. Thus, our combined team of software, archive and system engineers together with our scientists will put together their knowledge and experience to close this gap.

- **Development and handling of Scientific Data Processing Pipelines**
- **Scientific software validation procedures**

## Specific Services for EO Activities

SIMBAD facilitates the exploitation of EO data by developing applications to address societal challenges, enabling policymakers, authorities, and environmental agencies to develop long-term strategies as well as to react efficiently to sudden critical situations. Quasar has extensive experience in dealing with data and developing applications to enhance its scientific return.

- **Provide near real-time monitoring of different land and water-based resources at a spatial resolution of 10 m over a span of time**
- **Development of region-based monitoring systems by developing specific regional algorithms**
- **Dedicated tailor-made solutions for Sentinel-1 SAR, Sentinel-2 and Sentinel-3 optical applications**
- **Dedicated tailor-made solutions for satellite and model-based applications**
- **Consulting services about Sentinel data, products and applications**
- **Support the integration of Sentinel data into your solution**
- **Support the integration of auxiliary non-EO data into your EO solution**
- **Support the integration of Copernicus Land Monitoring Service and Marine Service products into your solution**
- **Participation in R&D projects at national and European levels with experience leading projects and working within large collaborations**

## SIMBAD Technology Stack

## SIMBAD Technology Stack

**SIMBAD provides,**

- Modular system easy to maintain and/or modify.
- Configurable and scalable in terms of performance and fault tolerance.
- Services are deployed as needed either locally or in any cloud environment.

**SIMBAD is based on,**

- Docker + Kubernetes for automating the deployment, scaling, and management of containerized applications.

**SIMBAD offers,**

- Security in cloud environments.

## SIMBAD incorporates,

### DOWNLOAD

**Automatic data download and data management.**

### ADMINISTRATION

**Region configuration, process configuration and automatization, data and image storage.**

### VISUALIZATION

**Data visualization, mask processing, alerts and notifications configuration.**

### MONITORIZATION

**Alerts and notifications management.**

# Journals, Conferences, News and Events with Quasar participation

## Journals and Conferences

*A deep learning approach to identify Posidonia oceanica using Sentinel-2 satellite images: the case of the Balearic Islands* –Masuma Chowdhury et al 2022– In preparation for submission for scientific journal publication

*Environmental forcing on blue whiting year-class strength in the Porcupine bank (NE Atlantic)* –Masuma Chowdhury et al 2022– Submitted for scientific journal publication

*Automatic mapping of Posidonia oceanica meadows of the Mediterranean Sea using deep learning approach and Sentinel-2 satellite data* –Masuma Chowdhury et al 2022– Contribution to the Oceanology International 2022 event, London Excel, UK

*SIMBAD: A Scientific Exploitation Platform to Protect Earth's Ecosystems from Space* –Ignacio de la Calle et al. 2021– Contribution to the ESA Industry Space Day 2021

*A deep learning approach to identify Posidonia oceanica using Sentinel-2 satellite images: the case of the Balearic Islands* –Alejo Martínez-Sansigre et al 2021– Contribution to the WACOMA Conference 2021

*Phenological characterization of Fagus sylvatica L. in Mediterranean populations of the Spanish Central Range with Landsat OLI/ETM+ and Sentinel-2A/B* –Gómez, C. et al 2020– Spanish Journal of Remote Sensing

*Remote sensing for the Spanish forests in the 21st century: a review of advances, needs, and opportunities. Forest Systems* –Gómez, C. et al 2019– Forest Systems Journal

## SIMBAD on the News

MadBlue Newsletter -8 March 2022- https://www.madblue.es/es/2022/03/08/5-qa-madbluers-10/

APTE Magazine -30 August 2021- https://www.apte.org/simbad-analisis-seguimiento-humedad-suelo-datos-radar-opticos-satelites-sentinel

APTE Magazine -29 September 2020- https://www.apte.org/quasar-science-resources-wooboat-unen-fuerzas-proporcionar-cartografia-interactiva-praderas-posidoni

El Mundo National Newspaper -27 February 2020- https://www.guiadeprensa.com/suplementos/tecnologia-2020/quasar/

Madri+d Newsletter -1 December 2019- https://www.madrimasd.org/notiweb/analisis/cop25_analisis6

La Vanguardia National Newspaper -13 October 2019- https://www.lavanguardia.com/vida/20191013/47944708022/empresa-mapeara-praderas-submarinas-de-posidonia-con-satelites-de-copernico.html

El Confidencial National Newspaper -13 October 2019- https://www.elconfidencial.com/ultima-hora-en-vivo/2019-10-13/empresa-mapeara-praderas-submarinas-de-posidonia-con-satelites-de-copernico_2632955/

La Razón National Newspaper -22 September 2019- https://www.larazon.es/damesuplementos/Innovadores/2019-09-22_INN/index.html

## Promoting Young Researchers at SIMBAD

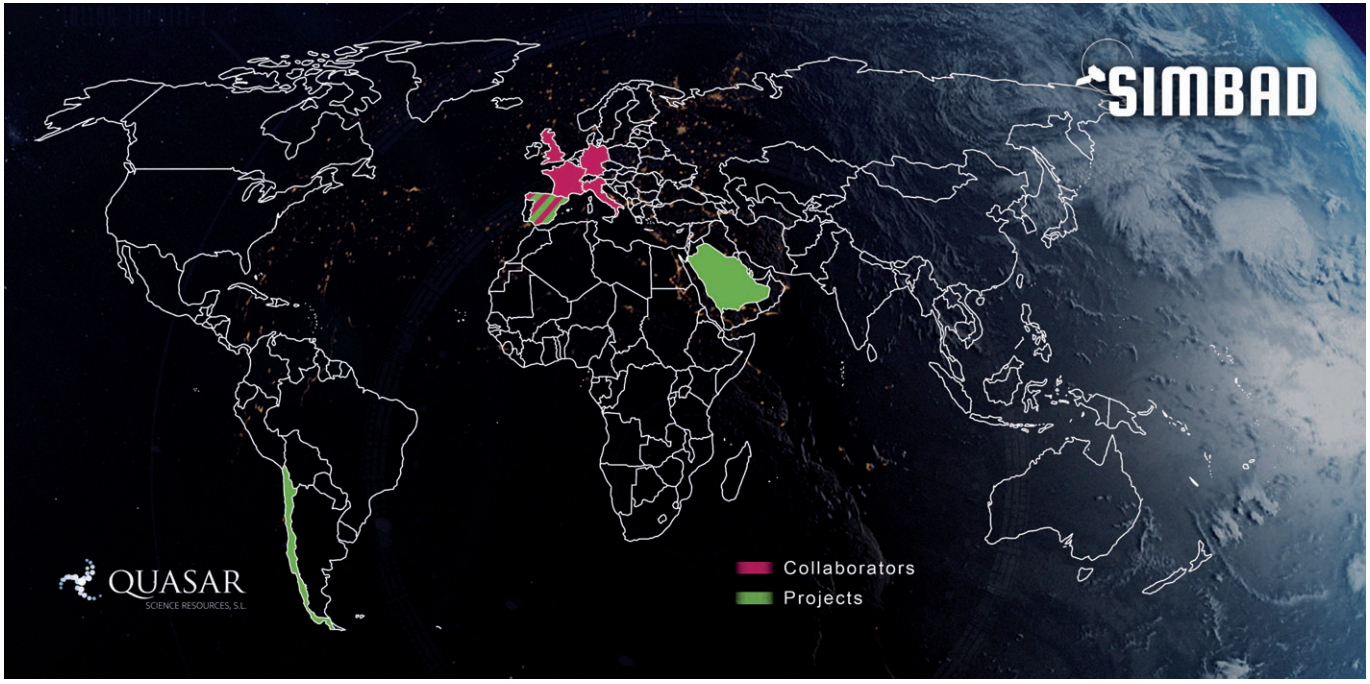
***Remote sensing time series and prediction dynamical models for the evaluation of agricultural systems.***

Industrial Doctorate Programme of the Comunidad de Madrid (IND2020/AMB-17747) in collaboration with the Universidad Politécnica de Madrid.

***Development of algorithms to characterize the quality of coastal waters using Sentinel data.***

Industrial doctorate programme from the Ministerio de Ciencia e Innovación Español (DIN2020-010979/AEI/10.13039/501100011033) in collaboration with Cádiz University.

## Projects by Geographical Representation



## SIMBAD *at a Glance*

**SIMBAD takes the EO data exploitation a step further by adding layers over existing tools as well as computer power and resources otherwise unavailable to the end user.**

**SIMBAD provides an innovative hardware and software infrastructure for the development, implementation and operation of EO scientific algorithms across different applications.**

**SIMBAD implements a rapid and convenient data processing platform and data access by hiding from the user the complexity of the system**

**SIMBAD encompasses worldwide coverage across a span of several years**

**SIMBAD takes pride on its excellent level of accumulated knowledge and user support**

**SIMBAD offers consultancy services and its participation in projects at national and European levels by providing different kind of support, including leading projects**

## SIMBAD Contact Information

**contact_simbad@quasarsr.com**

for any enquires related to SIMBAD products and applications

**helpdesk_simbad@quasarsr.com**

for any enquires about purchased SIMBAD products and applications

**https://quasarsr.com**

**https://www.instagram.com/quasar_sr**

**https://twitter.com/quasar_sr**

**https://facebook.com/quasarsr**

**https://es.linkedin.com/company/quasar-science-resources**

**+34 918 197 120**

**Edificio Ceudas. Ctra. de La Coruña. km 22,3**
**28232 Las Rozas de Madrid. Madrid -Spain-**

QUASAR
SCIENCE RESOURCES, S.L.

# SATELLITE IMAGERY
# PRODUCTS AND APPLICATIONS CATALOGUE 2022


https://quasarsr.com
https://www.instagram.com/quasar_sr
https://twitter.com/quasar_sr
https://facebook.com/quasarsr
https://es.linkedin.com/company/quasar-science-resources

contact@quasarsr.com
+34 918 197 120
Edificio Ceudas. Ctra. de La Coruña. km 22,3
28232 Las Rozas de Madrid. Madrid -Spain-


*Enhance your Research*