

ITU International Satellite Symposium 2017
Bariloche, Argentina 29-31 May



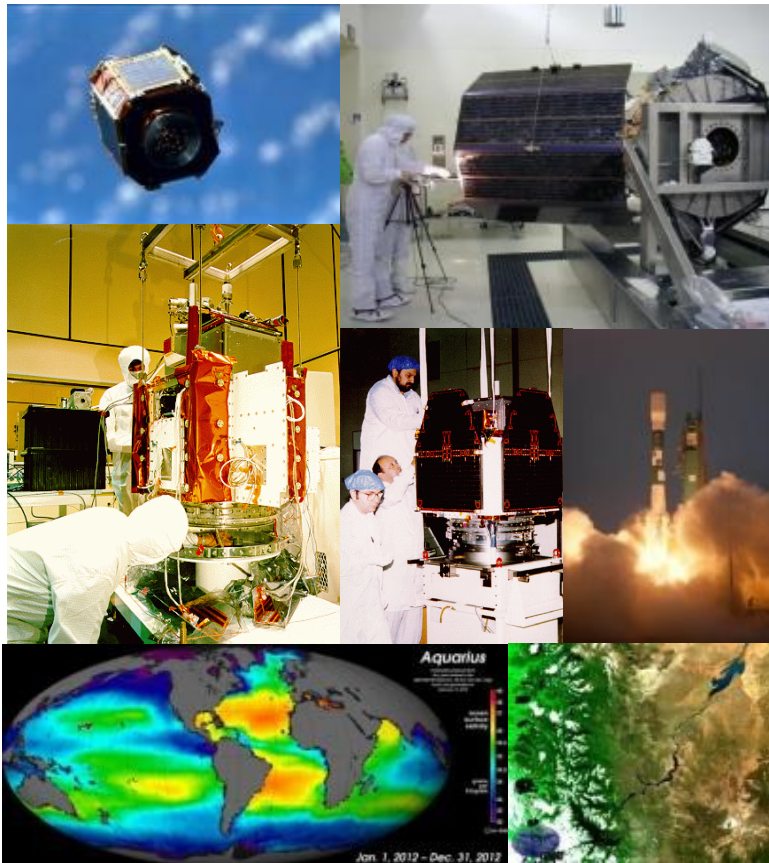
INVAP Next Generation Earth Observation LEO Satellites

Earth Observation Satellites:

SAC Program

Cooperation agreement between CONAE and NASA since 1991.

4 LEO satellites (SAC-A, SAC-B, SAC-C, SAC-D),
carrying Payload Instruments for Scientific and Earth Observation Applications.



INVAP participation in the Program:

- Mission design
- Project Management
- Systems Engineering
- Platform Design & Manufacturing
- Payload Design & Manufacturing
- Satellite Integration & Test
- Launch Base Operations
- Launch & Early Orbits Operations
- Platform & Payload Commissioning

SAC-D (2011)



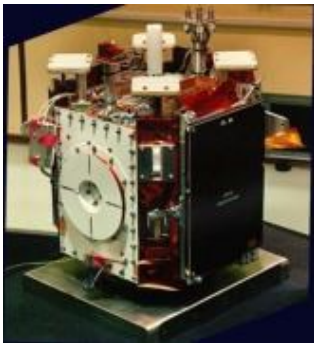
Highlight	NASA's decision to use a platform designed, manufactured and integrated entirely by INVAP, for the Aquarius instrument, is a clear sign of trust in INVAP's capabilities
Objective	Provide monthly global maps of the sea water surface salinity, to understand the ocean processes and climate change.
Mass	1350Kg
Payload	Main instrument: Aquarius. Other instruments including: Atmospheric Sounder (Italy), Debris and Radiation mapper (France), High Sensitivity camera, NIR camera and MW Radiometer (Argentina)

SAC-C (2000)



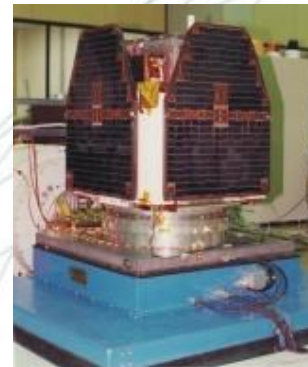
Highlight	SAC-C spacecraft became part of a "morning constellation", composed by Terra, Landsat-7, SAC-C and the EO-1.
Objective	Study the structure and dynamics of the atmosphere and ionosphere, and earth's magnetic field
Mass	485Kg
Payload	3 Electro-Optical cameras (Argentina) and 4 instruments from: USA, Denmark, Italy, France

SAC-A (1998)



Highlight	Designed, manufactured, integrated and tested in 10 months
Objective	Technology Demonstration
Mass	68Kg
Payload	Electro-Optical camera

SAC-B (1996)



Highlight	Gave birth to a new branch of technological development and engineering capabilities in the Argentina
Objective	Study solar physics and astrophysics through the examination of solar flares, gamma ray bursts and diffuse cosmic X-ray
Mass	191Kg
Payload	4 Scientific Instruments: 2 USA, 1 Italy and 1 Argentina

SAOCOM 1 A/B POLARIMETRIC L-BAND SAR

(CURRENTLY STATUS: SYSTEM AIT)

- The SAOCOM mission developed for CONAE includes **2 satellites** weighting 3 tons each, both carried out simultaneously, to be launched 1 year apart
- Mission Objective: **Natural Disasters & Emergency Management, Soil Moisture Measurement** by means of the Polarimetric L-Band Synthetic Aperture Radar (SAR)
- The two SAOCOM satellites will form part of the **joint Italian-Argentine SIASGE constellation** together with 4 Italian satellites carrying X-band SARs

SAR general characteristics:

- L-Band (1,275 GHz)
- Sun-Synchronous Orbit
- 620 km altitude
- 10 to 100 m resolution
- 30 to 350 km swath



OCEAN COLOR SATELLITES: SABIA-MAR

(CURRENT STATUS: CDR BY THE END OF 2017)

The SABIA-MAR satellites consist of 2 Brazilian (AEB) - Argentine (CONAE) LEO satellites flying in constellation.

INVAP is CONAE Prime Contractor for the satellites development including platform, electro-optical payload and system level AIT.

SABIA-MAR will be launched in 2021.

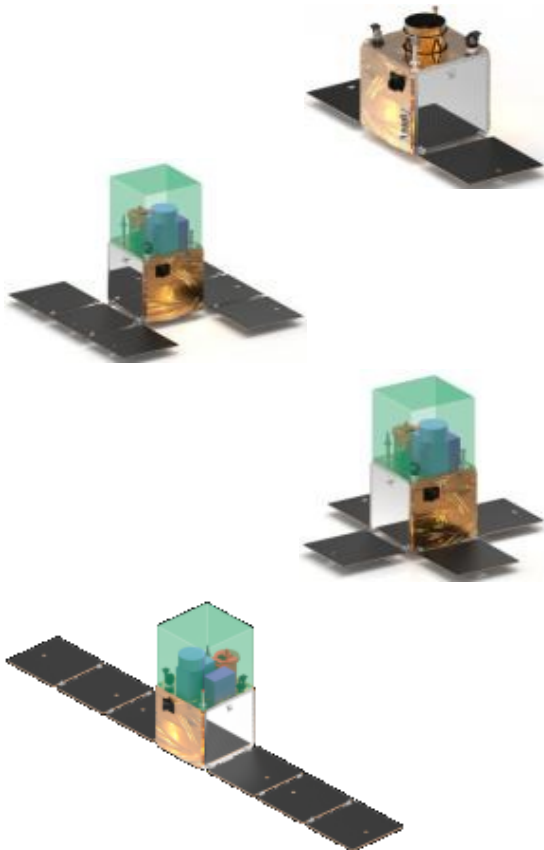


Objectives:

- Monitor the ocean surface, coastal regions and internal waters: in low, medium and high resolutions
- Collect data and provide information related to water and food production, through high spectrum, geometric and temporal resolution images

SMALL MULTI-MISSION SATELLITES

- The Multi-Mission Platform is based on a Modular and Scalable Architecture able to accommodate different LEO missions and applications:
 - **Electro-Optical Sensors:** High-Resolution PAN+MS, Hyper-spectral, High-Sensitivity and Infrared
 - **Microwave Active Sensors:** X-Band Synthetic Aperture Radar (SAR)



PARAMETERS RANGE	
Satellite Launch Mass	200 kg to 700 kg
Payload Mass	Up to 400 kg
Payload Power (modular solar panels)	Up to 500 W
Payload Volume Size	1m x 1m x 1m
Redundancy	Single String to Fully Redundant
Pointing Accuracy	< 200m @ 700km
Data Downlink	500 Mbps up to 2 Gbps
Stabilization	3-axis
Nominal Life	> 7 years
Launch Vehicle Compatibility	Falcon 9 / Vega / PSLV

SMALL MULTI-MISSION SATELLITES



X-BAND SYNTHETIC APERTURE RADAR



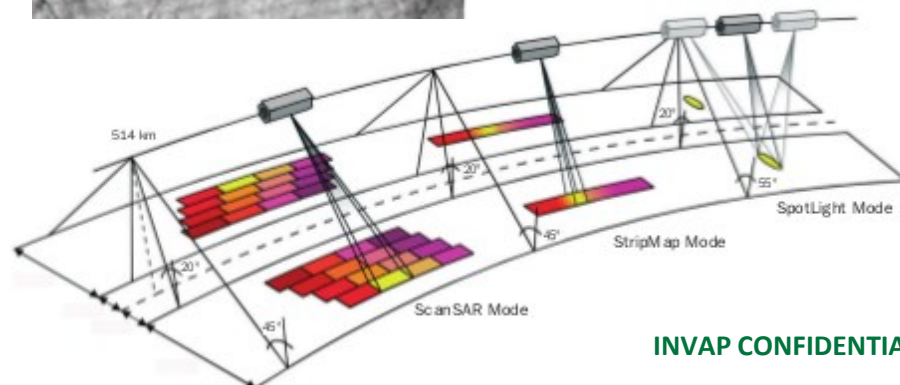
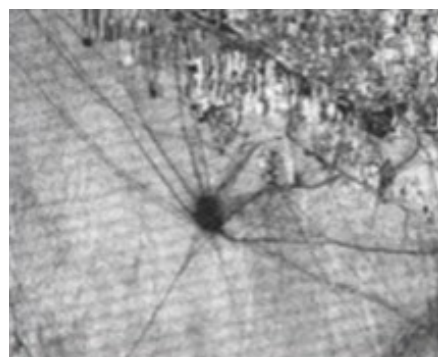
PRODUCTS & USES

- High Resolution weather independent operation
- Vessel Detection and Classification
- Border surveillance
- Precision agriculture
- Subsidence mapping (Interferometry)
- Digital Elevation Model (DEM) generation



2.5m x 0.7m antenna performance:

Mode	Swath (km)	Across Track Resolution (m) @ 20°
Stripmap	30	5
Spotlight	13	3.6
Scansar	300	20
Scansar	180	10

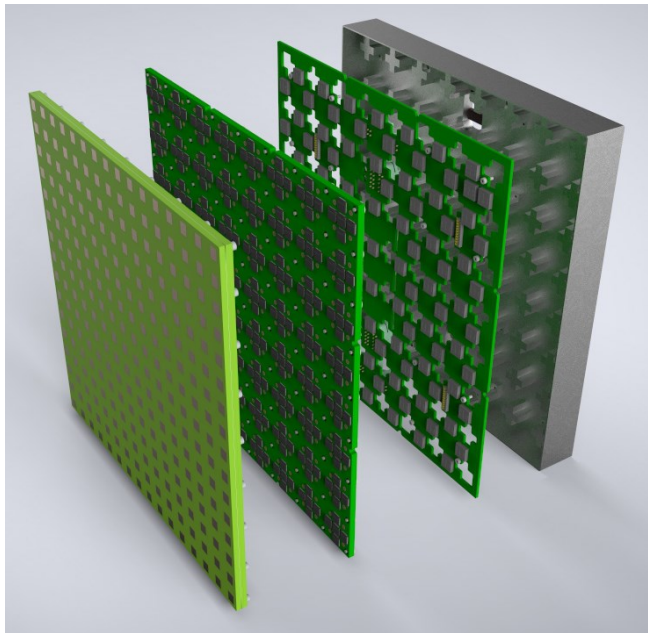


X-BAND SYNTHETIC APERTURE RADAR



CAPABILITIES

- Modular Multi-mission architecture meets varying mission requirements
- Multimode SAR instrument (Stripmap / Spotlight / ScanSAR)
- High geometric and radiometric resolution
- Single/dual polarization
- Repeat pass interferometry
- Along track interferometry

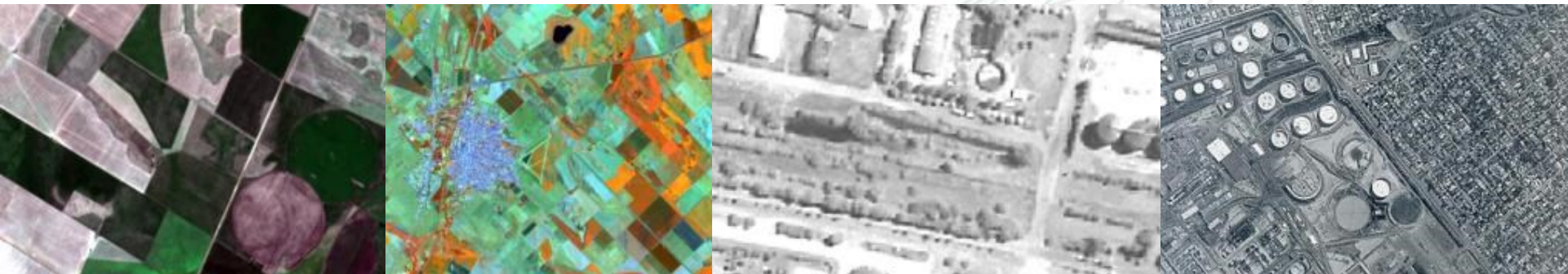


T/R MODULE TILE

- Antenna building block
- Azimuth/Elevation pointing
- Built-in element level test
- Distributed design:
 - Robust to multiple element failure

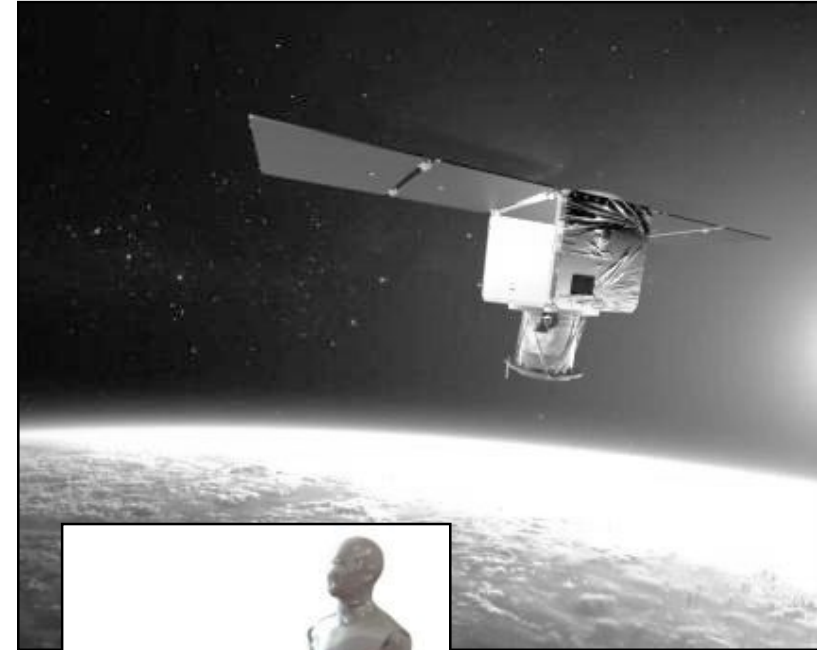
HIGH-RESOLUTION PANCHROMATIC & MULTISPECTRAL IMAGER APPLICATIONS / PRODUCTS

- Big Infrastructure mapping, public work, urban growth monitoring
- Surveillance and security
- Precision agriculture (effective use of water, fertilizers, herbicides and pesticides)
- Mining industry impact evaluation and mitigation
- Environment impact evaluation and change detection
- Monitoring of erosion phenomena, deforestation, acid rain, toxic spills, oil spills



IMAGER CHARACTERISTICS

- NIIRS > 4 (Criteria - Rating)
- Compact design for small and micro-sats
- Spectral Bands:
 - B1: 450-520 nm
 - B2: 520-590 nm
 - B3: 630-690 nm
 - B4: 770-890 nm
 - PAN: 450-900 nm
- Ground Sampling Distance:
 - 1m panchromatic
 - 4m multispectral
- 12 Km Swath
- 12 bits Radiometric resolution
- On board image processing
- 50 kg mass
- 30 W power
- 500 mm dia. x 1 m height envelope



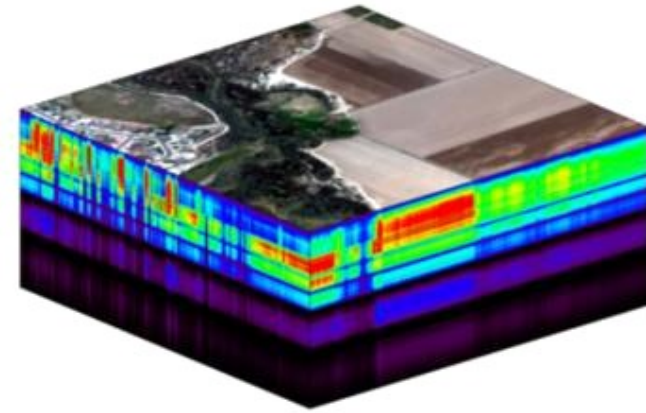
HYPER-SPECTRAL SENSOR

APPLICATIONS AND PRODUCTS

INVAP

HYPERSPECTRAL IMAGING (Data Cube)

- High resolution spectral signatures
- A family of instruments for broad-band applications
- Selected applications in one instrument

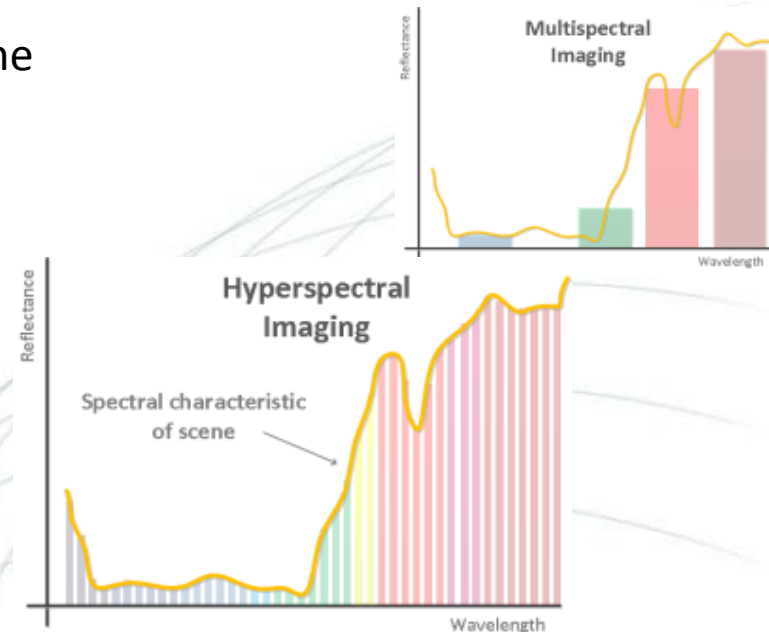


MOTIVATIONS

- Get a higher level of spectral details to “see the unseen”
- Make agriculture, forestry and fisheries more productive and sustainable (FAO)

APPLICATIONS AREAS

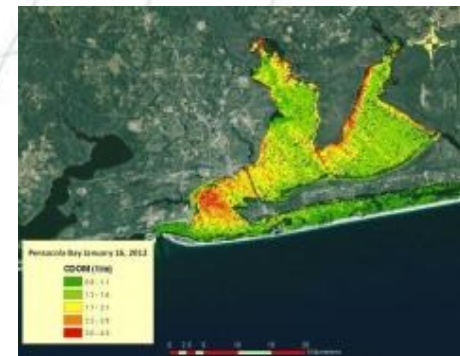
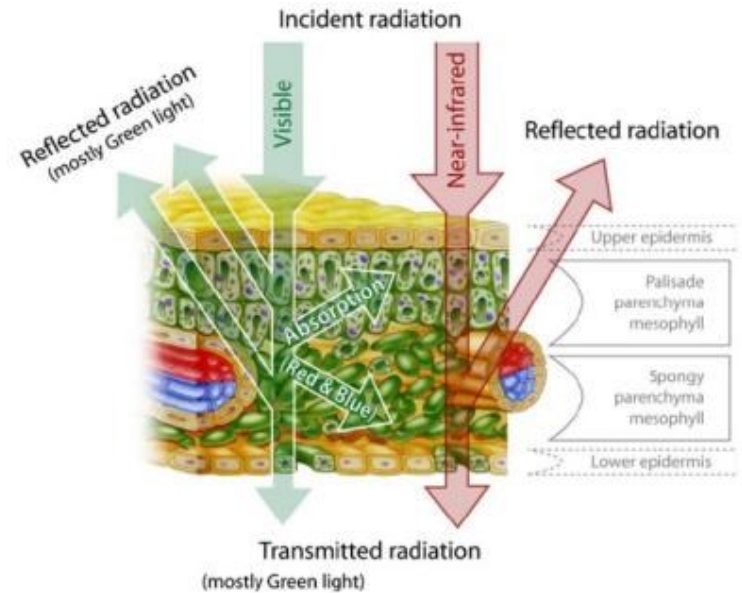
- Agriculture
- Forestry
- Water
- Oil & Gas
- Mineralogy & mining



APPLICATIONS & PRODUCTS

RENEWABLE RESOURCES

- Agriculture and environmental management
 - Crop classification
 - Crop health and stress estimation
 - Yield prediction
 - Chemical and mineral mapping, contaminant mapping
- Forestry
 - Species identification and inventory
 - Vegetation stress
- Water
 - Clear Water Sediment monitoring
 - Turbidity and aquatic vegetation monitoring
 - Chlorophyll concentration to estimate algae bloom



USER NEEDS DISCUSSION - MARKET OPPORTUNITIES

SPECTRAL BANDS

- Between 200 and 3000 bands over the entire spectral region VNIR-TIR
- Agriculture, water ecosystems, land use and vegetation content with 200-300 bands
- Geological, atmospheric and specific vegetation applications will need more than 300
- Atmospheric application requirements depend on the observation target and purpose

SPECTRAL RESOLUTION

- VNIR 0.05-30nm
- SWIR 0.2-40nm
- MIR-TIR 4-400nm

High spectral resolution in geology applications is significantly different to the other applications, especially in the MIR/TIR waveband.

SPATIAL RESOLUTION

Between 4m and 30m

SIGNAL TO NOISE RATIO

Wide range: between 400 and 1500 depending on the application



INSTRUMENT CHARACTERISTICS

RENEWABLE RESOURCES APPLICATIONS

- 20 m Ground sampling distance
- 40 km Swath, 300 km Accessible area
- 470-900nm (VNIR) Spectral Range
- 150 Spectral Bands
- 2,8nm Spectral Resolution
- Better than 10nm FWHM Bandwidth per band
- 10 bits Radiometric Resolution
- 60 dB Dynamic Range
- Area detector
- 1Gbps Raw Data Rate
- Refractive F#2 Optical Architecture
- 1 kg mass
- 2 W power
- 100 mm dia. x 100 mm height (Optical Head) envelope

END-USER SERVICES AND APPLICATIONS USING SPACE BASED INFORMATION

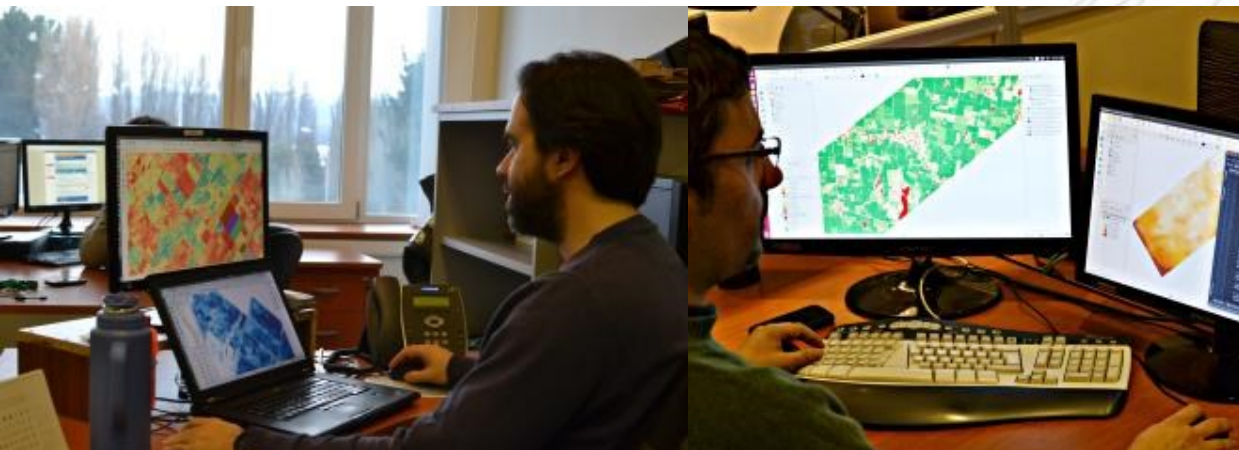
FRONTEC is a company fully owned by INVAP created in 2016 to supply services to the end-user based on satellite images processing and applications.

A technology platform which combines new developments in the **aerospace industry**, **information technologies** and **agronomy sciences** offers innovative and sustainable solutions for the **food production industries**.


This service allows the producer to increase efficiency and reduce costs per ton produced.

Services:

- **Precision agriculture**: including prescription of nutrients by crop and field
- Economic analysis of the **investments**
- Online monitoring which will generate **alerts for crop stresses**
- **Satellite image processing service**



Thank you for your attention
Any questions?

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NIIRS > 4 CLASSIFICATION CRITERIA

DETECTION AND IDENTIFICATION CAPABILITY

AGRICULTURAL CRITERIA

- Detect mechanized grain harvesting operations
- Detect active plowing of fields
- Identify small water sources in range land areas

URBAN AND TRANSPORTATION CRITERIA

- Distinguish between individual railcars in a train
- Detect an automobile
- Detect towers associated with power lines

MINING AND OTHER CRITERIA

- Distinguish between operational and abandoned quarries
- Identify cable logging operations
- Detect jeep trails in scrub brush