"Mide lo que es medible, y haz medible lo que no lo sea"

Galileo Galilei

02/04/2016

GALILEO GEOSYSTEMS

1ª reunion del Grupo RPA de la AET

Sensores comerciales de adquisición de imagen

Javier Sanchis Muñoz

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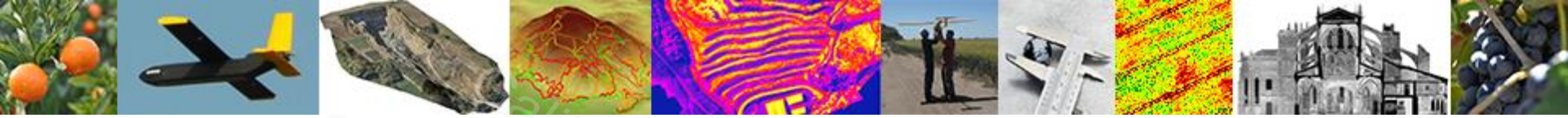


¿Quiénes somos?

Erik de Badts – Aplicaciones medioambientales.

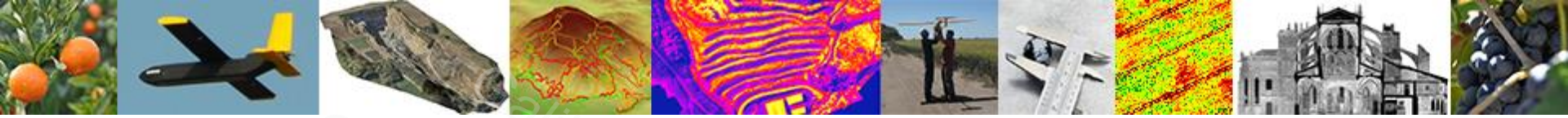
Juan Barba Polo – Aplicaciones geomáticas.

Bert Rijk – Aplicaciones para AP.

Ramiro Saiz – Aplicaciones RPAS.

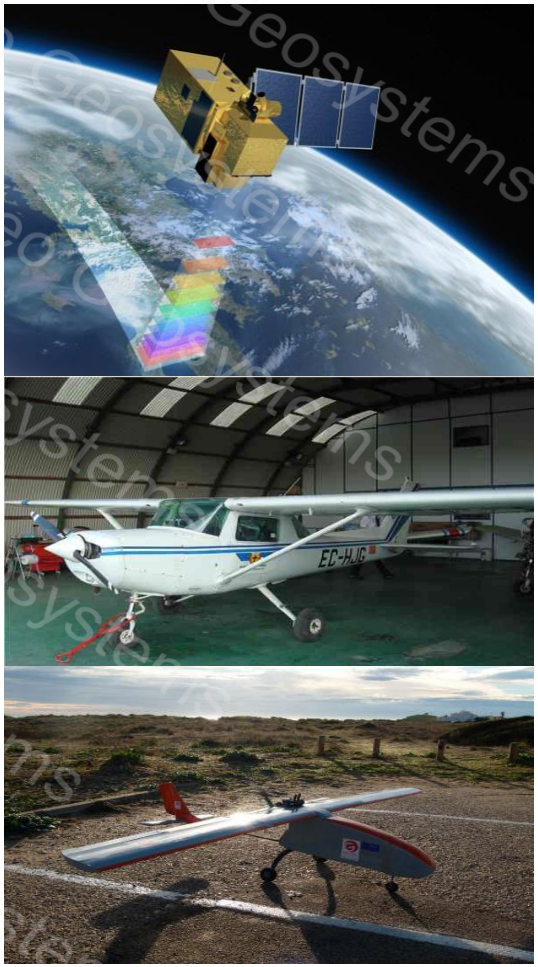
Javier Sanchis Muñoz – Aplicaciones de TD y RPAS.

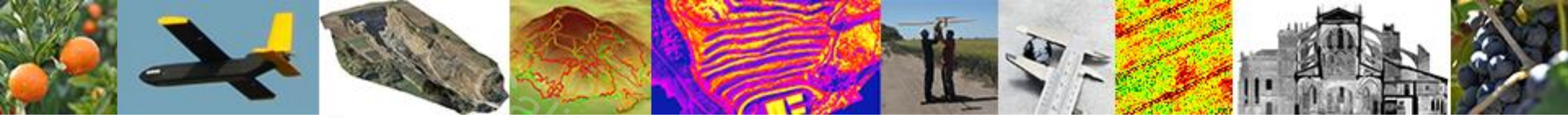
Philippe Serruys – Aplicaciones de SIG y TD.



¿Qué hacemos?

- Agricultura de precision.
- Gestión forestal.
- Medio ambiente. Ecología.
- Ingeniería civil.
- Minería.
- Ordenación del territorio.
- Arqueología. Patrimonio 3D.
- Inspecciones aéreas.

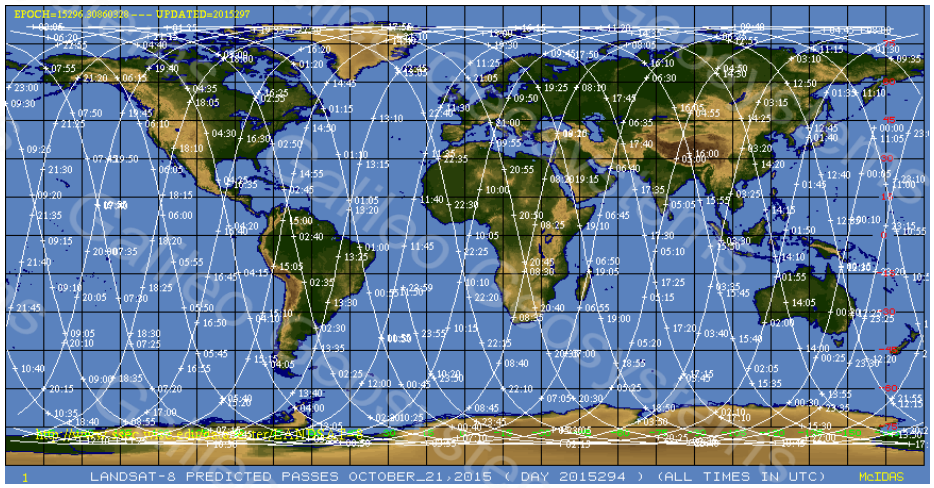


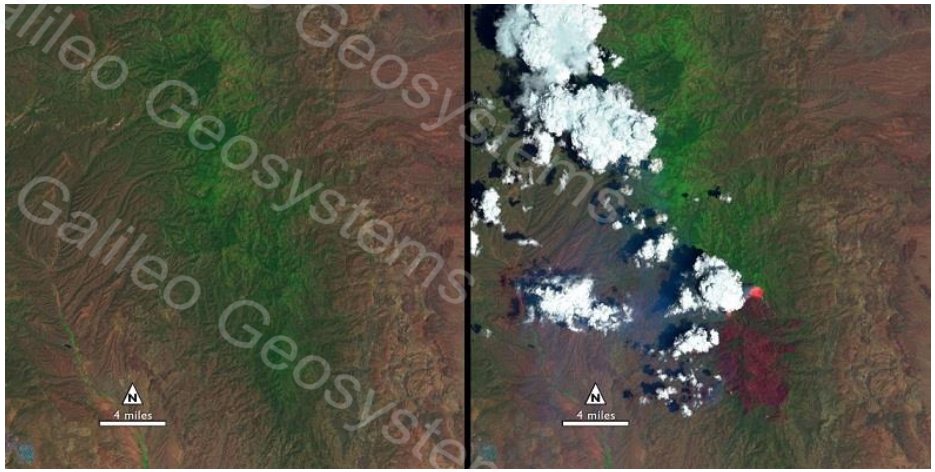


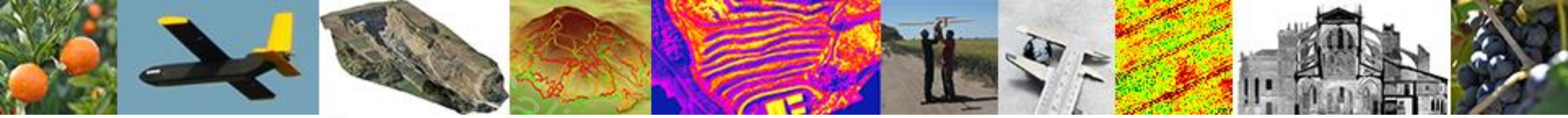
¿Por qué embarcar sensores en RPAs?

Disponibilidad de las medidas:

- Los satélites (con órbitas no geosíncronas) tienen **tiempos de revisita** de varios días.
- La imagen adquirida desde satélite es fuertemente **dependiente de la meteorología**.

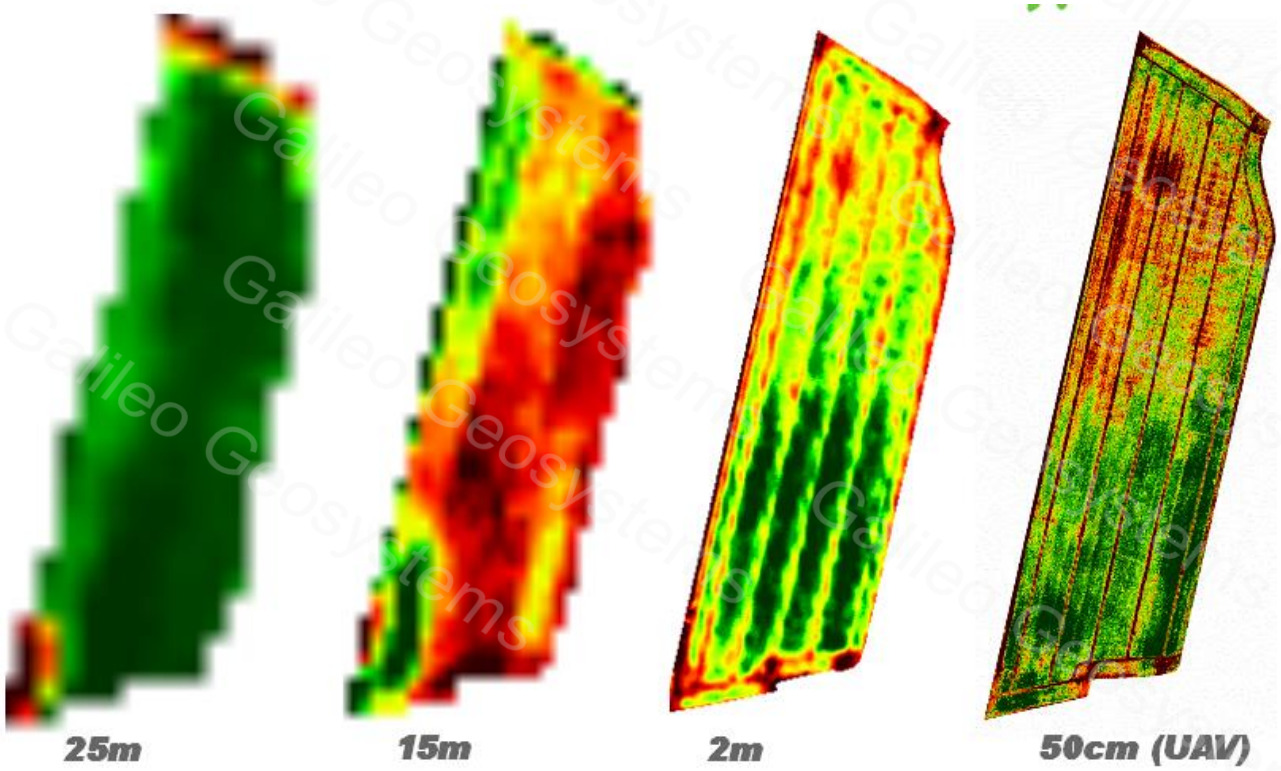




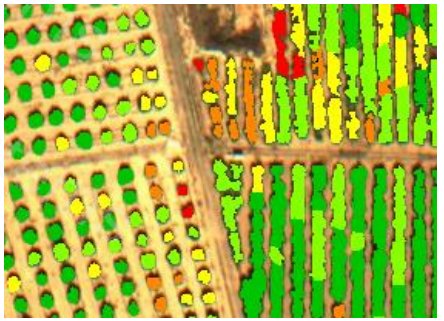


¿Porqué sensors embarcados en RPAS?

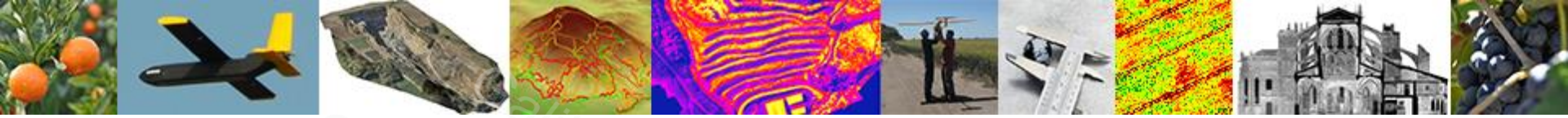
Resolución espacial:



¡OJO! Una resolución tan elevada puede ser inevitable con un RPAS y/o una mala idea.



5 – 2,5 cm (UAV)



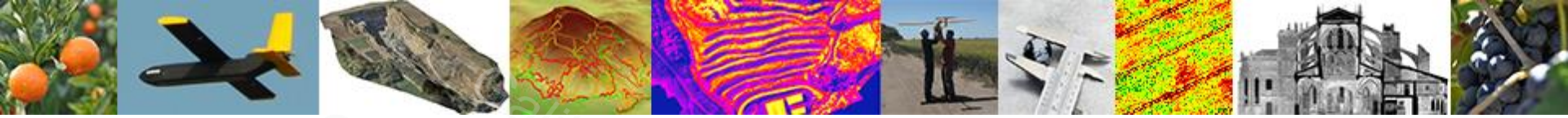
¿Qué tipo de datos adquirir?

Sensores Pasivos:

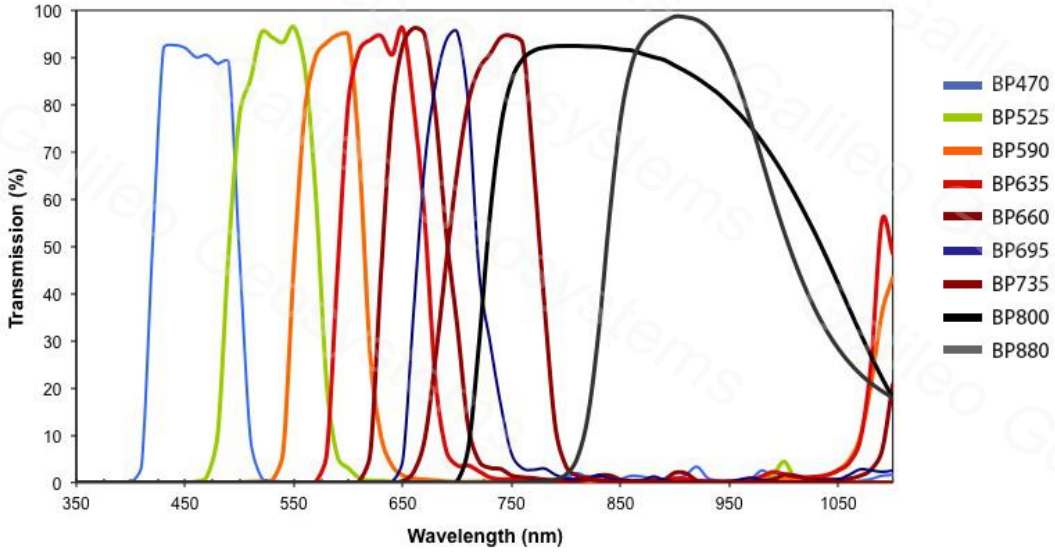
- **Cámaras RGB** (espectro visible).
- **Cámaras multiespectrales** (3-15 bandas)
  - VNIR (400 – 1000 nm / 10-40 nm).
- **Cámaras hiperespectrales** (>15 bandas)
  - VNIR (400 – 1000 nm / 1-8 nm)
  - NIR (900 – 1700 nm / 3.5 nm)
  - SWIR (1000 – 2500 nm / 5.5 nm)
  - MWIR (2600 – 5000 nm / 30 nm)
- **Cámaras térmicas** (LWIR: 7,5 y 13,5 µm / 400 nm).

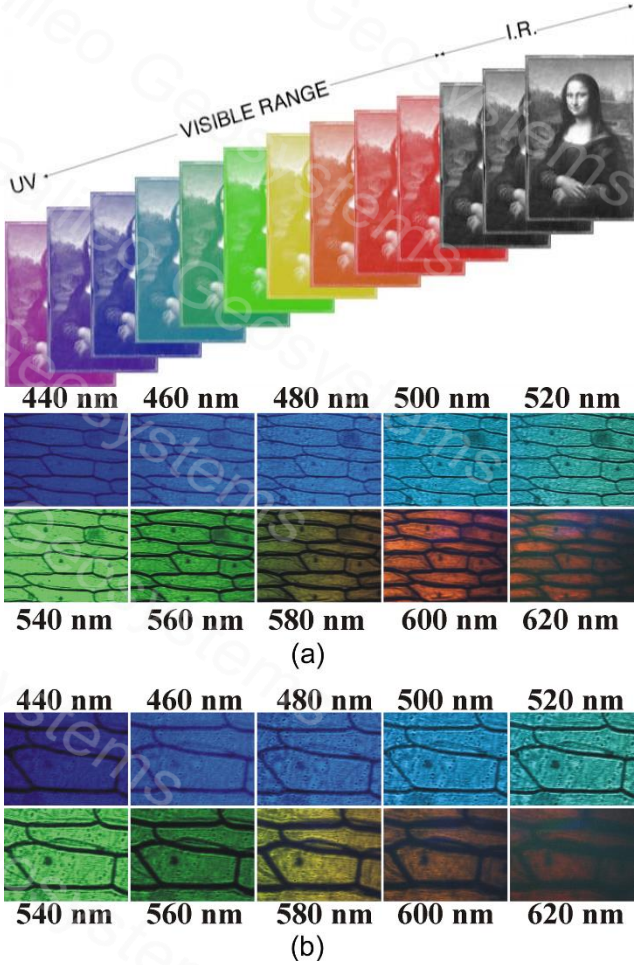
Sensores Activos:

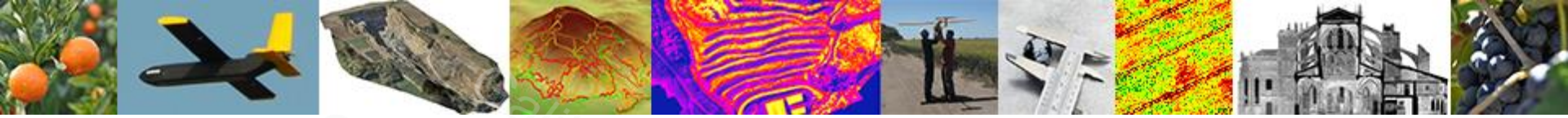
- **LIDAR**.



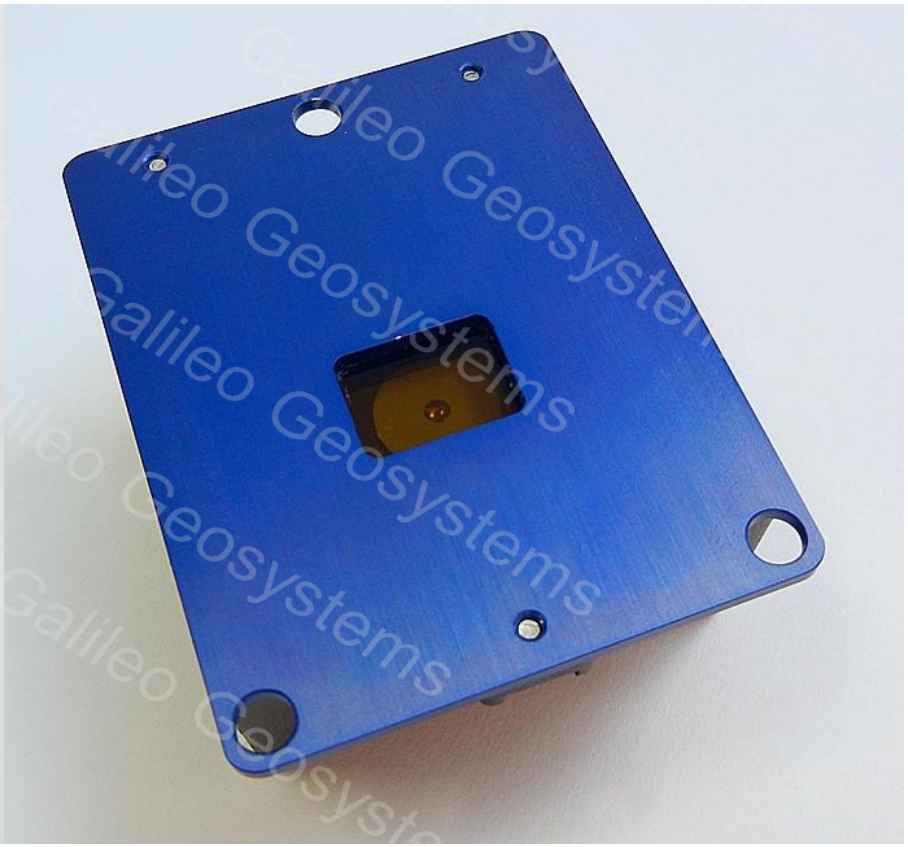
Fotografía multiespectral

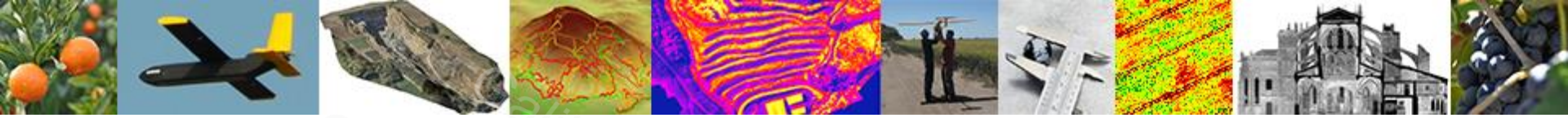






Tetracam µADC



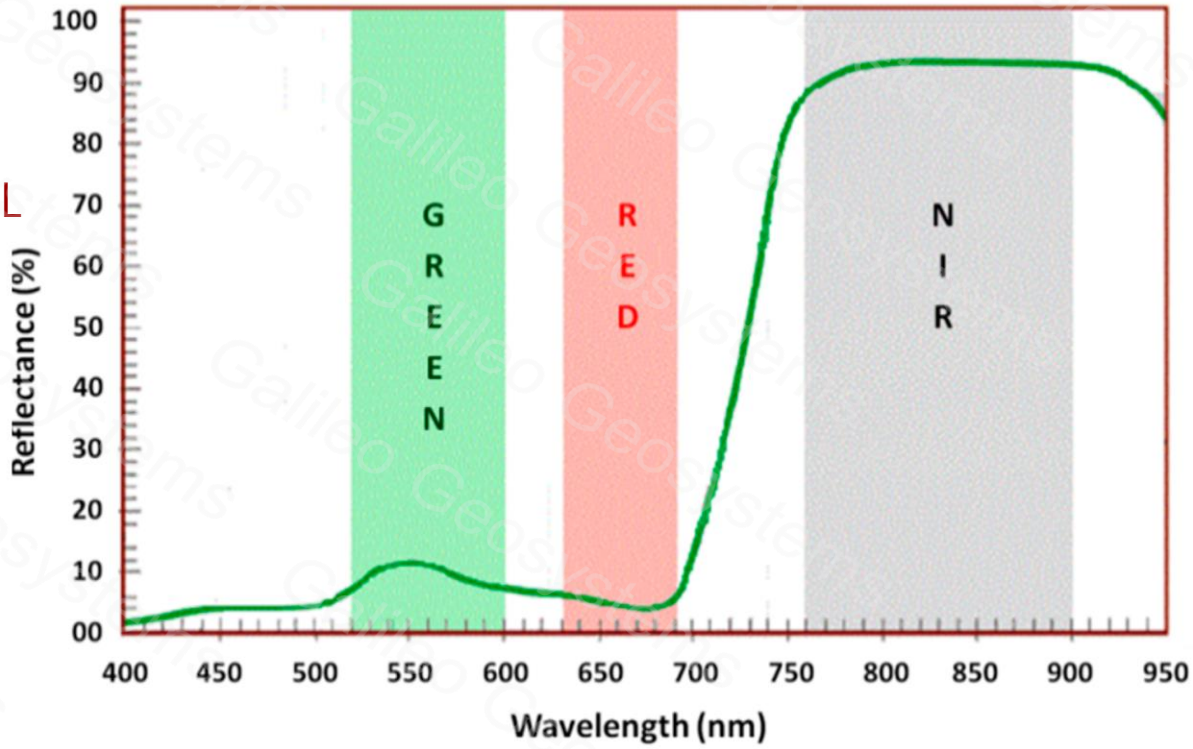


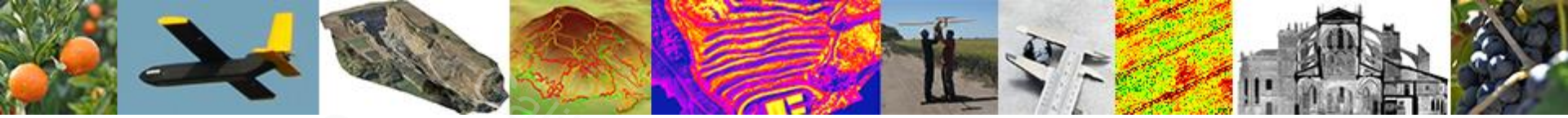
Tetracam µADC

Multi (global shutter)

- 3,2 Mpix
- 10 bits
- F=8,3 mm
- 4.55 cm@120 mAGL
- I. Size: 2048x1536

Bandas / Δ_λ	
G_{560}	80 nm
R_{660}	60 nm
NIR_{830}	140 nm

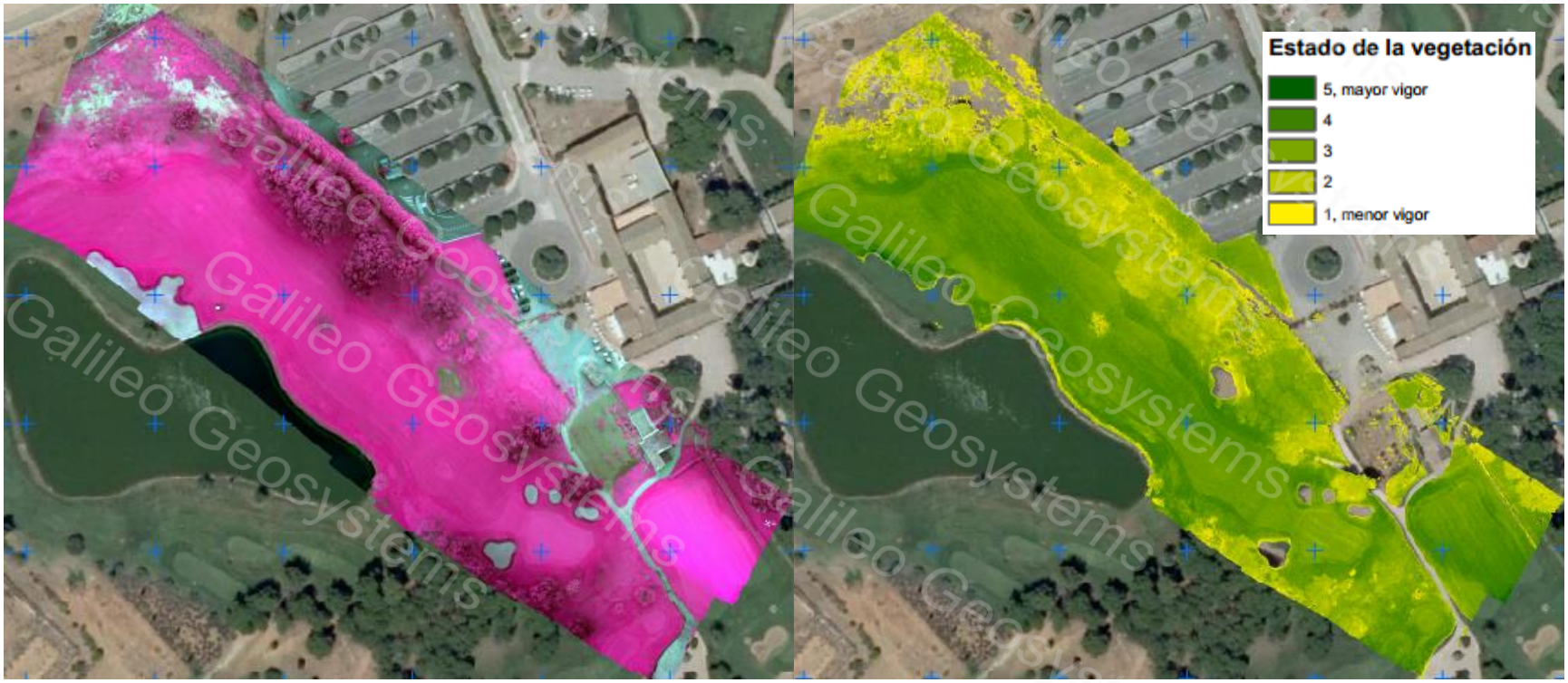


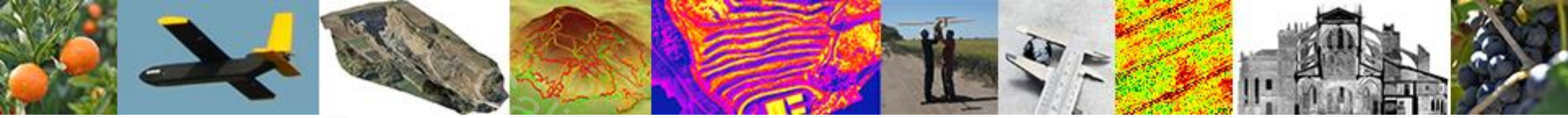


Tetracam µADC

CIR (RGNIR)

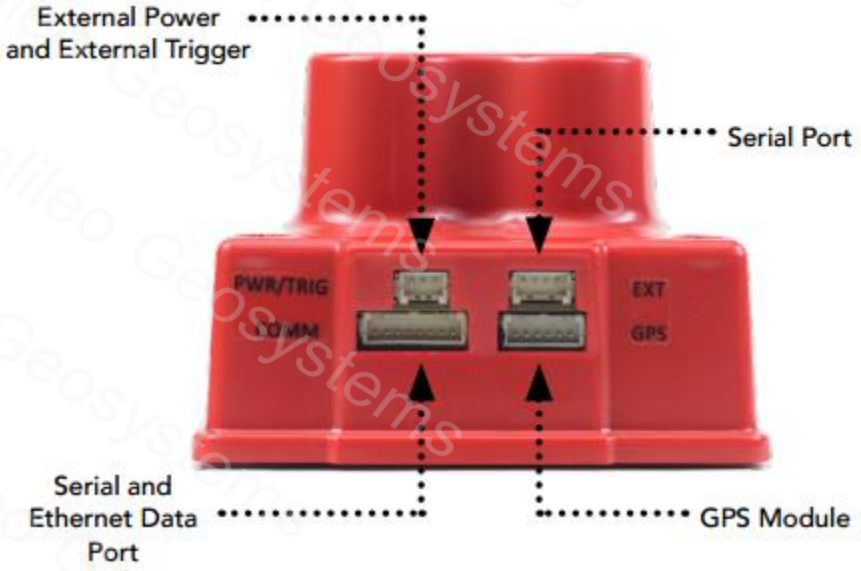
NDVI

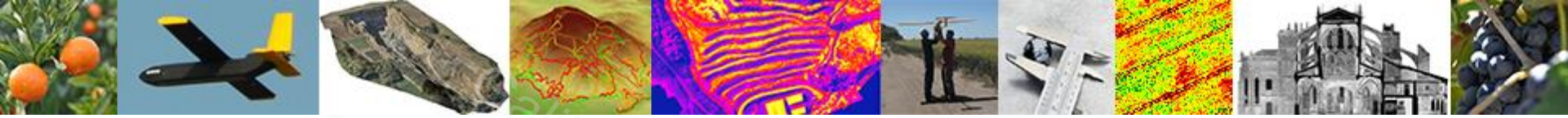




MicaSense RedEdge

RedEdge™ at a Glance



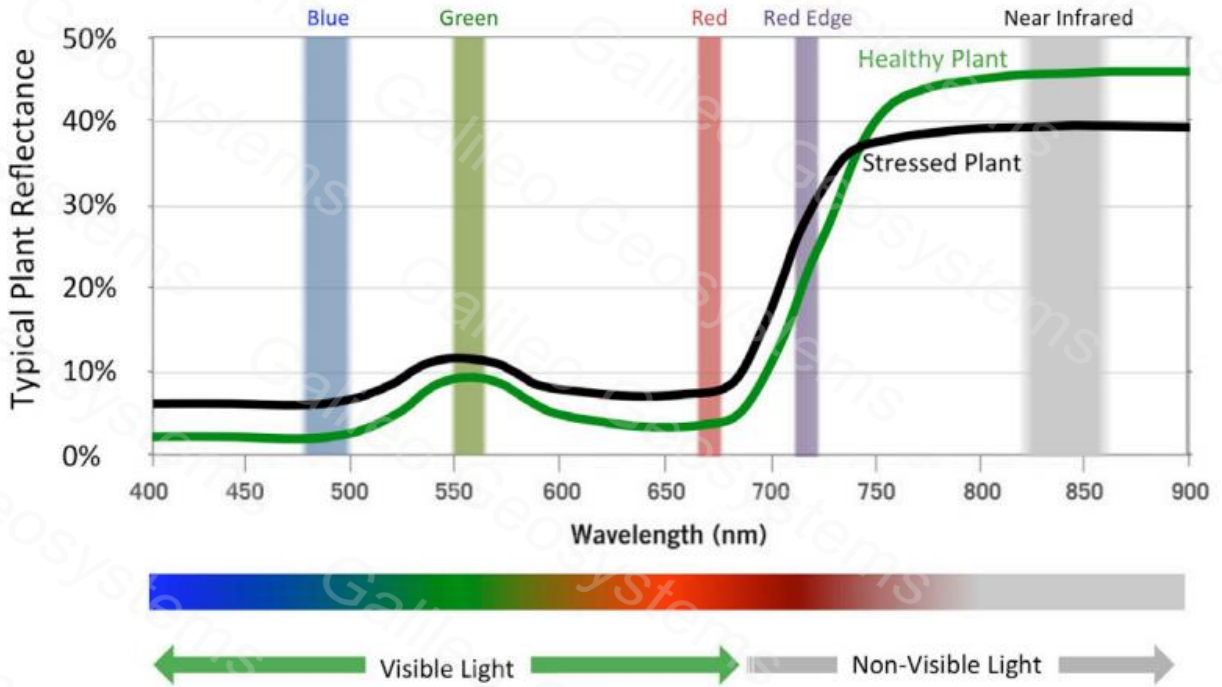


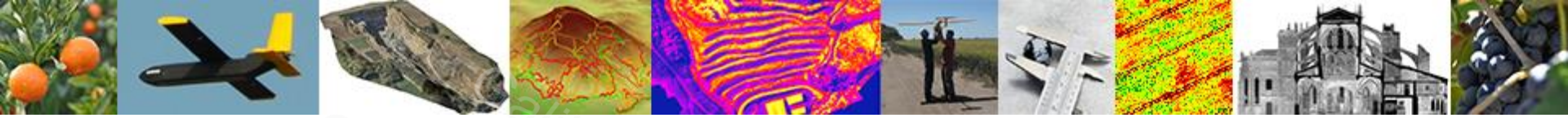
MicaSense RedEdge

Multi (global shutter)

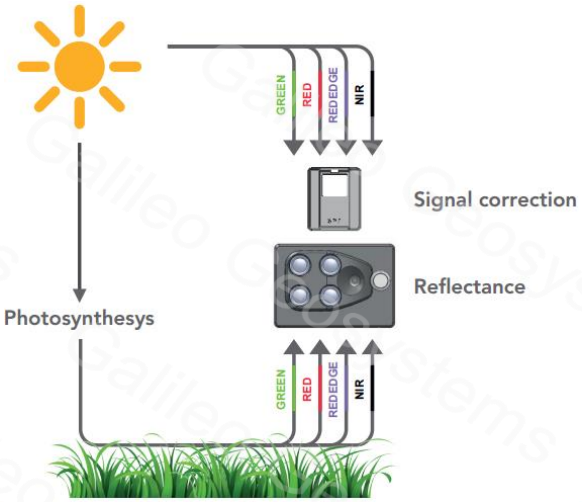
- 1,2 Mpix
- 12 bits
- F=4,2 mm
- 8 cm@120 mAGL
- I. Size: 1280x960

Bandas / Δ_λ	
B_{475}	20 nm
G_{560}	20 nm
R_{668}	10 nm
RE_{717}	10 nm
NIR_{840}	40 nm





Parrot Sequoia



Red
1.2 Mpx

Green
1.2 Mpx

Near infrared
1.2 Mpx

Red edge
1.2 Mpx

Lens protector
strong and durable

RGB camera
16 Mpx

Internal storage
64 GB = 10 flights
recording capacity

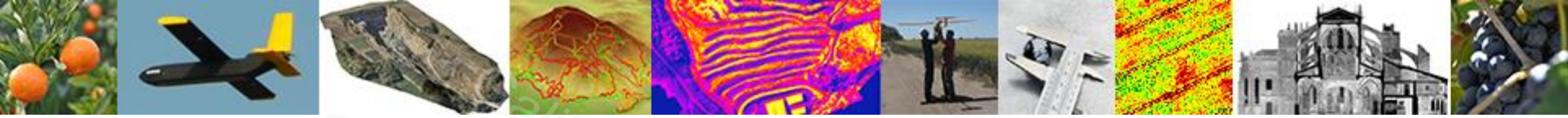
Easy and fast access
via WiFi and USB

72 g/2.5 oz

GPS & IMU
The best geo-tagging technology for optimum mapping accuracy

Additional storage
thanks to SD card slot

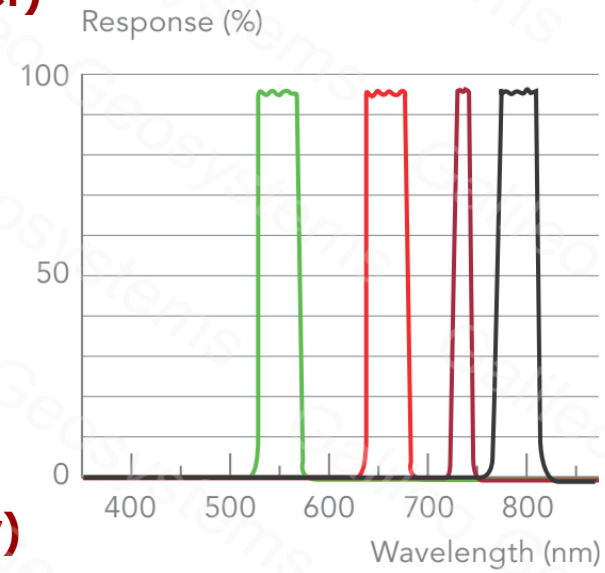
36 g/1.3 oz



Parrot Sequoia

Multi (global shutter)

- 1,2 Mpix
- 10 bits
- F=3,98 mm
- 11,31 cm@120 mAGL
- I. Size: 1280x960

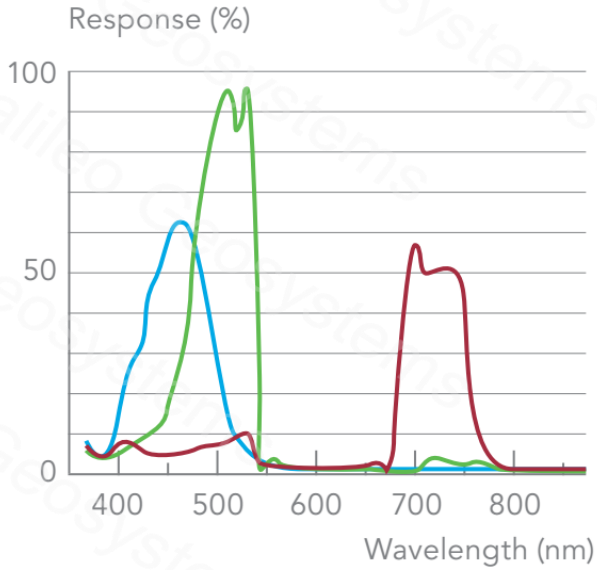


Discrete spectral bands

- Green (550BP40)
- Red (660BP40)
- Red Edge (735BP10)
- Near Infrared (790BP40)

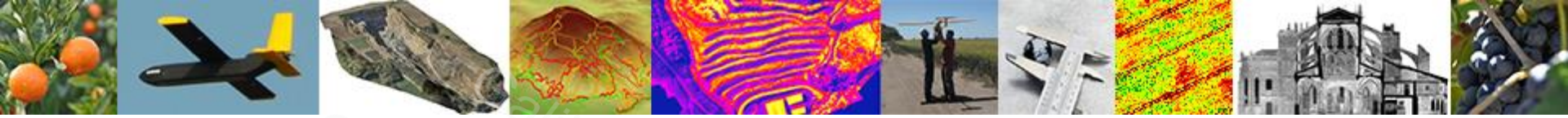
RGB (rolling shutter)

- 16 Mpix
- 16 bits
- F=4,88 mm
- 3,26 cm@120 mAGL
- I. Size: 4608x3456



Non discrete spectral bands

- Blue (450 nm)
- Green (500 nm)
- Red Edge (715 nm)

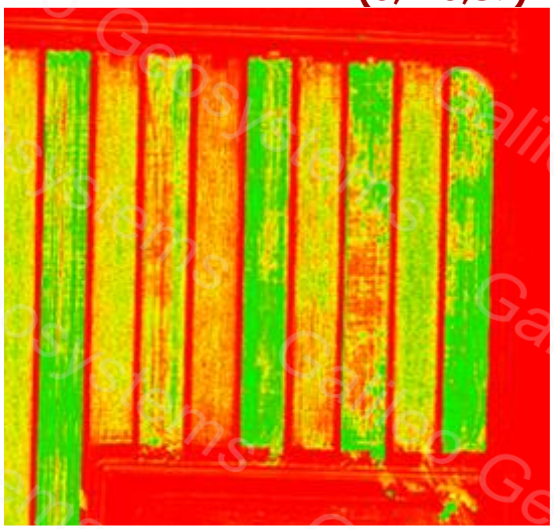


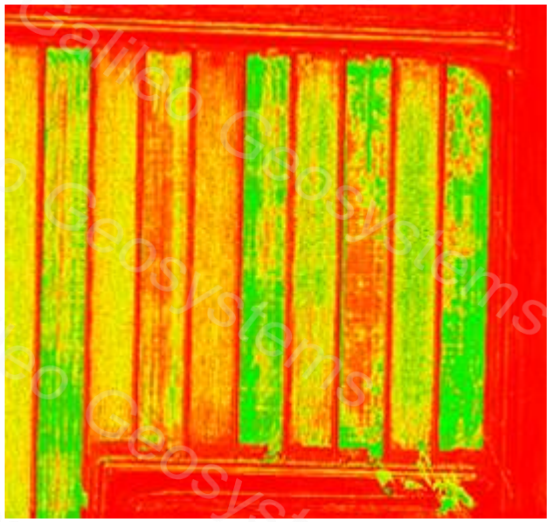
CIR: RedEdge

NDVI (0,2-0,87)

NDRE (0,1-0,5)

(90 mAGL / GSD: 6,1 cm)



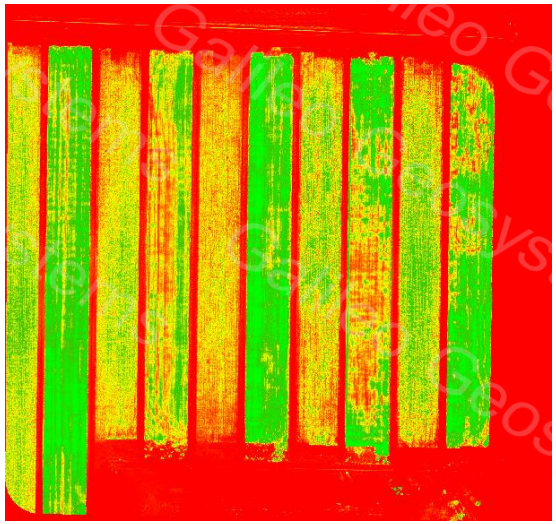


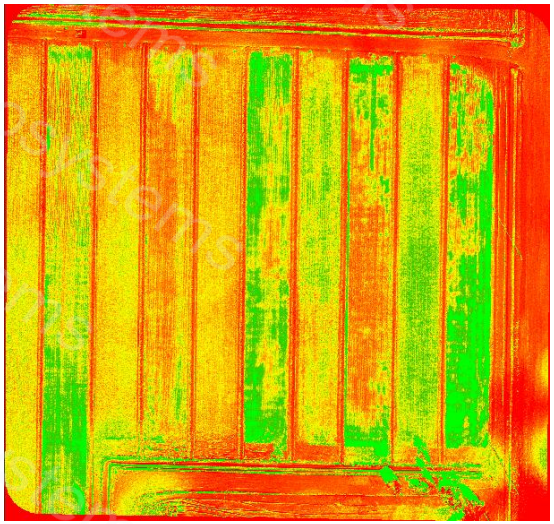
CIR: Sequoia

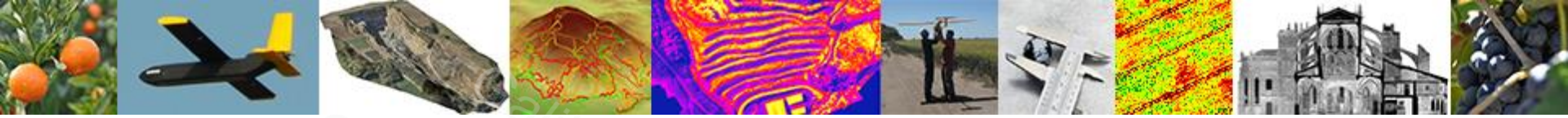
NDVI (0,2-0,87)

NDRE (0,04-0,2)

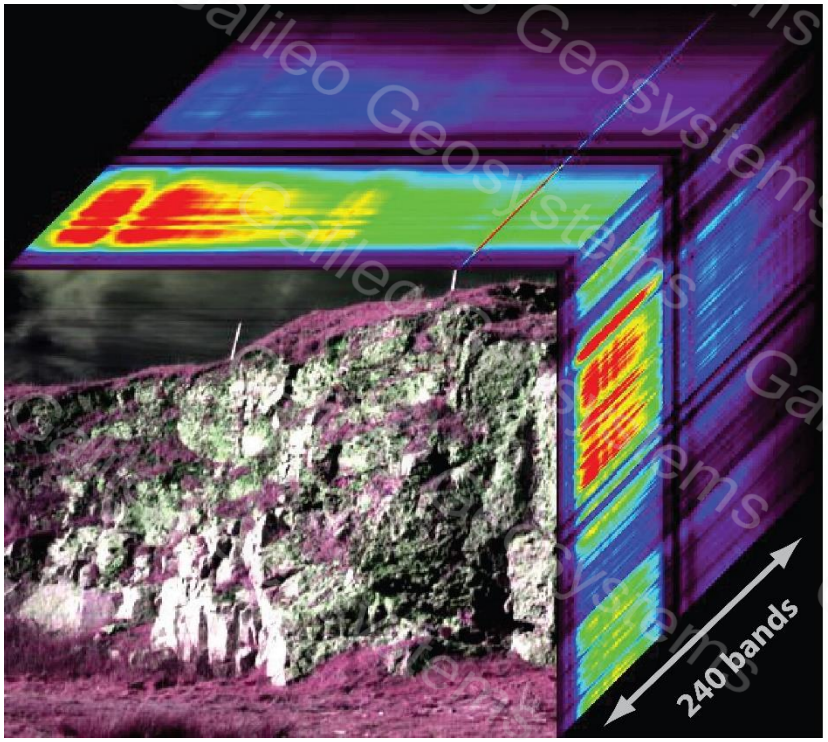
(70 mAGL / GSD: 6,6 cm)

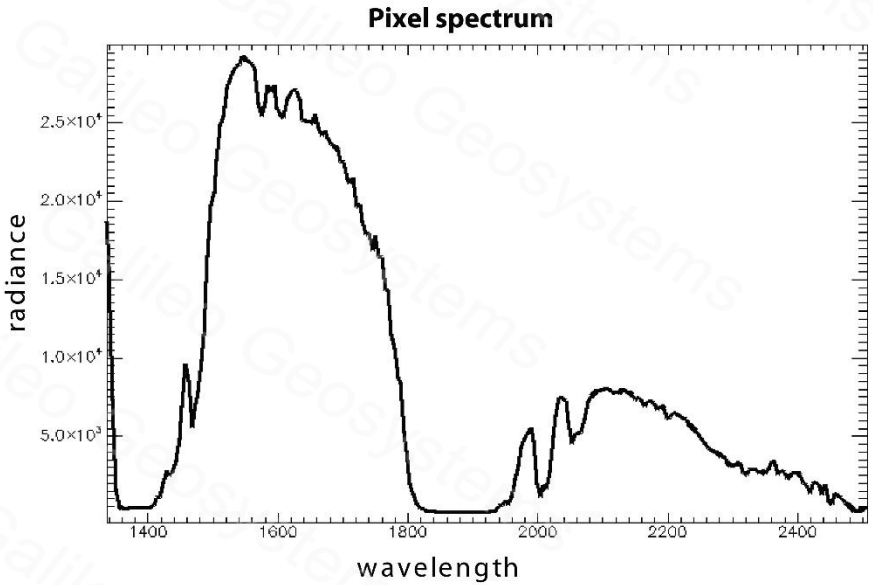


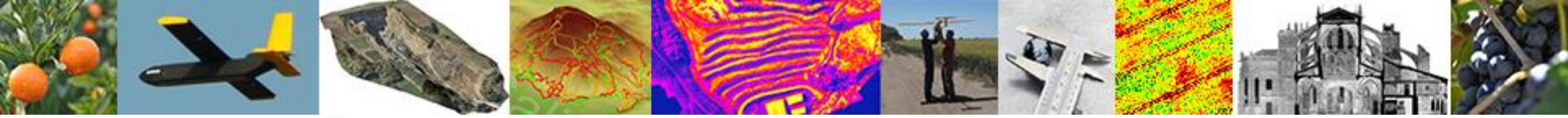




Fotografía hiperespectral

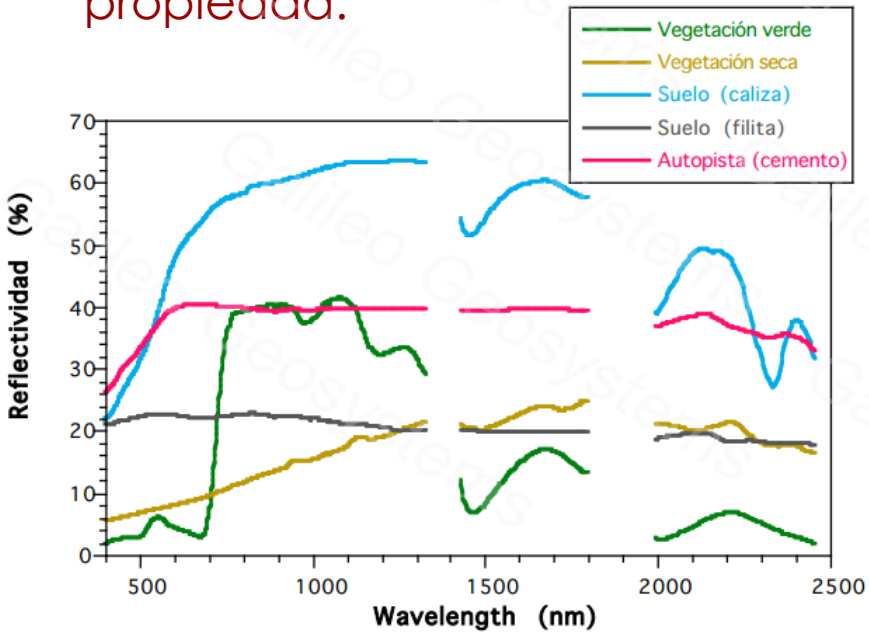


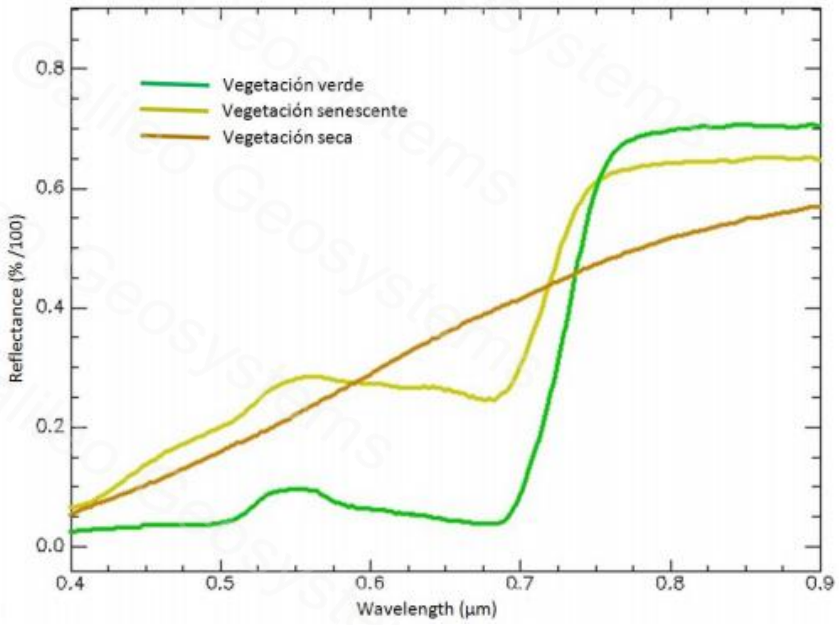


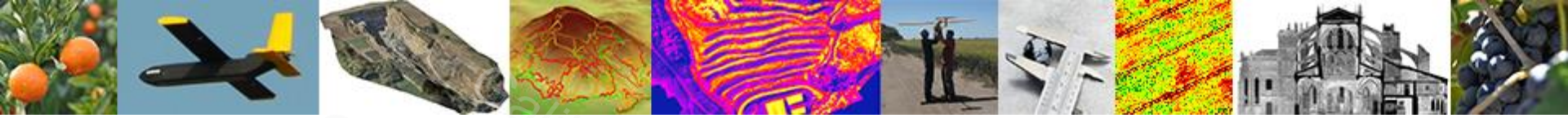


Signatura espectral

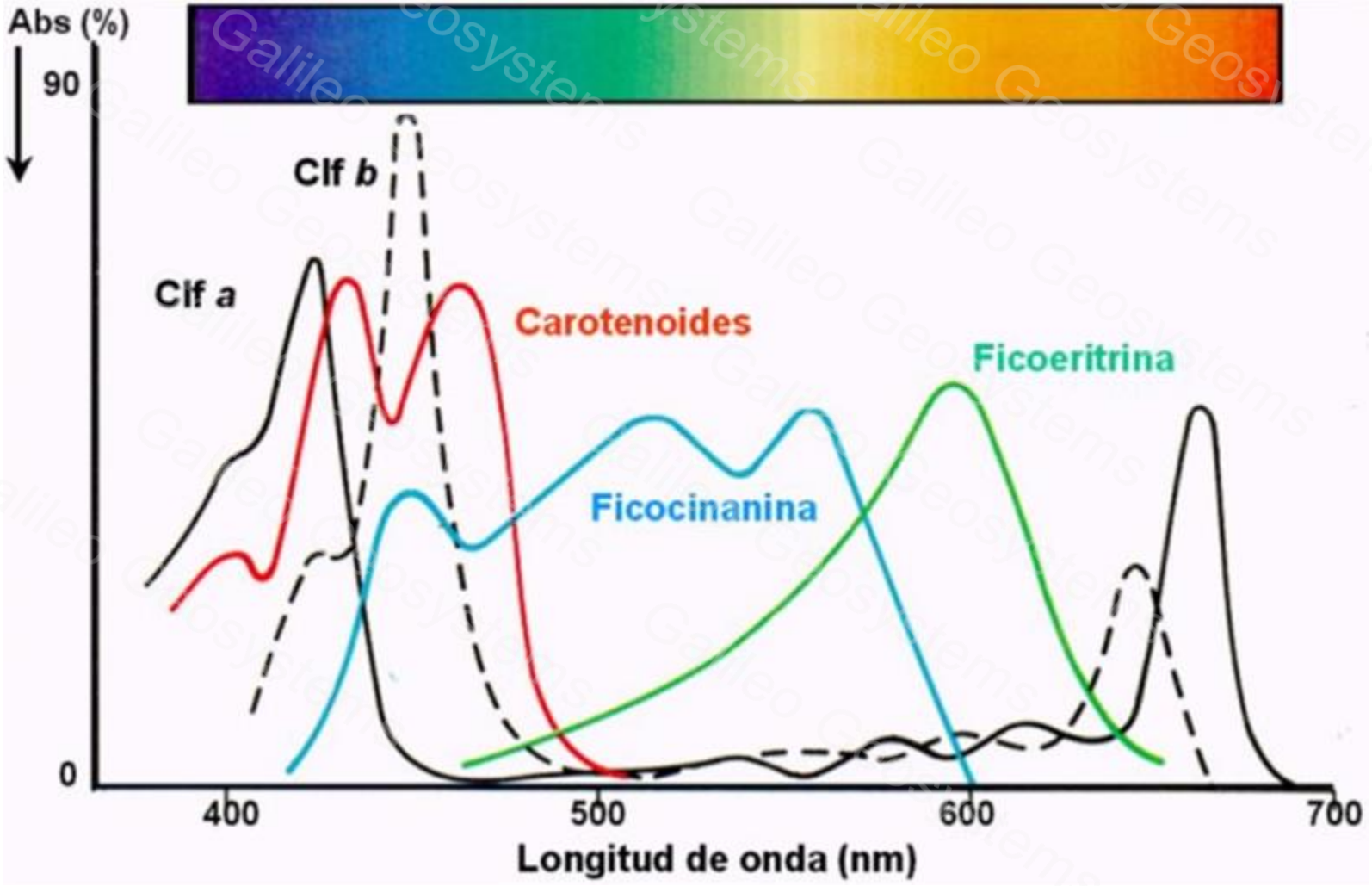
- Representación gráfica de la reflectividad (espectro solar) o la emisividad (espectro térmico) de una superficie en función de la longitud de onda.
- La identificación de superficies en teledetección se basa en esta propiedad.

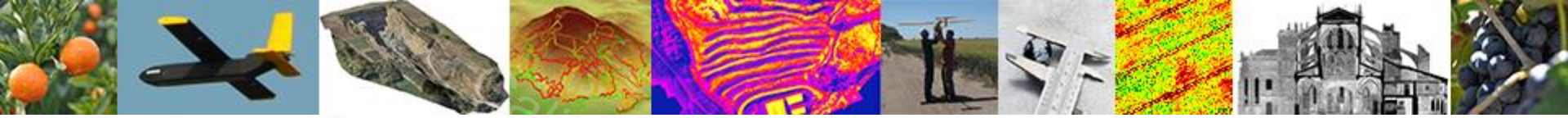






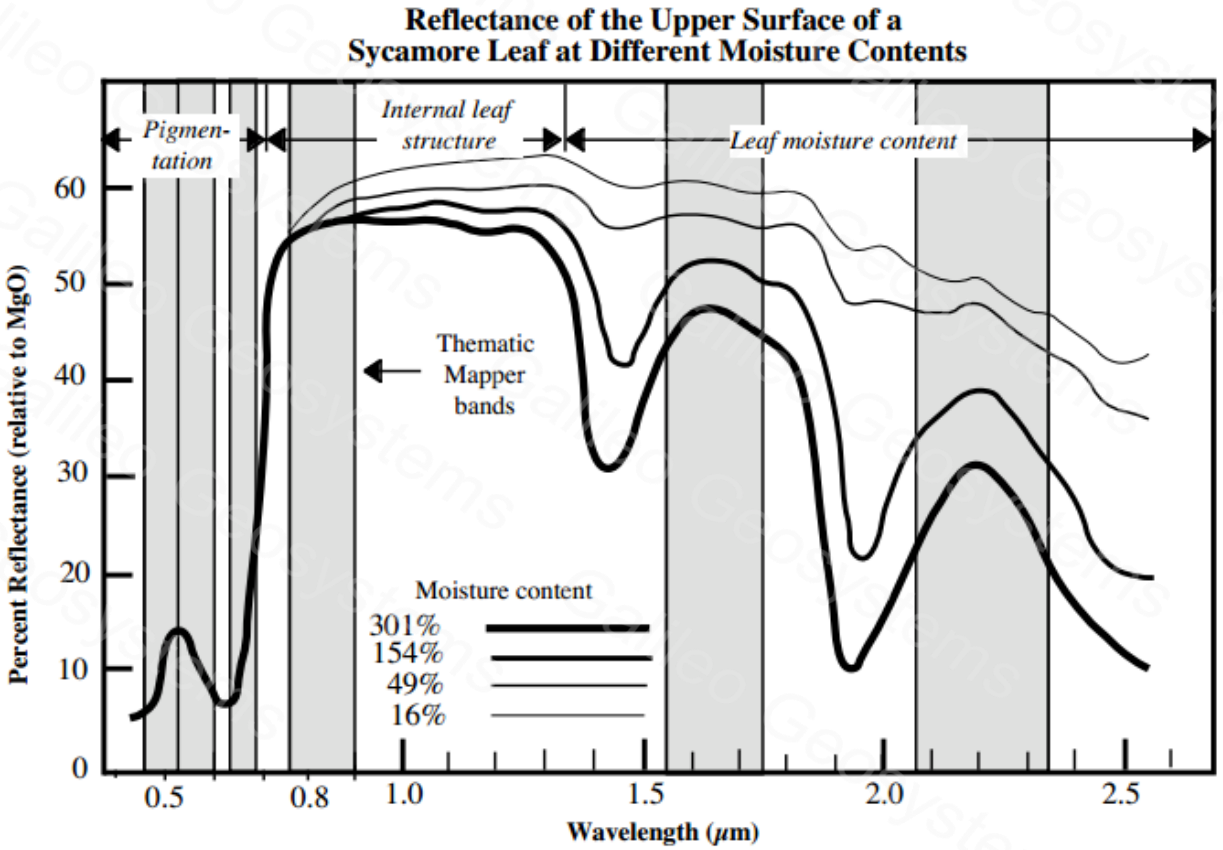
Bandas de absorción de los pigmentos

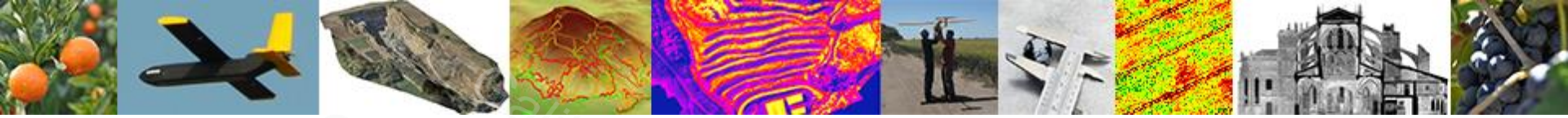




Reflectividad de la hoja

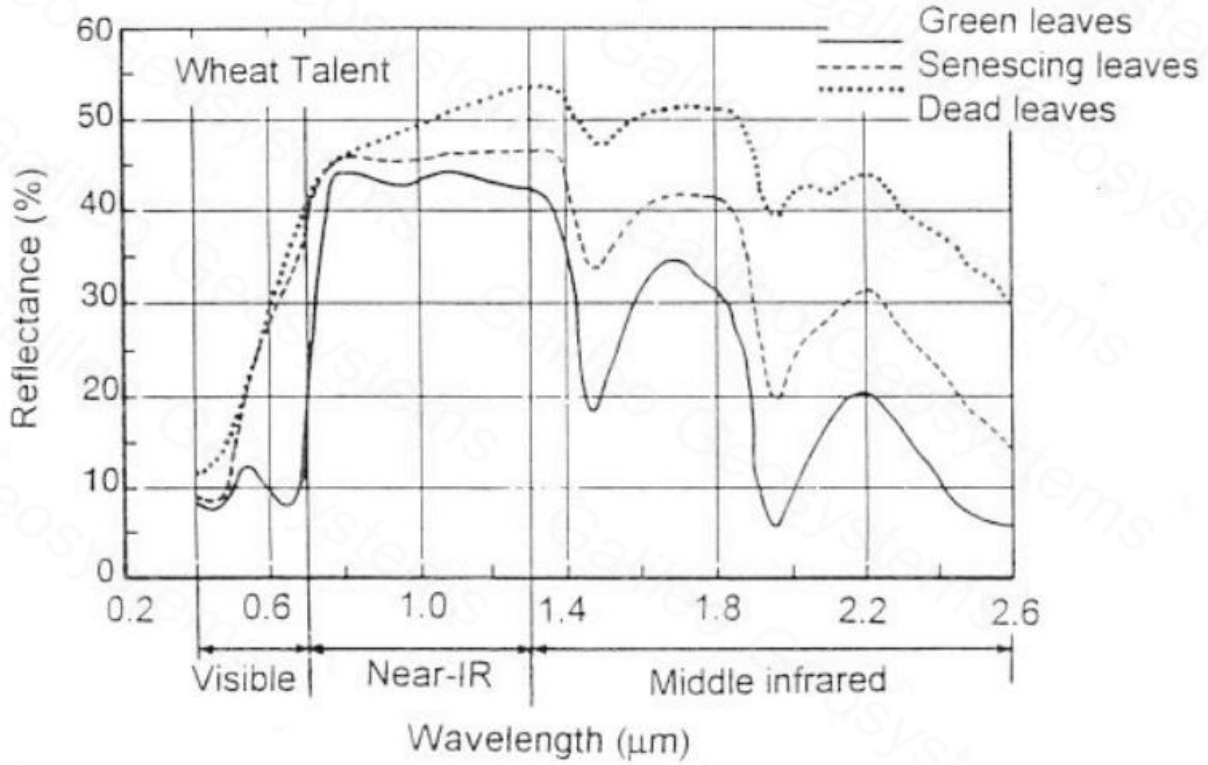
Influencia del contenido en agua:

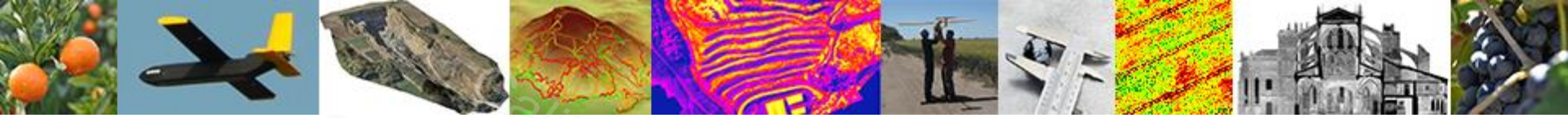




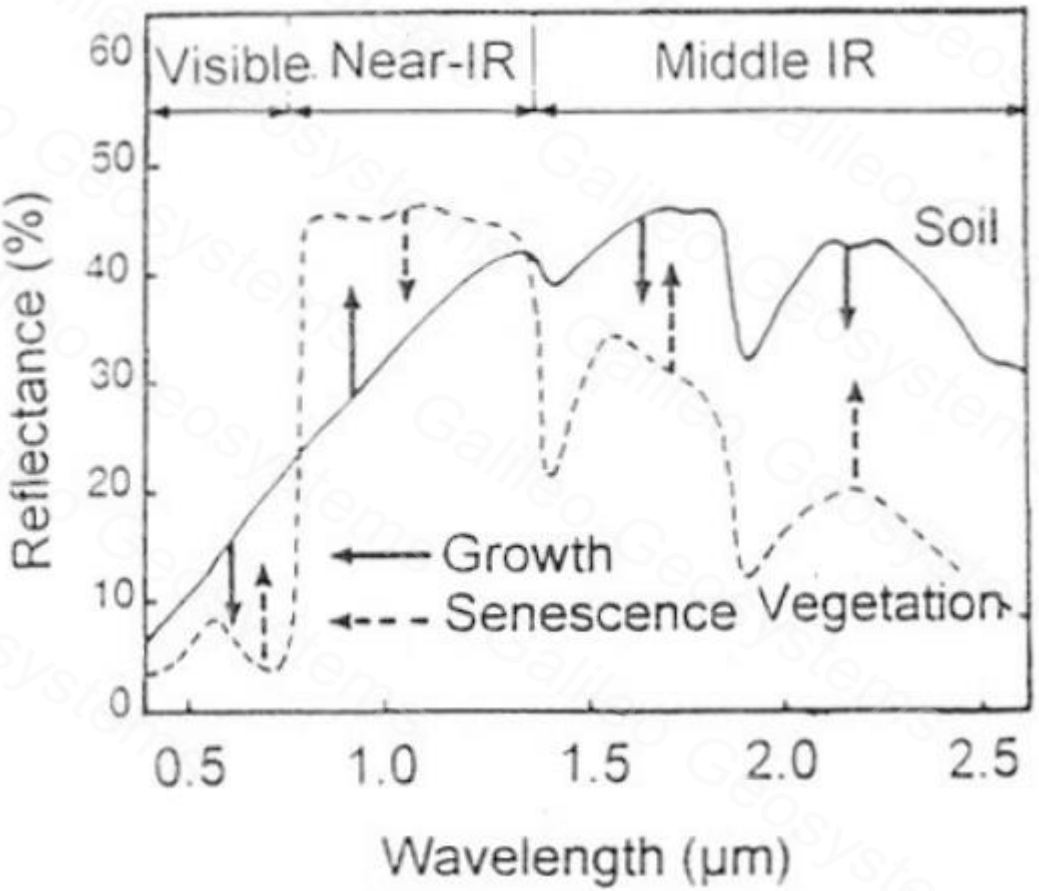
Reflectividad de la hoja

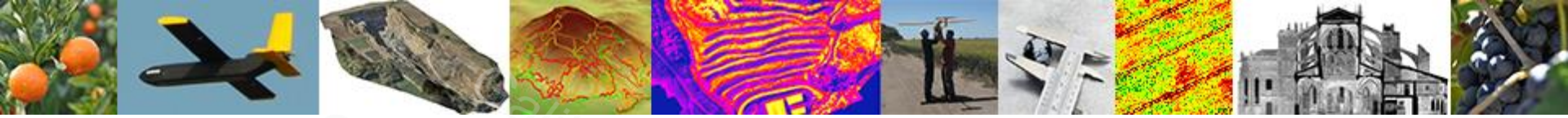
Influencia de la edad de la hoja:





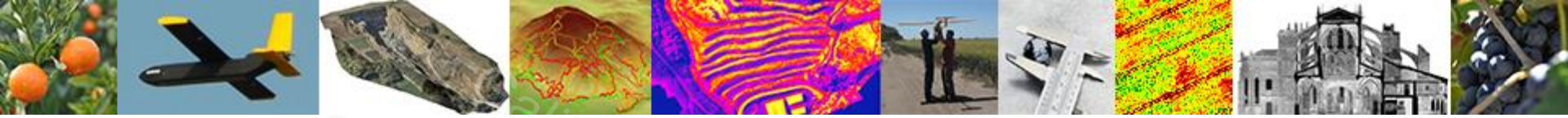
Características temporales



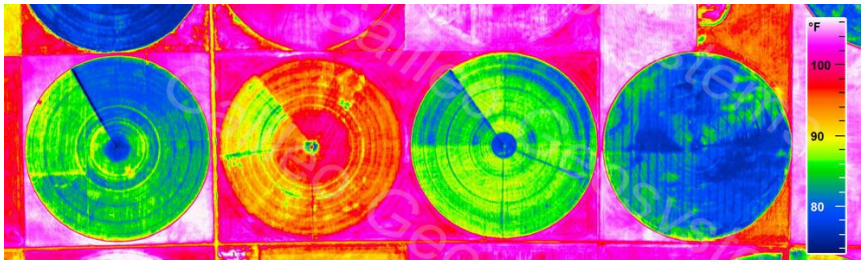


BaySpec OCI-UAV

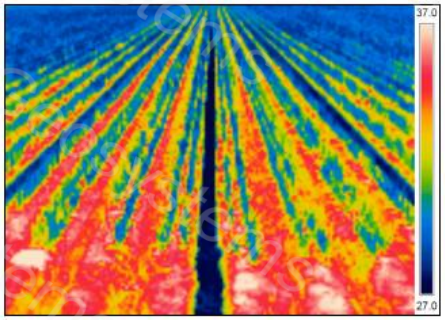
	Specifications	
Model	***OCI*™-UAV-1000**	***OCI*™-UAV-2000**
Operation Mode	True Push-broom	Snapshot
Spectral Range	Approx. 600-1000 nm	Approx. 600-1000 nm
Number of Spectral Bands	Approx. 100	Approx. 20-25
Spectral Resolution	< 5 nm FWHM	12-15 nm FWHM
Spatial Pixels	Up to 2048 X scan-length	Up to 400 X 200
Lens (Standard)	35 mm (18° FOV)[1]	
Objective Lens Interface	C-mount	
Exposure Time	1 – 300 ms	
Wavelength Calibration	Factory calibrated	
Frame Rate	Up to 120 frames/sec	
Operation	Automatic; frame rate control; delayed start	
Data Storage	Up to 500G (~ 2-4 hour non-stop, high-speed, high-resolution imaging)	
Data Format	ENVI-BSQ for hyper-cube, BMP band images, ROI spectra, and RAW (pixel data)	
Operating Temperature	-20°C to +60°C	
Power Consumption	< 4 W (powered by USB 3.0)	
Size	Camera with lens: 8 cm x 6 cm x 6 cm (3.2 in x 2.3 in. x 2.3 in.)	
	Onboard computer: 10 cm x 7.5 cm x 3 cm (4.0 in x 3.0 in. x 1.2 in.)	
Weight	Camera and lens: 0.40 lb. (180 g)	
	Onboard computer: 1.0 lb. (450 g)	
Onboard OS*	Windows 7 PRO	
Data Transfer Interface	USB 3.0 SuperSpeed	
Remote Control	WiFi (when in range)	

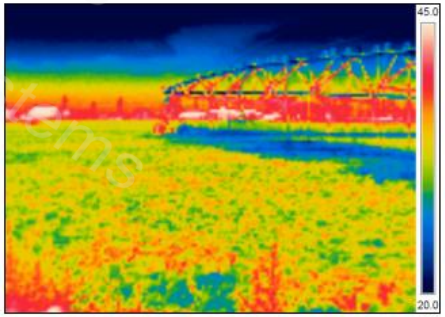


Fotografía térmica

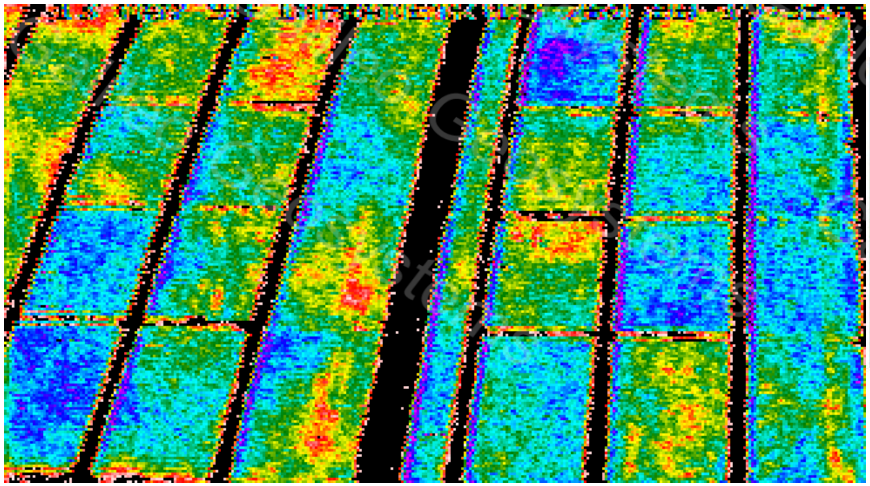


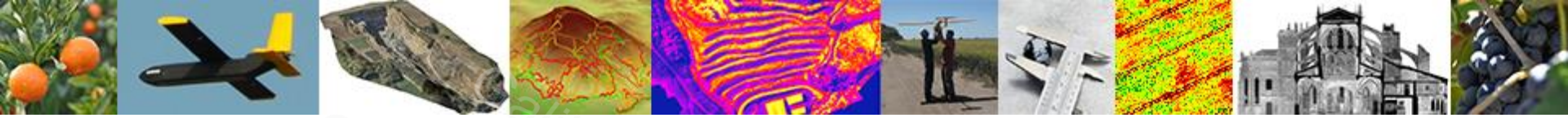
Irrigación





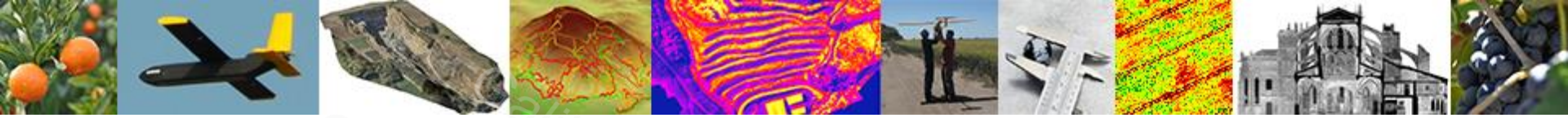
Estrés hídrico y plagas





Flir Tau 2

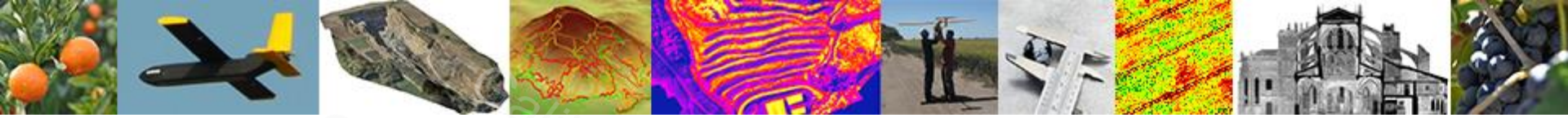
Overview	Tau 640	Tau 336	Tau 324
Thermal Imager	Uncooled VOx Microbolometer		
FPA / Digital Video Display Formats	640 × 512	336 × 256	324 × 256
Analog Video Display Formats	640 × 480 (NTSC); 640 × 512 (PAL)[1]		
Pixel Pitch	17 µm		25 µm
Spectral Band	7.5 - 13.5 µm		
Full Frame Rates	30 Hz (NTSC) 25 Hz (PAL)	30/60 Hz (NTSC) 25/50 Hz (PAL)	
Exportable Frame Rates	7.5 Hz NTSC; 8.3 Hz PAL		
Sensitivity (NEdT)	<50 mK at f/1.0		
Scene Range (High Gain)	-25°C to +135°C	-25°C to +100°C	-25°C to +135°C
Scene Range (Low Gain)	-40°C to +550°C		
Time to Image	<5.0 sec	<4.0 sec	
Factory Optimized Video	Yes		
Physical Attributes	**Tau 640**	**Tau 336**	**Tau 324**
Size (w/o lens)	1.75" x 1.75" x 1.18"		



Flir Tau 2

Wide Field of View (WFOV) Models

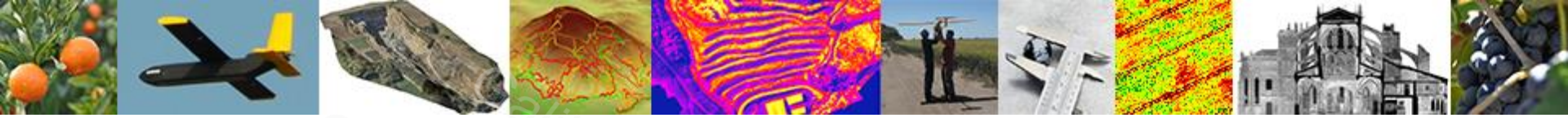
		7.5 mm f/1.4	9 mm f/1.25 for Tau 324 & 336 f/1.4 for Tau 640	13 mm f/1.25	19 mm f/1.25
Tau 640 (17µ 640×512)	FoV iFoV	90° x 69° 2.267 mr	69° x 56° 1.889 mr	45° x 37° 1.308 mr	32° x 26° 0.895 mr
Tau 336 (17µ 336×256)	FoV iFoV	45° x 35° 2.267 mr	35° x 27° 1.889 mr	25° x 19° 1308 mr	17° x 13° 0.895 mr
Tau 324 (25µ 324×256)	FoV iFoV	63° x 50° 3.333 mr	48° x 37° 2.778 mr	34° x 26° 1.923 mr	24° x 18° 1.316 mr
Min Focus Distance		2.5cm	3.2cm	7.6cm	15.3cm
Hyperfocal Distance		1.2m	2.1m	4.4m	9.5m
Hyperfocal Depth of Field		0.6m	1.1m	2.2m	4.8m
Lens Mount		M24x0.5 inside thread; M29x1.0 outside thread			
Length		8mm	9mm	13mm	19mm
Diameter		29mm	29mm	29mm	29mm
Weight		72g	72g	<70g	<70g



Flir Tau 2

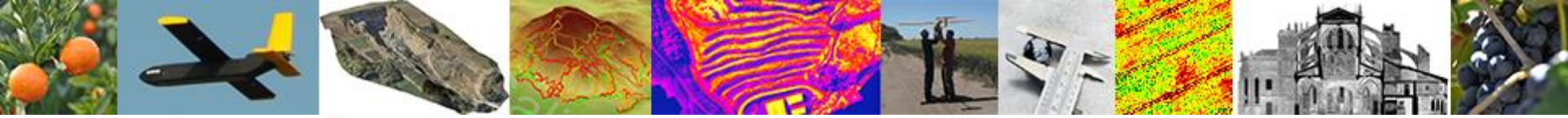
Narrow Field of View (NFOV) Models

		25 mm f/1.1	35 mm f/1.2	50 mm f/1.2	60 mm f/1.25	100 mm f/1.6
Tau 640 (17µ 640×512)	FoV iFoV	25° x 20° 0.680 mr	18° x 14° 0.486 mr	12.4° x 9.9° 0.340 mr	10.4° x 8.3° 0.283 mr	6.2° x 5° 0.170 mr
Tau 336 (17µ 336×256)	FoV iFoV	13° x 10° 0.680 mr	9.3° x 7.1° 0.486 mr	6.5° x 5° 0.340 mr	5.5° x 4.2° 0.283 mr	3.3° x 2.5° 0.170 mr
Tau 324 (25µ 324×256)	FoV iFoV	18° x 14° 1.000 mr	13° x 10° 0.714 mr	9.1° x 6.9° 0.500 mr	7.6° x 5.7° 0.417 mr	4.6° x 3.7° 0.250 mr
Min Focus Distance		30cm	60cm	1.5m	2.3m	7m
Hyperfocal Distance		21m	35m	71m	122m	160m
Hyperfocal Depth of Field		11m	18m	36m	61m	80m
Lens Mount		M34x0.5 inside thread.				
Length		25mm	35mm	50mm	60mm	100mm
Diameter		42mm	42mm	58mm	61mm	82mm
Weight		112g	150g	280g	265g	479g

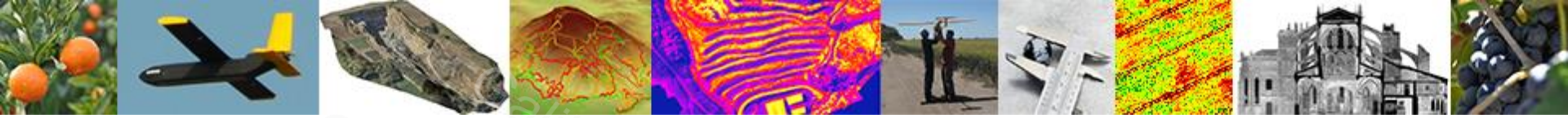


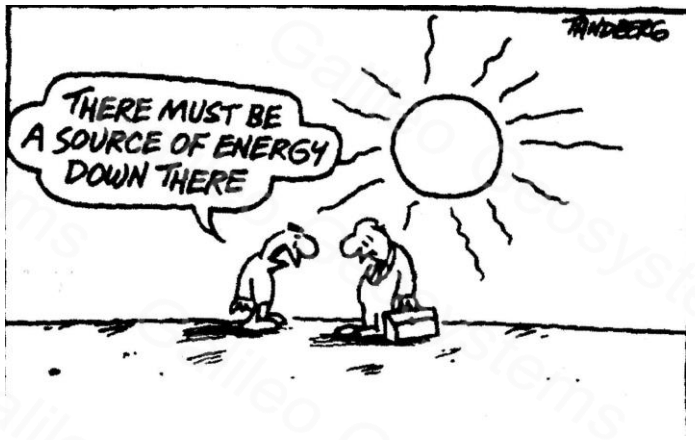
Flir Vue Pro

Overview		
Thermal Imager	Uncooled VOx Microbolometer	
Resolution	640x512	336x256
Lens Options	9 mm; 69° x 56° 13 mm; 45° x 37° 19 mm; 32° x 26°	6.8 mm; 45° x 35° 9 mm; 35° x 27° 13 mm; 25° x 19°
Spectral Band	7.5 - 13.5 µm	
Full Frame Rates	30 Hz (NTSC); 25 Hz (PAL) *US only, not for Export*	
Exportable Frame Rates	7.5 Hz (NTSC); 8.3 Hz (PAL)	
Physical Attributes		
Size	2.26" x 1.75" (57.4 x 44.4 mm) (including lens)	
Weight	3.25-4 oz (92.1 – 113.4 g) (configuration dependent)	



¿Preguntas?





¡MUCHAS GRACIAS!