



# PROCESAMIENTO DE IMÁGENES DE TELEDETECCIÓN MULTIPLATAFORMA (SATÉLITES Y DRON) PARA LA MONITORIZACIÓN (BATIMETRÍA, CLASIFICACIÓN DEL FONDO) DE AGUAS COSTERAS POCO PROFUNDAS

## MIEMBROS GRUPO DE INVESTIGACIÓN GPIT-IOCAG

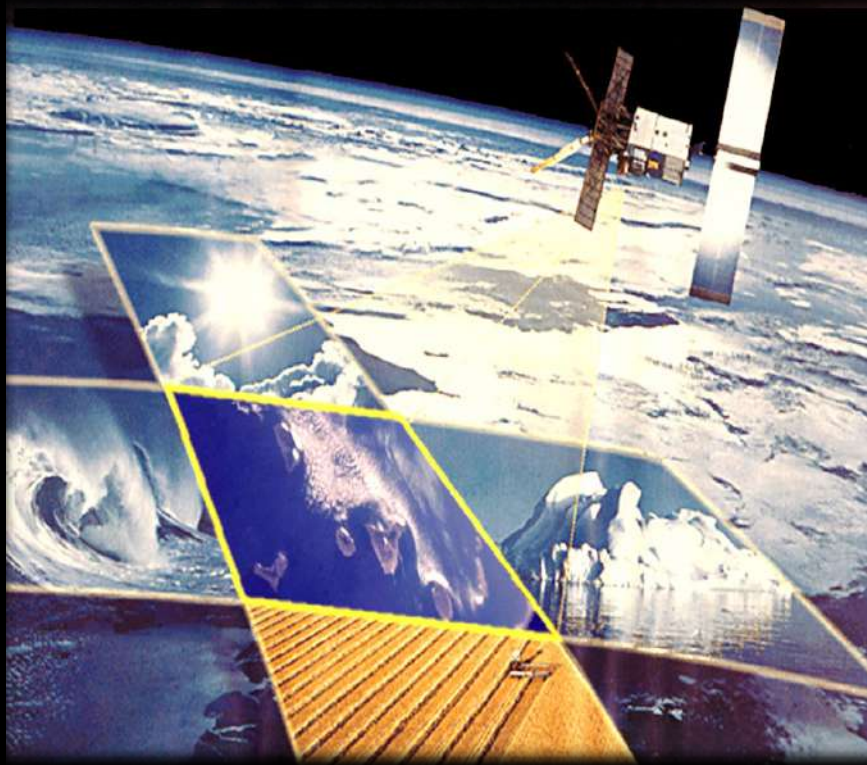
1. JAVIER MARCELLO (TU, ACREDITADO CU)
2. DIONISIO RODRIGUEZ (TU, ESTANCIA PAVÍA (ITALIA))
3. ANTONIO MEDEROS (CONTRATADO PREDOCTORAL, JULIO 2024)
4. FRANCIS EUGENIO (CU, RESPONSABLE/COORDINADOR GPIT)





# OCEANOGRAFÍA Y CAMBIO GLOBAL: Perspectivas para la formación de futuros investigadores

Table of Contents



1. **REMOTE SENSING CAPABILITIES**
2. **HIGH RESOLUTION SATELLITES**
3. **MULTIPLATFORM HR COASTAL MONITORING**





An adequate and efficient **monitoring** of bathymetry and distribution of benthic habitats of **coastal waters ecosystems** is important for:

**MARINE LIFE QUALITY, GLOBAL CLIMATE CHANGE AND TOURISTIC ACTIVITIES**



**Remote Sensing Satellite Imagery**

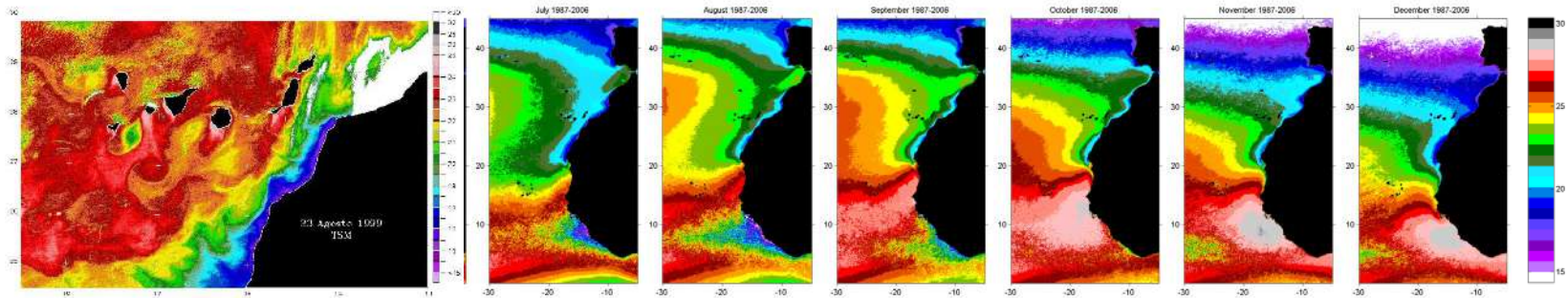




## Monitoring Oceanographic/Marine Resources

- ✓ **Historically: Medium-low resolution satellites (MODIS, MERIS, SENTINELS, ...)**

Global Scale Oceanographic Research: Clear deep ocean areas



- ✓ **At present: High resolution satellites (WorldView-2/3): Shallow coastal water monitoring: Turbid coastal waters**

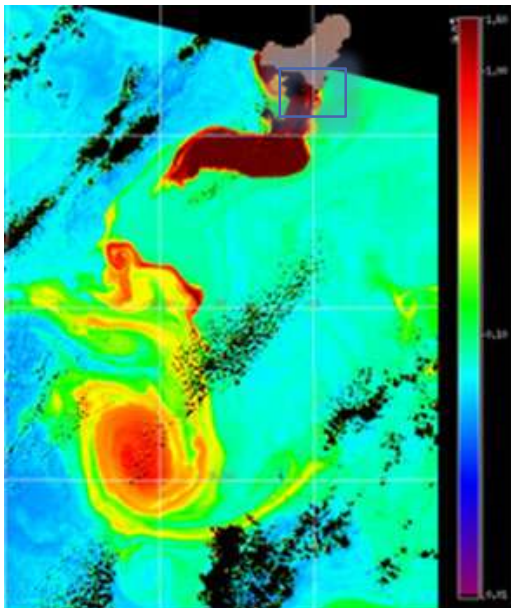


**MULTIPLE SCIENTIFIC CHALLENGES**





It is now possible to carry out, using collected data from Very High Resolution (VHR) satellites, many applications that in the recent past were exclusive to airborne and on site surveys:



MERIS/ESA: November, 9



WORLDVIEW-2

RAPIDEYE

EARTH OBSERVING-1

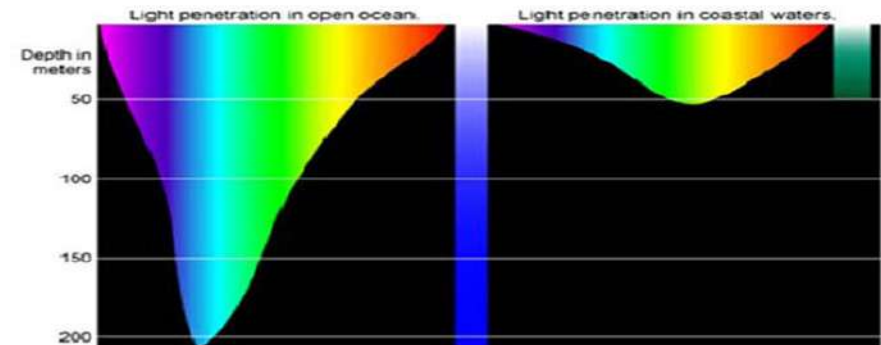
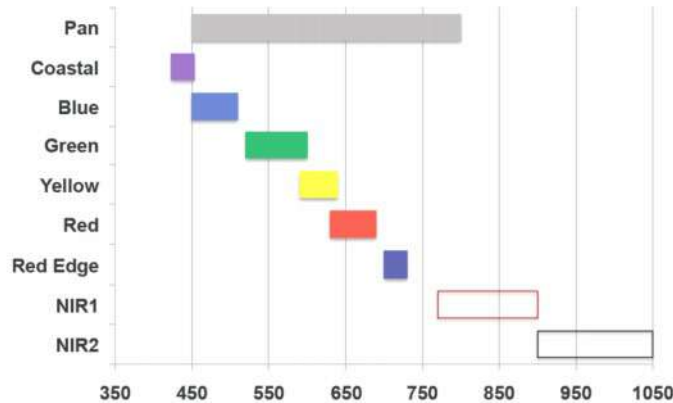
Eugenio, F.; Martín, J.; Marcello, J.; Fraile-Nuez, E. **Environmental monitoring of El Hierro Island submarine volcano, by combining low and high resolution satellite imagery.**

*International Journal of Applied Earth Observation and Geoinformation* (IF:3.48), 2014, 29, 53–66.



## WorldView-2 High-Resolution Commercial Imaging Satellite: General Characteristics

Remote sensing of coastal areas requires multispectral satellite images with a high spatial resolution



- At nadir, the collected nominal ground sample distance is **0.5 m** (panchromatic) and **2 m** (multispectral).
- The images included **8 multispectral bands** and one **panchromatic band**.



## High Resolution Satellite Bathymetry Mapping



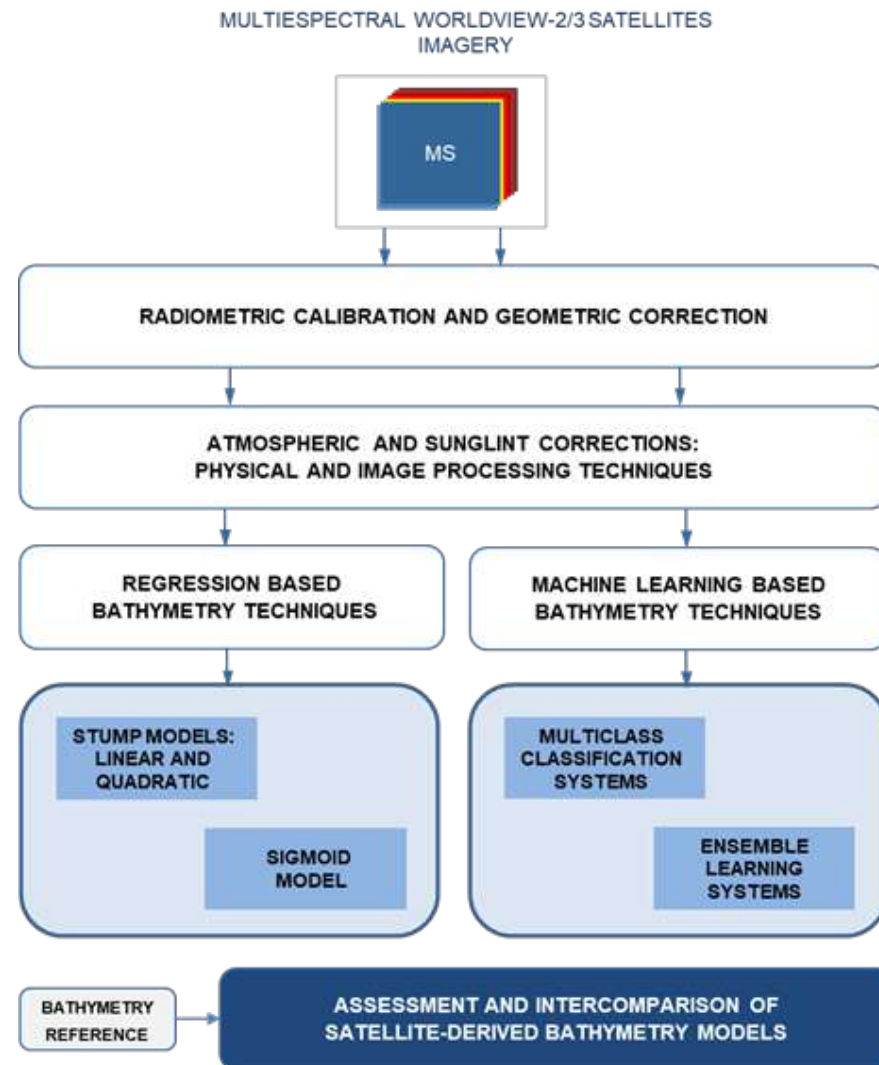
(a)

(b)



(c)

Worldview-2/3 scenes used in the analysis: (a) Cabrera, 2016. (b) Maspalomas, 2018. (c) Granadilla, 2019.







## High Resolution Satellite Bathymetry Mapping

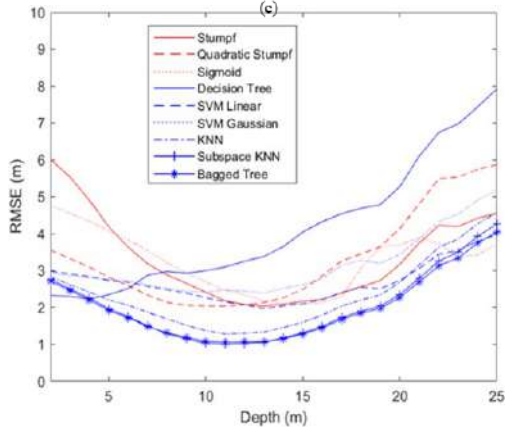


(a)

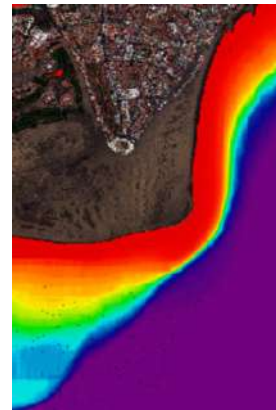
(b)



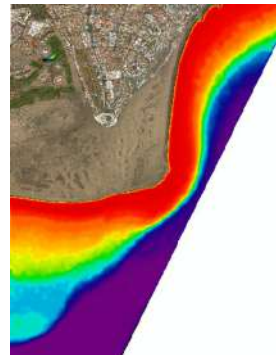
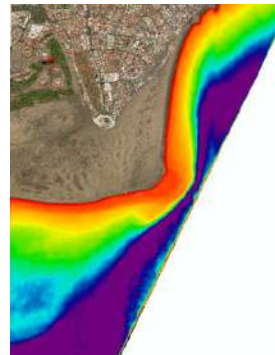
(c)



(a)



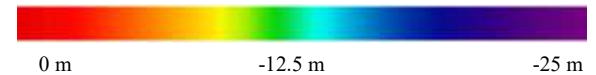
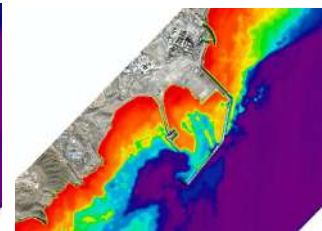
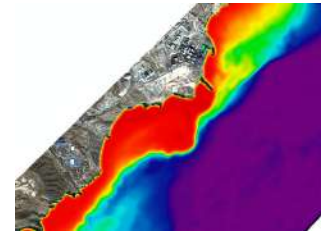
(b)



(a)



(b)





## High Resolution Multipatform Bathymetry Mapping




The main objective, linked to the **sustainable management of littoral areas**,



Implementation of a robust image processing methodology



To generate accurate bathymetry maps in coastal shallow waters using **remote sensing multipatform** imagery

	PLATFORM SENSOR	Spectral Band	Spatial Resolution (m)	Wavelength (nm)	Bandwidth (nm)
	<b>SATELLITE WorldView-3</b>	Visible and Short-wave IR (8 channels)	1.6	400 – 1633	39.3 - 86.0
	<b>SENTINEL-2</b>	Visible, near infrared and short wave infrared (13 channels)	10, 20 and 60	430-2280	20
	<b>DRONE LIKA-L</b>	Visible and Near-IR (150 channels)	0.25	400-1000	2.1



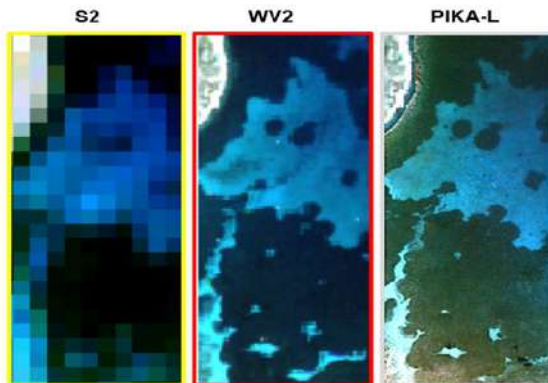
## High Resolution Multiplatform Bathymetry Mapping



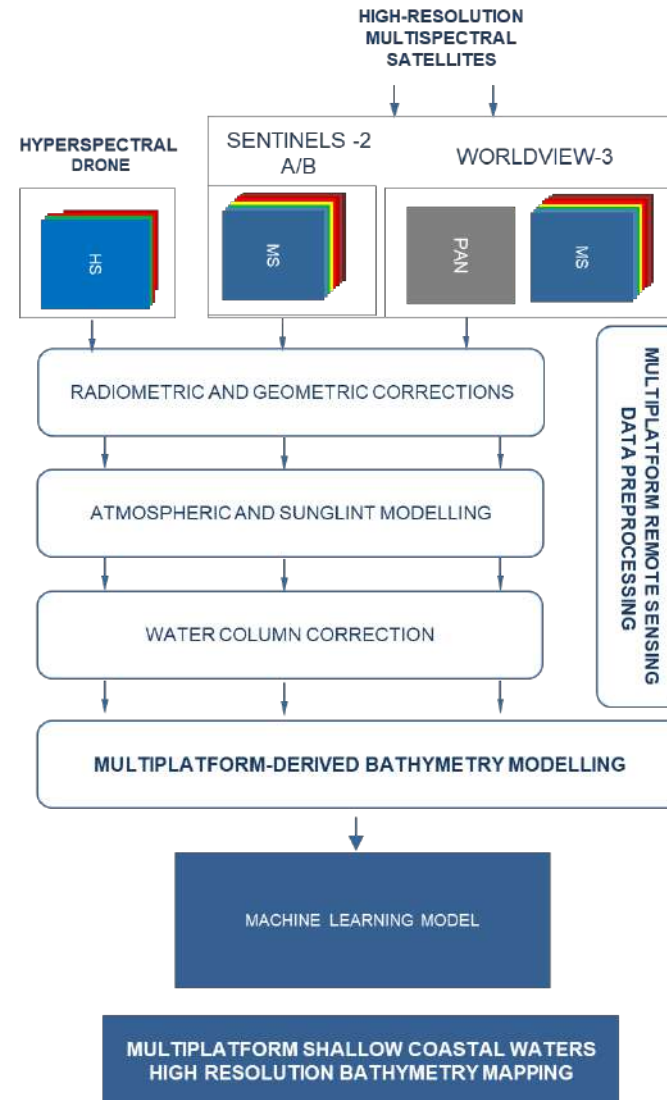
(a)



(b)



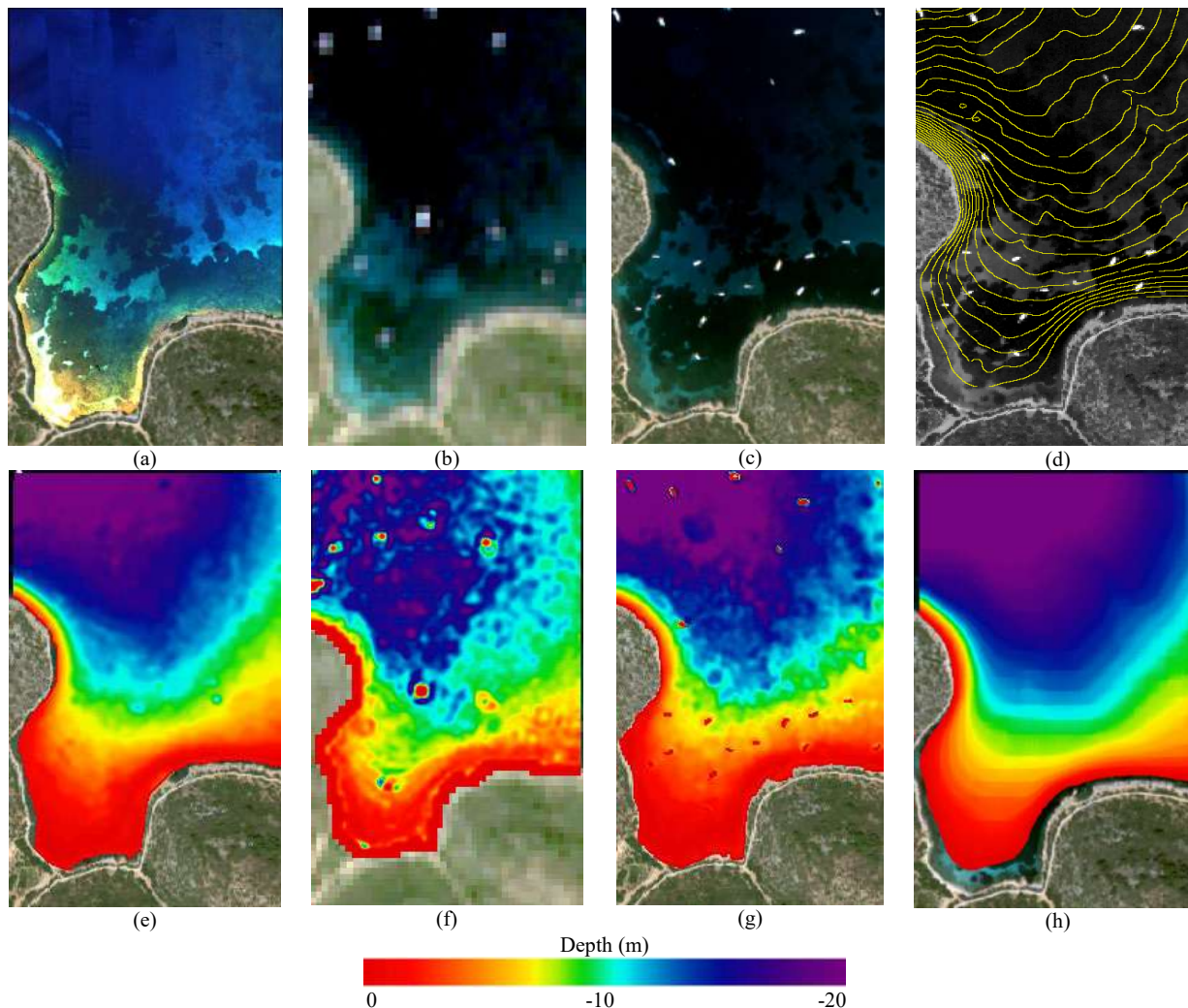
(a) Balearic Islands geographic location (Google©) and panoramic view of Cabrera Island specific area; (b), (c) Areas from the Cabrera National Park covered by each sensor: Sentinel-2 in yellow, Worldview-2 in red and Pika-L in white.







## High Resolution Multiplatform Bathymetry Mapping





## High Resolution Multipatform Bathymetry Mapping

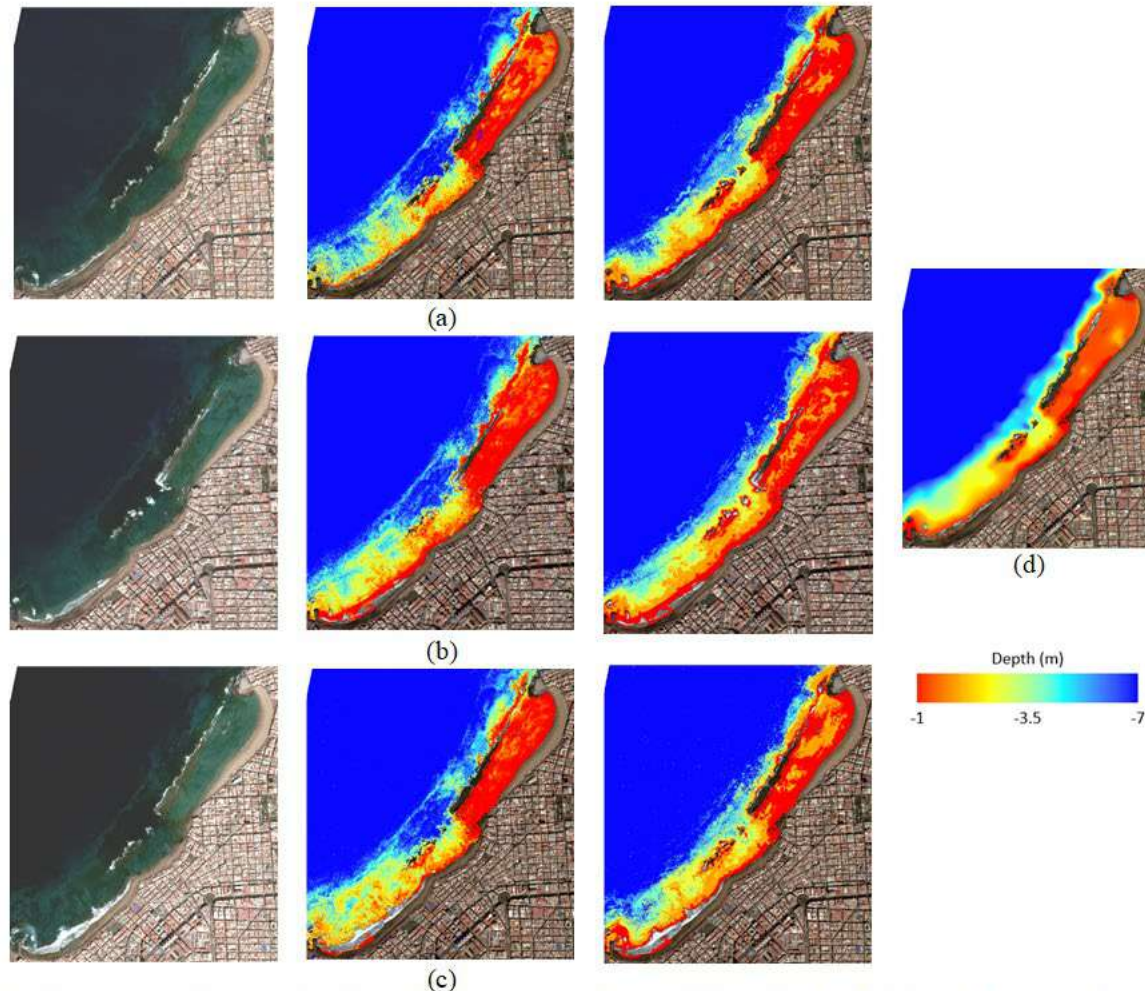


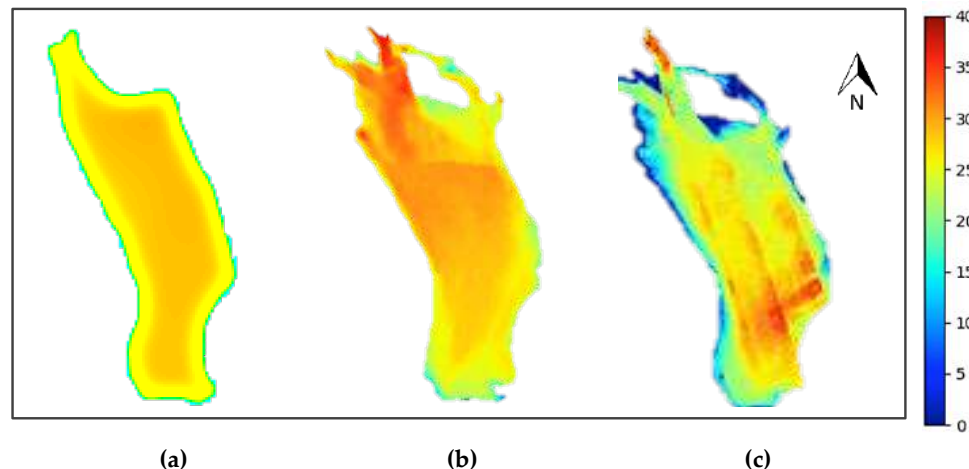
Figure 1. Bathymetric multitemporal analysis (Las Canteras beach): (a) 14 October 2014 (WV-2); (b) 18 October 2016 (WV-2), and (c) 28 February 2020 (WV-3). Left to right: RGB imagery, Sigmoid bathymetry, and Subspace KNN bathymetry. (d) Reference bathymetry.



- ✓ **MULTIPLATFORM PROCESSING METHODOLOGY TO PROPERLY RETRIEVE COASTAL SHALLOW WATER PARAMETERS:**



- **MONITORING OF MARINE NATURAL RESOURCES, SPECIFICALLY:**
  - Water quality parameter: Chl-a, TSM and CDOM.
  - Benthic habitat mapping.



**Example:** Multiplatform estimated chlorophyll-a concentration in an INNER LAGOON:  
(a) Satellite Worldview-3, (b) Airborne AHS and (c) Drone Pika-L.

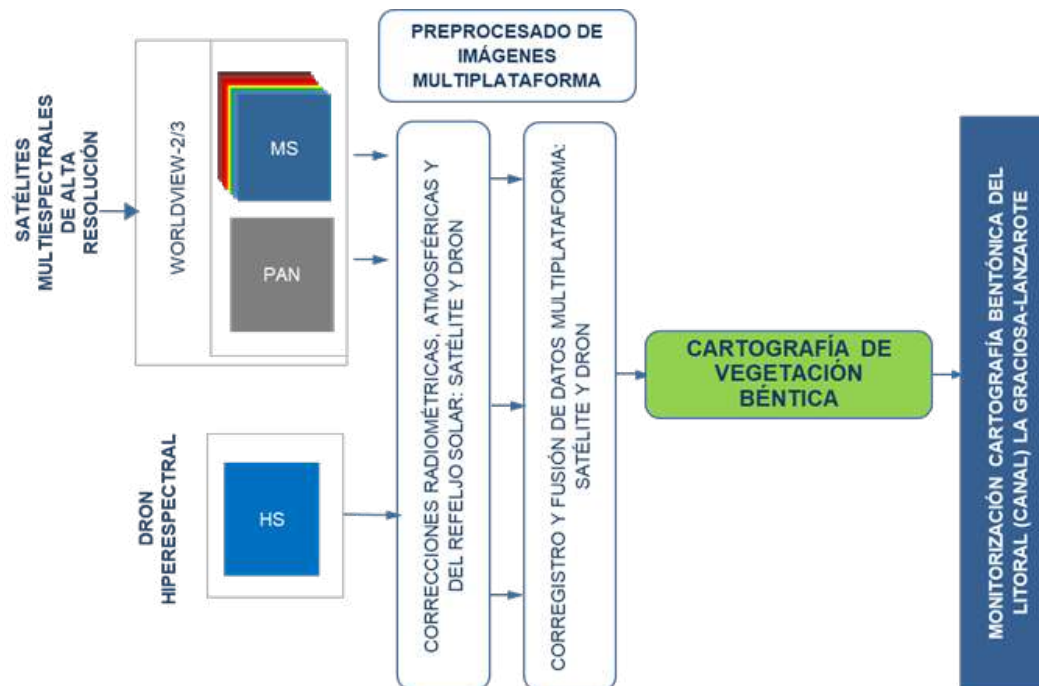




- ✓ THIS PAPER DESCRIBES A NOVEL **MULTIPLATFORM PROCESSING METHODOLOGY** TO PROPERLY RETRIEVE **COASTAL SHALLOW WATER PARAMETERS**:



- **MONITORING OF MARINE NATURAL RESOURCES**, SPECIFICALLY:
  - Water quality parameter: Chl-a, TSM and CDOM.
  - Benthic habitat mapping.

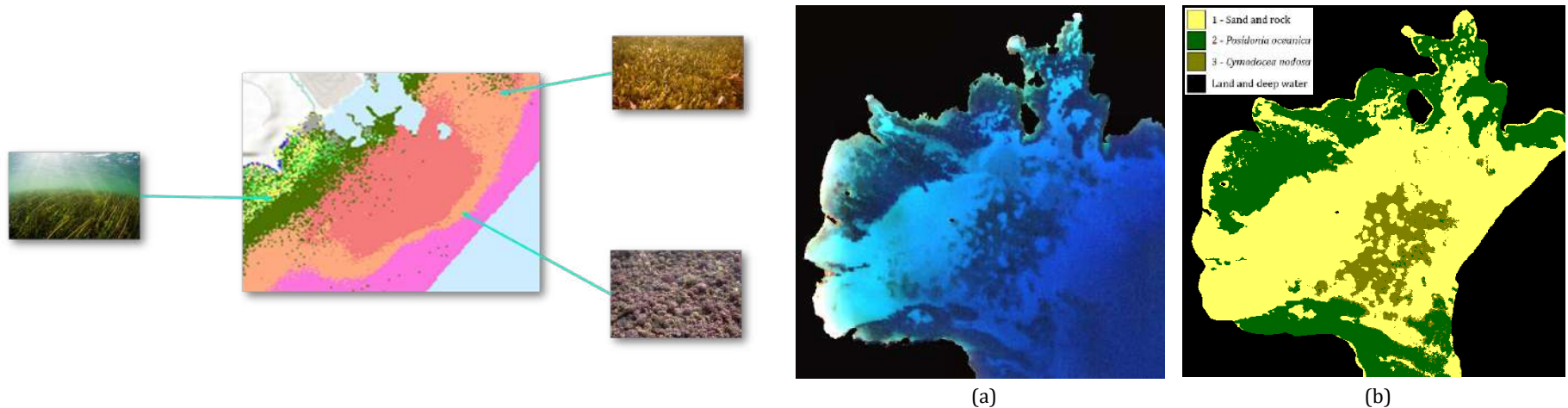




- ✓ THIS PAPER DESCRIBES A NOVEL MULTIPLATFORM PROCESSING METHODOLOGY TO PROPERLY RETRIEVE COASTAL SHALLOW WATER PARAMETERS:



- **MONITORING OF MARINE NATURAL RESOURCES**, SPECIFICALLY:
  - Water quality parameter: Chl-a, TSM and CDOM.
  - Benthic habitat mapping.



**Example:** Bottom classification for Cabrera Island: (a) WorldView-2 true color composite, (b) Machine learning, Subspace-KNN map .



- ✓ PUBLICATIONS: **MULTIPLATFORM PROCESSING METHODOLOGY TO PROPERLY RETRIEVE COASTAL SHALLOW WATER PARAMETERS:**



[1] F. Eugenio, J. Marcello, and J. Martin, "High-resolution maps of bathymetry and benthic habitats in shallow-water environments using multispectral remote sensing imagery," IEEE Transactions on Geoscience and Remote Sensing, vol. 53, no. 7, pp. 3539-3549, July 2015.

[2] J. Marcello, F. Eugenio, C. Gonzalo-Martín, D. Rodríguez-Esparragón and F. Marqués, "Advanced Processing of Multiplatform Remote Sensing Imagery for the Monitoring of Coastal and Mountain Ecosystems," IEEE Access, vol. 9, pp. 6536-6549, 2021.

[3] F. Eugenio, J. Marcello, A. Mederos-Barrera, and F. Marqués, "High Resolution Satellite Bathymetry Mapping: Regression and Machine Learning Based Approaches," IEEE Transactions on Geoscience and Remote Sensing, vol. 60, pp. 1-14, 5407614, March 2022.

[4] A. Mederos-Barrera, J. Marcello, F. Eugenio, and E. Hernández, "Seagrass mapping using high resolution multispectral satellite imagery: A comparison of water column correction models," International Journal of Applied Earth Observation and Geoinformation, 113, 102990, 2022.



# OCEANOGRAFÍA Y CAMBIO GLOBAL: Perspectivas para la formación de futuros investigadores

Conclusions and  
Actual/Future Works



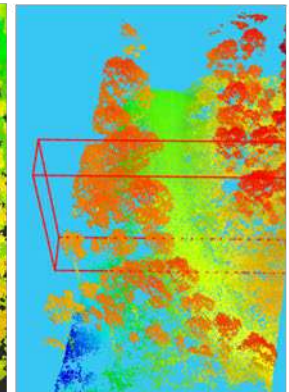
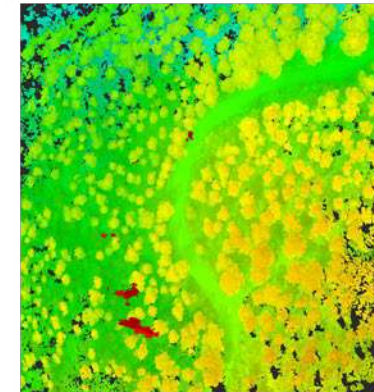
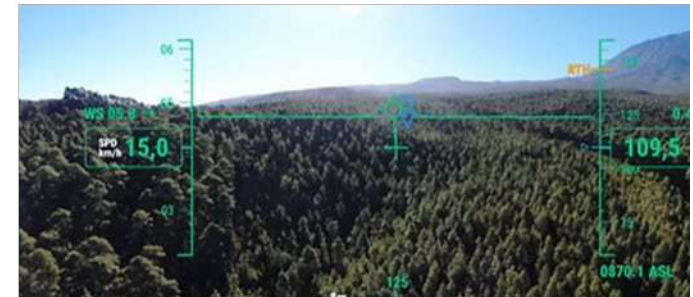
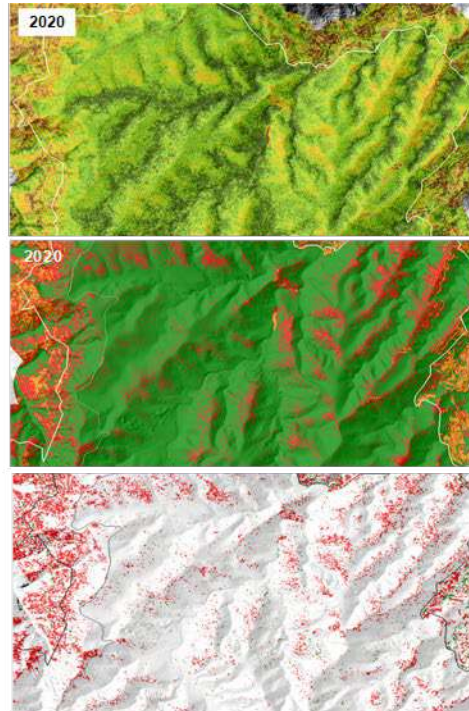
- ✓ VIGILANCIA ESPACIOS TERRESTRES NATURALES (PARQUES NACIONALES): ANÁLISIS DEL ESTADO DE SALUD DE ZONAS NATURALES MEDIANTE DATOS ÓPTICOS Y LIDAR (MULTIPLATAFORMA).



# OCEANOGRAFÍA Y CAMBIO GLOBAL: Perspectivas para la formación de futuros investigadores



- ✓ VIGILANCIA ESPACIOS TERRESTRES NATURALES (PARQUES NACIONALES): ANÁLISIS DEL ESTADO DE SALUD DE ZONAS NATURALES MEDIANTE DATOS ÓPTICOS Y LIDAR (MULTIPLATAFORMA).







# PROCESAMIENTO DE IMÁGENES DE TELEDETECCIÓN MULTIPLATAFORMA (SATÉLITES Y DRON) PARA LA MONITORIZACIÓN (BATIMETRÍA, CLASIFICACIÓN DEL FONDO) DE AGUAS COSTERAS POCO PROFUNDAS

GRACIAS!!!