| SFPTGH - Paris 5-6 Juillet 2023

Underwater Hyperspectral Imaging

Discriminating and assessing ecological status of benthic habitats in deep environment

T. Bajjouk, M.Ferrera, T. Petit & A. Anaubec




marha marine habitats

iAtlantic INTEGRATED ASSESSMENT OF ATLANTIC MARINE ECOSYSTEMS IN SPACE AND TIME

Ifremer

Objectives

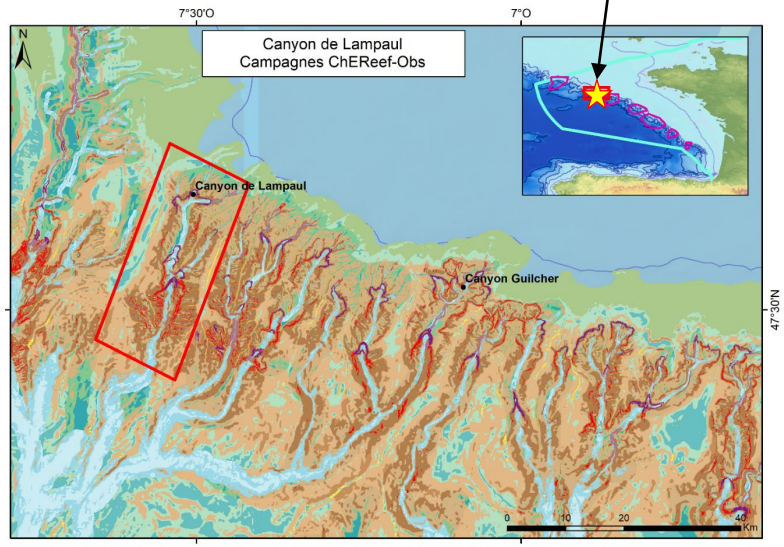
Deep Environment Context

- Massive expansion of the of collected **data volume**
- Extraction of thematic from underwater **videos** mainly by **visual interpretation**
- Very **time-consuming** processing

Added values of UHI high spectral resolution ?

- **Automatic classification** for spatio-temporal monitoring
- Seabed type **discrimination enhancement**
- Seabed description **Metrics**
- Ability to **assess ecological status**

Lampaul Canyon (700-1000m)



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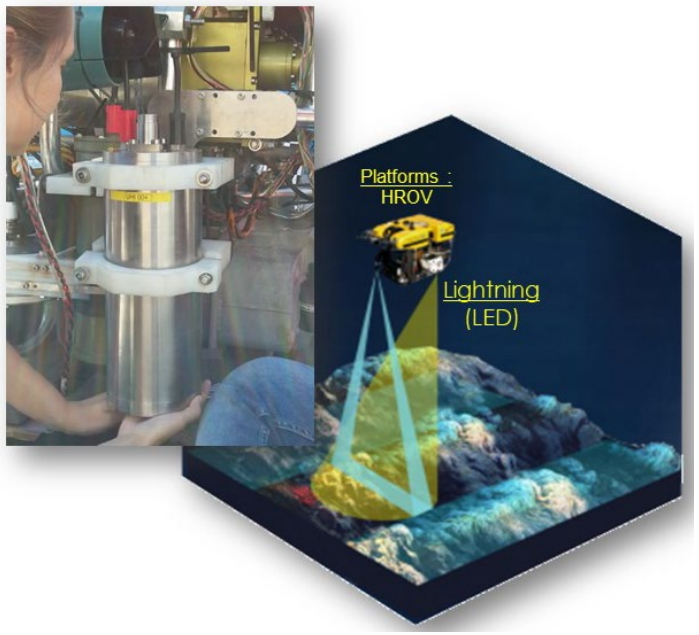
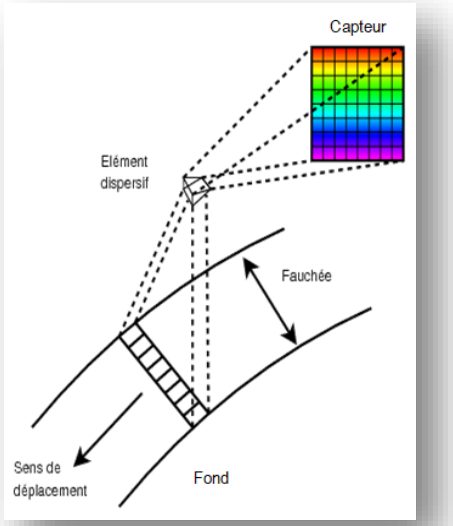
UHI Sensor specification

Underwater Hyperspectral Imaging (UHI)



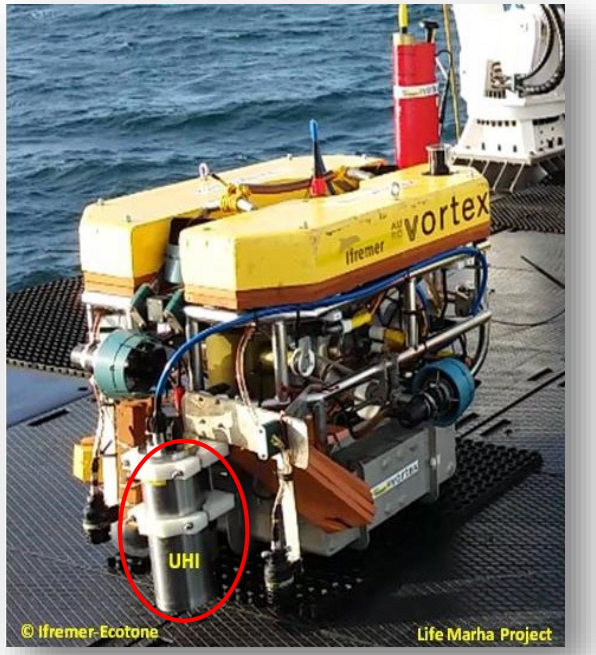


UHI Technical specifications :

- **Push-broom** scanner
- Lines of **1900 pixels** perpendicular to the track direction
- Spectral bands between **378 and 800 nm**
- Spectral resolution of **4 nm**.
- Depth rating : **3000 m**
- Integrated **IMU**
- Run in **parallel with RGB** high resolution camera.

UHI Integration Test-Survey

Life Marha project (2019)
(Brest, Atlantic, 10-30m)

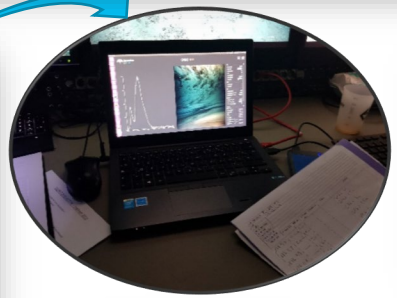


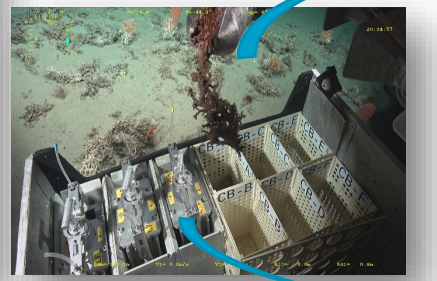
Integration to Ifremer HROV

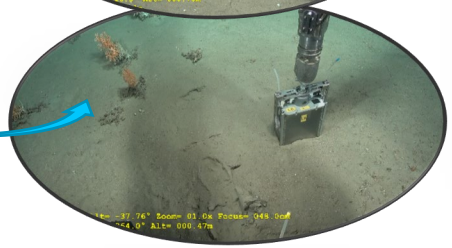
EU Marine Robots Project (2021)
(Toulon, Mediterranean sea, 200-500m)

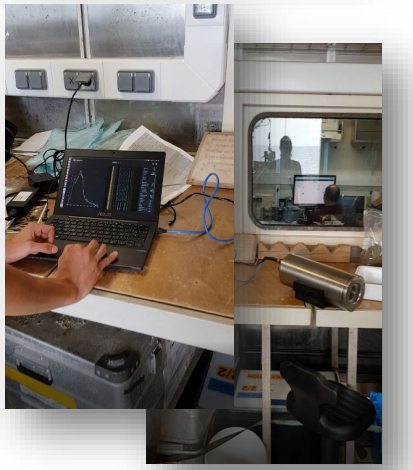
Elaborate data acquisition protocol

Data Acquisition









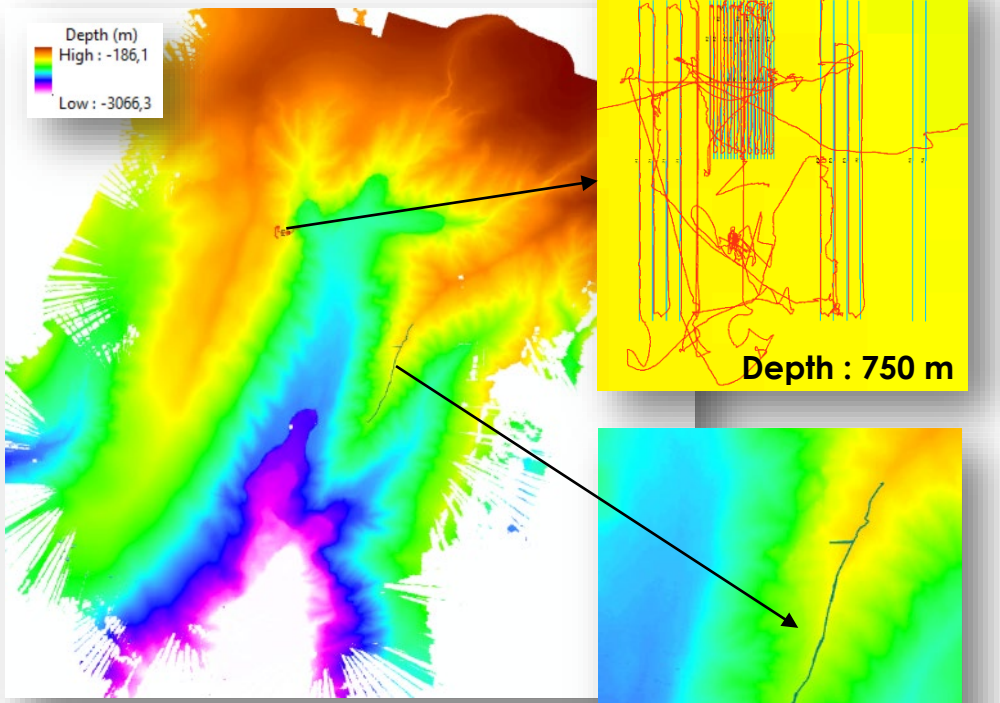
Water Turbidity Measurement

Calibration chart Deployment

Chereef cruise, August 2022
(Lampaul Canyon)

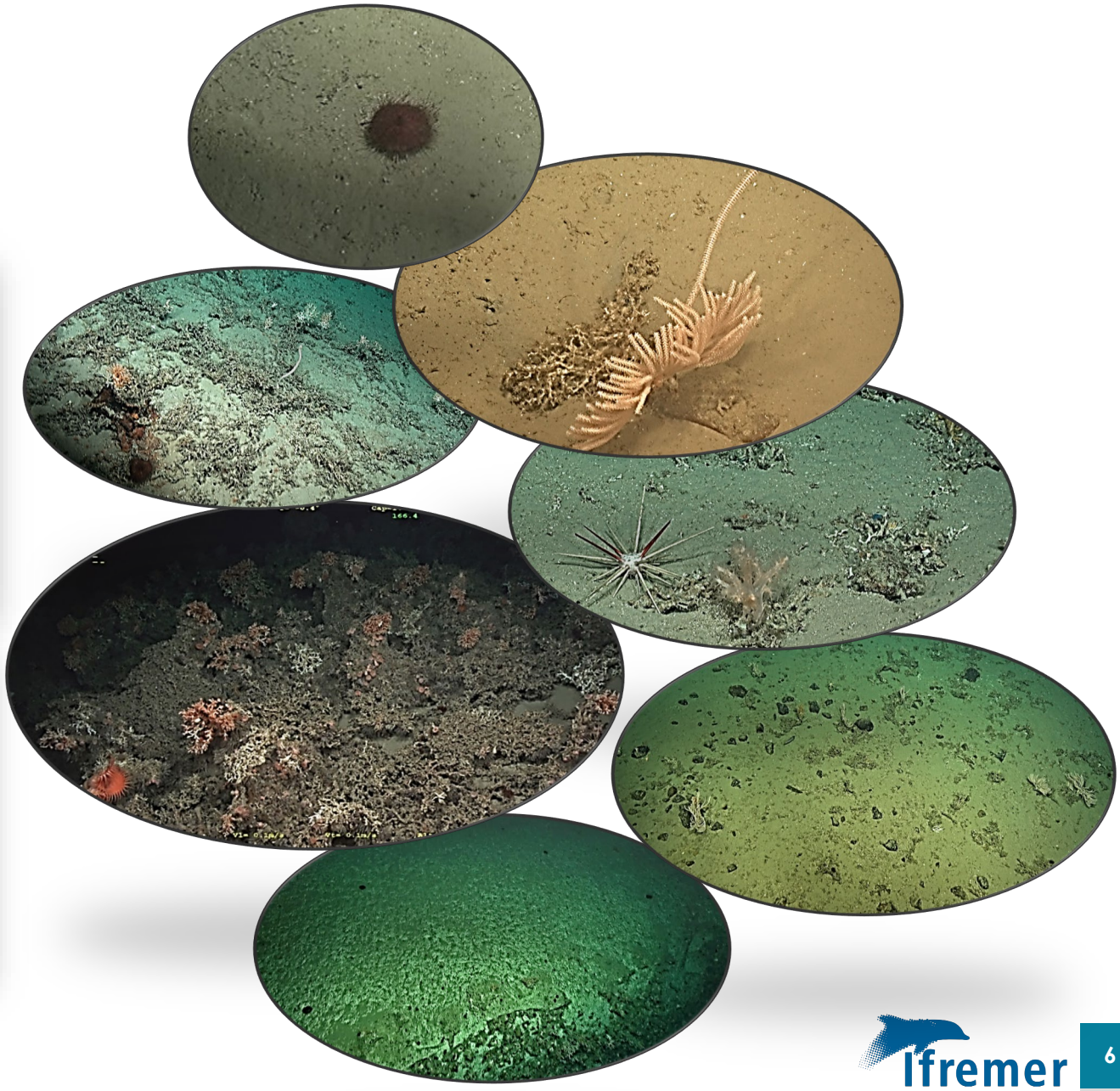
Data Acquisition

29 profiles (45 to 90 m)

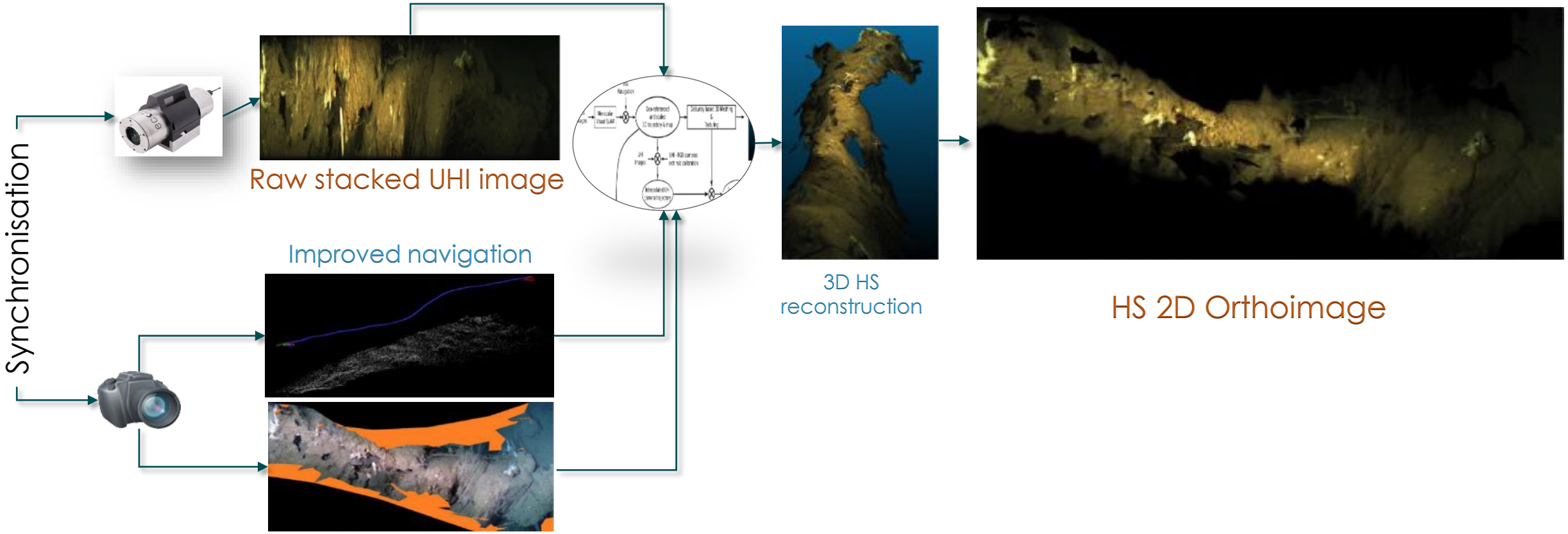


Lampaul Canyon

1 long profile (3000 m)



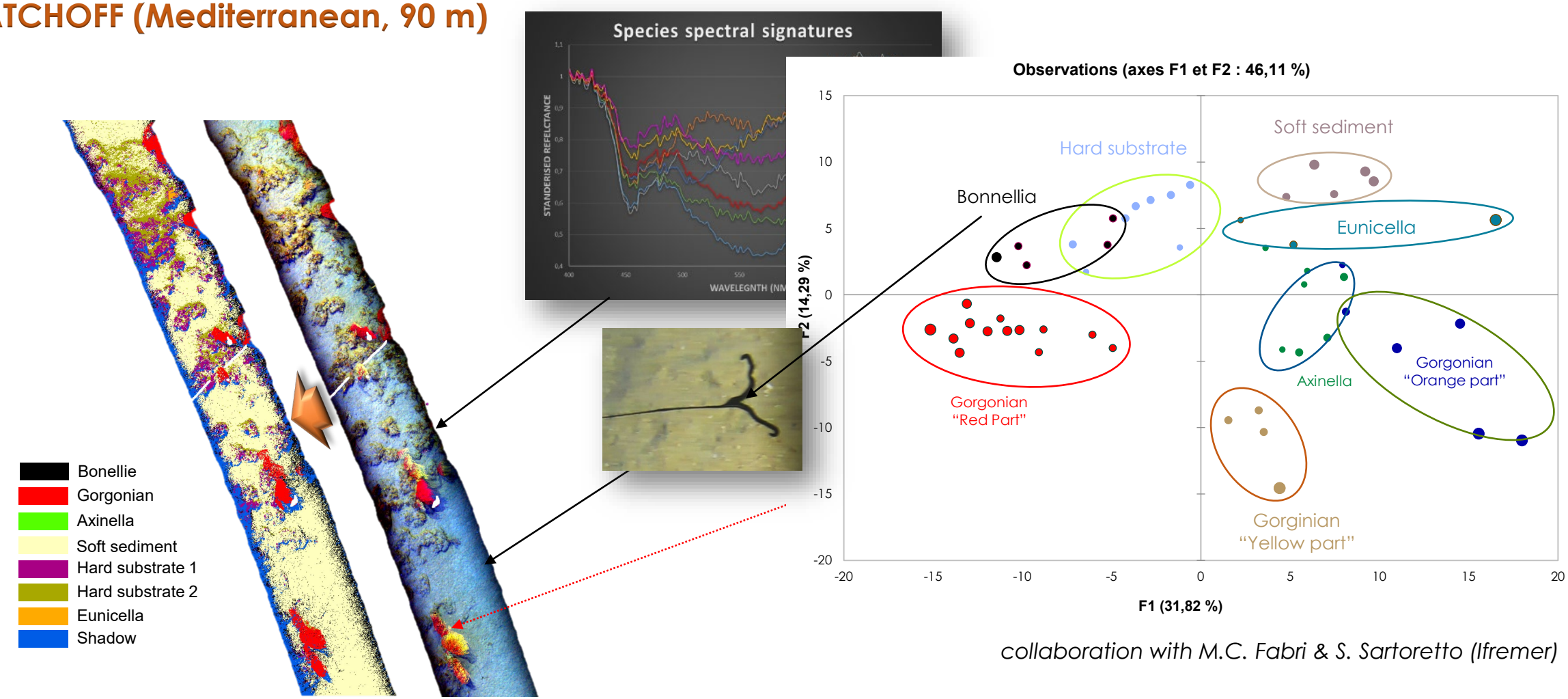
Geocorrection Improvements



Ferrera et al., ICCVW 2021

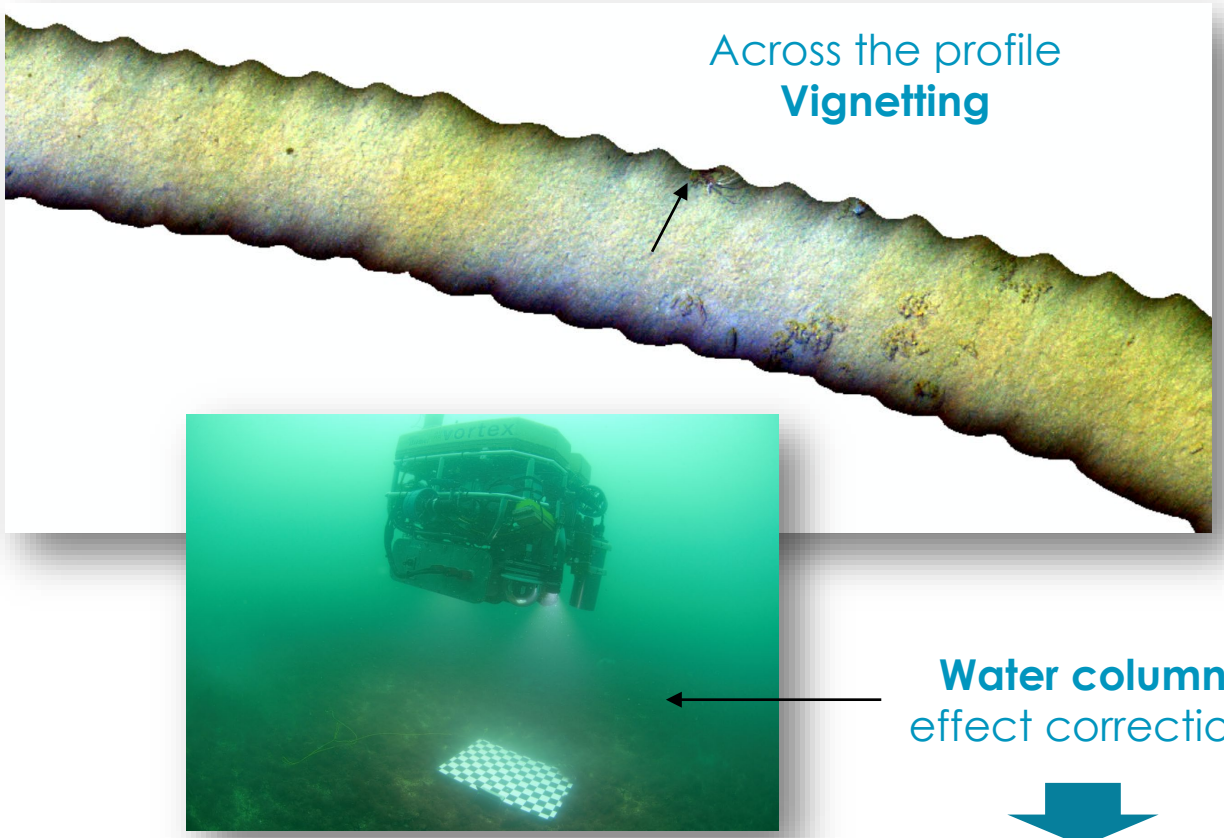
Mapping Gorgonian Ecosystem

CATCHOFF (Mediterranean, 90 m)

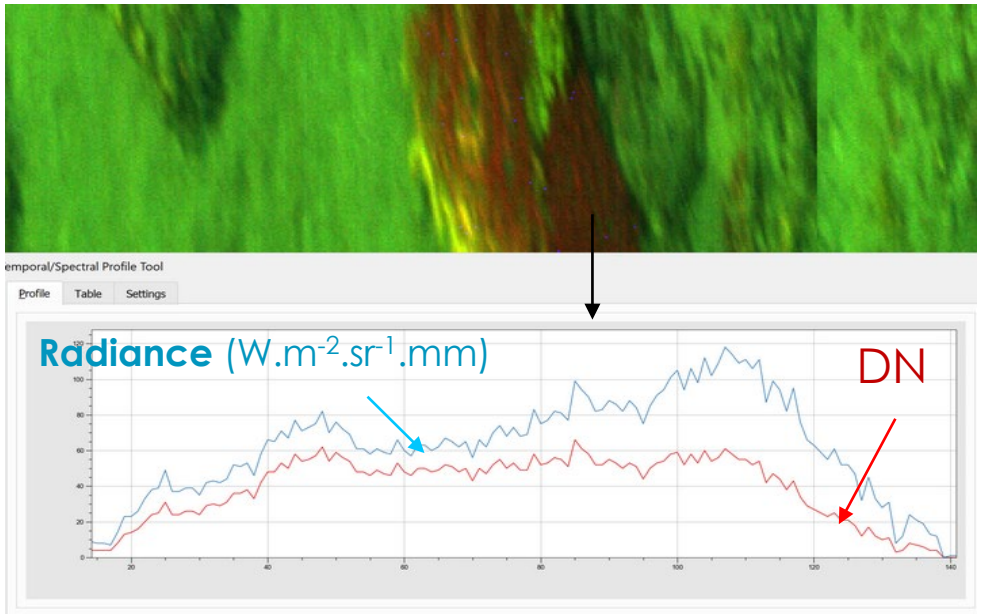


collaboration with M.C. Fabri & S. Sartoretto (Ifremer)

Radiometric calibration

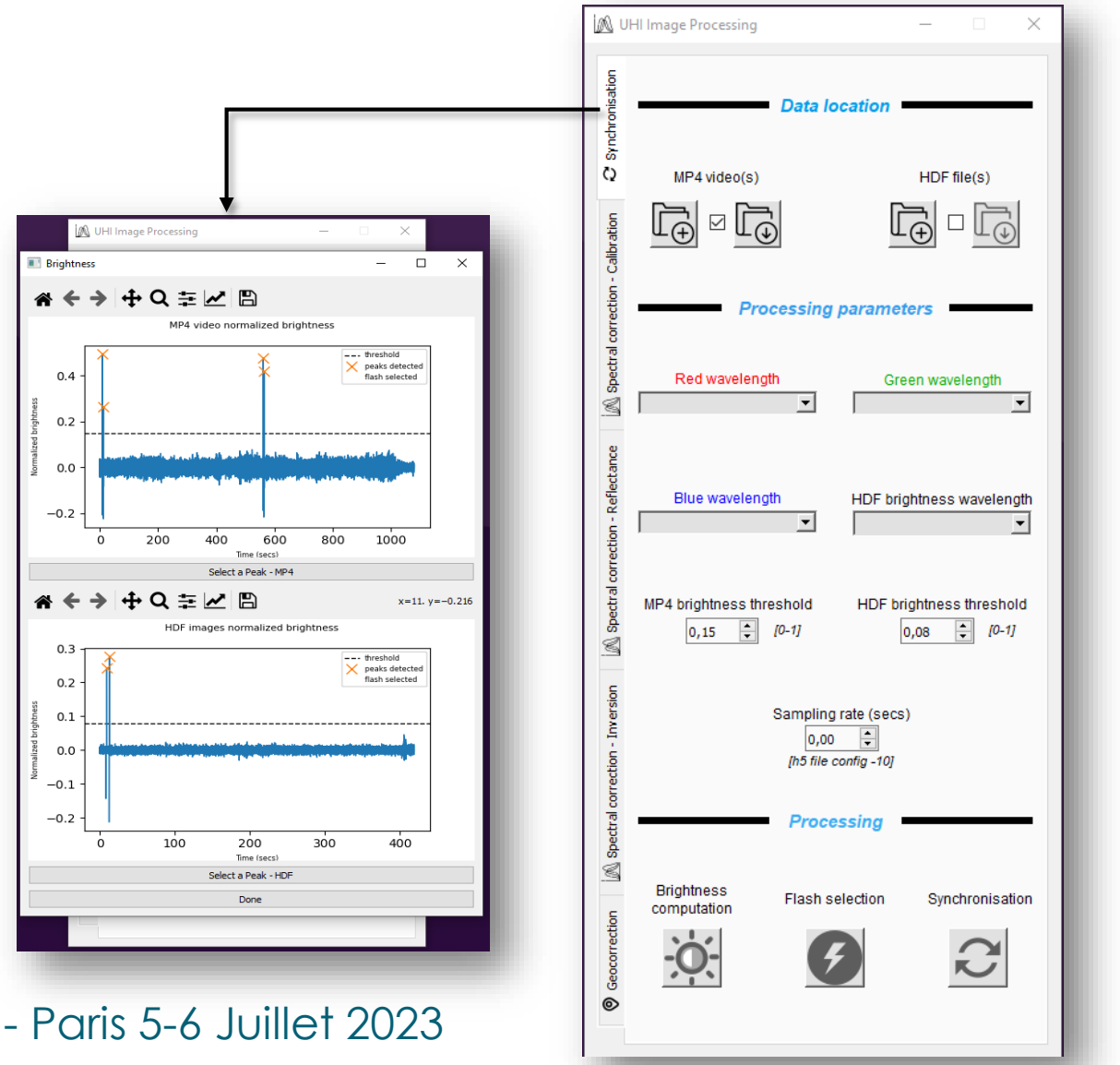


Raw data
Need to be radimetricaly calibrated !



Gorgonian specterum

Pre-processing Software Development



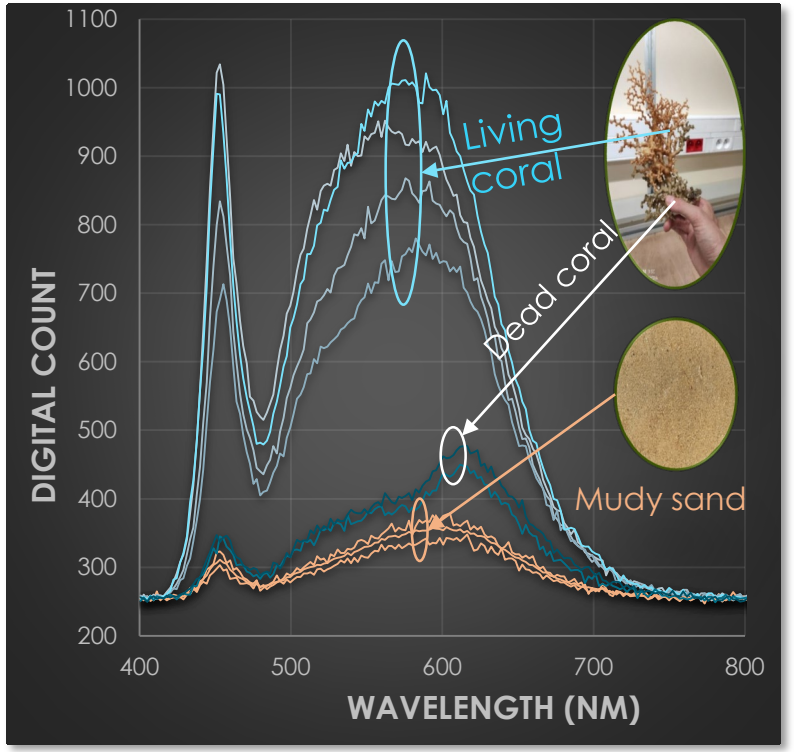
UHI Software Functionality

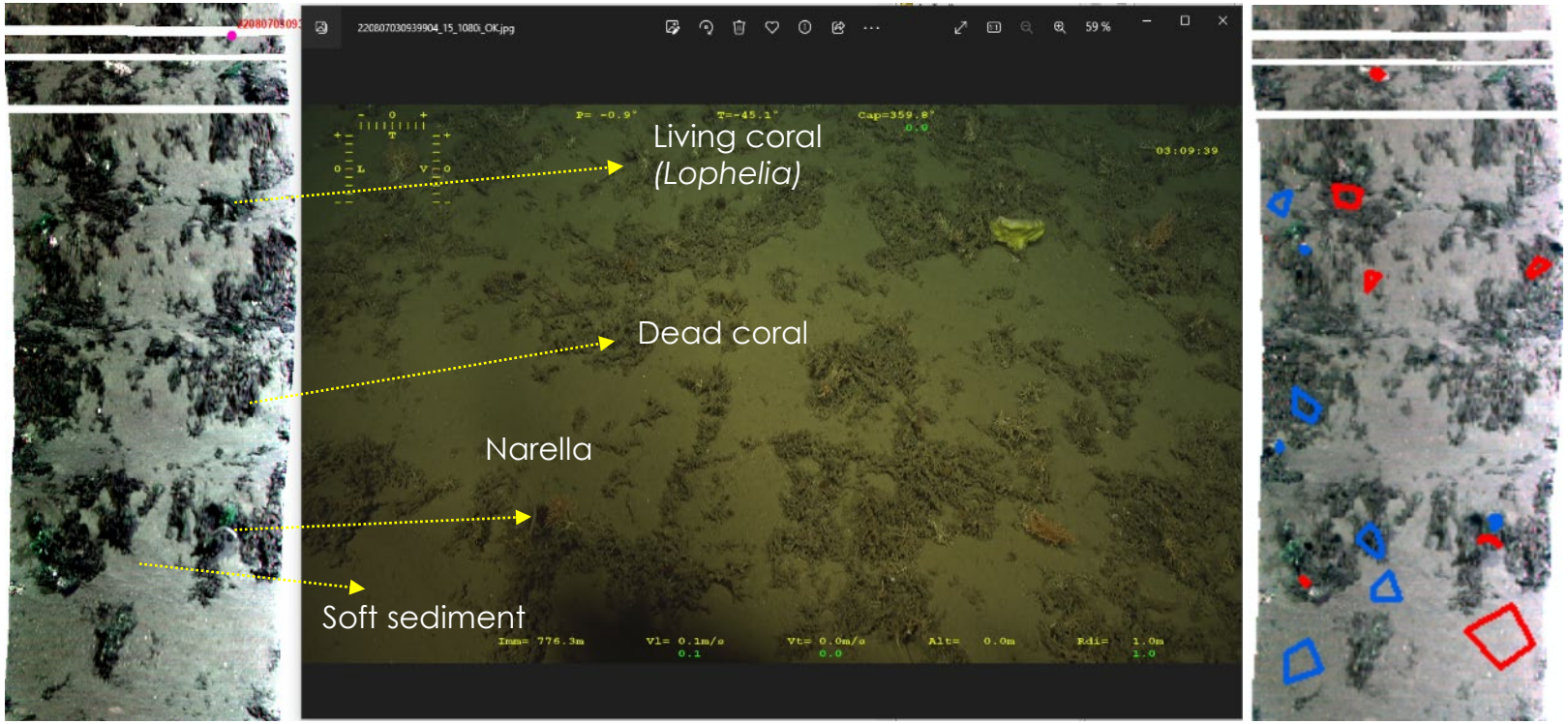
- Synchronisation
- Radiometric calibration
- Radiative Transfet Model Inversion
- Geocorrection

Ferrera M., Tristan P., Arneaubec A., Lelandais T. and Bajjouk T. (2023). *Geometric correction and radiometric calibration tool for underwater hyperspectral imaging.*

CWC Ecological Status Assessement

Lampaul Canyon (Atlantique, 750 m)





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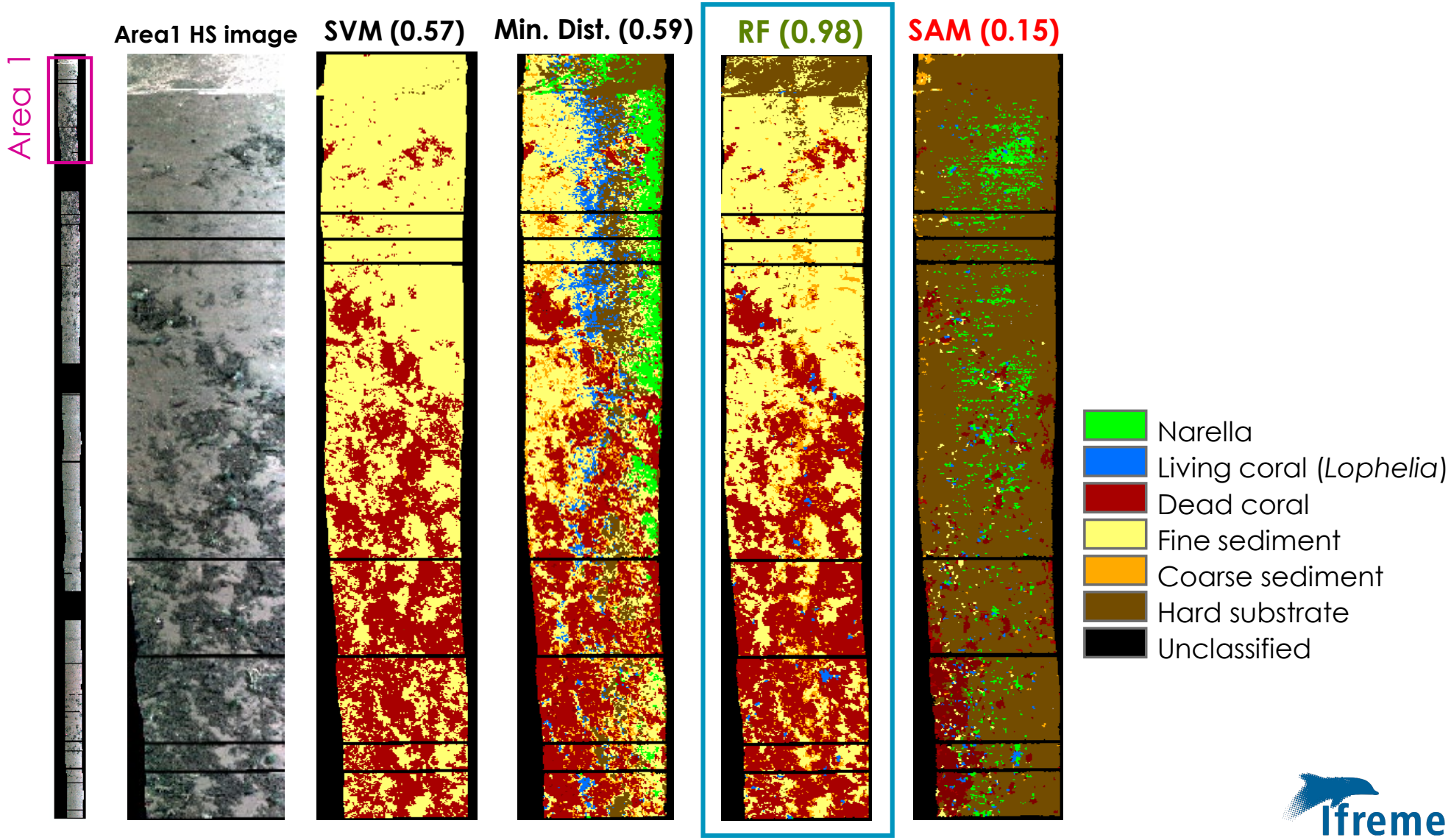

CWC Ecological Status Assessement

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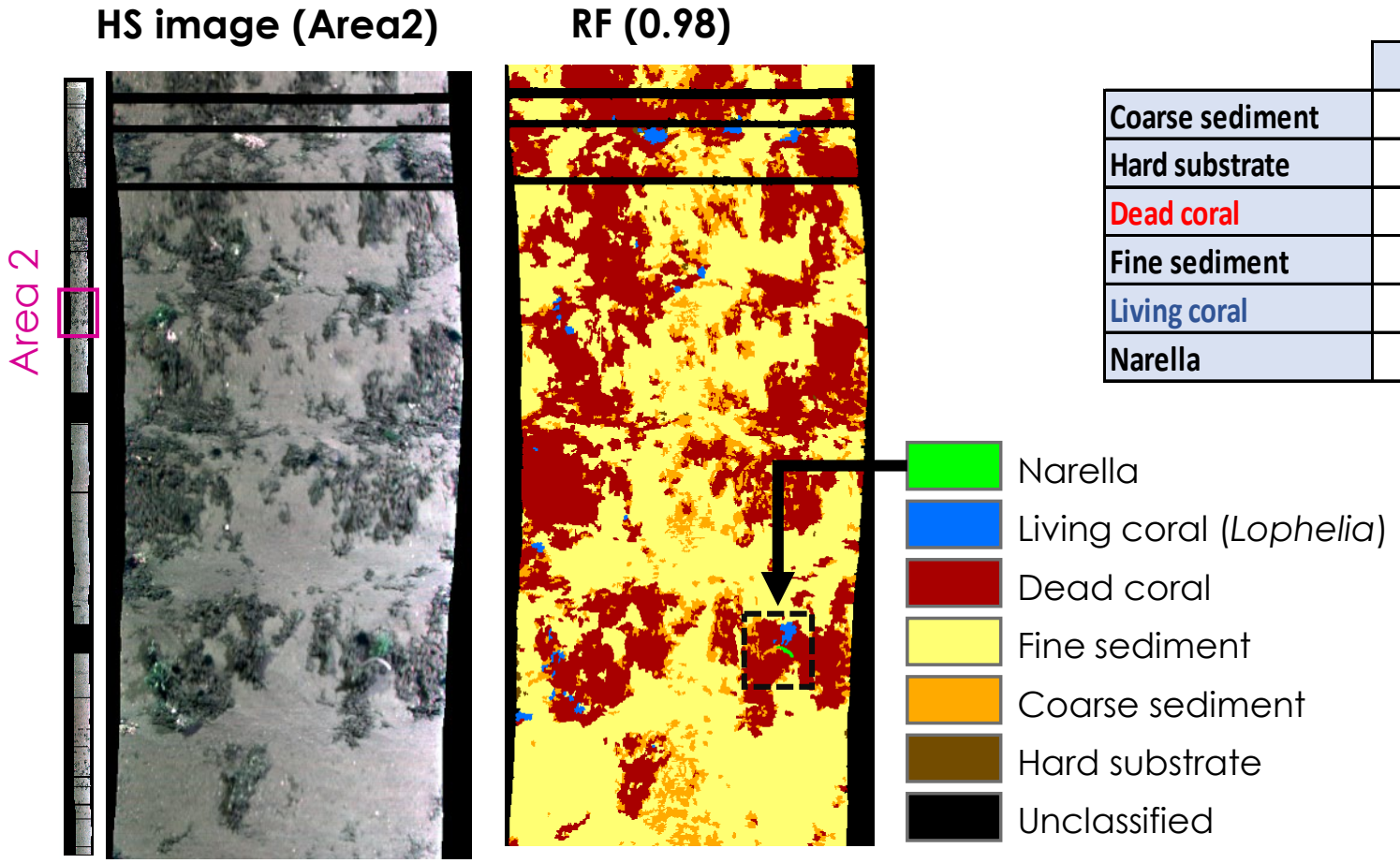

	Area (m²)	Area (%)	NB pachs
Coarse sediment	17,80	15,17	6783
Hard substrate	1,36	1,16	451
Dead coral	19,44	16,57	1497 (77)
Fine sediment	78,38	66,78	2057
Living coral	0,37	0,32	222 (595)
Narella	0,01	0,01	6

Conclusion

- **Ability of UHI to automatically** extract relevant **information** on deep sea environments
- The main **difficulties** are related to the **geometric correction**
- **3D reconstruction** based on structure-from-motion methods can significantly improve the geometric correction qualities
- **Protocol and recommendations** for UHI deployments

& next steps …

- Can UHI data help to characterize **Biodiversity on shallow coral** reef area (Recif-3D Project) ?
- UHI deployment in **operational framework** for spatio-temporal seabed monitoring ?
- Does **Snapshot architecture** with its **ability** to acquire 2D images improve geometric data quality ?

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And to ecotone team

touria.bajjouk@Ifremer.fr

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