

Espace-Dev IRD - Université de La Réunion

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Espace-Dev: Earth Observation Science

- Expertise in remote sensing, signal processing, geomatics, environmental geography and GIS, oceanography and climatology.

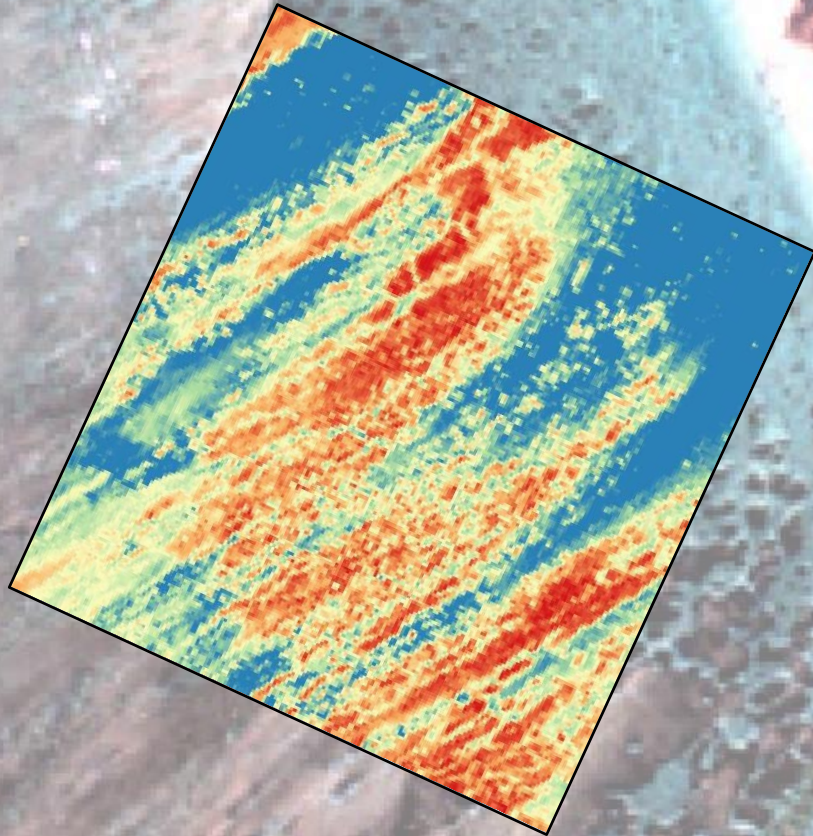
- Mainly in the geography of coastal, island, tourism and health territories, but also in anthropology, environmental law and botany.



AIRBUS

USE CASE

Live coral detection and
mapping
using satellite data



Application: Coral Reef Monitoring, Environment, Global Changes

Location: South West Indian Ocean (Reunion, Mayotte)

Products: Pléiades Neo, Pléiades, SPOT, Sentinel-2, in-situ data



Challenge

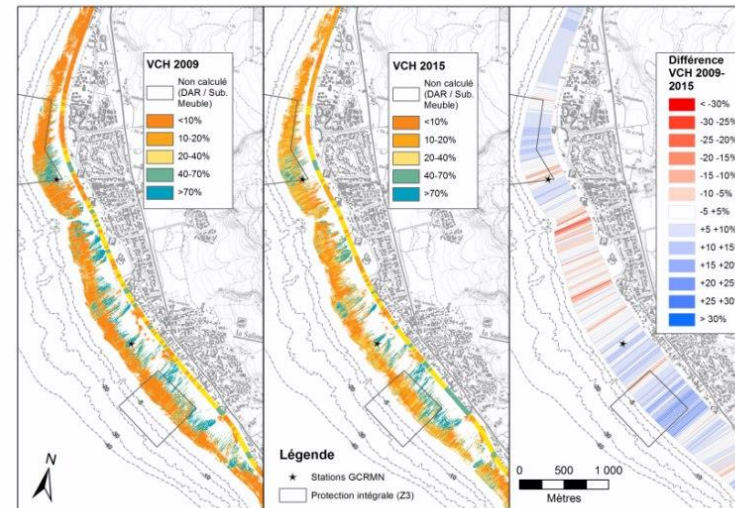
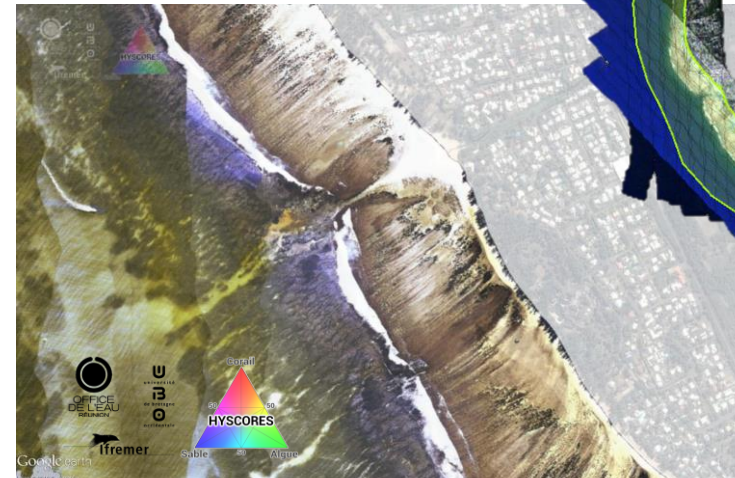
Coral reef ecosystems are facing increasing pressures and disturbances, leading to a worldwide degradation of their status

- Optical remote sensing is commonly used to map and monitor coastal benthic habitats.
- Hyperspectral aerial images, have been used to monitor the evolution of living corals over the reef platforms of Reunion Island
- In 2022 correlations with spectral indices computed from high and very high resolution satellite images (Pléiades, SPOT6/7, Sentinel-2) and historical and field data have been established.

Could new Pléiades Neo images, with enhanced spectral and spatial resolutions, be used to:

=> detect spatial and temporal evolutions of geomorphological and biological features across the reef flats ?

=> improve coral distribution models and mapping ?



	PL	SPOT	S2
2015/2016			
2021			
2022			



Data used

- Pléiades Neo image

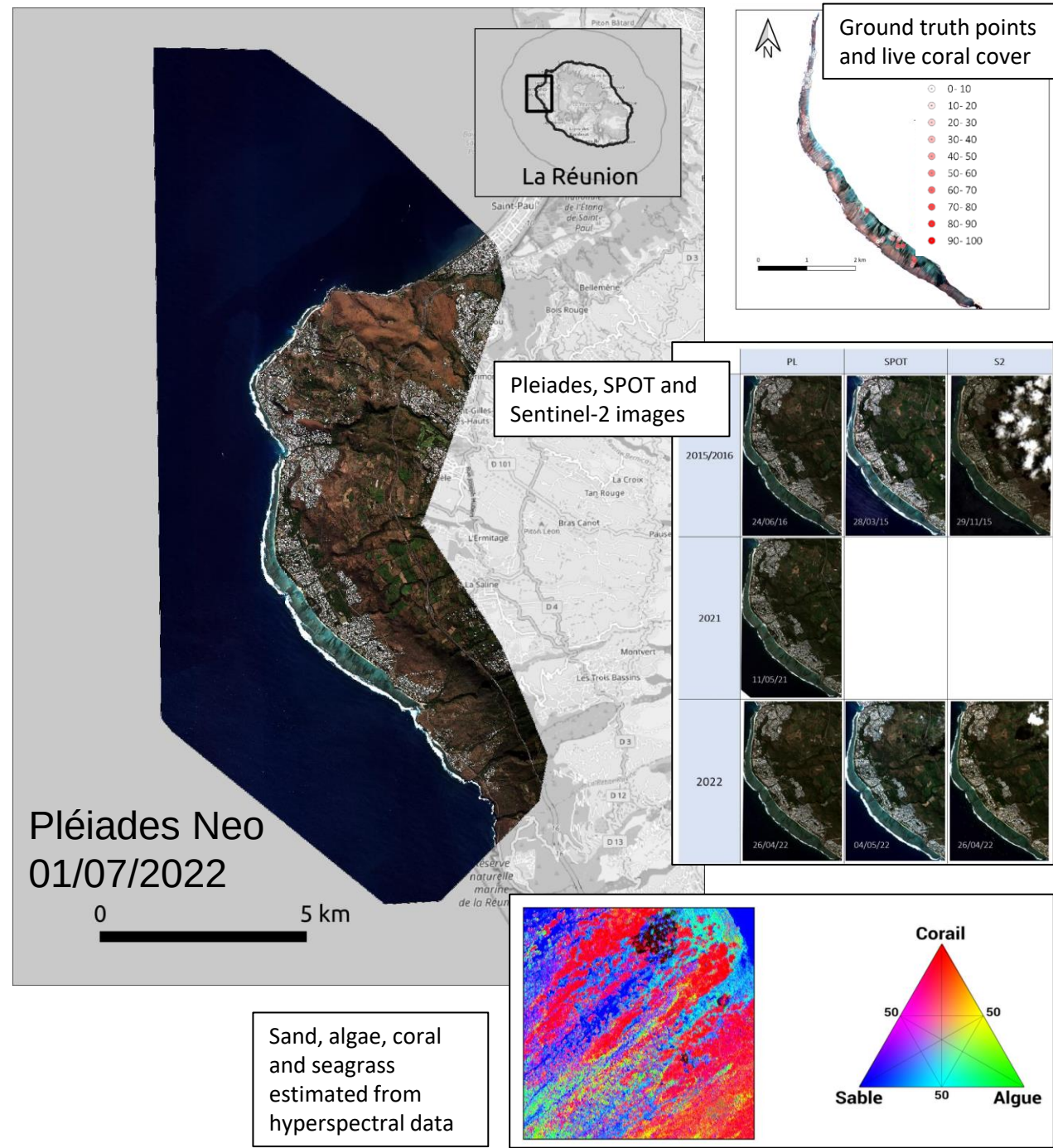
Acquisition date	Location	Acquisition Angle	Cloud cover	Processing level	Area
01/07/2022	La Reunion	18.37°	17%	Orthorectified	77km ²

- In situ measurement points

- GPS locations
- Identification of benthic components (coral / algae / substrate) and covers

- Historical data

- Estimated live coral cover from HS data
- Other satellite images (Pleiades, SPOT, Sentinel-2)





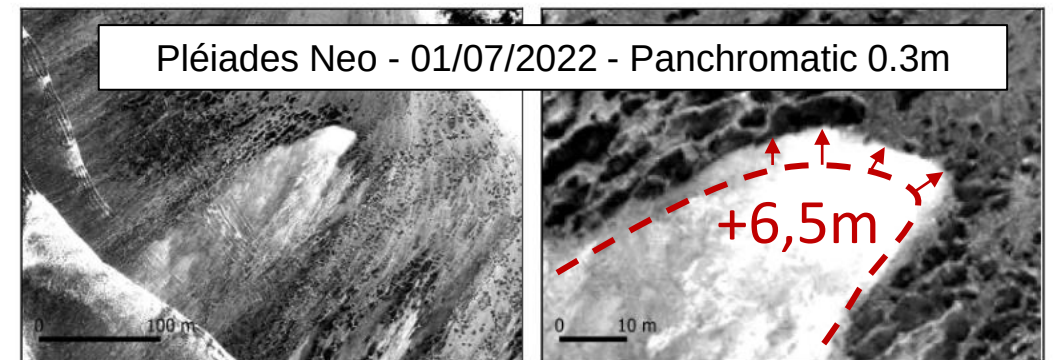
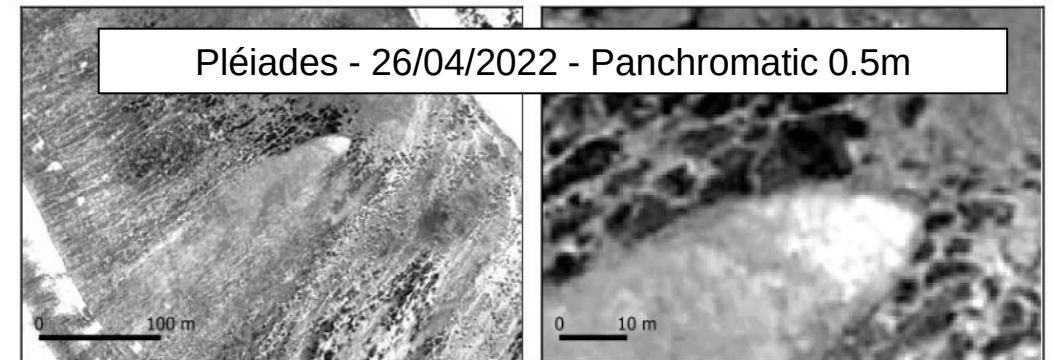
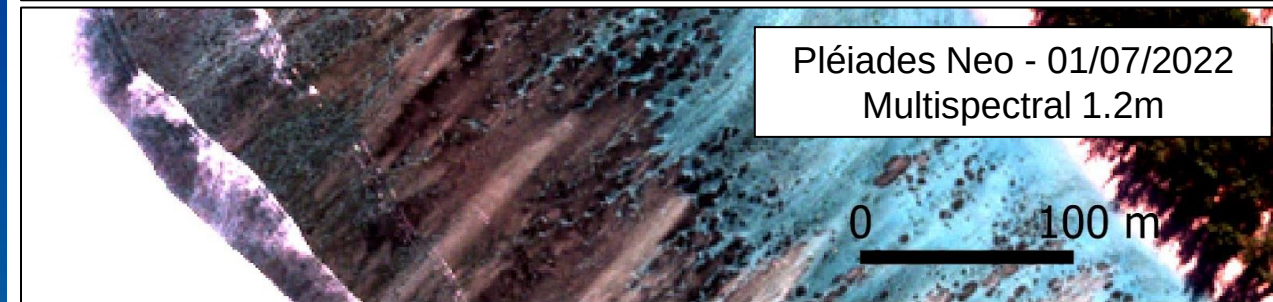
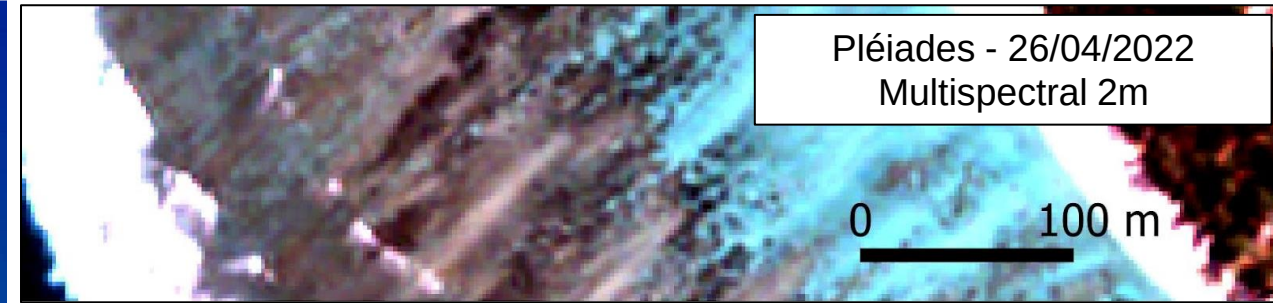
Solution & Results

1. Visual analysis

- Seafloor features are easily recognizable and their outlines are sharp. The darker isolated coral colonies stand out clearly on the light colored sandy bottoms of the back reef depression, and the sandy grooves crossing the hard algal reef flats are clearly visible.
- Estimation of the progression of a rubble tongue at approximately 6.5 m in 2 months, with significant loss of reef structural complexity and heterogeneity and decrease in live coral covers (mainly of the Acropora genus).

Pléiades Neo Imagery advantages:

- **Benefits of the superior spatial resolution offered by the PNEO images, compared to conventional satellite images, including Pléiades**
- **The PNEO images seem here more suitable to the specificities of the reef platforms of Reunion, with low coral covers and small colonies scattered and isolated in the middle of the underlying substratum (hard reef flats or sandy backreefs).**



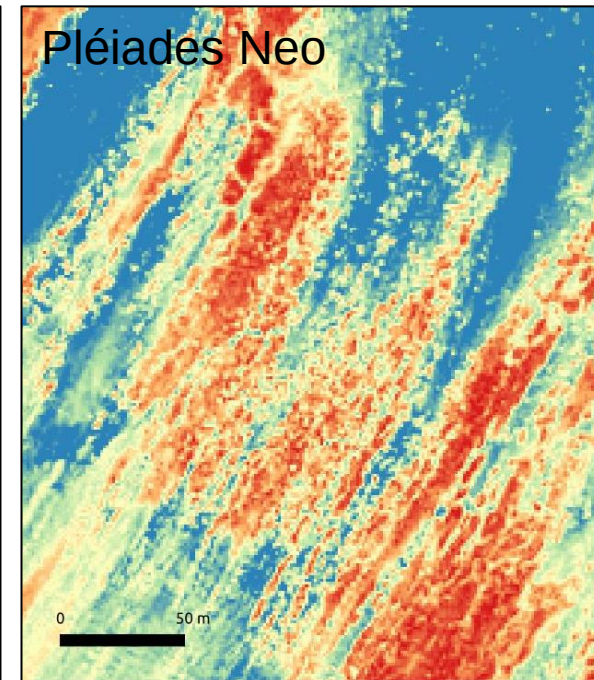
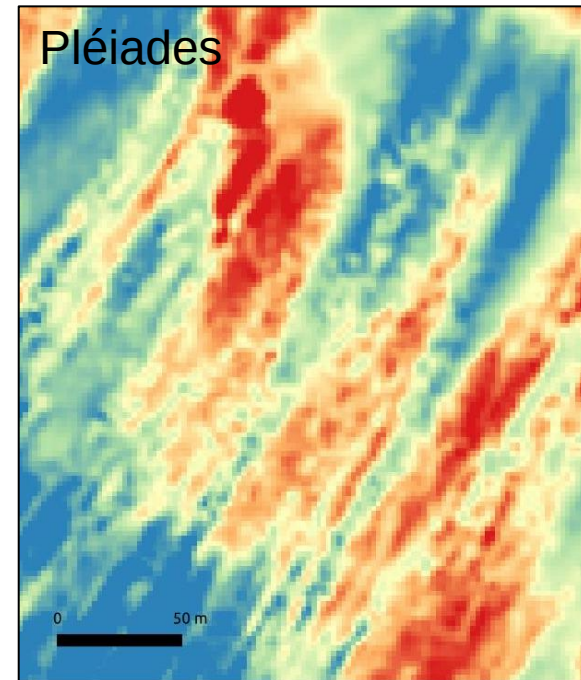
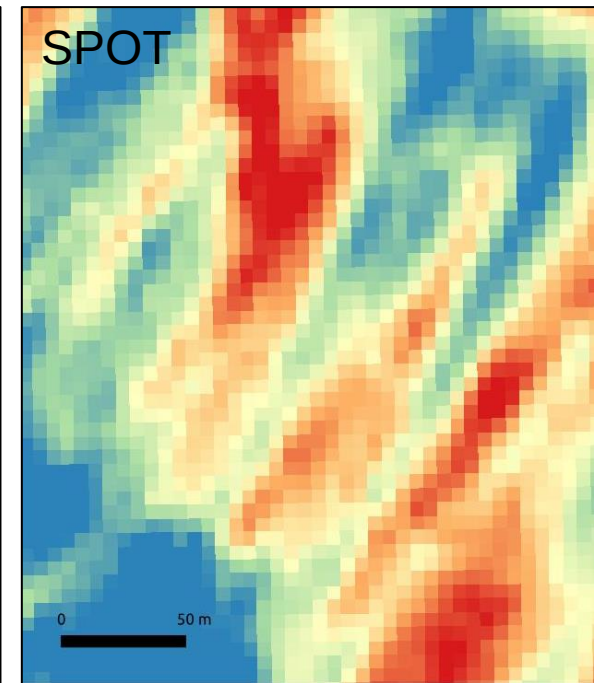
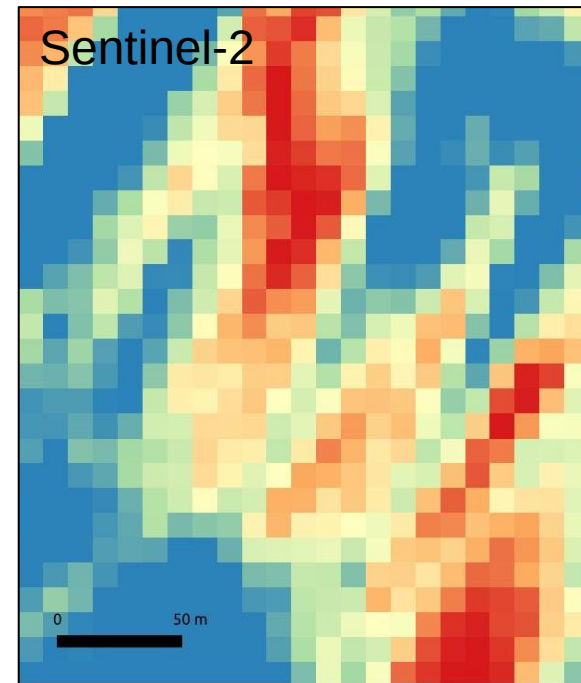
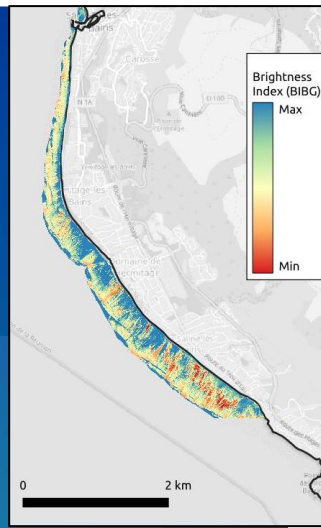


Solution & Results

2. Spectral analysis

- Brightness Index calculated from the Blue and Green spectral bands (BIBG index) used to detect live coral
- Calculated on 4 different satellite image types with varying spectral and spatial resolutions
- Correlation between live coral cover measured in situ and detected from satellite images is the highest when using PNEO images

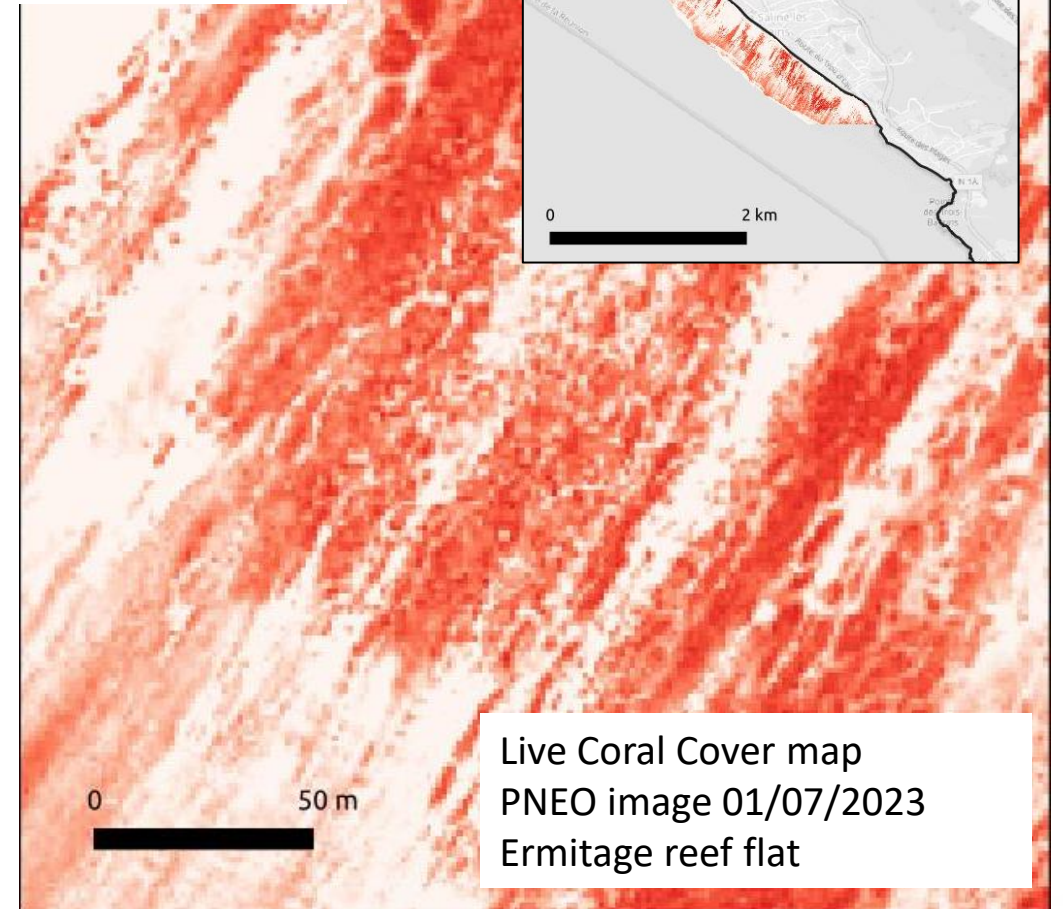
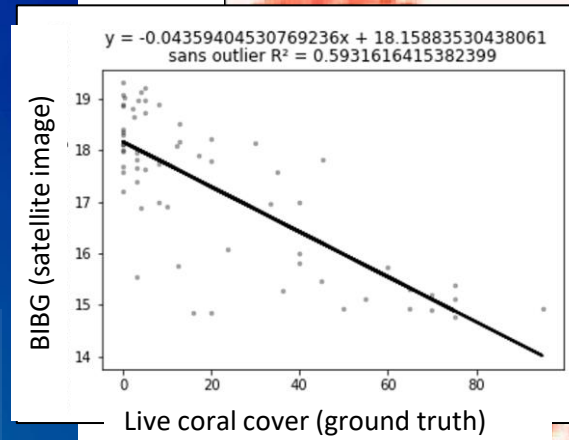
Image	Date	Correlation coefficient (R2)
Sentinel-2	26/04/2022	0.381
SPOT6/7	04/05/2022	0.610
Pléiades	26/04/2022	0.590
Pléiades Neo	01/07/2022	0.611





Solution & Results

- Using DeepBlue band from PNEO, the BIDBBG (Brightness Index Deep Blue, Blue and Green) offers even higher correlation with in situ data
- Using the regression equation, a map of living corals can be produced over the entire Ermitage reef platform.
- Such a map makes it possible to highlight the strong spatial heterogeneity of the Ermitage reef flat, and to precisely locate the living coral and the dead zones composed of coral debris.
- Regular temporal monitoring would allow to follow the reef evolution at a very high spatial resolution, and to identify the zones of progression and regression of the corals.





Benefits & limits

- The very high spatial resolution of the PNEO images (30cm in panchromatic, 1.2m in multispectral) is undoubtedly a significant improvement compared to the commercial satellite images so far available from CNES / Airbus DS (Pléiades and SPOT6/7).
- For coastal applications and the coral reef flats of Réunion, these **higher spatial resolutions**, of the same order of magnitude as the coral colony size, allow **better identification** of these **features** which are then purer and less mixed with the underlying substratum.
- The new **Deep Blue band**, proved useful to **improve** the computation of **spatial indices** that can be used to **accurately describe** these mosaic and very heterogeneous environments that are **coral reefs**.
- Additional analyzes should be carried out to clarify the importance of a noise which seems systematic in this spectral band (not shown here), which could limit its use for deeper areas.

