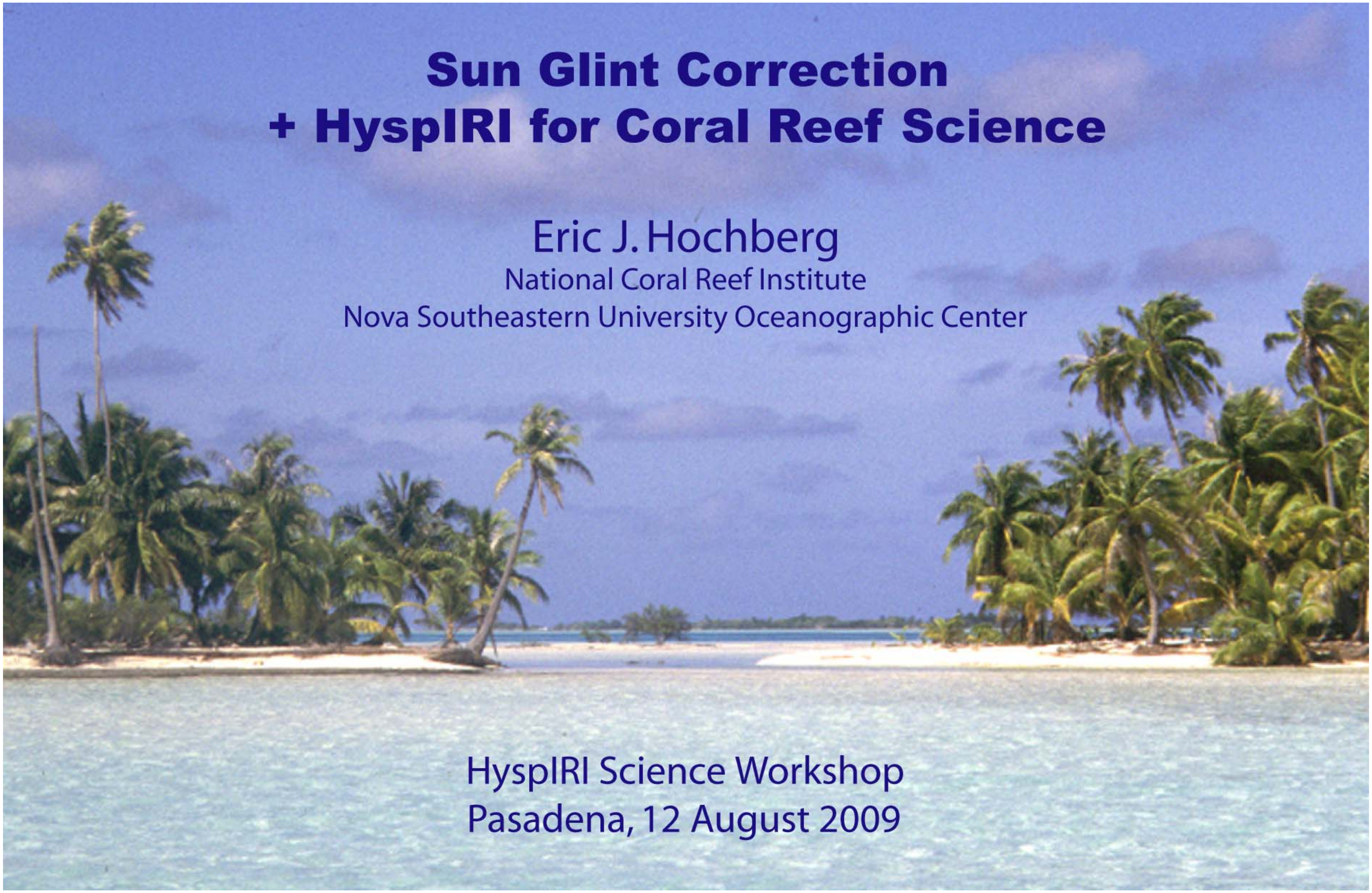
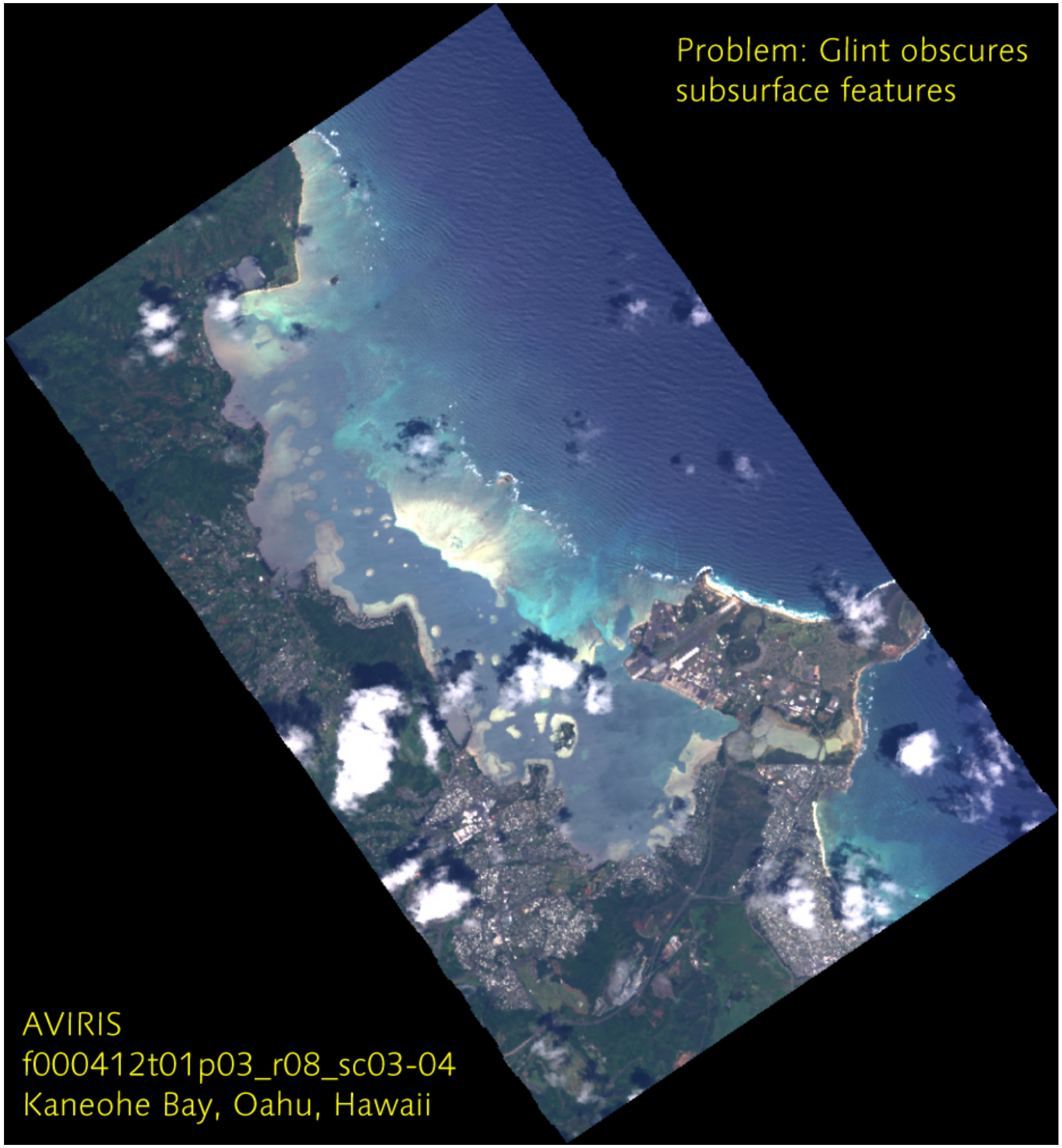


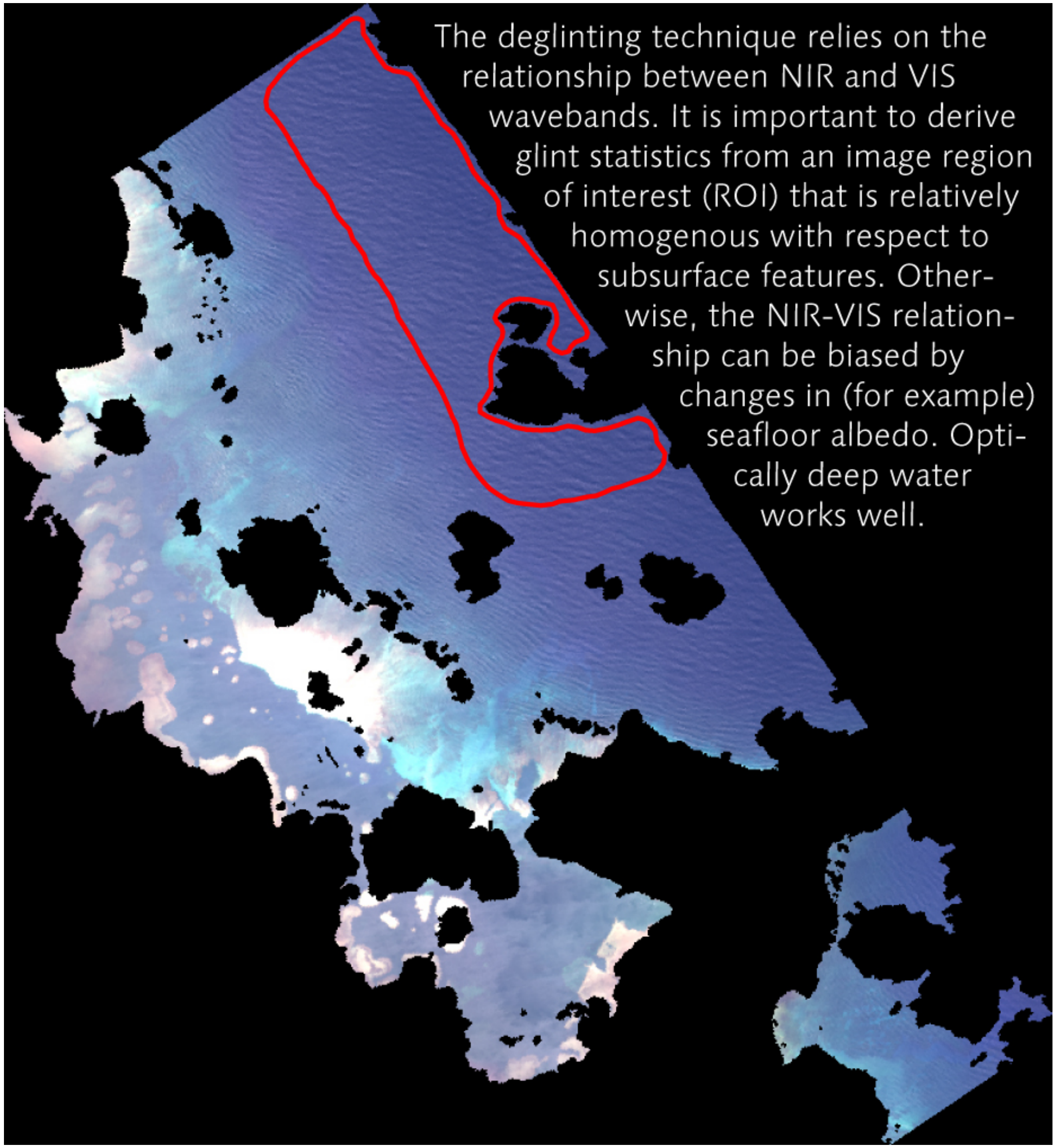
Sun Glint Correction + HyspIRI for Coral Reef Science

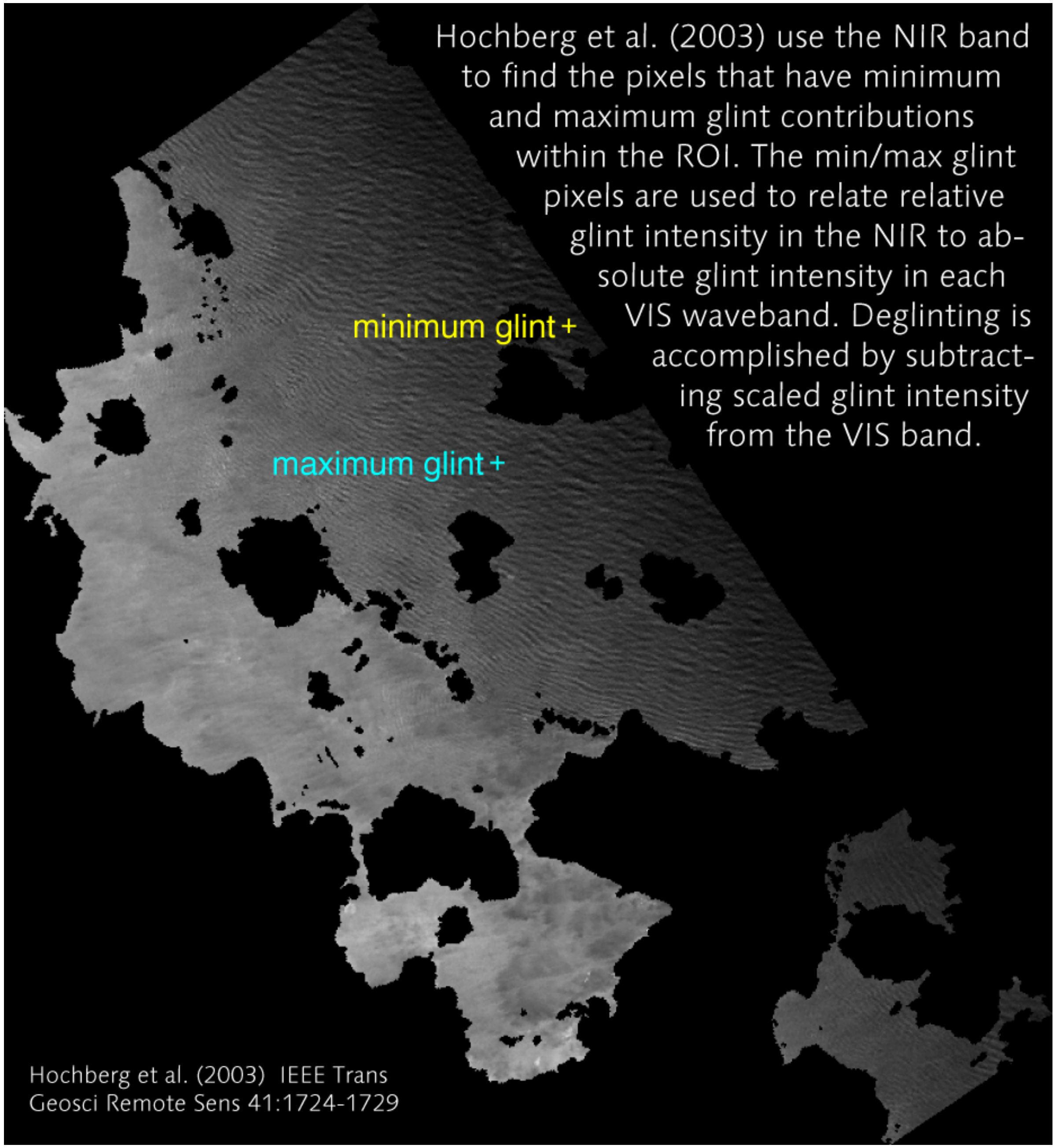
Eric J. Hochberg
National Coral Reef Institute
Nova Southeastern University Oceanographic Center

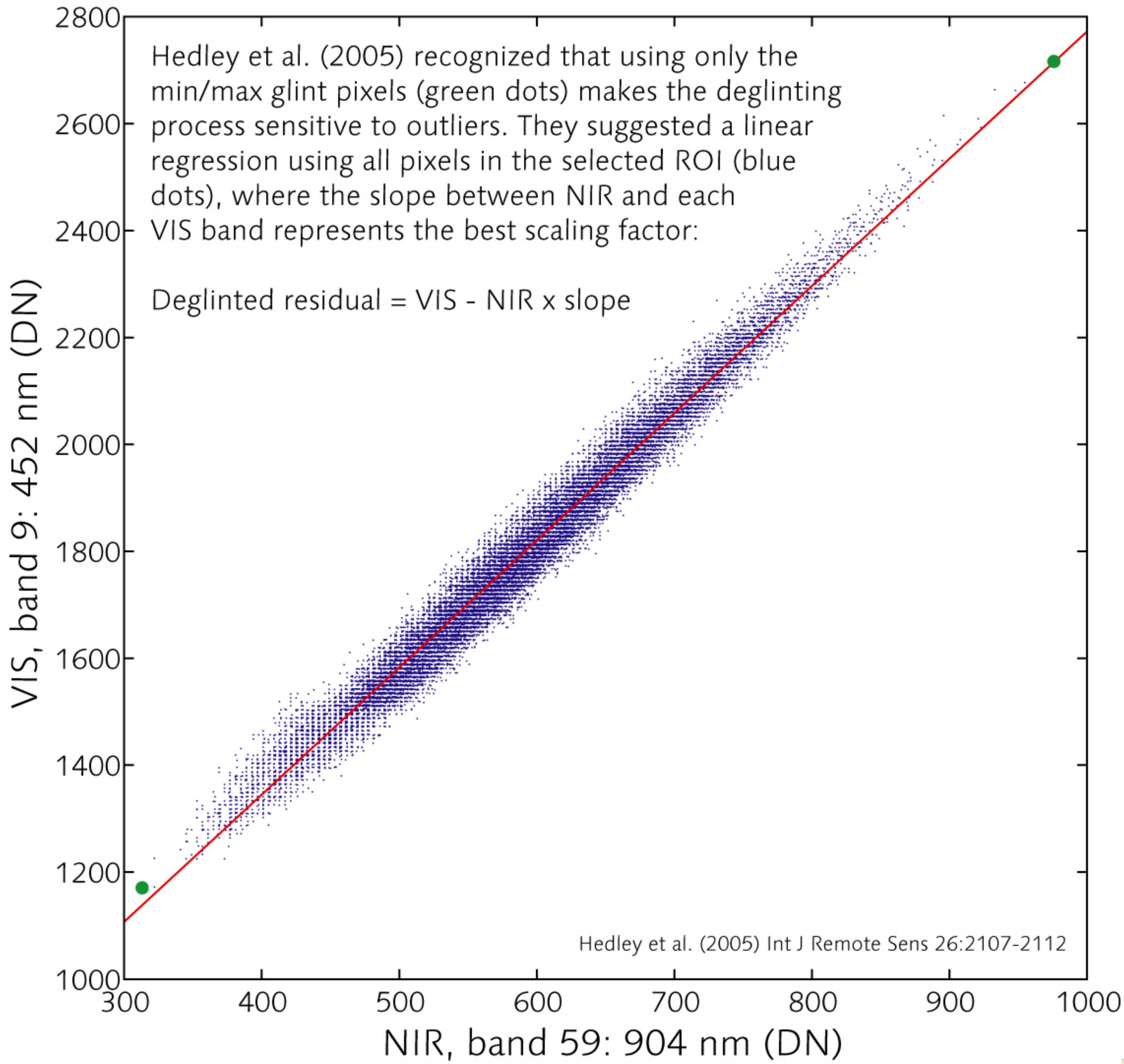
HyspIRI Science Workshop
Pasadena, 12 August 2009



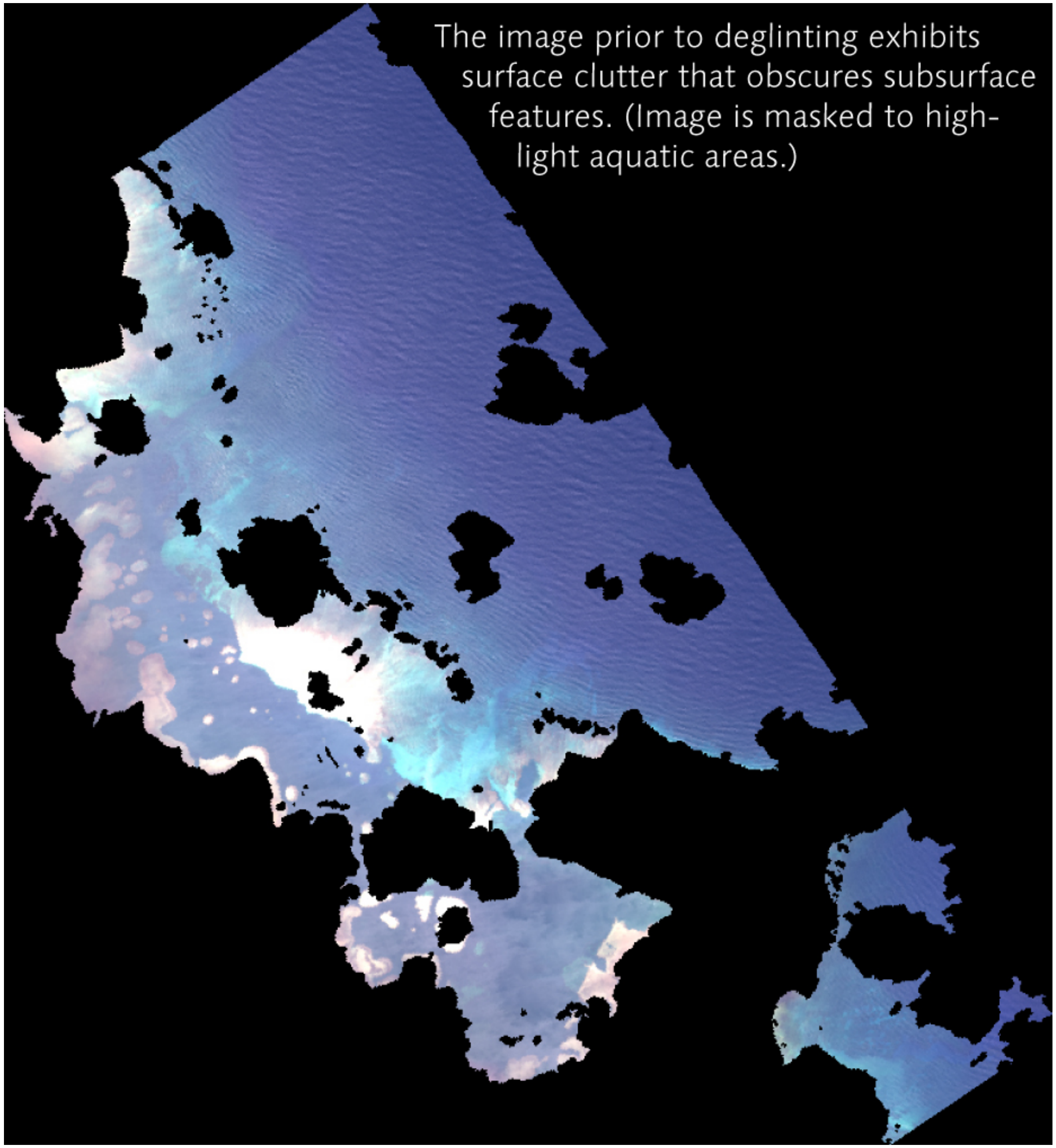
NCRI
NATIONAL CORAL REEF INSTITUTE

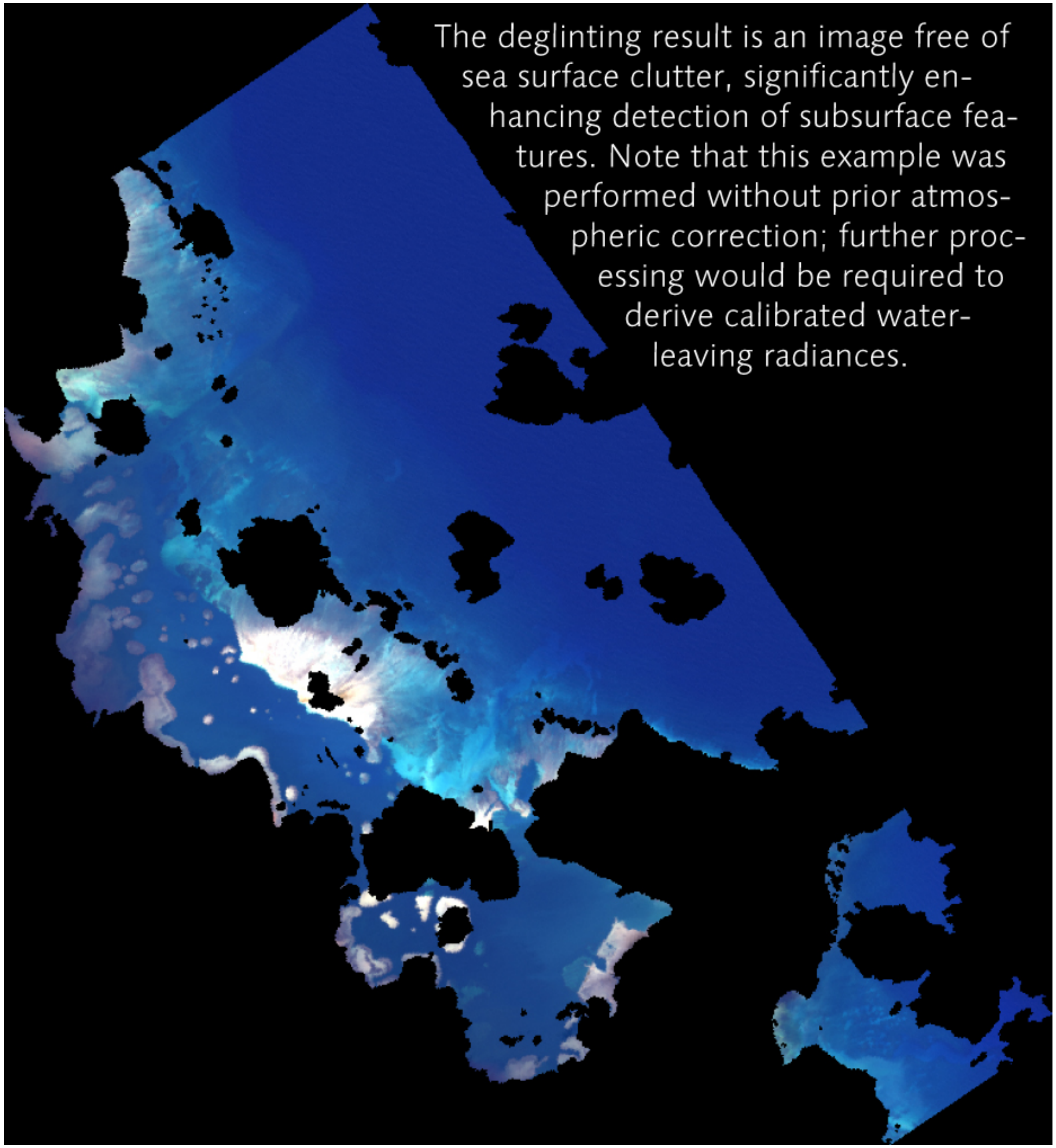

The deglinting technique relies on the relationship between NIR and VIS wavebands. It is important to derive glint statistics from an image region of interest (ROI) that is relatively homogenous with respect to subsurface features. Other-wise, the NIR-VIS relation-ship can be biased by changes in (for example) seafloor albedo. Opti-cally deep water works well.


Hochberg et al. (2003) use the NIR band to find the pixels that have minimum and maximum glint contributions within the ROI. The min/max glint pixels are used to relate relative glint intensity in the NIR to absolute glint intensity in each VIS waveband. Deglinting is accomplished by subtracting scaled glint intensity from the VIS band.
minimum glint +
maximum glint +
Hochberg et al. (2003) IEEE Trans
Geosci Remote Sens 41:1724-1729

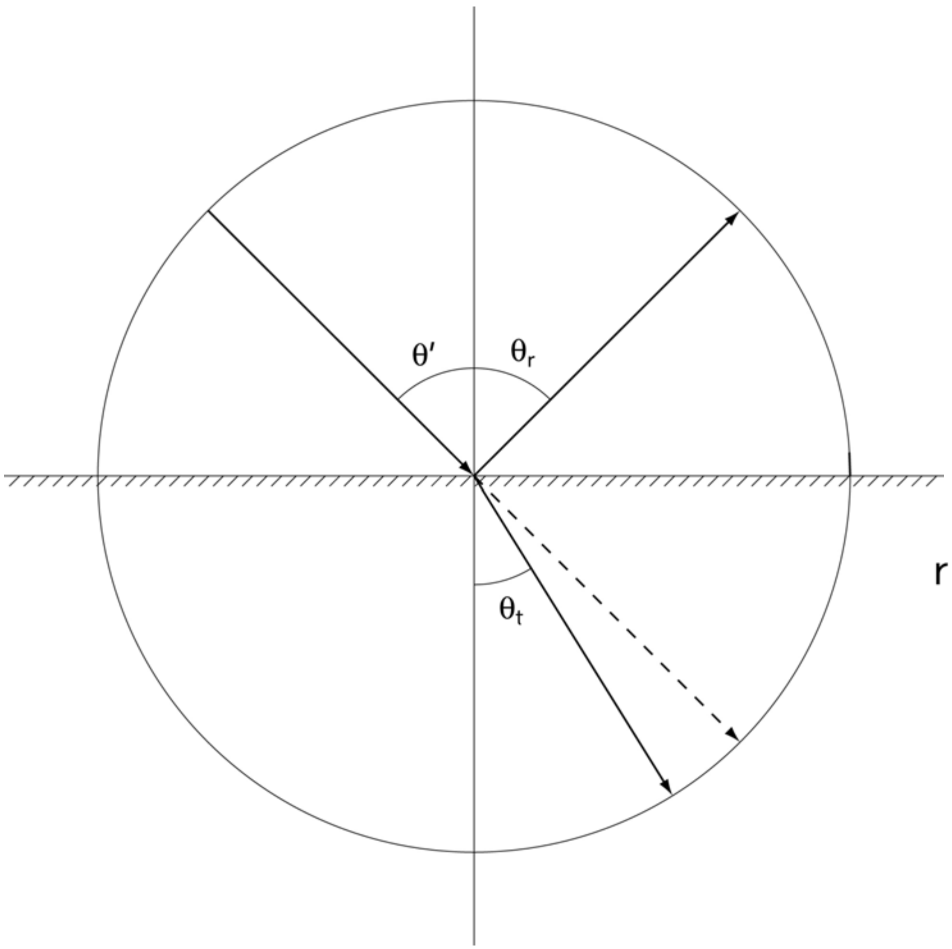


NCRI
NATIONAL CORAL REEF INSTITUTE


The image prior to deglinting exhibits surface clutter that obscures subsurface features. (Image is masked to highlight aquatic areas.)

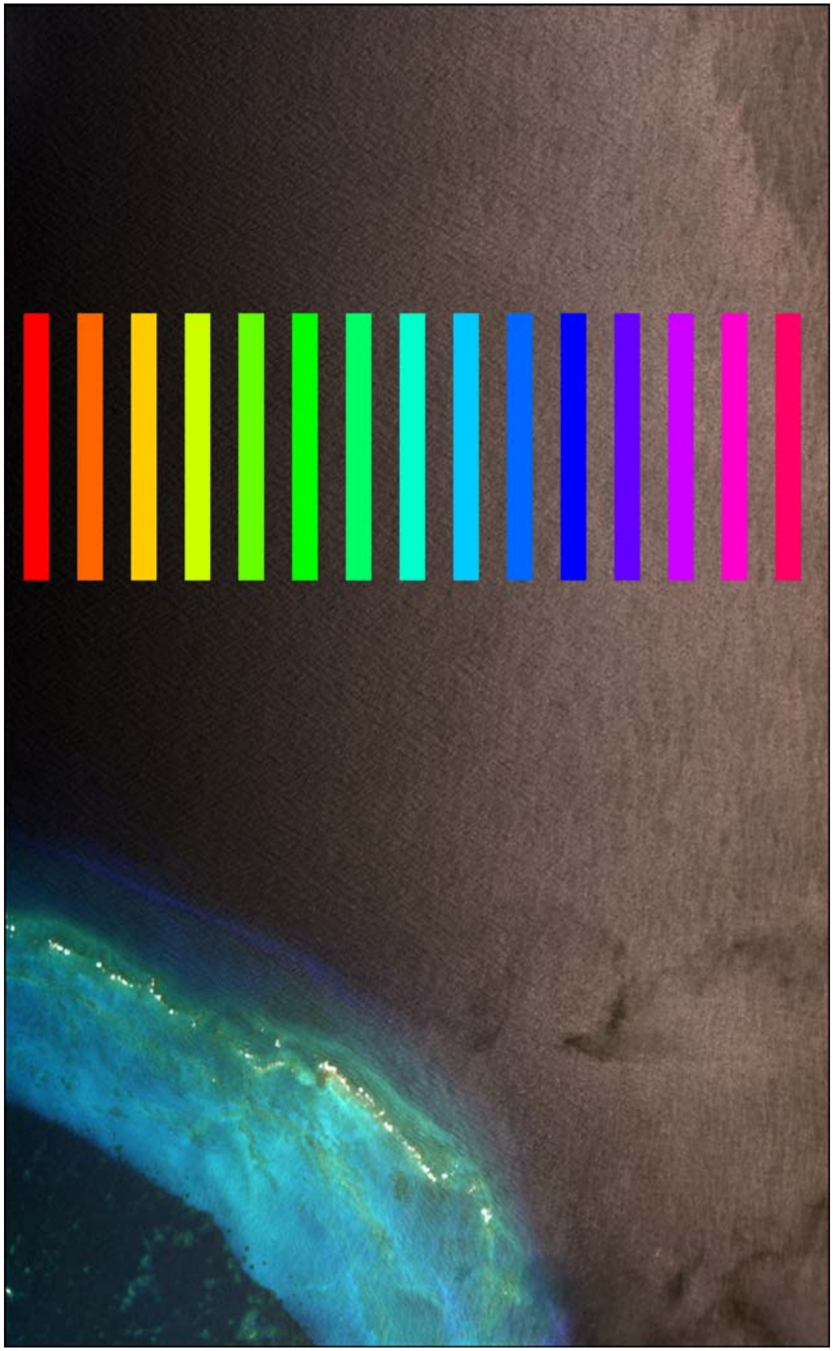


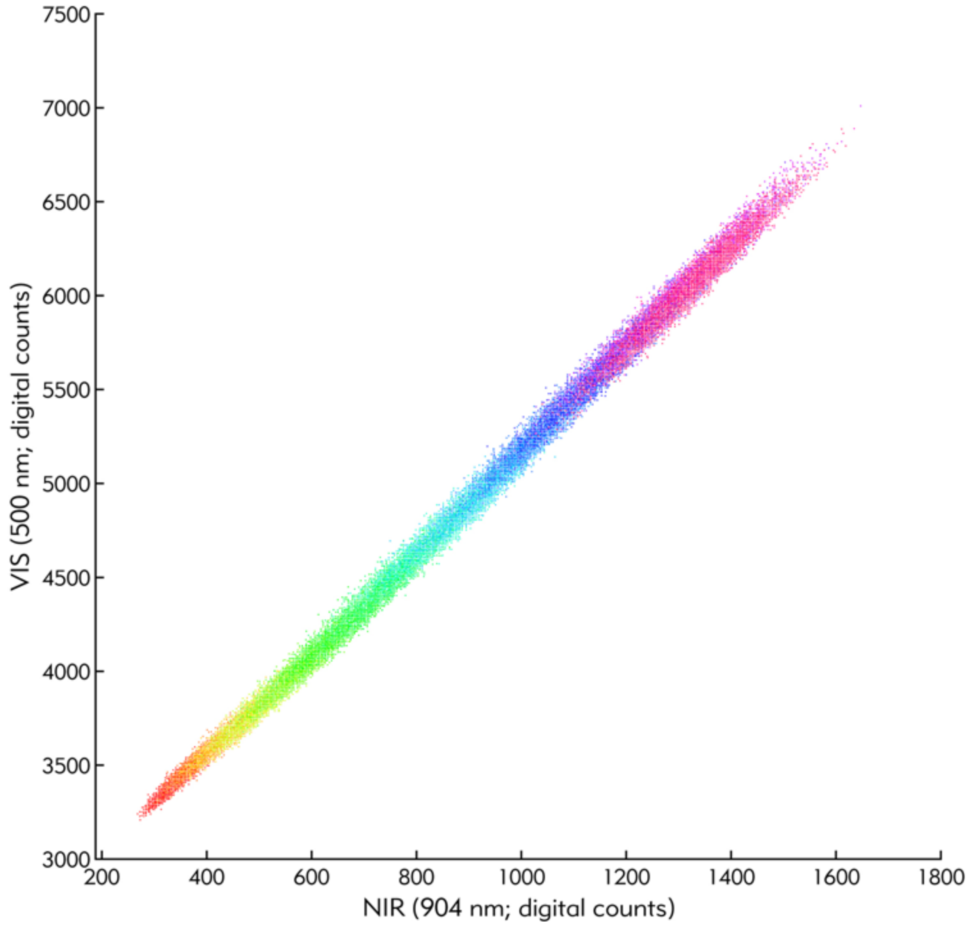
NCRI
NATIONAL CORAL REEF INSTITUTE



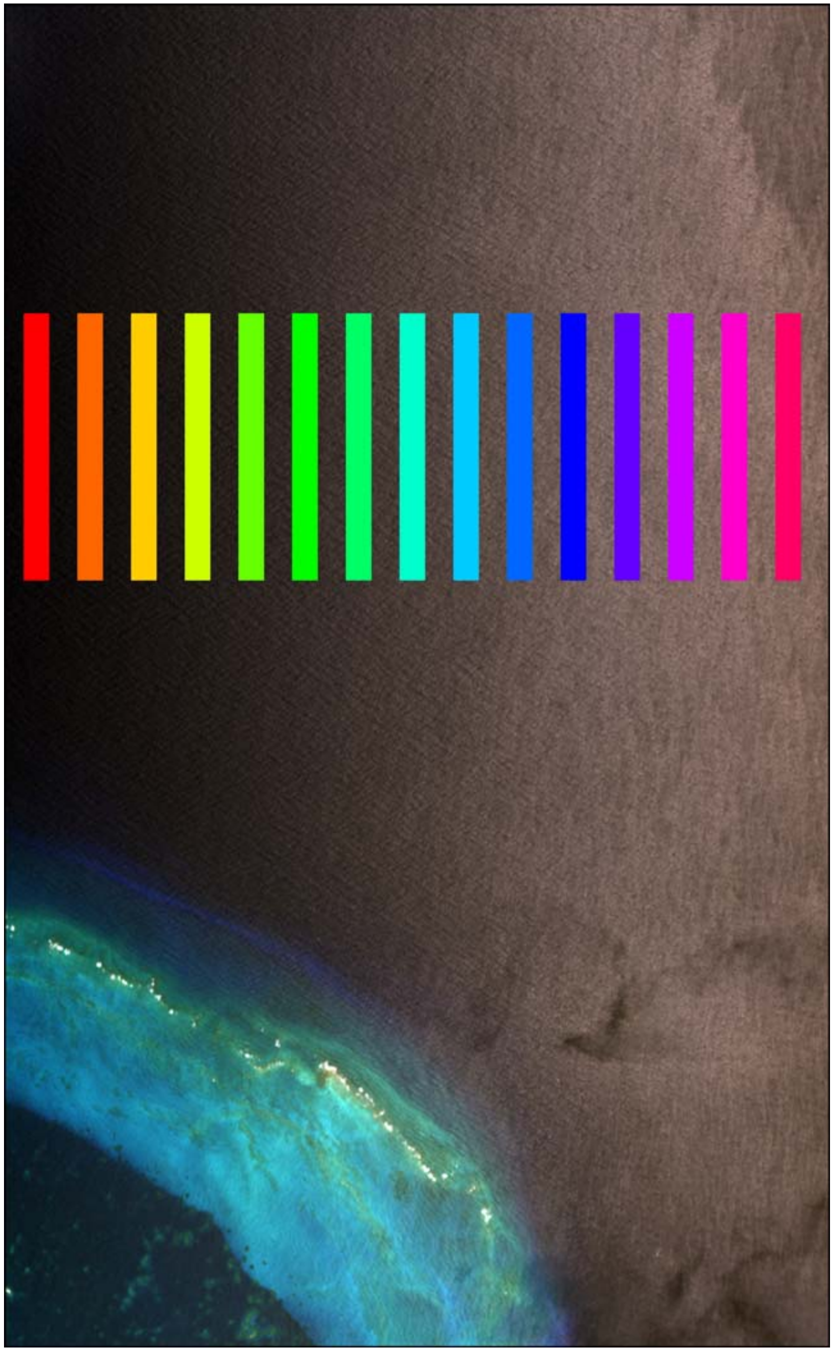
$$\theta_t = \sin^{-1}\left(\frac{1}{n_w}\sin\theta'\right)$$

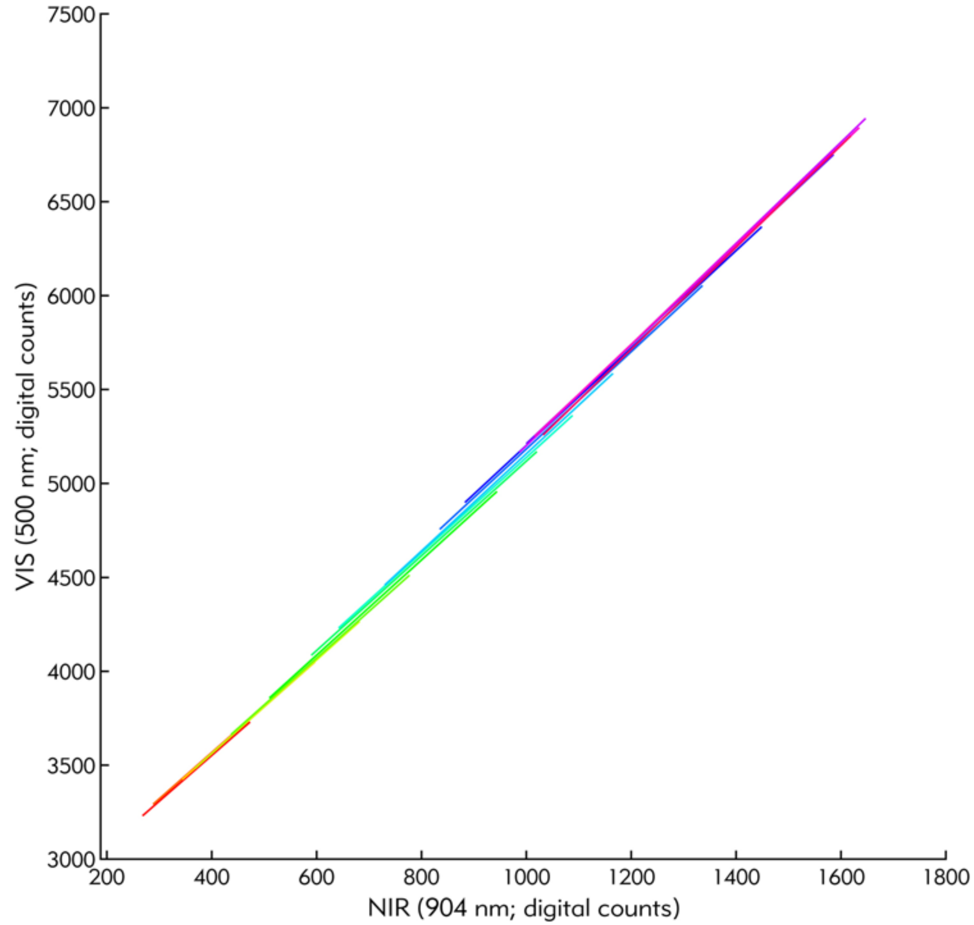
$$r(\theta') \equiv \frac{1}{2}\left\{\left[\frac{\sin(\theta'-\theta_t)}{\sin(\theta'+\theta_t)}\right]^2 + \left[\frac{\tan(\theta'-\theta_t)}{\tan(\theta'+\theta_t)}\right]^2\right\}$$



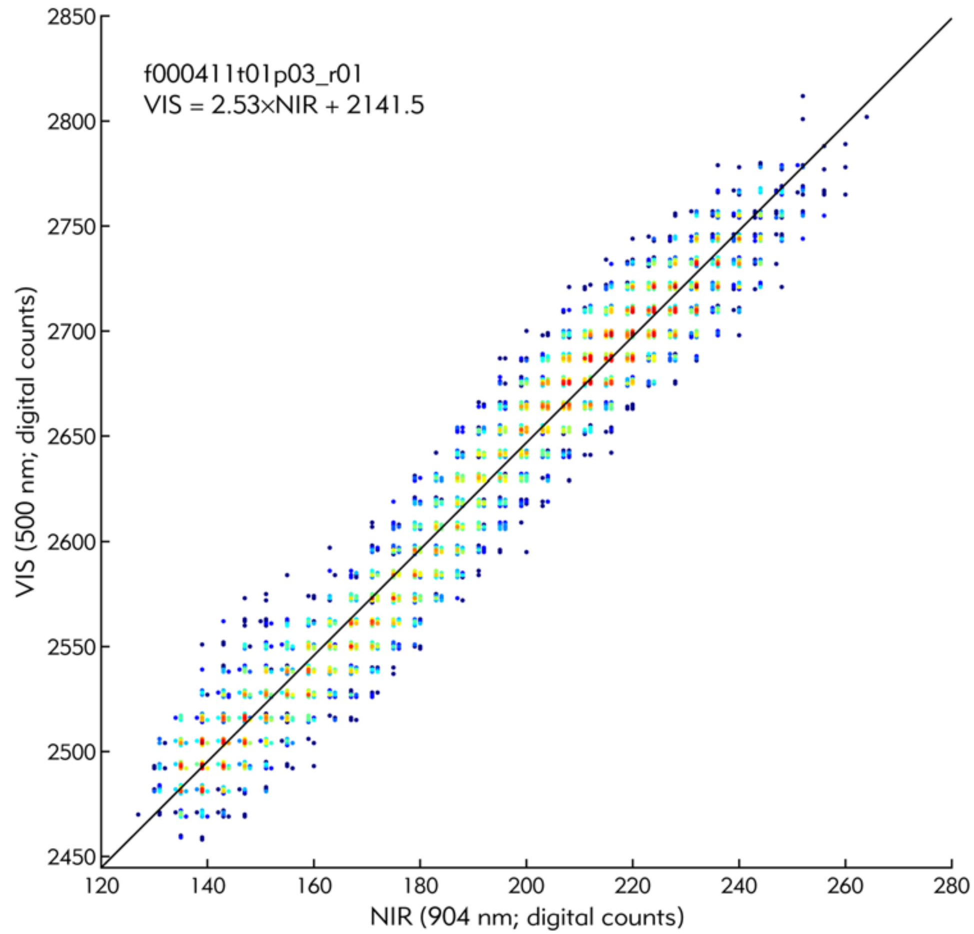


NCRI
NATIONAL CORAL REEF INSTITUTE

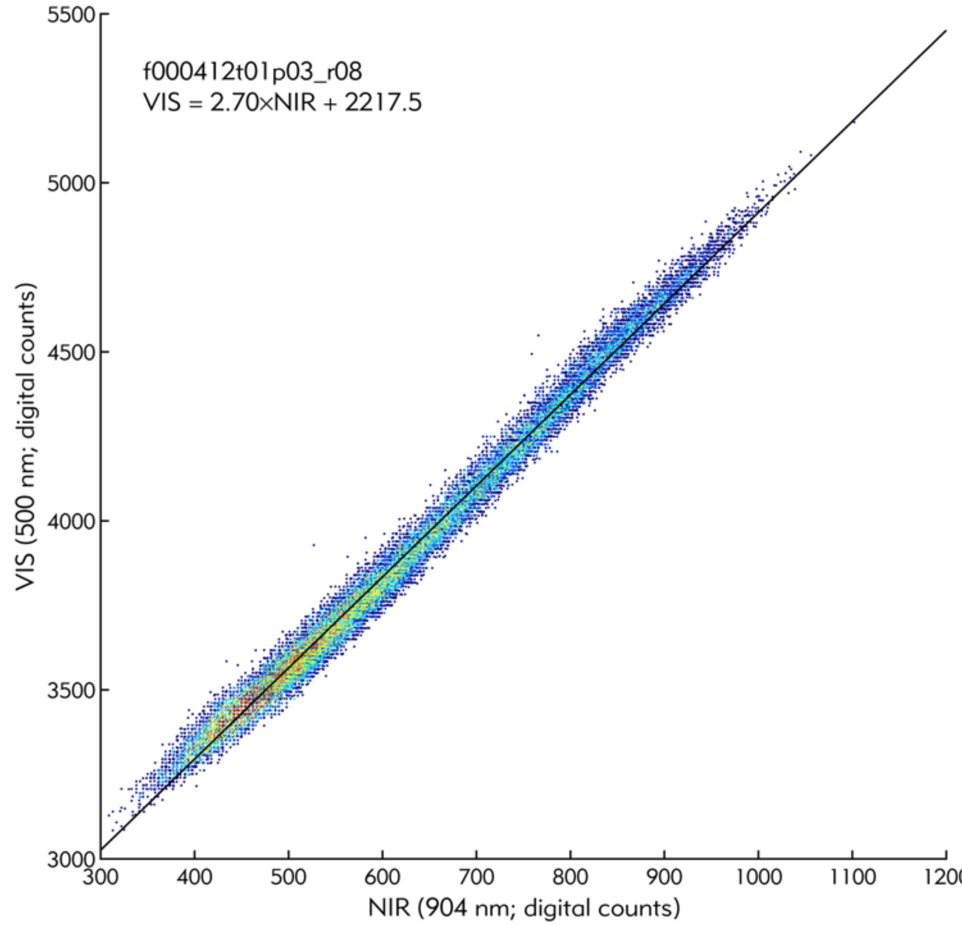




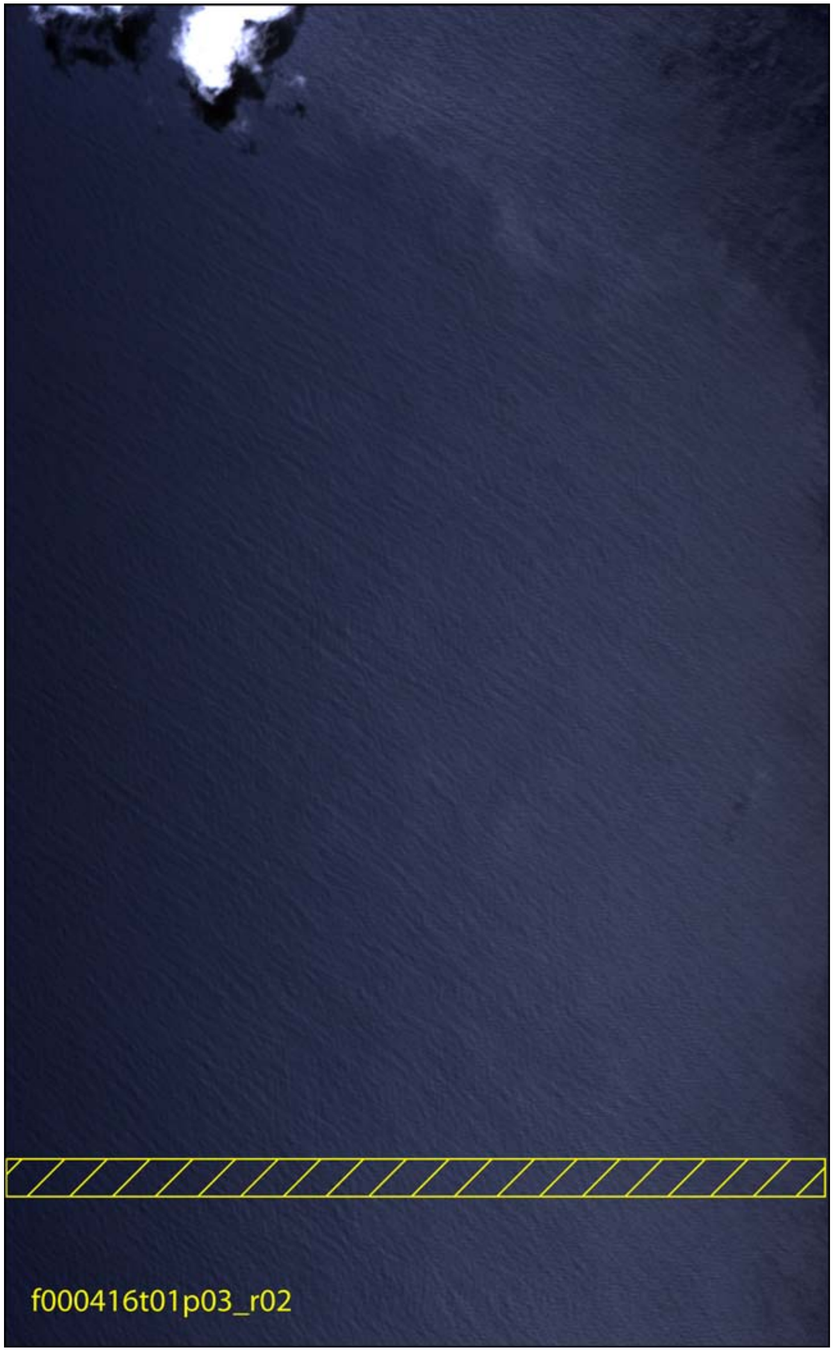
NCRI
NATIONAL CORAL REEF INSTITUTE

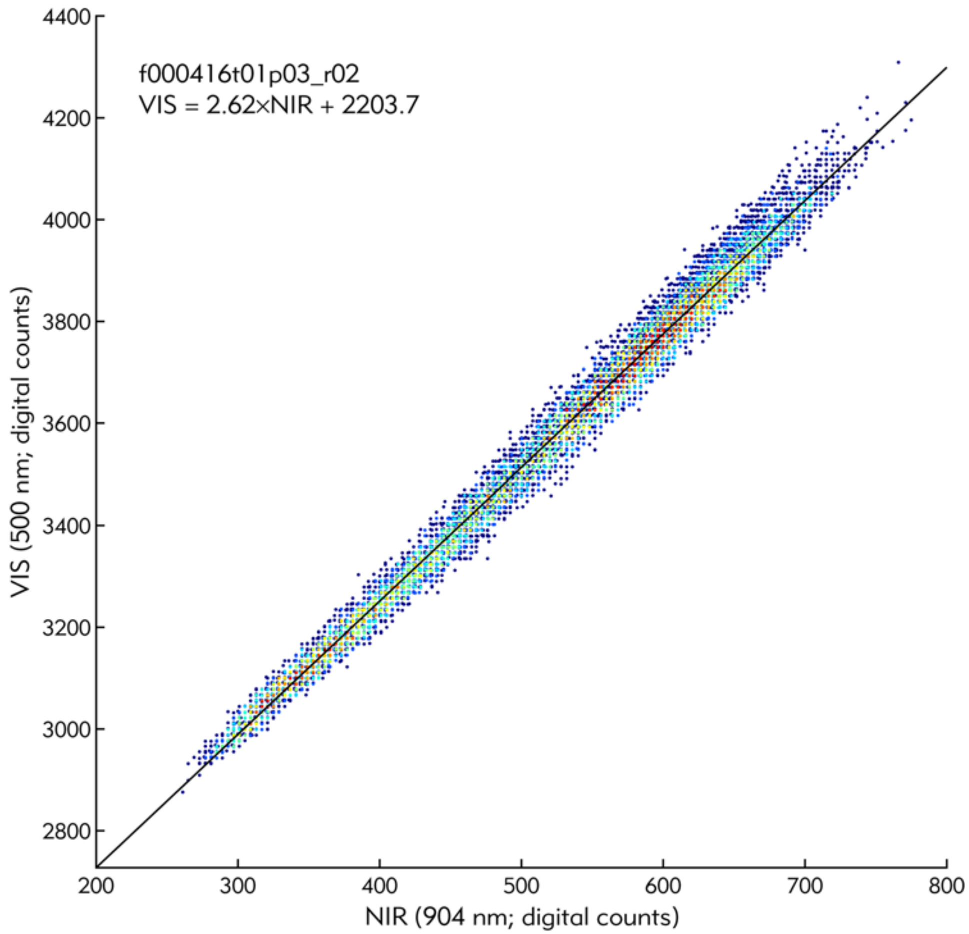


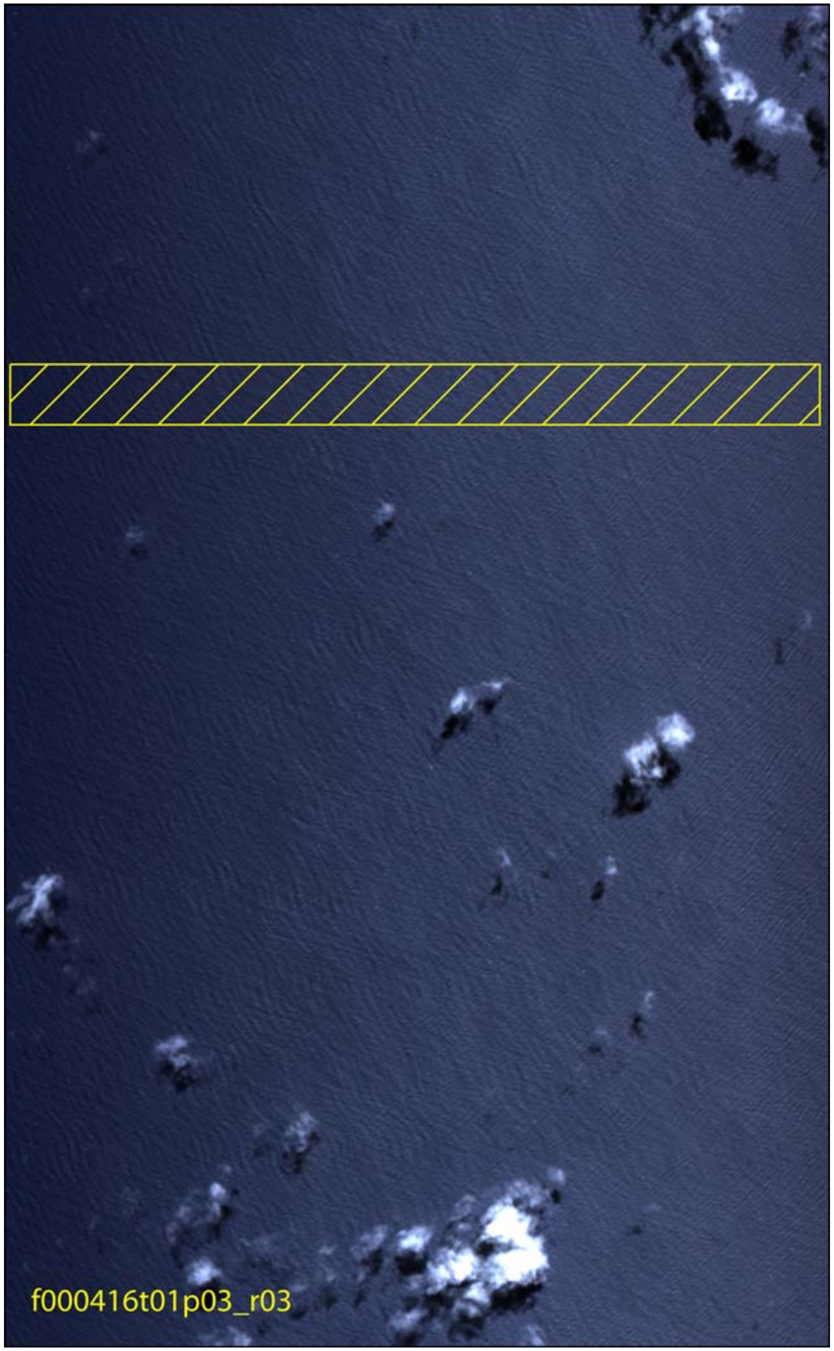
NCRI
NATIONAL CORAL REEF INSTITUTE

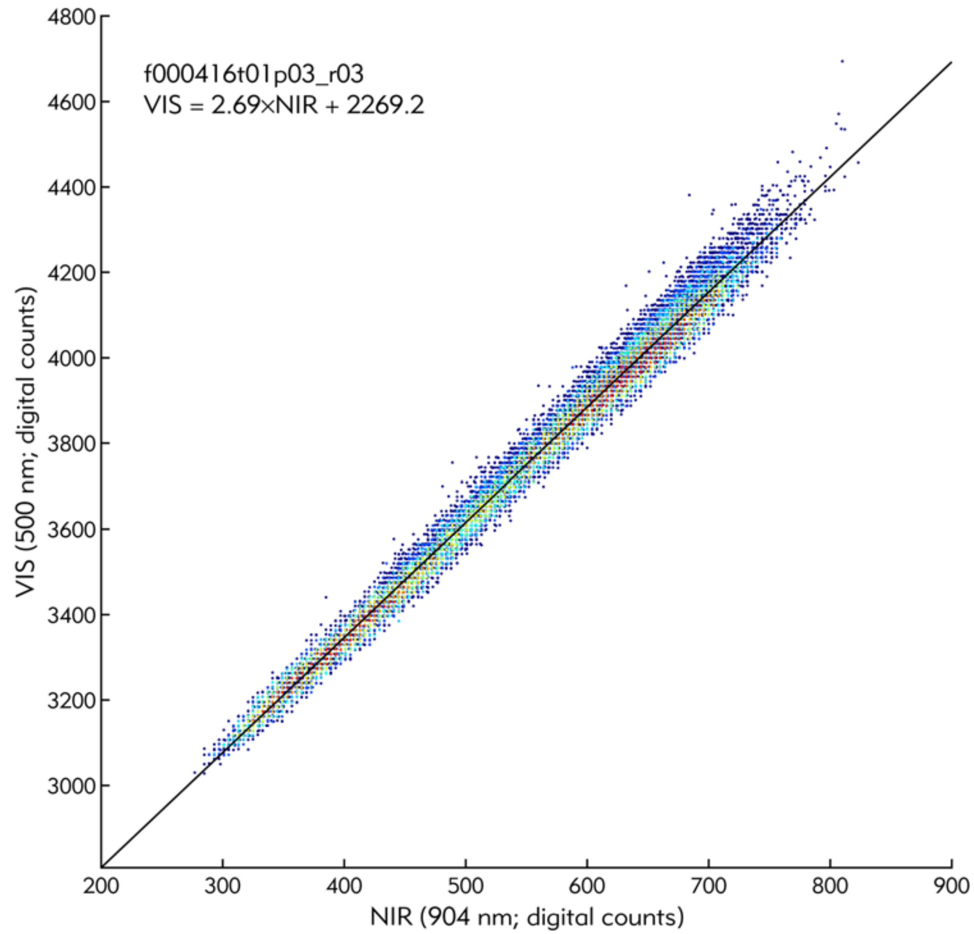


NCRI
NATIONAL CORAL REEF INSTITUTE

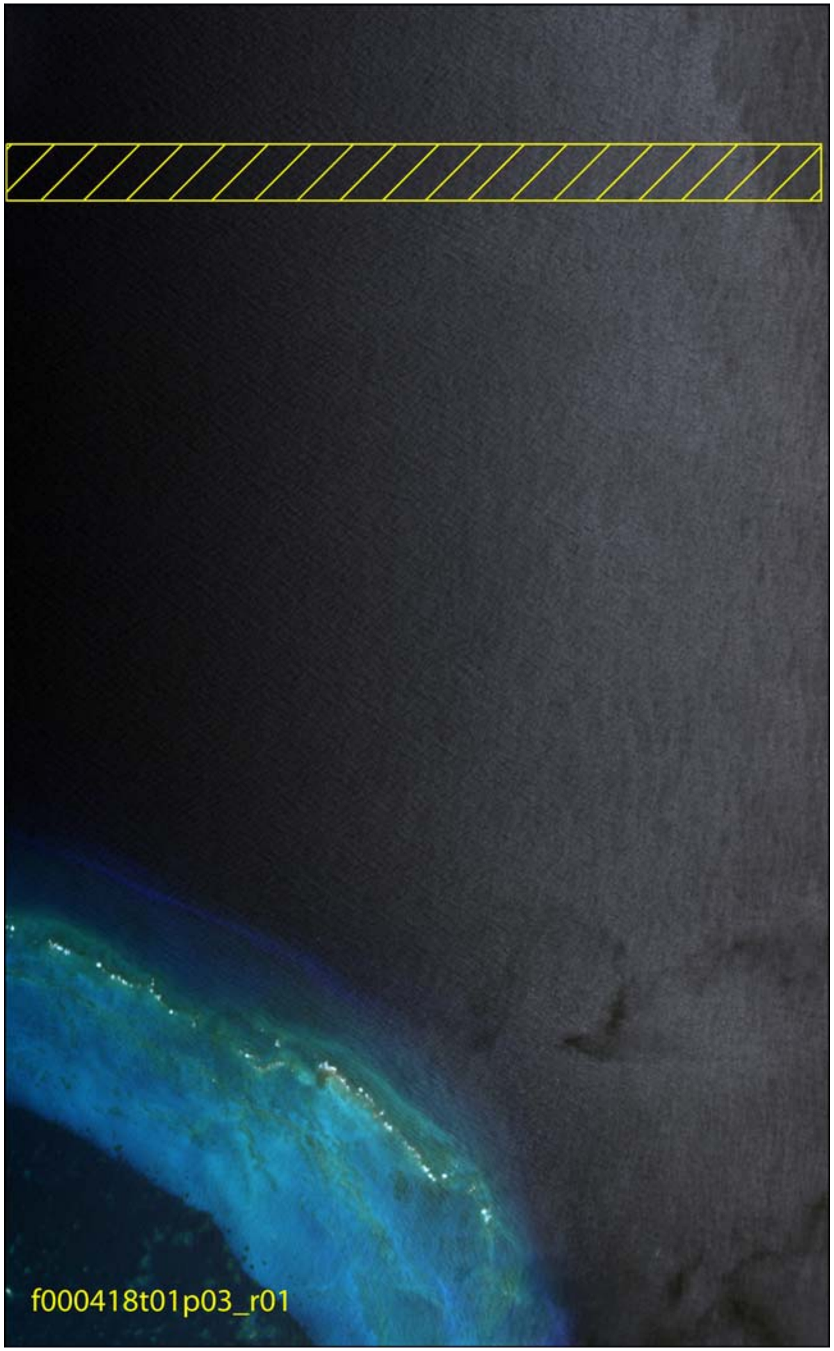

f000416t01p03_r02

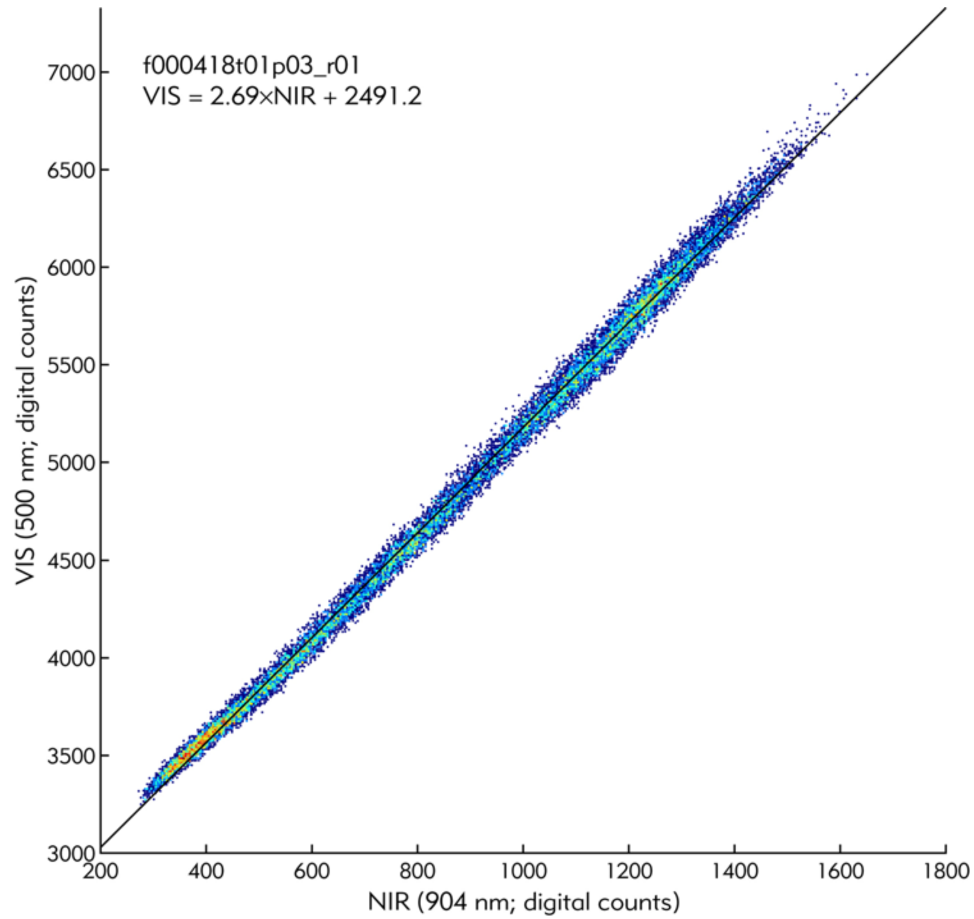

f000416t01p03_r02
VIS = 2.62×NIR + 2203.7
VIS (500 nm; digital counts)
NIR (904 nm; digital counts)
4400
4200
4000
3800
3600
3400
3200
3000
2800
200
300
400
500
600
700
800



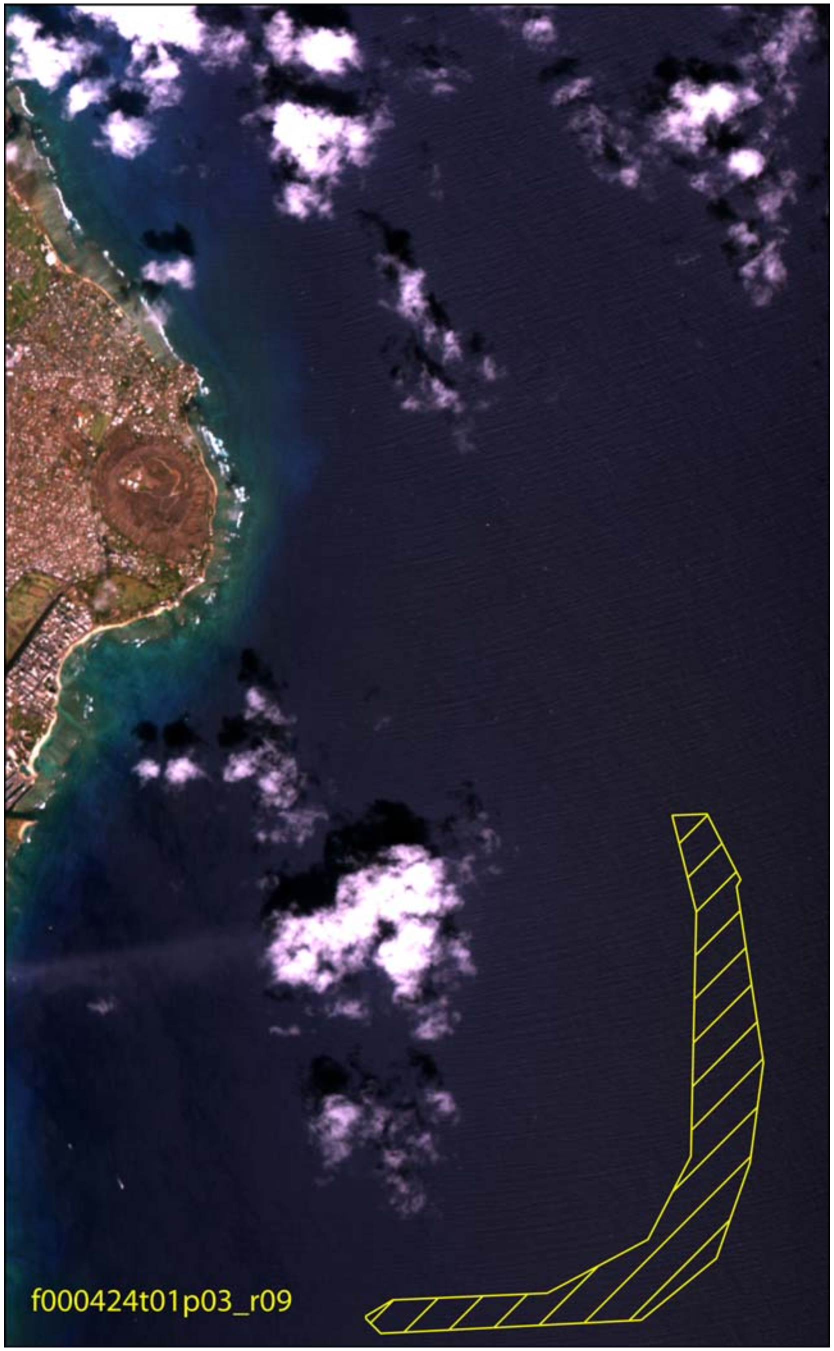


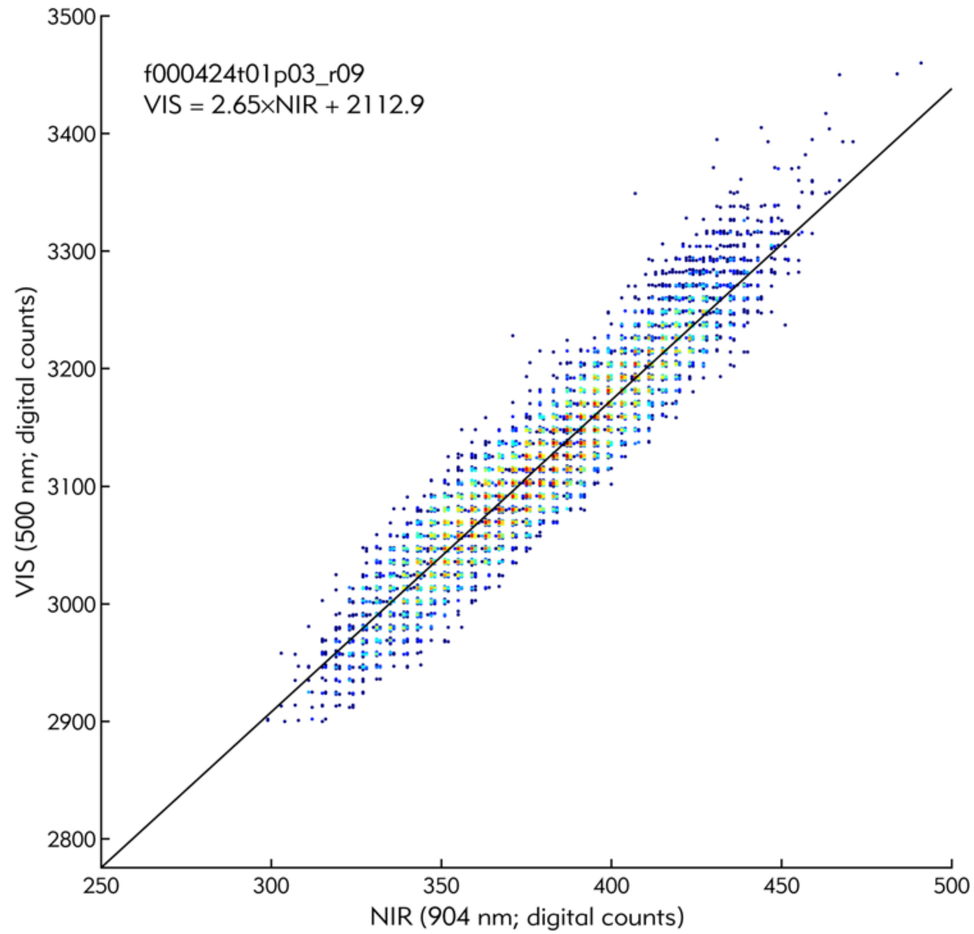
NCRI
NATIONAL CORAL REEF INSTITUTE



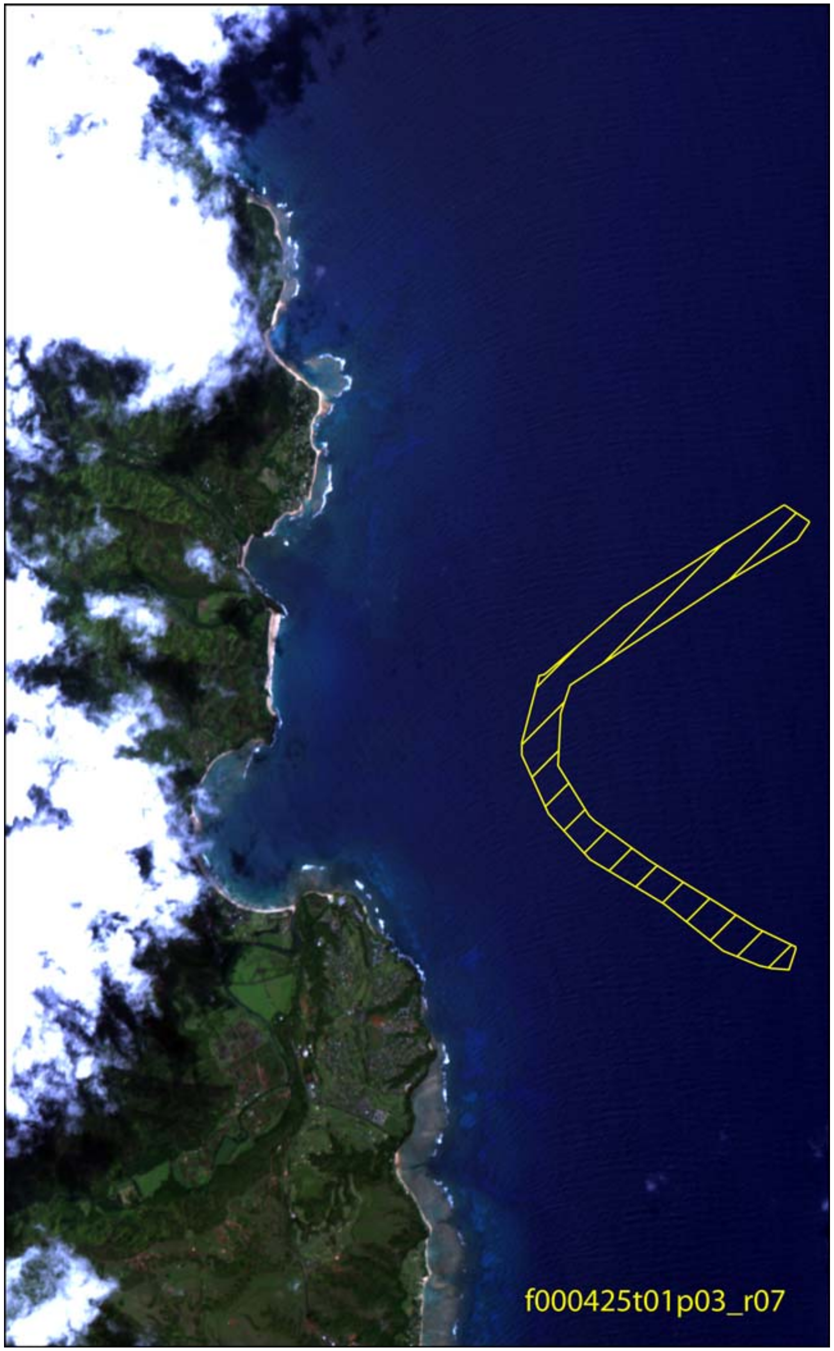


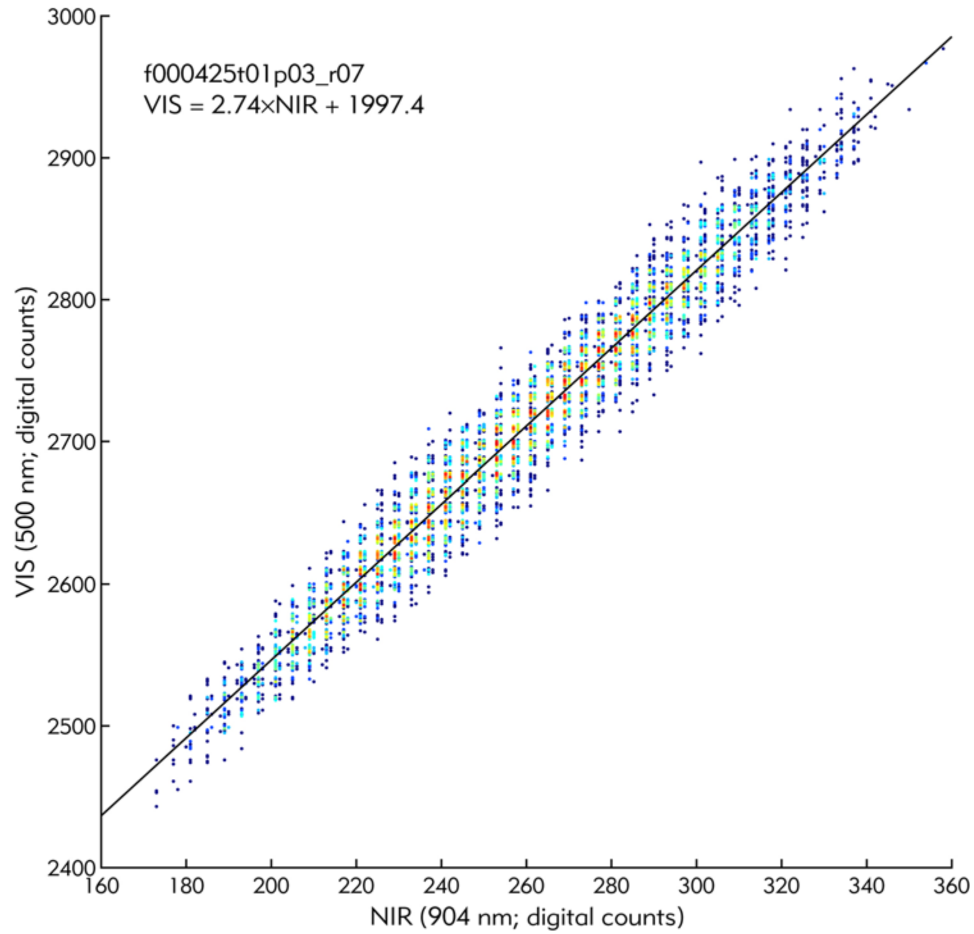
NCRI
NATIONAL CORAL REEF INSTITUTE

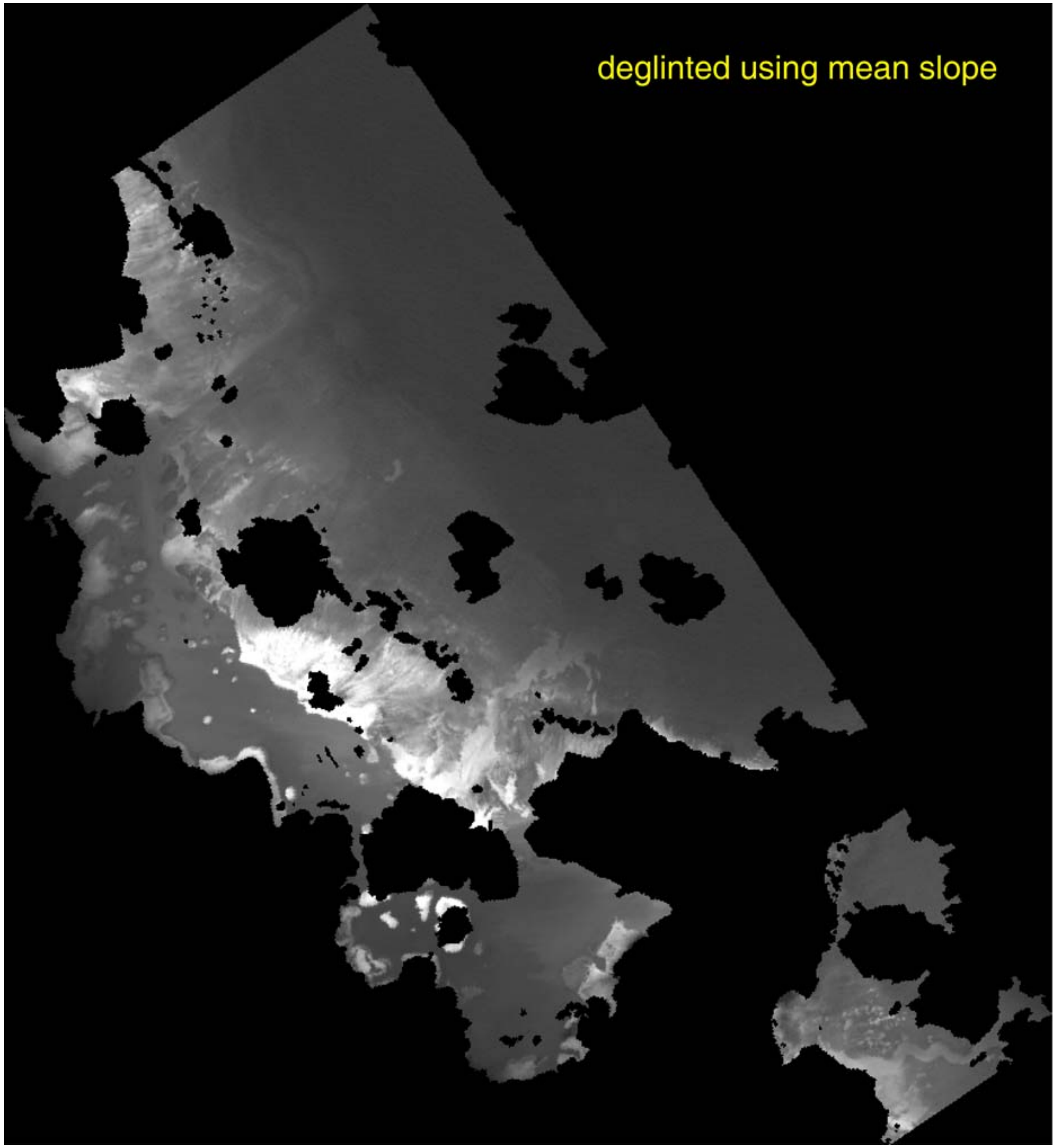


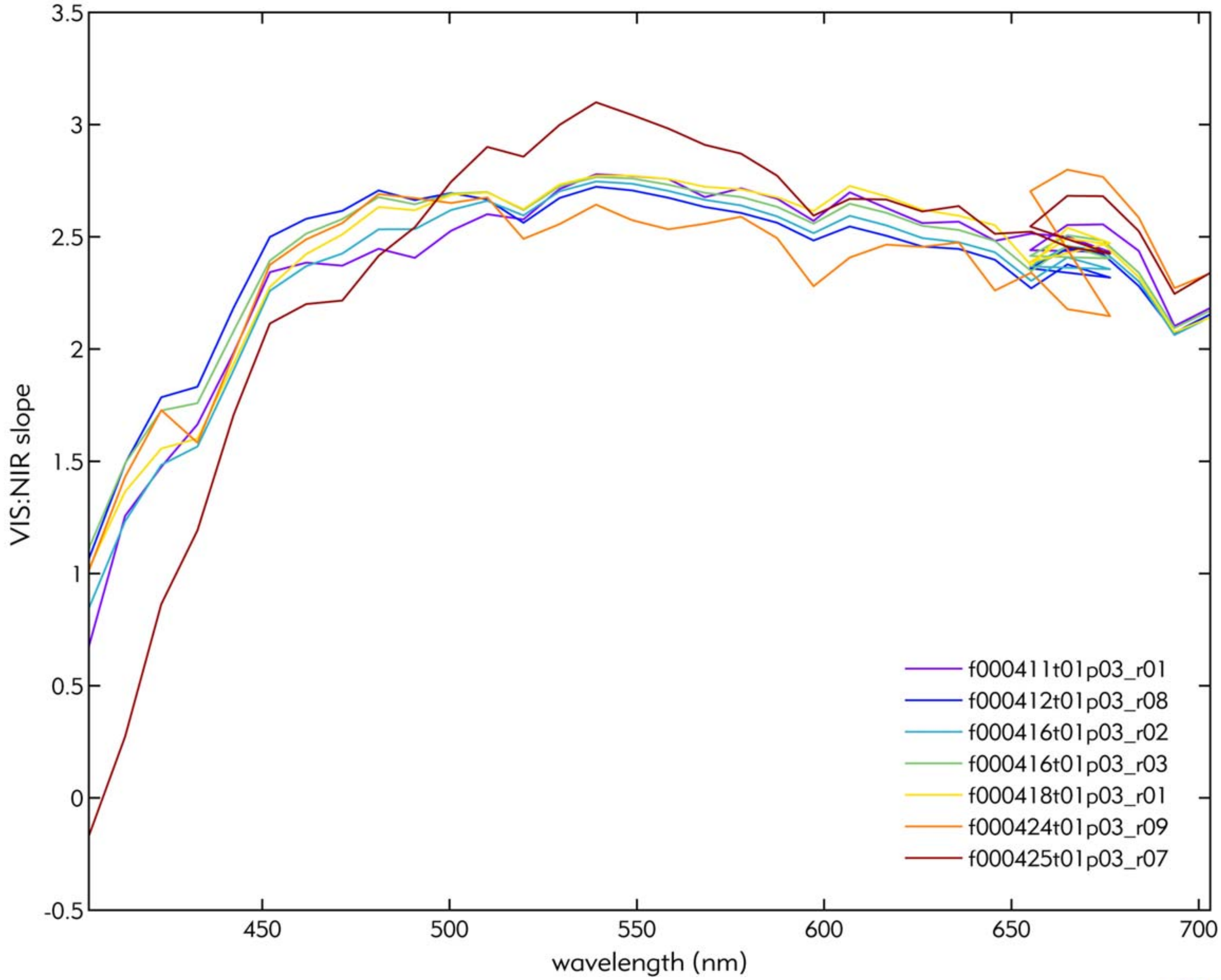


NCRI
NATIONAL CORAL REEF INSTITUTE


f000425t01p03_r07


f000425t01p03_r07
VIS = 2.74×NIR + 1997.4
VIS (500 nm; digital counts)
NIR (904 nm; digital counts)
3000
2900
2800
2700
2600
2500
2400
160
180
200
220
240
260
280
300
320
340
360


deglinted using mean slope

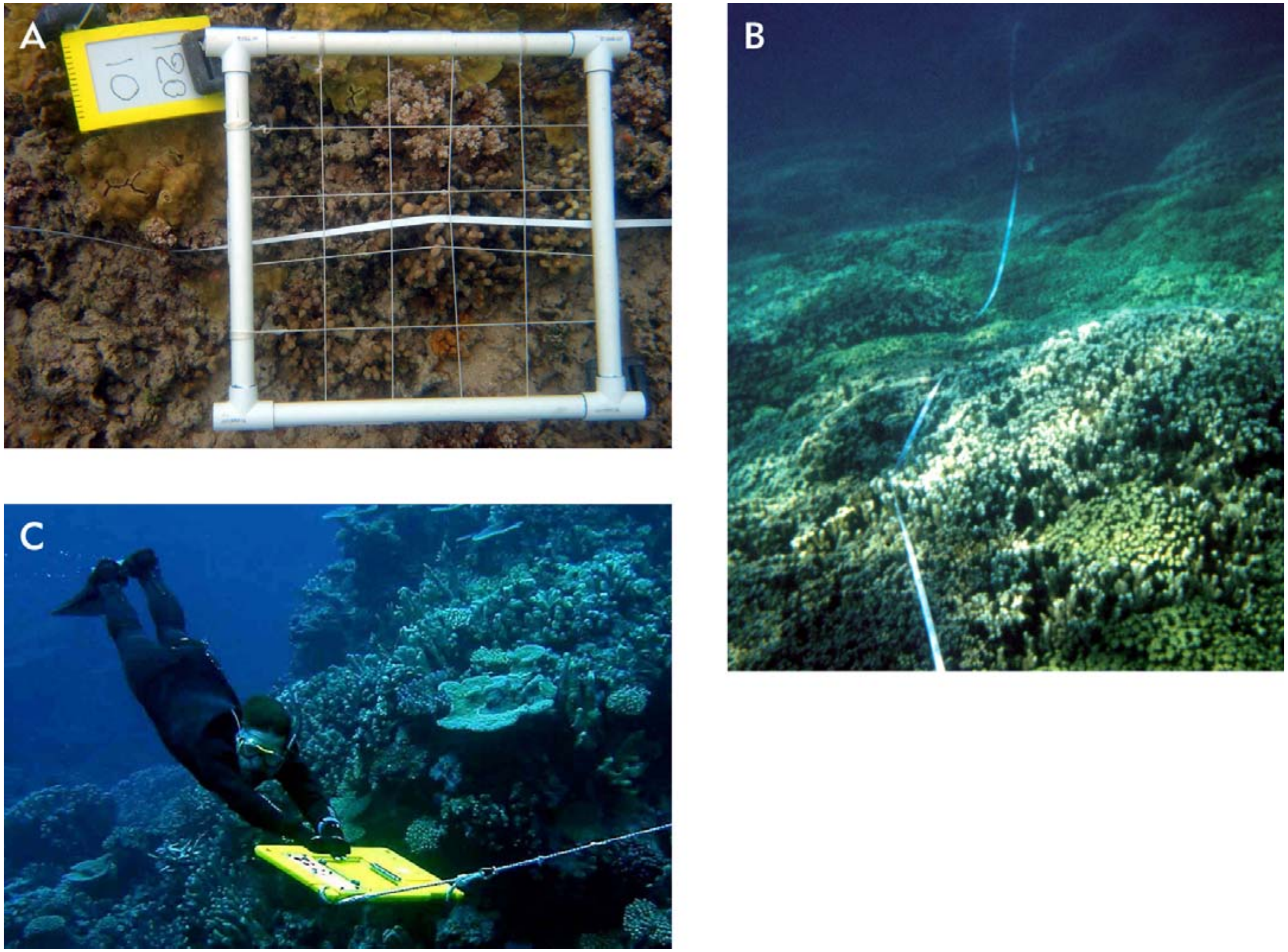


NCRI
NATIONAL CORAL REEF INSTITUTE

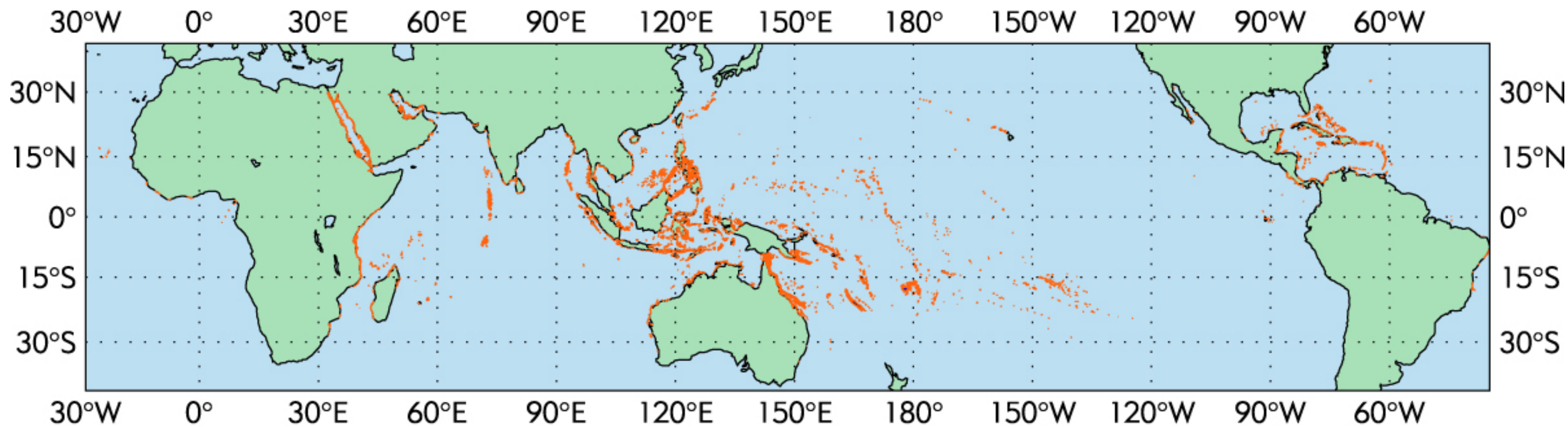

Photo: P. L. Colin

- Rough
- High productivity/calcification
- "Healthy"

- Smooth
- Low productivity/calcification
- Not "healthy"

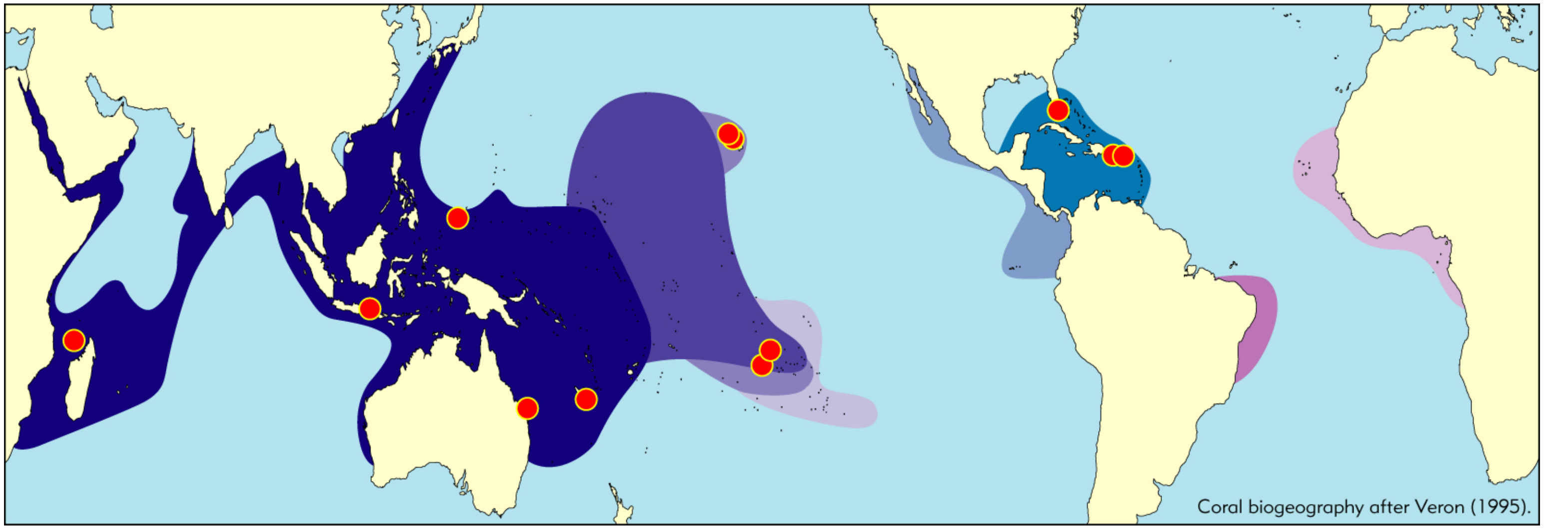


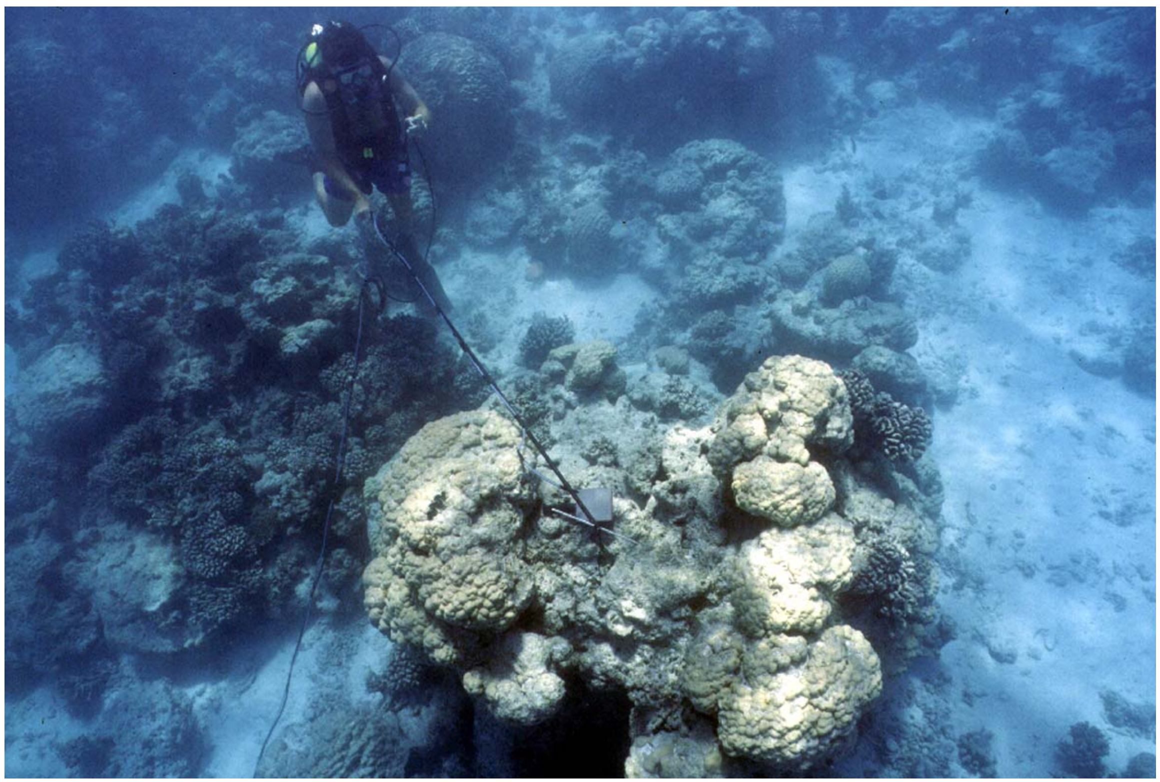
NCRI
NATIONAL CORAL REEF INSTITUTE



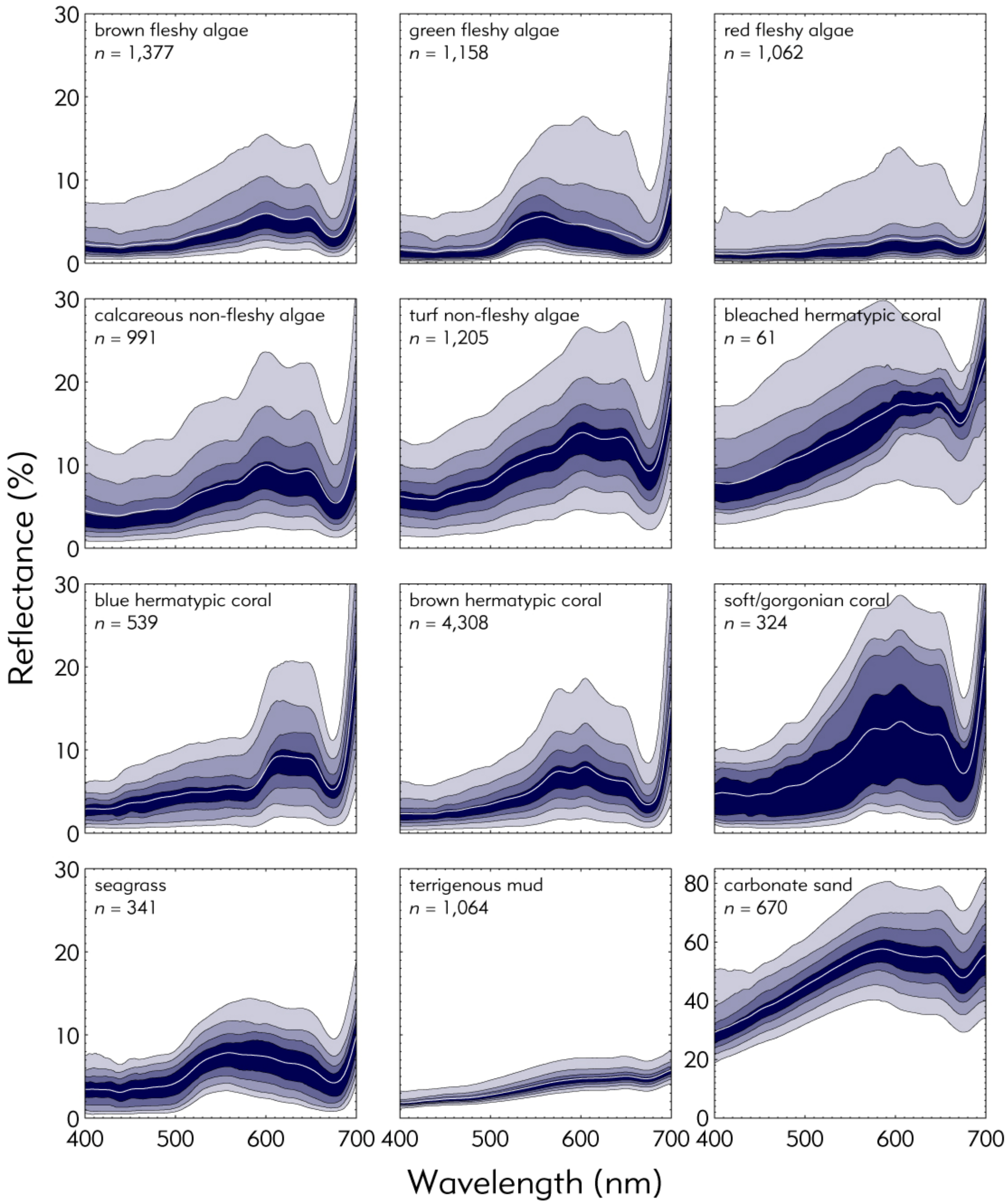
- ~9,000 reefs in the world, covering 500,000 km^2
- spread across 200,000,000 km^2 of ocean
- Quantitative in situ surveys cover only 10s to 100s of km^2 worldwide
- *Only 0.01–0.1% of the world's reef area*

NCRI
NATIONAL CORAL REEF INSTITUTE





NCRI
NATIONAL CORAL REEF INSTITUTE



NCRI NATIONAL CORAL REEF INSTITUTE

Capabilities of remote sensors to classify coral, algae, and sand as pure and mixed spectra

Eric J. Hochberg*, Marlin J. Atkinson

Remote Sensing of Environment 85 (2003) 174–189

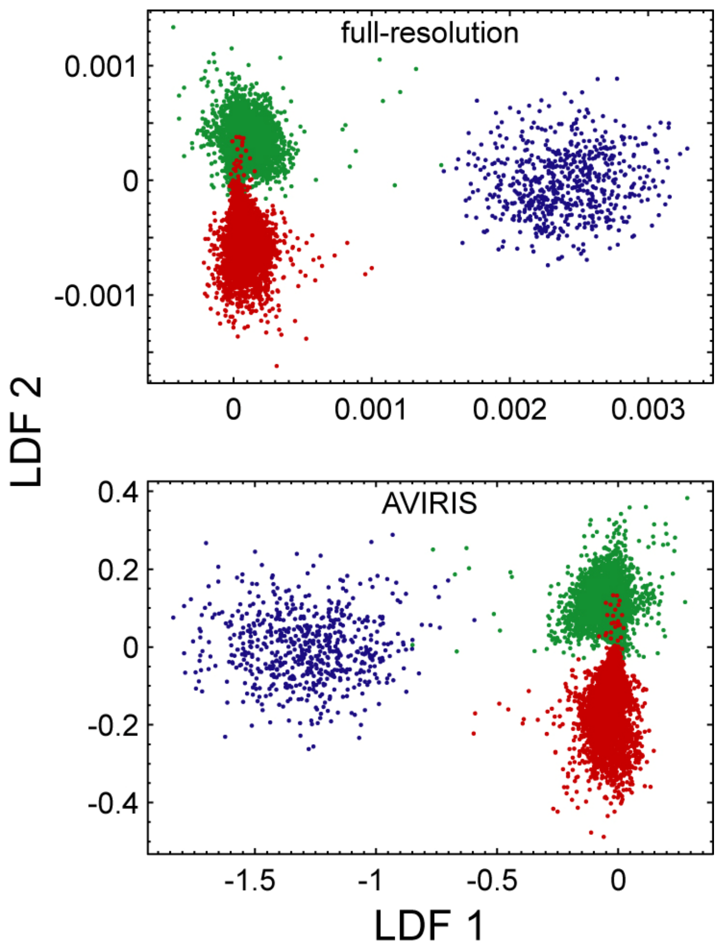
Table 1
Classification error matrices for in situ spectral reflectances of three coral reef classes: coral, algae, and carbonate sand

(A) Full-resolution: overall accuracy = 98%

		Actual class		
		Algae	Coral	Sand
Predicted class	Algae	2726 (99.2)	75 (3.3)	1 (0.3)
	Coral	23 (0.8)	2168 (96.6)	0 (0.0)
	Sand	0 (0.0)	1 (0.0)	320 (99.7)

(C) AVIRIS: overall accuracy = 98%

		Actual class		
		Algae	Coral	Sand
Predicted class	Algae	2725 (99.1)	74 (3.3)	1 (0.3)
	Coral	24 (0.9)	2170 (96.7)	0 (0.0)
	Sand	0 (0.0)	0 (0.0)	320 (99.7)



NCRI
NATIONAL CORAL REEF INSTITUTE

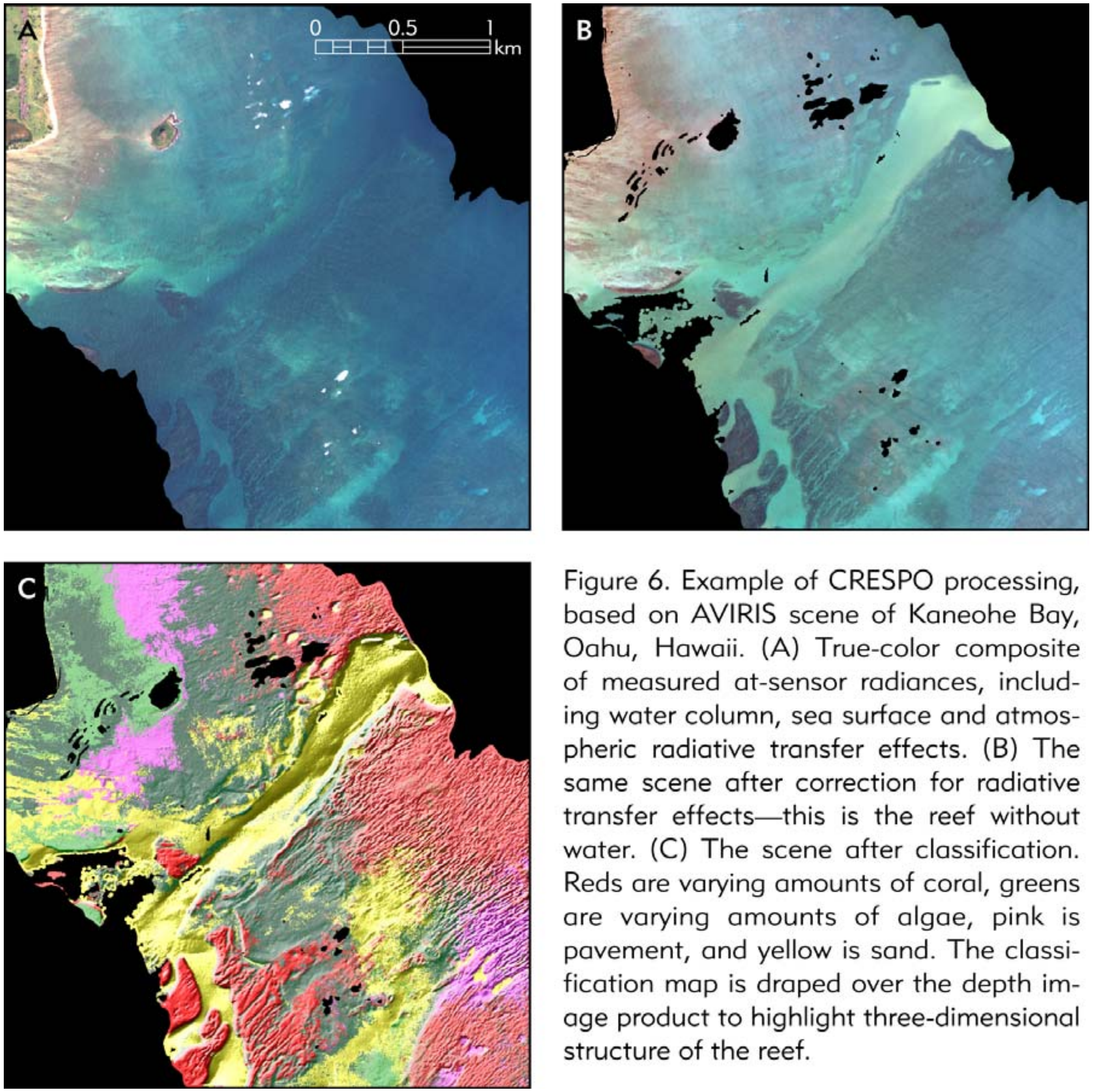
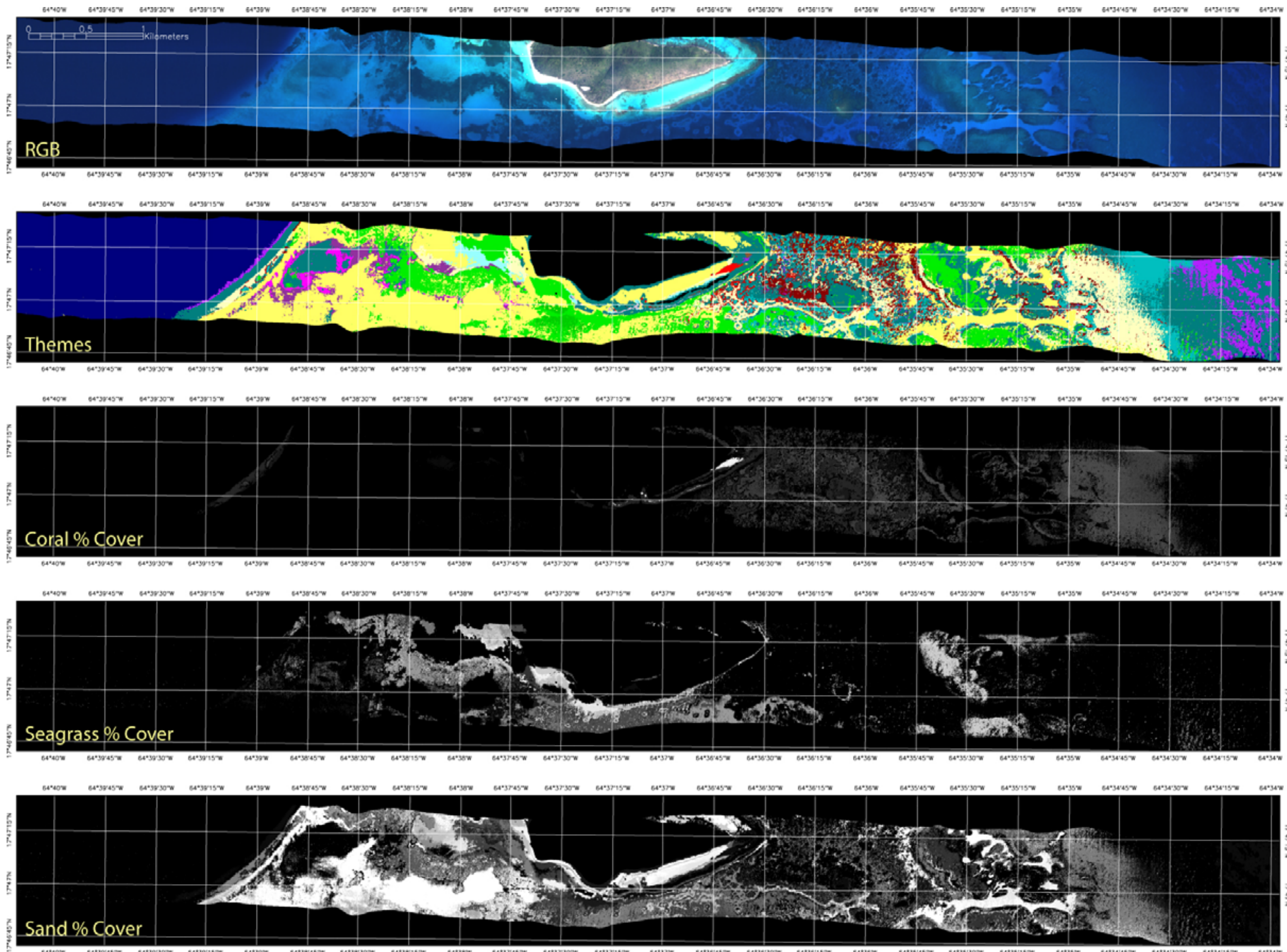
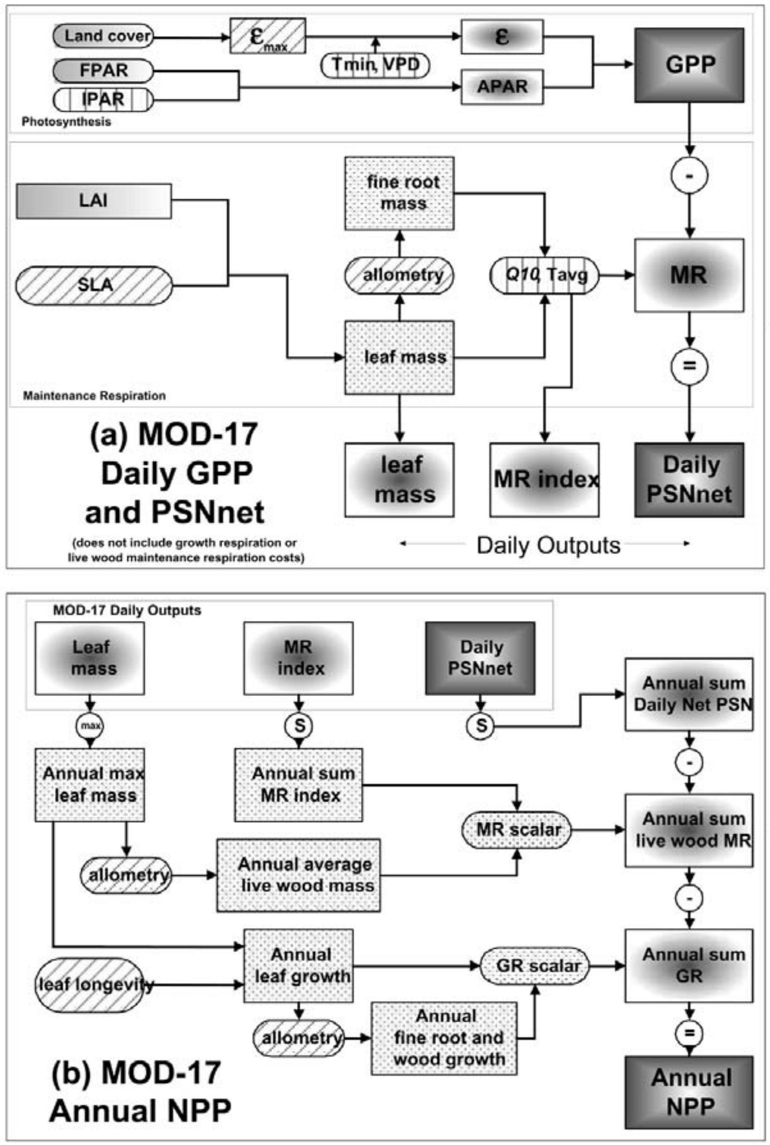


Figure 6. Example of CRESPO processing, based on AVIRIS scene of Kaneohe Bay, Oahu, Hawaii. (A) True-color composite of measured at-sensor radiances, including water column, sea surface and atmospheric radiative transfer effects. (B) The same scene after correction for radiative transfer effects—this is the reef without water. (C) The scene after classification. Reds are varying amounts of coral, greens are varying amounts of algae, pink is pavement, and yellow is sand. The classification map is draped over the depth image product to highlight three-dimensional structure of the reef.

NCRI
NATIONAL CORAL REEF INSTITUTE



NCRI
NATIONAL CORAL REEF INSTITUTE



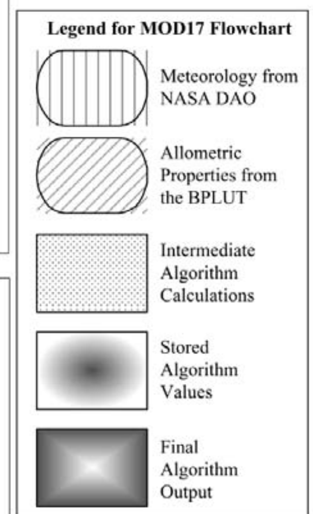


Figure 1.1. Flowcharts showing the logic behind the MOD17 Algorithm in calculating both (a) 8-day average GPP and (b) annual NPP.

$$GPP = E_d \times A \times \varepsilon$$

mol C/O_2 m^{-2} d^{-1} mol photons m^{-2} d^{-1} mol C/O_2 mol^{-1} photons

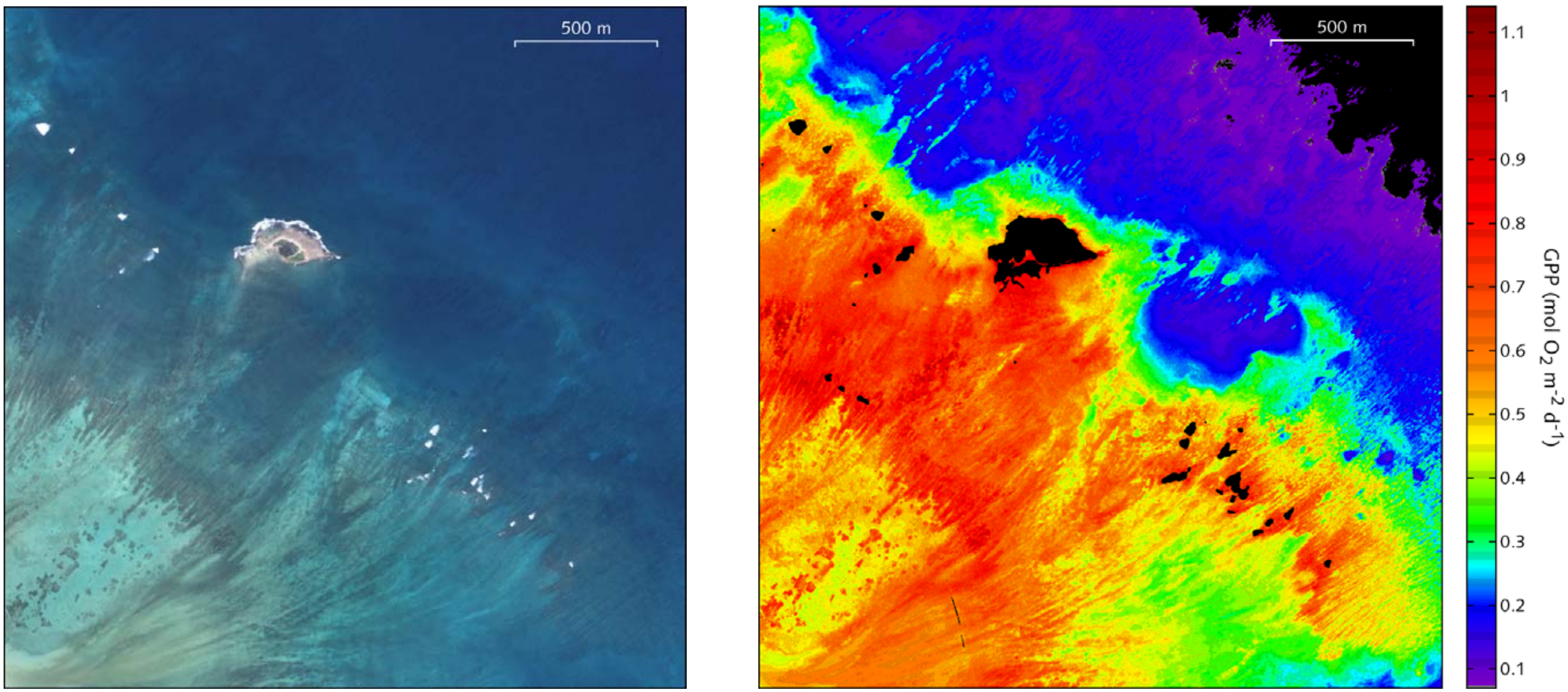
NCRI
NATIONAL CORAL REEF INSTITUTE

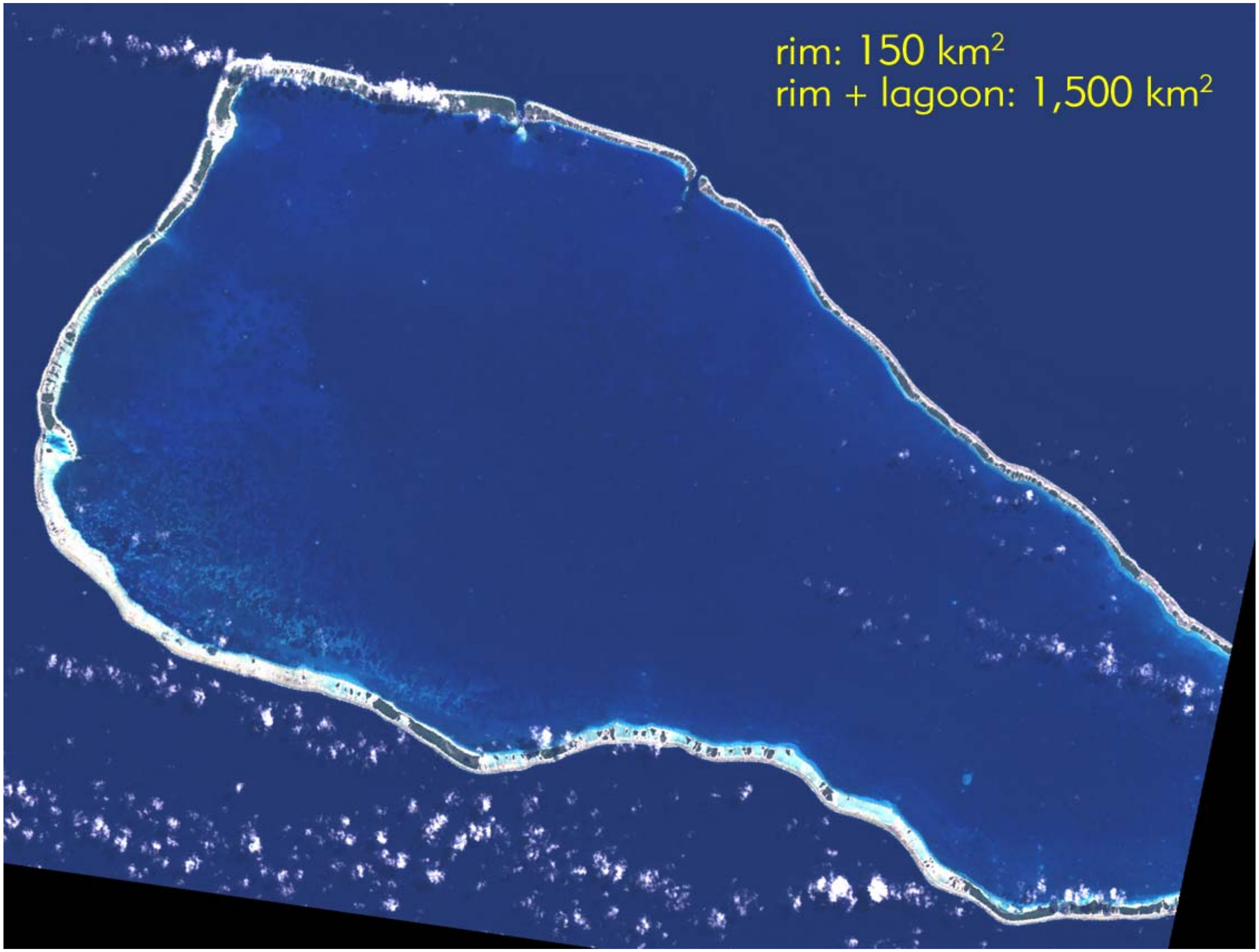
Coral Reefs
DOI 10.1007/s00338-007-0289-8

REPORT

Coral reef benthic productivity based on optical absorptance and light-use efficiency

E. J. Hochberg · M. J. Atkinson




rim: 150 km²
rim + lagoon: 1,500 km²