High Resolution Imagery Applications in the Littorals

SPIE/EOS Remote Sensing Conference
Toulouse, Fr
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High resolution multispectral systems

Aircraft

Altitude - 300-900 m
Resolution - 0.5m-1m
Multispectral bands - 19-50+
12 bits

Satellite

IKONOS
Altitude - 700 km
Resolution - 1m (pan), 4m (MS)
Multispectral bands - 4
11 bits

QuickBird
0.6m (pan), 2.5m (MS)

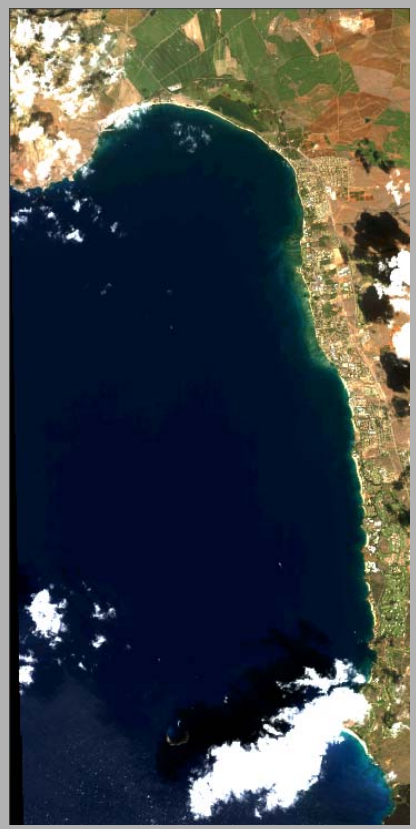
OrbView 4
+ 200-band hyperspectral with 8m resolution

Applications

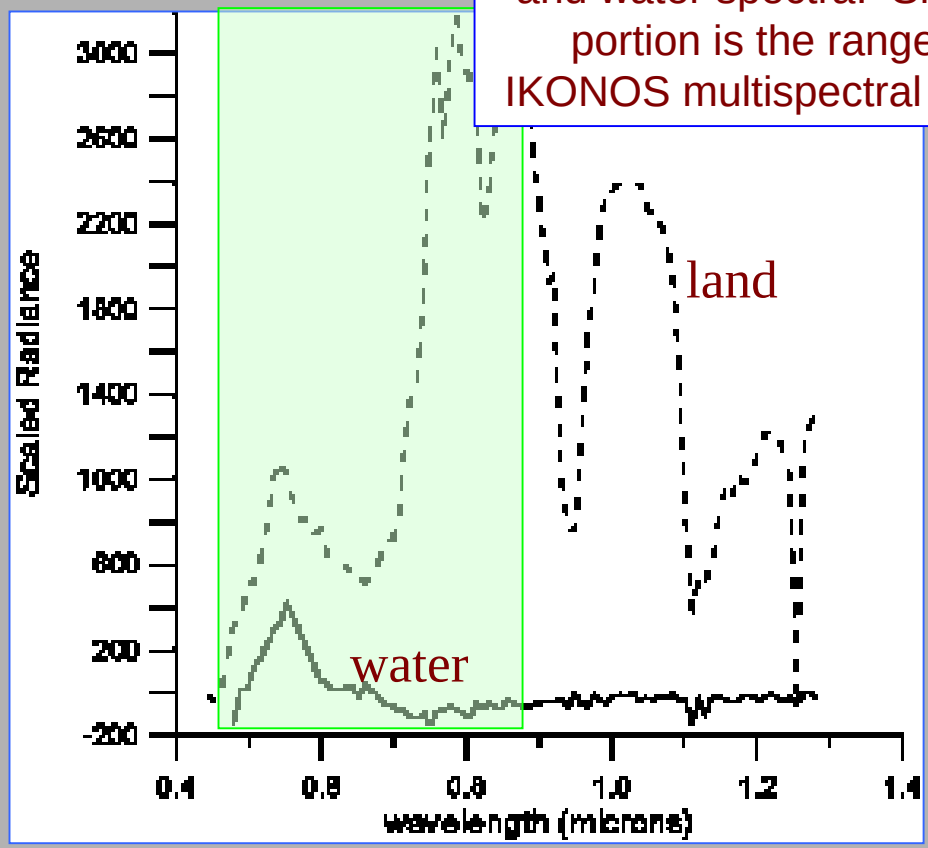
Bathymetry
Coral reef health
Marine mammals census

Sample Image

Maui, 25 January 2001

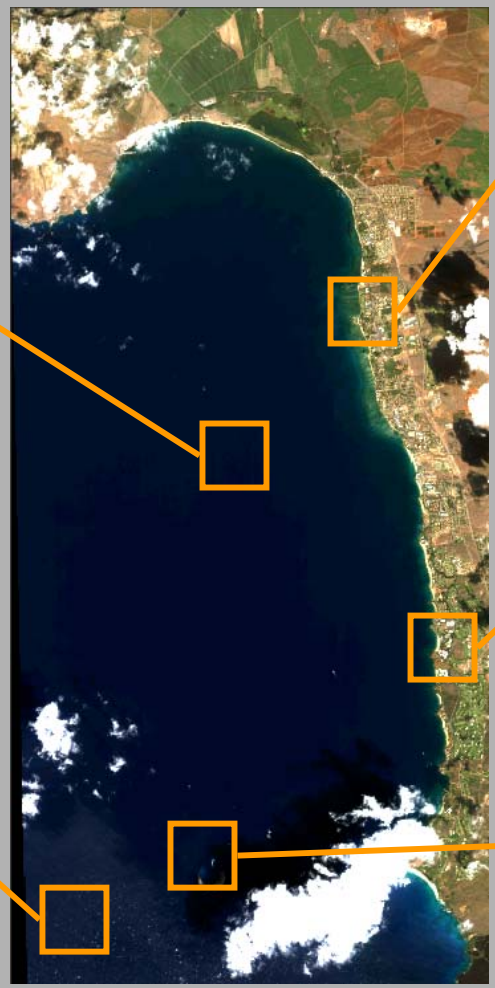


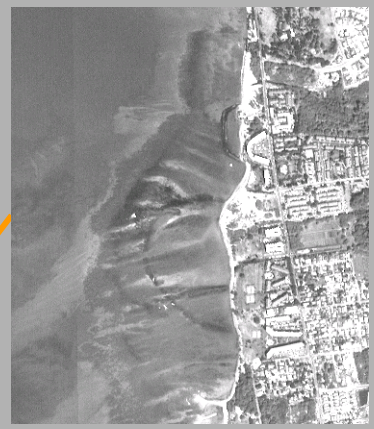
SpaceImaging.com

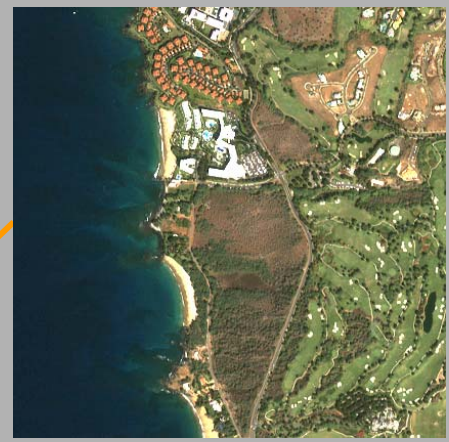


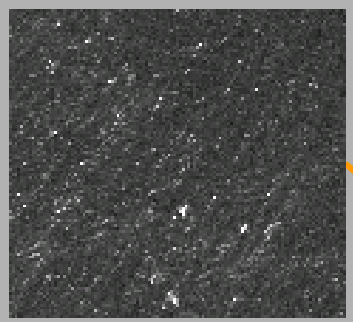
Comparison of typical land and water spectra. Shaded portion is the range of IKONOS multispectral bands

Quick Tour









Radiance at Sensor

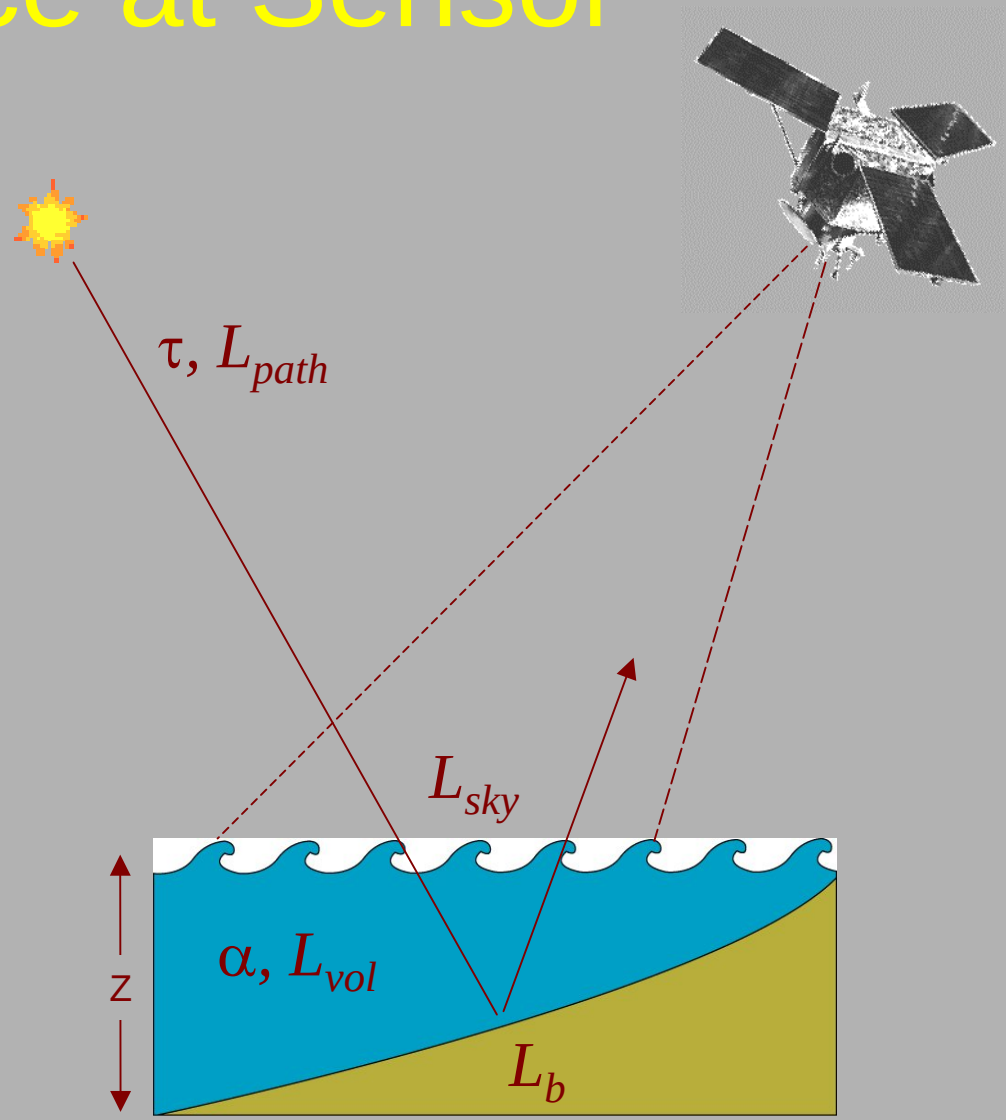
Objects on land

$L_{sensor} = L_{path} + \tau L_b$

Objects in water

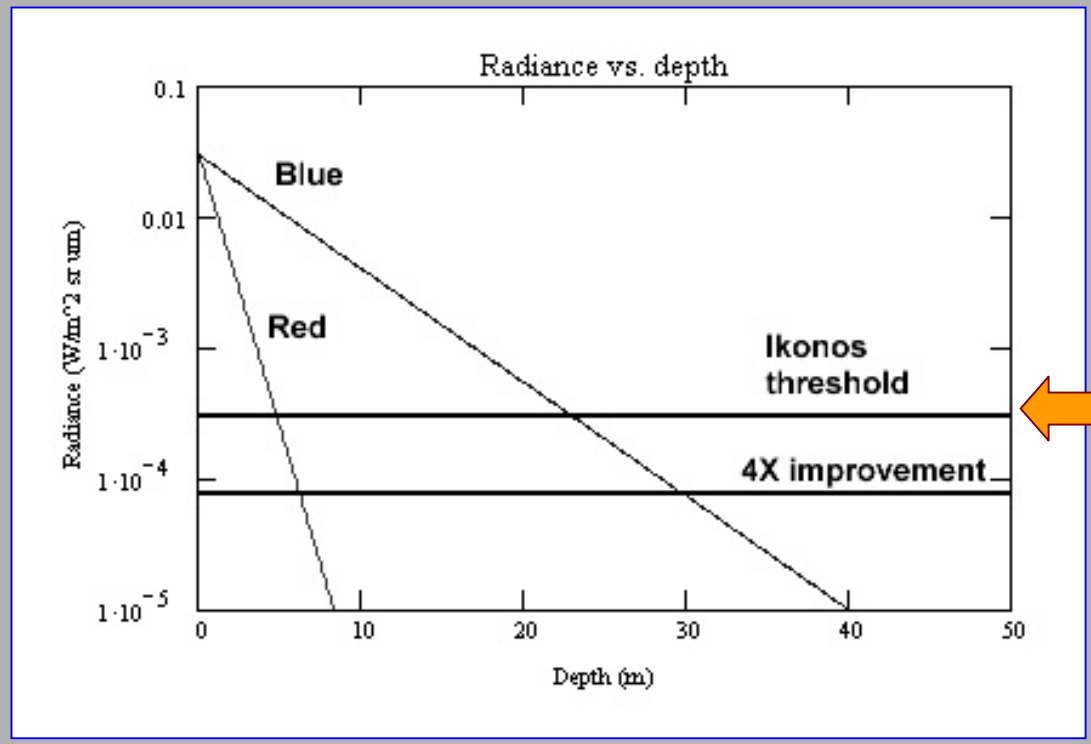
$L_{sensor} = L_{path} + \tau [L_{sky} + e^{-2kz} L_b + (1 - e^{-2kz}) L_{vol}]$

L_{sensor} = Radiance at sensor
L_{path} = Atmosphere path radiance
τ = Atmosphere path attenuation
L_{sky} = Skylight reflected from surface
K = Water attenuation
z = Depth
L_b = Target radiance
L_{vol} = Water volume scattering



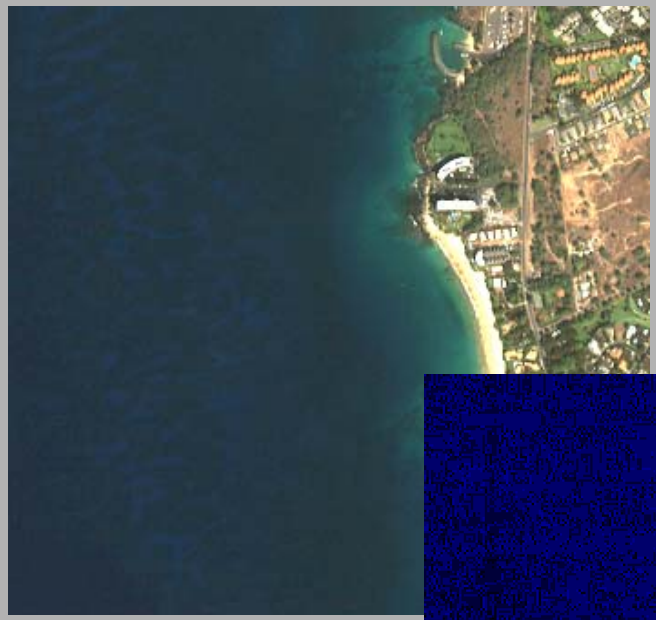
Radiance Vs Depth

Water leaving radiance for a 10% Lambertian target, chlorophyll concentration of 2 mg m^3



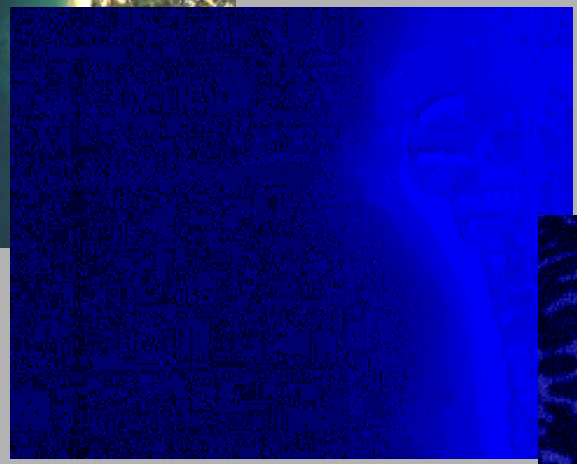
LSB of 11 bits

11-bit vs 8-bit

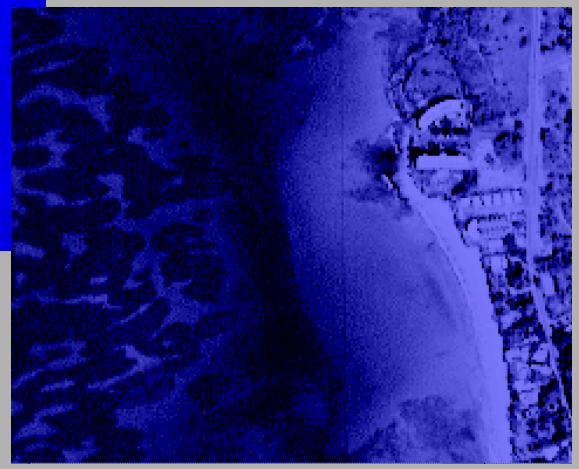


Maui coast

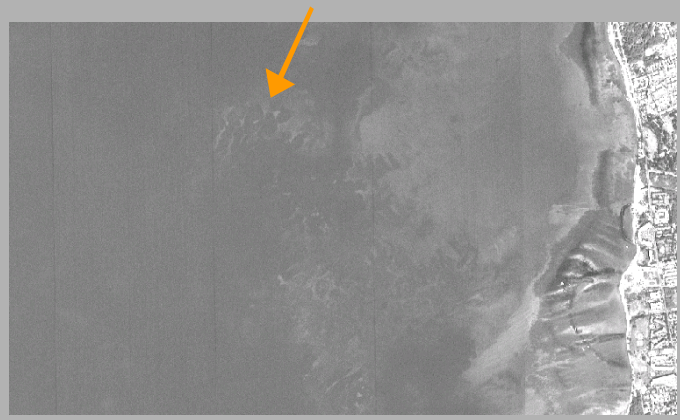
8-bit blue with histogram equalization



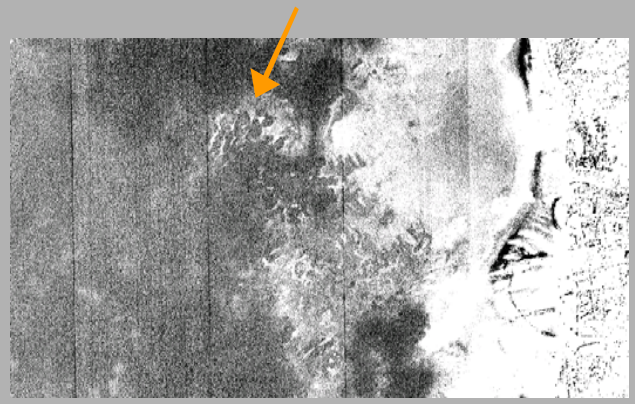
11-bit blue with histogram equalization



Bathymetry

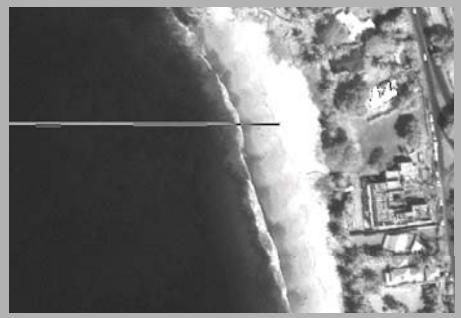


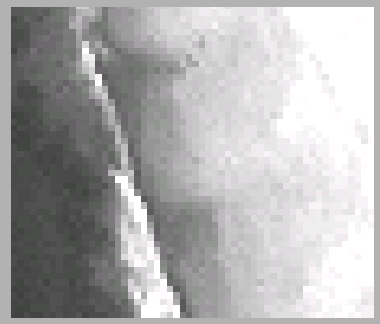
Blue



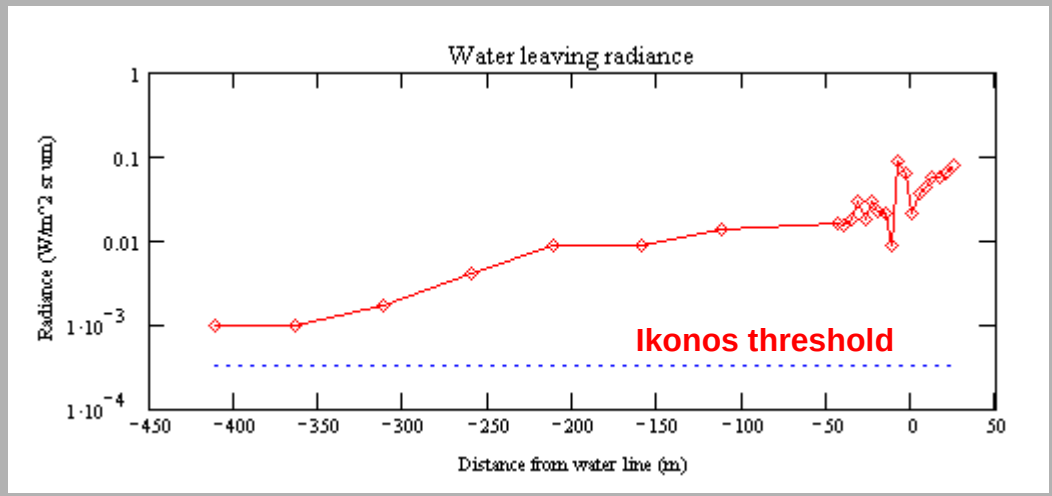
Blue with histogram equalization

Bathymetry





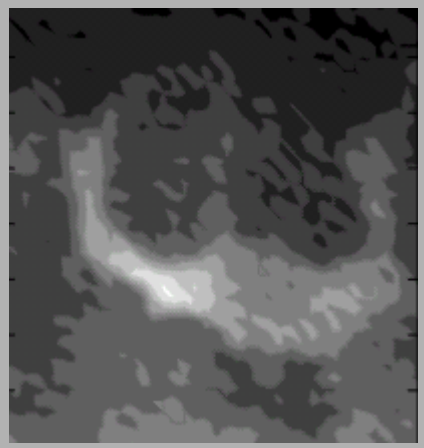
Source: Space Imaging, LLC.



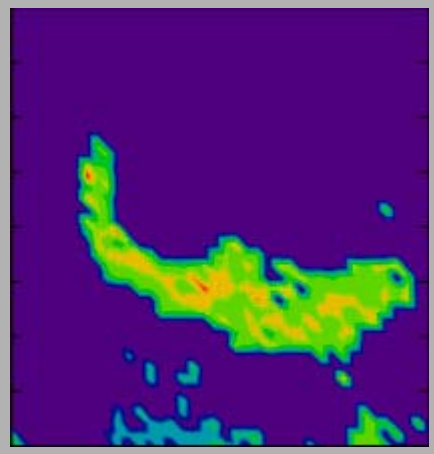
Coral Reef

Aerial photo

Blue band



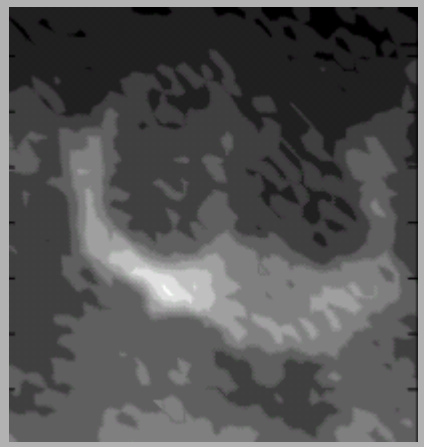
Blue-Green ratio



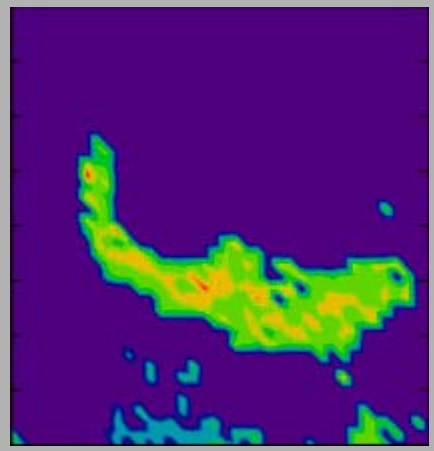
Molokini Coral Reef

Aerial photo of Molokini crater and coral reef.

Ikonos image blue band radiance (gray scale) for a small section of Molokini coral reef.

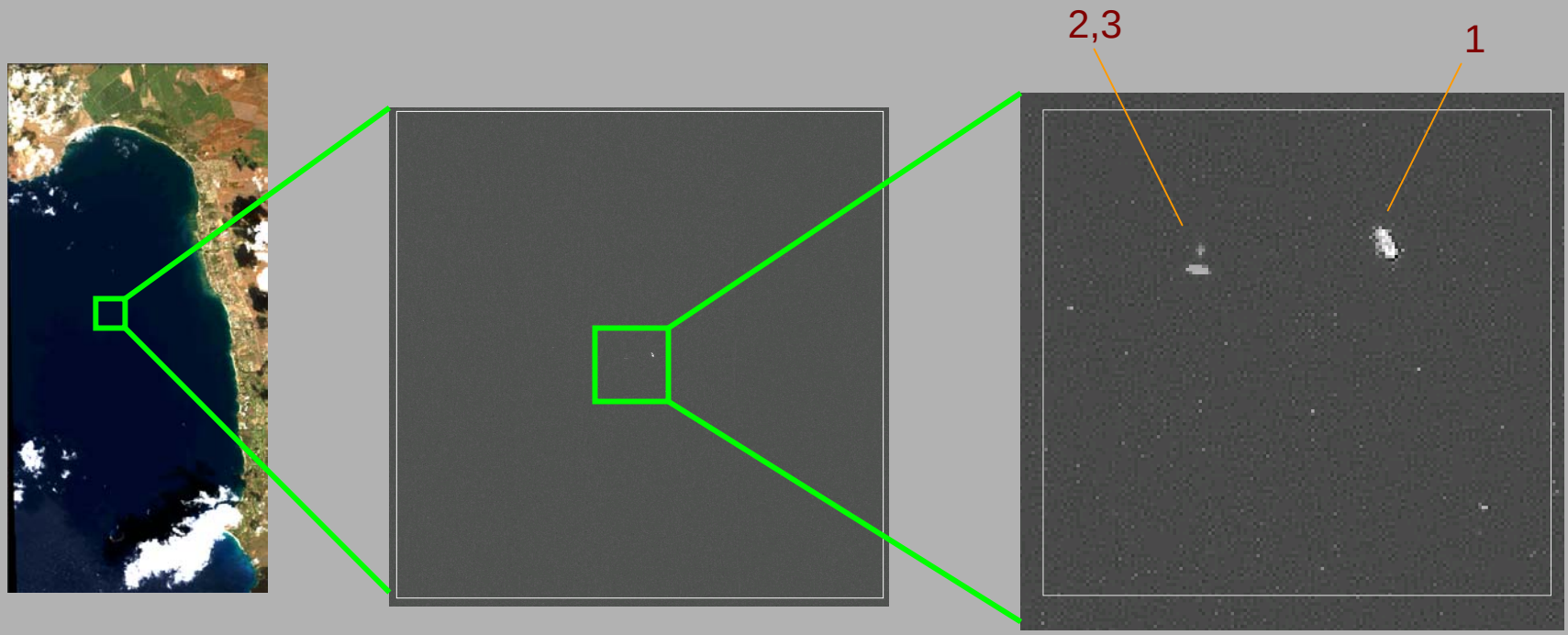


Corresponding Ikonos Blue-Green ratio

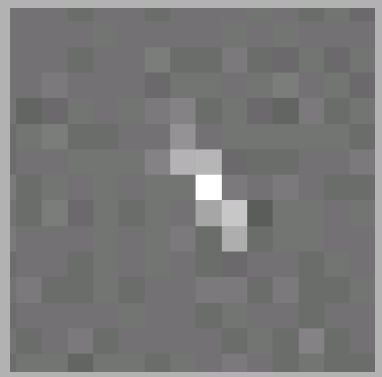


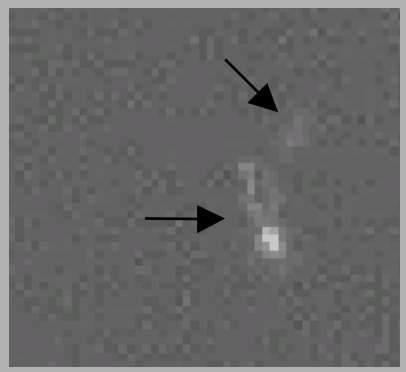
Area is 540 m x 540 m. Pixel resolution is 4 m x 4 m. Higher B/G ratio (right) correlates with higher B radiance (left). Given the water optical properties of this case, this correlation implies that there are two types of coral materials, which are color coded as yellow and green in above plot.

Marine Mammals



Marine Mammals





Fusion

Bathymetry

SeaWiFS - water diffuse attenuation (*k*) 1-km resolution

Coral reef health

OrbView 4 - Pan (1m) + MS (4m) + 200-band hyperspectral (8m)

Marine mammals census

Aerial - specie classification