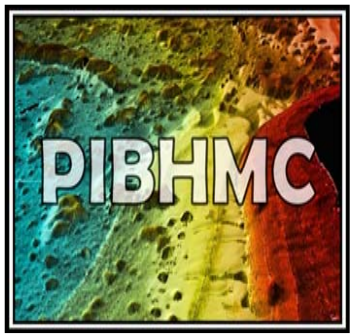


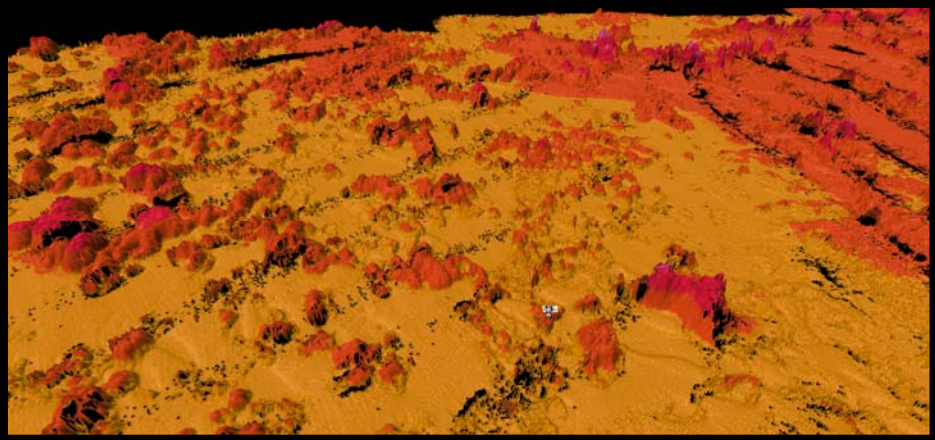
Pacific Islands Benthic Habitat Mapping Center

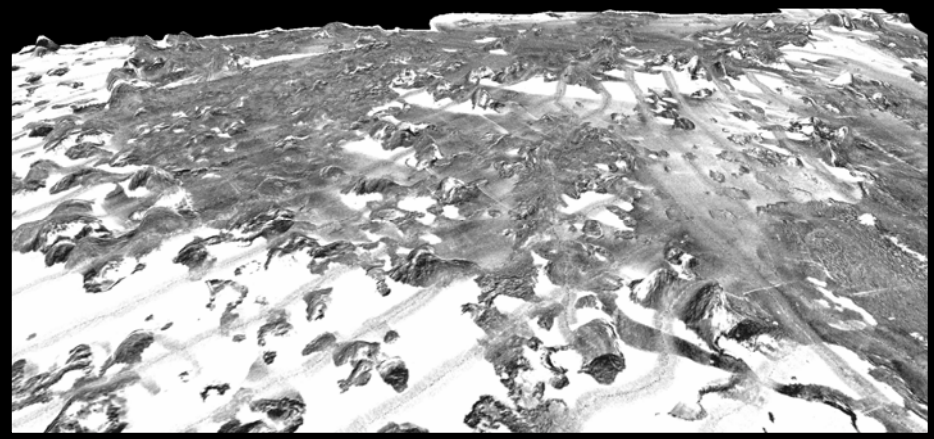
Seafloor characterization using high-resolution multibeam bathymetry and backscatter at French Frigate Shoals, Northwestern Hawaiian Islands

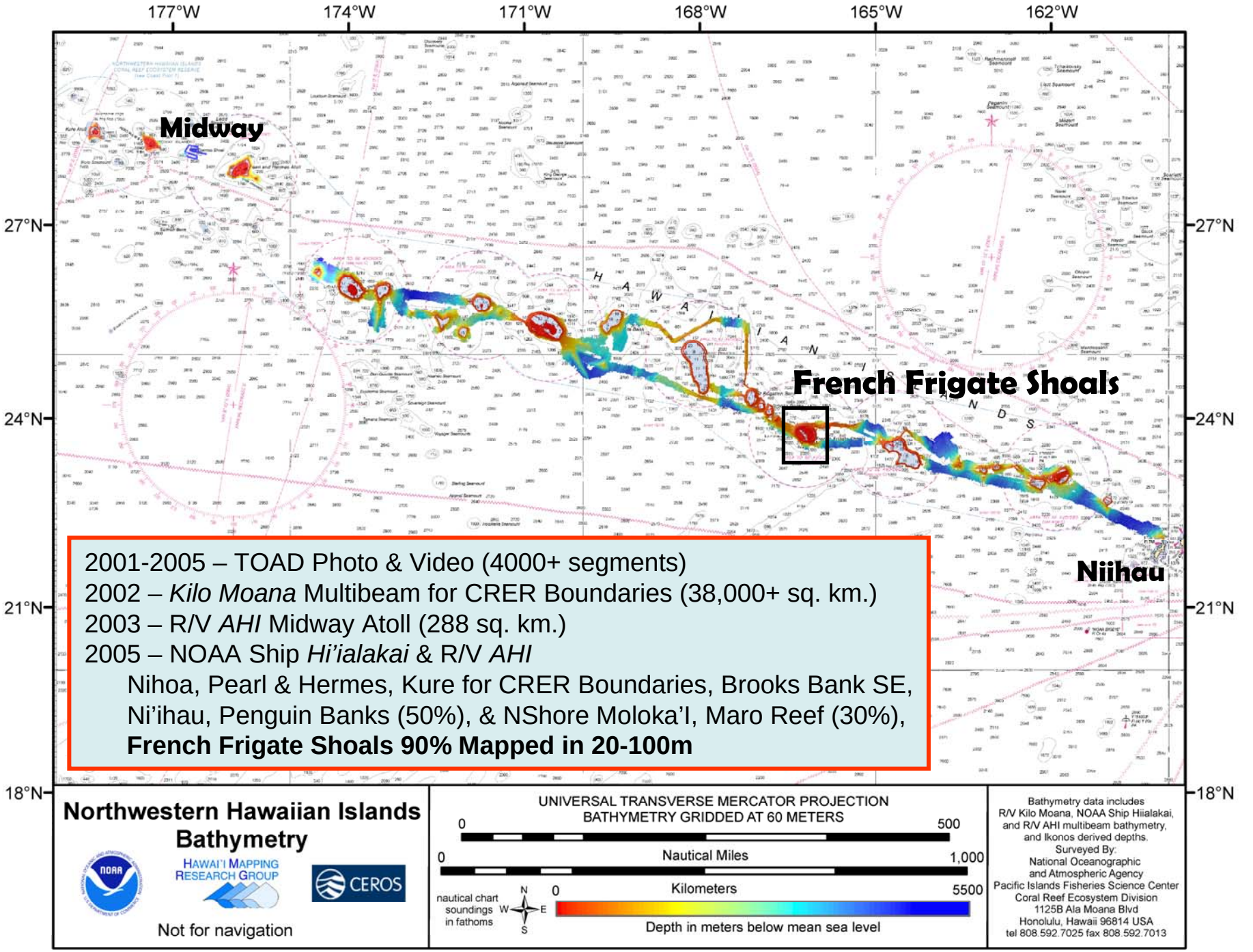
Jonathan Weiss, **Joyce Miller, Emily Lunblad**
JIMAR/NOAA Pacific Islands Fisheries Science Center
Coral Reef Ecosystem Division
Susan Vogt
NOAA/National Marine Sanctuaries Program
Robert O'Conner
NOAA Pacific Islands Regional Office

Talk Outline

I Introduction to mapping in the NWHI & FFS
II High-resolution bathymetry & backscatter
III Optical ground truth – central banktop
IV Optical ground truth – southern banktop
V Summary & Conclusions
VI Continuing Work







2001-2005 – TOAD Photo & Video (4000+ segments)
2002 – *Kilo Moana* Multibeam for CRER Boundaries (38,000+ sq. km.)
2003 – R/V *AHI* Midway Atoll (288 sq. km.)
2005 – NOAA Ship *Hi'ialakai* & R/V *AHI*
Nihoa, Pearl & Hermes, Kure for CRER Boundaries, Brooks Bank SE, Ni'ihau, Penguin Banks (50%), & NShore Moloka'I, Maro Reef (30%),
French Frigate Shoals 90% Mapped in 20-100m

Northwestern Hawaiian Islands Bathymetry

NOAA

HAWAI'I MAPPING RESEARCH GROUP

CEROS

Not for navigation

UNIVERSAL TRANSVERSE MERCATOR PROJECTION
BATHYMETRY GRIDDED AT 60 METERS

0 — 500 Nautical Miles

0 — 1,000 Kilometers

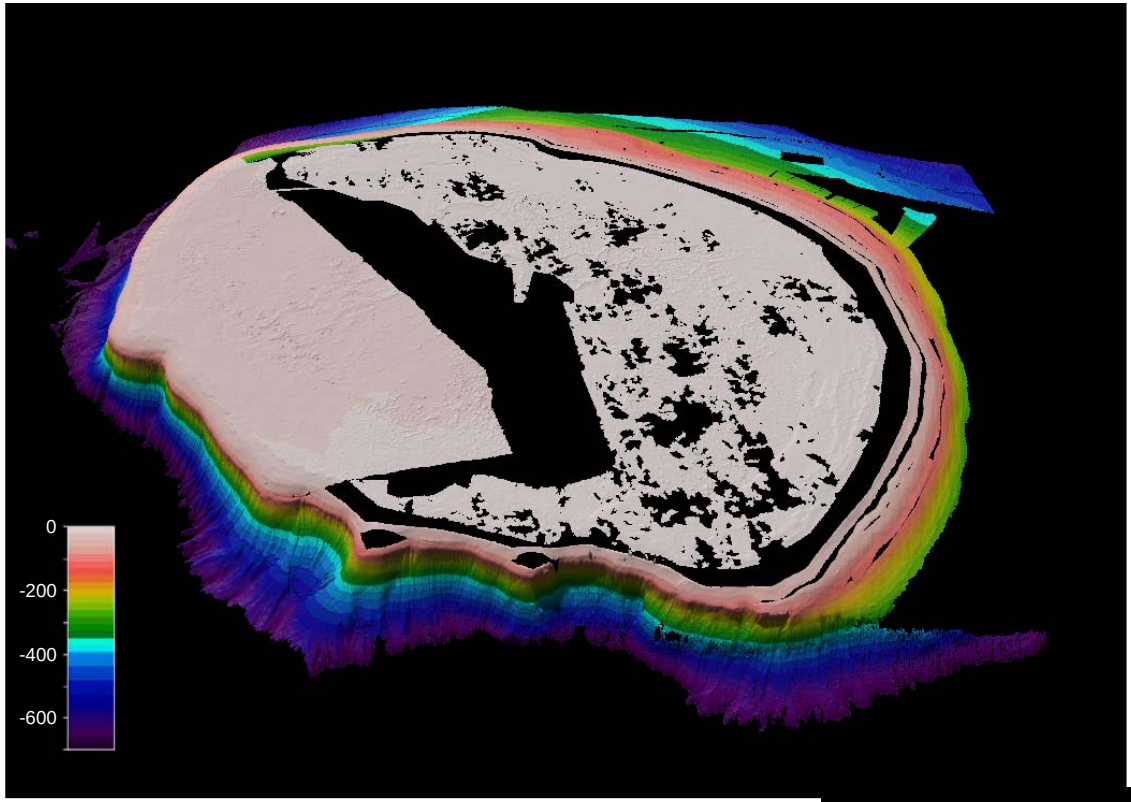
0 — 5500 Depth in meters below mean sea level

nautical chart soundings in fathoms

Bathymetry data includes R/V Kilo Moana, NOAA Ship Hiialakai, and R/V AHI multibeam bathymetry, and Ikonos derived depths.

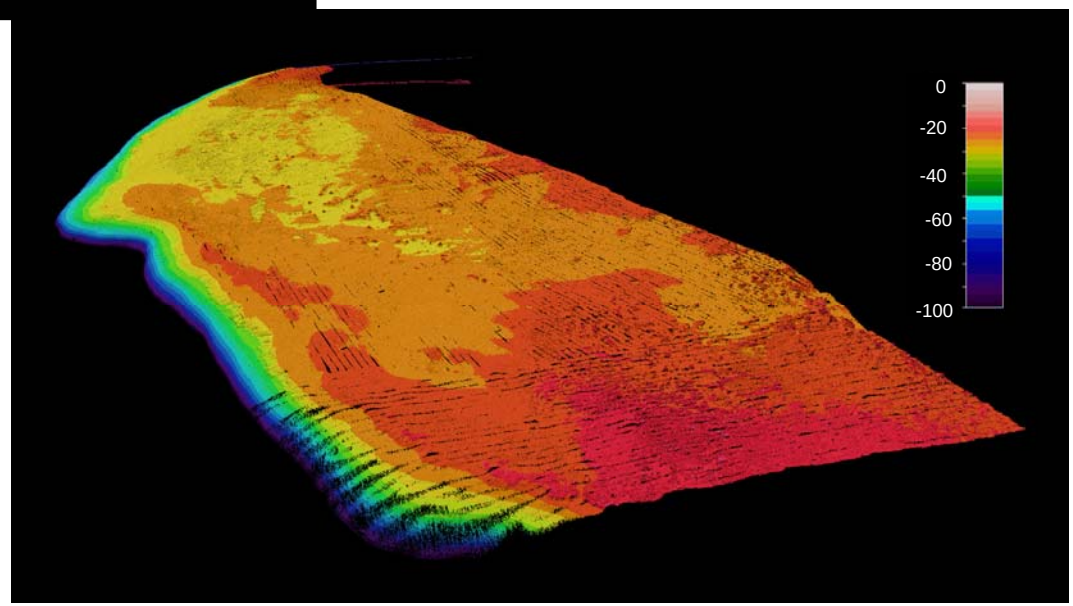
Surveyed By:
National Oceanographic and Atmospheric Agency
Pacific Islands Fisheries Science Center
Coral Reef Ecosystem Division
1125B Ala Moana Blvd
Honolulu, Hawaii 96814 USA
tel 808.592.7025 fax 808.592.7013

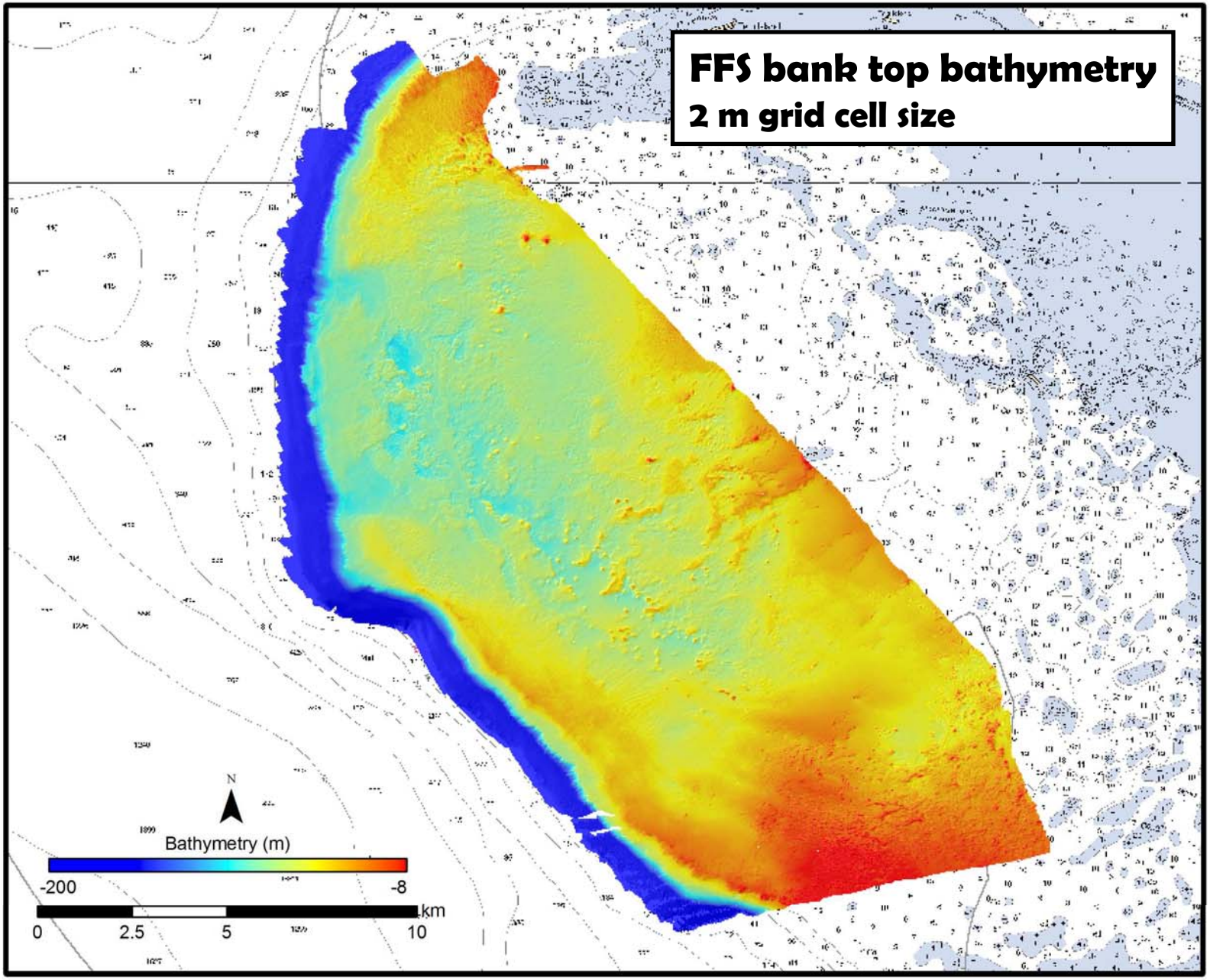
French Frigate Shoals, NWHI

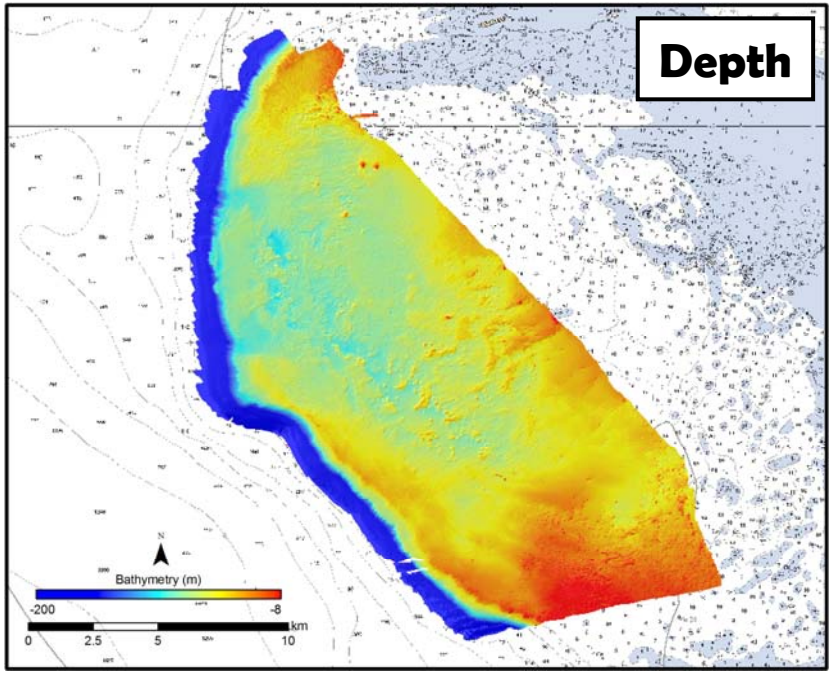


- Total landmass = 0.23 km²
- Tern Island and other small islets

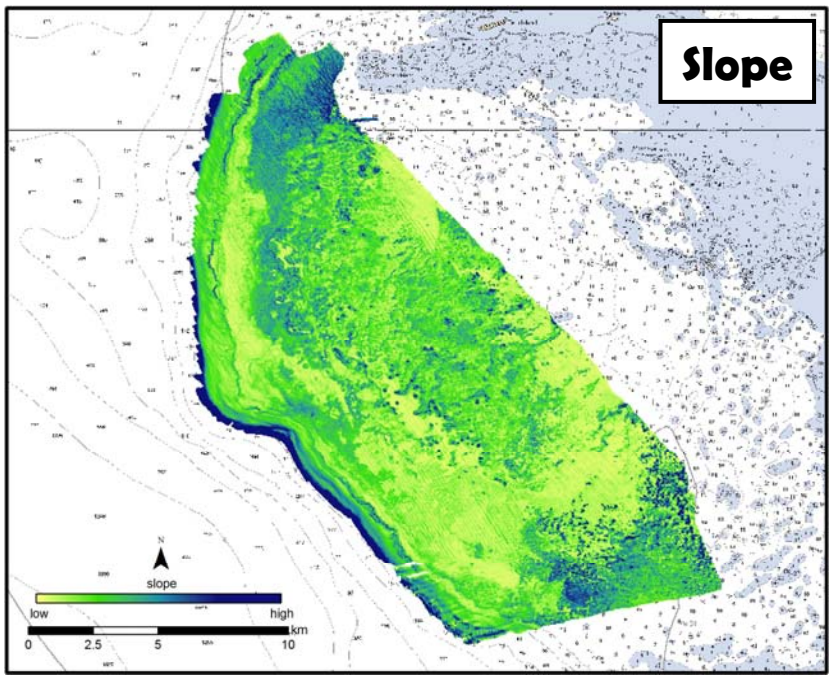
- Open on the leeward side
- 733 km² of coral habitat <-100 m
- Wide range of reef habitats
  - ocean-facing reef slopes
  - patch/linear reefs, pinnacles
- Highest coral diversity in NWHI
- Seal, turtle, and seabird sanctuary

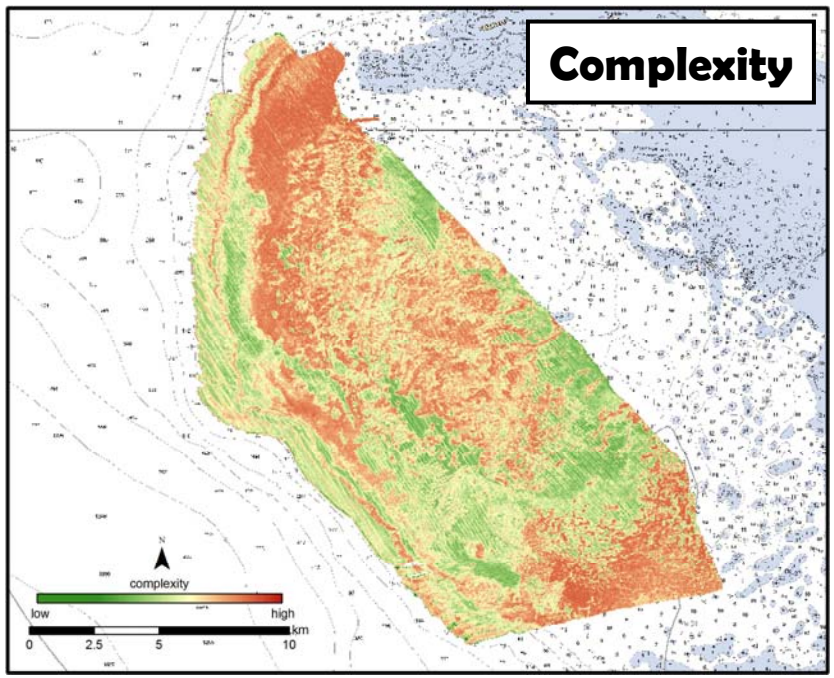


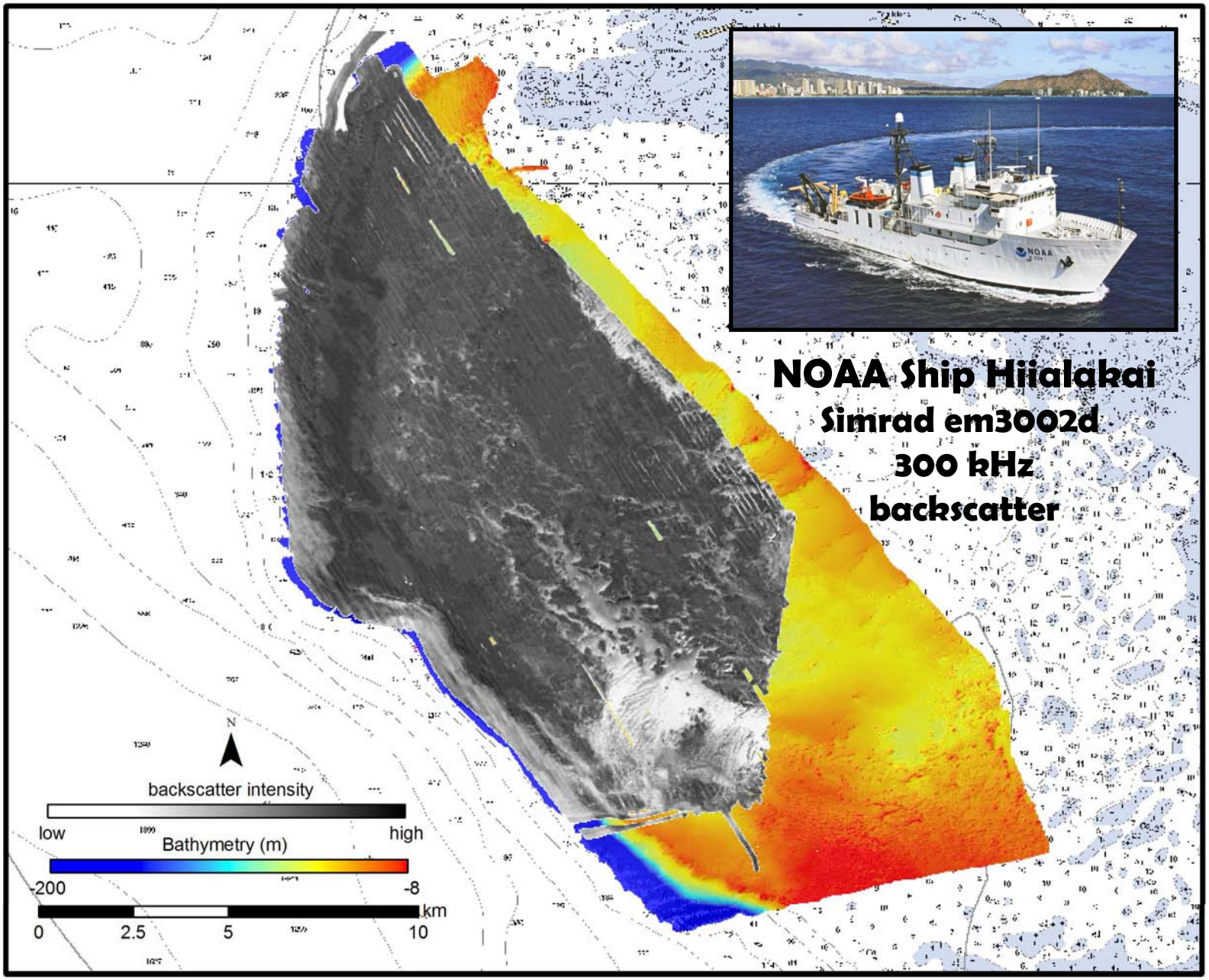

FFS bank top bathymetry
2 m grid cell size
N
Bathymetry (m)
-200
-8
0
2.5
5
10
km

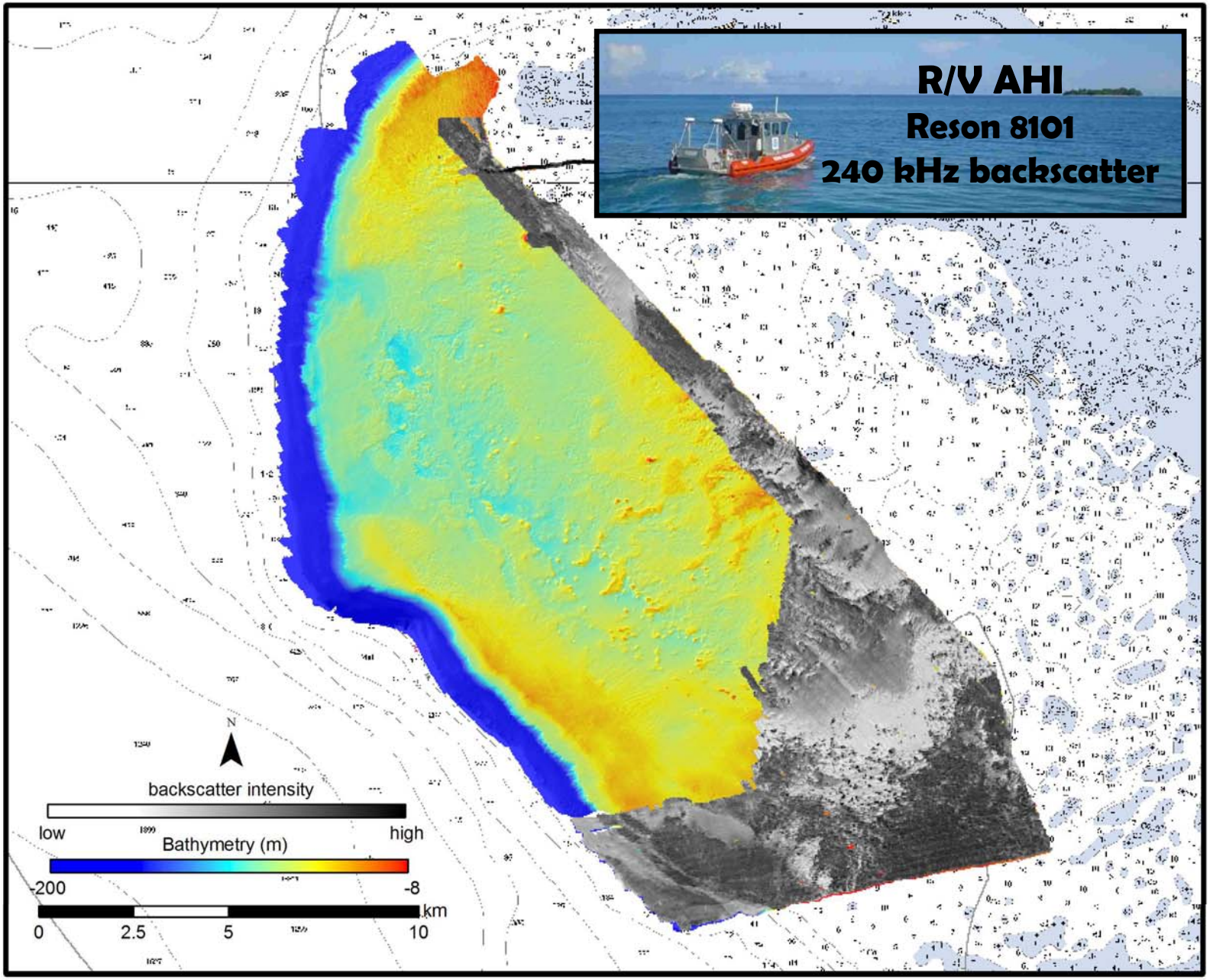


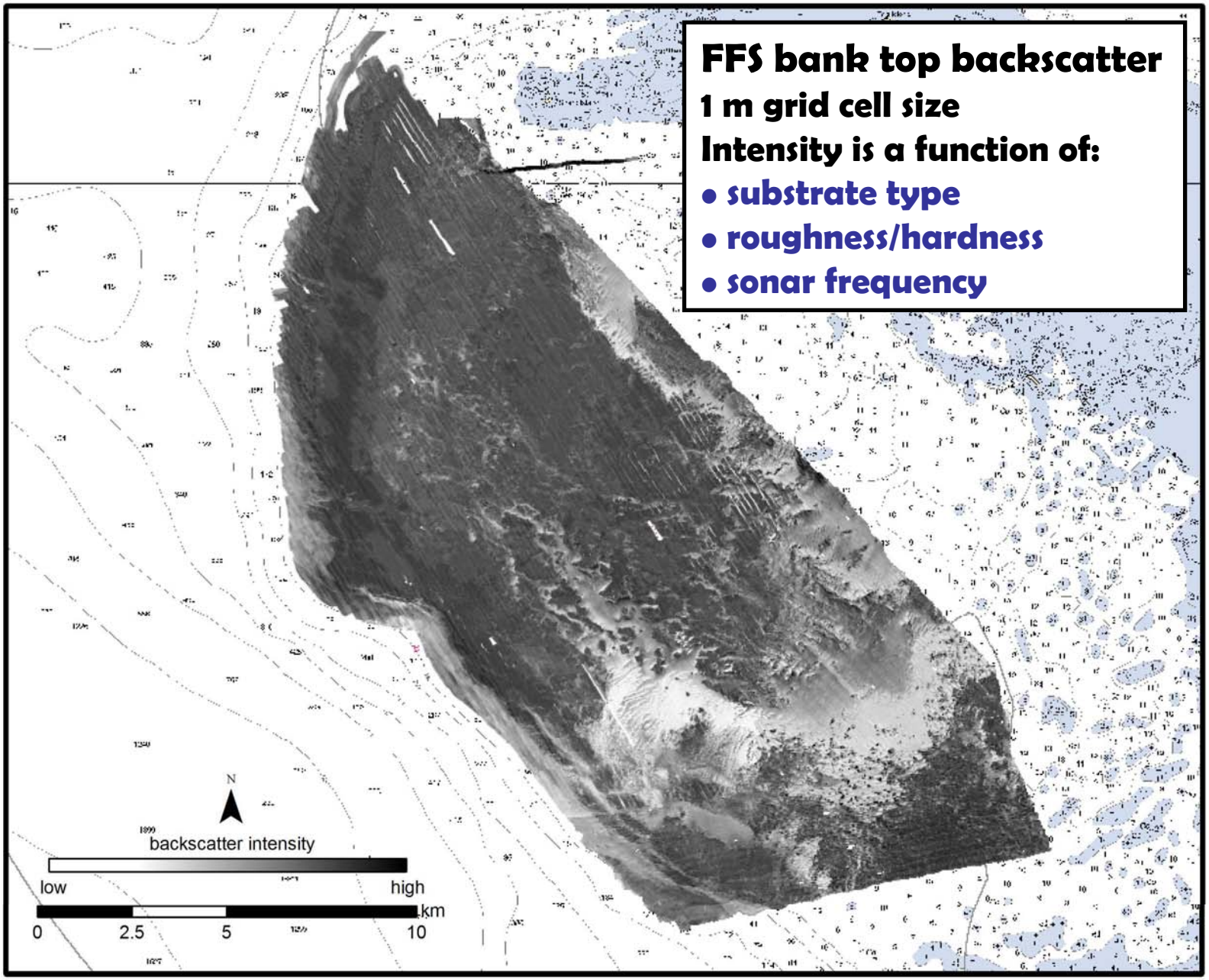
FFS West Bank
Analysis of Multibeam Bathymetry

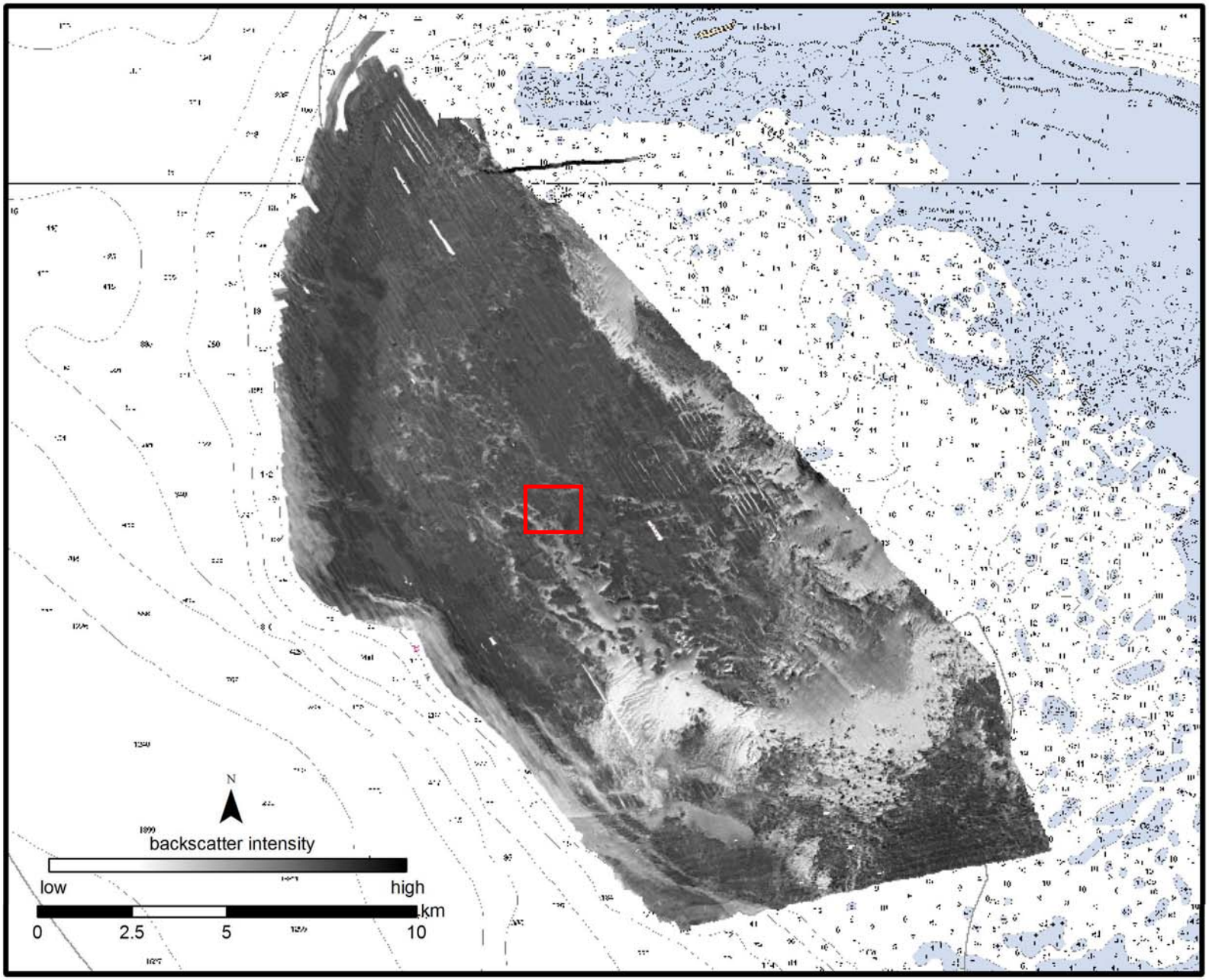




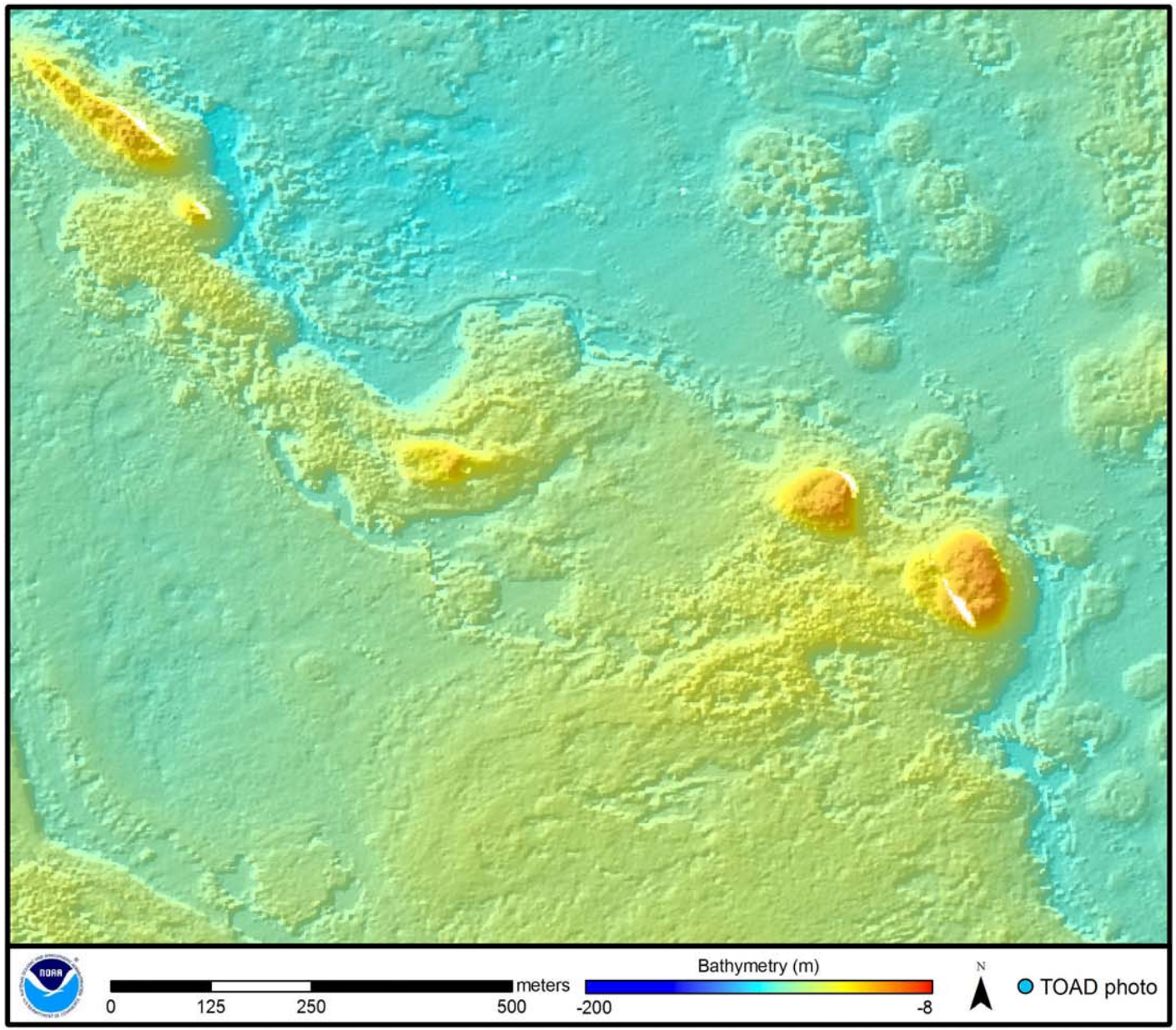

NOAA Ship Hiialakai
Simrad em3002d
300 kHz
backscatter
N
backscatter intensity
low
high
Bathymetry (m)
-200
-8
km
0
2.5
5
10


R/V AHI
Reson 8101
240 kHz backscatter
N
backscatter intensity
low
high
Bathymetry (m)
-200
-8
km
0
2.5
5
10

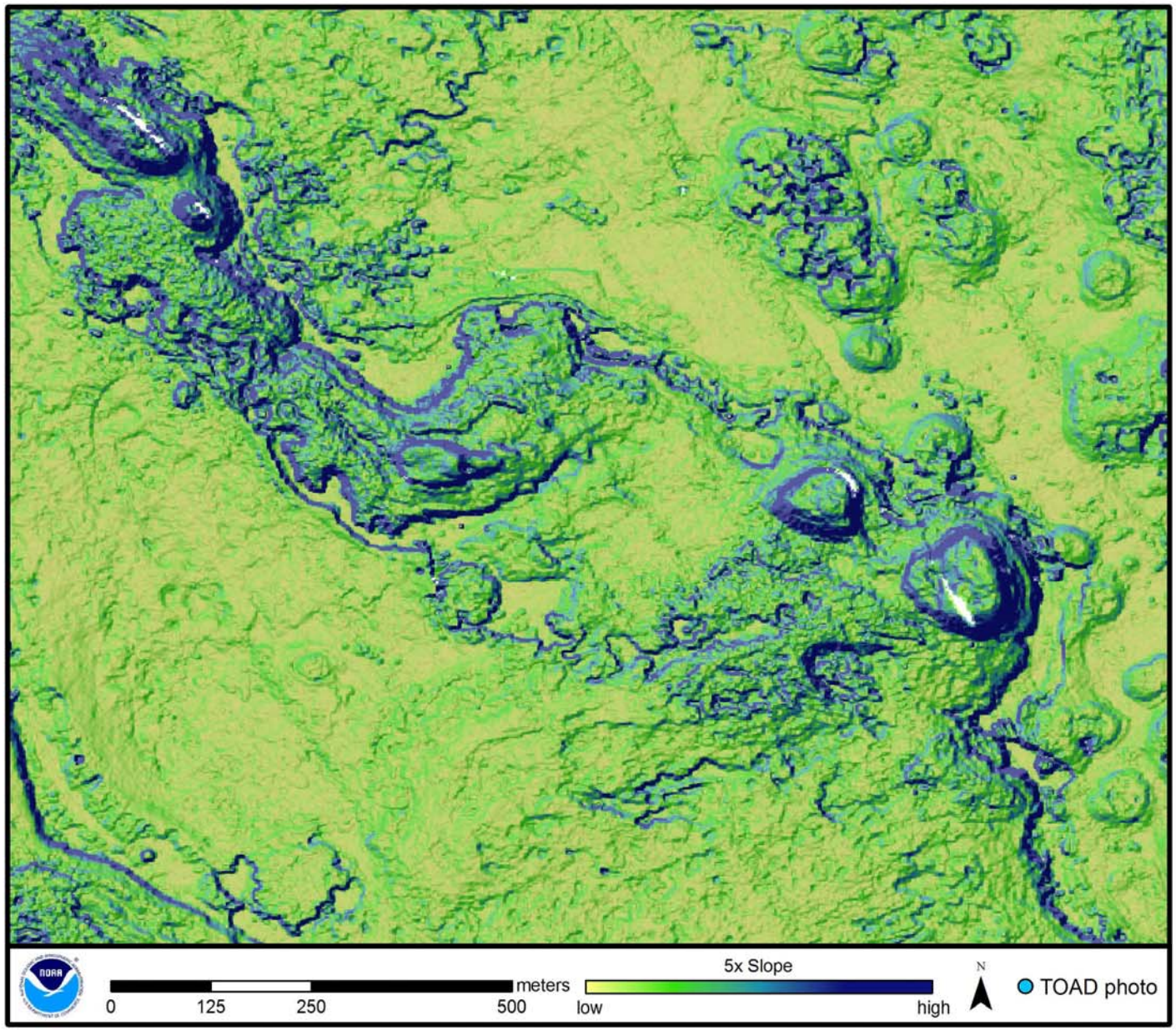

FFS bank top backscatter
1 m grid cell size
Intensity is a function of:
• substrate type
• roughness/hardness
• sonar frequency
N
backscatter intensity
low
high
0
2.5
5
10
km


N
backscatter intensity
low
high
0
2.5
5
10
km

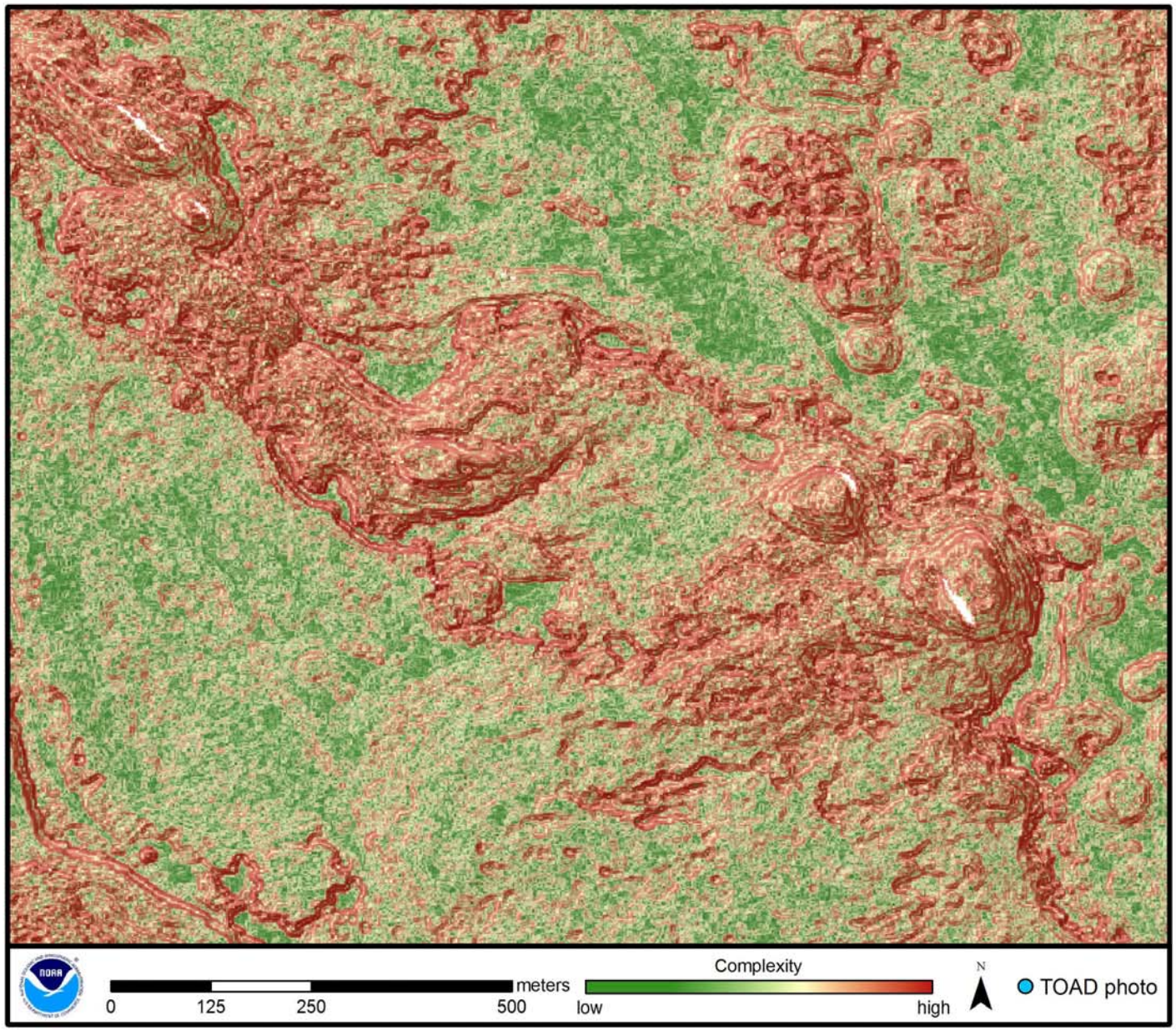
multibeam bathymetry



5x slope

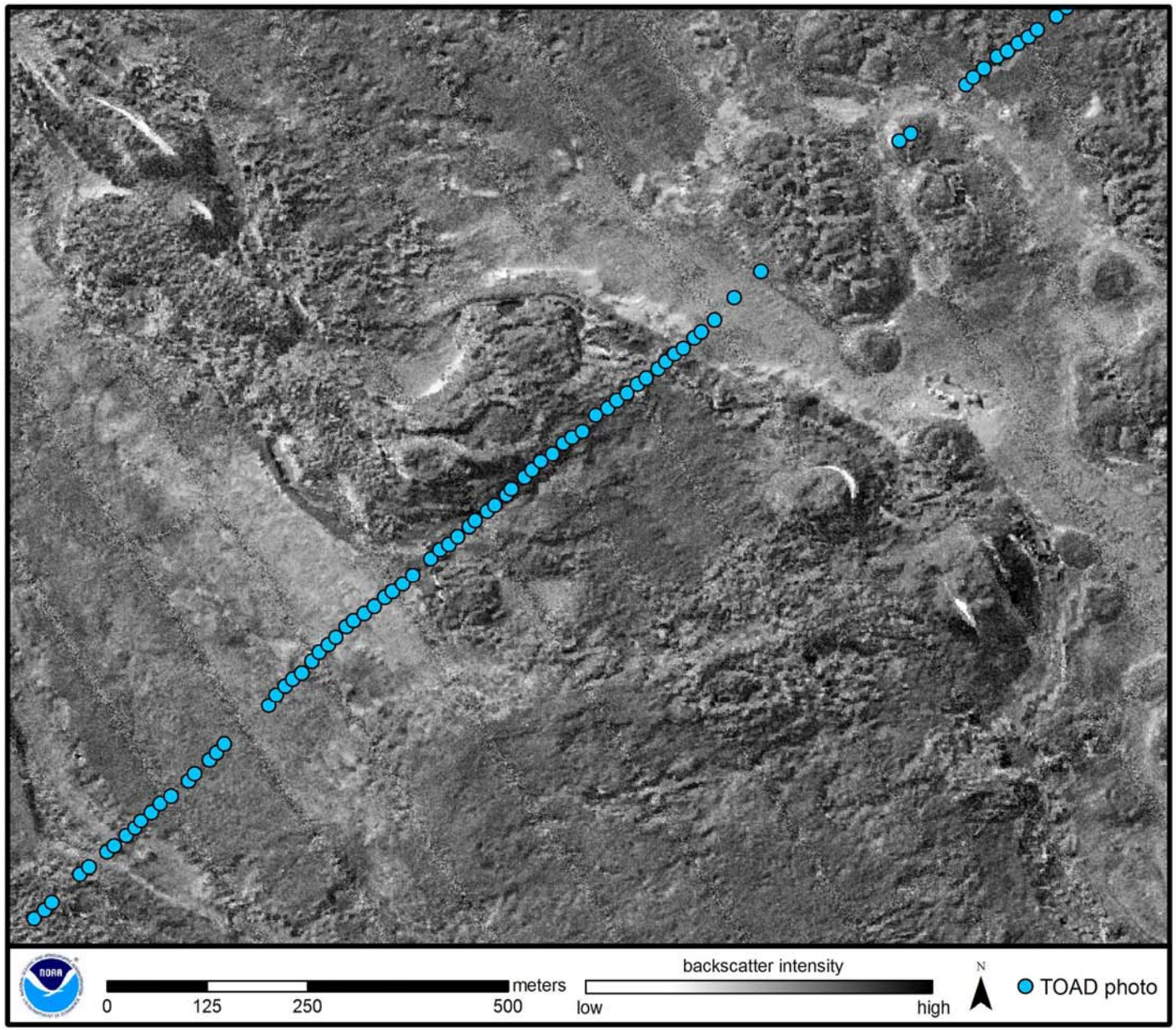


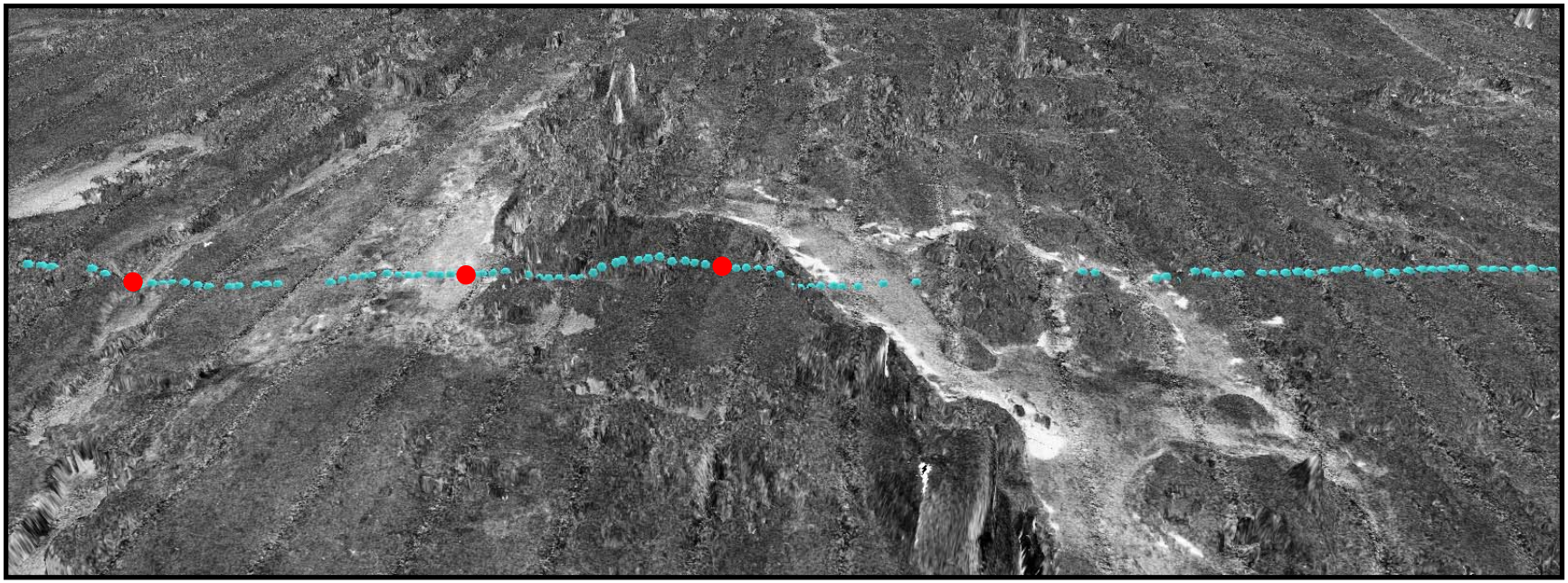
complexity

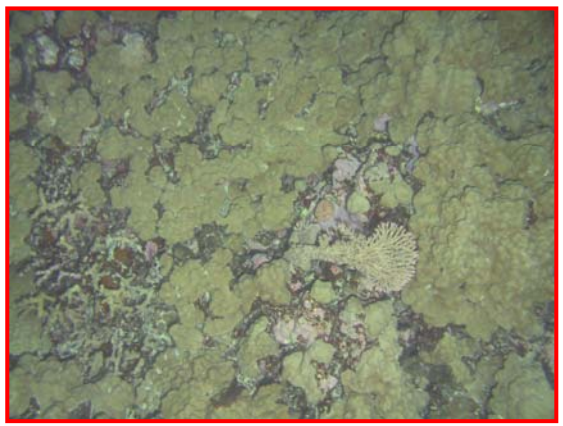


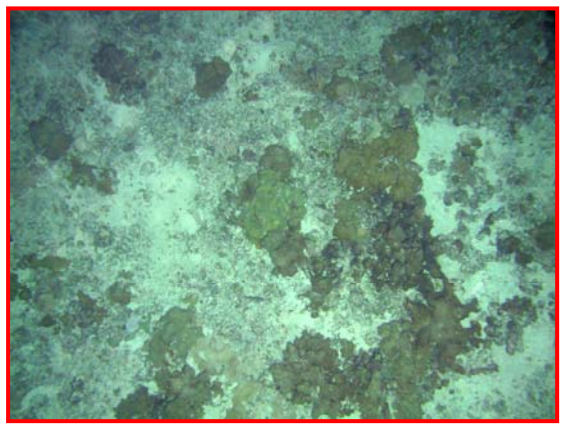
multibeam backscatter

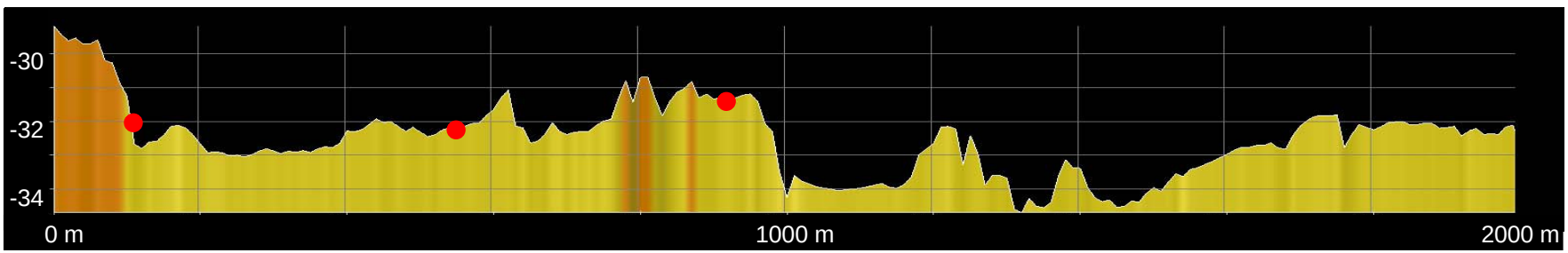
multibeam backscatter

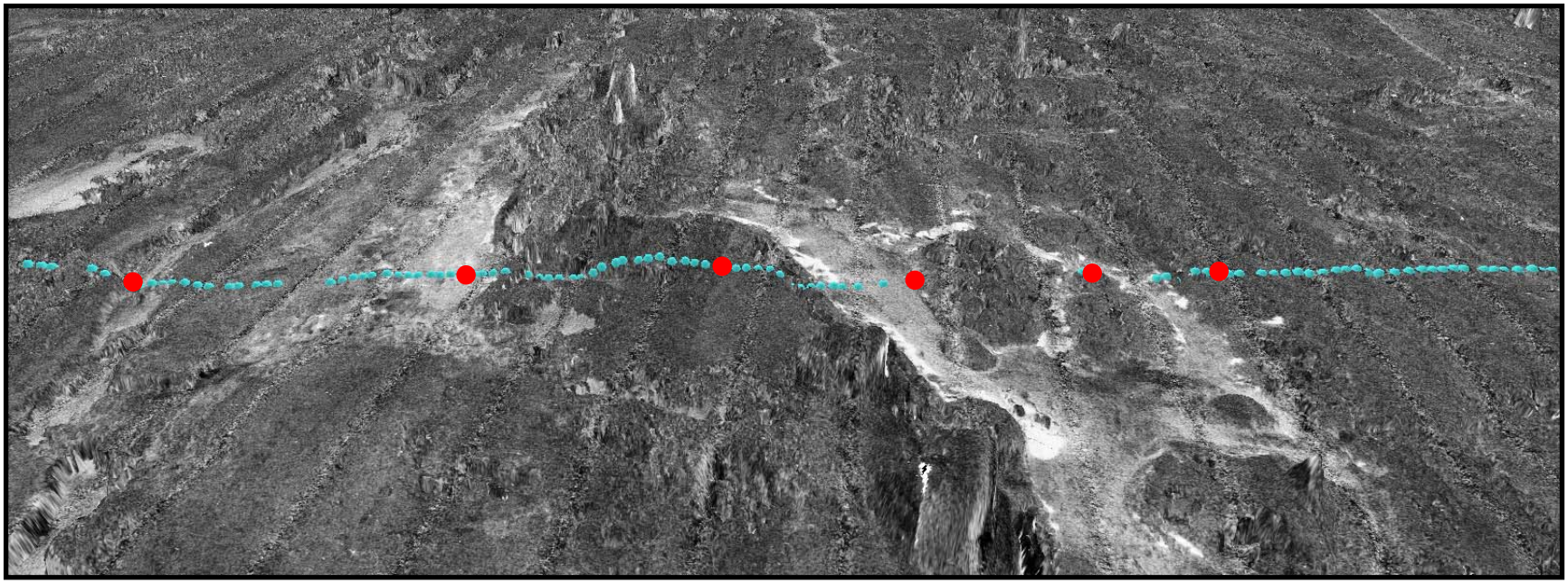


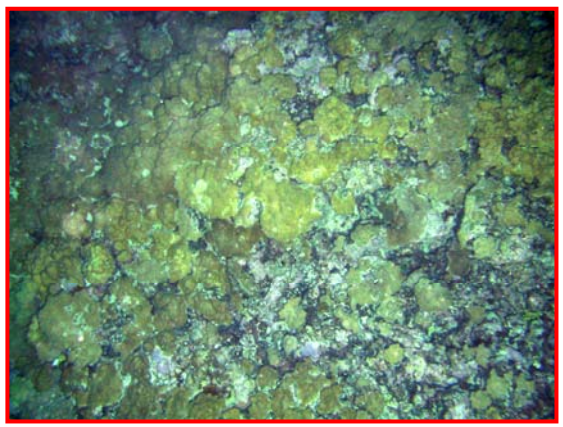


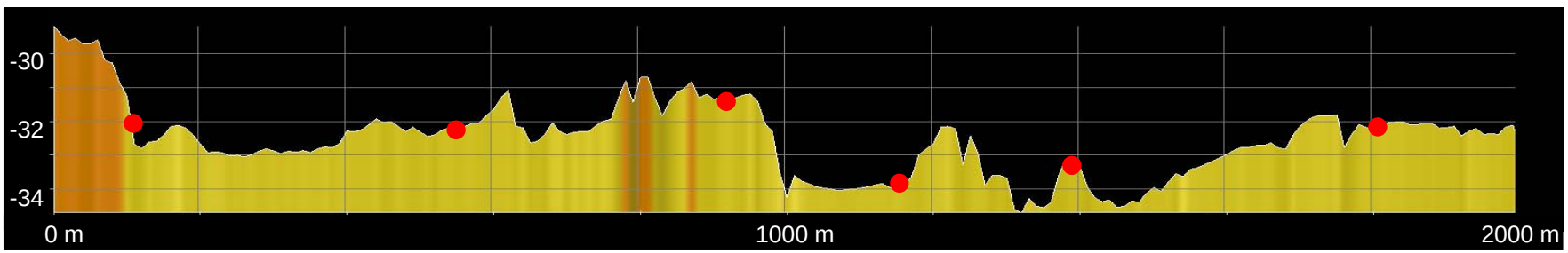


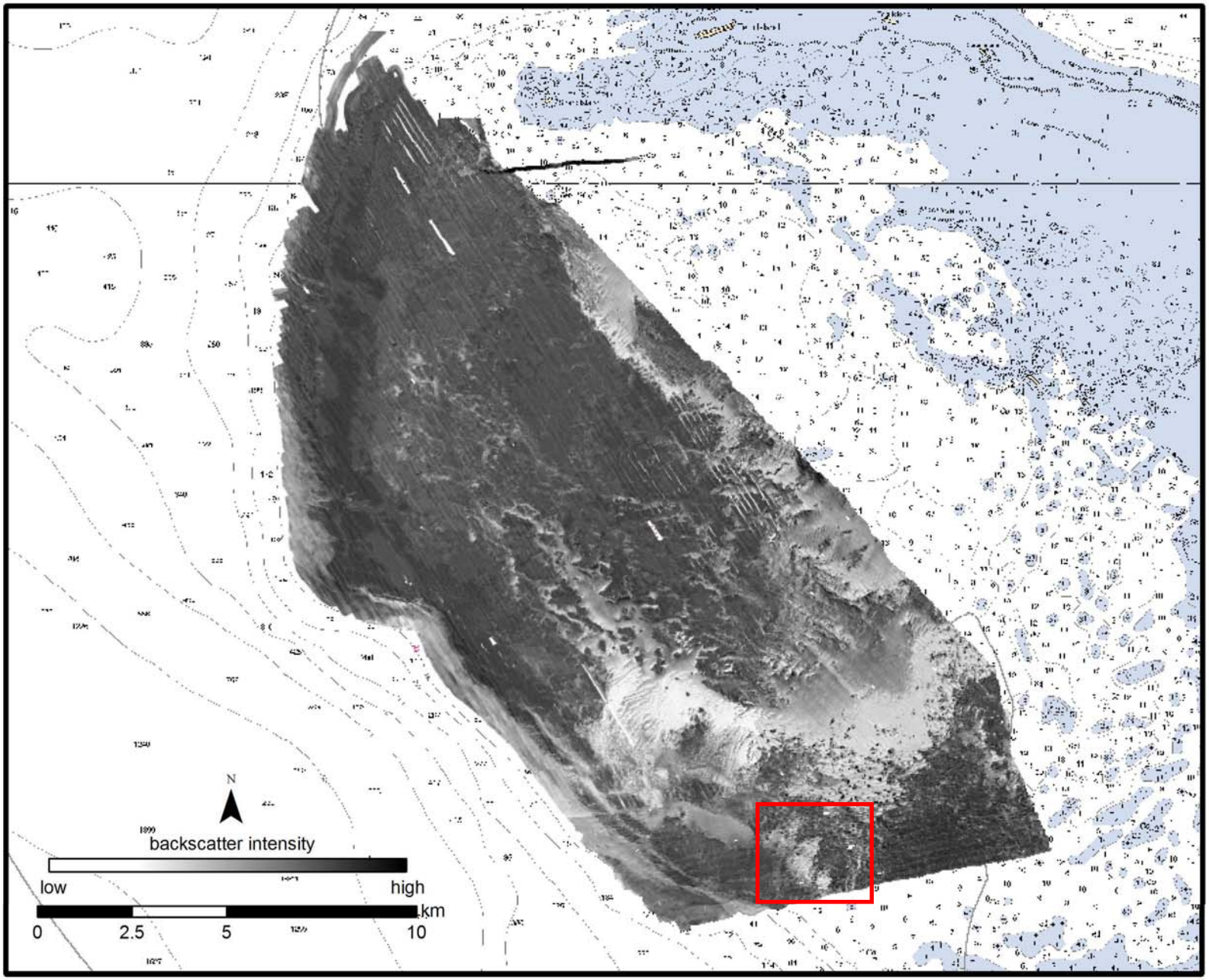



-30
-32
-34
0 m
1000 m
2000 m

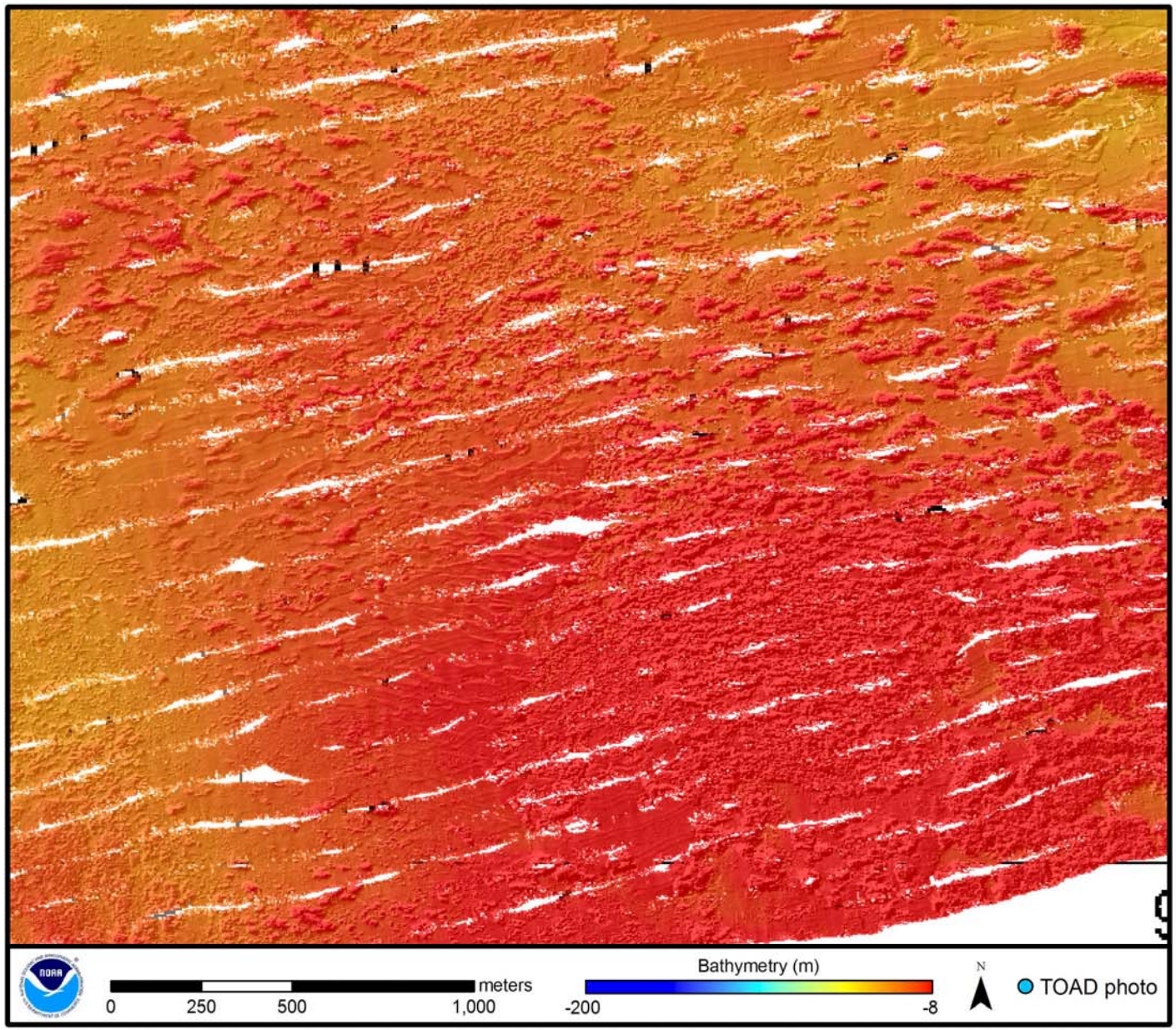




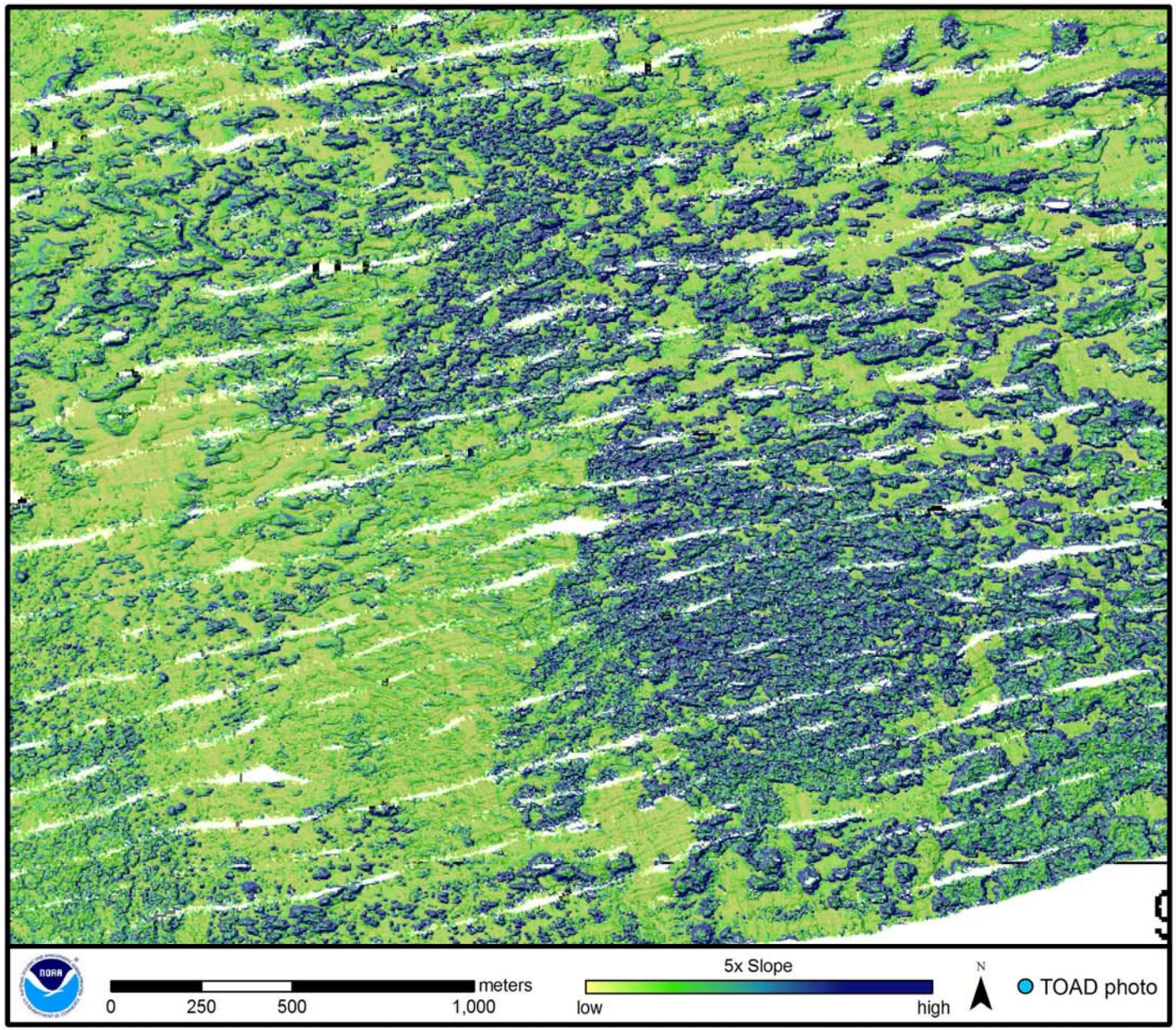

-30
-32
-34
0 m
1000 m
2000 m


N
backscatter intensity
low
high
0
2.5
5
10
km

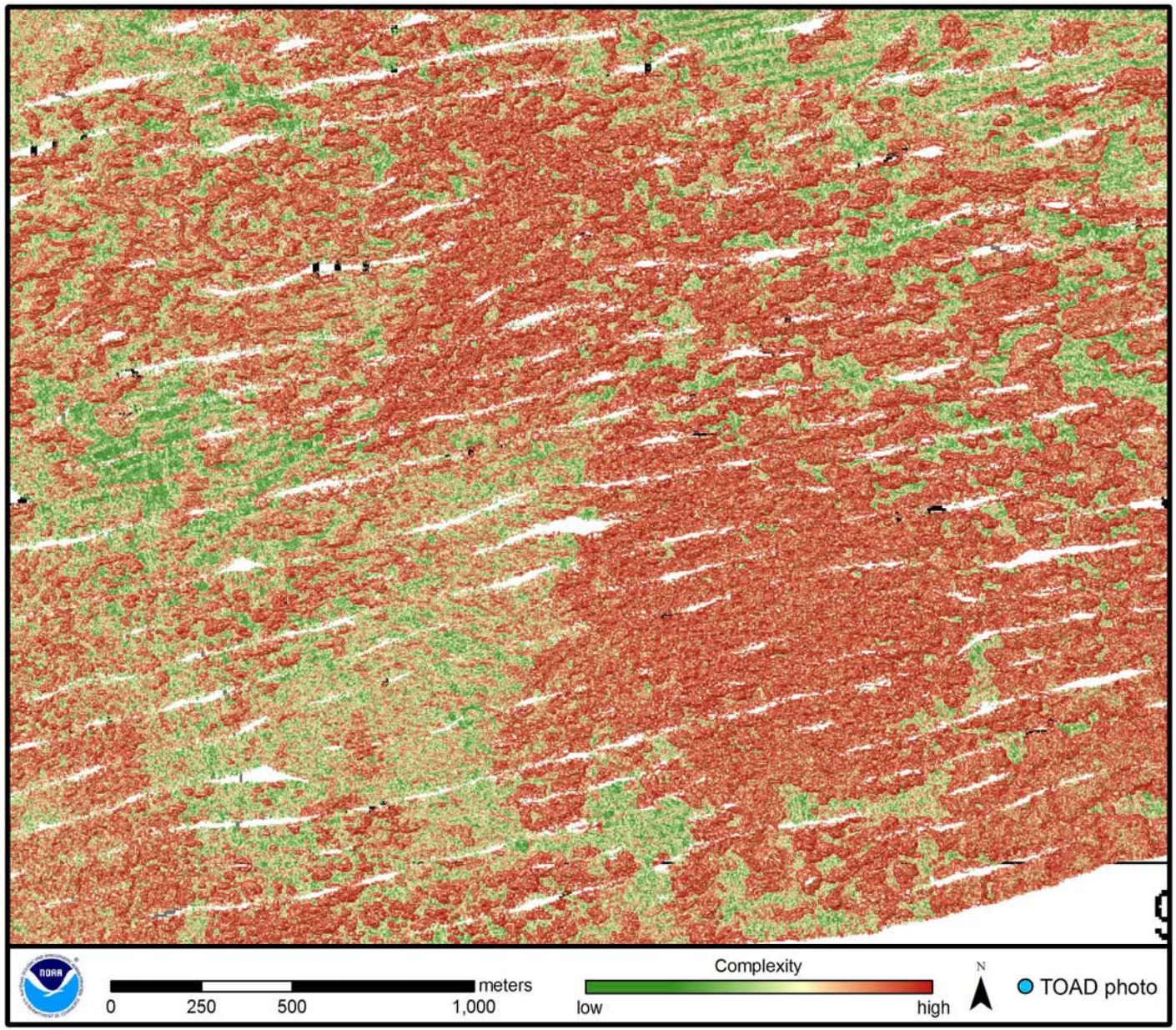
multibeam bathymetry



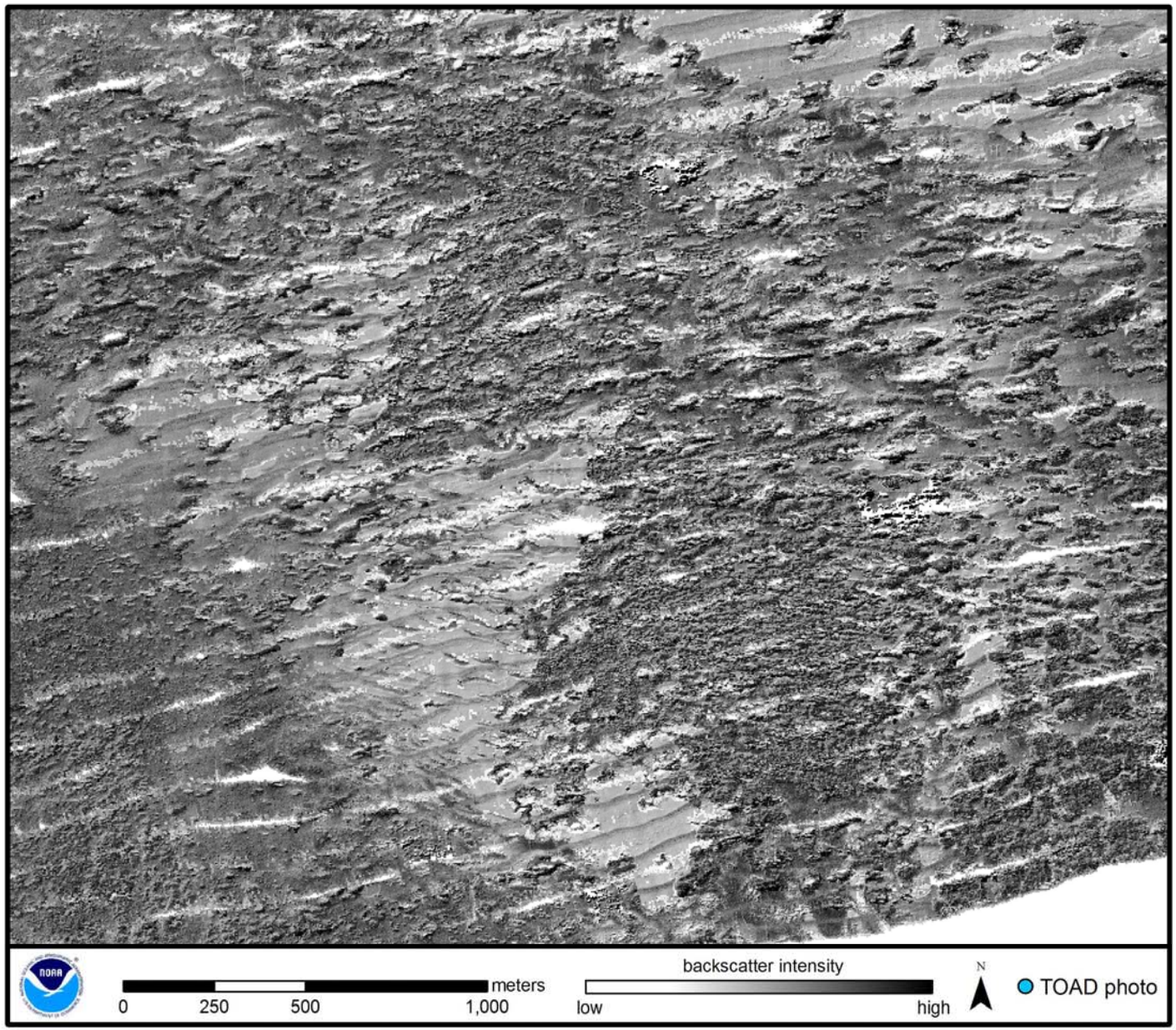
5x slope



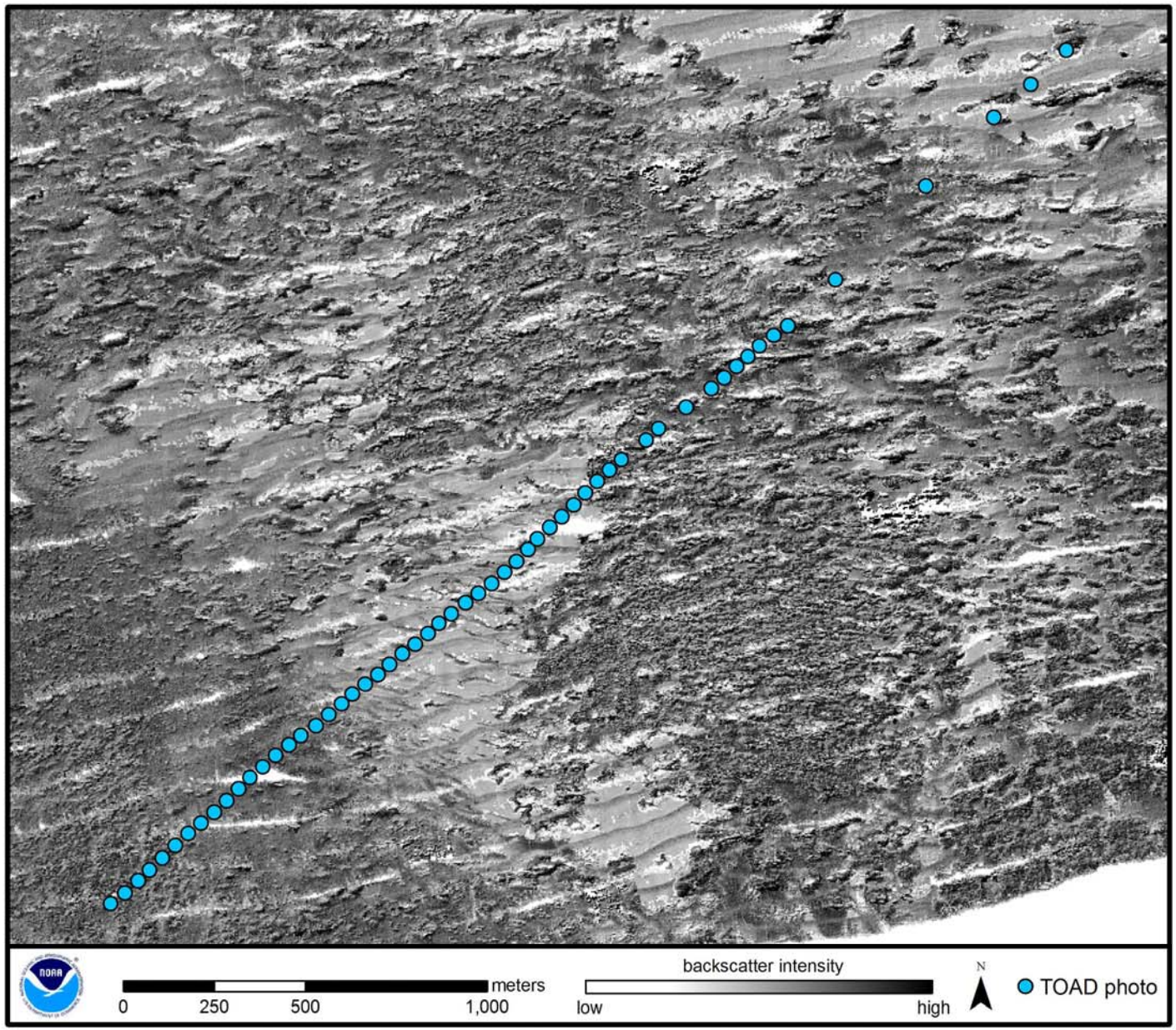
complexity

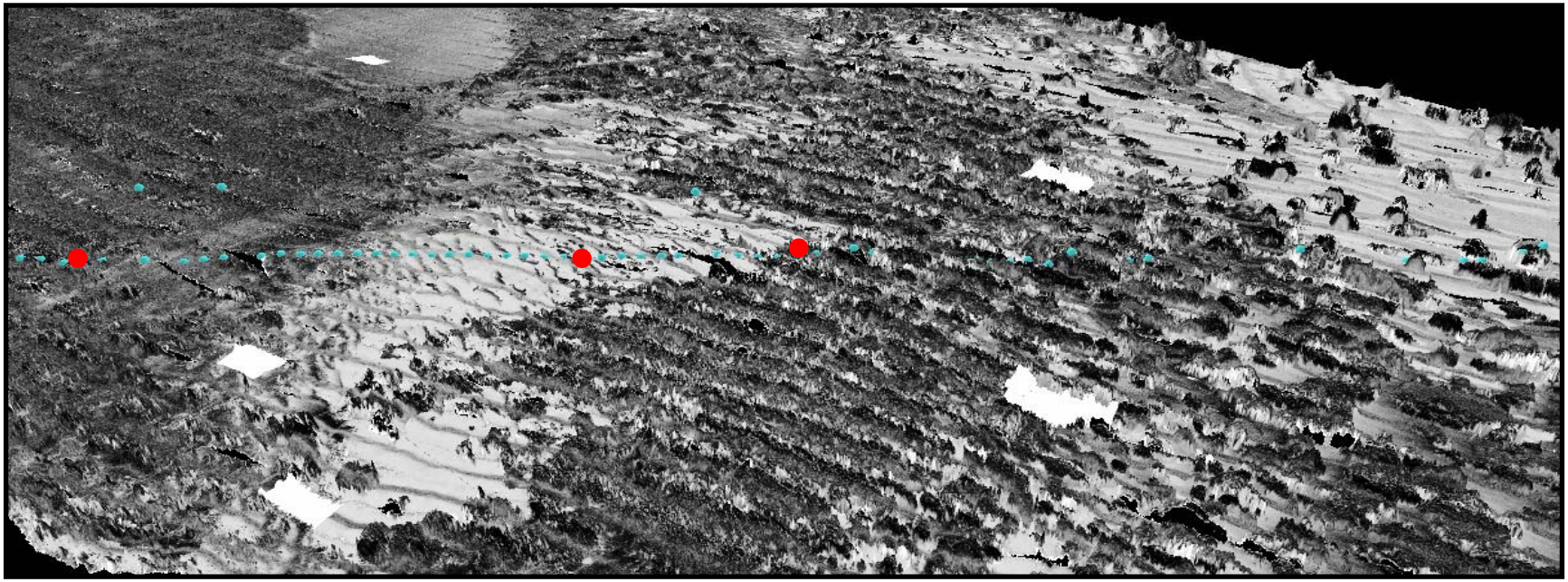


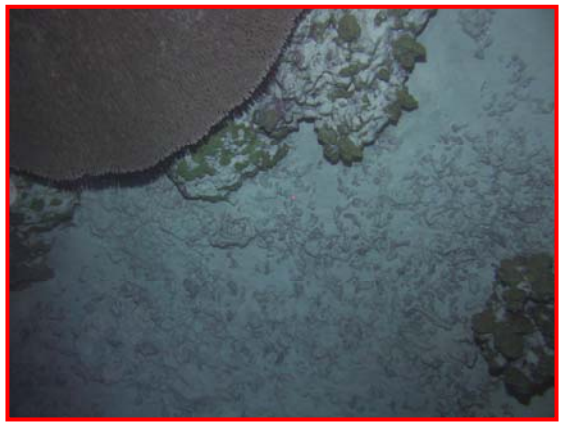
multibeam backscatter

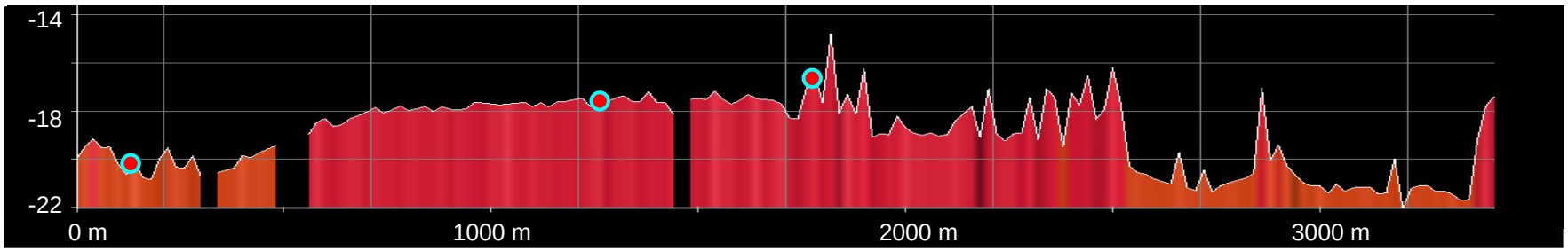


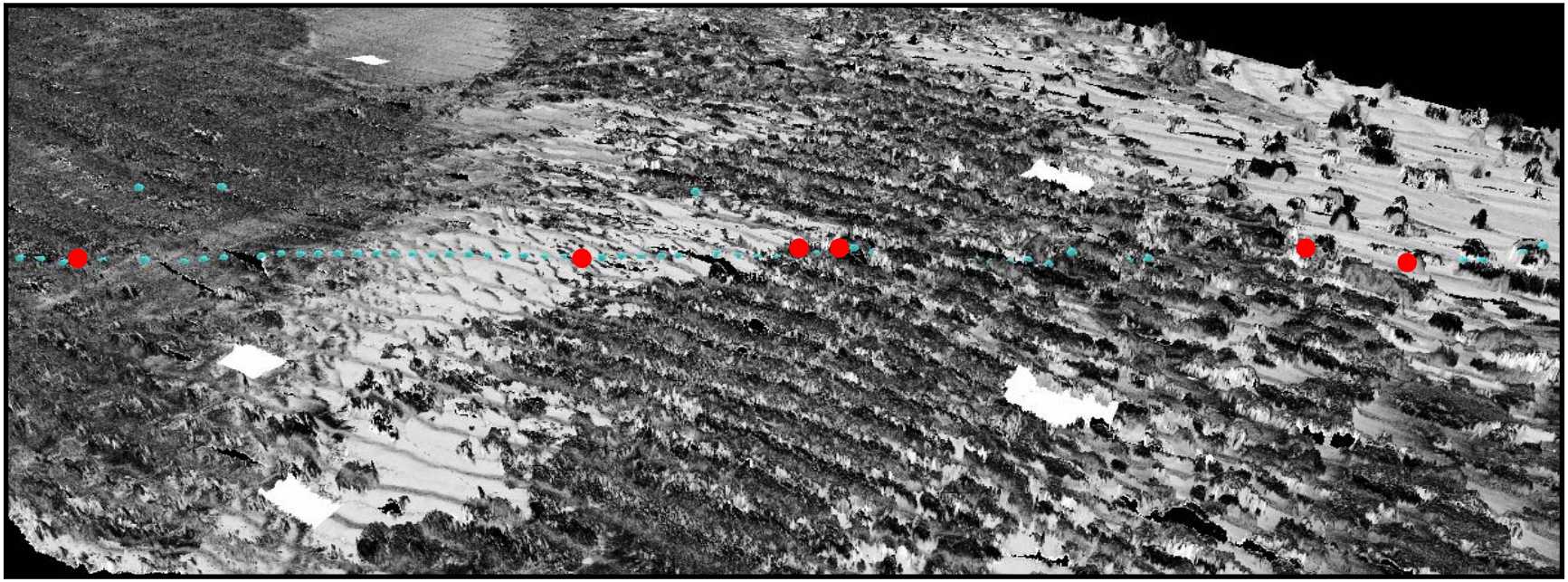
multibeam backscatter

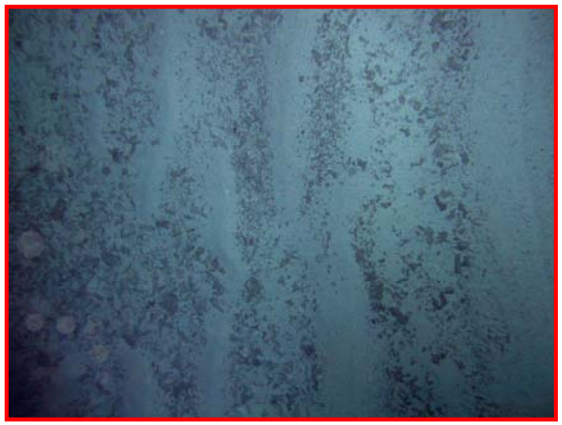


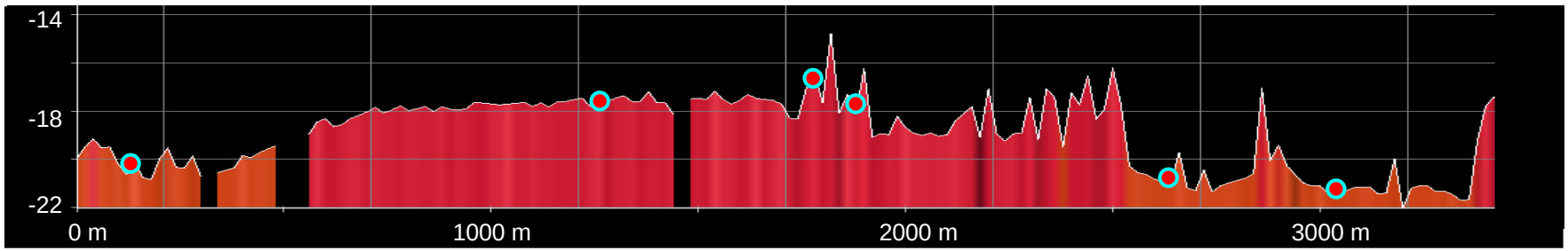





-14
-18
-22
0 m
1000 m
2000 m
3000 m

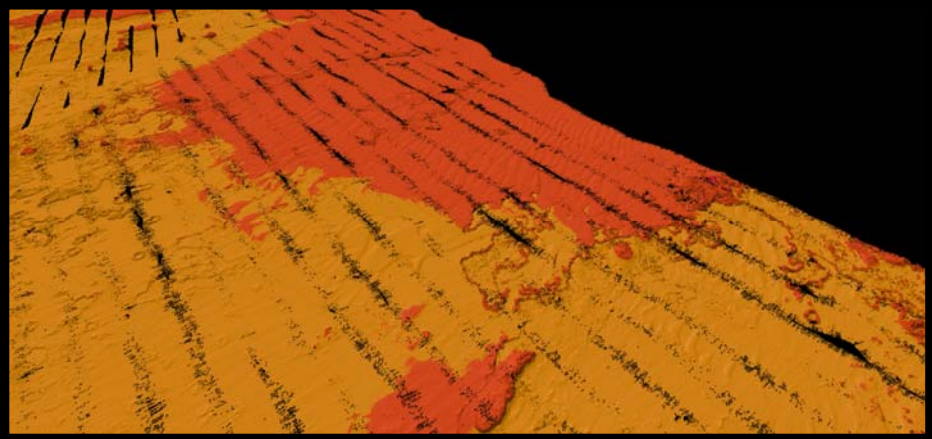


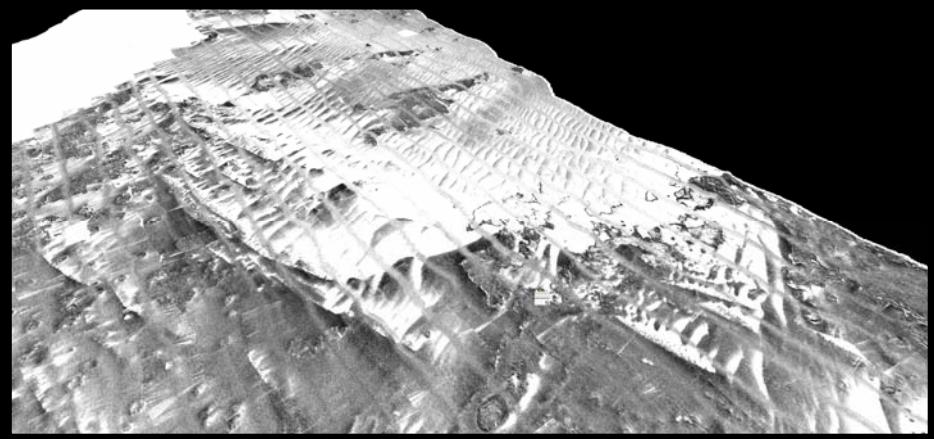



-14
-18
-22
0 m
1000 m
2000 m
3000 m

Summary & Conclusions

- Multibeam bathymetry is required in places too deep/remote for satellite/aerial mapping
- Backscatter tells us about the roughness/hardness of the bottom and can be used to directly infer substrate type
- Optical and towed diver data can be used to "ground truth"
- High-resolution data contains information at the scale of coral environments
- Serve as the base layer for other of scientific information (fish, corals, marine mammals, turtles, etc.)
- The resulting *benthic habitat maps* are critical for *ecosystem based management*
- Can also be used for geological and paleoclimatological studies





Continuing Work

- Enhance methods for acquisition, processing, and interpretation of multibeam and optical data
- Application of statistical methods to multibeam and optical data
- Make non-sensitive data available on the Web

Happy Mapping!

data downloads
www.soest.hawaii.edu/pibhmc

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NOAA
U.S. DEPARTMENT OF COMMERCE