Multiple Applications of Bathymetric LIDAR

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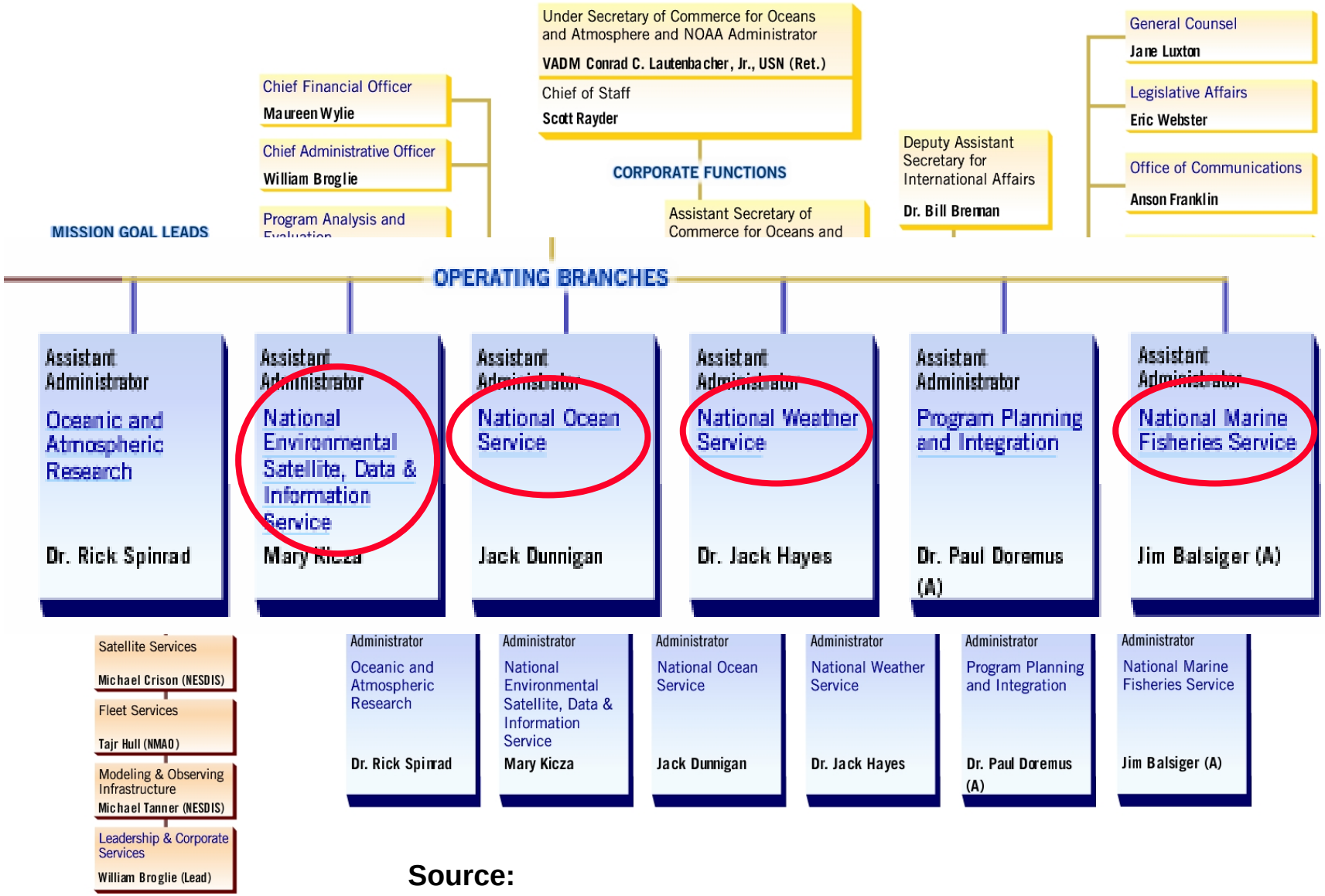
Background

Tenix began collecting Airborne Lidar Bathymetry for the NOS of NOAA in 2001 primarily for the purpose of nautical charting. Since then, Tenix ALB datasets are used within several branches of NOAA for multiple purposes.

- **This paper examines the use of ALB within NOAA**
- **Will examine the derivation of multidisciplinary datasets from one survey source**

NOAA Organization



Source:
http://www.pco.noaa.gov/org/NOAA_Organization.htm

NOAA / Tenix History

- **2001**
  - **Subcontractor to NOAA/NOS via Thales**
- **2003-2006**
  - **Lidar Anywhere contract NOAA/NOS**
- **2006**
  - **PR Reflectance data contract NOAA/NMFS**
  - **PR Inundation Mapping NOAA/NWS**
- **2007-2009**
  - **Lidar Anywhere contract 2 NOAA/NOS**

Tenix LADS Mk II System

- deHavilland Dash 8 – 200
- Endurance: 8 hours
- Transit speed: 250 knots
- Survey speed: 160 knots
- Laser: Nd: Yag
  - IR wavelength: 1064 nm
  - Green wavelength: 532
- Pulse rate: 1 kHz
- Sounding patterns: 2x2 up to 6x6
- Swath width: 50 to 288 m
- Survey altitude: 1200 to 2200 ft

Maximizing a Survey's Value

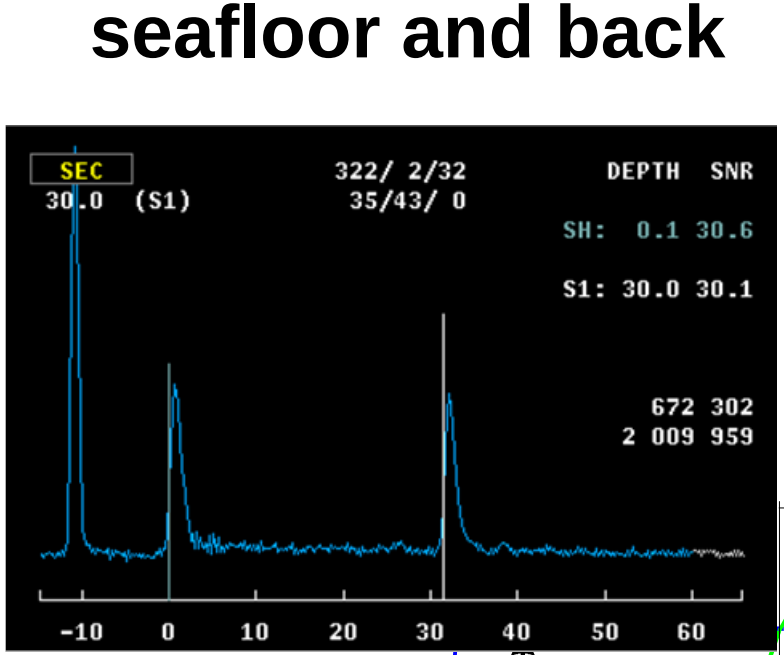
- **In recent years emphasis has been placed on "surveying once for multiple uses".**
  - **What kind of or how many sensors can I place on my survey platform?**
  - **Can my dataset be analyzed in different ways to provide different information?**

Data Types

- Topography/Bathymetry
- Relative Reflectance
- Georeferenced Imagery

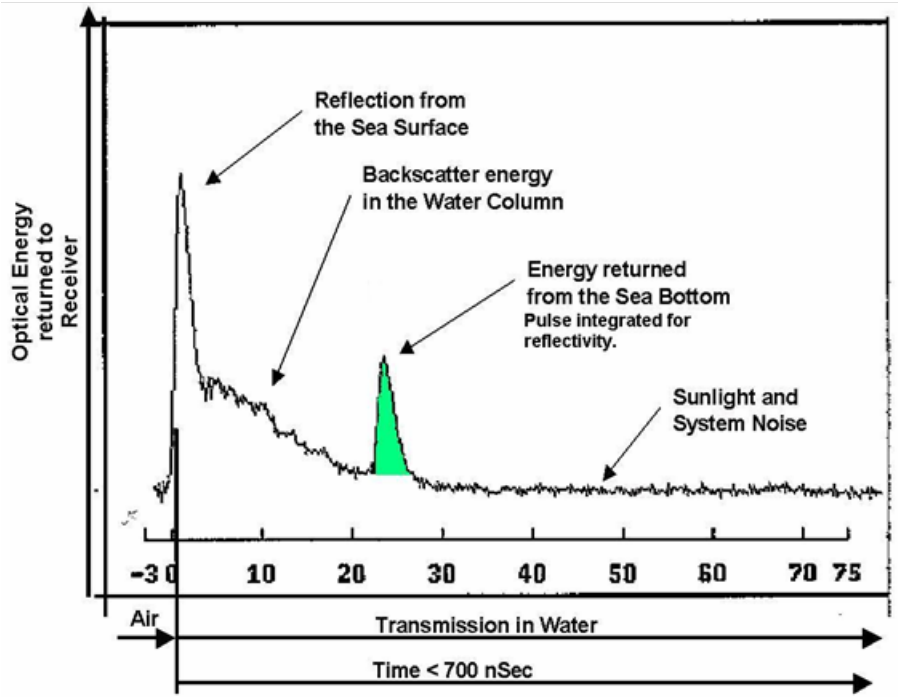
Topography/Bathymetry

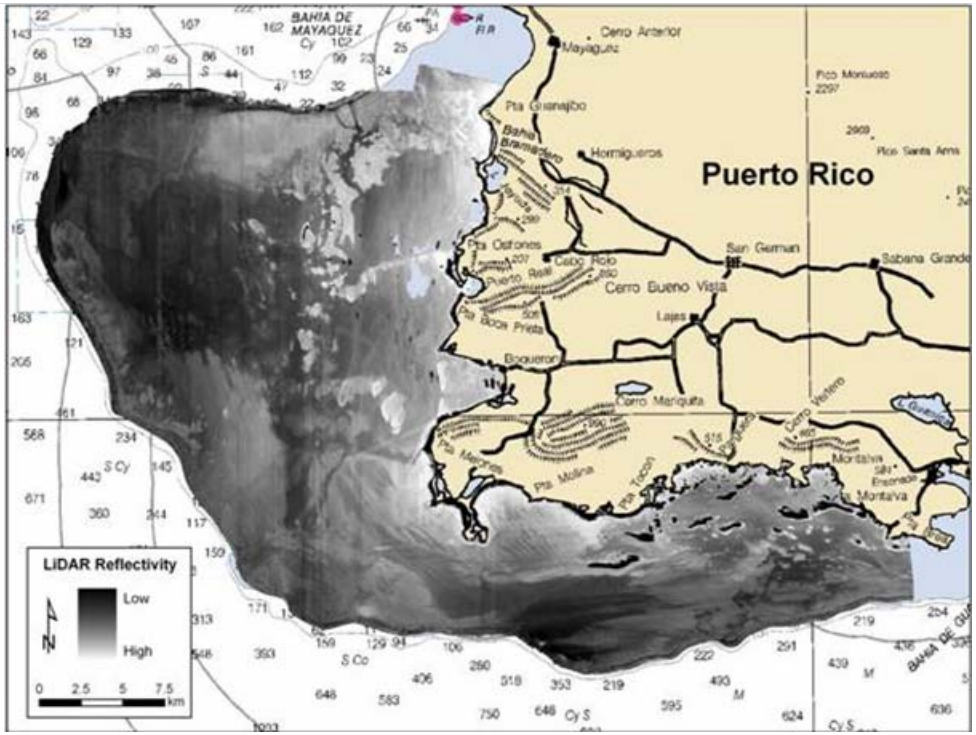
- **Analyzing the waveform to determine the time it takes a laser pulse to travel to the seafloor and back**



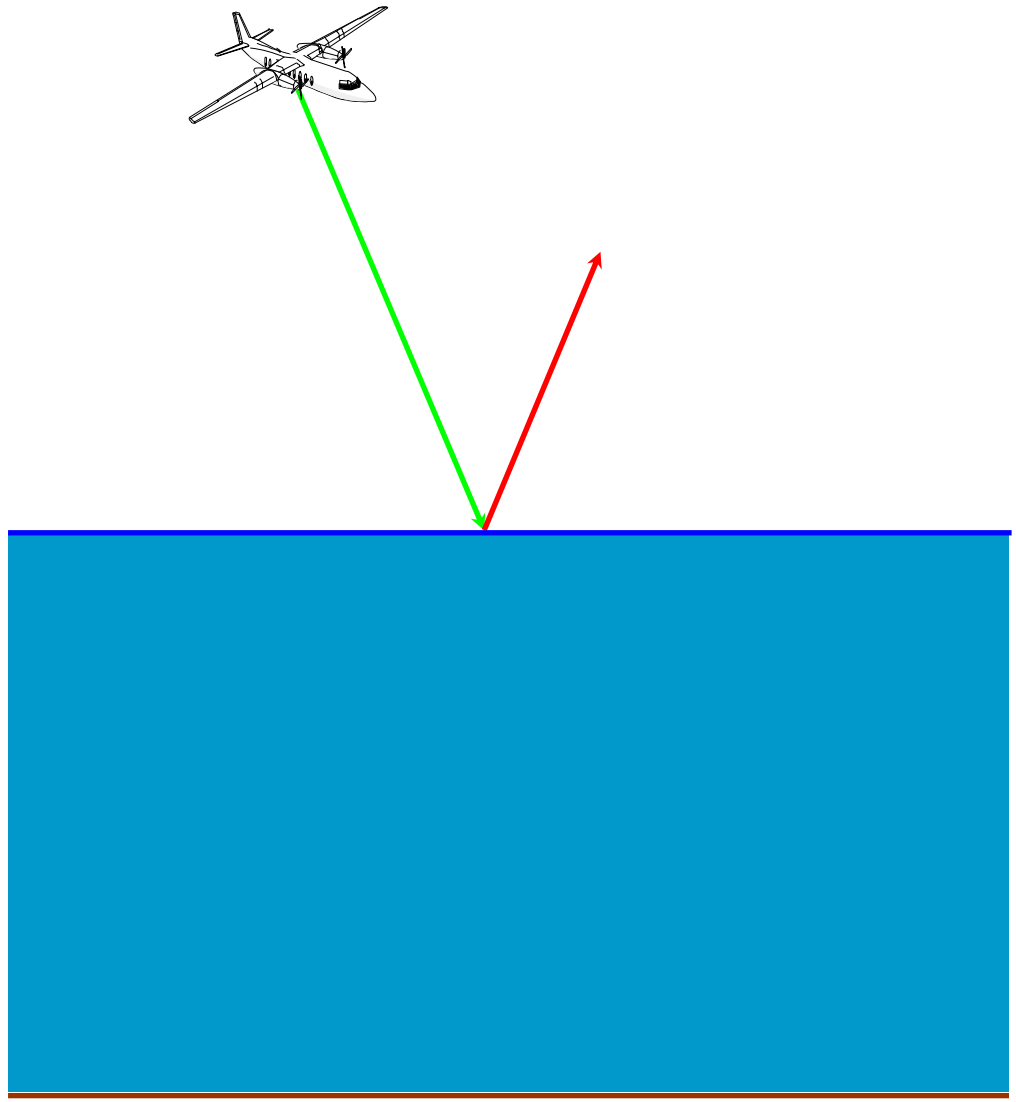
Relative Reflectance

- Algorithm determines relative reflectivity by using a simple energy summation for each sounding
- reflectance = energy received[#]/energy transmitted
  - [#] normalized for path losses
- Important to account for all losses

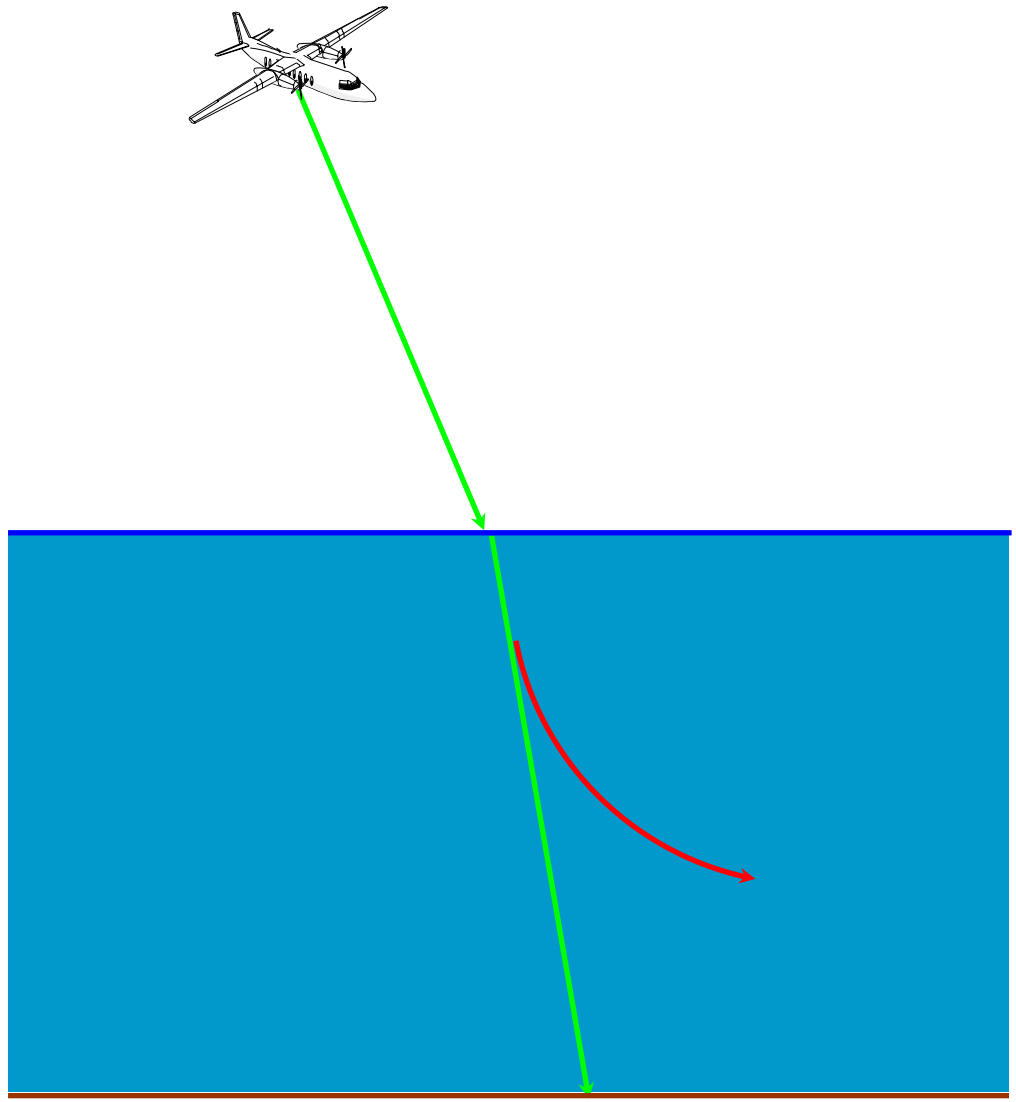




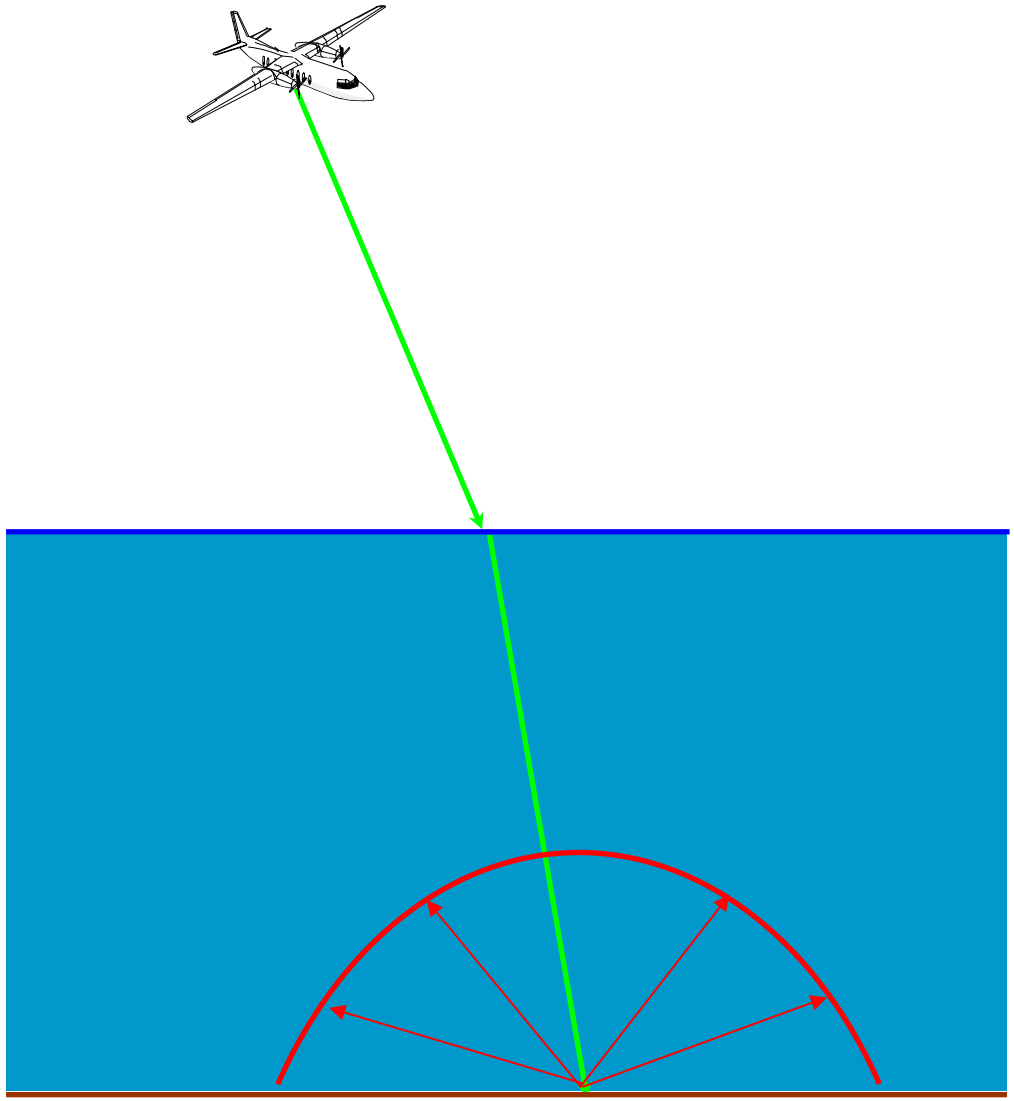
Path Loses: surface reflection



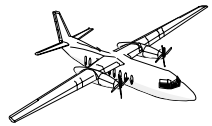
Path Loses: scattering and absorption

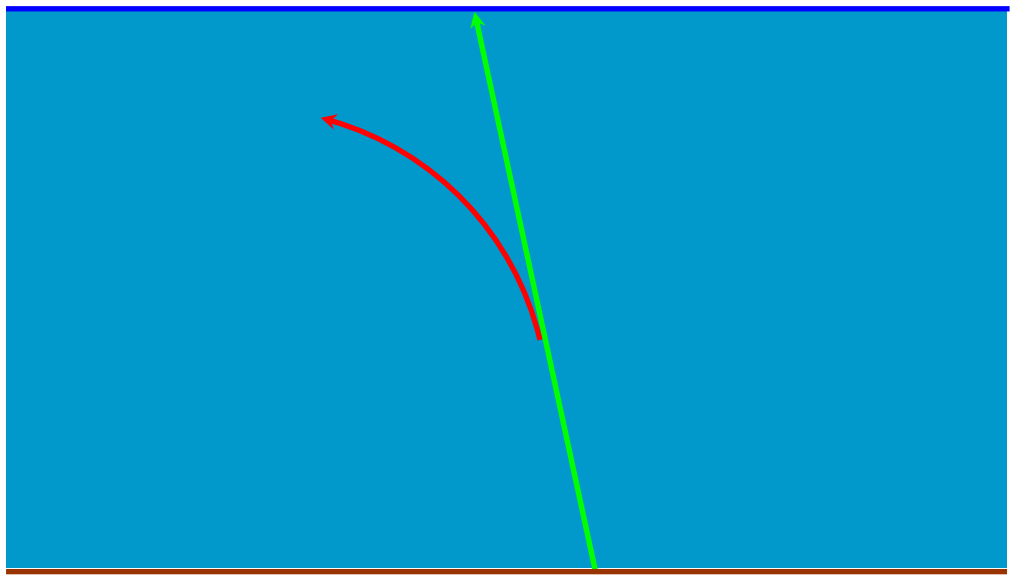


Path Loses: isotropic reflection

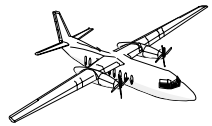


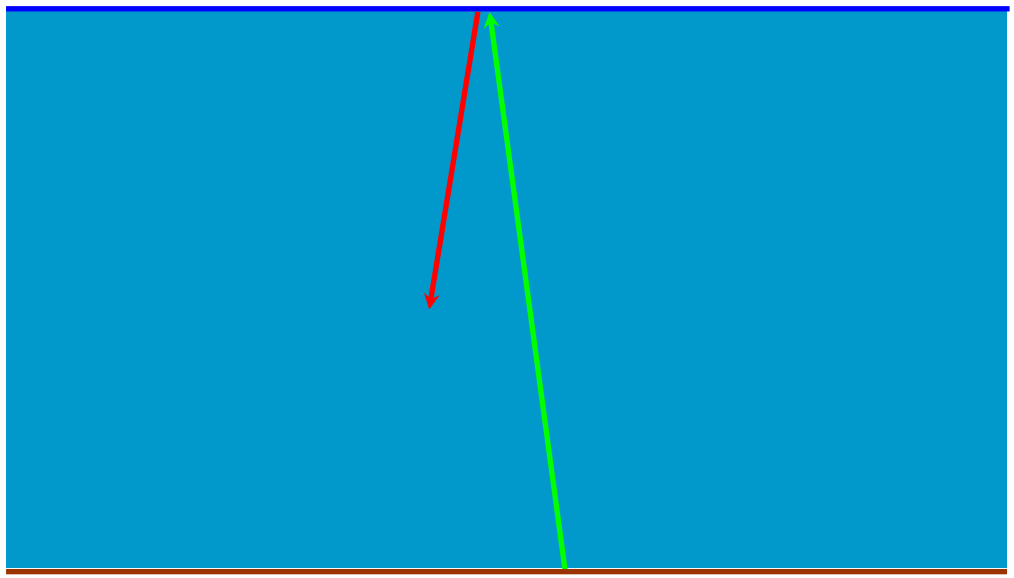
Path Loses: scattering and absorption



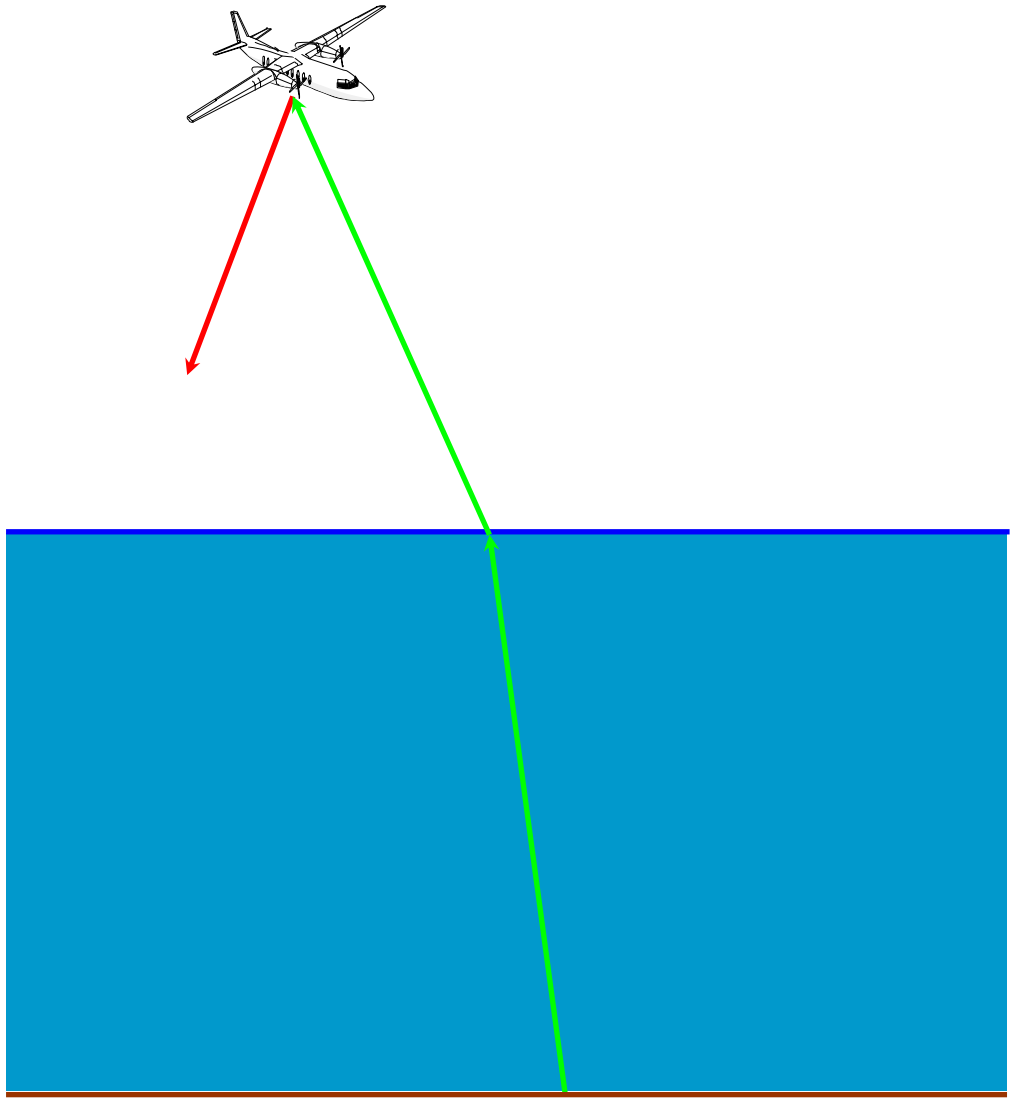


Path Loses: surface reflection

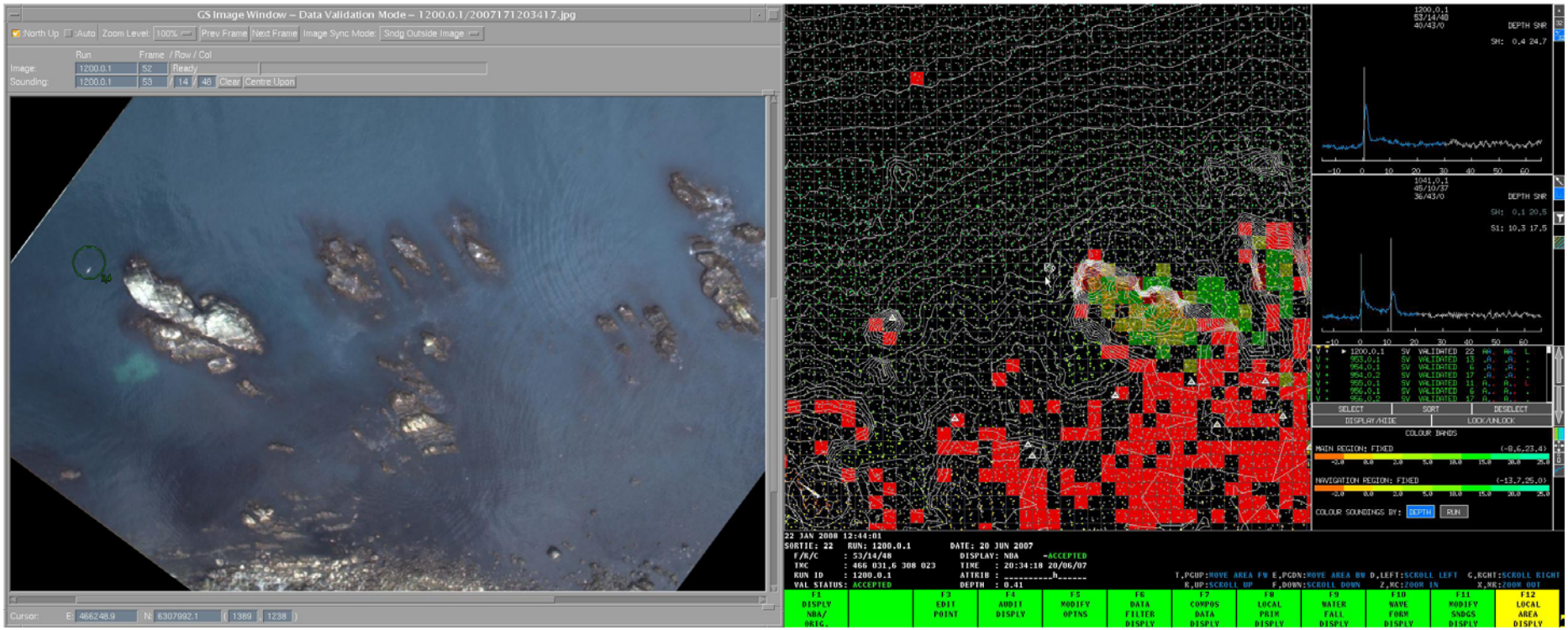




Path loses: receiver loses



Imagery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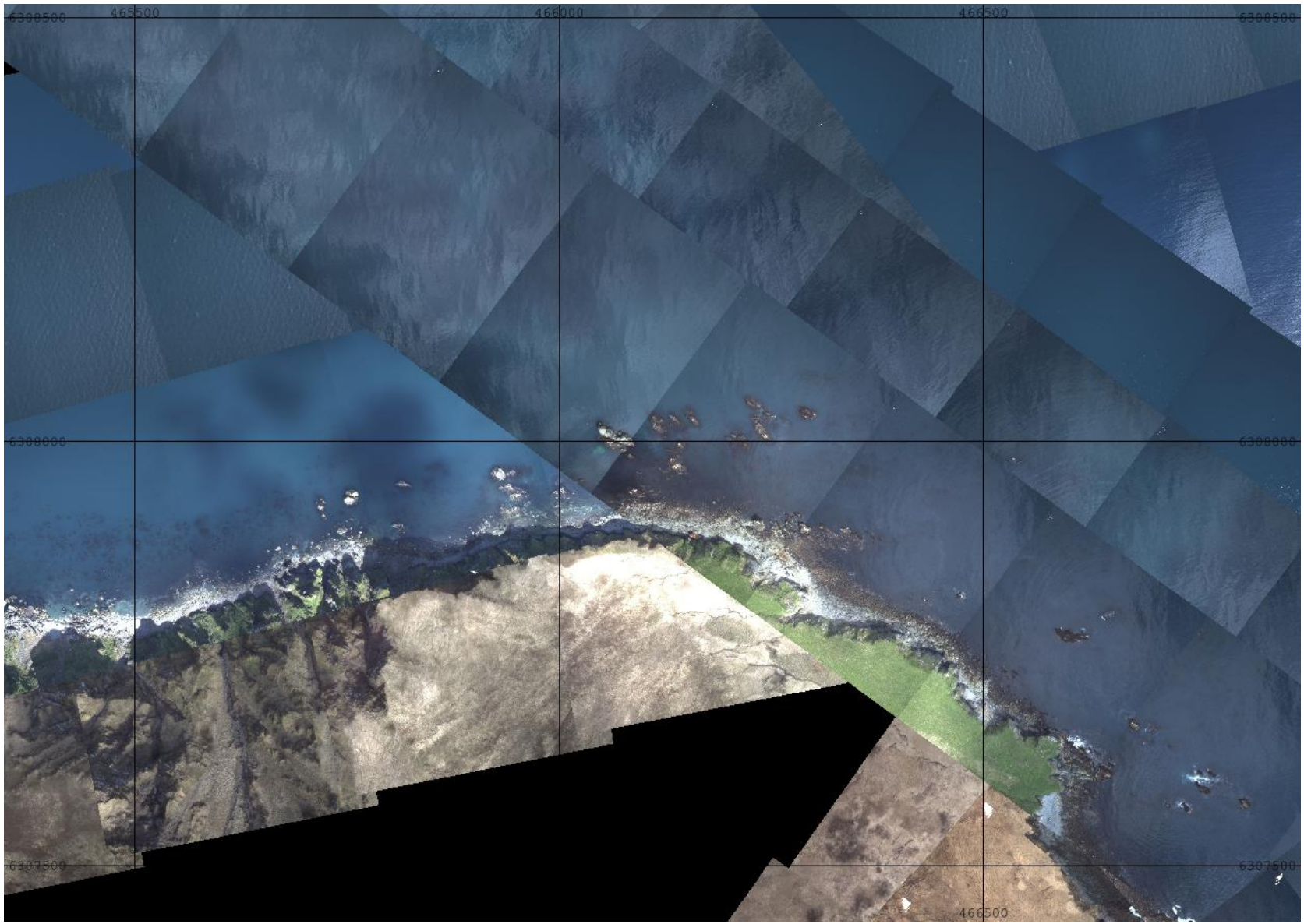
F5 MODIFY OPTNS
F6 DATA FILTER DISPLY
F7 COMPOS DATA DISPLY
F8 LOCAL PRIM DISPLY
F9 WATER FALL DISPLY
F10 WAVE FORM DISPLY
F11 MODIFY SNDGS DISPLY
F12 LOCAL AREA DISPLY

Imagery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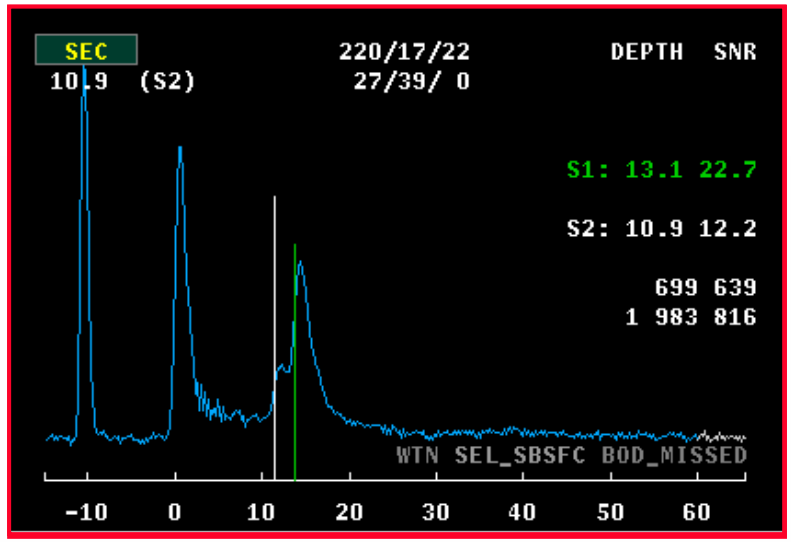
Applications

- Nautical charting
- Shoreline delineation
- Habitat mapping
- Inundation Mapping

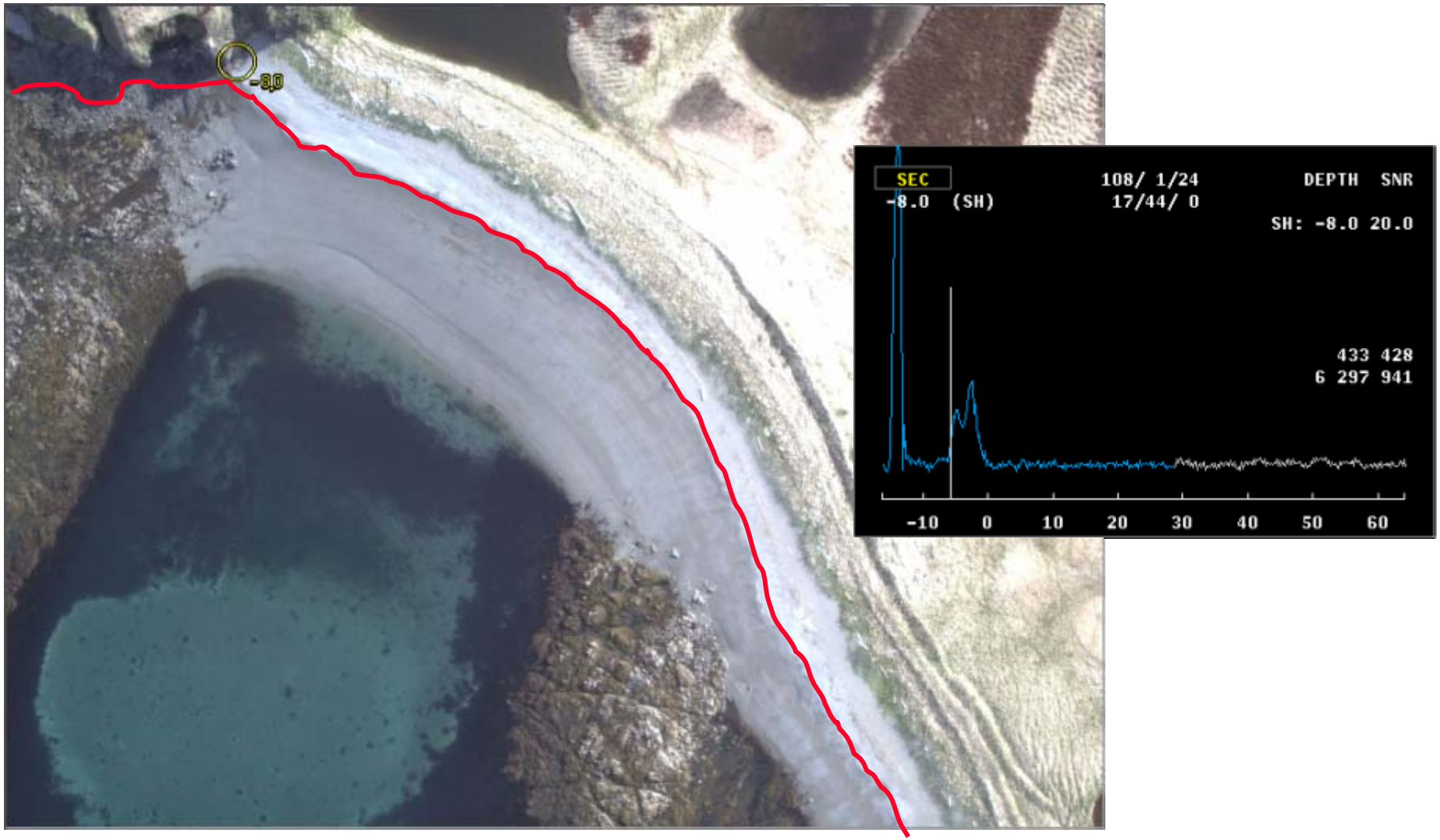
Nautical Charting



Shoreline Mapping

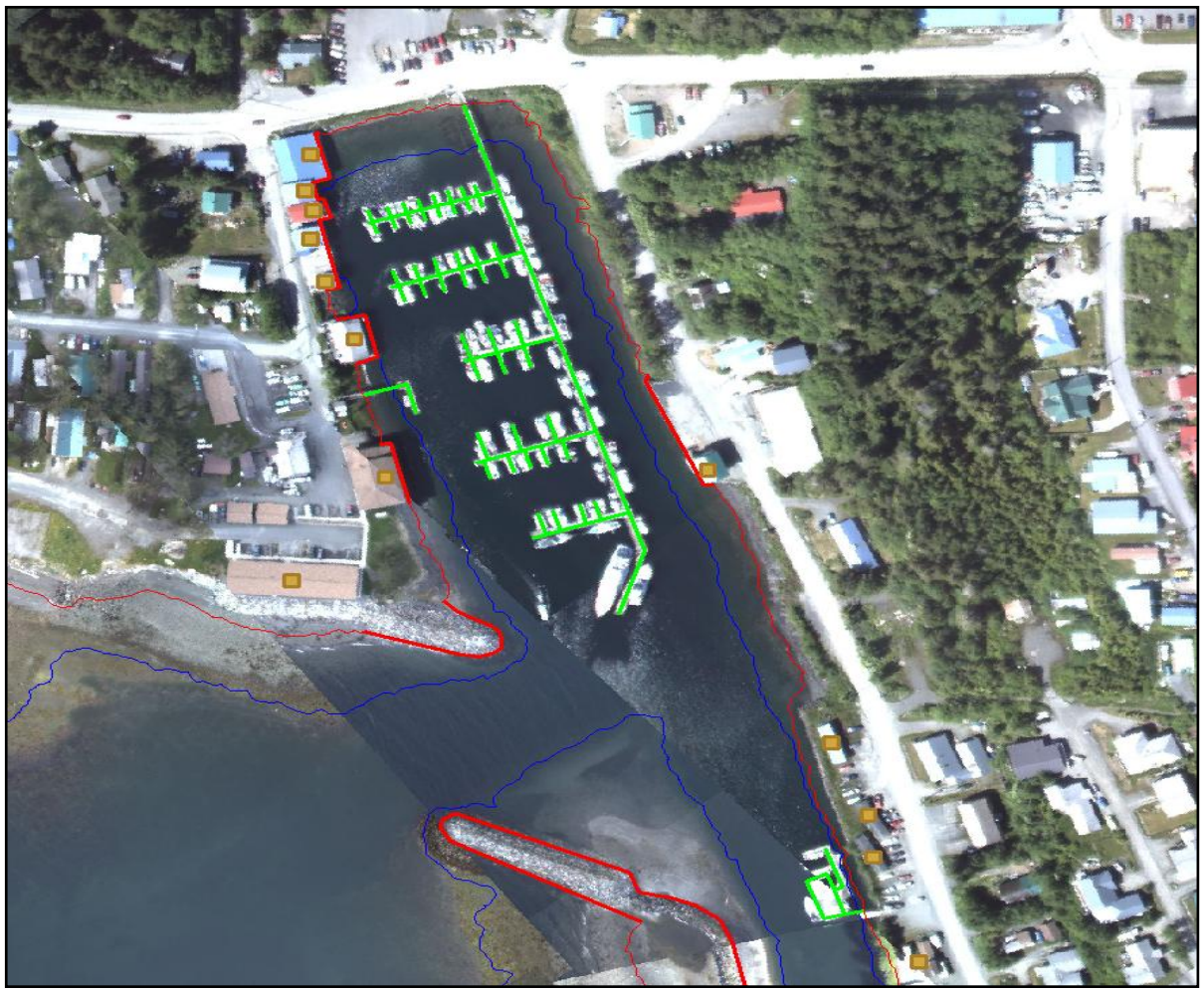
- U.S. has ~ 150,000 km of coastline
- NGS responsible for delineating
  - Stereo photogrammetry using tide coordinated aerial photography
  - Moving toward topo lidar
- Bathy Lidar allows for seamless data collection across the land-water interface
- Any vertical datum could be used

Shoreline Mapping



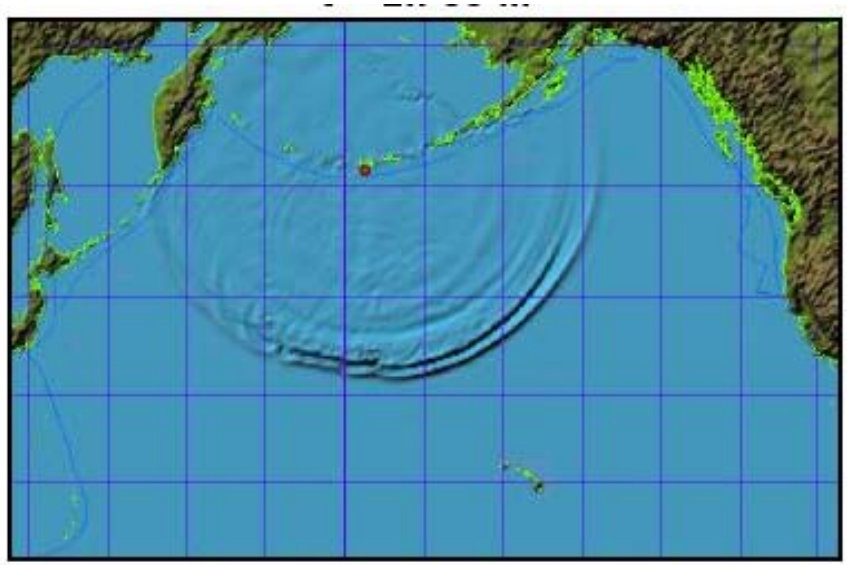
Shoreline Mapping

- **Cultural features are compiled from georeferenced imagery**



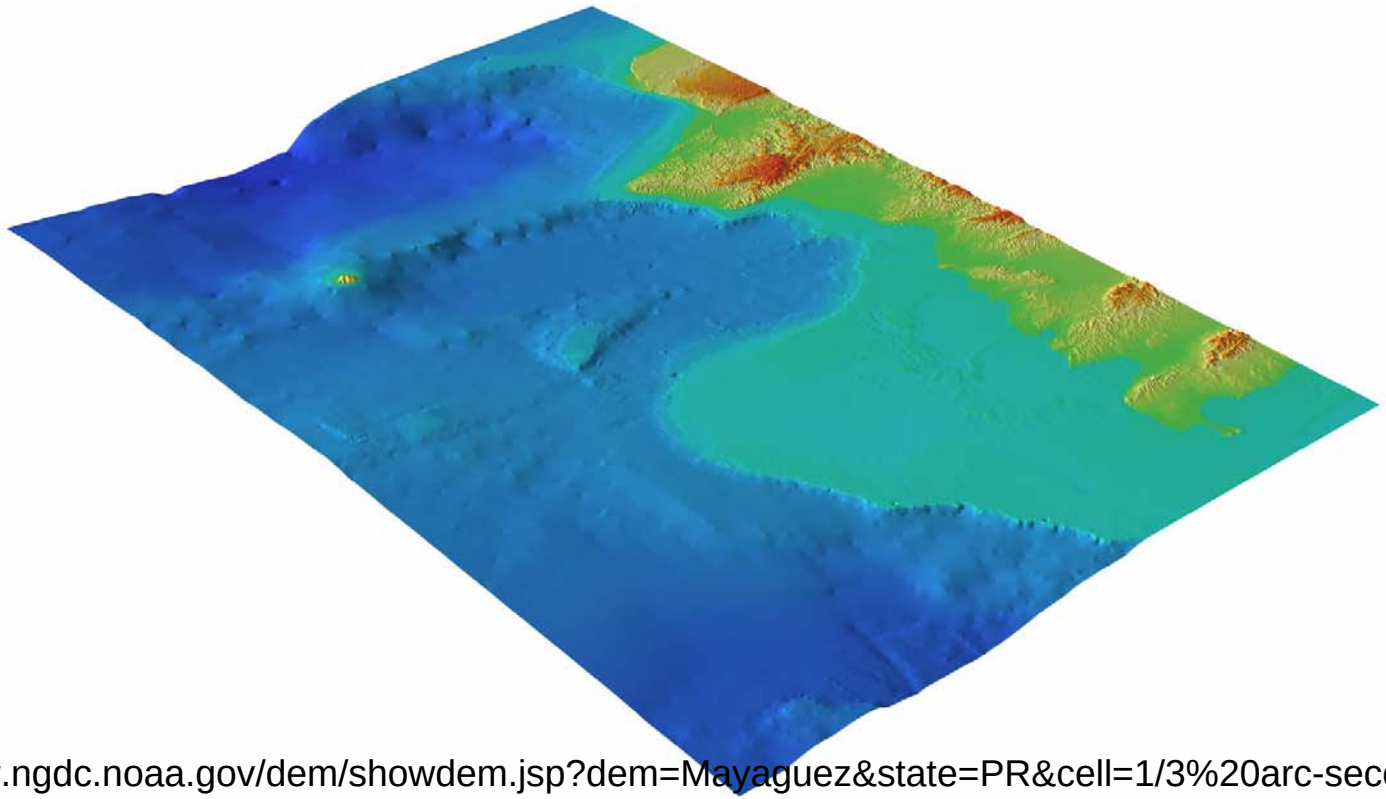
Inundation Modeling

- NOAA responsible for providing Tsunami warnings
- NGDC building DEMs to support models used for simulating tsunami generation, propagation and inundation
  - Method Of Splitting Tsunami (MOST)
  - Short-term Inundation Forecasting for Tsunamis (SIFT)



Inundation DEM

- **NGDC uses data from multiple sources for compiling DEMs**
  - **ALB data from Mayaguez, PR used in DEM**

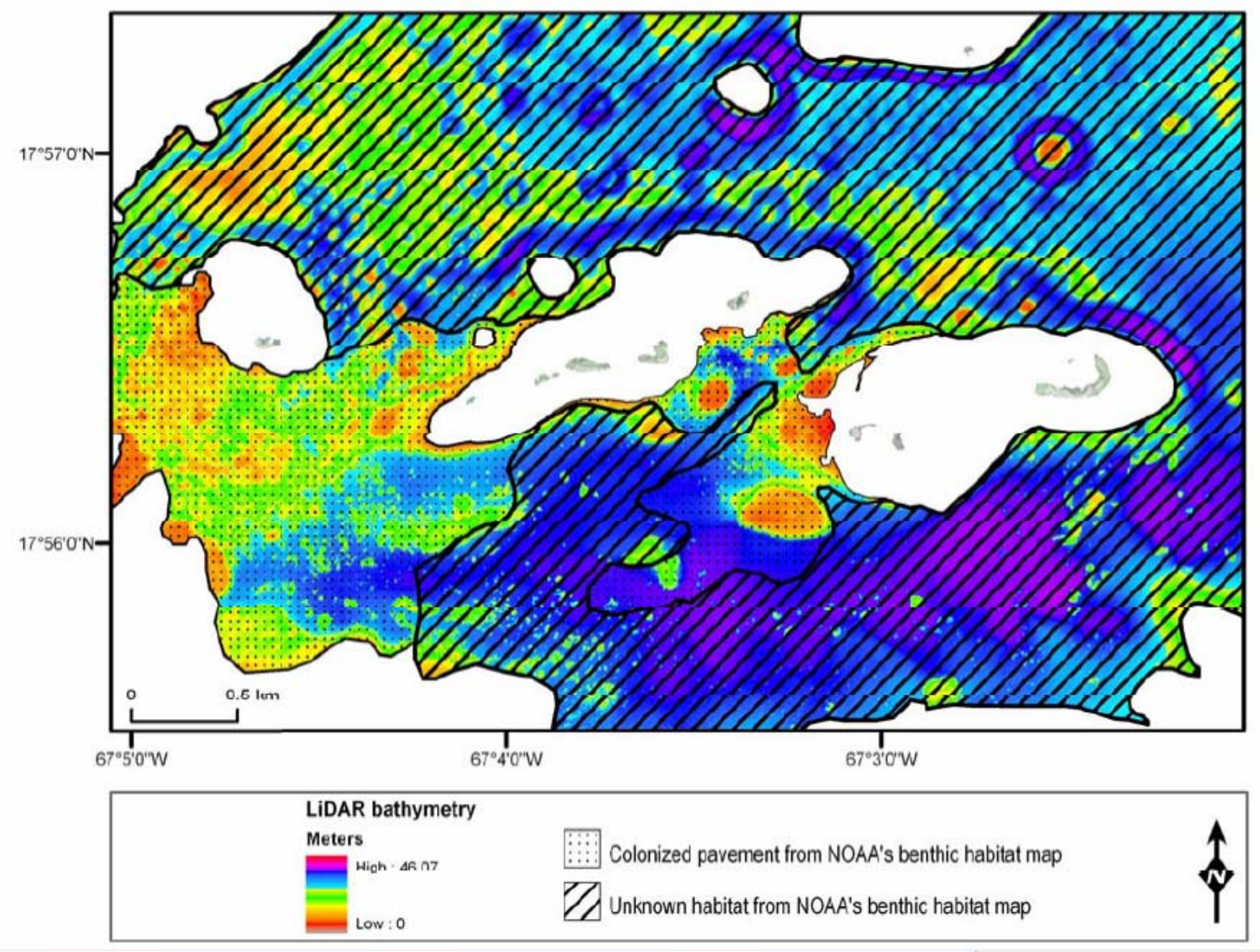


Source: http://www.ngdc.noaa.gov/dem/showdem.jsp?dem=Mayaguez&state=PR&cell=1/3%20arc-second

Habitat Mapping

- NOAA responsible for conserving and protecting coral reef ecosystems
- NOAA uses bathymetry to quantify surface morphology
  - Standard deviation of water depth
  - Rugosity
  - Slope
  - Curvature
- In-situ benthic habitat surveys performed to correlate lidar derived habitat with fish species

Habitat Mapping



Conclusion

- **Puerto Rico Survey demonstrates the "Survey once – use multiple times" philosophy**
- **Lidar can support NOAAs mission of conserving and managing coastal and marine resources**

QUESTIONS?