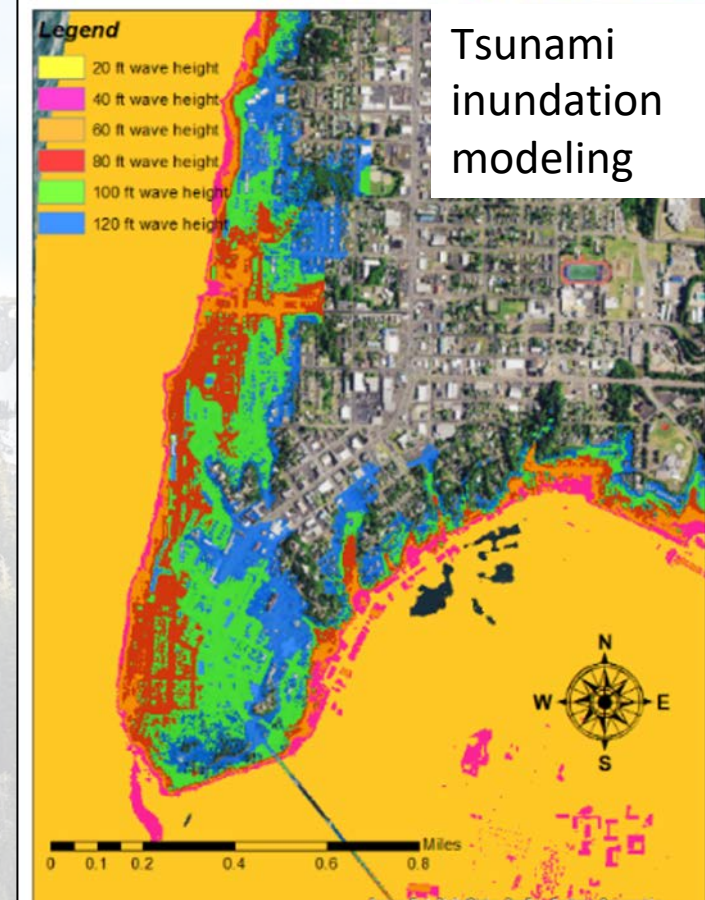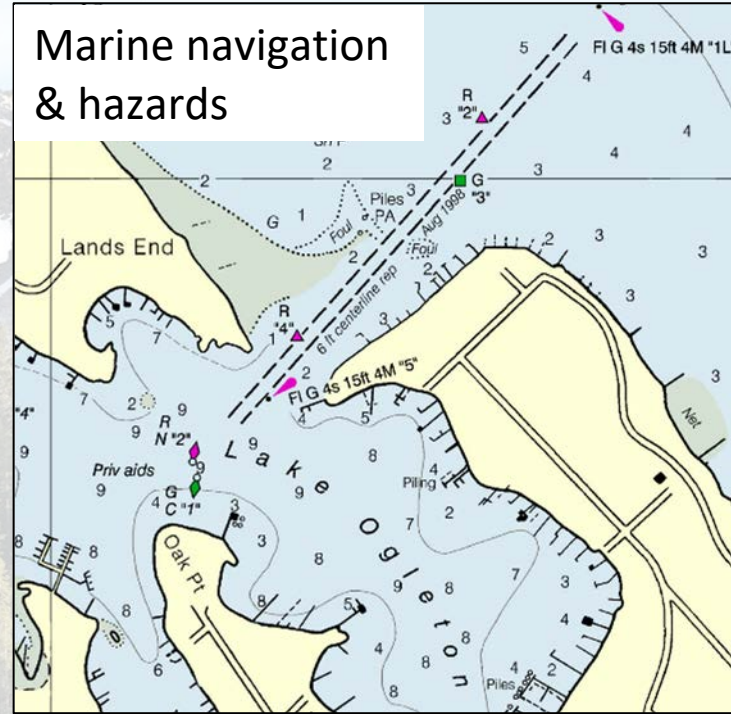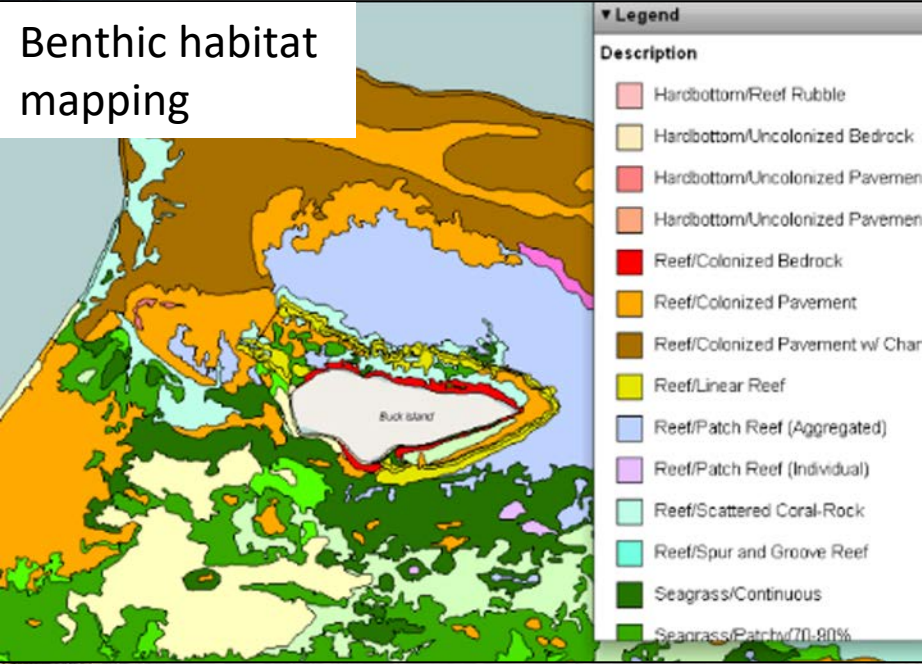# Coastal Processes

Chris Parrish, Oregon State Univ.

- Storm surge and tsunami inundation hazards
- Shoreline erosion and sediment transport
- Benthic habitat and marine ecosystems
- Tidal interaction with mangroves and salt marshes
- Shallow water navigation and hazards

Coastal Science & Application Needs

Benthic habitat mapping

Marine navigation & hazards

Tsunami inundation modeling

Marine ecological assessment

Coastal management

Sediment transport/ management

Image credits: OSU, NOAA NCCOS, and USACE

Coastal Processes Scope of Study for STV

- Topics within scope
  - Coastal geomorphology and geologic hazards
  - Inundation (e.g., storm surge and tsunami)
  - Marine ecosystems
  - Sediment erosion, transport, and deposition
  - Marine archaeology
  - Marine navigation
  - Relative sea level rise (subsidence + eustatic SLR)

SATM – Draft Goals, Objectives, and Targeted Observables

Goals	Objectives	Targeted Observable (s)	Physical Parameter(s) Required
(S-1) How can large-scale **geological hazards** be accurately forecast in a socially relevant timeframe?	(S-1d) Forecast, model, and measure **tsunami** generation, **propagation, and run-up** for major seafloor events.	Shallow Bathymetry Vegetation (mangroves & submerged aquatic veg) Land topography	A) Seafloor height, relative to a known vertical datum (orthometric or tidal) B) Seafloor rugosity

From Decadal Survey

SATM – Draft Goals, Objectives, and Targeted Observables

Goals	Objectives	Targeted Observable(s)	Physical Parameter(s) Required
(E-1) What are the structure, function, and biodiversity of **Earth's ecosystems**, and how and why are they changing in time and space?	(STV) What are current and predicted **threats to marine ecosystems and coastal/benthic habitats** (e.g., coral reef, saltmarsh, mangroves, seagrass, oyster reefs, etc.)?	Shallow Bathymetry Vegetation (mangroves, submerged aquatic veg)	A) Time series of shallow bathymetry
			B) Time series of rugosity and seafloor structure

SATM – Draft Goals, Objectives, and Targeted Observables

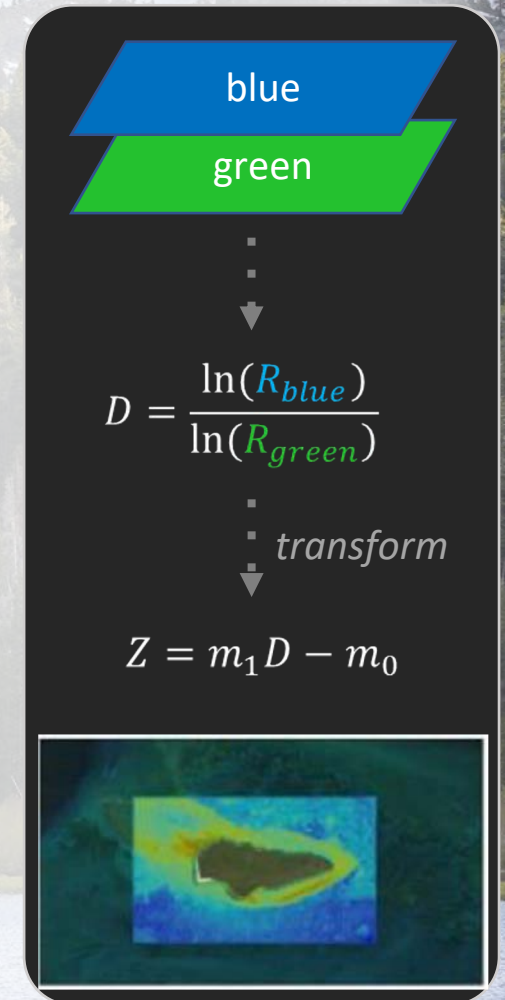| Goals	Objectives	Targeted Observable(s)	Physical Parameter(s) Required
(C-8i) Quantify how increased fetch, sea level rise and permafrost thaw increase **vulnerability of coastal communities** to increased coastal inundation and erosion as winds and storms intensify.	A) How will coasts change by **rising seas, erosion, subsidence, accretion, and anthropogenic influences**? B) What are the predicted impacts of **coastal storms** and surge on coasts?	Shallow Bathymetry Vegetation (mangroves and submerged aquatic veg) Land topography	A) Time series of shallow bathymetry B) Time Series of rugosity and seafloor structure

SATM – Draft Goals, Objectives, and Targeted Observables

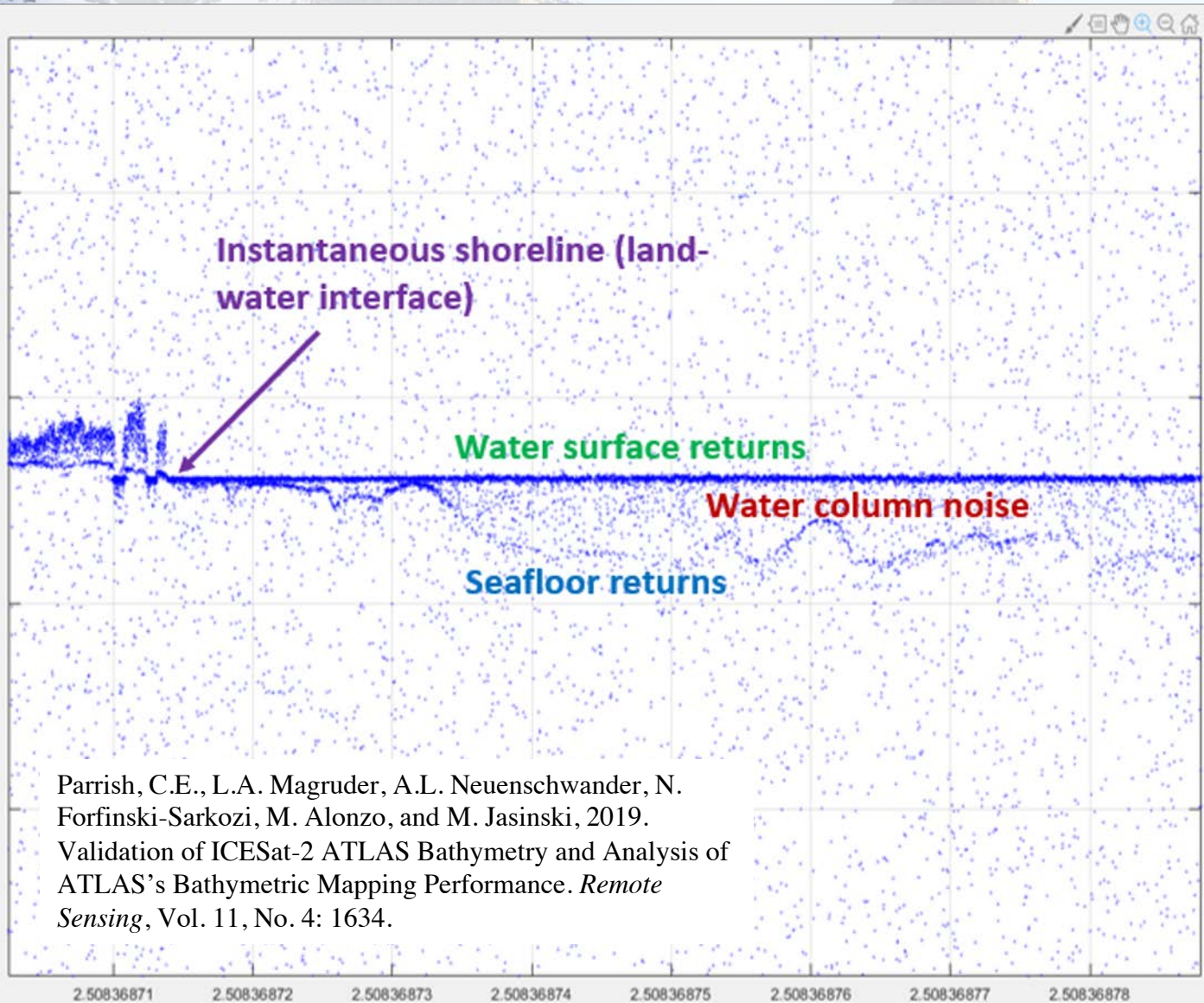| Goals	Objectives	Targeted Observable(s)	Physical Parameter(s) Required
Support **safety of marine navigation** in nearshore areas	Where are shoals, reefs and other **hazards to marine navigation**, and how are they changing with time?	Shallow bathymetry	Time series of shallow bathymetry

Space-based Shallow Bathymetric Mapping

- Growing interest since 1970s; estimate bathymetry from spectral image bands
- Based on wavelength-dependent, exponential attenuation of downwelling irradiance with depth (Beer-Lambert Law)
- Dozens of approaches in published literature
- Requires reference bathymetry ("seed depths")

Jerlov Curves: Kd vs. λ

$$L_{obs} = (L_b - L_w) \cdot e^{-2K(\lambda) \cdot z} + L_w$$

Diffuse Attenuation Coefficient, K_d (m^{-1})

Wavelength (nm)

Water Type
- I
- IA
- IB
- II
- III
- 1
- 3
- 5
- 7

Stumpf algorithm
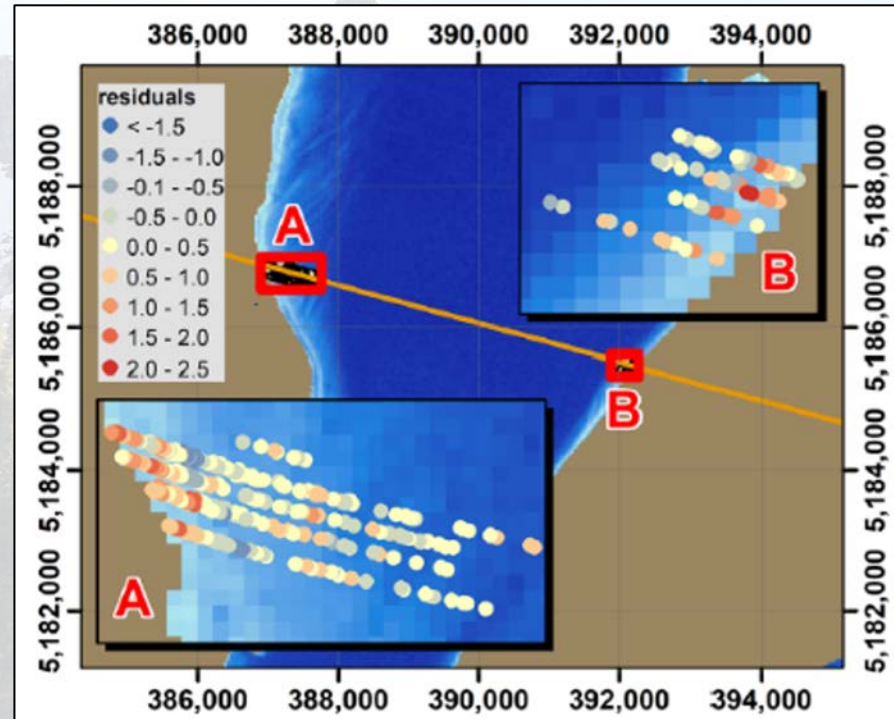
blue

green

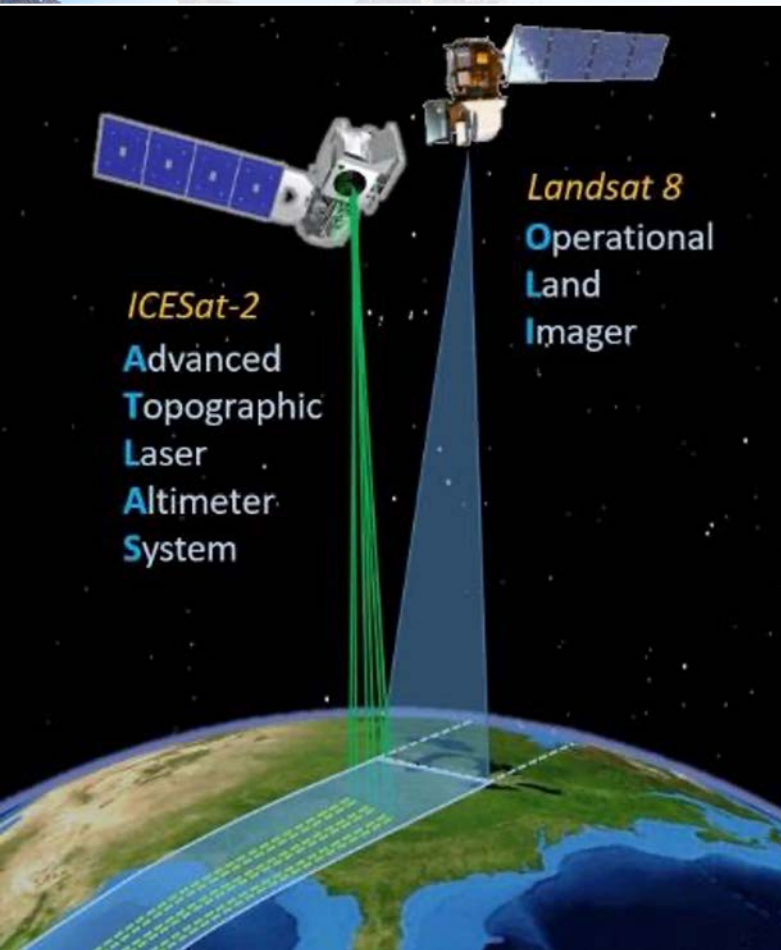$$D = \frac{\ln(R_{blue})}{\ln(R_{green})}$$

transform

$$Z = m_1 D - m_0$$
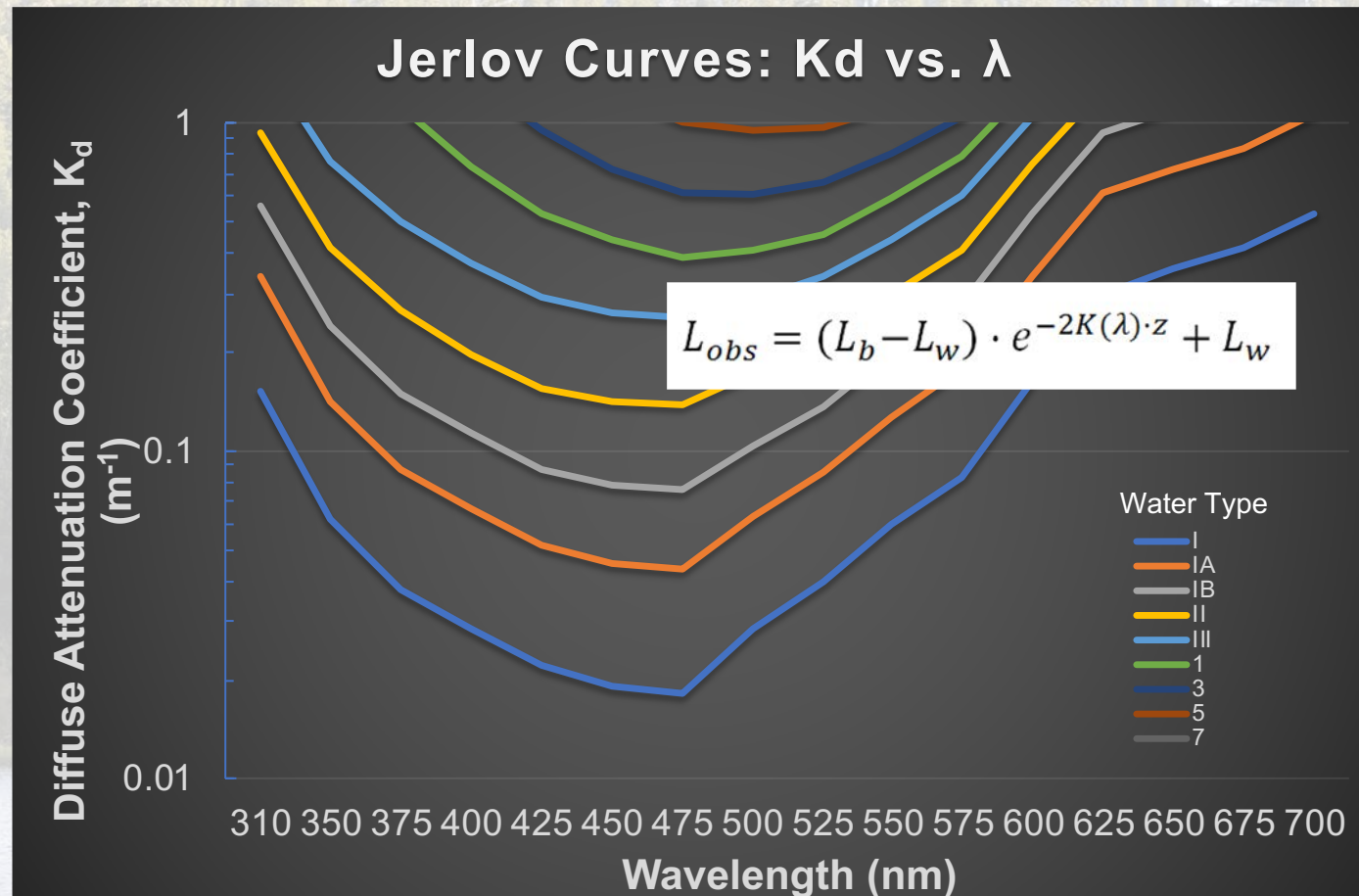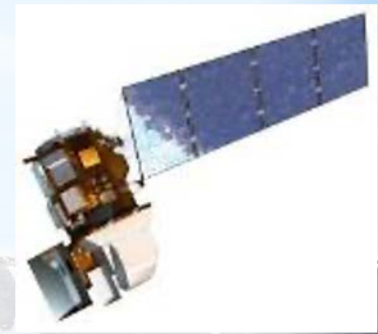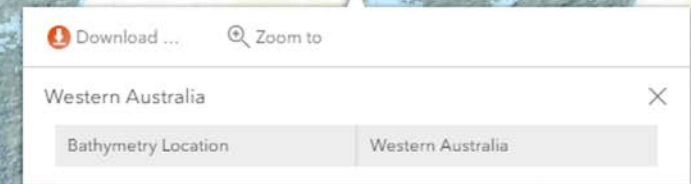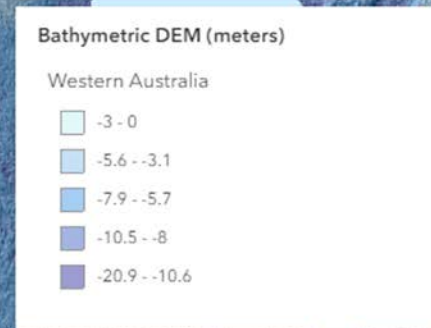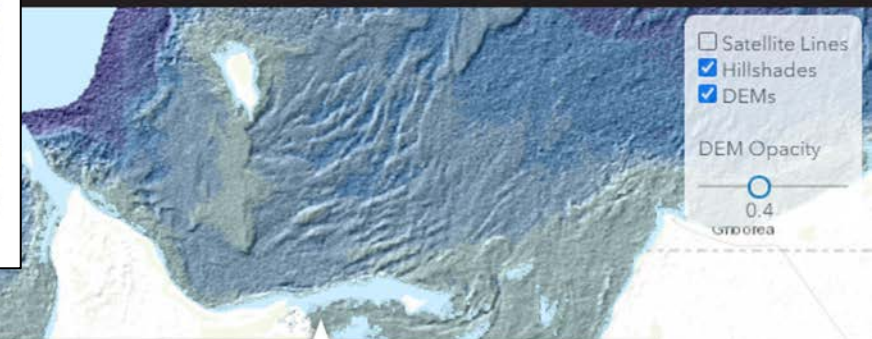
ICESat-2 ATLAS Bathymetry

Parrish, C.E., L.A. Magruder, A.L. Neuenschwander, N. Forfinski-Sarkozi, M. Alonzo, and M. Jasinski, 2019. Validation of ICESat-2 ATLAS Bathymetry and Analysis of ATLAS's Bathymetric Mapping Performance. *Remote Sensing*, Vol. 11, No. 4: 1634.
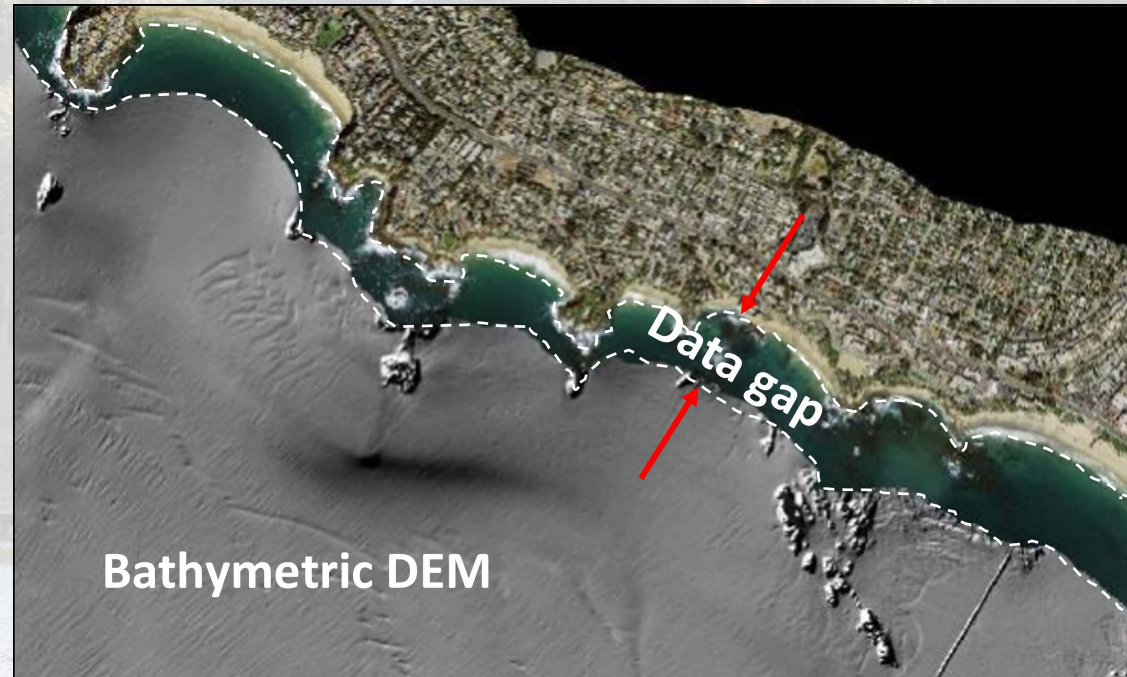
Active-Passive Fusion Based Approaches

Forfinski-Sarkozi, N.A., and C.E. Parrish, 2019.
Active-Passive Spaceborne Data Fusion for Mapping
Nearshore Bathymetry. *Photogrammetric Engineering
and Remote Sensing*, Vol. 85, No. 4, pp. 281-295.

Gaps/Data Needs

- Data lacking in many coastal areas
  - Nautical charts obsolete in many areas (IHO)
  - Shore-adjacent areas (0-5 m) generally the most critical gap

- Spatial accuracies and resolutions don't meet all science and application needs
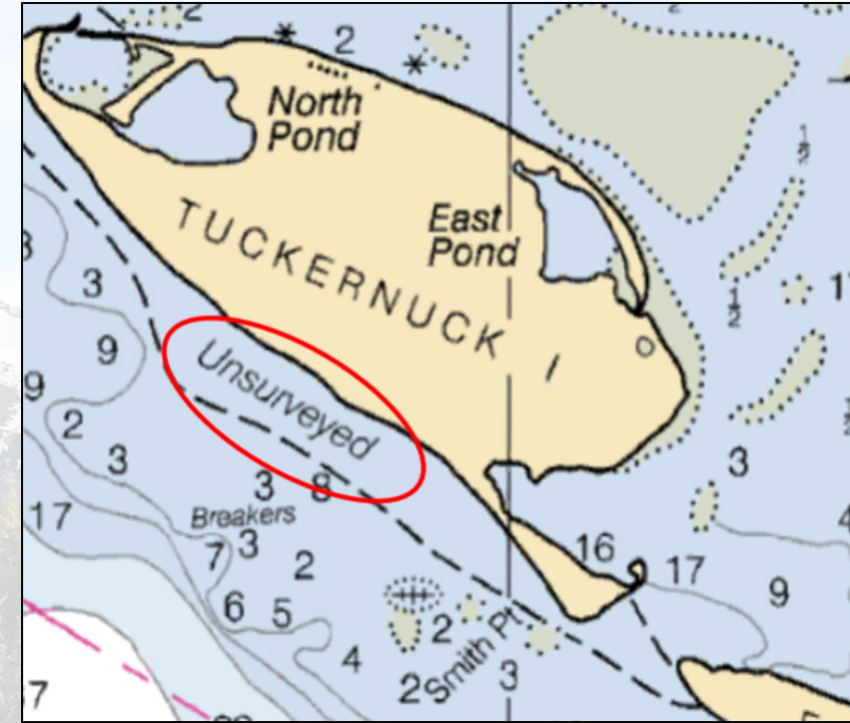
Existing Standards Docs

INTERNATIONAL HYDROGRAPHIC ORGANIZATION

IHO Standards for Hydrographic Surveys

5th Edition, February 2008

Special Publication N° 44

Integrated Ocean and Coastal Mapping

Map Once, Use Many Times

HOME   DATA SHARING   MAPPING & SURVEY PLANNING

STANDARDS & PROTOCOLS   MAPPING CAMPAIGNS & ANNUAL OPERATIONS

INNOVATION   ABOUT US

Search

INTERAGENCY WORKING GROUP ON
Ocean and Coastal Mapping

MAPPING THE COAST OF ALASKA

A 10-Year Strategy in Support of the United States Economy, Security, and Environment

NATIONAL COASTAL MAPPING STRATEGY 1.0:
COASTAL LIDAR ELEVATION FOR A 3D NATION
DRAFT FOR PUBLIC REVIEW AND COMMENT

PRODUCT OF THE

National Science and Technology Council

Science Data Requirements

- Not as well documented as those of mapping/hydrographic surveying community

Need input from community!

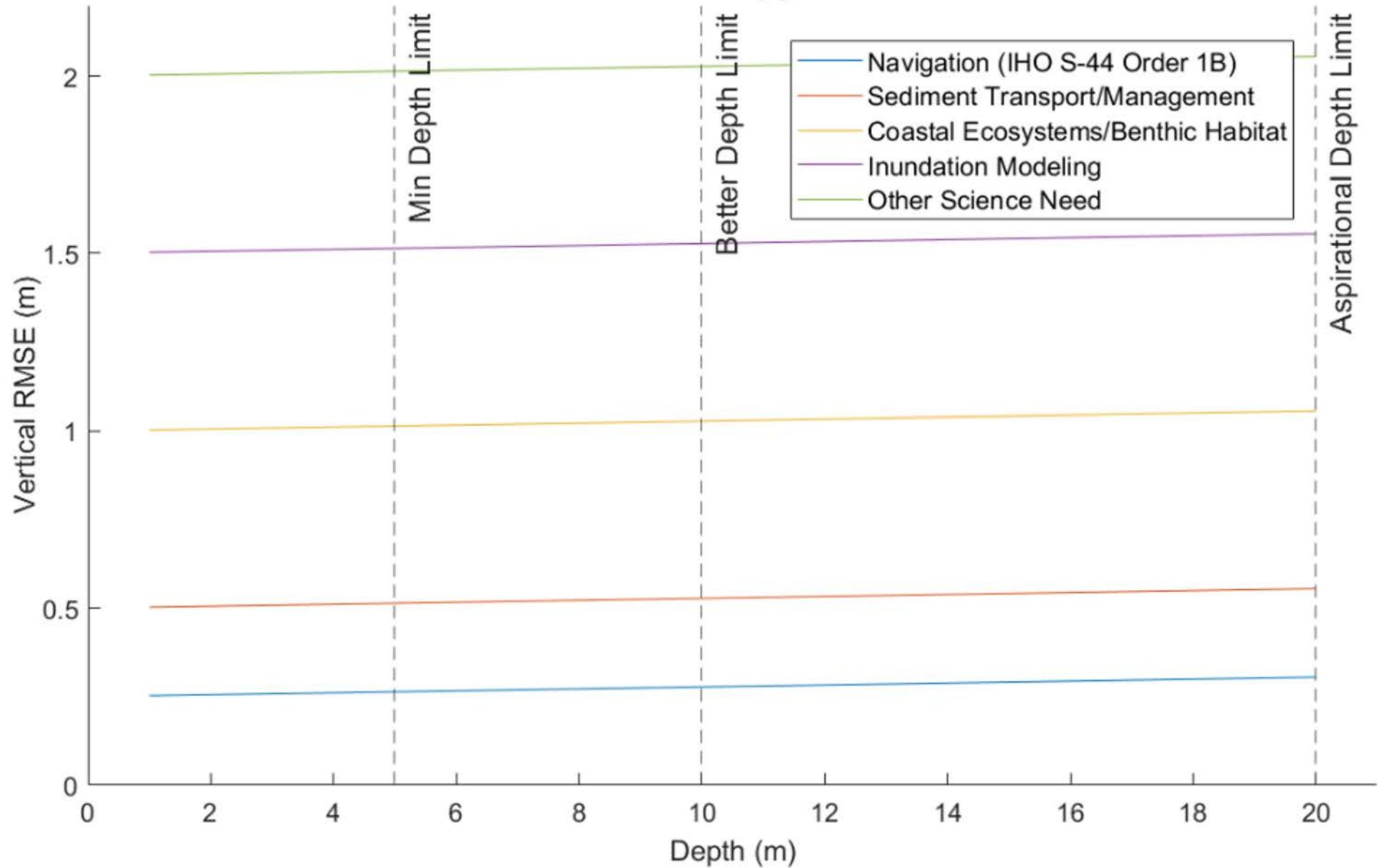## Seamlessly integrating bathymetric and topographic data to support tsunami modeling and forecasting efforts

Barry W. Eakins[1] and Lisa A. Taylor[2]

Shallow Bathymetry Accuracy Needs for Different Science/Application Areas

Science and Applications				Level 3 or 4 Product					
Goals	Objectives	Targeted Observable(s)	Physical Parameter(s) Required		Area of Interest	Coverage (%)	Smallest Feature Resolution (m)		
								Horizontal	Vertical
(E-1) What are the structure, function, and biodiversity of Earth's ecosystems, and how and why are they changing in time and space?	(STV) What are current and predicted threats to marine ecosystems and coastal/benthic habitats (e.g., coral reef, saltmarsh, mangroves, seagrass, oyster reefs, etc.)?	Shallow Bathymetry Vegetation (mangroves & submerged aquatic veg) Land topography	A) Time series of shallow bathymetry	Time series of bathymetry DEMs (2D grid)	Coral reefs, saltmarsh, mangroves, seagrass beds, oyster reefs and other priority habitat areas worldwide	30% 100%	5 m 0.5 m	1 m 0.25 m
			B) Time series of rugosity and seafloor structure	Time series of gridded seafloor rugosity		30% 100%	5 m 0.5 m	1 m 0.25 m

Aspiration
Threshold

Coastal Processes

- Charge to Community:
  - Come prepared to discuss your product gaps/needs
  - If possible, please identify published papers, reports that we can cite in justifying the needs
    - "T" in SATM = Traceability
      - Need references!