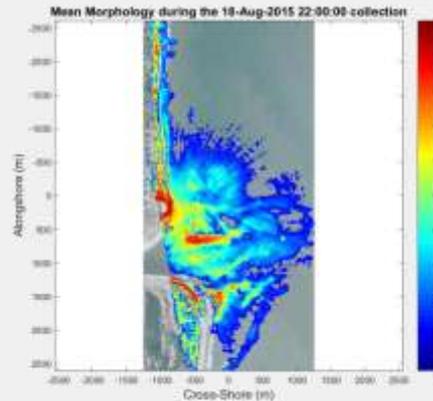
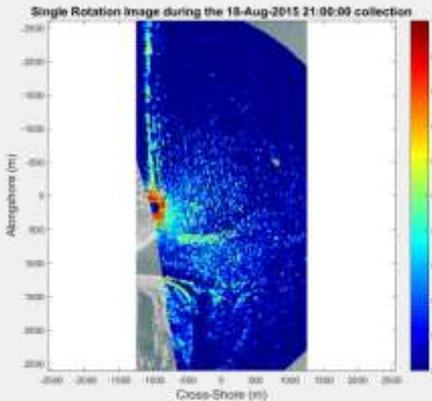


# Radar Inlet Observing System (RIOS)

J. McNinch

- RIOS makes continuous, hourly observations of waves in shallow-water settings (e.g. tidal inlets, nearshore placement) to determine bathymetry.
- Input: shallow-water waves  
Output: - waves observations (T, angle)  
- bathymetry



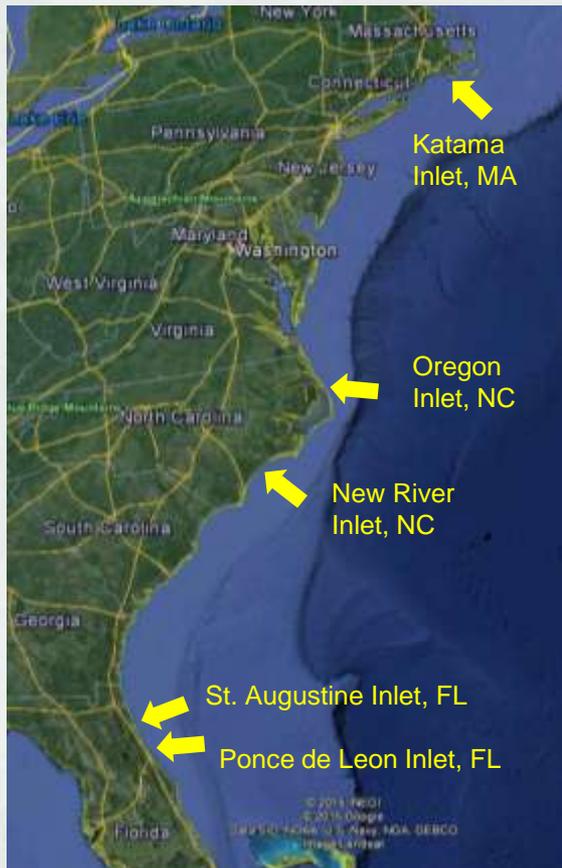
- How does the tool help the Districts:
  - ▶ continuous monitoring of shoals and channels around tidal inlets
  - ▶ monitoring of large, nearshore (<8m) placement?
  - ▶ Others??



**ERDC**

# RIOS deployments and use

- Conducting a demonstration deployment at St. Augustine Inlet with SAJ (started 4 days ago): August 2015 – February 2016
- RIOS deployment sites (primarily in R&D phase)



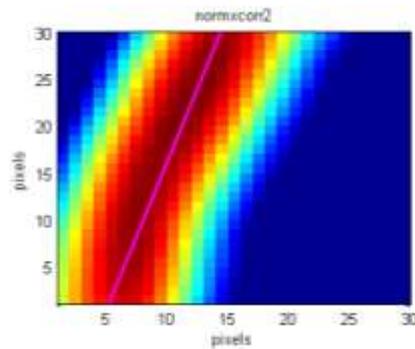
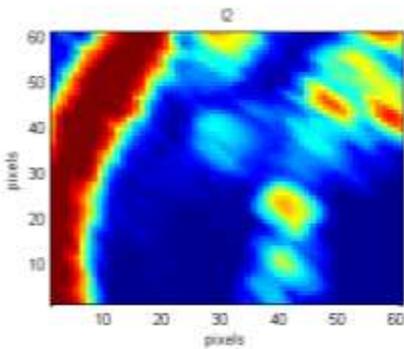
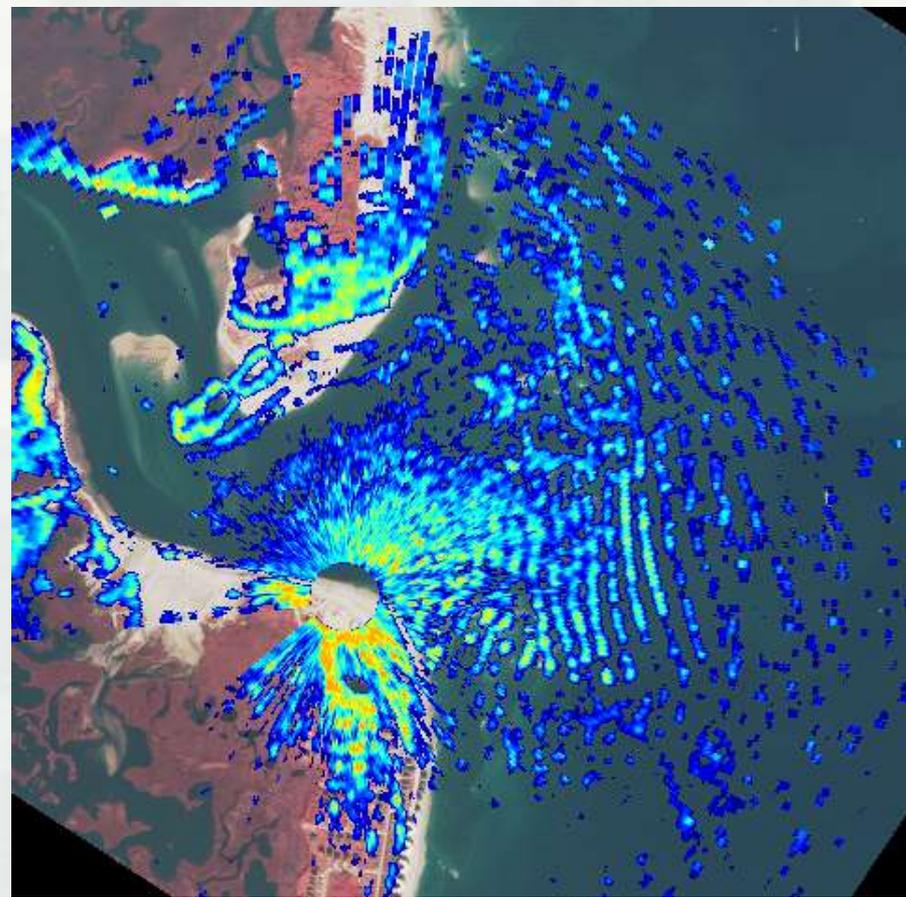
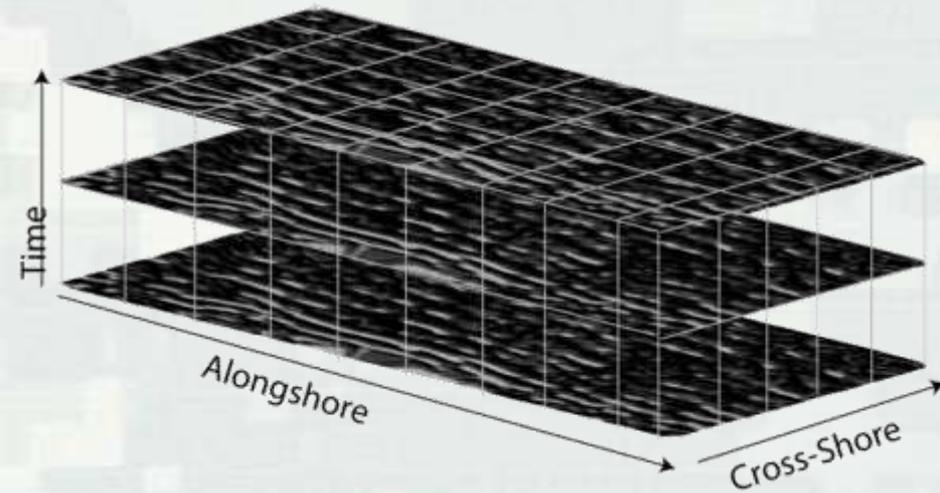
# The Problem

- Extremely dangerous conditions for navigating
  - ▶ Rapidly changing depths, waves, and currents
- Traditional on-the-ground survey techniques are dangerous, expensive and quickly become dated
- No 'one' remotely sensed data option solves the problem



New remote sensing techniques required

# How RIOS works



Linear dispersion:

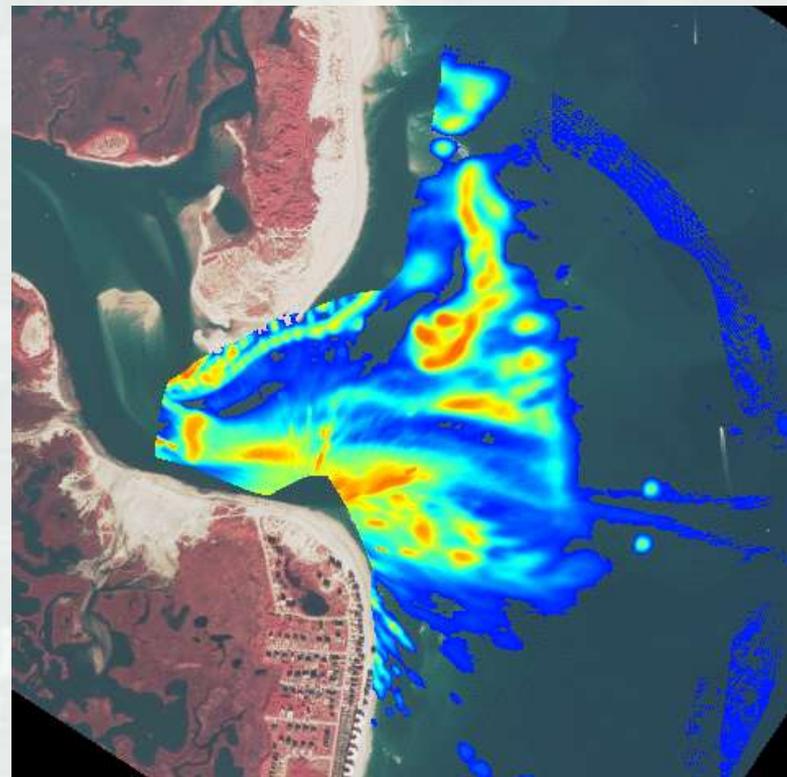
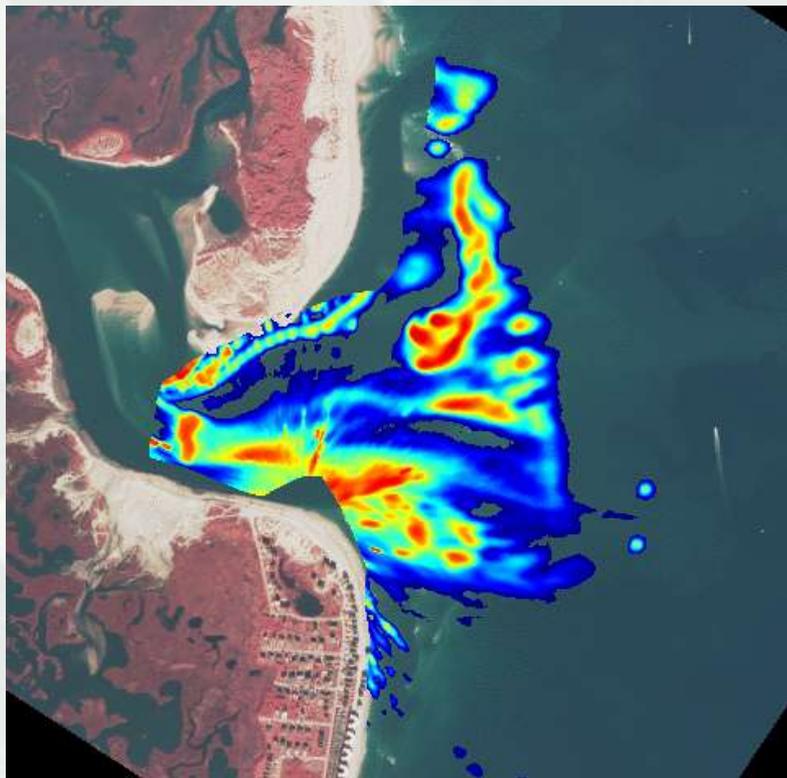
$$h(t) = \frac{1}{k(t)} \tanh^{-1} \left( \frac{\omega(t)^2}{gk(t)} \right)$$

**ERDC**

# RIOS – depths scaled from radar intensities

Radar intensities provides high detail in shoal and channel morphology

Multiple-day dwell times enable averaging over tidal-cycles to produce more robust results



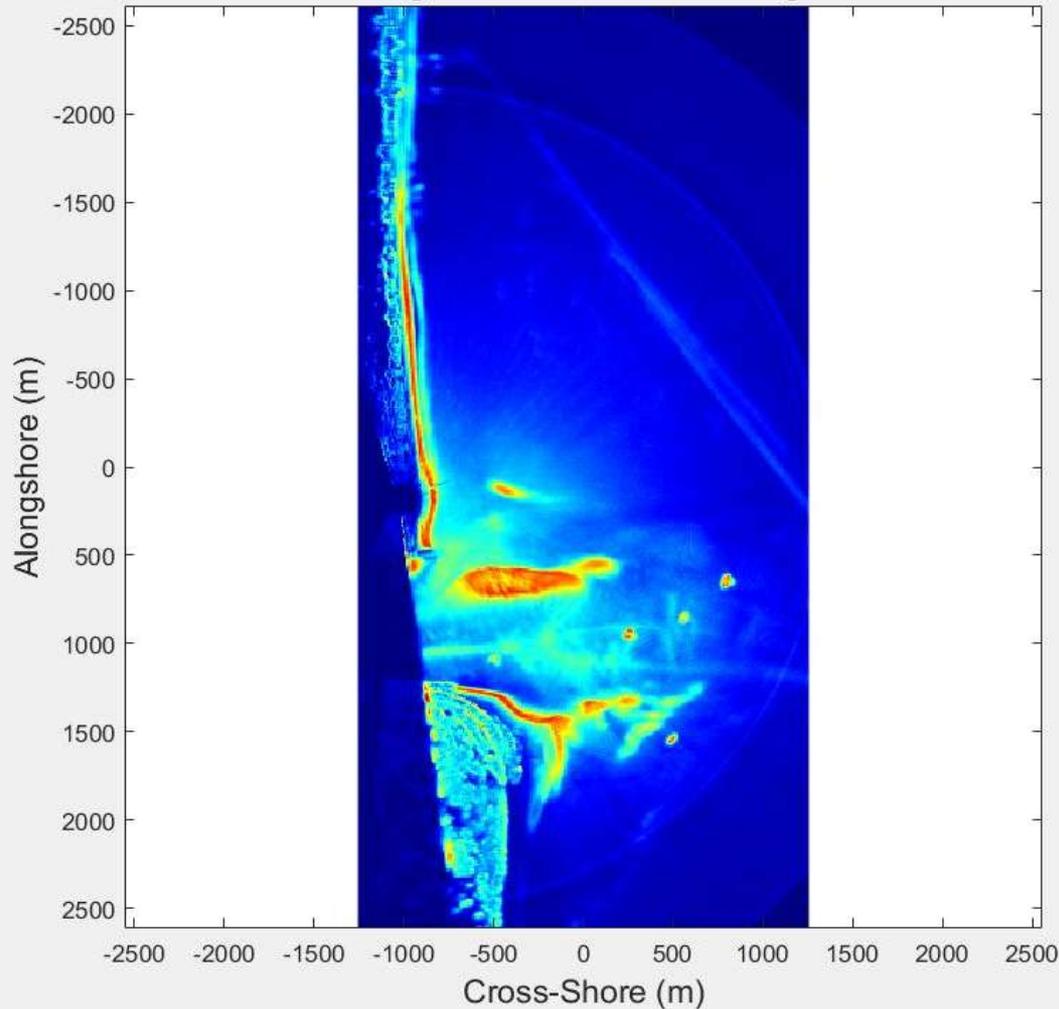
BUILDING STRONG®



*Innovative solutions for a safer, better world*

# Shoal and channel morphology

Scaled Depth from Filtered Morphology Image  $R^2 = 0.18232$   
Files from: 17-Aug-2015 10:00:00 to 18-Aug-2015 22:00:00

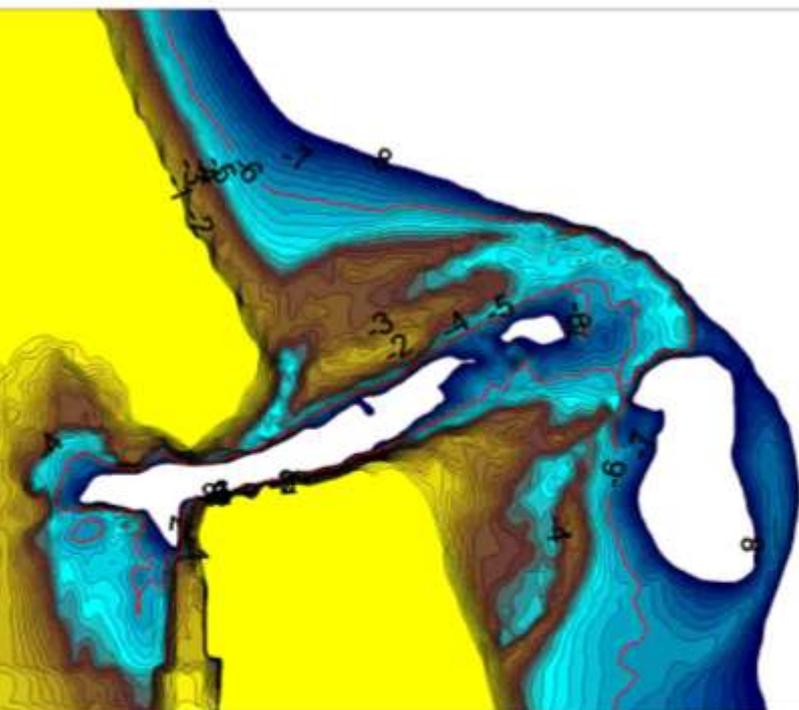


- Time-averaged, scaled-depth bathymetry using linear equation determined from radar intensities and inferred-bathymetry plus previous survey data

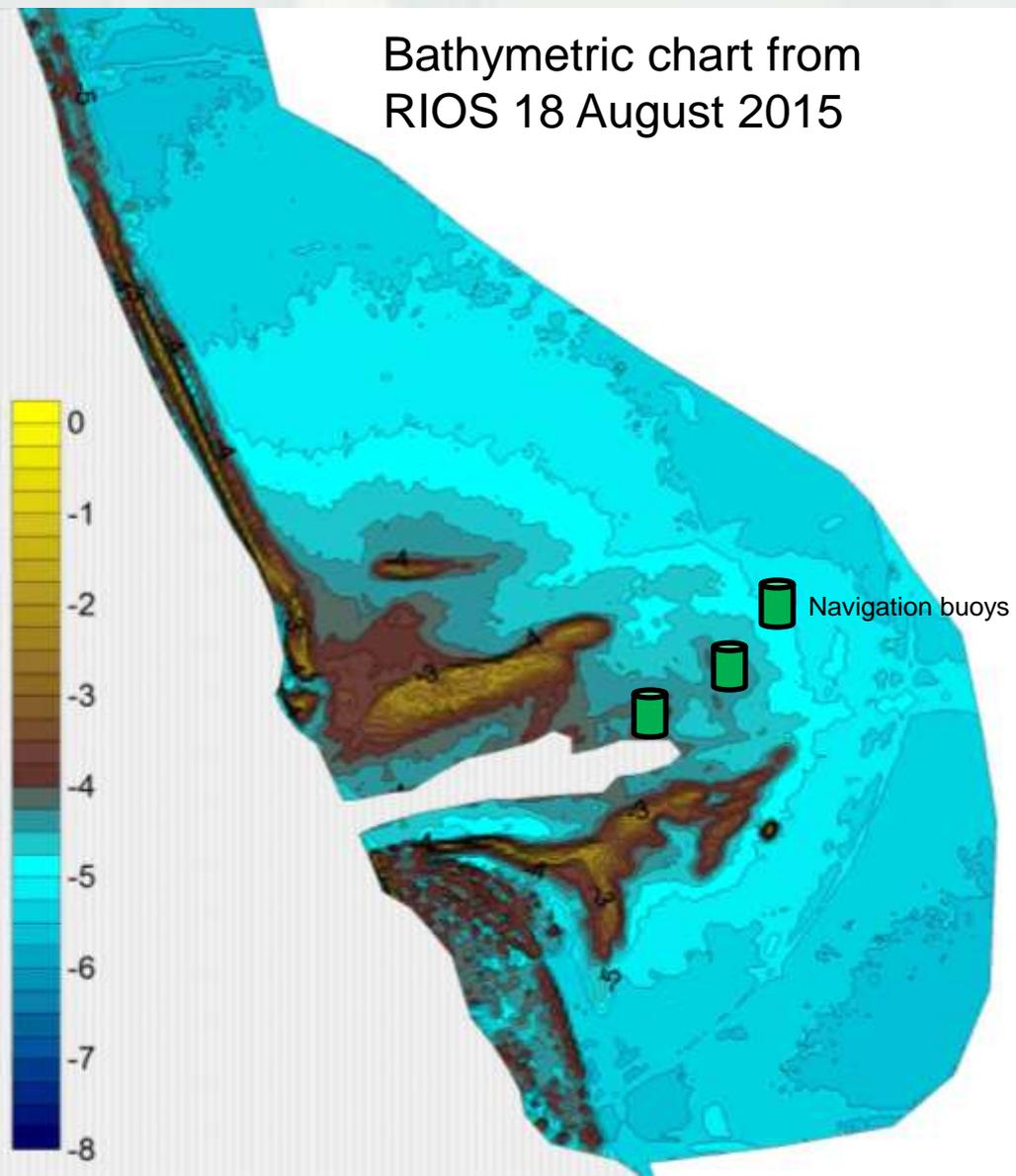
**ERDC**

# Bathymetric chart plotted from hourly RIOS data: St. Augustine Inlet

Bathymetric chart from 2014 survey data

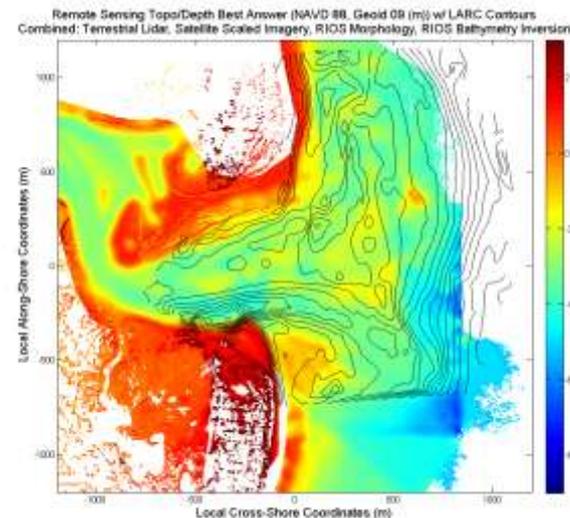
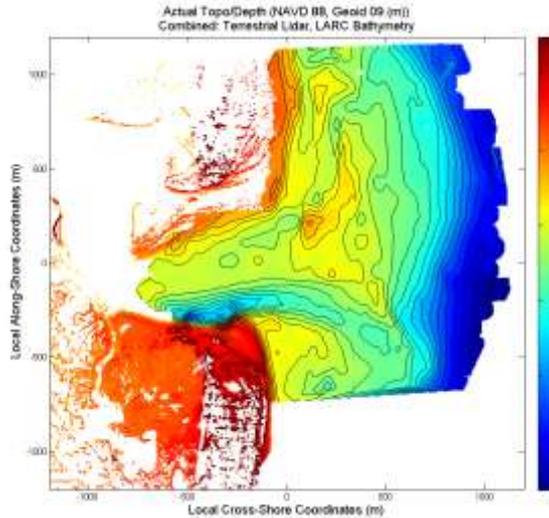


Bathymetric chart from RIOS 18 August 2015



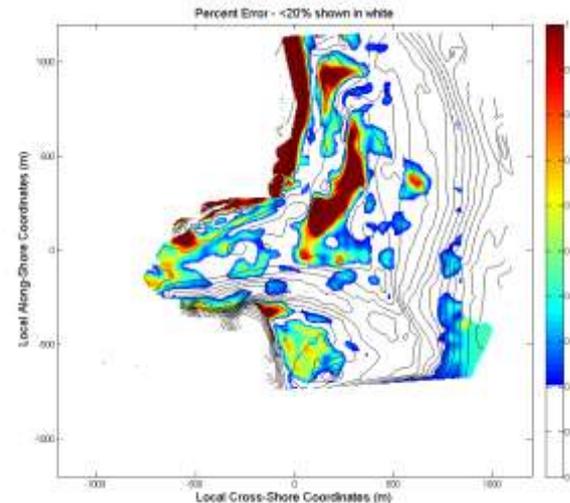
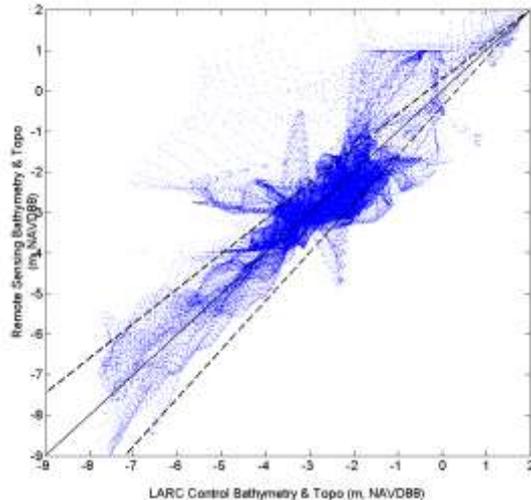
# Precision estimates

'True' bathymetry & topography



Remotely sensed bathymetry & topography

'True' vs. remotely sensed depth comparison



'True' vs. remotely sensed spatial error assessment



# RIOS Improvements for long-term deployments, 'Off-grid'



- off-grid 24v DC based system
- solar provides primary power source
- propane self-contained generator as backup
- climate-controlled computer box
- aircard online link for hourly data transfer and web posting
- lightning protection



Special thanks to Dan Freer, FRF



# RIOS Products

## What RIOS will do:

- Hourly measurements of shallow-water waves (especially shoaling and dissipating)
- Shoal and channel morphology
- Shoreline position (defined by swash)
- Nearshore sandbar morphology (possibly placement berms?)
- Hourly products posted to web in real-time.

## What RIOS will NOT do:

- Obtain explicit depth measurement (never completely replace hydrographic surveying)
- Work where there are no waves



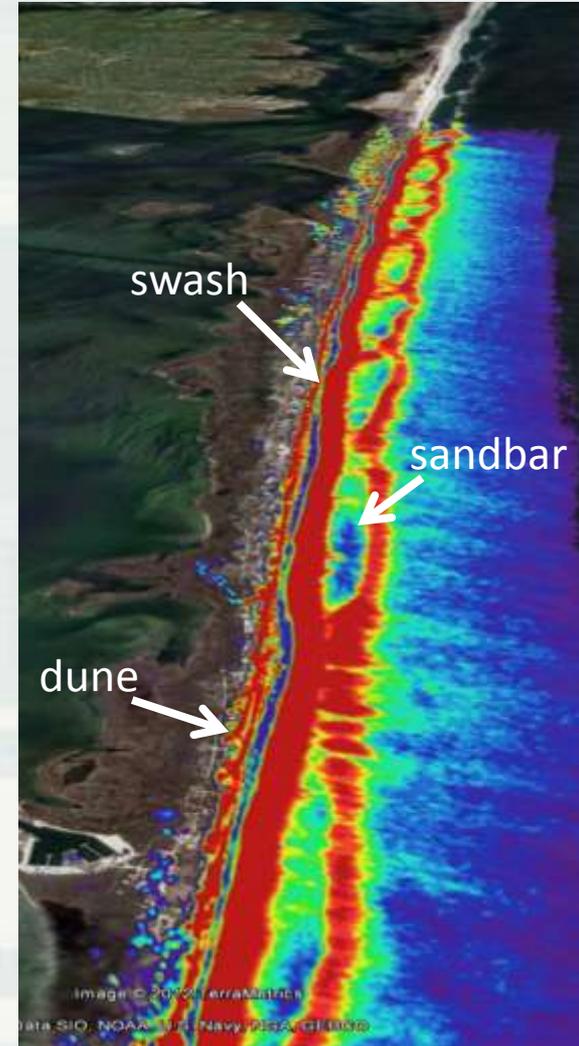
# Coastal Lidar And Imaging System (CLARIS)

## K. Brodie, CHL-COAB

- CLARIS is a mobile lidar and radar system designed to collect seamless topography and bathymetry over large areas during storm conditions.
- Input: shallow-water waves
- Output:
  - high-resolution topography
  - waves observations (T, angle)
  - inferred-radar bathymetry

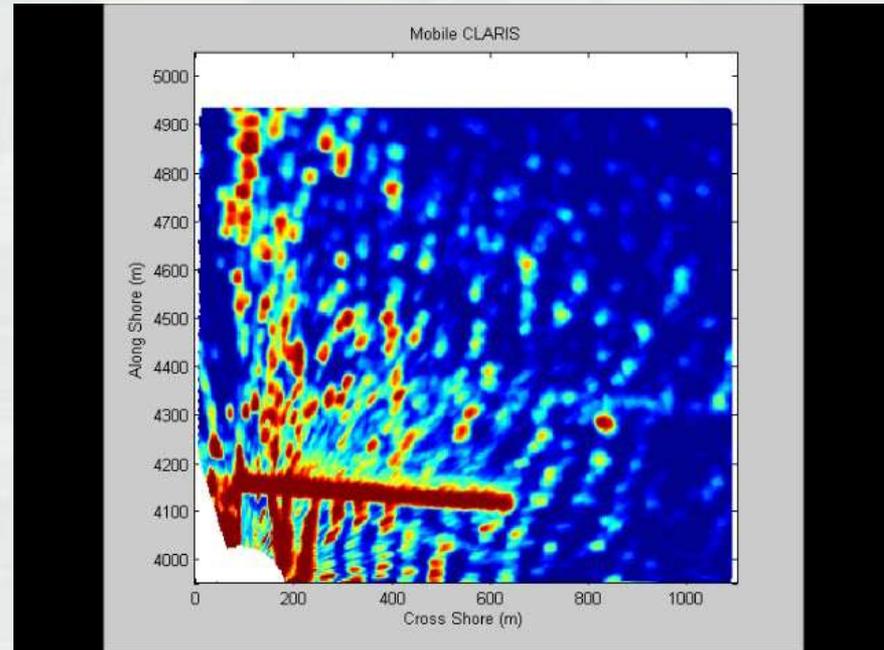


- How does the tool help the Districts:
  - ▶ Map evolution of coastal projects during storms
  - ▶ Support morphology model development (3d spatial)
  - ▶ Others??



# CLARIS – Coastal LIDAR and Imaging System

Created to survey during storms over large scale and at high resolution



## challenges

- mobile nature; very short dwell-time
- narrow freq. spectra of X-band
- storm waves not linear in surf & highly variable in time

**ERDC**