NOAA Lidar Coastal Mapping: Tools and Applications

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NOAA/NOS/NGS
Remote Sensing Division

Airborne Lidar
Technology & Applications Workshop
June, 2007

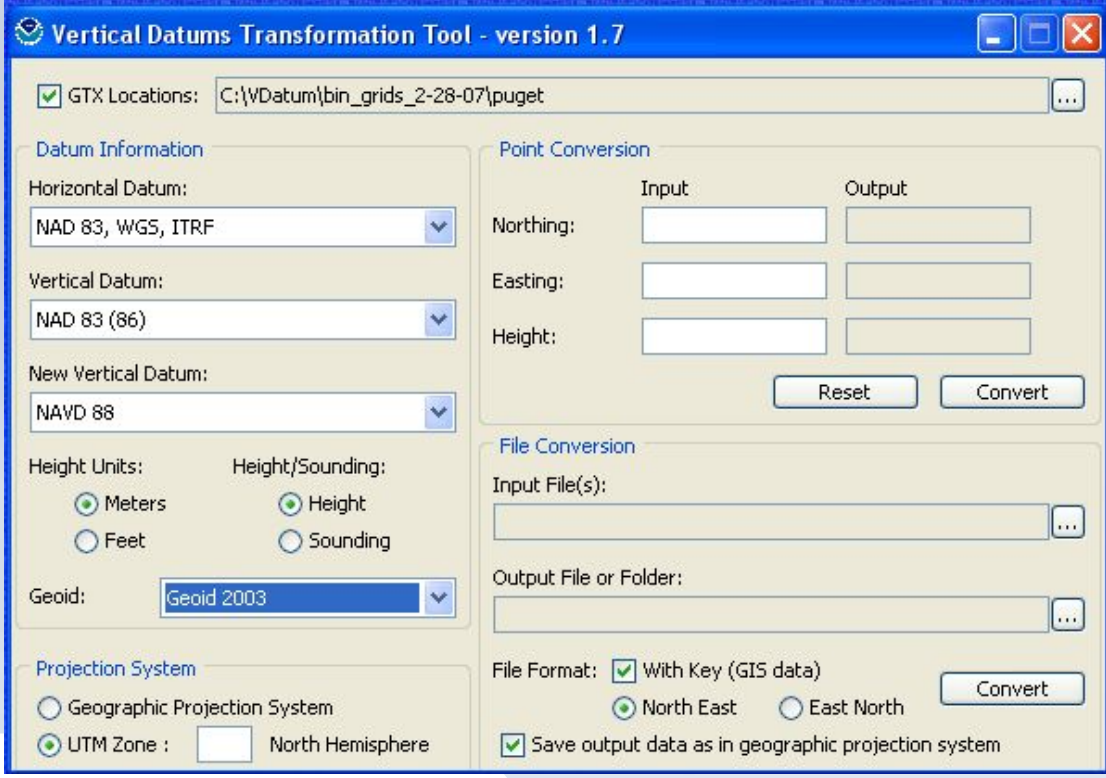
National Oceanic and Atmospheric Administration

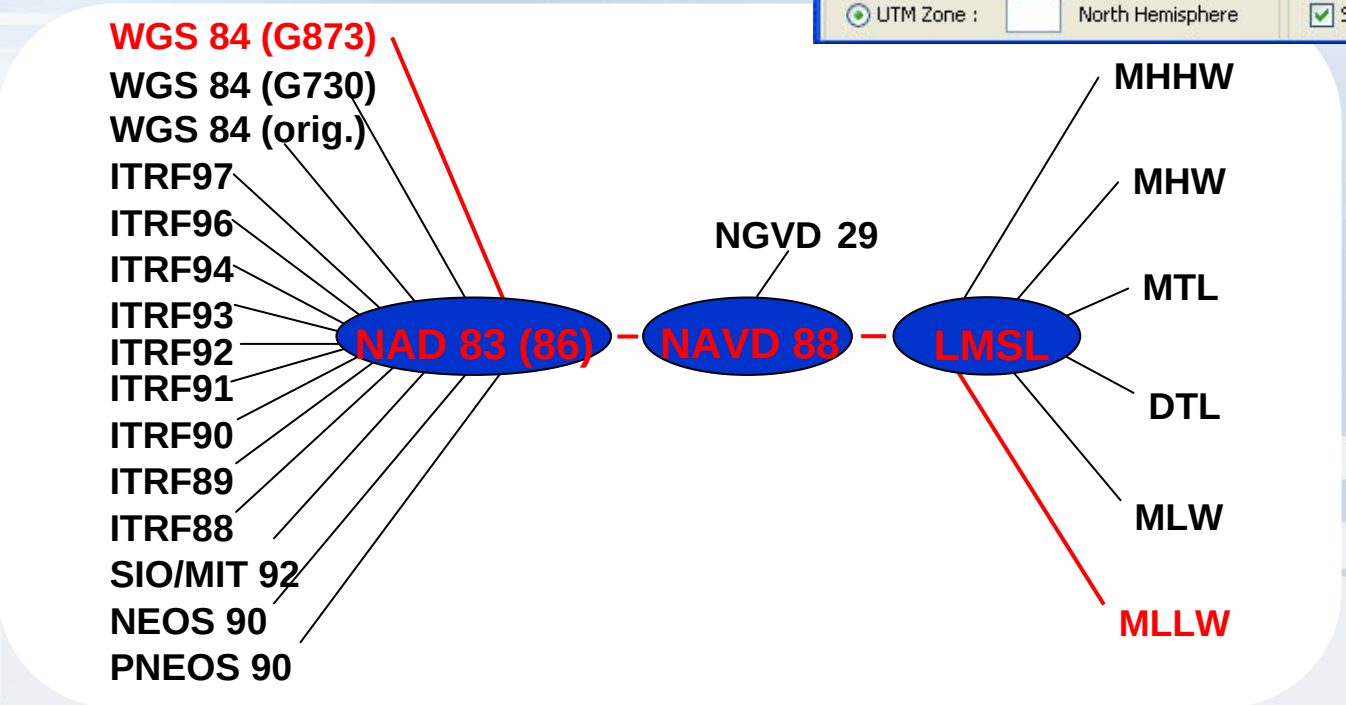
Overview:

- Tools/Enabling Technologies
  - VDatum
  - CORS & OPUS
- Applications
  - Auto-extraction of tidally-referenced shoreline from lidar data using VDatum
  - Sea level rise
  - Emergency response
- Research
  - EAARL
  - Sensor fusion & IOCM
  - Object detection in lidar waveform data

VDatum

Enables coastal elevations from a variety of different sources to be accurately compared or merged





VDatum Availability, Gulf Coast

Lake Charles

Port Fouchon

Tampa Bay

VDatum Available

2007

2008

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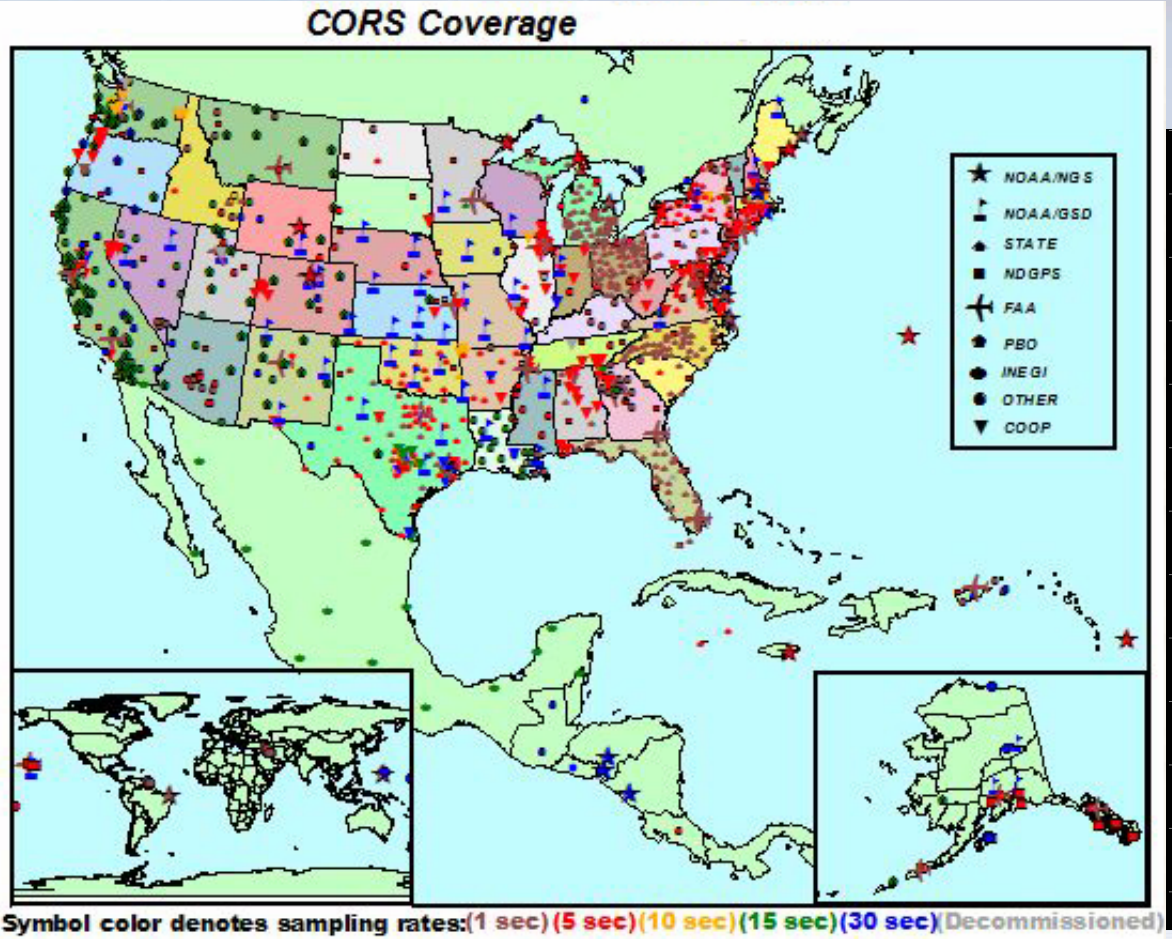
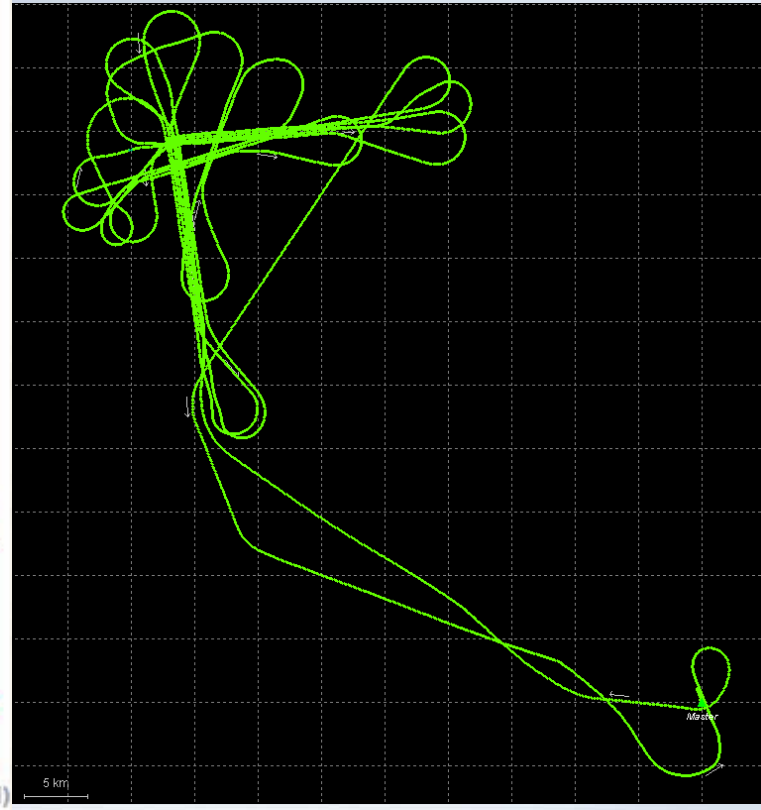
CORS Network Facilitates Lidar Acquisition



Airborne GPS trajectory



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OPUS

OPUS solution : san_2393.03o 000100017 - OPUS solutions - Netscape 7.1

File Edit View Go Message Tools Window Help

Get Msgs Compose Reply Reply All Forward Next Junk Delete

Subject: OPUS solution : san_2393.03o 000100017
From: opus@ngs.noaa.gov
Date: 8/28/2003 1:50 PM
To: jason.woolard@noaa.gov

```
 2004   WARNING!  The IGS precise orbit was not available at processing
 2004   time.  The IGS rapid orbit was/will be used to process the data.
 2004
                              NGS OPUS SOLUTION REPORT
                              ========================

      USER: jason.woolard\@noaa.gov                  DATE: August 28, 2003
 RINEX FILE: san_2393.03o                            TIME: 17:50:21 UTC


  SOFTWARE: page5  0203.19 ./master.pl              START: 2003/08/27  03:10:00
 EPHEMERIS: igr12333.eph [rapid]                     STOP: 2003/08/27  07:10:30
  NAV FILE: brdc2390.03n                         OBS USED:  7451 /  7589   :  98%
  ANT NAME: ASH701975.01A                     # FIXED AMB:    31 /    33   :  94%
 ARP HEIGHT: 2.0                              OVERALL RMS: 0.014(m)


 REF FRAME: NAD83(CORS96)(EPOCH:2002.0000)             ITRF00  (EPOCH:2003.6526)

          X:     -2433206.043(m)   0.041(m)          -2433206.731(m)   0.028(m)
          Y:     -4781306.050(m)   0.073(m)          -4781304.669(m)   0.049(m)
          Z:      3438108.991(m)   0.026(m)           3438108.991(m)   0.025(m)

        LAT:   32 49 45.47849      0.032(m)        32 49 45.49466      0.022(m)
      E LON:  243  1 42.46534      0.019(m)       243  1 42.41769      0.019(m)
      W LON:  116 58 17.53466      0.019(m)       116 58 17.58231      0.019(m)
     EL HGT:           78.776(m)   0.085(m)                78.004(m)   0.057(m)
  ORTHO HGT:          112.391(m)   0.088(m) [Geoid99 NAVD88]

        UTM:          Zone  11
   NORTHING:      3632363.697(m)
    EASTING:       502663.965(m)

US NATIONAL GRID DESIGNATOR: 11SNS0266432364(NAD 83)



                              BASE STATIONS USED
PID        DESIGNATION                        LATITUDE    LONGITUDE DISTANCE(m)
DE6603 SIO3 SCRIPPS 3 CORS ARP             N325152.912 W1171501.419   26398.7
AF9569 PLO3 POINT LOMA 3 CORS ARP          N323955.495 W1171434.851   31267.5
AF9705 MONP MONUMENT PEAK CORS ARP         N325330.965 W1162520.403   51910.1

                 NEAREST NGS PUBLISHED CONTROL POINT
DC0525       J 281                         N324937.    W1165826.        342.2

This position was computed without any knowledge by the National Geodetic
Survey regarding the equipment or field operating procedures used.
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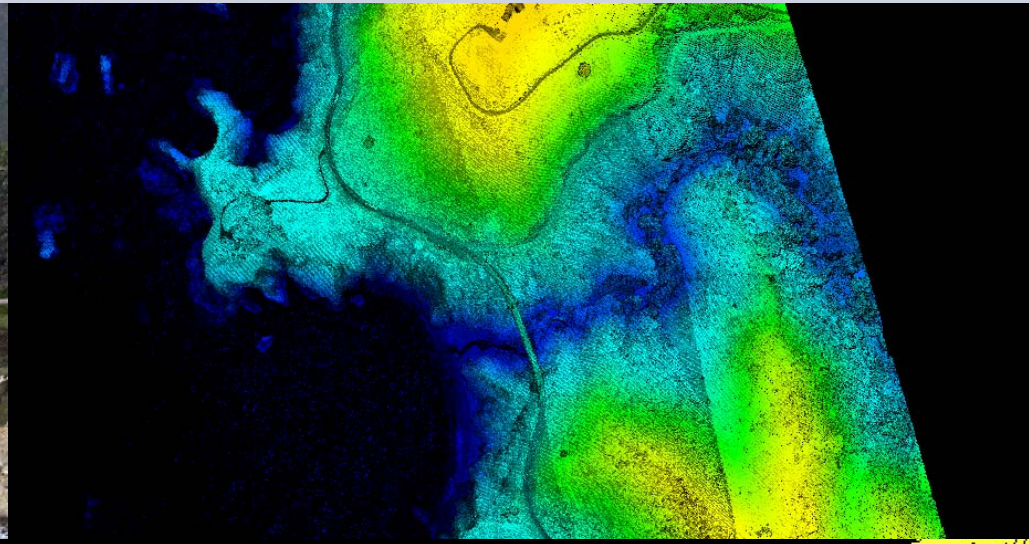
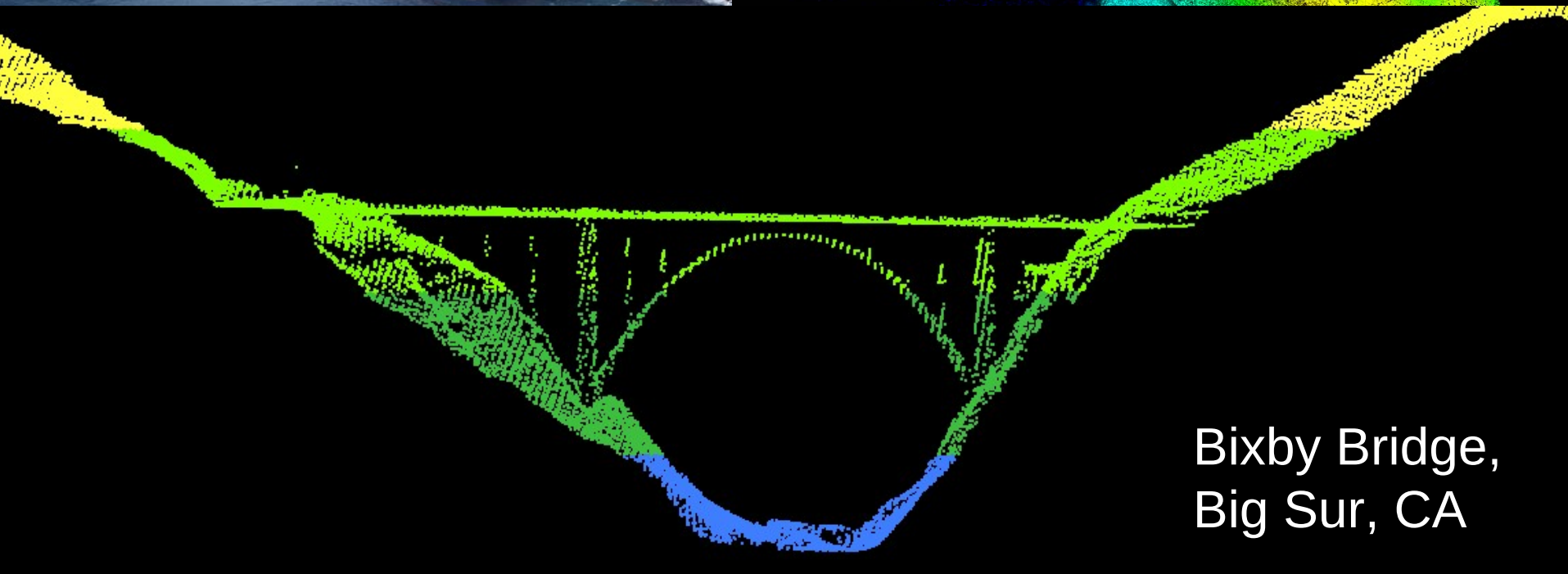
There are no new messages on the server.

Online positioning saves time in the field

NOAA Lidar Coastal Mapping

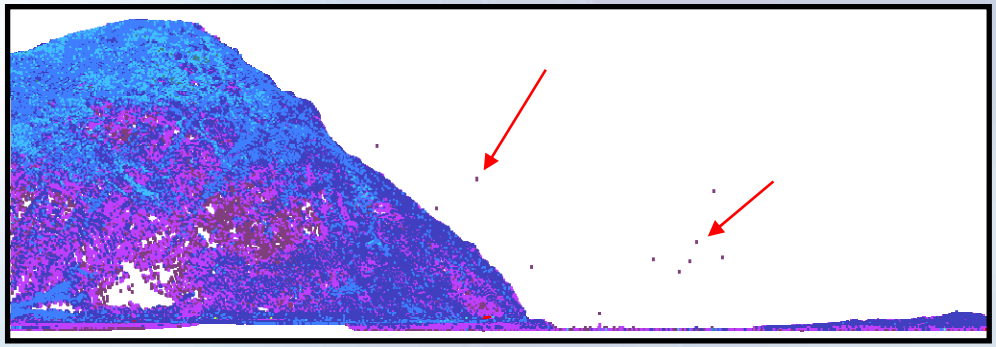


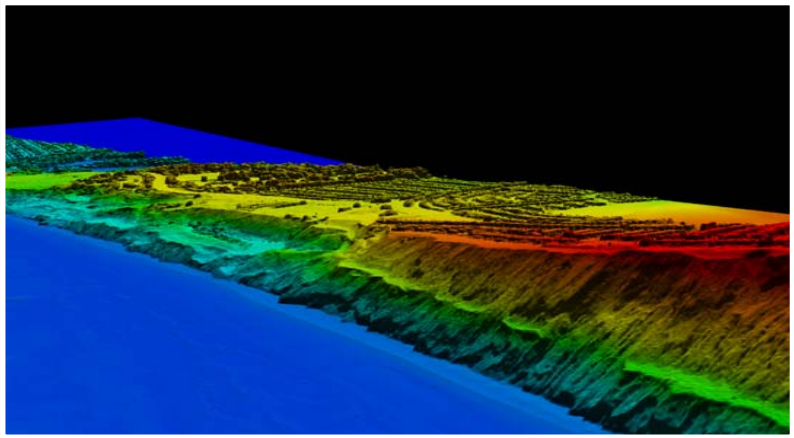


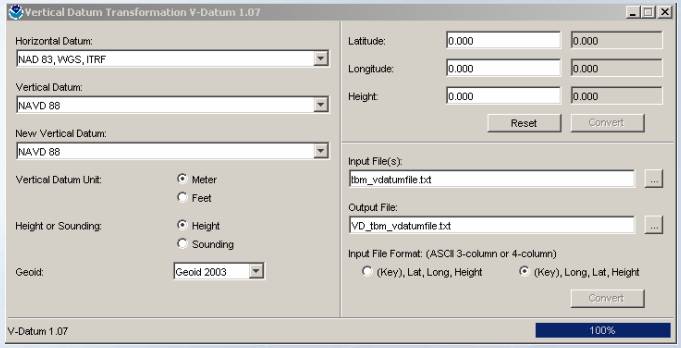
Bixby Bridge,
Big Sur, CA

Lidar Shoreline Extraction

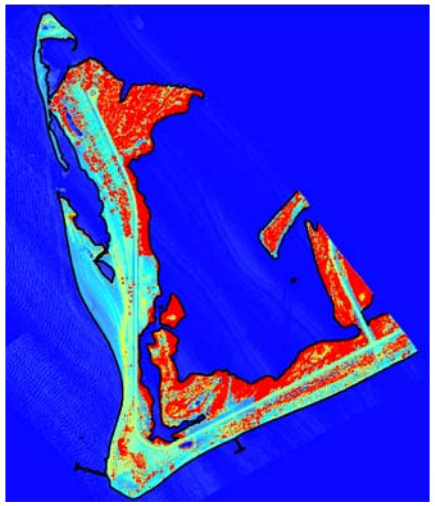
Edit Lidar Point Cloud







VDatum



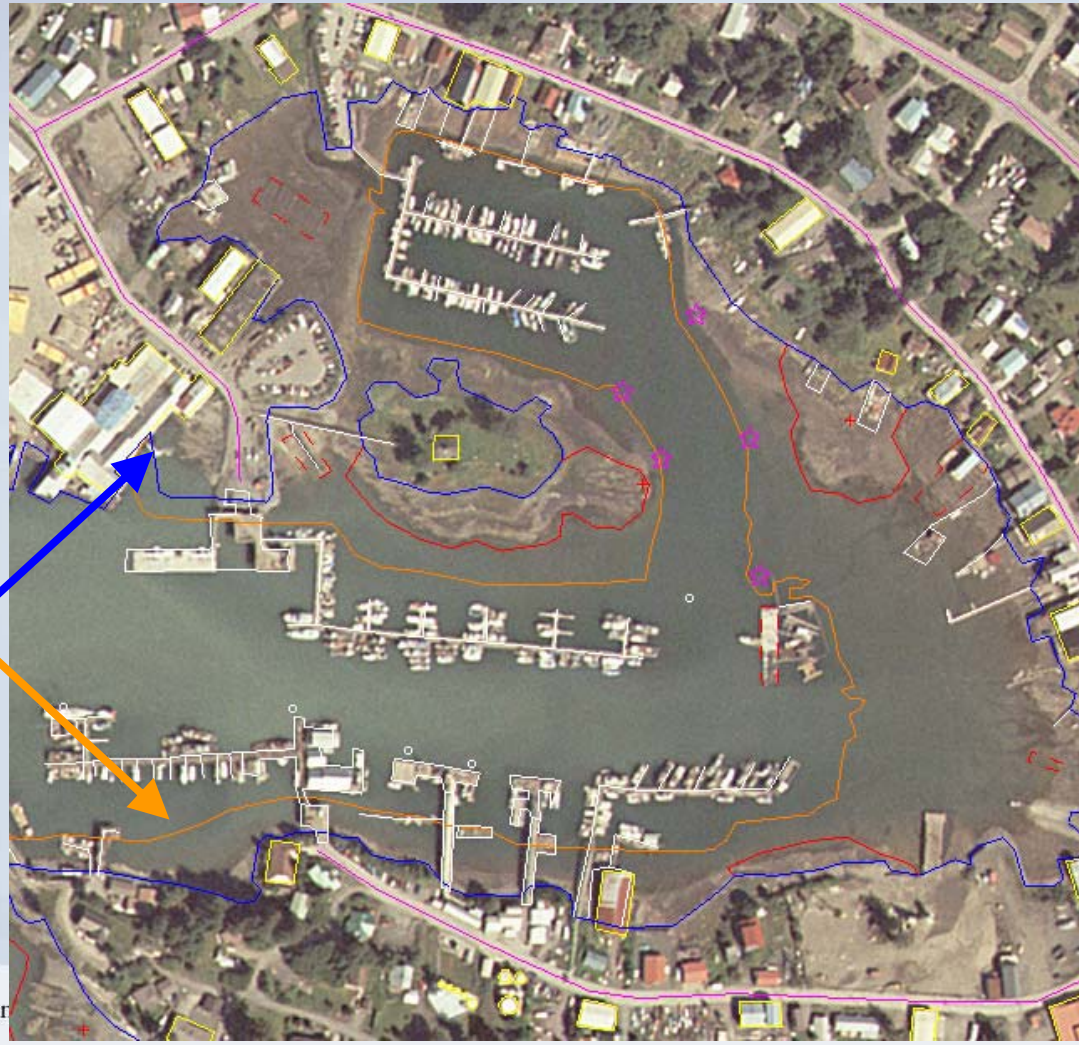
Contour Shoreline from DEM

QA/QC & error analysis

National Oceanic and Atmospheric Administration

Advantages of Lidar-Derived Shoreline

- Provides consistent, non-interpreted shoreline
  - Minimizes variability and subjectivity
- Allows for flexibility in data acquisition (2 tide windows per day in some situations)
- Has been shown to provide good results for a wide variety of coastline types
- Can (theoretically) enable multiple tidally-based shorelines (e.g., MHW & MLLW) to be derived from a single dataset



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Lidar-derived Shorelines on Varying Coastline Features

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Reference Shoreline for Accuracy Assessments

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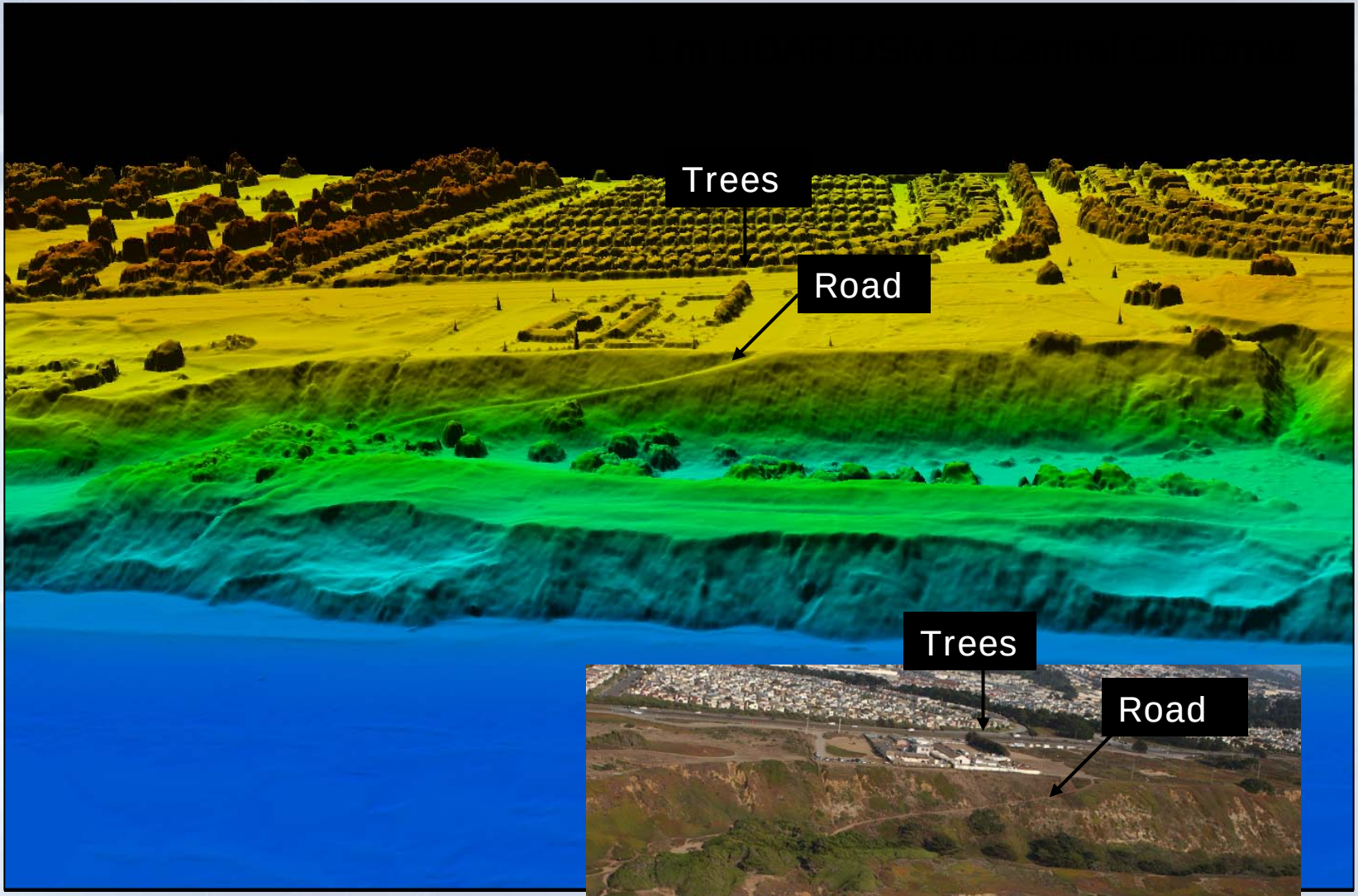
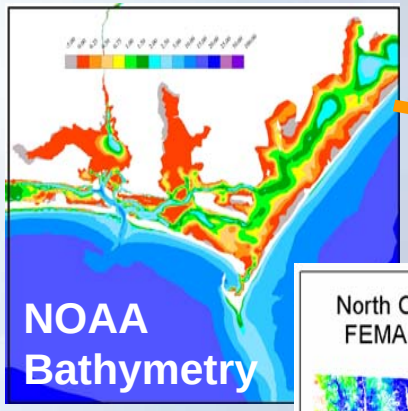


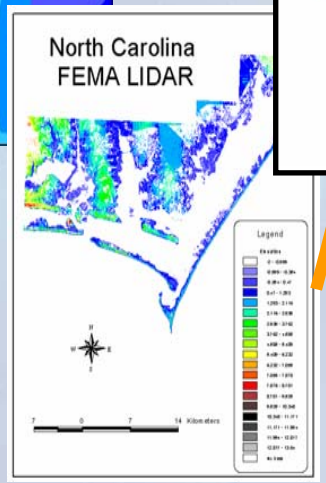
Image credit: www.californiacoastline.org

Topo Lidar DSM

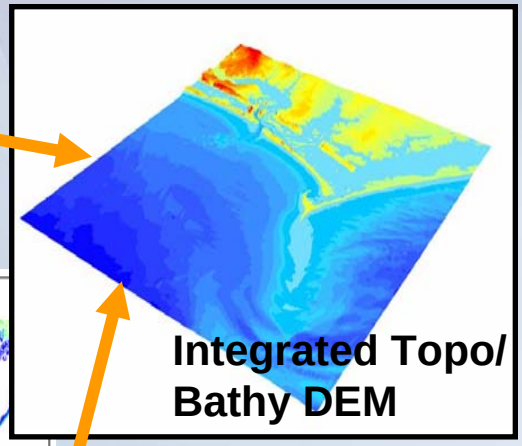
National Oceanic and Atmospheric Admin

One Important Application: Sea Level Rise

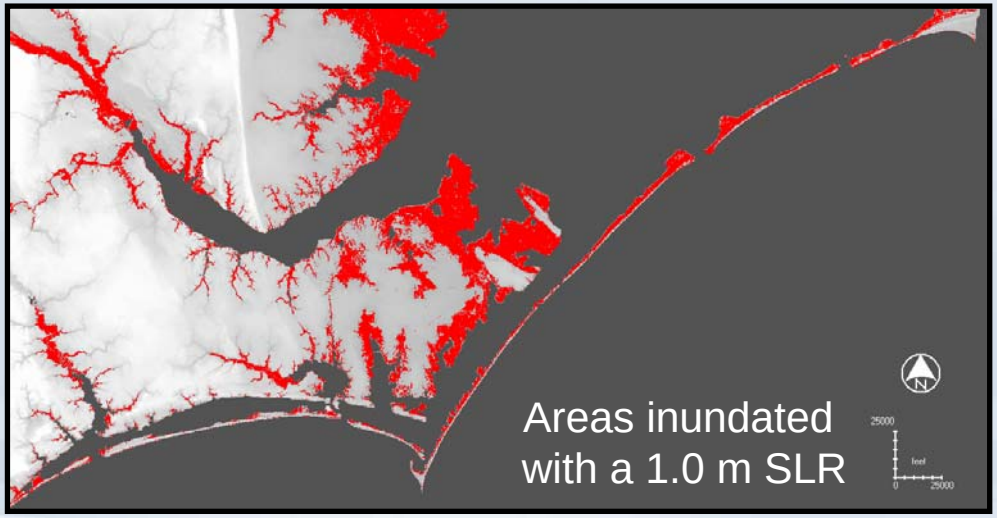




Land
Elevations



**Create a DEM
To assess
Sea Level Rise**



Emergency Response

2005

- Dennis
- Katrina
- Ophelia
- Rita
- Wilma

Hurricane Katrina NOAA Images - Mozilla Firefox

File Edit View Go Bookmarks Tools Help

http://ngs.woc.noaa.gov/katrina/

National Oceanic and Atmospheric Administration's National Geodetic Survey

NOAA

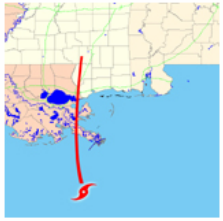
Hurricane Katrina Images

The imagery posted on this site is of the Gulf coast of Louisiana, Mississippi and Alabama after Hurricane Katrina made landfall.

This imagery was acquired by the NOAA Remote Sensing Division to support NOAA national security and emergency response requirements. In addition, it will be used for ongoing research efforts for testing and developing standards for airborne digital imagery.

Please note that these images are uncorrected and not rotated. The approximate ground sample distance (GSD) for each pixel is 37 cm (1.2 feet). The images have 60% forward overlap, and sidelap unknown. Image file size is between 2 MB and 3 MB.

Index Maps:



Click here for imagery.

Click on the image on the left to locate and view individual images.

Click here for additional Information, including batch downloads and Exterior Orientation files.

In an effort to acquire imagery in a timely manner after the landfall of the Hurricane Katrina, clouds may be present in the imagery.

NOTE: The date of the photography can be derived from the first 3 characters of the image name. Image names beginning with 243 were acquired Aug 30, 2005, those beginning with 244 were acquired Aug 31, and so on.

Other Emergency Response Imagery:

Click here

Contact:

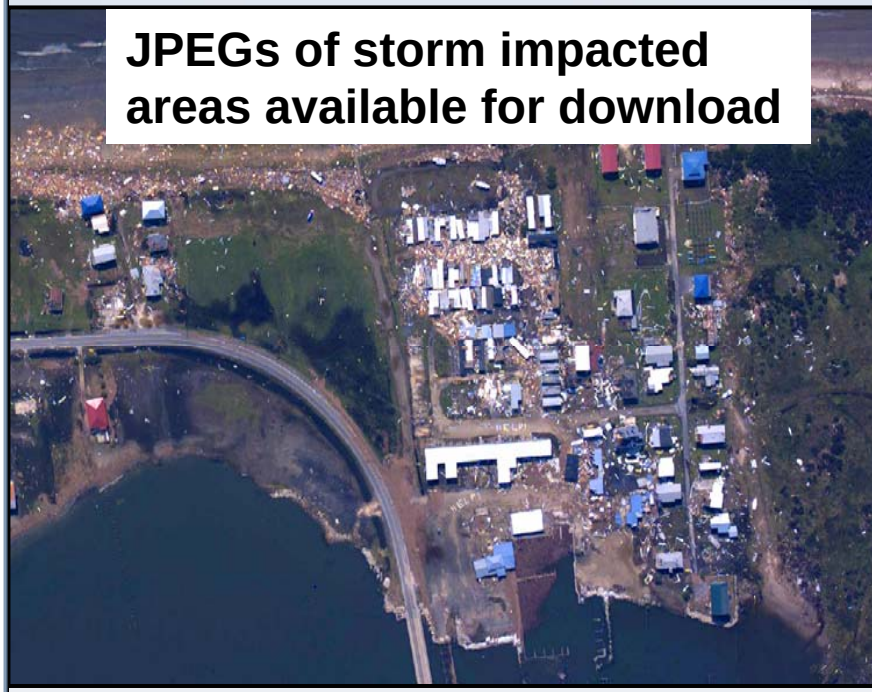
Email: Mike Aslaksen Chief, Remote Sensing Division

National Oceanic and Atmospheric Administration

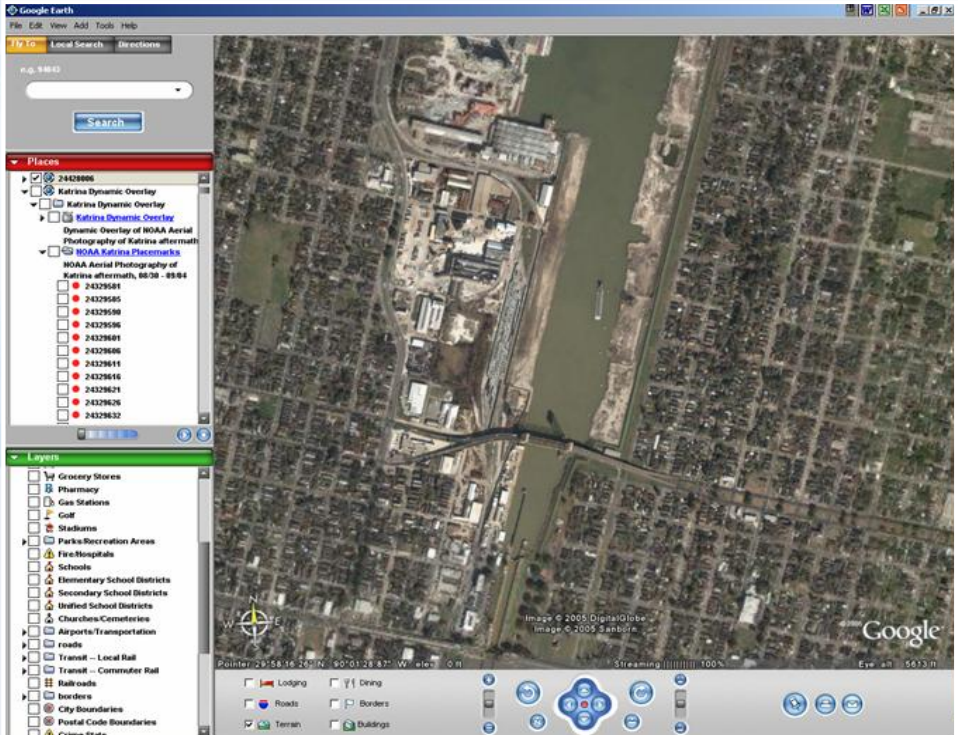
NOAA News Story

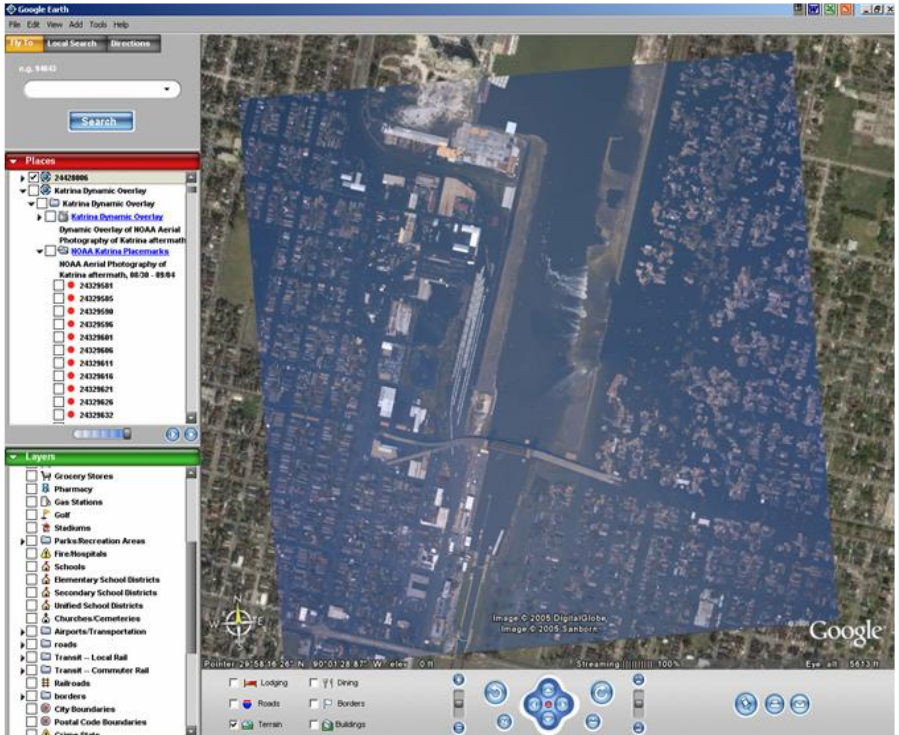
Last Modified: September 9, 2005 8:26 AM

JPEGs of storm impacted areas available for download

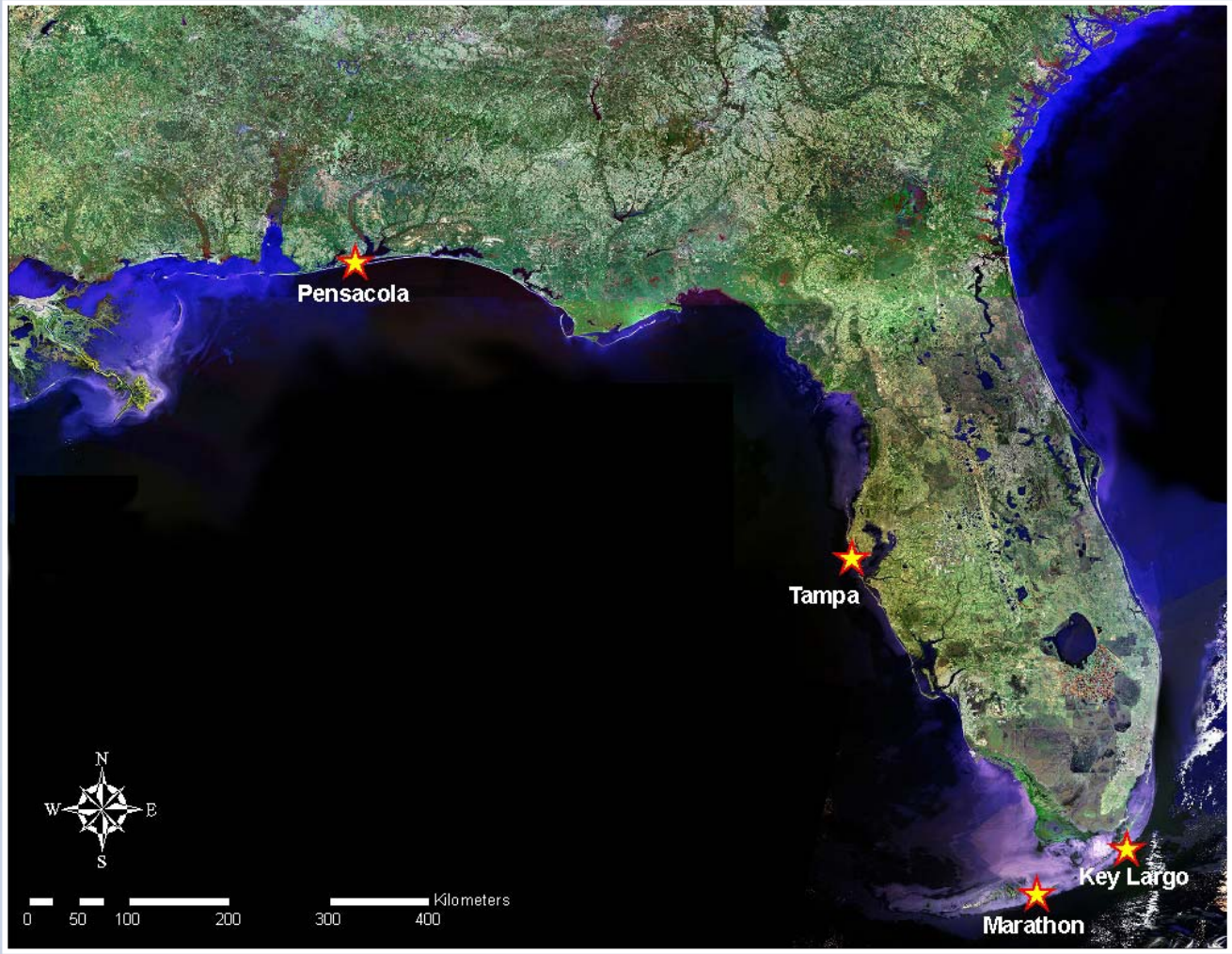


Google Earth Incorporates NOAA Post-Katrina Imagery





Experimental Advance Airborne Research Lidar (EAARL)



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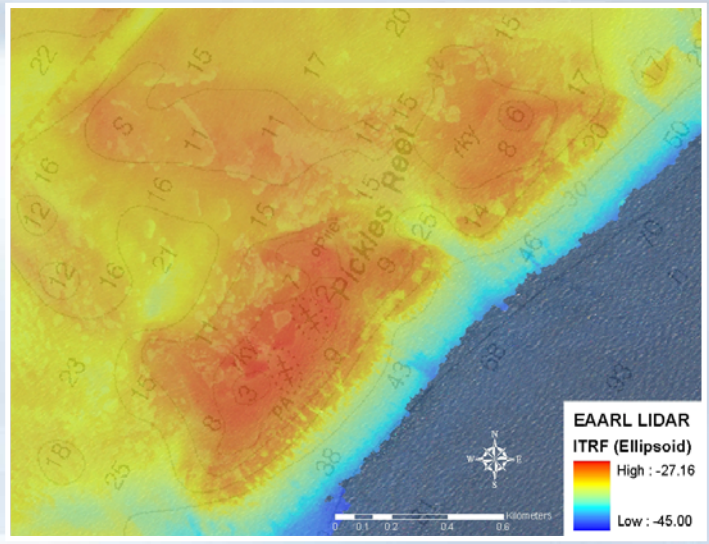
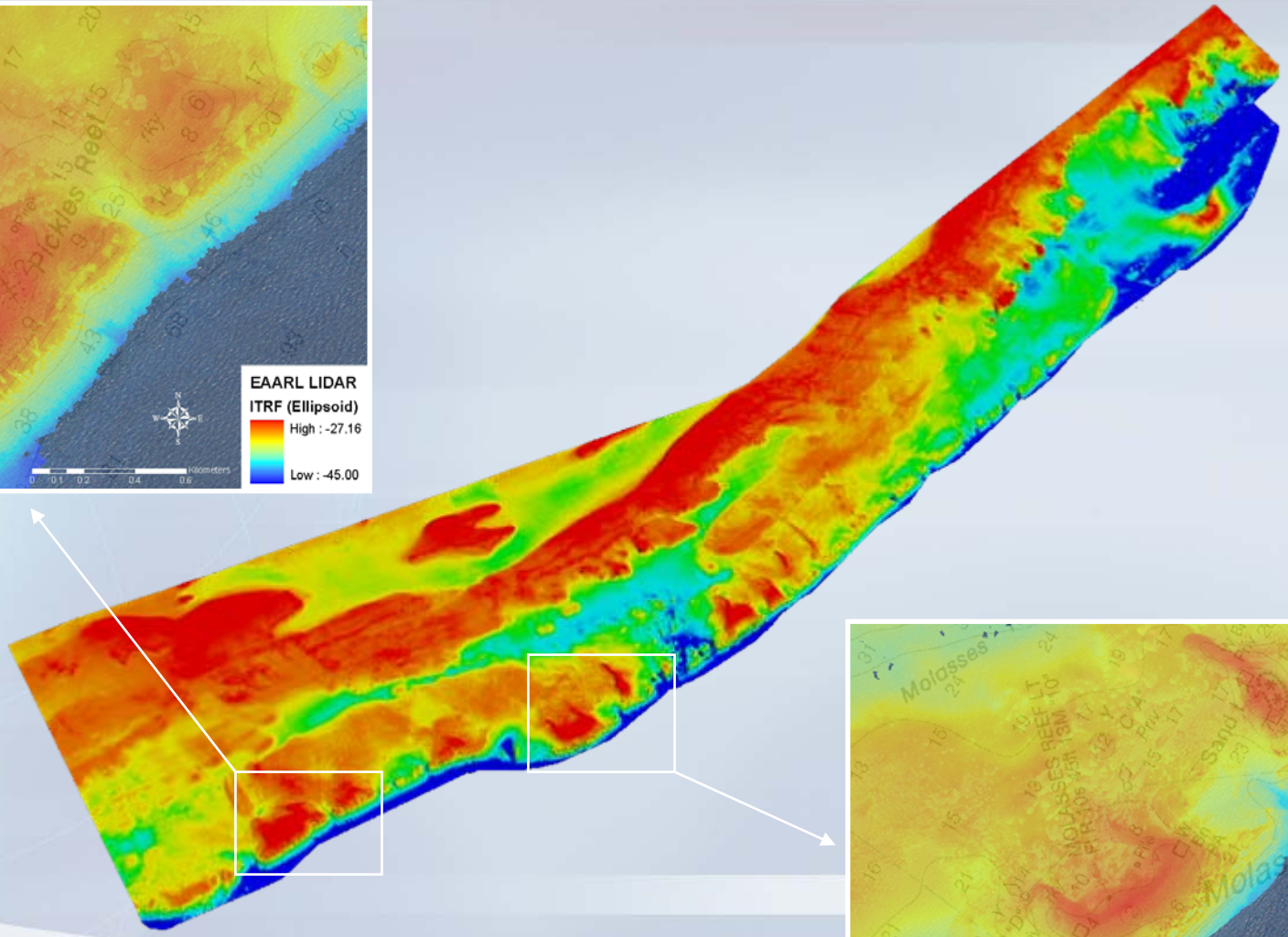
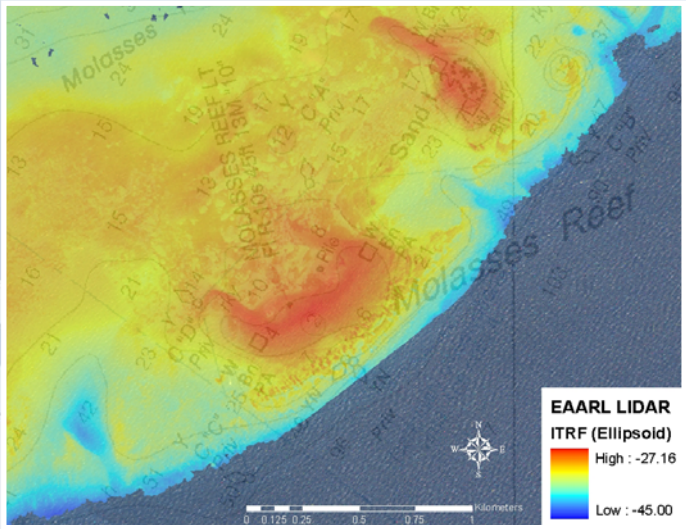
The EAARL Project: Objectives

- **Evaluate the NASA EAARL for NOAA National Ocean Service (NOS) mapping programs:**
  - **Capability to update coastal shallow water bathymetry (nautical charting) and topography**
  - **Capability for benthic habitat mapping**
  - **Capability to utilize for ecosystem protection and monitoring**
  - **Capability for rapid response navigation and post-disaster damage assessment projects**
  - **Capability for updating the national shoreline**

The EAARL Project: Florida Keys







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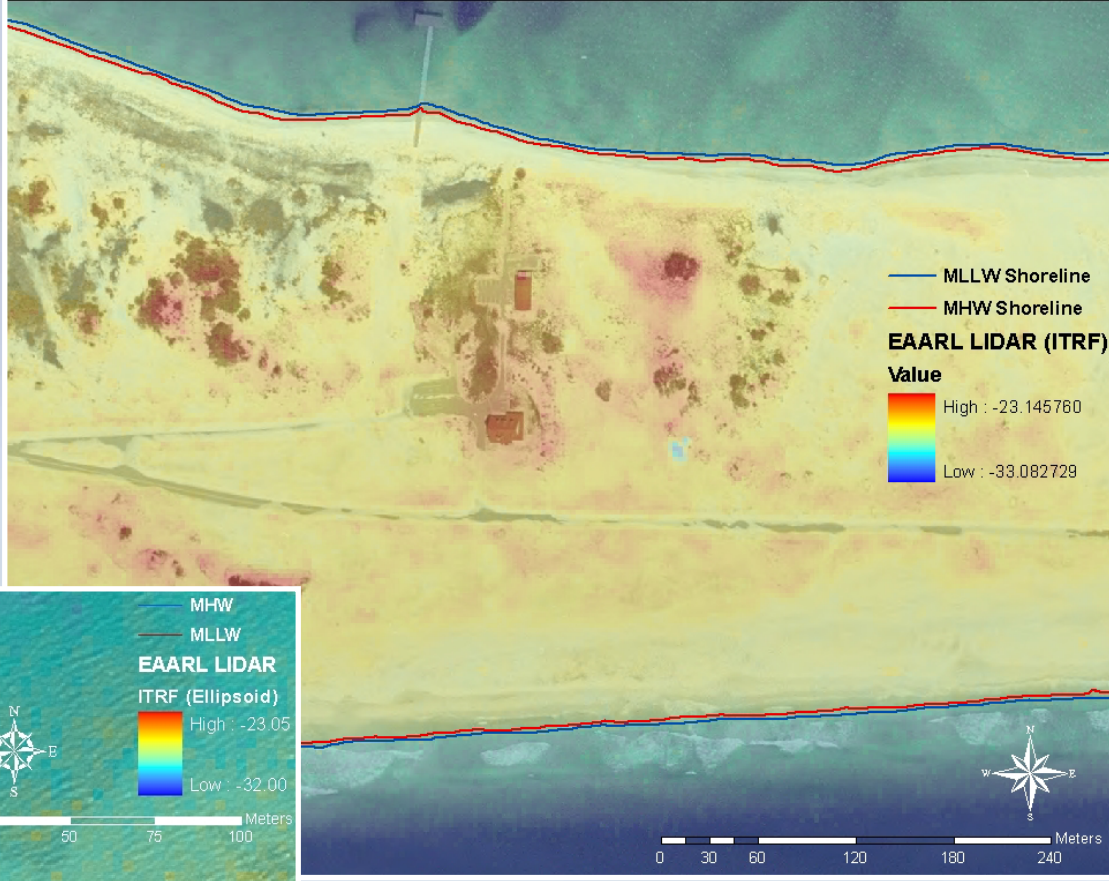
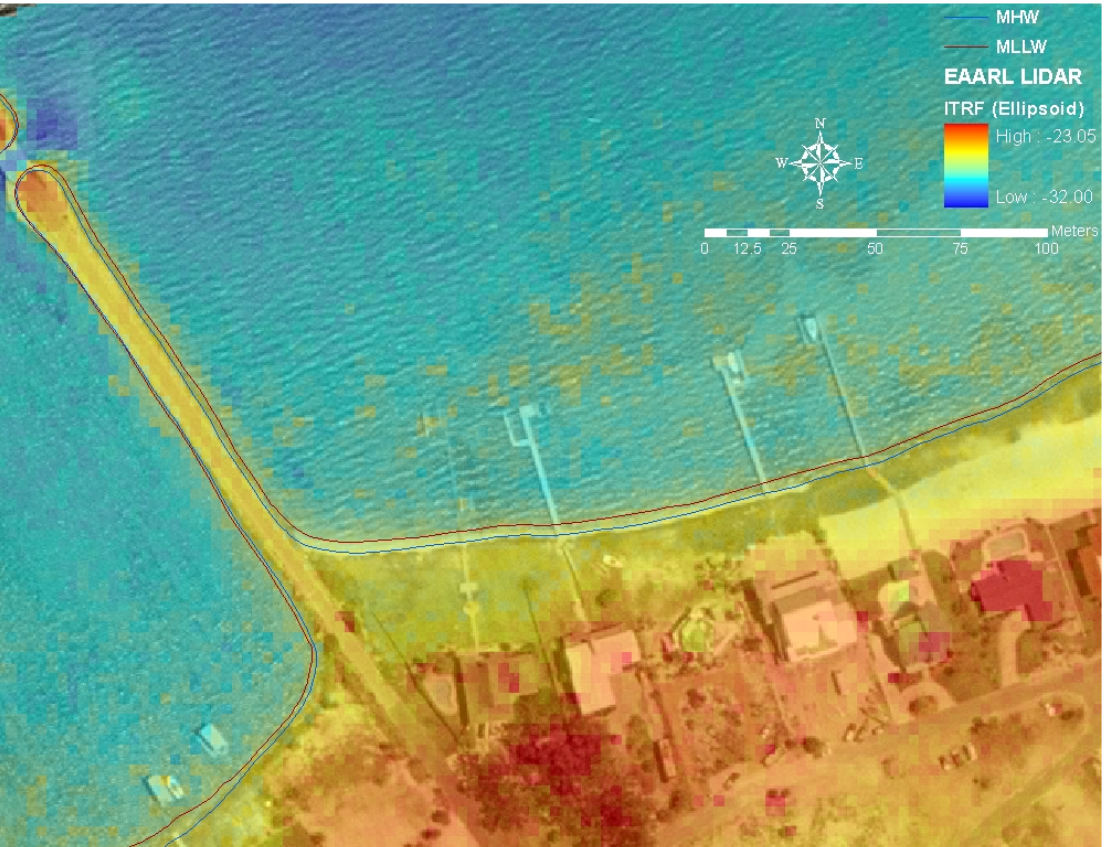
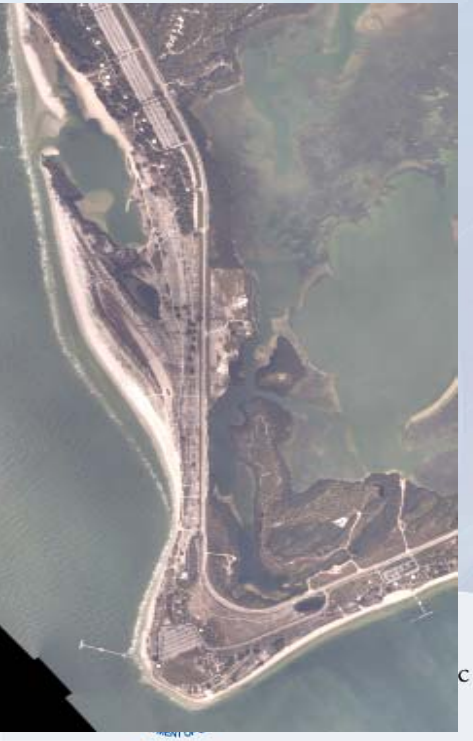
The EAARL Project: Shoreline Extraction (Pensacola)

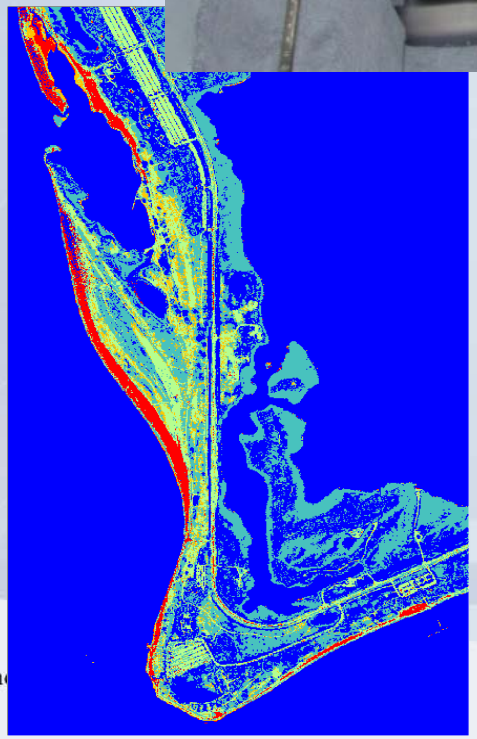




Sensor Fusion Research



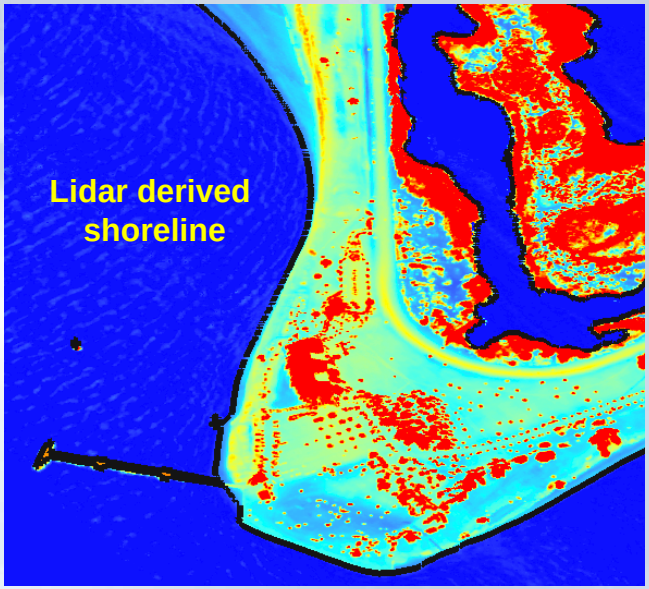
Digital Photography

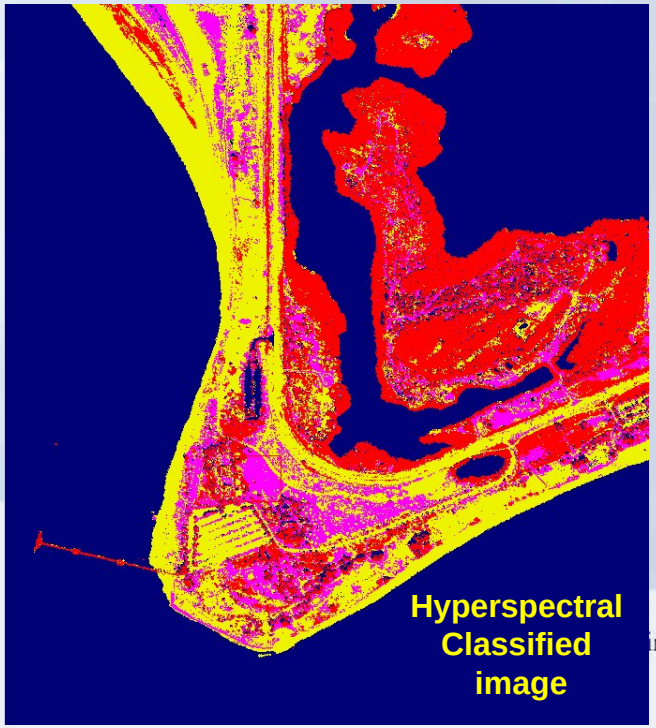


Hyperspectral

Topographic Lidar

Shoreline Extraction and Feature Attribution





Feature attributed lidar-derived shoreline superimposed on an orthorectified image

inistration