ICCE 2018
36TH INTERNATIONAL CONFERENCE ON COASTAL ENGINEERING 2018
Baltimore, Maryland | July 30 – August 3, 2018
The State of the Art and Science of Coastal Engineering

National Geodetic Survey Positioning America for the Future geodesy.noaa.gov

Replacing NAVD88: Effects Of Vertical Datum Modernization On Coastal Engineering

Nicole Kinsman, Alaska Geodetic Advisor, Ph.D.

NOAA National Geodetic Survey




Importance of Vertical Datums to Coastal Engineering (in pictures)

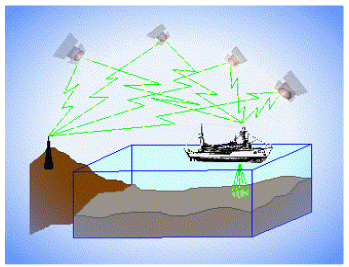
Container barge in Bergum, Netherlands (C. Fries, 2011)

Allure of the Seas passes under the Store Belt Bridge, Denmark (October, 201

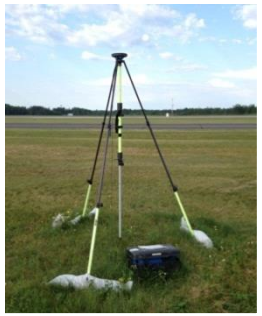
Tianjin passes under the Talmadge Bridge, Georgia (Steve Bisson, 201

3 Categories of Vertical Datums

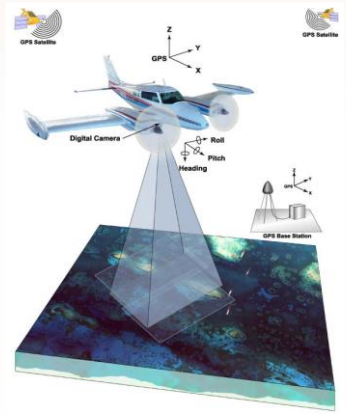
Ellipsoidal



Raw Hydrographic Surveys vertically referenced with RTK-GPS

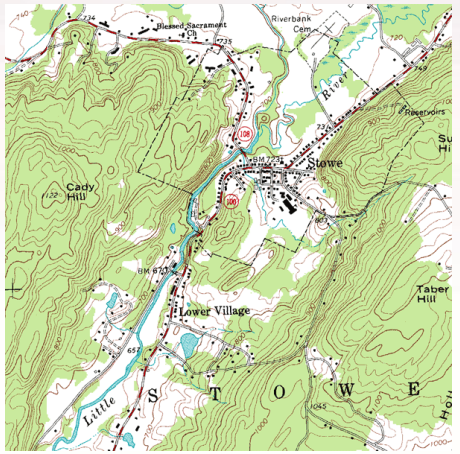


Native GPS measurements

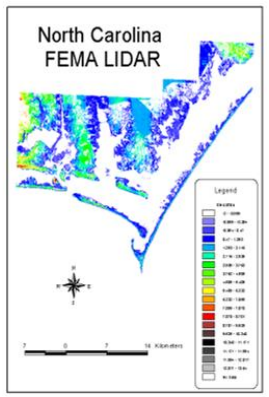


Raw Lidar

Orthometric



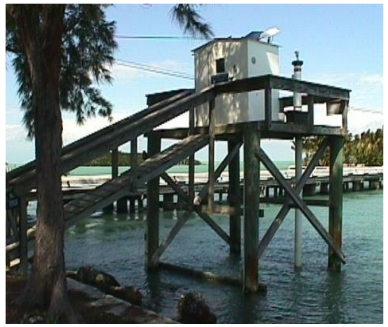
USGS Topography



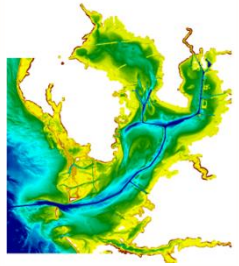
FEMA Flood Insurance Rate Maps

Engineering and Development Site Surveys

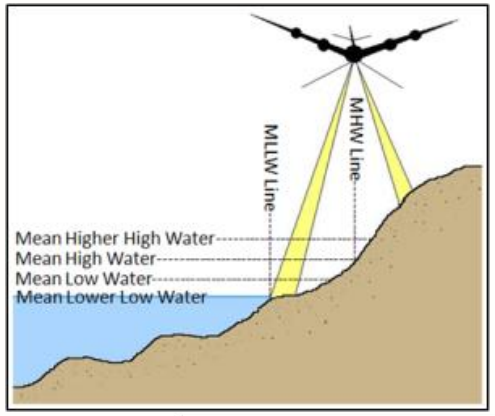
Tidal



Daily and Extreme Water Levels



NOAA Bathymetry (MLLW)



Shoreline Mapping (MHW) and Regulatory Boundaries at the Coast

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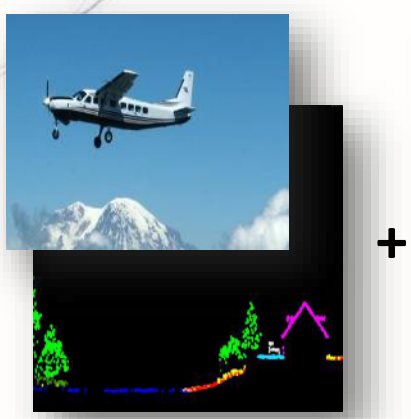
The National Spatial Reference System (NSRS)

A **common** and **consistent** geospatial framework to meet the economic, social, and environmental positioning needs of our Nation.

Foundational elements include:

Latitude • Longitude •
Elevation • Gravity •
Shoreline Position
+ changes over time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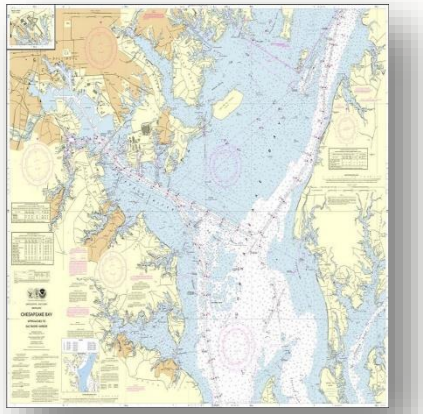
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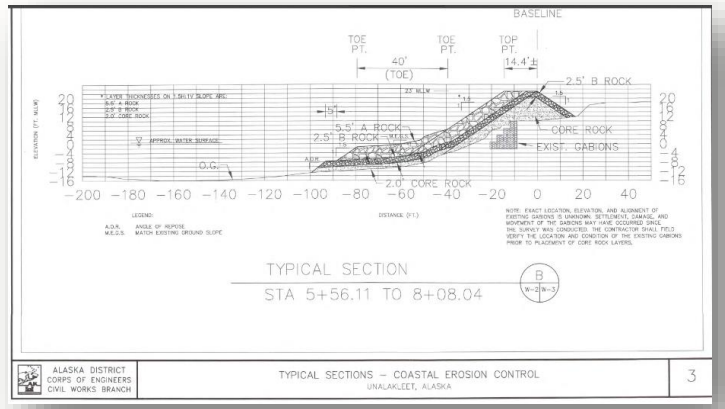
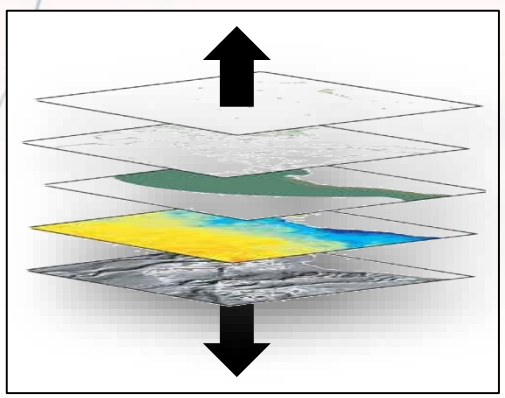


Reliable design heights require data from disparate sources and dates be consistently aligned

NSRS Considerations – The 4 C's

Requirements

CONSISTENCY



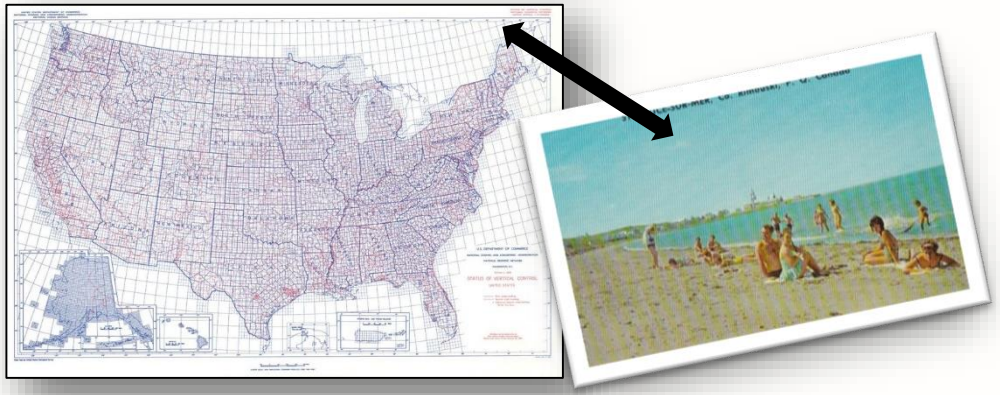
CONVENIENCE

Expectations

Semi-CONSTANT Coordinates

stamped with elevation

COHERENCE with Sea Level



The NSRS of Today *(simplified)*

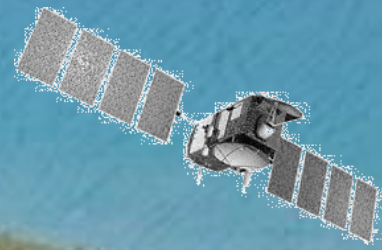
Primary elements:

- Horizontal North American Datum of 1983 - **NAD 83(2011)** coordinates
- Vertical North American Vertical Datum of 1988 - **NAVD88** orthometric heights

These elements are **geodetic datums** that define the shape and size of the earth to enable precise positioning

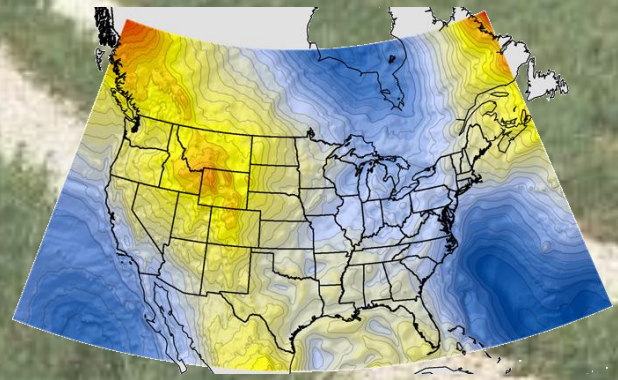
System based on connections to published passive control

NGS Supports Access to NAVD88 Heights



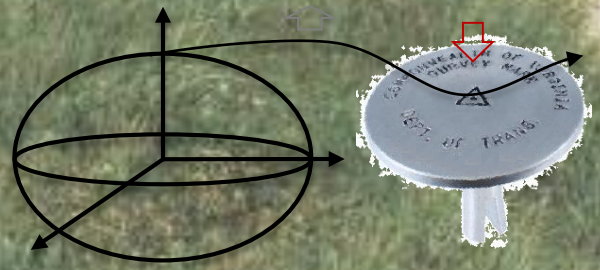
official path

GEOID12B

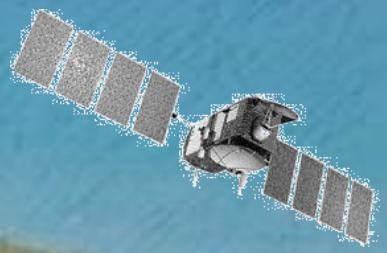


The NGS Data Sheet

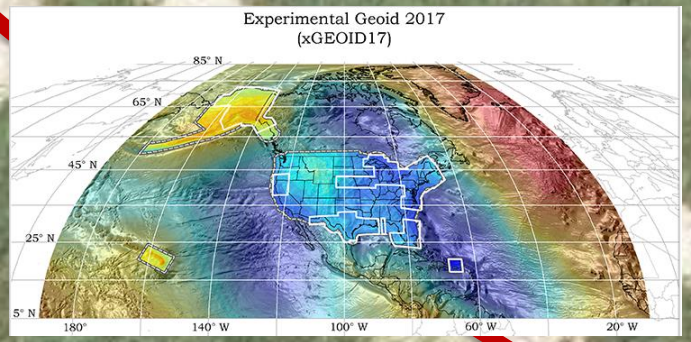
```
PROGRAM = datasheet95, VERSION = 8.12.3
1                National Geodetic Survey,   Retrieval Date = SEPTEMBER 27, 2017
CJ0146 ***********************************************************************
CJ0146  TIDAL BM    -  This is a Tidal Bench Mark.
CJ0146  DESIGNATION -  JOHNSON
CJ0146  PID         -  CJ0146
CJ0146  STATE/COUNTY-  SC/CHARLESTON
CJ0146  COUNTRY     -  US
CJ0146  USGS QUAD   -  CHARLESTON (1983)
CJ0146
CJ0146                         *CURRENT SURVEY CONTROL
CJ0146 ______________________________________________________________________
CJ0146* NAD 83(2001) POSITION- 32 45 05.94606(N) 079 53 51.69504(W)    ADJUSTED
CJ0146* NAVD 88 ORTHO HEIGHT -      2.446 (meters)          8.02  (feet) ADJUSTED
CJ0146 ______________________________________________________________________
CJ0146  GEOID HEIGHT    -        -33.300 (meters)                       GEOID12B
CJ0146  LAPLACE CORR    -         -3.01  (seconds)                      DEFLEC12B
CJ0146  DYNAMIC HEIGHT  -          2.443 (meters)          8.02  (feet) COMP
CJ0146  MODELED GRAVITY -    979,535.3   (mgal)                         NAVD 88
CJ0146
CJ0146  HORZ ORDER      - THIRD
CJ0146  VERT ORDER      - FIRST     CLASS I
CJ0146
CJ0146.The horizontal coordinates were established by classical geodetic methods
CJ0146.and adjusted by the National Geodetic Survey in March 2004.
CJ0146
CJ0146.The orthometric height was determined by differential leveling and
CJ0146.adjusted by the NATIONAL GEODETIC SURVEY
CJ0146.in June 1991.
CJ0146
CJ0146.Significant digits in the geoid height do not necessarily reflect accuracy.
CJ0146.GEOID12B height accuracy estimate available here.
CJ0146
CJ0146.This Tidal Bench Mark is designated as VM 4219
CJ0146.by the CENTER FOR OPERATIONAL OCEANOGRAPHIC PRODUCTS AND SERVICES.
CJ0146
CJ0146.The Laplace correction was computed from DEFLEC12B derived deflections.
CJ0146
CJ0146.The dynamic height is computed by dividing the NAVD 88
```

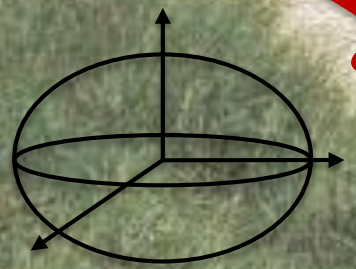


NGS Will Support Access to the NSRS of the Future



GEOID 2022





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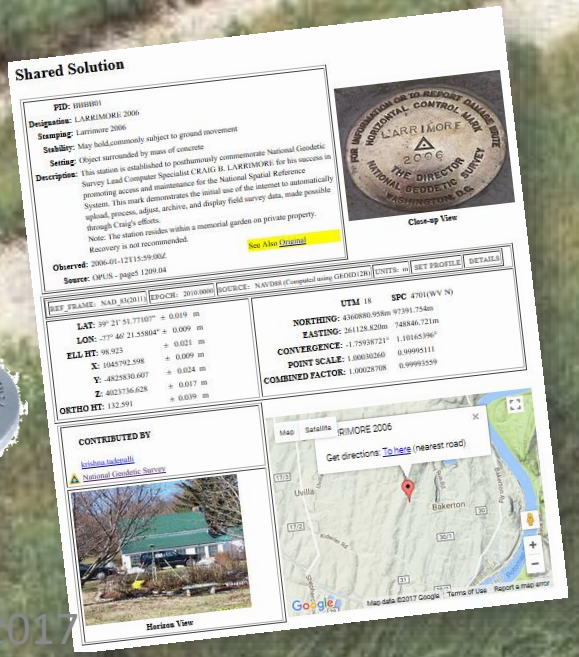

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The North American-Pacific Geopotential Datum of 2022 (NAPGD2022):

- Time-dependent and geocentric
- Defined by relationships to a global/international ideal frame
- Primarily accessed via GPS technology and a newly refined semi-dynamic geoid model

Benefits:

remove nationwide tilt

UAS/UAV support

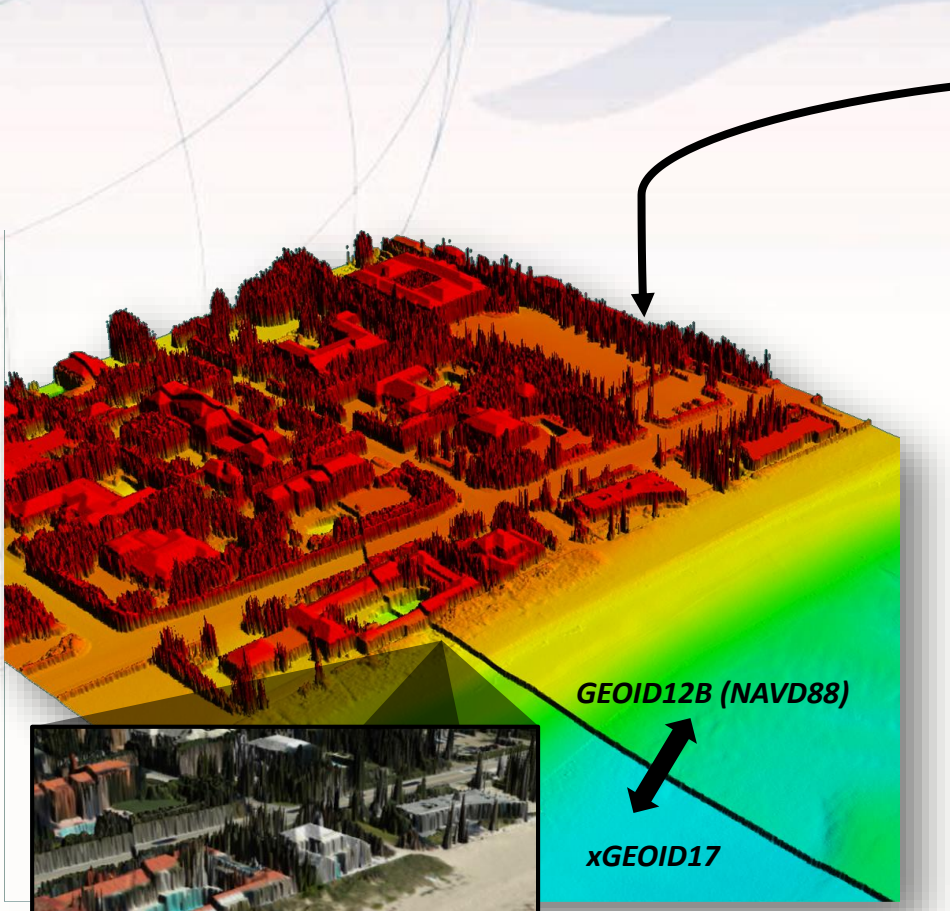
improved subsidence/uplift monitoring

international alignment

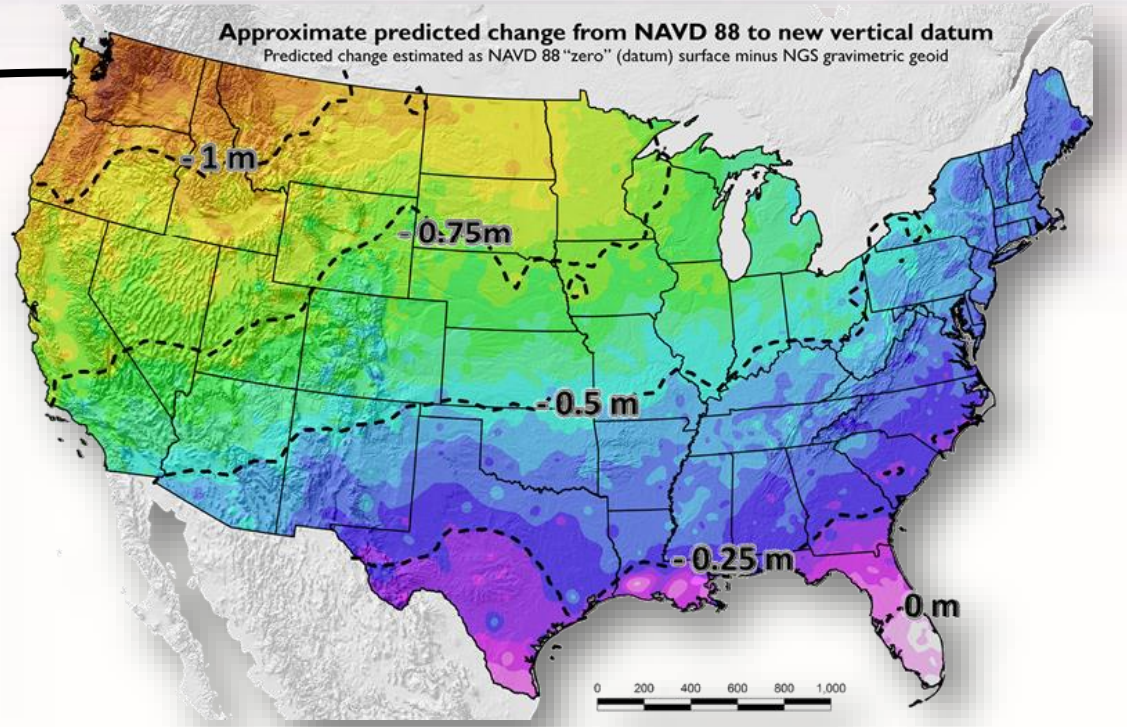
NSRS access in remote areas

improved tidal/geodetic ties

NSRS Modernization: Vertical Change



Vertical offset of more than 1 meter



Updates available online from the **New Datums** website and **Modernization News**

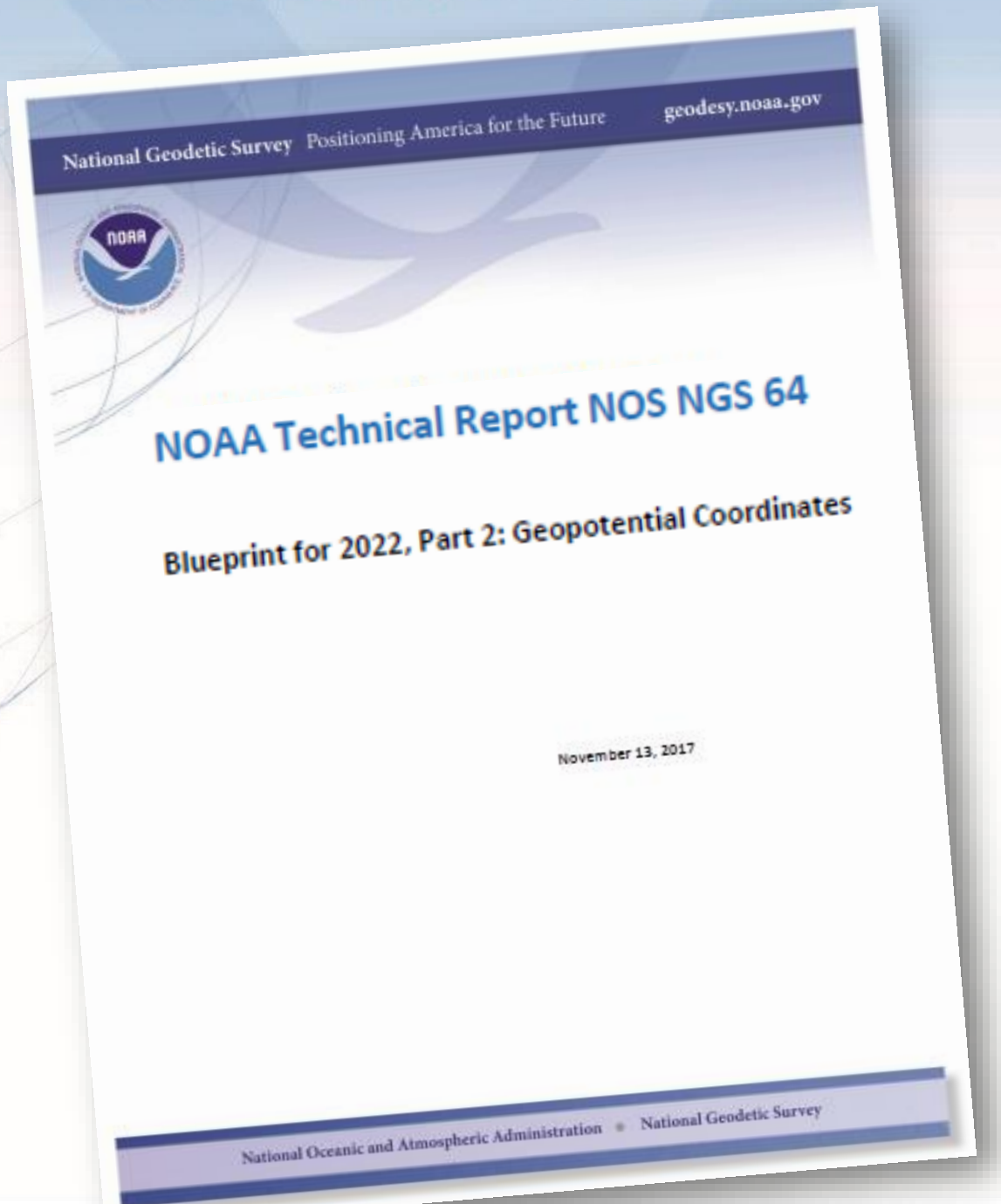
https://geodesy.noaa.gov/datums/newdatums/index.shtml

Continued Role of Passive Control

Calibration sites for GNSS technology, Real Time Network validation, and verification of datum transformation tool results.

Sites for **monitoring** motion to enhance velocity models (via repeat/campaign GNSS occupations)

Convenience for local project control, in areas with limited GNSS coverage (e.g. cities, forests), or in the event of GNSS failure (e.g. geomagnetic storms)



- Executive Summary
- An eloquent history of the role of leveling in 'Geodetic Control'
- Geoid Modeling 101
- Spherical Harmonics: *Gravitation, CF, and Gravity… oh my!*
- Does the geoid age well?
- Which comes first, the Sea Level or the GMSL W_0 value?
- The many parts of the Geopotential Datum of 2022: *Creation, Use, and Maintenance*

… GIVE IT A GLANCE!

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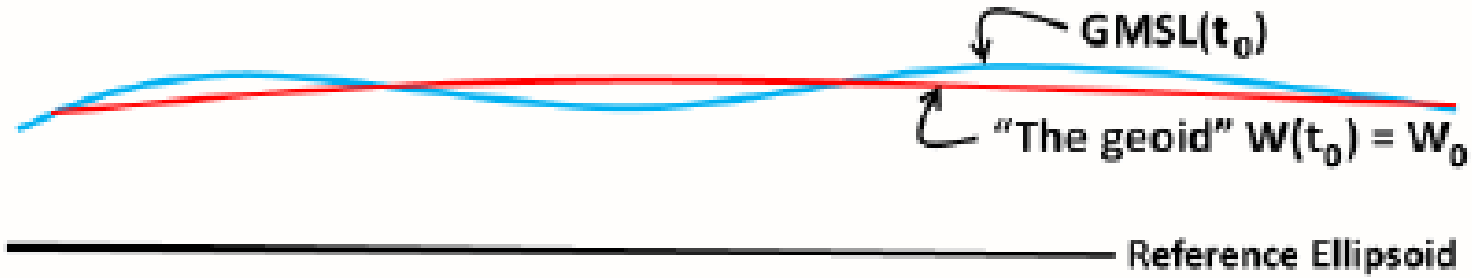
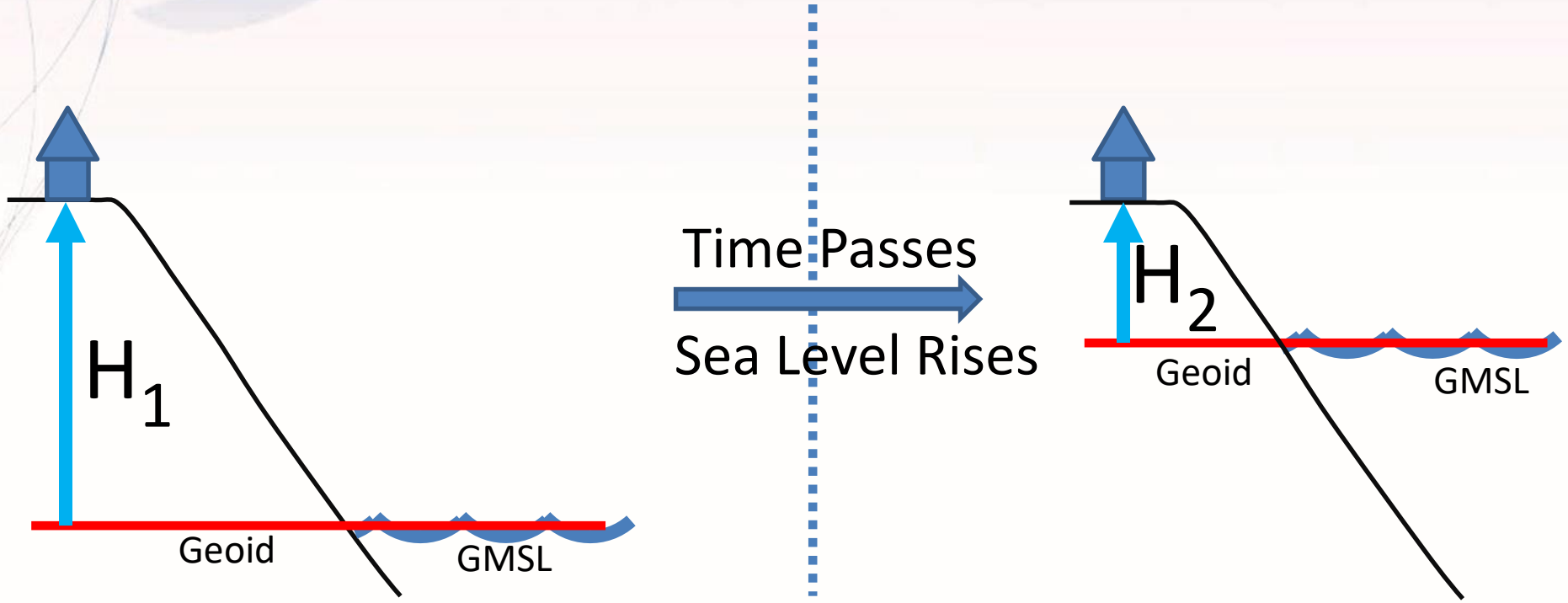
Sea Level and The Geoid

$T = t_0$



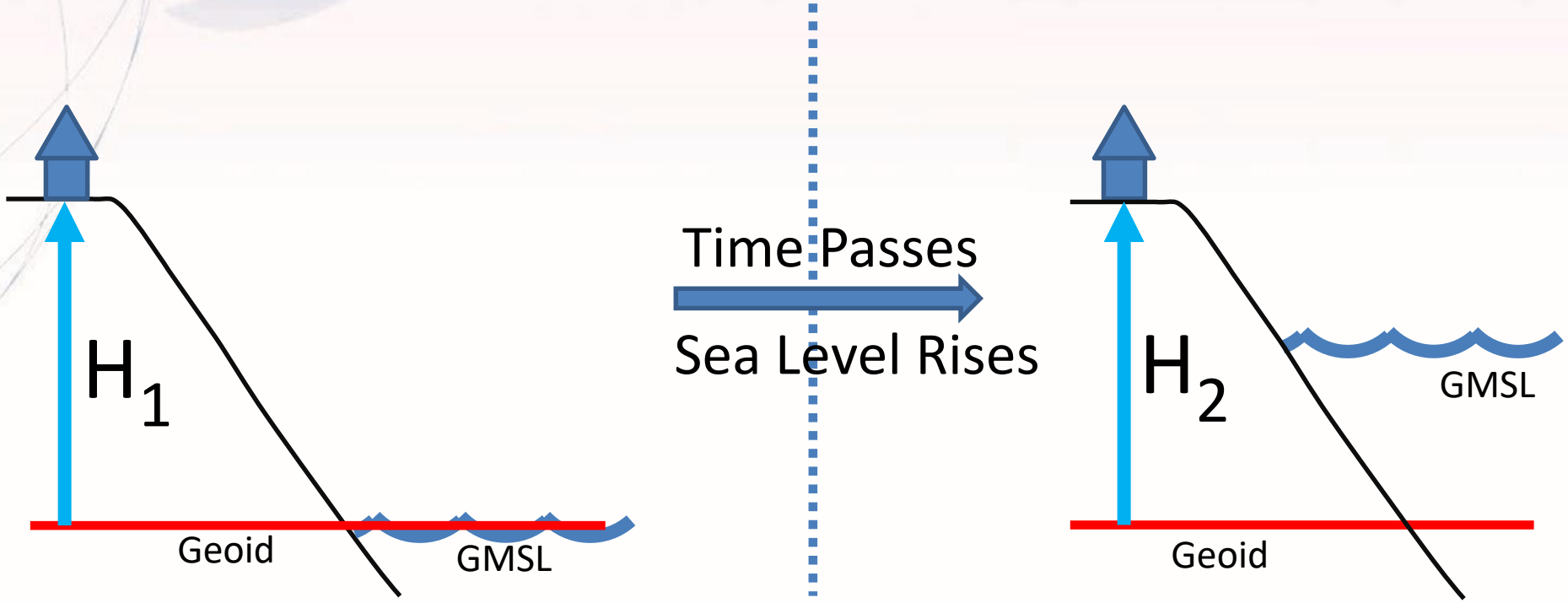
Standing definition of geoid:
The equipotential surface of the Earth's Gravity Field which best fits, in a least squares sense, global mean sea level.

Scenario 1: Geoid Definition remains tied to GMSL



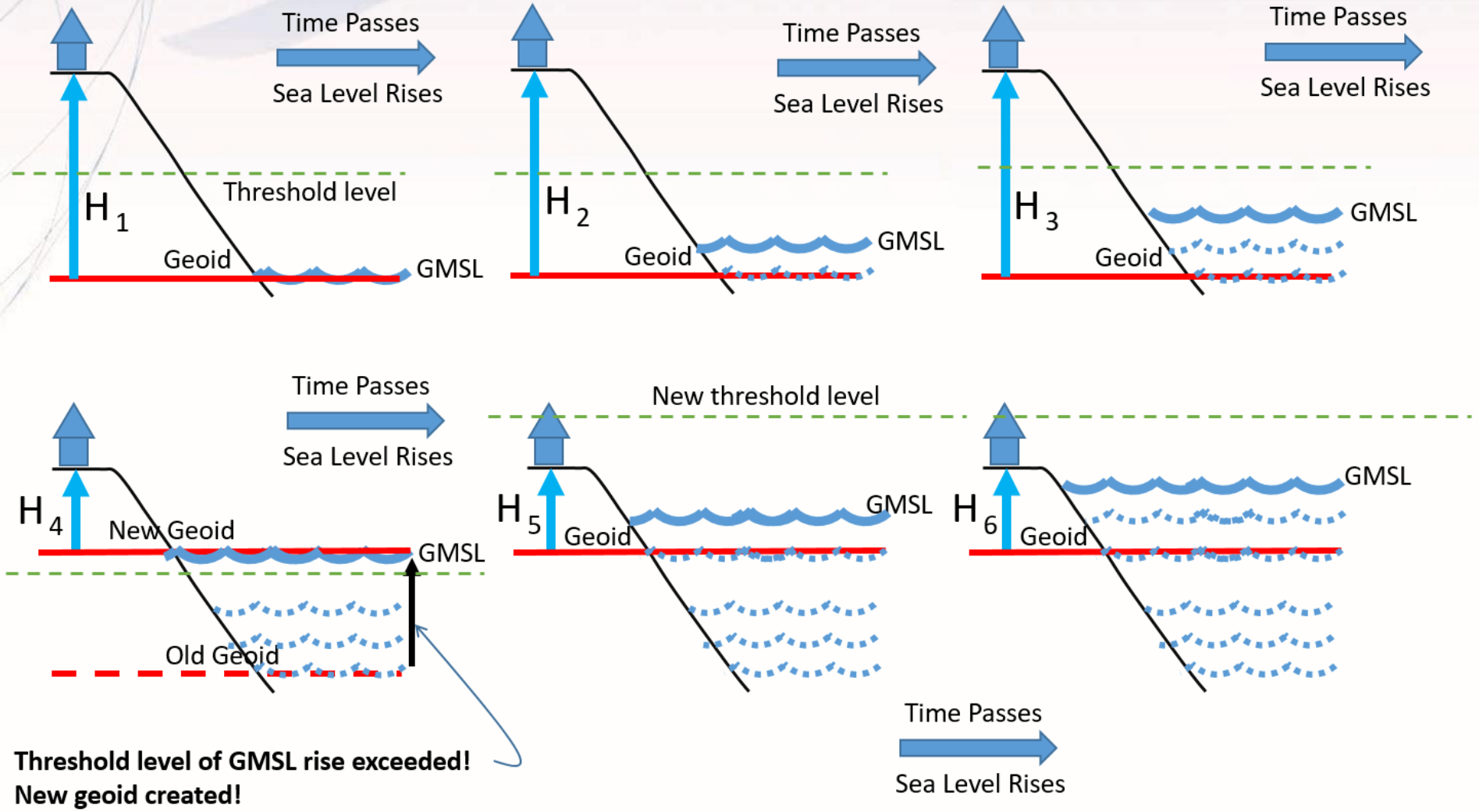
As Global Mean Sea Level rises, orthometric height gets smaller

Scenario 2: Geoid Definition decoupled from GMSL



As Global Mean Sea Level rises, orthometric height remains constant

The Threshold Compromise: Choosing a new geoid as GMSL changes



(Approximately 20cm of GMSL, or ~50-75 years)

What can you do?

Coordinate

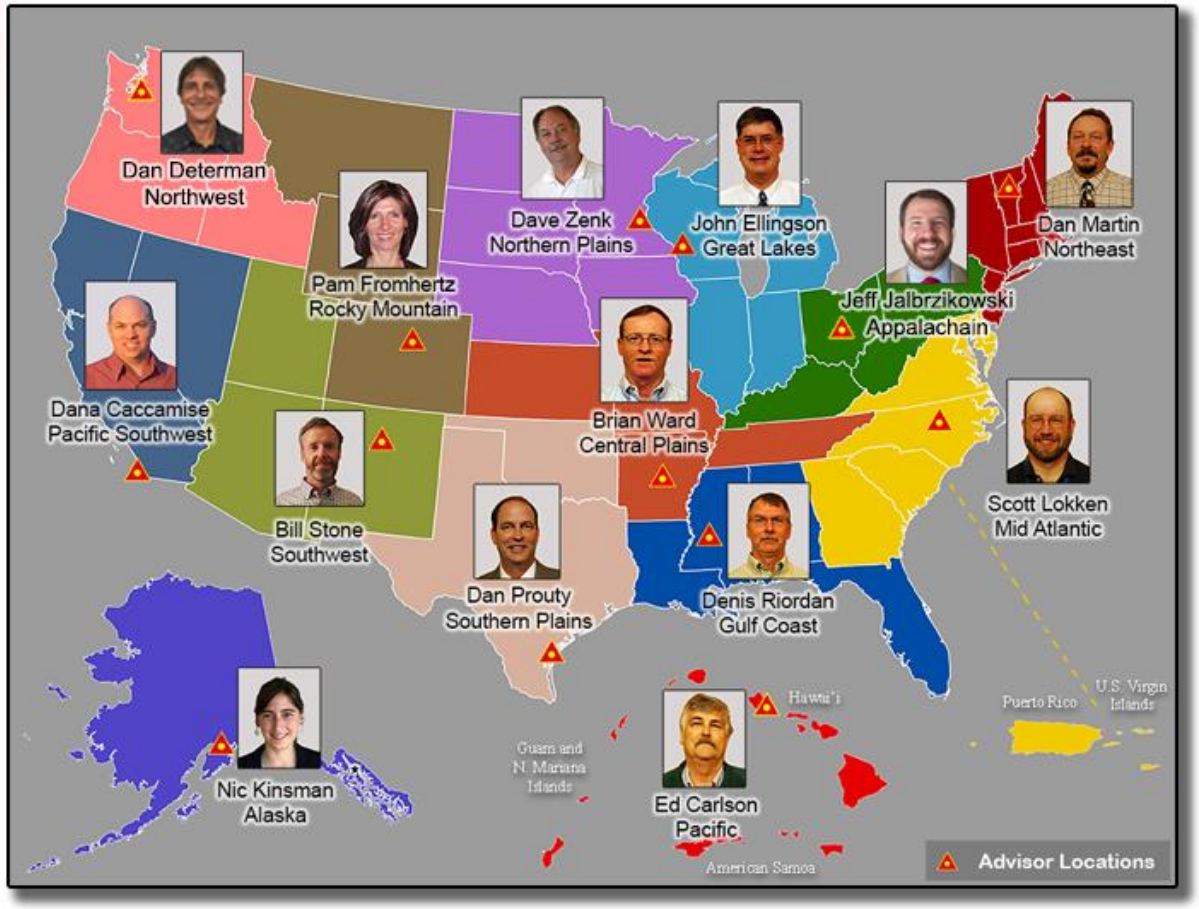
Spread the word and tell others about NSRS Modernization

Educate

Review materials and ask for support from NGS

Prepare

Lead by example and use best metadata practices



NGS Regional Advisor Program can provide customized guidance

Resources from geodesy.noaa.gov

National Geodetic Survey

Positioning America for the Future

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New Datums
- Home
- What to expect
- Get prepared
- Track our progress
- Naming Convention
- Watch videos
- Related projects
- Learn more
- New Datums FAQ
- Contact Us

Subscribe for email notifications

Events
- Industry Engagement
- 2017 Summit
- 2015 Summit
- 2010 Summit

New Datums: Replacing NAVD 88 and NAD 83

NAD 83 and NAVD 88 will be replaced in 2022, and there are many related projects to make sure the transition goes smoothly. Read the NGS Ten-Year Plan to learn more and continue to visit this web-page for more information.

What to Expect | Get Prepared

Track our Progress | Naming Convention

Watch Videos | Related Projects

Why is NGS replacing NAD 83 and NAVD 88?

NAD 83 and NAVD 88, although still the official horizontal and vertical datums of the National Spatial Reference System (NSRS), have been identified as having shortcomings that are best addressed through defining new horizontal and vertical datums.

Specifically, NAD 83 is non-geocentric by about 2.2 meters. Secondly, NAVD

Visit geodesy.noaa.gov & click icon below

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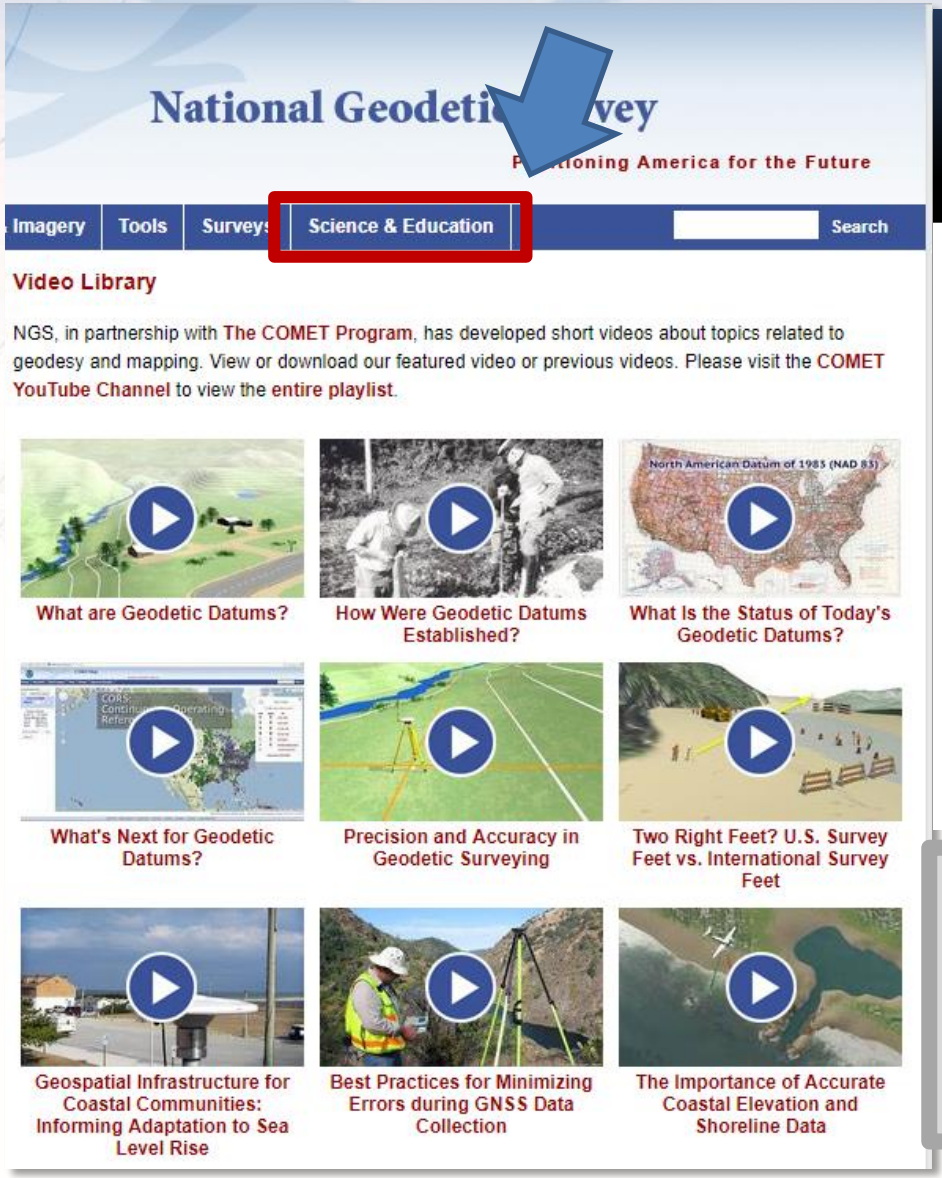
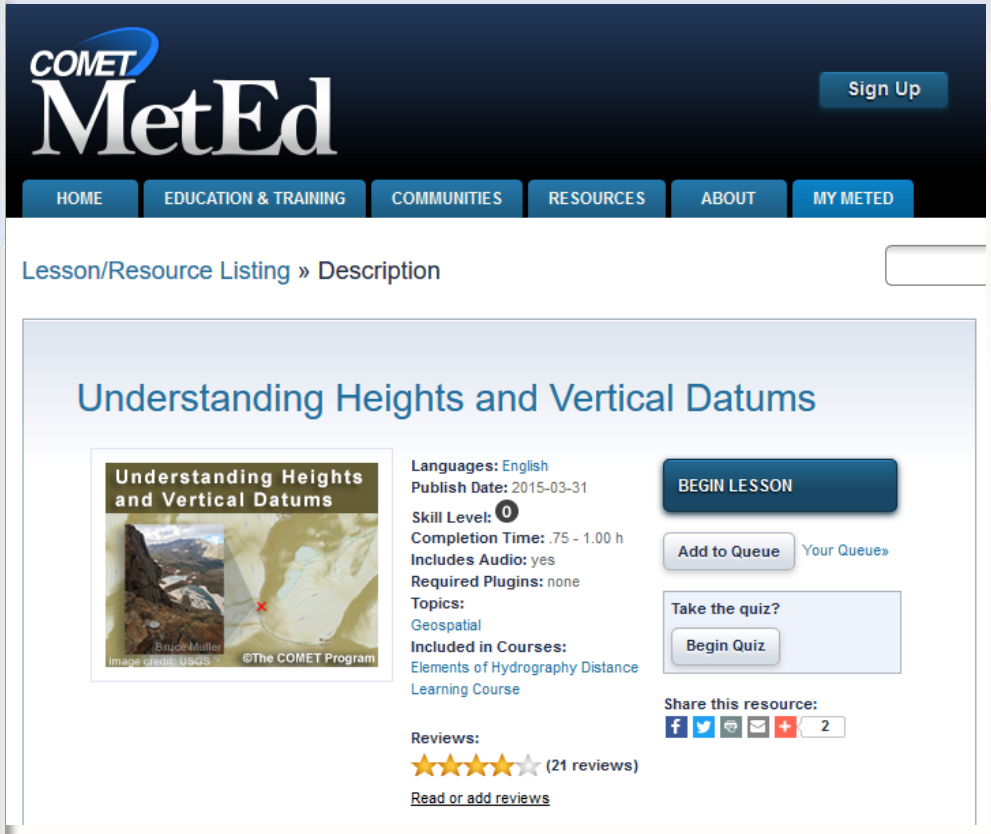
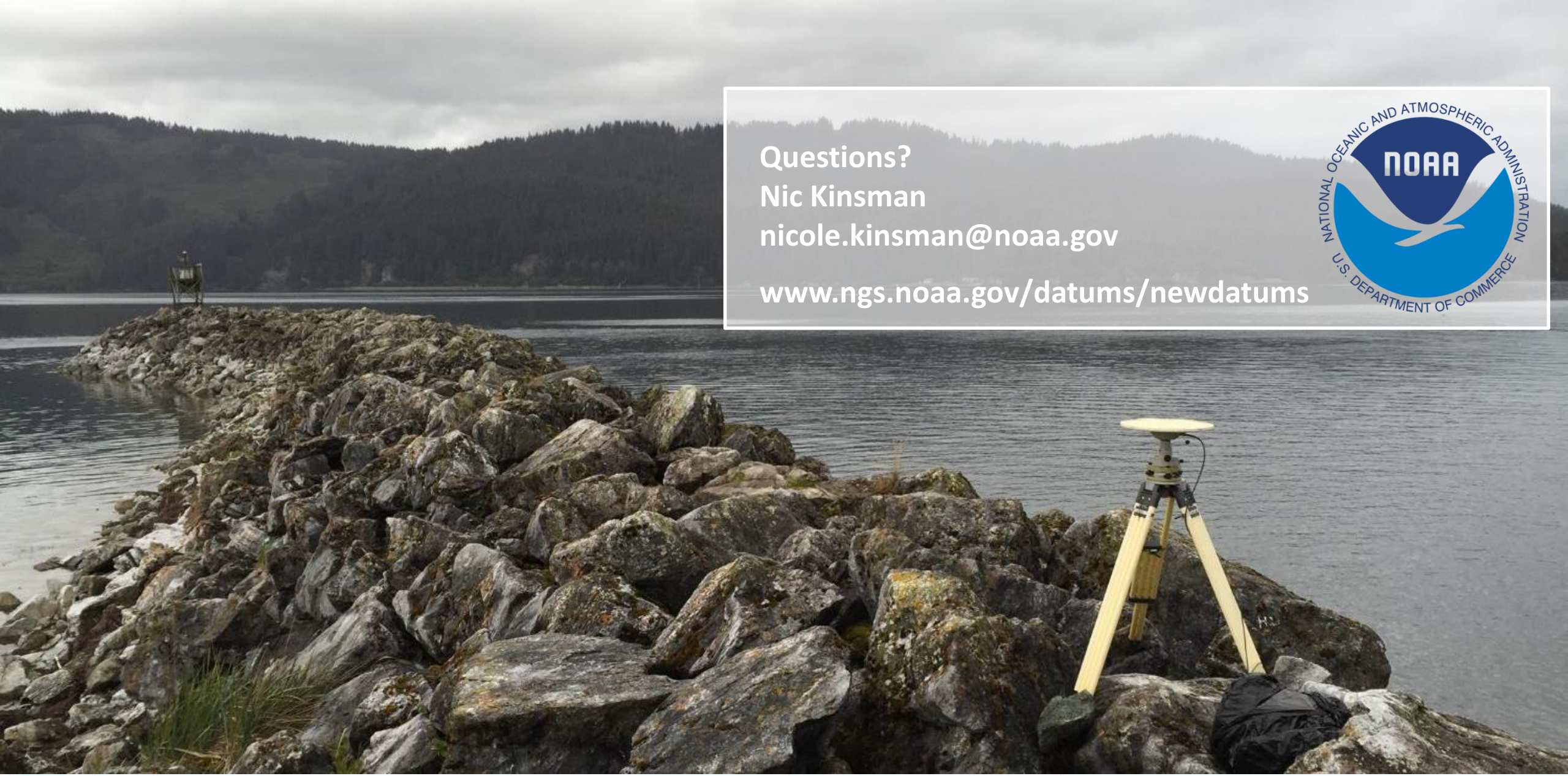
Educational Videos & Online Tutorials





Videos are ~3-5 minutes

Vertical Datums Tutorial is ~1 hour



Questions?
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nicole.kinsman@noaa.gov

www.ngs.noaa.gov/datums/newdatums




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