



The National Conference On Beach Preservation Technology

National Geodetic Survey Positioning America for the Future

geodesy.noaa.gov



Replacing NAVD88: Effects Of Vertical Datum Modernization On Coastal Engineering

Scott Lokken, Mid-Atlantic Geodetic Advisor

NOAA National Geodetic Survey





Allure of the Seas passes under the Store Belt Bridge, Denmark (October, 2010)

Importance of Vertical Datums to Coastal Engineering (in pictures)



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



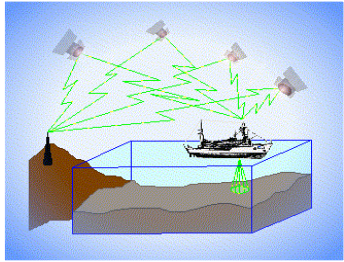
Tianjin passes under the Talmadge Bridge, Georgia (Steve Bisson, 2015)



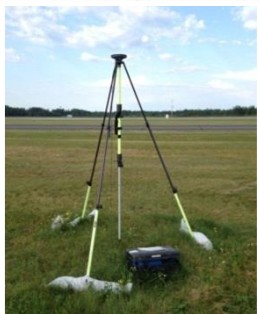


3 Categories of Vertical Datums

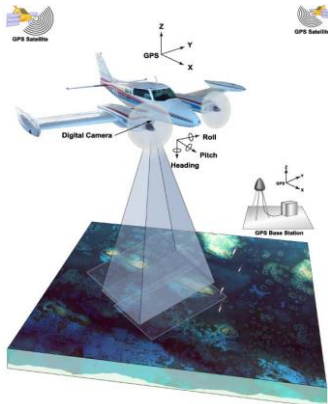
Ellipsoidal



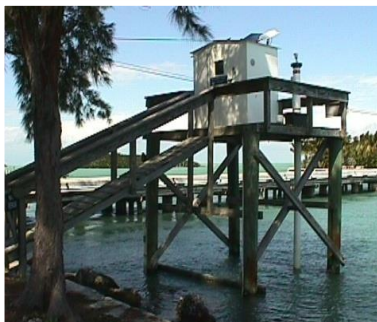
Raw Hydrographic Surveys vertically referenced with RTK-GPS



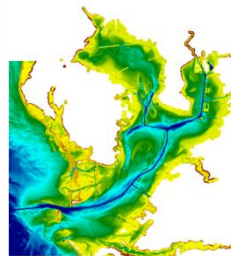
Native GPS measurements



Raw Lidar

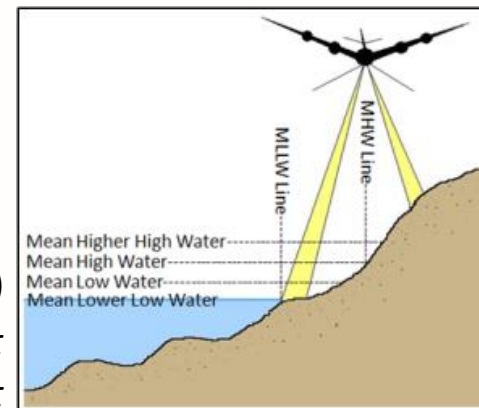


Daily and Extreme Water Levels



Tidal
NOAA Bathymetry (MLLW)

Shoreline Mapping (MHW) and Regulatory Boundaries at the Coast



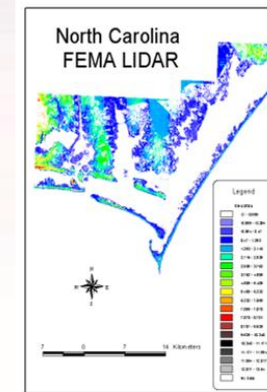
Orthometric



USGS Topography



Engineering and Development Site Surveys



FEMA Flood Insurance Rate Maps



The National Spatial Reference System (NSRS)

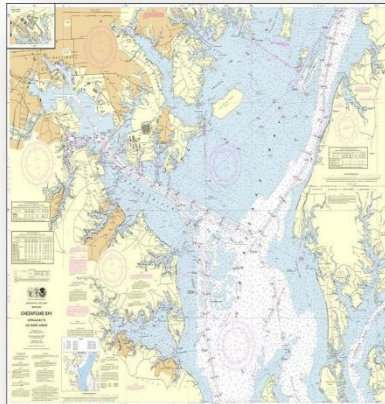
A **common** and **consistent** geospatial framework to meet the economic, social, and environmental positioning needs of our Nation.

Foundational elements include:

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



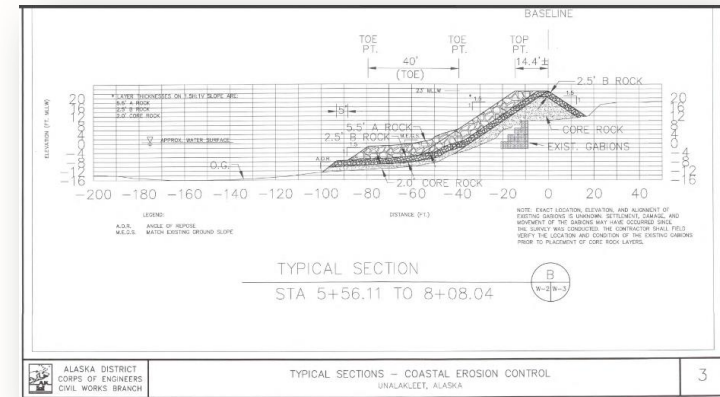
+



+



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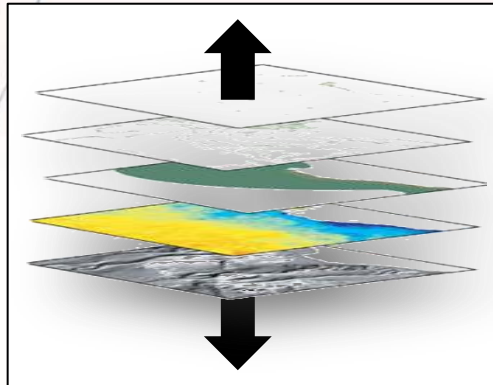
Reliable design heights require data from disparate sources and dates be consistently aligned



NSRS Considerations – The 4 C's

Requirements

CONSISTENCY



CONVENIENCE



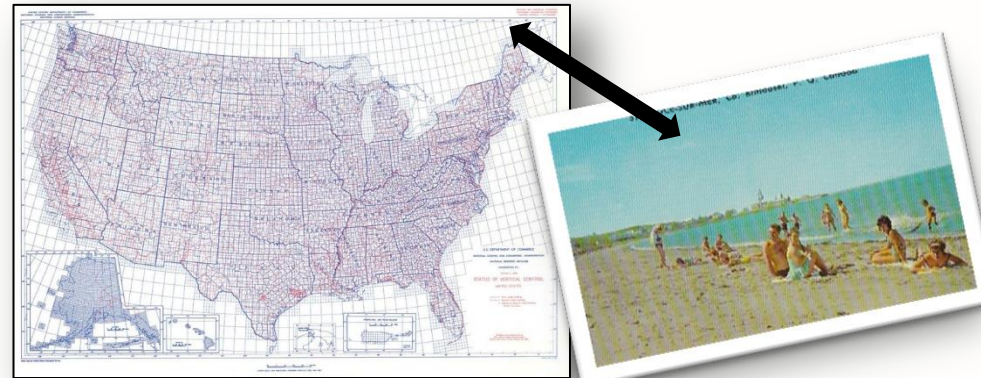
Expectations

Semi-CONSTANT Coordinates



stamped with elevation

COHERENCE with Sea Level





The NSRS of Today (*simplified*)

Primary elements:

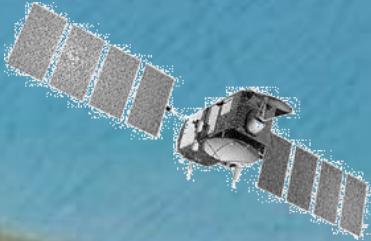
- Horizontal North American Datum of 1983 - **NAD 83(2011)** coordinates
- Vertical North American Vertical Datum of 1988 - **NAVD88** orthometric heights

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

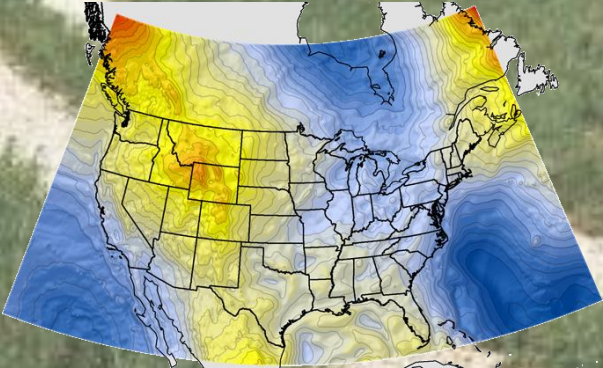


NGS Supports Access to NAVD88 Heights



official path

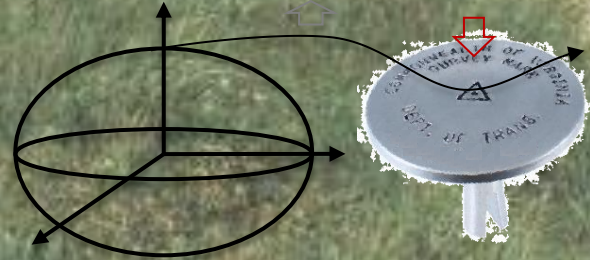
GEOID12B



The NGS Data Sheet

PROGRAM = databeet99, VERSION = 9.12.3
 1 National Geodetic Survey, Retrieval Date = SEPTEMBER 27, 2017

CJ0146 ***** This is a Tidal Bench Mark. *****
 CJ0146 TIDAL BM - JOHNSON
 CJ0146 DESIGNATION - CJ0146
 CJ0146 FID - SC/CHARLESTON
 CJ0146 STATE/COUNTY - US
 CJ0146 COUNTRY - CHARLESTON (1982)
 CJ0146 USGS QUAD -
 CJ0146 *****
 CJ0146 *CURRENT SURVEY CONTROL
 CJ0146 *****
 CJ0146 NAD 83(2011) 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 NAVD 88 ORTHO HEIGHT - -22.200 (meters) GEOID12B
 CJ0146 GEOID HEIGHT - -3.01 (seconds) DEFLEC12B
 CJ0146 LAPLACE CORR - 2.446 (meters) 8.02 (feet) COMP NAVD 88
 CJ0146 DYNAMIC HEIGHT - 979,535.3 (mgal)
 CJ0146 MODELED GRAVITY -
 CJ0146 *****
 CJ0146 HORIZ ORDER - THIRD CLASS I
 CJ0146 VERT ORDER - FIRST
 CJ0146 *****
 CJ0146 The horizontal coordinates were established by classical geodetic methods
 and adjusted by the National Geodetic Survey in March 2004.
 CJ0146 The orthometric height was determined by differential leveling and
 adjusted by the NATIONAL GEODETIC SURVEY
 in June 1991.
 CJ0146 Significant digits in the geoid height do not necessarily reflect accuracy.
 CJ0146 GEOID12B height accuracy estimate available here.
 CJ0146 This Tidal Bench Mark is designated as VM 4219
 by the CENTER FOR OPERATIONAL OCEANOGRAPHIC PRODUCTS AND SERVICES.
 CJ0146 The Laplace correction was computed from DEFLEC12B derived deflections.
 CJ0146 The dynamic height is computed by dividing the NAVD 88

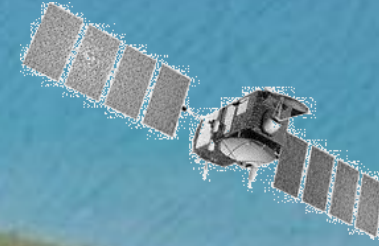


Beach Dr

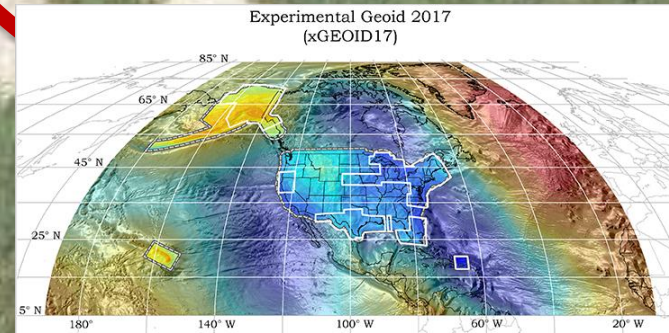
House Way



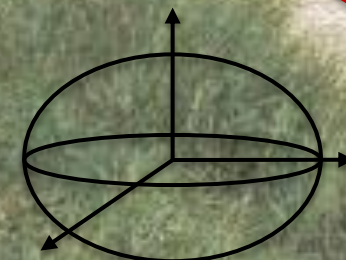
NGS Will Support Access to the NSRS of the Future



GEOID 2022



official path



Shared Solution

PID: BHBHBI
Designation: LARKIMOR1 2006
Seating: Larkimore 2006
Stability: May hold commonly subject to ground movement
Setting: Object surrounded by mass of concrete
Description: This station is established to permanently commemorate National Geodetic Survey Lead Computer Specialist CRAIG B. LARKIMOR1 for his success in promoting access and maintenance for the National Spatial Reference System. This mark demonstrates the total use of the internet to automatically upload, process, adjust, archive, and display field survey data, made possible through Craig's efforts.
Note: The station resides within a memorial garden on private property. Recovery is not recommended.
Observed: 2006-01-12T15:59:02Z
Source: OPUS - pages 1209.04

Click-up View

INDUSTRIAL USE-TO REPORT DAMAGE ONLY
LARKIMOR1
2006
THE DIRECTOR
NATIONAL GEODETIC SURVEY
WASHINGTON, DC

CONTRIBUTED BY
[Link to profile](#)
 National Geodetic Survey

Map **Satellite** **RIMORE 2006**
 Get directions [To here](#) (nearest road)
 Uvilla
 Bakerton
 Google
 Map data ©2017 Google
 Terms of Use
 Report a map error

Historic View



July 13, 2017

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House Way



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

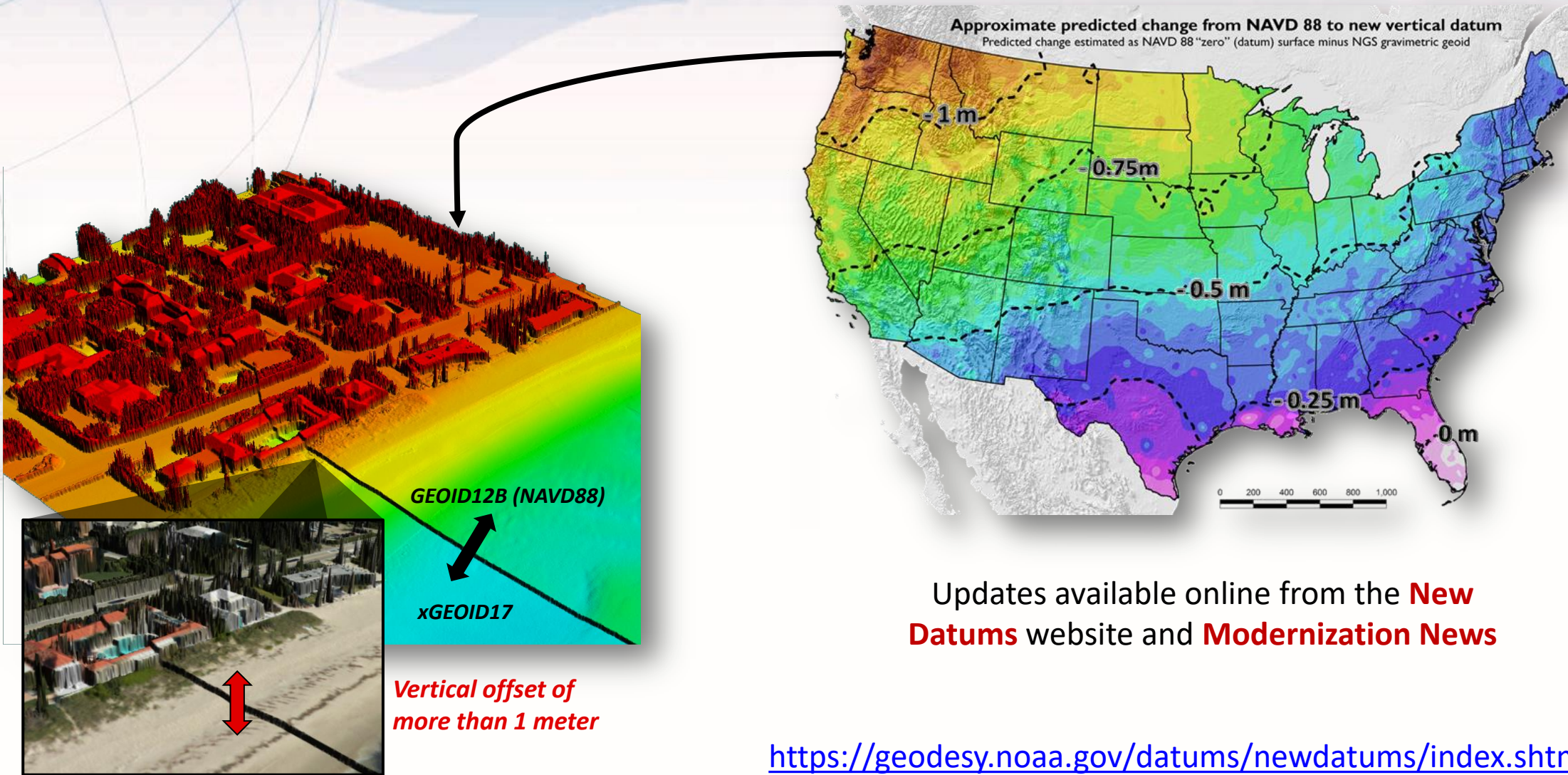
- Time-dependent and geocentric
- Defined by relationships to a global/international ideal frame
- Primarily accessed via GPS technology and a newly refined semi-dynamic geoid model

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



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

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

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House Way



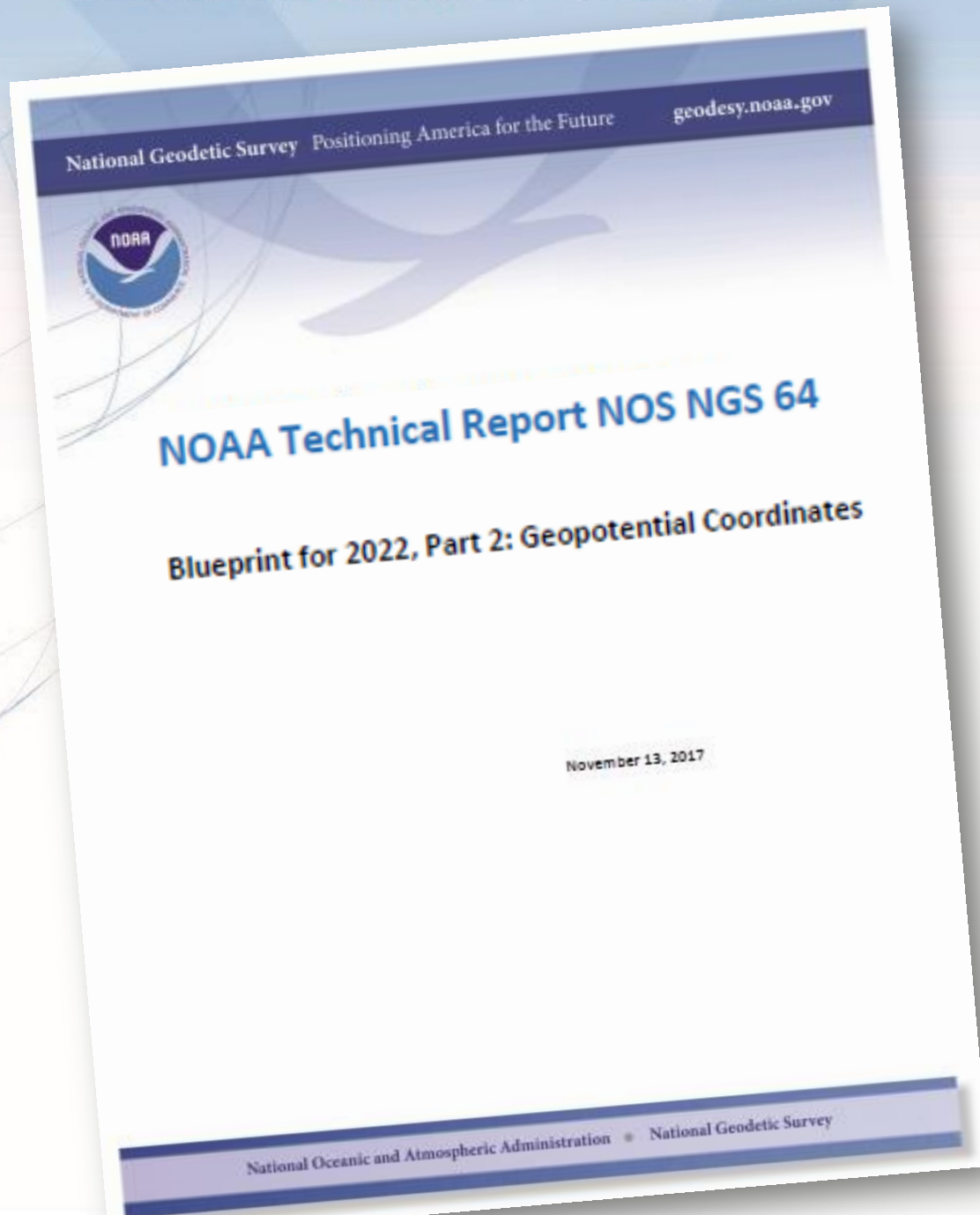
Continued Role of Passive Control



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)



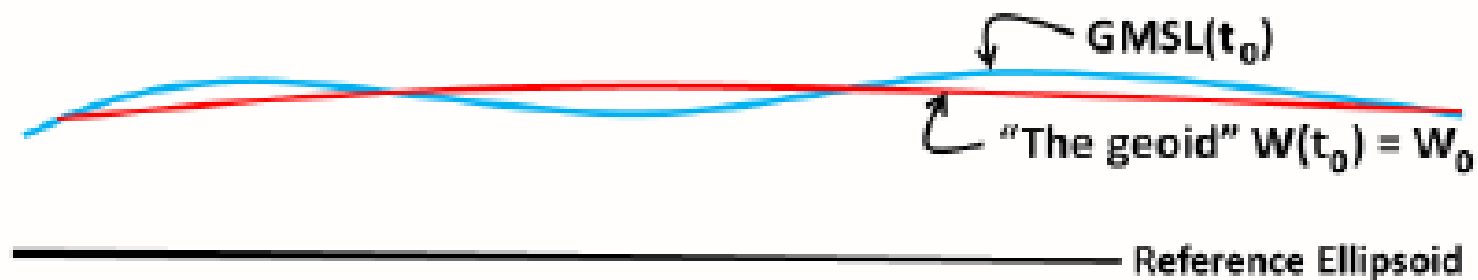
- Executive Summary
- An eloquent history of the role of leveling in 'Geodetic Control'
- Geoid Modeling 101
- Spherical Harmonics: *Gravitation, CF, and Gravity...*
- Does the geoid age well?
- Which comes first, the Sea Level or the GMSL W_0 value?
- The many parts of the Geopotential Datum of 2022: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

... GIVE IT A GLANCE!



Sea Level and The Geoid

$$T = t_0$$

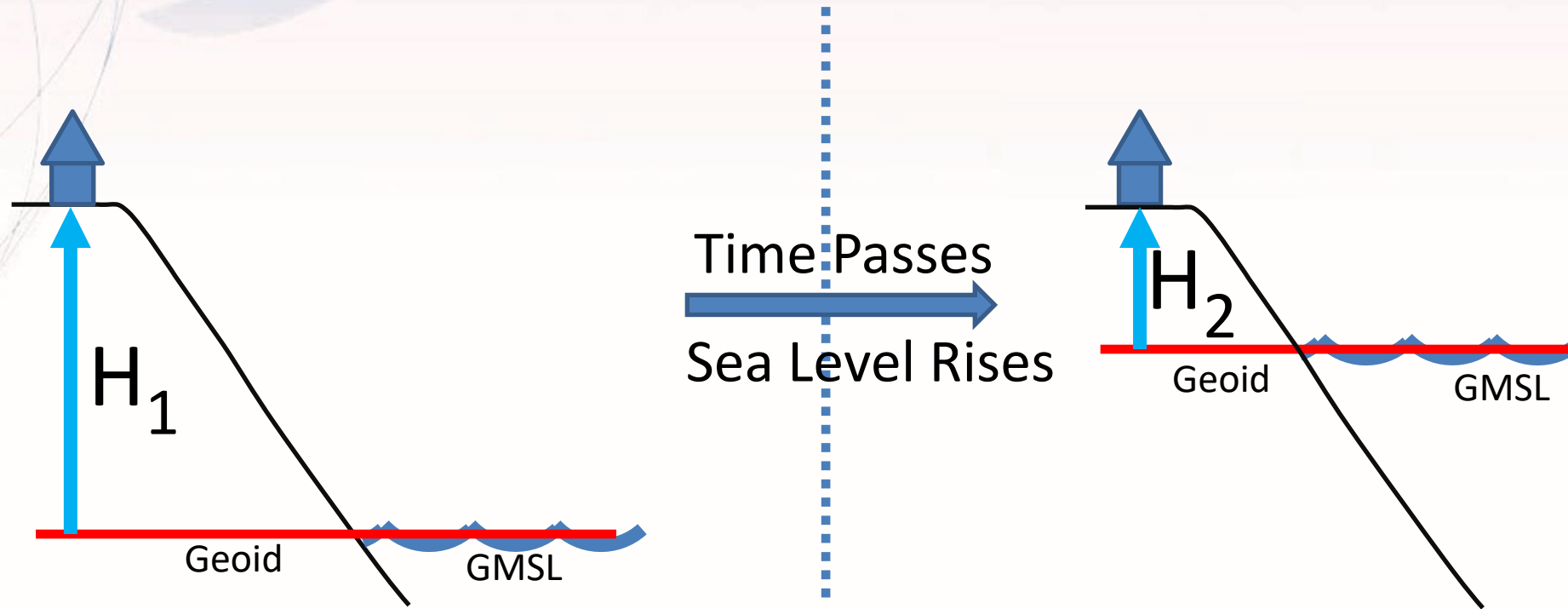


Standing definition of geoid:

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



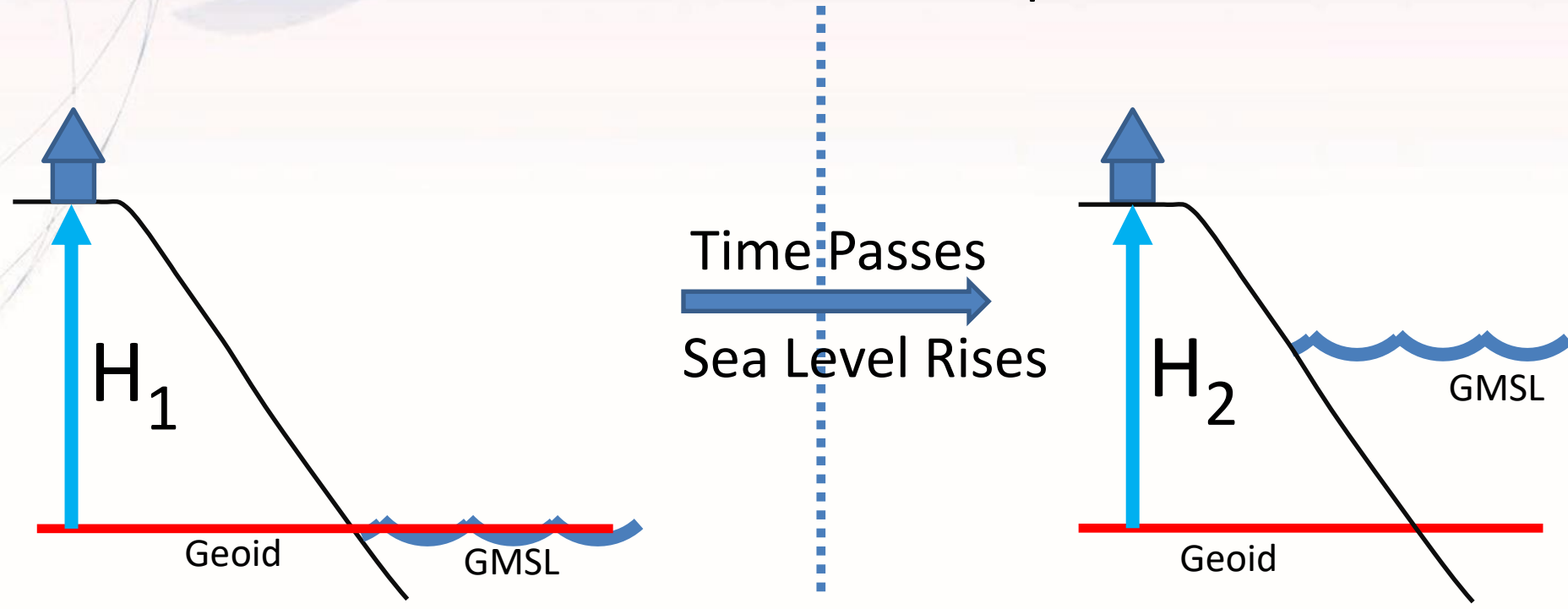
As Global Mean Sea Level rises, orthometric height gets smaller

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House Way



Scenario 2: Geoid Definition decoupled from GMSL

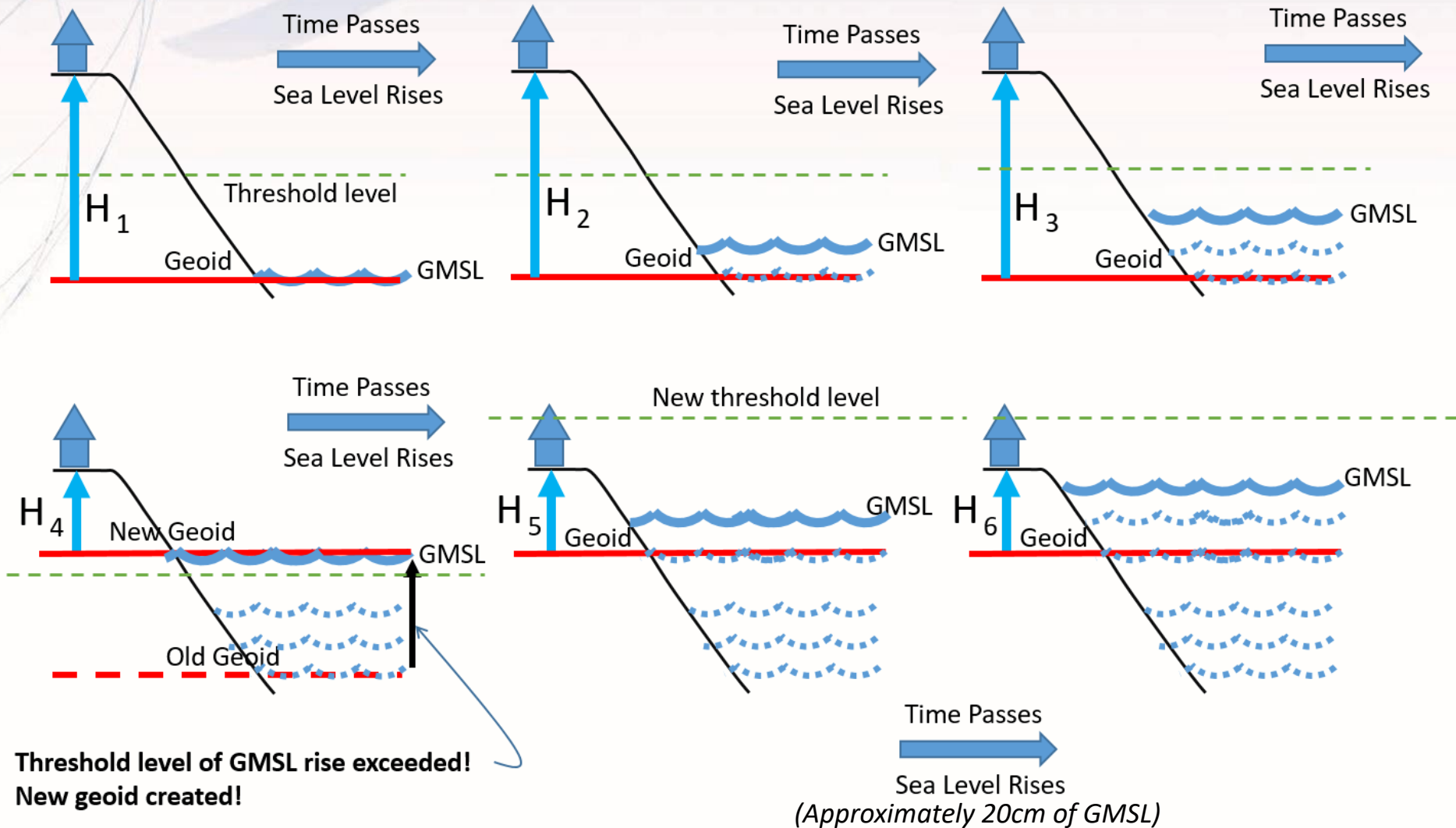


As Global Mean Sea Level rises, orthometric height remains constant





The Threshold Compromise: Choosing a new geoid as GMSL changes



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What can you do?

Coordinate

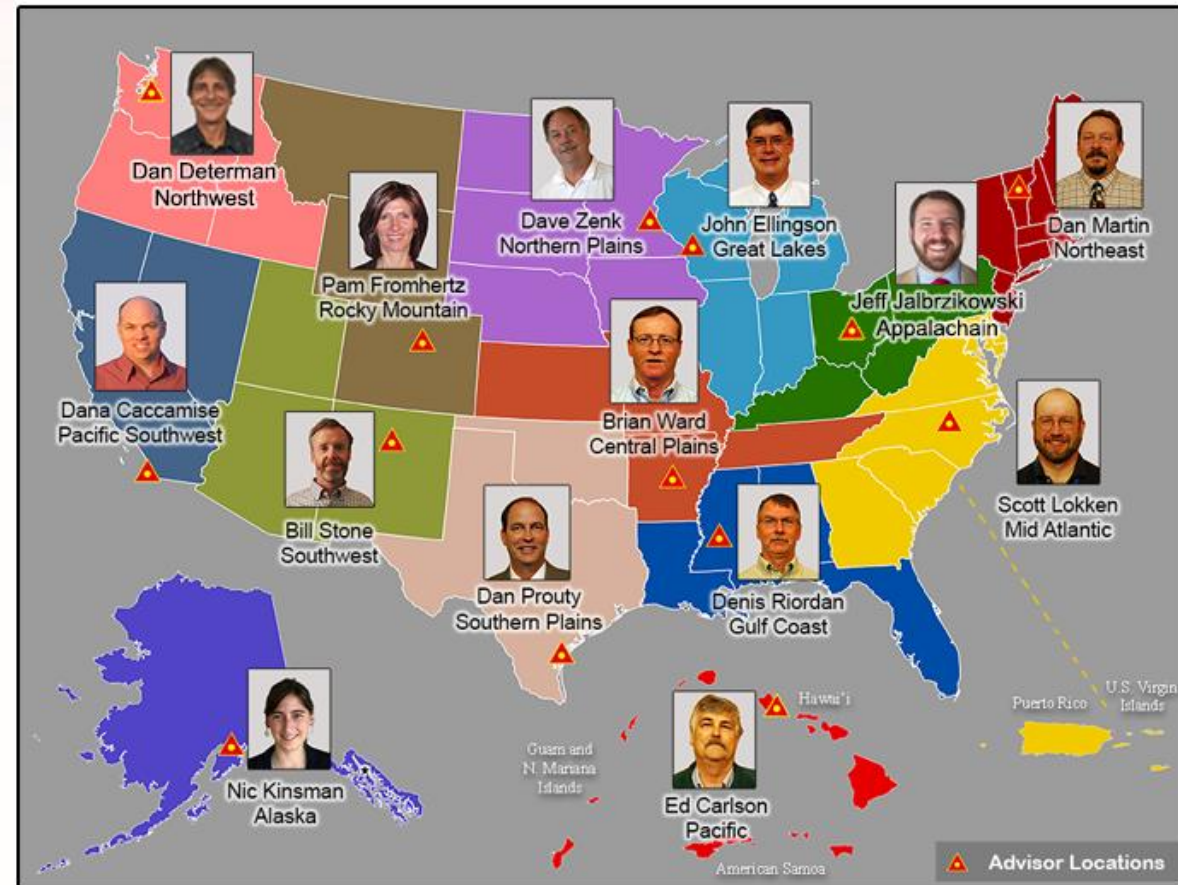
Spread the word and tell others about NSRS Modernization

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

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Events

- [Industry Engagement](#)
- [2017 Summit](#)
- [2015 Summit](#)
- [2010 Summit](#)

New Datums: Replacing NAVD 88 and NAD 83

NAVD 88 and NAD 83 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?

NAVD 88 and NAD 83, 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

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Video Library


NGS, in partnership with **The COMET Program**, has developed short videos about topics related to geodesy and mapping. View or download our featured video or previous videos. Please visit the **COMET YouTube Channel** to view the **entire playlist**.




What are Geodetic Datums?



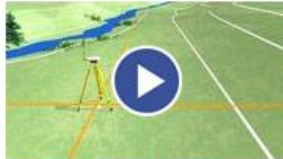
How Were Geodetic Datums Established?




What Is the Status of Today's Geodetic Datums?




What's Next for Geodetic Datums?




Precision and Accuracy in Geodetic Surveying




Two Right Feet? U.S. Survey Feet vs. International Survey Feet



Geospatial Infrastructure for Coastal Communities: Informing Adaptation to Sea Level Rise



Best Practices for Minimizing Errors during GNSS Data Collection



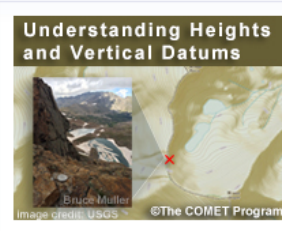
The Importance of Accurate Coastal Elevation and Shoreline Data

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HOME EDUCATION & TRAINING COMMUNITIES RESOURCES ABOUT MY METED

Lesson/Resource Listing » Description

Understanding Heights and Vertical Datums



Understanding Heights and Vertical Datums

©The COMET Program

Languages: English
Publish Date: 2015-03-31
Skill Level: 0
Completion Time: .75 - 1.00 h
Includes Audio: yes
Required Plugins: none
Topics: Geospatial
Included in Courses: Elements of Hydrography Distance Learning Course

BEGIN LESSON

Add to Queue Your Queue»

Take the quiz?
Begin Quiz

Share this resource:
f t+ 2

Reviews:
★★★★☆ (21 reviews)
[Read or add reviews](#)

Videos are ~3-5 minutes

Vertical Datums Tutorial is ~1 hour



Questions?
Scott Lokken
Scott.lokken@noaa.gov

www.ngs.noaa.gov/datums/newdatums



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