



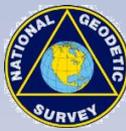
# Southwest Regional Activity Supporting the Modernization of the NSRS

62<sup>nd</sup> Meeting of the Civil GPS Service Interface Committee  
Denver CO 2022

*Lynda Bell, SW Regional Advisor (AZ, NM, UT)*

*NOAA's National Geodetic Survey*





# NGS Mission

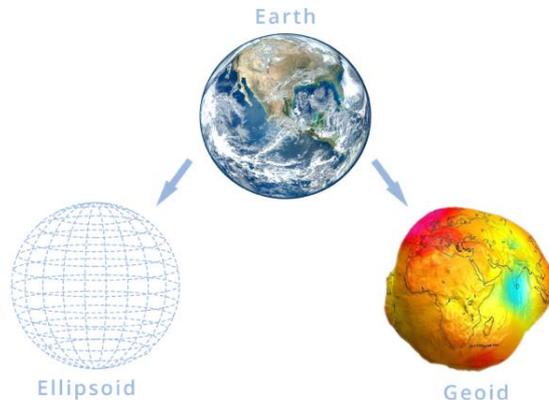
Define, maintain, and **provide access** to the *National Spatial Reference System (NSRS)*

“The NSRS is a consistent coordinate system that defines latitude, longitude, height, scale, gravity, orientation, and shoreline throughout the United States”



# NSRS :Datums & Reference Frames

- A geodetic datum or reference frame is an abstract coordinate system with a reference surface (such as sea level) that serves to provide known locations to begin surveys and create maps
- NGS defines official geodetic datums for all federal mapping activities in the U.S. as part of the National Spatial Reference System (NSRS)



- 1) Vertical Datums
- 2) Horizontal/Geometric Datums
- 3) Tidal Datums

# What is NSRS Modernization?

## *Improving the National Spatial Reference System*

The National Geodetic Survey has been working over the last ten plus years to remove inaccuracies in the existing datums of the United States.

By tracking the dynamic nature of the Earth, and giving users tools to account for it, NGS will provide a new National Spatial Reference System that is semi-dynamic.

**“By fully embracing the benefits of GNSS as the positioning tool of today, and of the future, NGS will effectively link the replacements for NAD 83 and NAVD 88 through a geocentric reference frame and gravimetric geoid model”**

*-Dr. Dru Smith, Chief Geodesist, National Geodetic Survey, 2010*



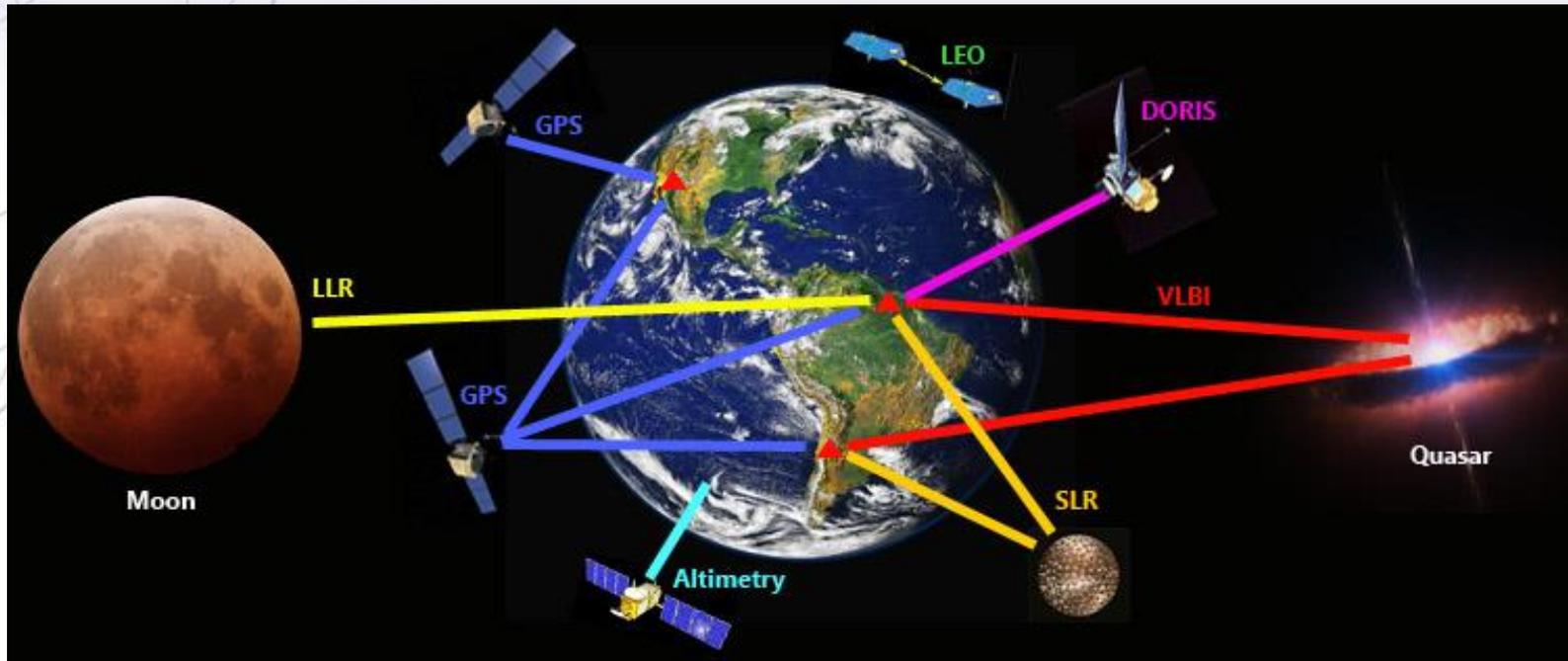
# How do we support the Modernization of the NSRS: By Precisely Measuring the Earth's Position in the Universe



NASA Space Geodesy Profiles: Dr. Chopo Ma

*Scientists from NASA's Space Geodesy Project discuss the techniques they use to precisely measure the Earth's position in the universe, determine the Earth's center of mass, calibrate satellites, observe sea level rise, and track the movements of the tectonic plates.*

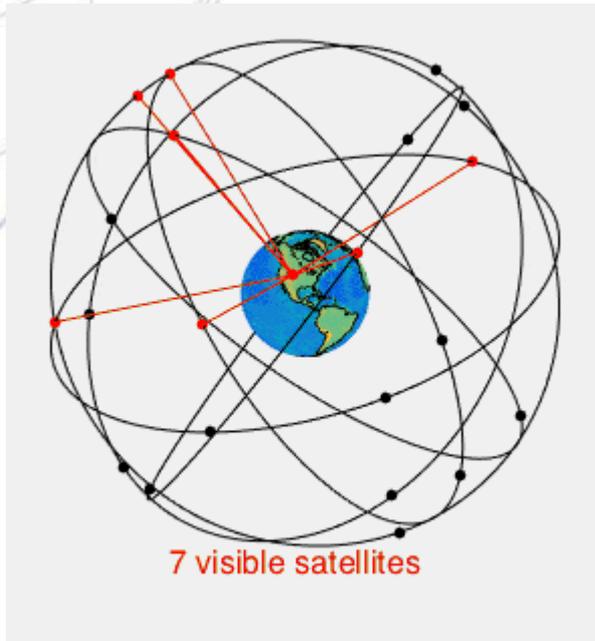
# Supporting the Modernization of the NSRS: A Need for Precise Positioning



[International Association of Geodesy](http://www.iau.org/science/geodesy/)

# High Accuracy GNSS Data Processing at NGS

**NGS supports surveyors and others with high-accuracy Global Navigation Satellite System (GNSS) data, ground control marks, models and tools, guidelines and tutorials.**



## GNSS Tools

- [Online Positioning User Service \(OPUS\)](#): Tie your GPS observations to U.S. and international frames.
- [Antenna Calibration](#): Look up antenna biases for high-accuracy data processing.
- [Transformation tools \(Geodetic toolkit\)](#): Transform data between reference frames and datums.
- [Geoid Models](#): Convert GPS heights to orthometric (e.g., NAVD 88).
- [Orbits](#): See International GNSS orbit products.

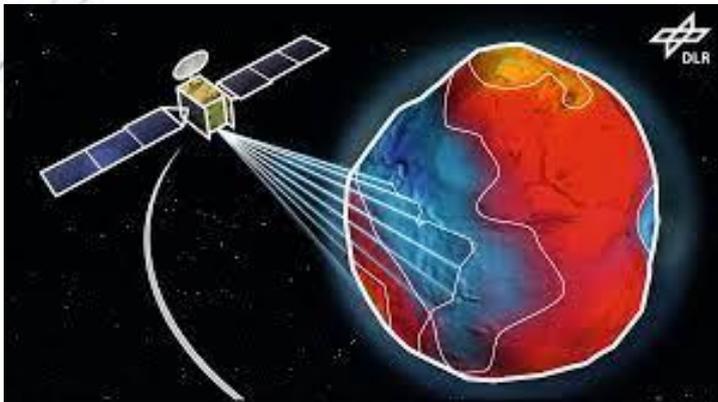
## GNSS Survey Methods

NGS is exploring a proposed new file format, [GNSS Vector Exchange \(GVX\)](#) to more consistently use GNSS vectors in survey networks.

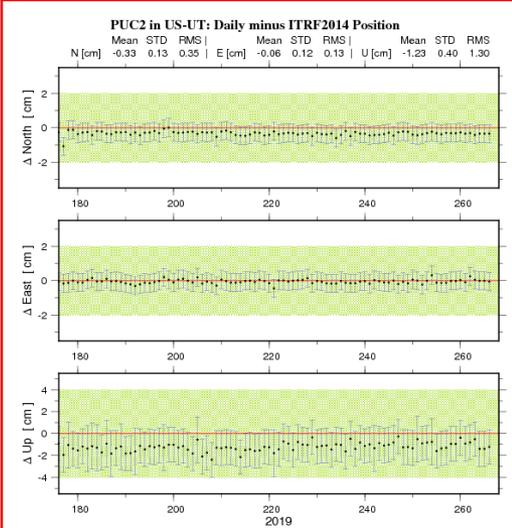
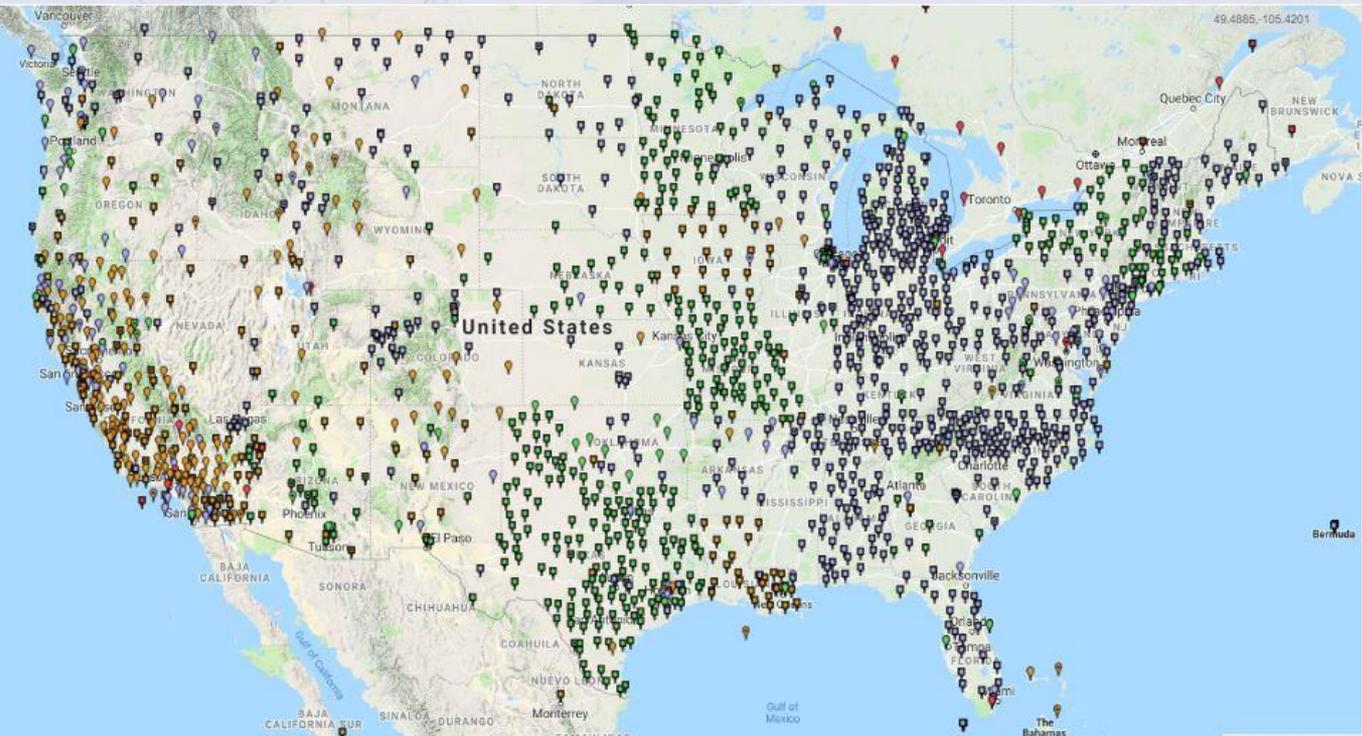
# Setting a Geodetic Standard

**For 200 years**, NGS and its predecessor agencies have collaborated with public and private organizations to establish reference stations at precisely determined locations.

More recently, NGS has fostered a network of **continuously operating reference stations (CORS)** where each CORS includes a highly accurate receiver that continuously collects radio signals broadcast by **Global Navigation Satellite System (GNSS) satellites** forming a network used to accurately position other points of interest.



# NOAA's Continuously Operating Reference Station Network (NCN)



## NOAA's Continuously Operating Reference Stations (CORS):

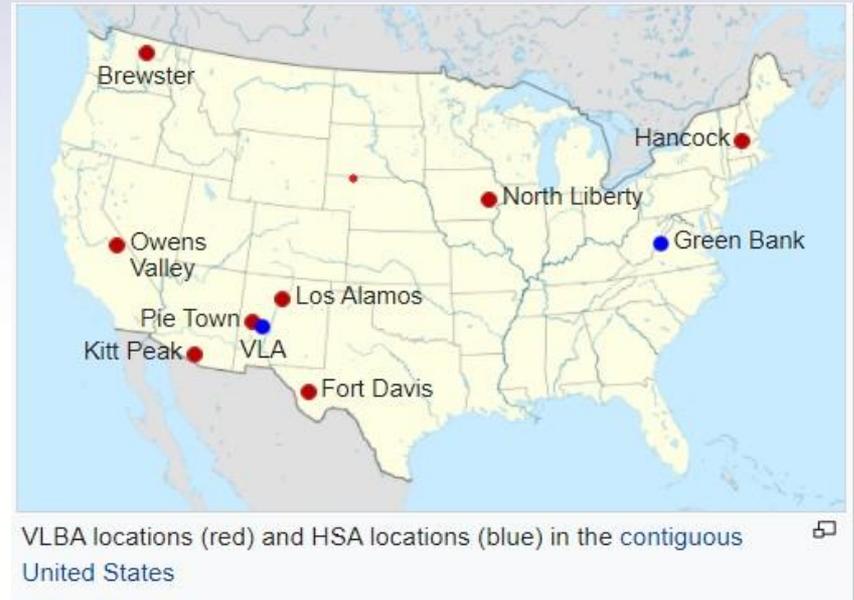
NGS provides GNSS data files, station coordinates, and velocities from this nationwide array of tracking stations which are used for survey processing and geophysical research

# Projects Supporting the NSRS in the SW Region

- New AZCORS AGIC Committee
- Braced Monument Workshops
- CORS Station Improvements
- GPS on Benchmarks
- OPUS Training
- Water Management
- Subsidence Monitoring
- Control Densification
- Partnership Work
- Foundation CORS



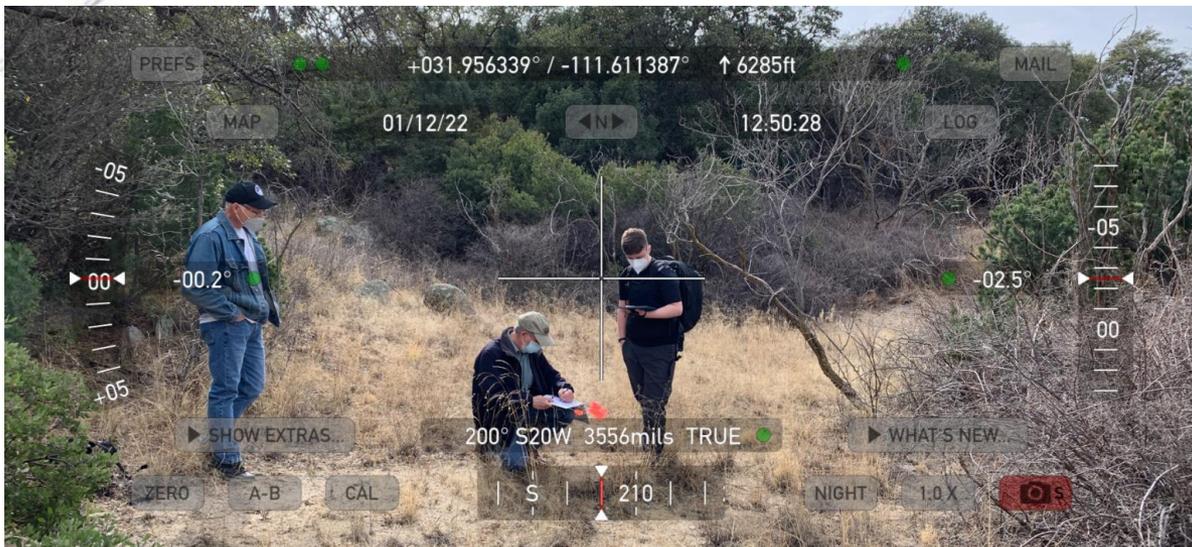
# Four Foundation CORS Sites in the SW Region



- Los Alamos – New Mexico
- Pie Town – New Mexico
- Apache Peak – New Mexico
- Kitt Peak – Arizona

Kitt Peak, AZ

# Kitt Peak National Observatory Tucson, AZ Foundation CORS Reconnaissance 2022





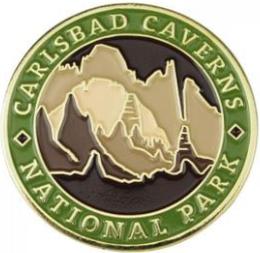
Foundation CORS Site, McDonald Observatory, Texas

# Densification of Survey Control through Partnerships

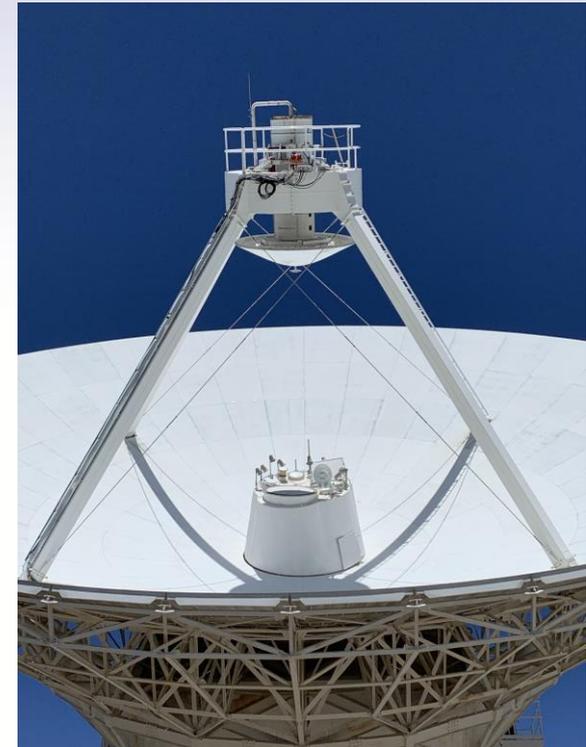
- Positioning – improvements in both vertical and horizontal positioning
- Ground truthing – improve base station positions for LIDAR, aerial, drone, photogrammetric, altimetric data
- Datum consistency - throughout multiple data sets used for digital elevation modeling



# NGS Partnership Activity in New Mexico



National Park Service  
Braced Monument NOAA  
CORS Network Site



NRAO's Very Long Baseline Array  
Pietown, Los Alamos, Apache Point  
NGS/NGA/ARL FCORS

# NGS Partnership Activity in Utah

- USGS Great Salt Lake Datum and Hydrologic Survey
- Aseismic Restructuring of the Mormon Temple/Base Meridian Preservation



# City of Phoenix, CAP, and NGS partner to build new Braced Monument CORS Stations in AZ





Technical Crew  
City of Phoenix Survey Team  
Mike Deaton, Survey Engineer  
Ernie Fisher, CAP/NGS Station Coordinator  
Lynda Bell, NGS SW Regional Advisor




A Partnership Project:  
NOAA's National Geodetic Survey  
City of Phoenix, AZ

## JOIN US!

### NOAA's NGS CORS Desert Hills Braced Monument Workshop

**INSTRUCTOR: NOAA'S NATIONAL GEODETIC SURVEY'S CORS BRANCH CHIEF, JOHN GALETZKA**

You are cordially invited to join us in this exciting training opportunity to participate in the construction of a future City of Phoenix/ NOAA CORS Network braced monument GNSS site. **NOAA's National Geodetic Survey's CORS Branch Chief, John Galetzka, will be your instructor** with a city of Phoenix professional survey crew leading the construction. Please come prepared to be part of this hands-on workshop and to get in the dirt! BYO support supplies for a morning of work—gloves, water, field clothes! **RSVP: [lynda.bell@noaa.gov](mailto:lynda.bell@noaa.gov) 240-988-5919, NGS SW Regional Advisor**

**WED, March 23, 2022, 7am to 12 pm Build Workshop**  
**THURS, March 24, 2022, 7am to 12 pm Wrap Up**

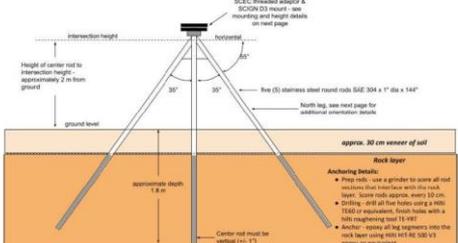
**Directions:** Site located just behind (north of) the Equestrian Parking Lot. Park in main parking lot to the west of the site.

**705 W Carefree Hwy  
Desert Hill Trailhead  
City of Phoenix Parks  
Phoenix, AZ**

RSVP Phone: 240-988-5919  
 Email: [lynda.bell@noaa.gov](mailto:lynda.bell@noaa.gov)  
 NGS SW Regional Advisor  
 Tucson, AZ

National Geodetic Survey  
 "Positioning for America's Future"  
[geodesy.noaa.gov](http://geodesy.noaa.gov)





**Desert Hill Trailhead City of Phoenix Parks  
705 W Carefree Hwy, Phoenix, AZ**

# Enhancing SW Geodetic Control to Improve Positioning Data and Imagery in 2022

- Bringing downed NOAA CORS Network sites back online – six sites currently
- Building new CORS stations with improved stability and monumentation – Shallow and Deep Braced Monuments
- Building a new Foundation CORS array at VLBA's in NM and AZ



NGS/City of Phoenix Braced Monument Workshop



Partnership Work!



NGS siting new GNSS array at Kitt Peak National Observatory, AZ

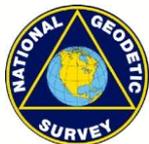
# Supporting the NSRS from the Beautiful Southwest

- Stay tuned for presentations from Arizona's Department of Water Resources and Utah's Geospatial Resource Center





**Lynda Bell**  
**NGS SW Regional Advisor**  
**(AZ,NM,UT)**  
**[lynda.bell@noaa.gov](mailto:lynda.bell@noaa.gov)**  
**240-988-5919**



## About

I am currently a full time civil servant for the Department of Commerce, serving as the Southwest Regional Geodetic Advisor for NOAA's National Geodetic Survey (NGS). I am serving as a liaison between NGS and its public, academic, and private sector customers within my region (Arizona, New Mexico, and Utah), providing guidance and assistance on geospatial activities that are tied to the National Spatial Reference System. My current duty station is located at the University of Arizona, in the Department of Geosciences, Tucson, AZ.

I have also had the great privilege to serve several other federal agencies in the geospatial community, working as a Geophysicist and Senior Scientist at NASA's Goddard Space Flight Center in Greenbelt, MD and as a Sea Level Specialist at the National Park Service Headquarters in Fort Collins, CO.