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Reinforcing the U.S. National GNSS Reference Network

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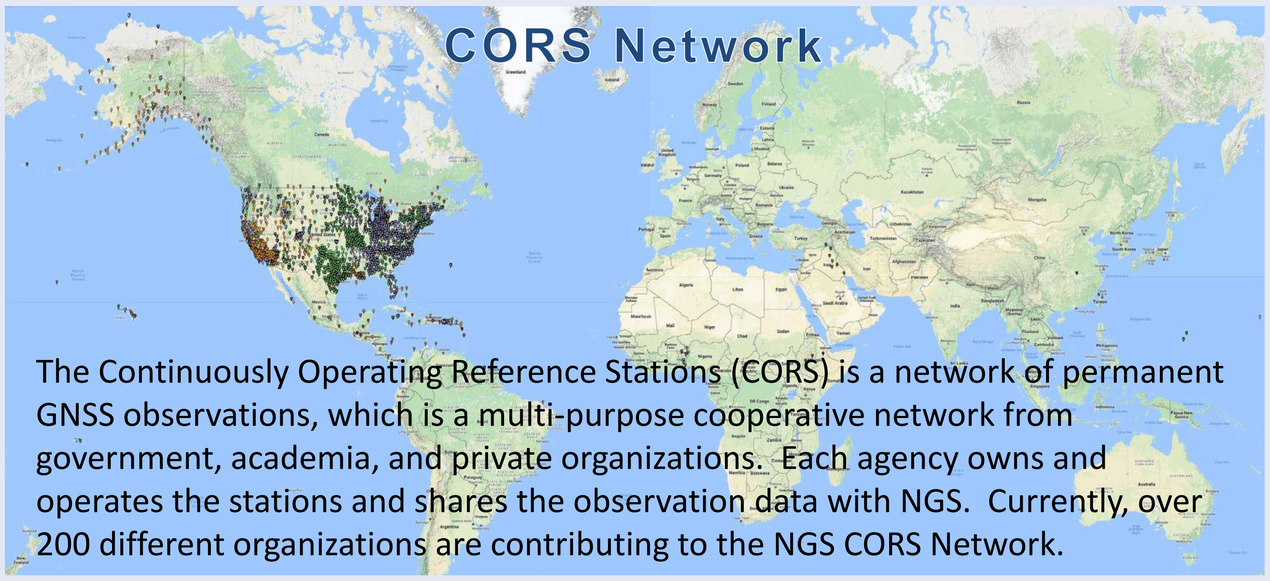
Abstract

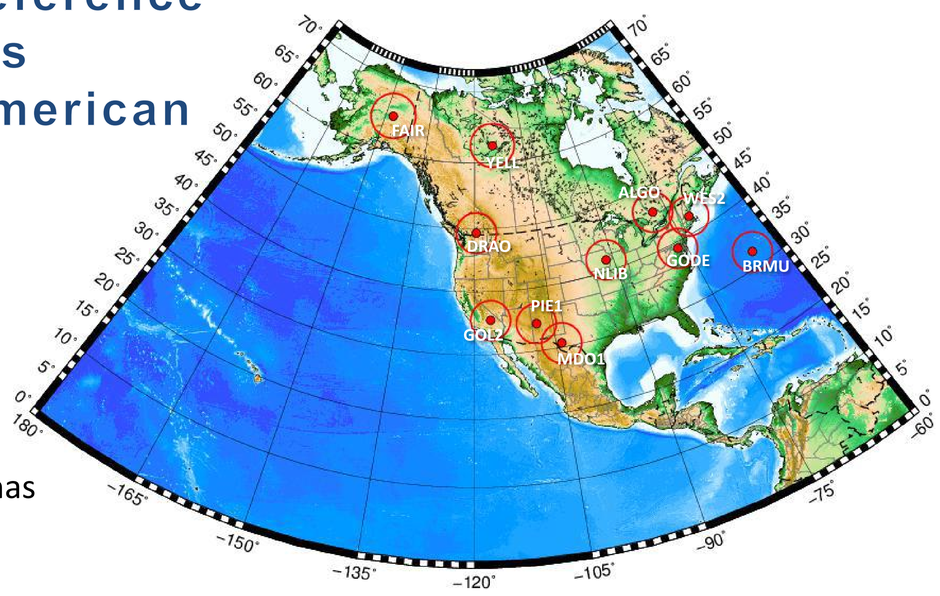
- With recent advancement of Satellite Geodesy techniques, the global frame realization has been relying on coordinates computed using continuously observed GPS data and corresponding satellite orbits. The GPS-based reference system continues to depend on the physical stability of a ground-based network of points as the primary foundation for these observations.
- NOAA's National Geodetic Survey (NGS) has been managing the CORS network and has identified the need to increase its participation in the maintenance of the U.S. component of the fiducial GPS tracking network in order to realize a long-term stable national terrestrial reference frame. To meet this need, NGS will designate and upgrade a subset of the current network for this purpose, or install new stations accordingly. This subset of stations must have the highest operational standards to serve dual functions: to improve the U.S. contribution to the international frame, and to provide the link to the U.S. national datum. NGS plans to add these reference stations based on scientific merit such as: colocation with other geodetic techniques, geographic area, and monumentation stability.

CORS Network



The Continuously Operating Reference Stations (CORS) is a network of permanent GNSS observations, which is a multi-purpose cooperative network from government, academia, and private organizations. Each agency owns and operates the stations and shares the observation data with NGS. Currently, over 200 different organizations are contributing to the NGS CORS Network.

Historic Reference Frame Sites in North American plate



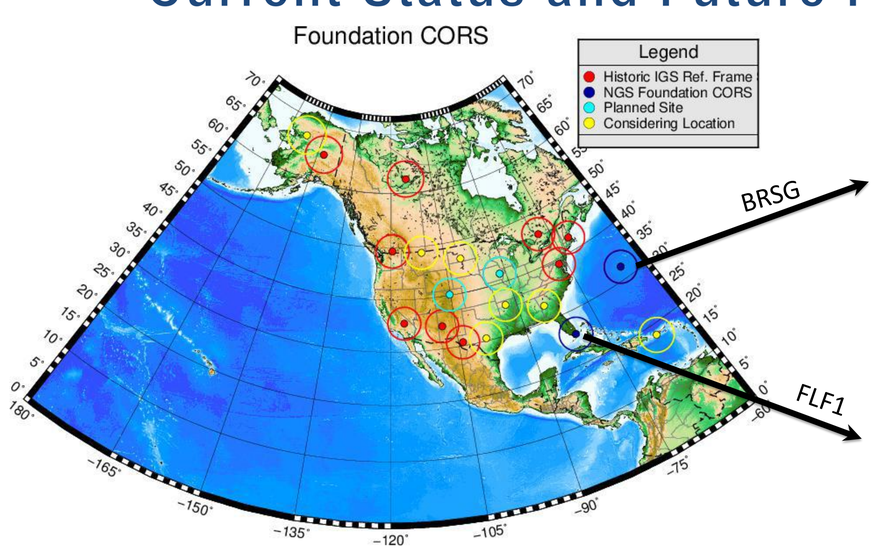
The number CORS network in the US has been increasing. In order to keep the long-term consistency with the ITRF and IGS frames, It is desirable to maintain the historic sites with higher standard. These 12 sites were used for the IGS realization of ITRF frame since ITRF96.

Site	Agency	Domes #	Location	Begin	Status	Constellation	Colocation
ALGO	NRCan	40104M002	ON, CAN	1991	Op.	GPS, GLO, GAL	SLR
DRAO	NRCan	40105M002	BC, CAN	1991	Op.	GPS, GLO, GAL	Seismo.
YELL	NRCan	40127M003	NT, CAN	1991	Op.	GPS, GLO, GAL	DORIS
FAIR	JPL	40408M001	AK, USA	1991	Op.	GPS only	None
GODE	JPL	40451M123	MD, USA	1993	Op.	GPS only	SLR, VLBI
GOL2	JPL	40405S031	CA, USA	1997	Op.	GPS only	None
MDO1	JPL	40442M012	TX, USA	1993	Op.	GPS, GLO	SLR
NLIB	JPL	40465M001	IA, USA	1993	Op.	GPS only	VLBI
PIE1	JPL	40456M001	NM, USA	1992	Op.	GPS, GLO	VLBI
BRMU	NGS	42501S004	Bermuda	1993	Op.	GPS, GLO	None
WES2	NGS	40440S020	MA, USA	1993	Non-Op.	GPS, GLO	VLBI
THU1	DNSC	43001M001	Greenland	1995	Decomm. Jan. 2003 Replaced by THU3	GPS only	None

Reference Frame Station Requirements

Criteria	Details
Geographic Distribution	• No greater than 2000 km to nearest RF station • Strong tie to the national geodetic network
Surroundings	• Clear sky view with minimal obscurations > 5 deg. • Free from radio frequency interference • Free from surface vibrations and heavy traffic
Geologic/ Tectonic	• Away from active source of deformations (e.g., faults, volcano, or subsidence due to ground water variation)
Monumentation	• Permanent physical monument with ultra-stable design • Discontinuation of primary monument to be decided only when it is unavoidable – one year of overlapping data must be provided
Site Survey	• GNSS antenna phase center eccentricity must be ~1 mm accuracy • Regular conventional 3D surveys with 1-3 mm accuracy
Operation	• Long-term commitment by an institution preferably by a government agency • Site not to be overtaken by other uses • Personnel available for maintenance and repairs as needed • Reliable site security, power, and data transfer
Instrumentation	• High quality, dual-frequency GNSS receiver with low multipath/cycle slip antenna (chokering) • Observe all new GNSS signals • Avoid unnecessary changes in the GNSS instrumentation; when unavoidable, any configuration change must ensure no position discontinuity by thorough testing beforehand in a parallel, non-interfering operation and must be announced in advance • high-quality meteorological sensors for temperature, barometeric pressure, and humidity are highly desirable • high-quality external frequency standards are highly desirable but not required
Co-location	• Co-location with other space geodetic systems (SLR, VLBI, and DORIS) are highly desirable • Other geophysical systems such as absolute or superconducting gravimeters, Earth tide gravimeters, seismometers, strain meters, ocean tide gauges are also desirable and will enhance the value of the station for multi-disciplinary studies
Metadata/ Analysis	• RINEX data file headers must be current, accurate, and consistent with the IGS site log information • Planned equipment changes must be announced in advance via IGS Mail and must always be reflected in updated RINEX headers and site logs • Sufficient observing history is needed (usually >2 years) • Adequate stability & performance must be demonstrated

Current Status and Future Plan



Recently, NGS has installed two pilot stations: one in Bermuda (BRSG) and the other in Miami, Florida (FLF1). NGS' next installation will be at the Table Mountain Gravity Observatory in Boulder, Colorado (nearby TMGO). It will be a Deep-Drilled Braced Monument, and will be co-located with an absolute gravimeter.

NGS plans to upgrade or install an adequate number of GNSS reference tracking stations to ensure robust maintenance of the National Spatial Reference System. It is expected that at least 8 stations are to be upgraded, adopted, or installed in the continental U.S., with additional stations being implemented in other areas of interest, as needed. **This activity will be performed in collaboration with other U.S. government agencies or groups sharing similar long-term objectives.**