

# **NOAA/CO-OPS cGNSS Implementation within National Water Level Observation Network (NWLON)**

**Peter Stone and Jerry Hovis**

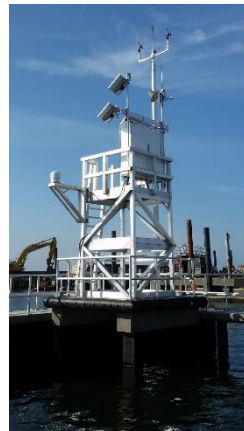
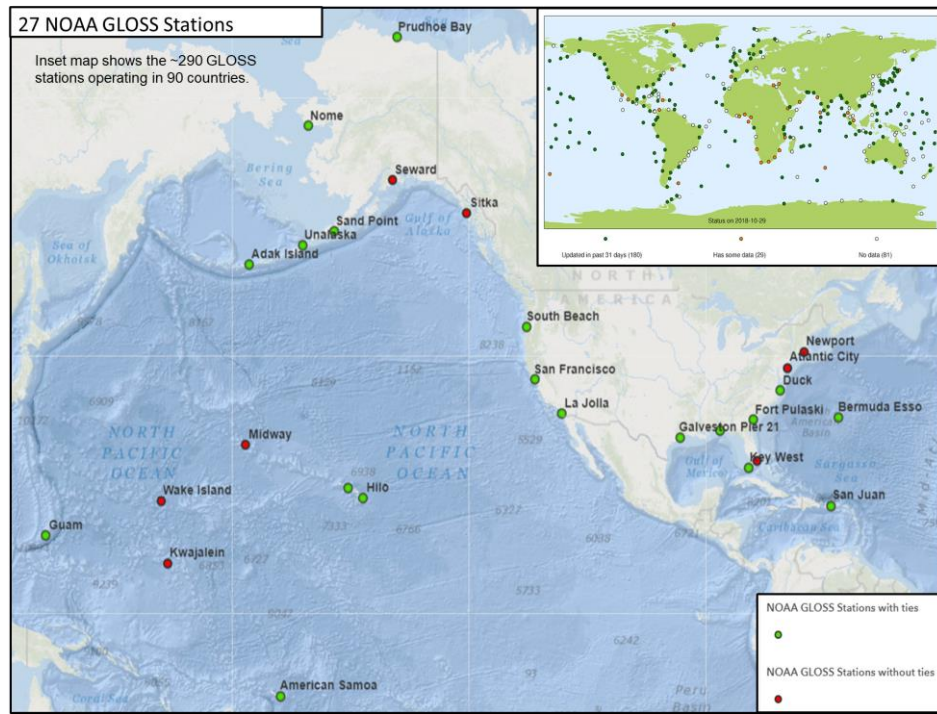
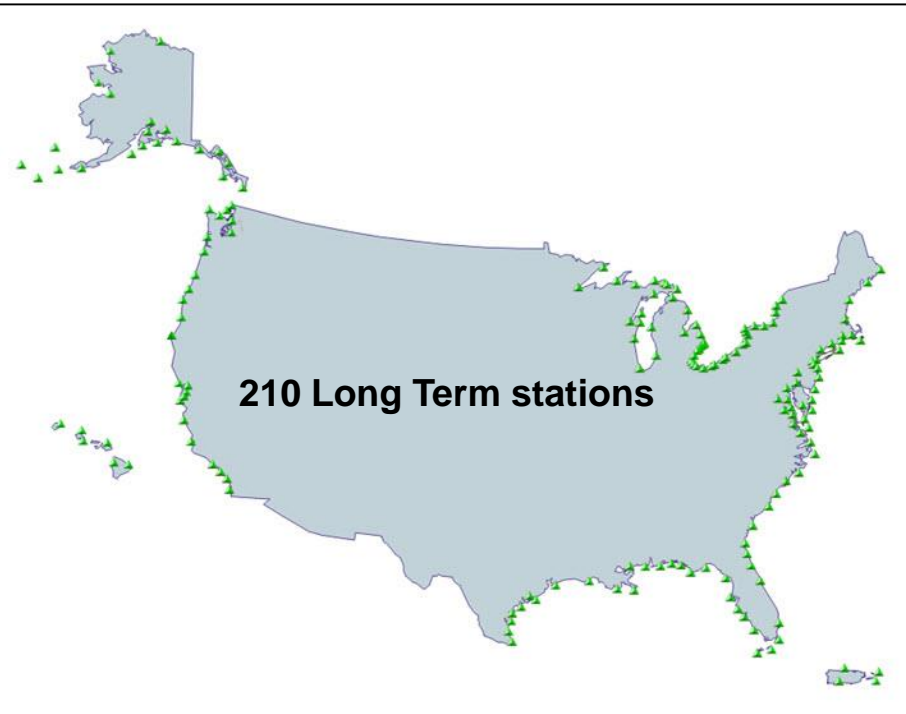
Joint Meeting of IHO TWCWG & GLOSS GE

April 2019

# NOAA/CO-OPS's Water Level Network

## NOAA National Water Level Observation Network (NWLON)

## NWLON GLOSS Stations

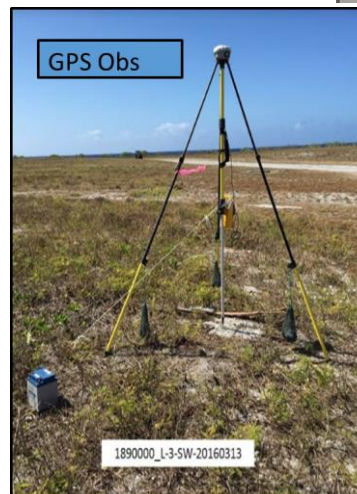
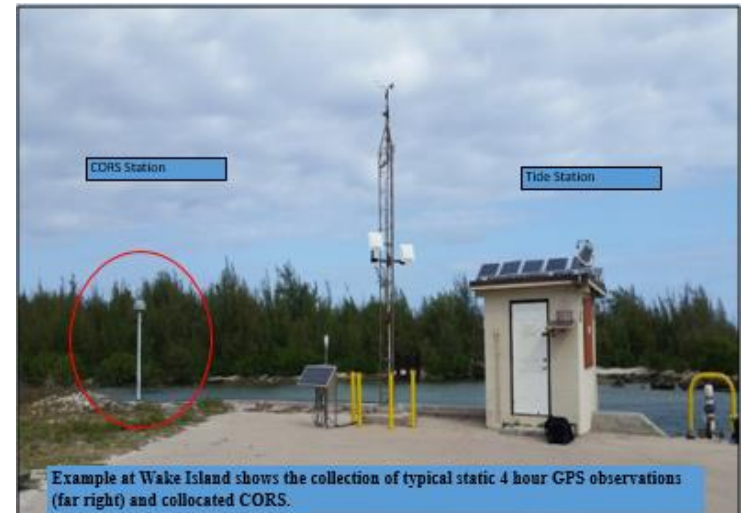


# CO-OPS' Vision for cGNSS Implementation

- **Goal 1** - Monitoring & accounting for vertical movement of water level sensors
  - Implement GNSS as a means of measuring sensor stability for various timescales and in a range of environments
  - Reduce need for leveling at stations
- **Goal 2** - Linking water level stations to national & global reference systems
  - Improve GNSS-based connections between water level datums and NSRS at all stations
  - Increase spatial and temporal VDatum coverage and reduce VDatum transformation errors
- **Goal 3** - Understanding the movement of land near water level stations to resolve components of relative sea level trends
  - Support determination of the land and ocean components of relative sea level change at long-term NWLON stations using GNSS.
  - Investigate the resolution of regional and local variability in absolute sea level change

# Work Priorities

- Install cGNSS systems at NWLON & NWLON GLOSS stations (GLOSS Stations funded by NOAA Ocean Observation and Monitoring Division)
- Develop O&M Procedures & resource requirements
- Level between cGNSS systems, water level sensors and Primary Benchmark (PBM)
- Accurately connect tidal datums to ellipsoidal elevations
- Develop data pathway & management plan, dissemination methodology and archive system



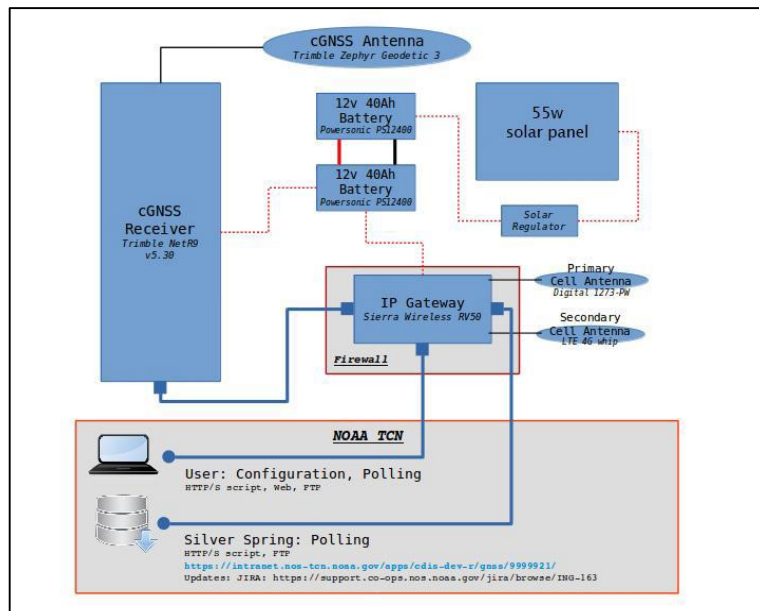


# NOS Tide Gauge Network Virginia Key, FL GNSS Installation

Location



Station Installation



System Design



Leveling to Water Level Sensor

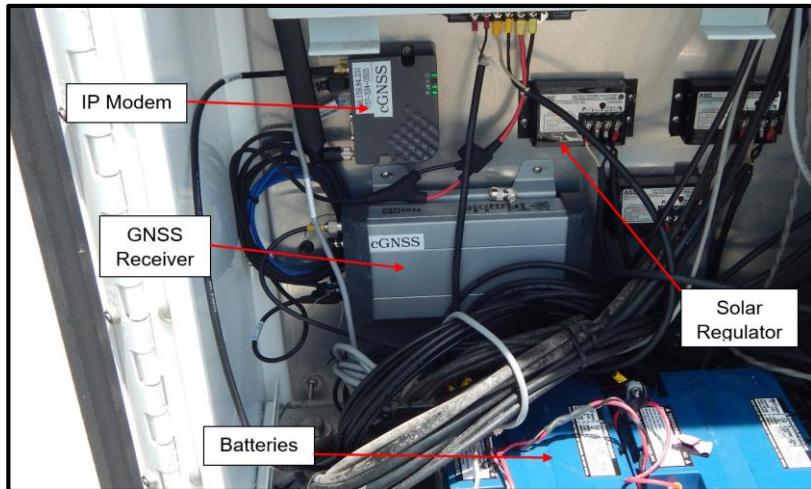
# NOS Tide Gauge Network

## Galveston Pier 21, TX GNSS Installation

Location



Station Installation



Electronics



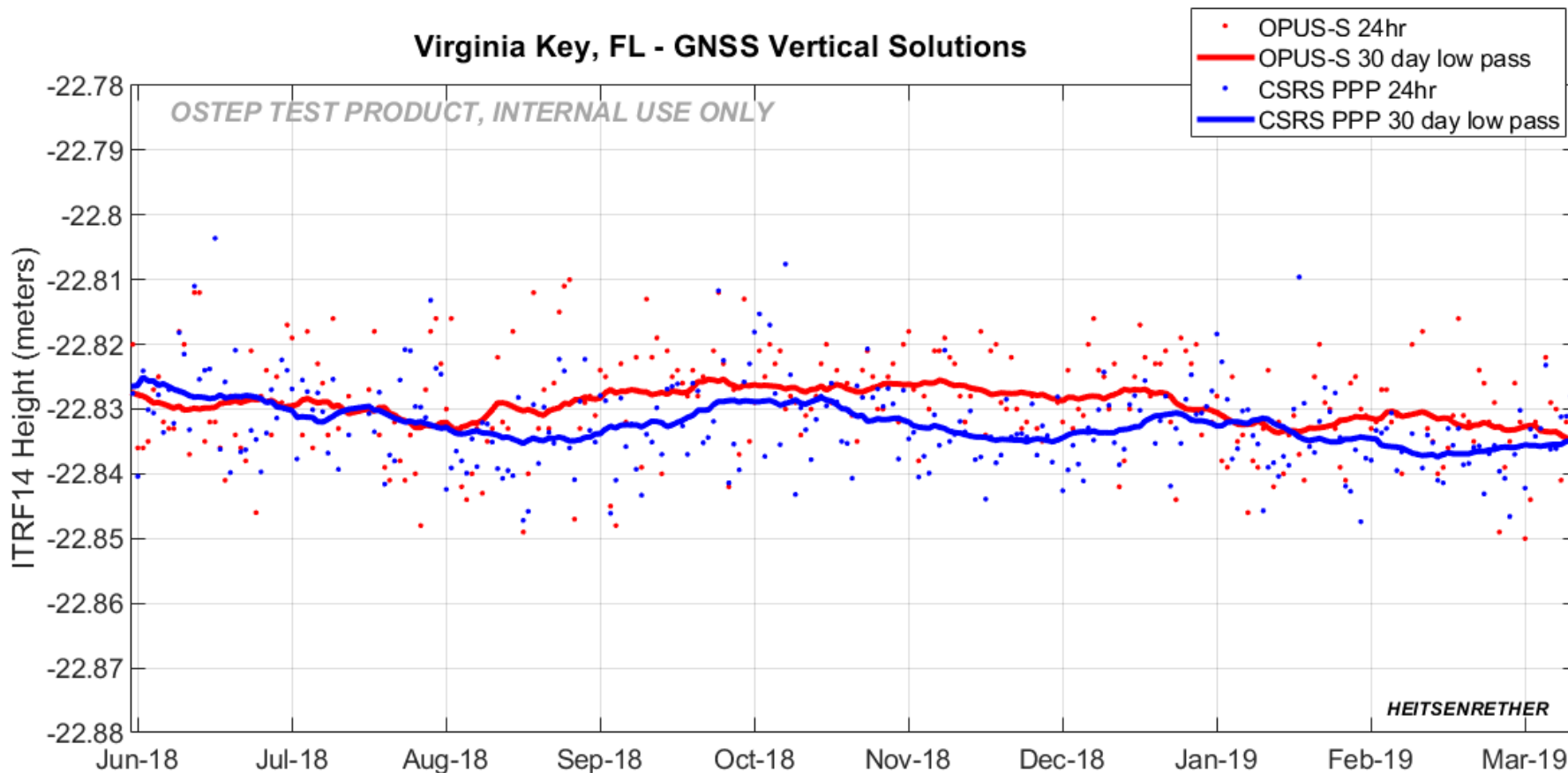
Antenna Mount



# cGNSS Data Processing

## Test & Evaluation Phase

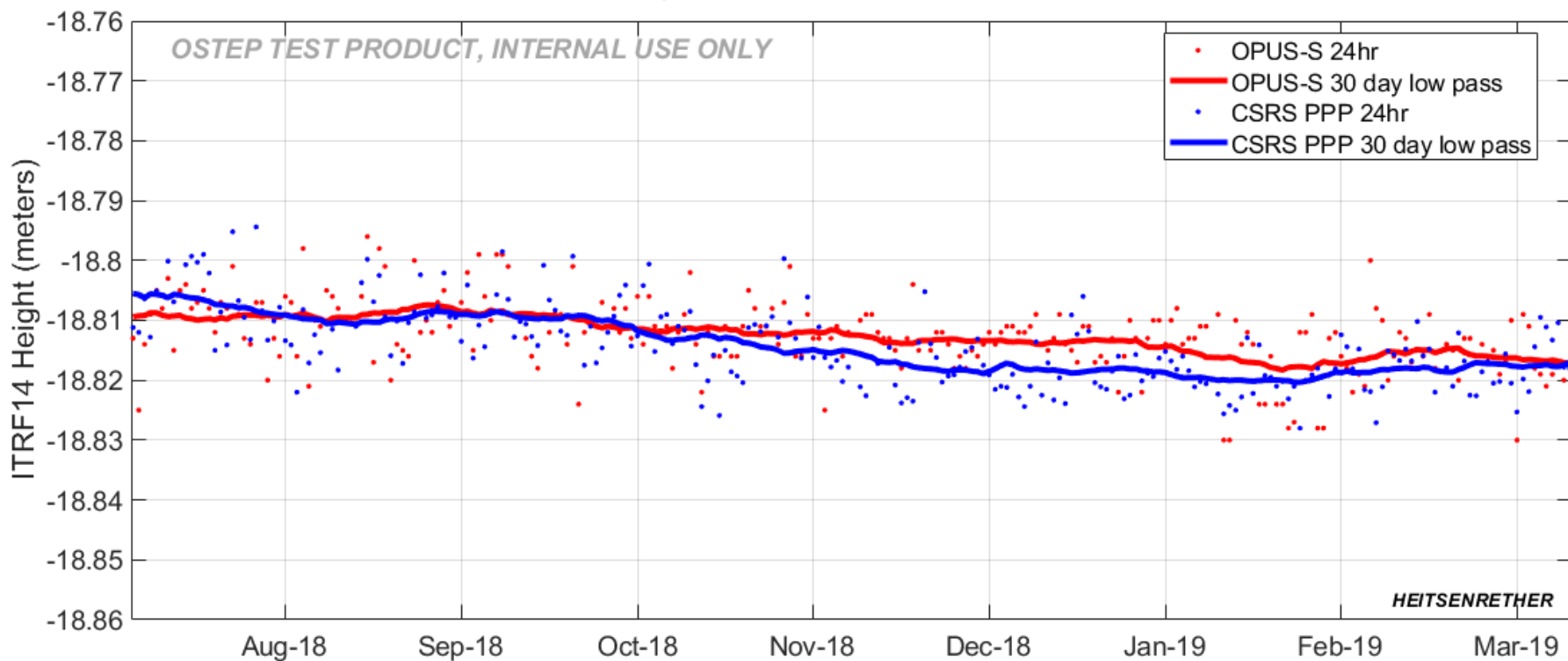
Virginia Key, FL - GNSS Vertical Solutions



# cGNSS Data Processing

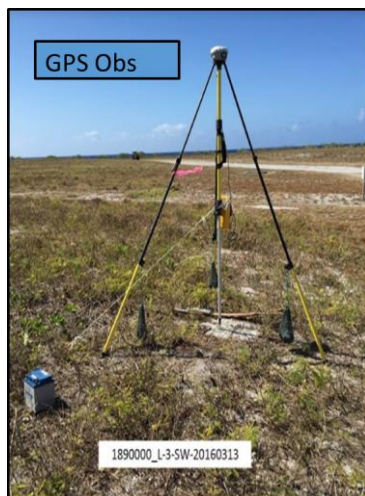
## Test & Evaluation Phase

Galveston Pier 21, TX - GNSS Vertical Solutions

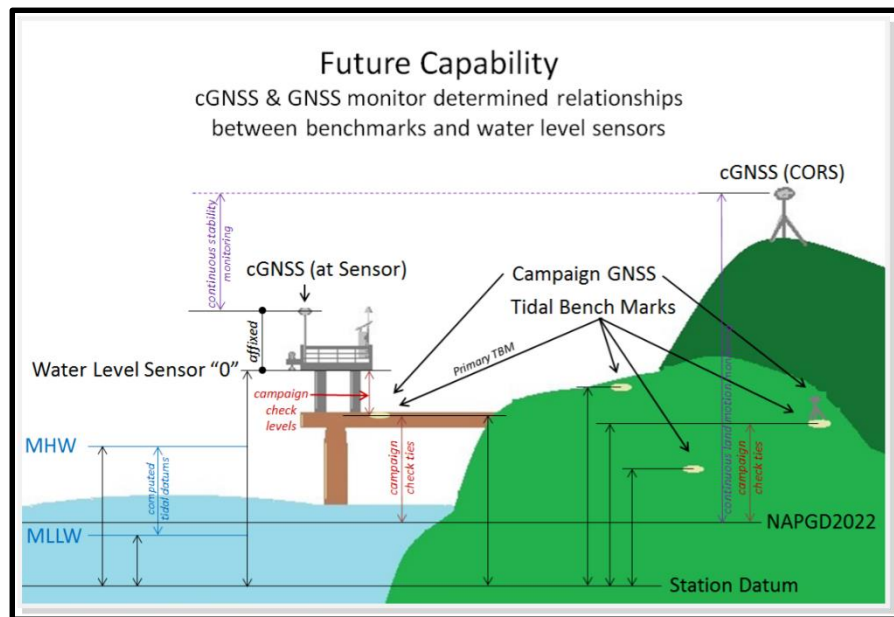




# Linking water level stations to national & global reference systems

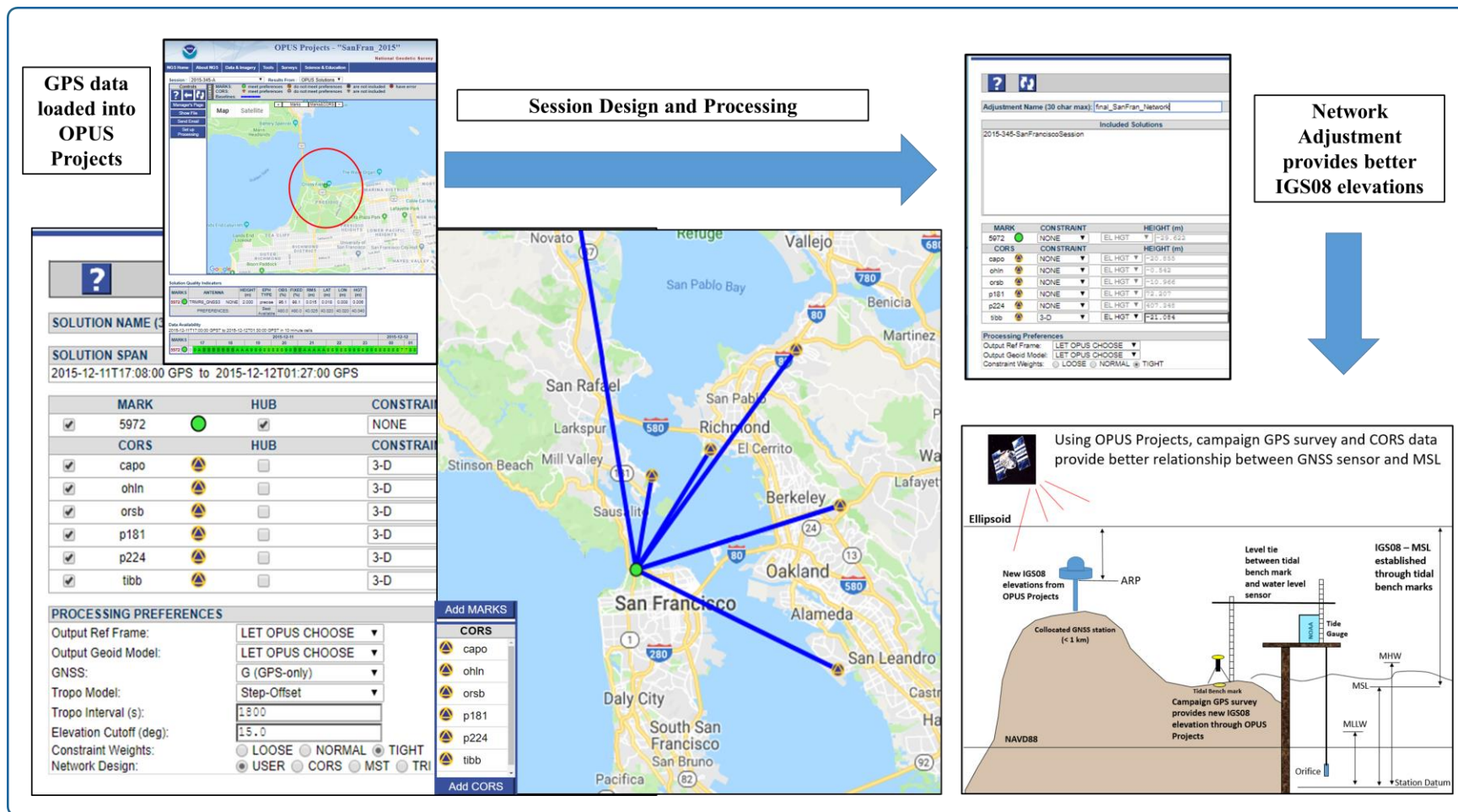


- Leveling provides the most accurate ties to GNSS sensors but GPS ties can be used where leveling is impractical or impossible
- CO-OPS collects static GPS observations at tidal bench marks permitting preliminary ties between water level and GNSS sensors
- In addition to continued leveling wherever feasible, simultaneous GPS observations will be collected permitting still more robust ties
- Improved data collection & processing methodology should increase the level of accuracy in GNSS ties to more closely reflect those obtained through classical leveling



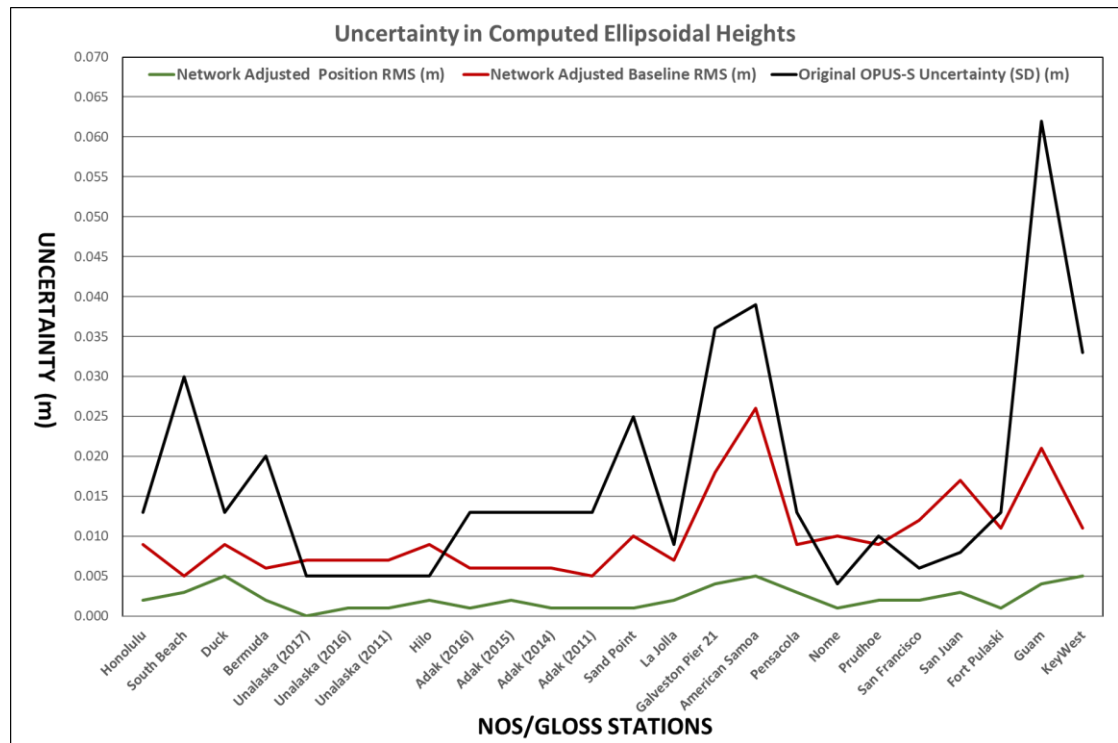
# Linking water level stations to national & global reference systems

Static GPS data reprocessed with OPUS Projects constraining GNSS sensor – LMSL relationship to local tidal bench mark at tide station resulting in reduced uncertainty.



# RESULTS

- Preliminary GNSS-based ties established at 19 of the 27 active GLOSS stations. Ties at 8 stations not possible as GNSS stations were decommissioned or not operational at time of GPS campaign survey
- Digital leveling tie at Honolulu agreed to within 2 mm of the computed GNSS tie
- Baseline RMS values fell within 0-2cm tolerance (except American Samoa and Guam). Values outside this tolerance do not indicate a “bad” solution but further investigation may be warranted
- Network adjusted position RMS values for tidal bench marks ranged from 0 to 5 mm indicating a relative position error of < 1 cm
- Original OPUS-S Standard Deviation values range from 4 mm to 6.2 cm suggesting using these data alone does not meet sub centimeter requirements



# Some Next Steps

- Develop plan to install at NWLON GLOSS station where existing CORS is greater 1km
- Develop cost and resource estimates to operationalize system to full NWLON system
- Develop operational data management plan
- Incorporate ellipsoidal products into existing products suite
- Work with SONEI and other data centers to send data to them



# QUESTIONS?