



Use of High-Rate CORS for Airborne Positioning

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1b. Surveying, Mapping, and Geosciences Session

Aerial Surveying

- All types of aircraft (helicopter, fixed wing, balloon, UAS)
- Many tools for surveying, mapping, and geosciences.
 - Photogrammetry, (Topo-Bathy) LIDAR, Gravity, Magnetics, Hyperspectral or Multispectral, Radiometric, etc.
- Advantages: Cover a lot of ground quickly and with consistent sampling
- Positioning is crucial!

aoc.noaa.gov



NGS Airborne Programs

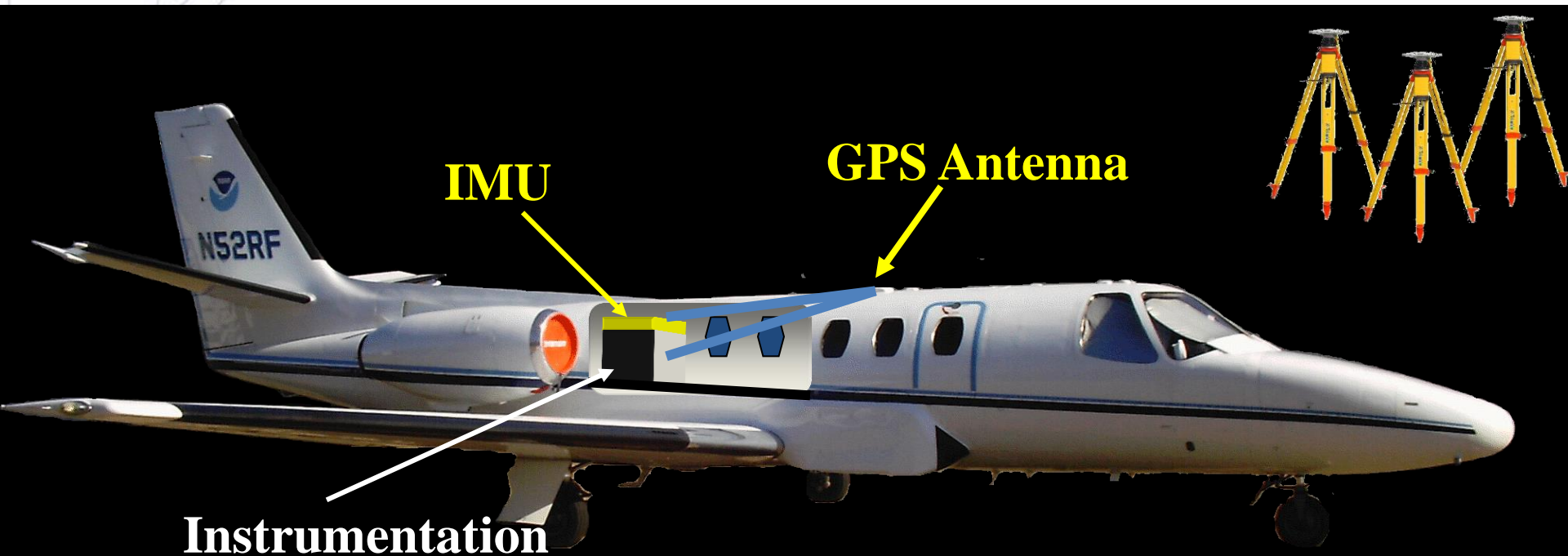


- Critical to U.S. National Geodetic Survey's (NGS') mission to define, maintain, and provide access to the U.S. National Spatial Reference System
- **Gravity for the Redefinition of the American Vertical Datum (GRAV-D)**
 - 2007 – 2022 (9 years remaining)
 - Airborne Gravity Snapshot
 - Target: 2 cm accuracy orthometric heights
- Coastal Mapping Program
- Photogrammetry and Topo-Bathy LIDAR
- Emergency Response Imagery

Positioning



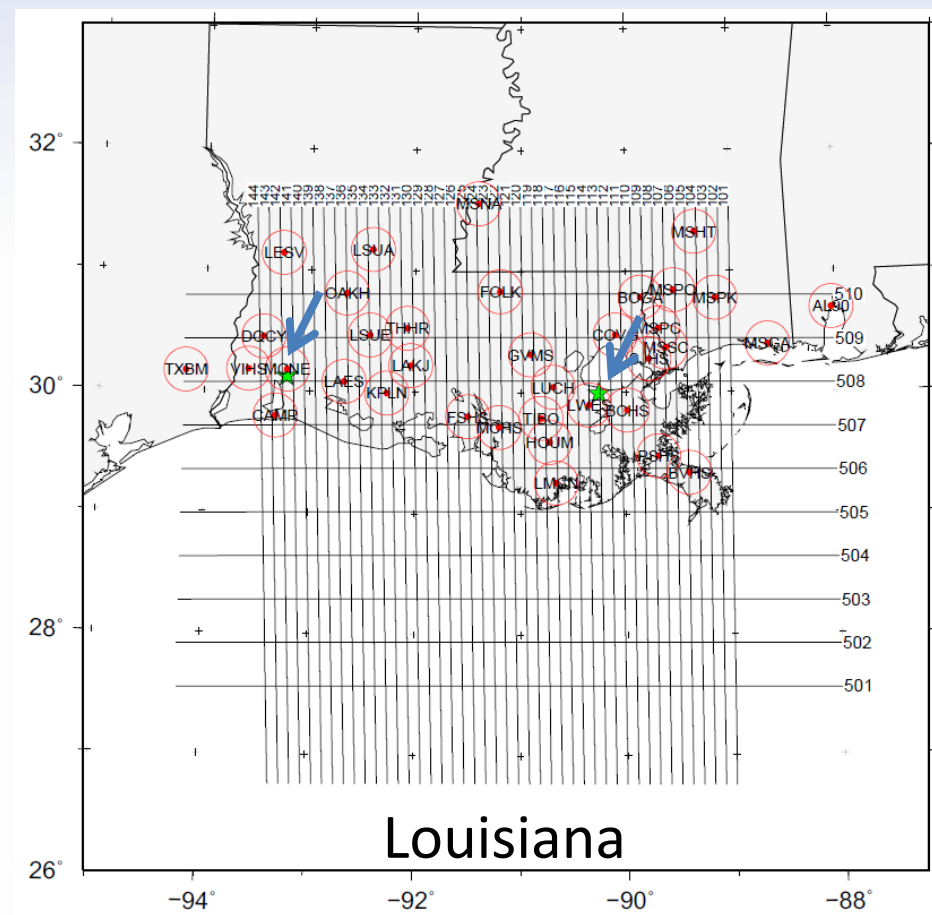
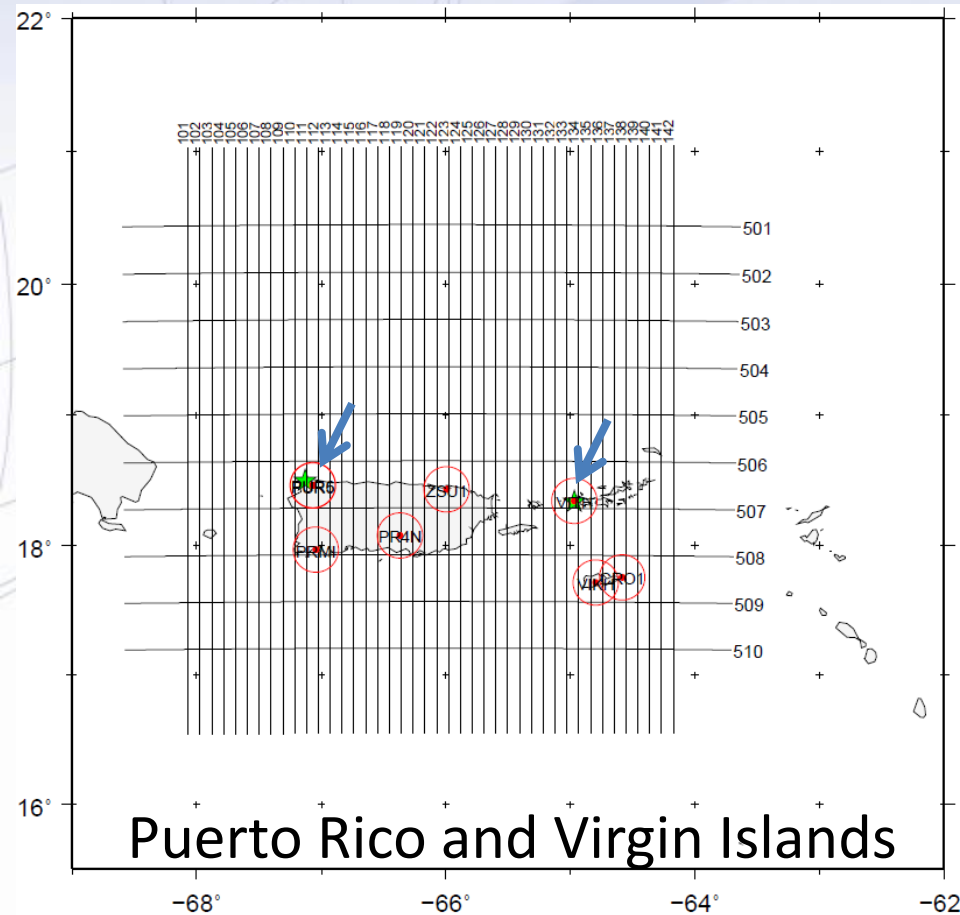
- High-altitude, high-speed, long duration flights for gravimetry
- Low-altitude, slow-speed, short duration for coastal mapping
- Traditionally, Differential Single Baseline or Differential Network
- Consecutive epochs at 1 Hz required
- Inertial measurements for aircraft orientations



UAS

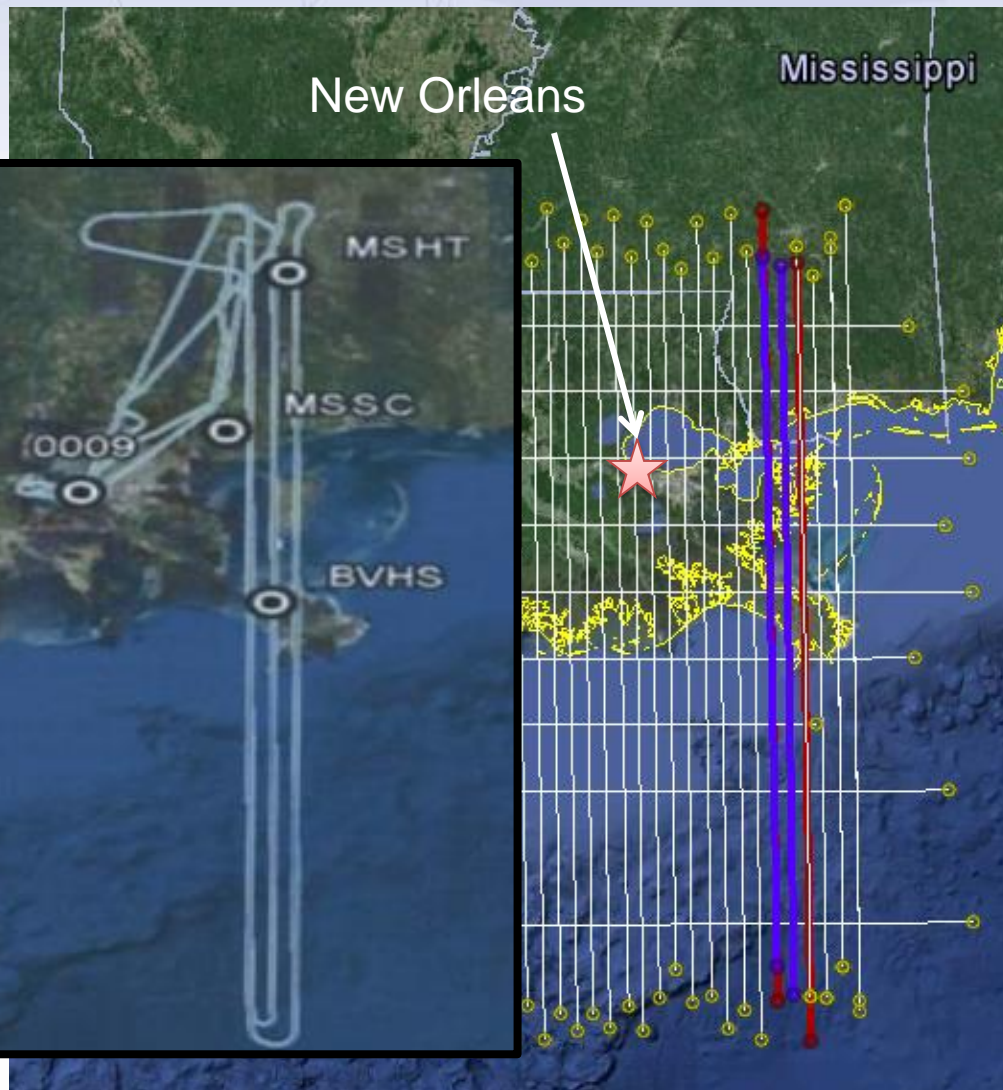
- Unmanned Aerial Systems (UAS) of great interest to surveying and mapping in U.S.
- Logistically desirable- less equipment, less personnel, less fuel
- Fast, easy deployment
- In-field quality control without setting up your own base stations would be advantageous- can CORS support that?

Differential Positioning and CORS



Two GRAV-D surveys completed in 2008/2009

Kinematic GPS Processing Challenge



- Louisiana 2008
- Two days
- Altitude: 35k ft. (~10 km)
- Longest Baseline: 400 km
- Flight Time: 3.5 Hours

- Network and Single Baseline Diff
- **Post-Processing** is **Not Applicable to Low-Altitude**
- Precise (PPP) is equivalent

Immediate Positioning

- PPP cannot be used for immediate processing of airborne data, since it requires precise IGS ephemeris (Lag time: 12 days)
- For quality control during a survey, you must have one or more bases. How many? Where located?
- For rapid response or easy logistics, can you use one?
- Single point of failure; high risk for long duration missions; Use CORS as a backup station

Causes of GPS Failures at Airports

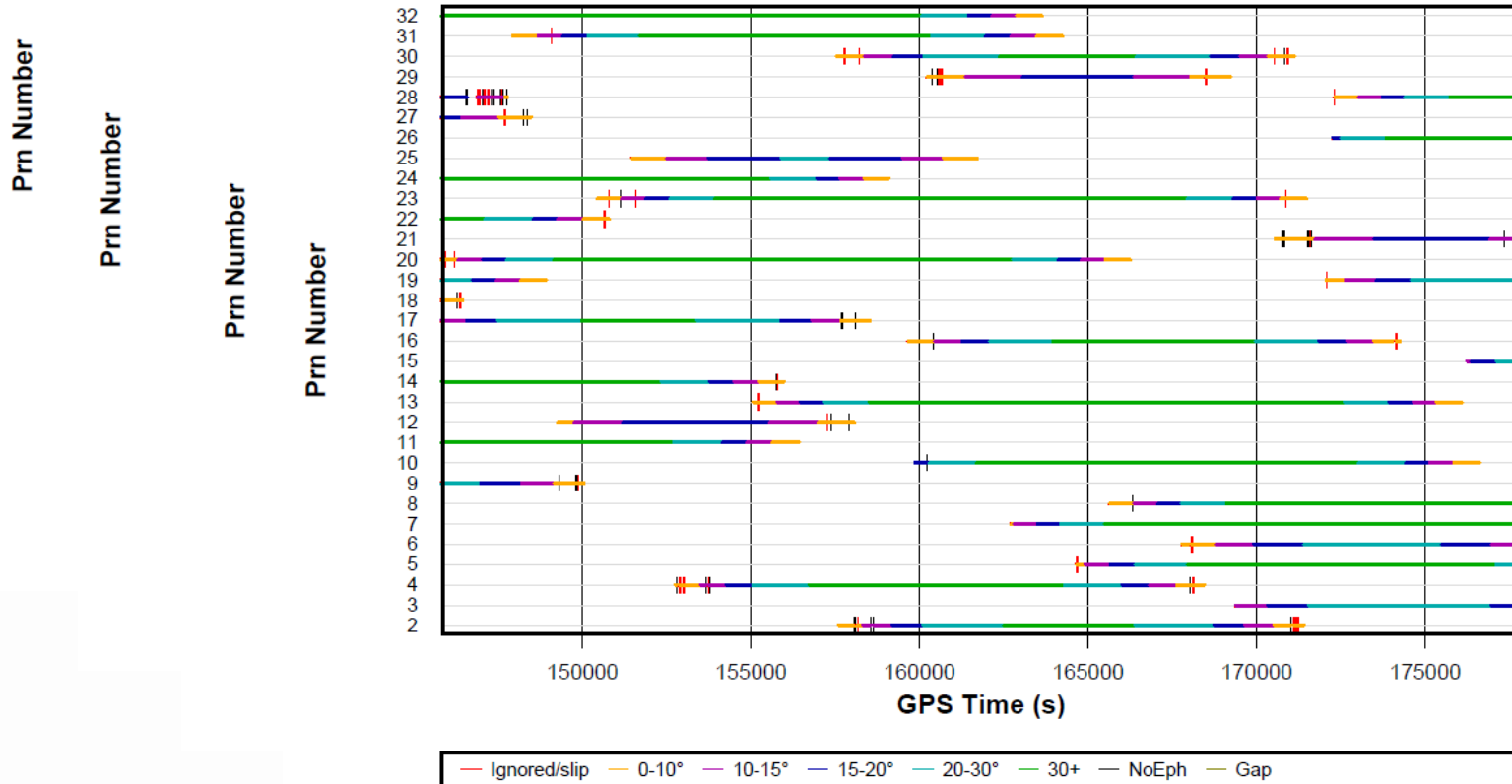
BNORTA11.gpb - L2 Satellite Lock/Elevation

don't last

BSOUTA11.gpb - L2 Satellite Lock/Elevation

BNORTA11.gpb - L2 Satellite Lock/Elevation

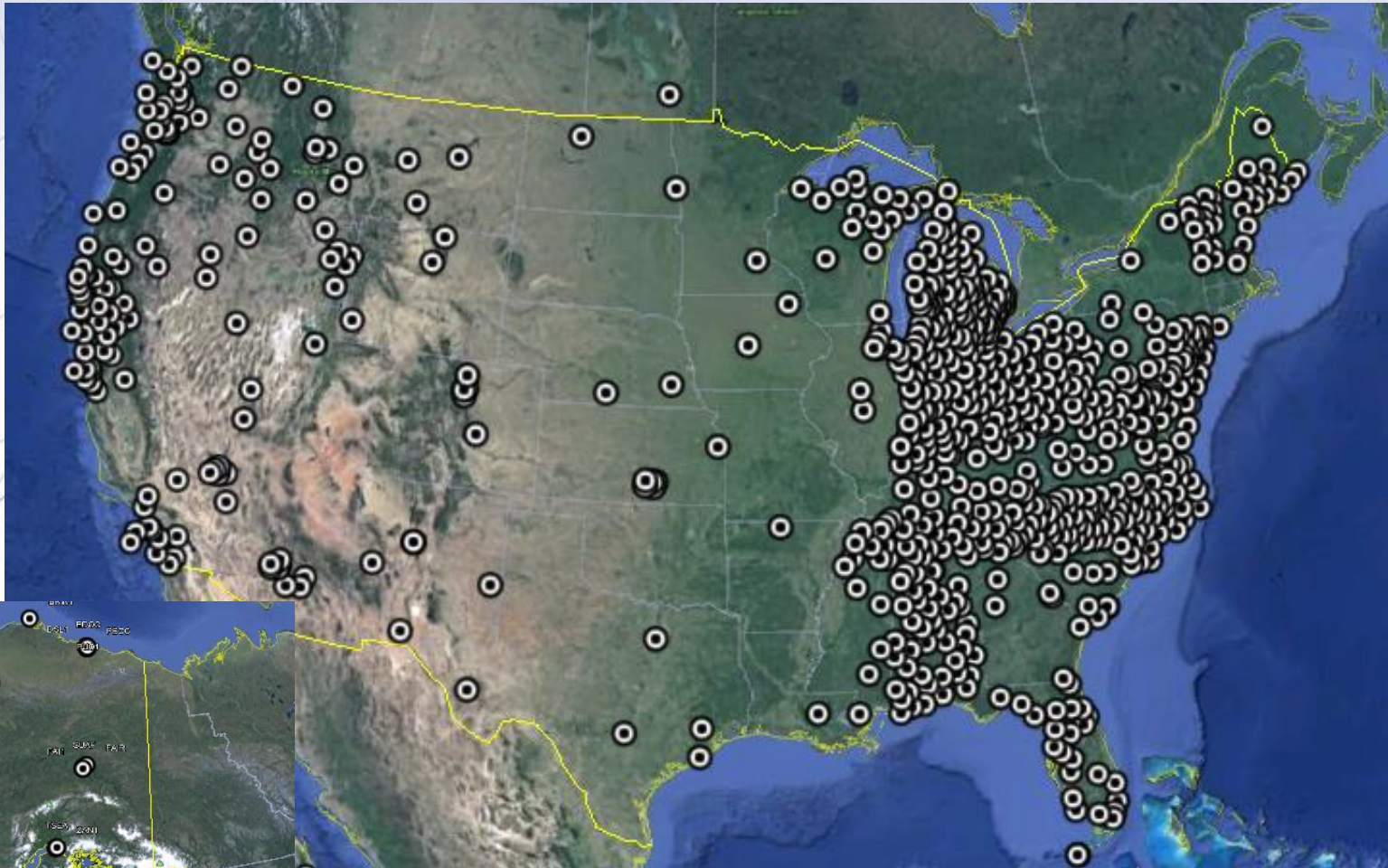
BUSERA11.gpb - L2 Satellite Lock/Elevation



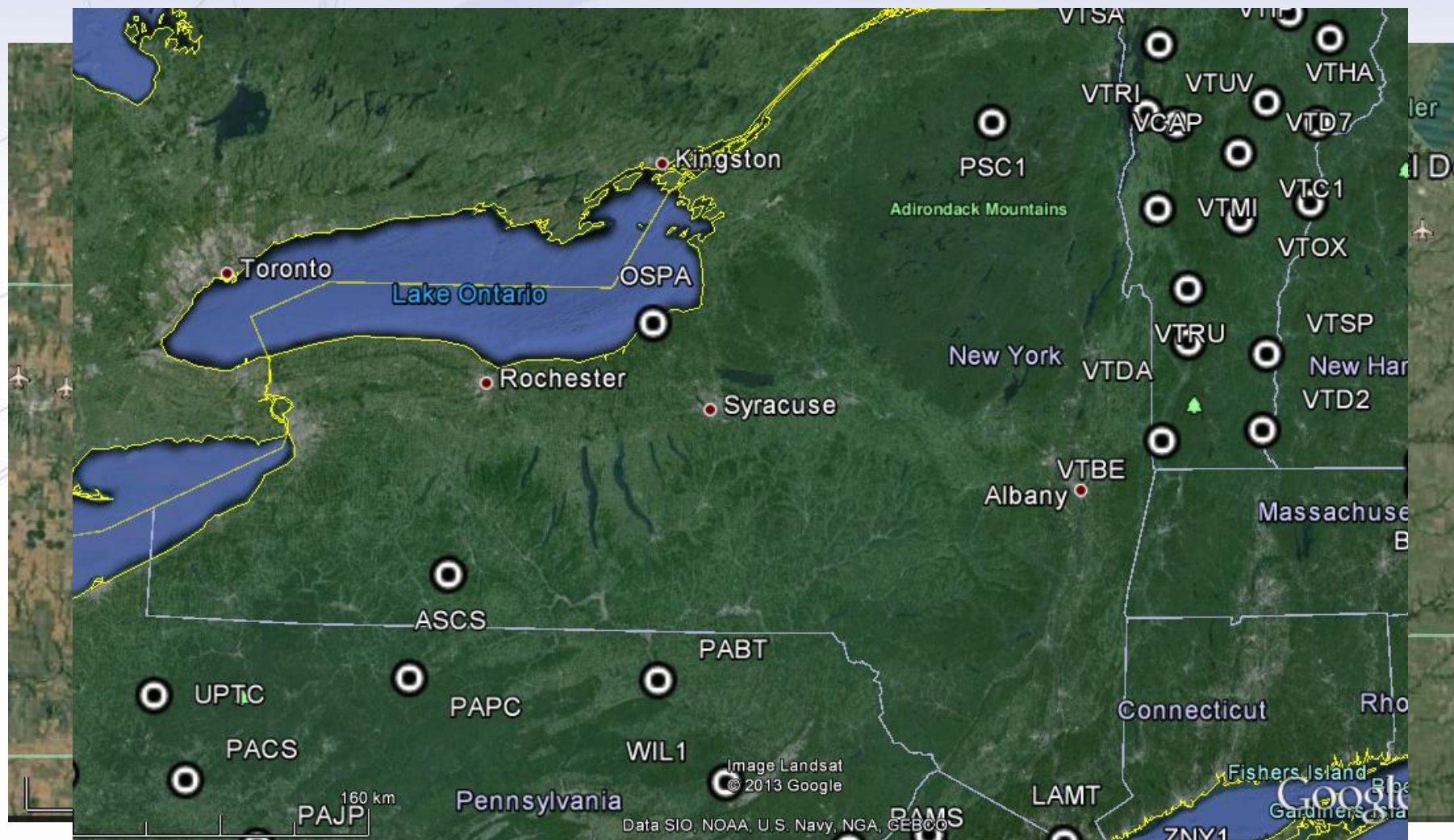
High-Rate CORS Available Now

- 1 Hz data rate necessary
- Restriction for use as a base station in airborne positioning: Located within ~15 km of the airport
- Pros: Managed, permanent site; low effort
- Cons: No control over quality and continuity
- ~670 1s stations in network
- Concentrated in eastern 1/3 of U.S. and West Coast

Map of Operational 1s CORS



Co-location with airports



Conclusions

- Airborne positioning for geoscience applications benefits from the co-location of high-rate CORS with U.S. airports
- With potential increase in UAS surveying, low-effort and rapid aerial deployments are of continuing interest
- Over most of the U.S., airborne operators currently have to run at least 1 of their own base stations.
- Some places (like Wichita, KS) are CORS-ready for rapid deployment.
- NGS Programs Information:
 - <http://www.ngs.noaa.gov/GRAV-D>
 - <http://www.ngs.noaa.gov/RSD>