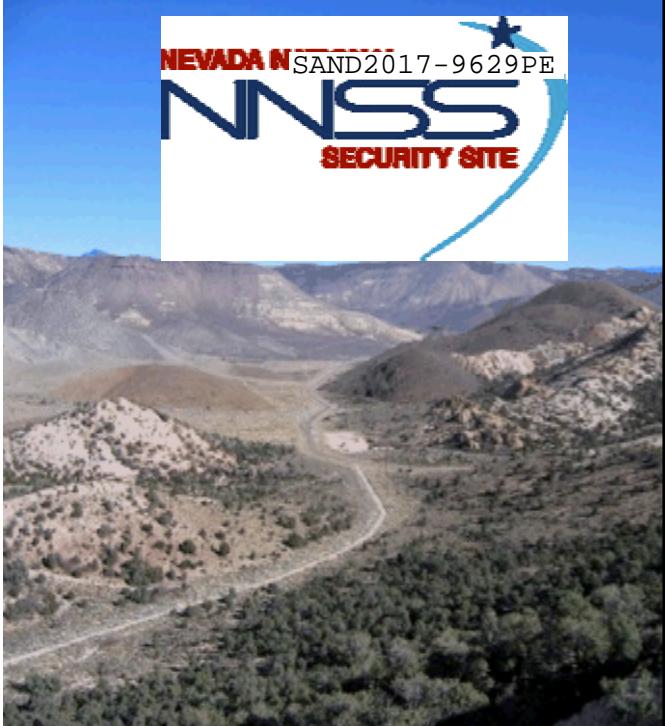


# Secondary: GPS Array for Ionospheric Sounding

Danny Bowman, Attila Komjathy and Michael Pauken



9-13-17



## Secondary Diagnostic: GPS Array

- ▶ Objectives:
  - Determine if acoustic waves from the DAG shots perturb the ionosphere
  - Relate ionospheric response to shot parameters
- ▶ Secondary Diagnostic
- ▶ Sensors:
  - Four dual-frequency GNSS high-precision geodetic receivers
  - Self-contained digitizers, no telemetry
  - Power supplied via existing seismic/acoustic photovoltaic systems

# System Design: Receivers



## System Design: Location

One GPS receiver at the end of each Thor line.

## Stations:

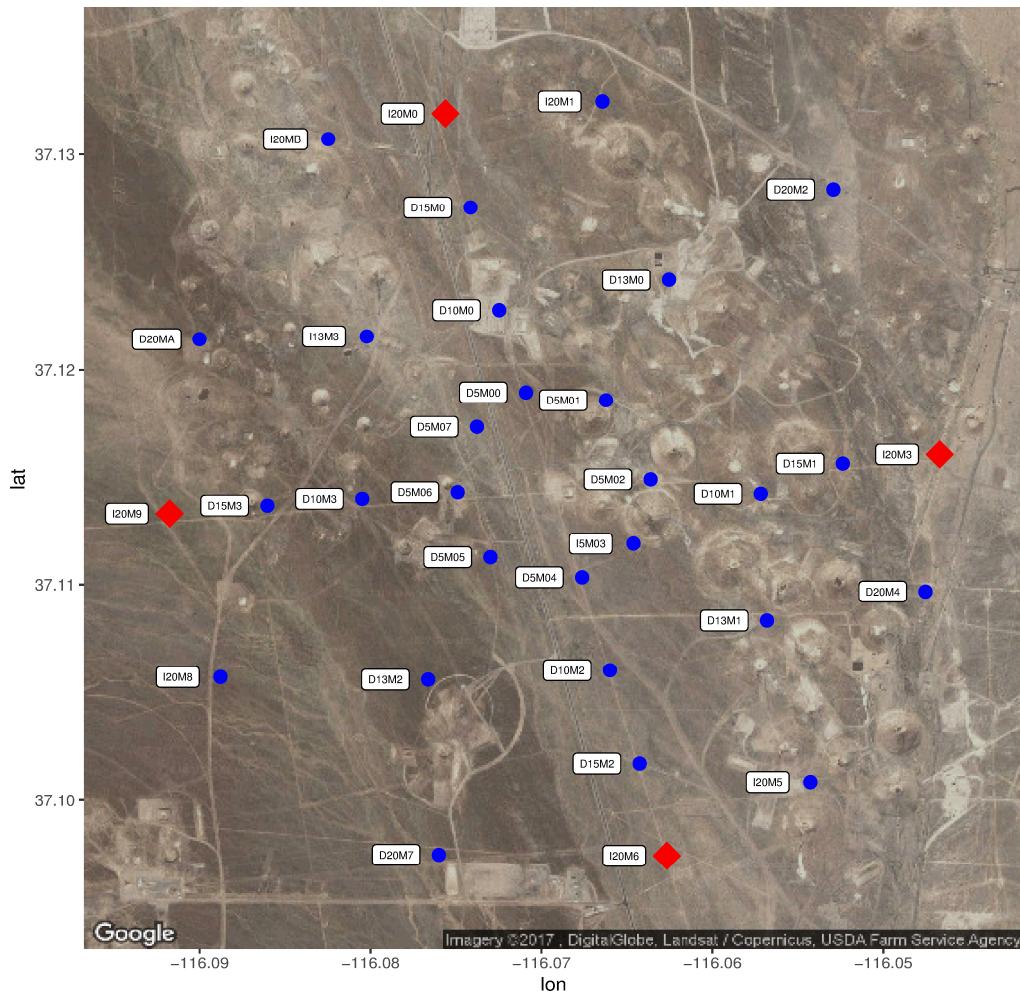
I20M0

I20M3

120M6

I20M9

Install prior to DAG - 1 and run continuously through series.  
Download data after each shot.



# Readiness

## ► Technical

- Design: Off-the-shelf hardware
- Hardware/Assembly
  - Need to source GNSS receivers and verify proper operation (JPL)
- Qualification/Demonstration
  - Since DAG-1 is not expected to produce a measurable signal, it will be used as a test run for DAG 2-4.

## ► Hardware

- GNSS unit and housing
- Interface to existing photovoltaic system

# Readiness

- ▶ Procedures/Checklists
  - Install systems prior to mandatory dry runs for DAG - 1.
  - Verify system operation during DAG - 1, where no signal is expected
  - For the following shots:
    - T – 24 hours: Check unit to make sure it is operating correctly
    - After shot: recover data (no specific timeline)
- ▶ Authorizations
  - Covered under site REOP and Seismic/Infrasound work package
- ▶ Installation Needs from the NNSS
  - Interface to photovoltaic system on ground stations
- ▶ Training
  - No specific training required beyond seismic/infrasound field work

# Risk

- ▶ Risk to Diagnostic Goals
  - Autonomous operation -> risk of unit failure during shot
  - Poorly developed ionosphere (should not be an issue since shots happen late morning/early afternoon)
  - Null detection: not a “risk” as it benchmarks system performance
- ▶ Risk to Personnel
  - Commensurate with seismic/infrasound station maintenance
- ▶ Risks to other diagnostics
  - The unit is an autonomous receiver and will not interfere with other instrumentation or operations on site

## Operations Summary

- ▶ Access needed before shots: **T – 24 hours to verify sensor operation**
- ▶ Location of personnel during shots: **BEEF**
- ▶ Fielding Team: **Danny Bowman (SNL), Mike Pauken (JPL), Attila Komjathy (JPL)**
- ▶ Resources needed from Execution Team
  - **Power from station photovoltaic system**
- ▶ Frequencies provided to NNSS: **N/A**
- ▶ ES&H Concerns: **None specific to this operation**
- ▶ Go/No Go Criteria: **Sensors operating nominally at T – 24 hours**
- ▶ Plans for changing sensor/systems after experiment for the next DAG experiment **None**

## Post Shot Data Deliverable

- ▶ Required deliverable: GPS sounding data from -24 to +24 hours relative to shot; accompanying report
- ▶ Timeline for delivery: 4 weeks
- ▶ Quality analysis: Noise levels in the ionosphere
- ▶ Written documentation: A report describing the experiment setup and sounding results.

## Next Steps

- ▶ Source GNSS receivers and test them (Fall 2017)
- ▶ Install receivers at DAG site (Spring 2018)