Airborne Gravity on the Centaur Optionally Piloted Aircraft

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Background

- NGS Mission Statement
  - To define, maintain, and provide access to the National Spatial Reference System (NSRS) to meet our nation's economic, social, and environmental needs.
  - NSRS is a consistent coordinate system that is the foundation for all geospatial information

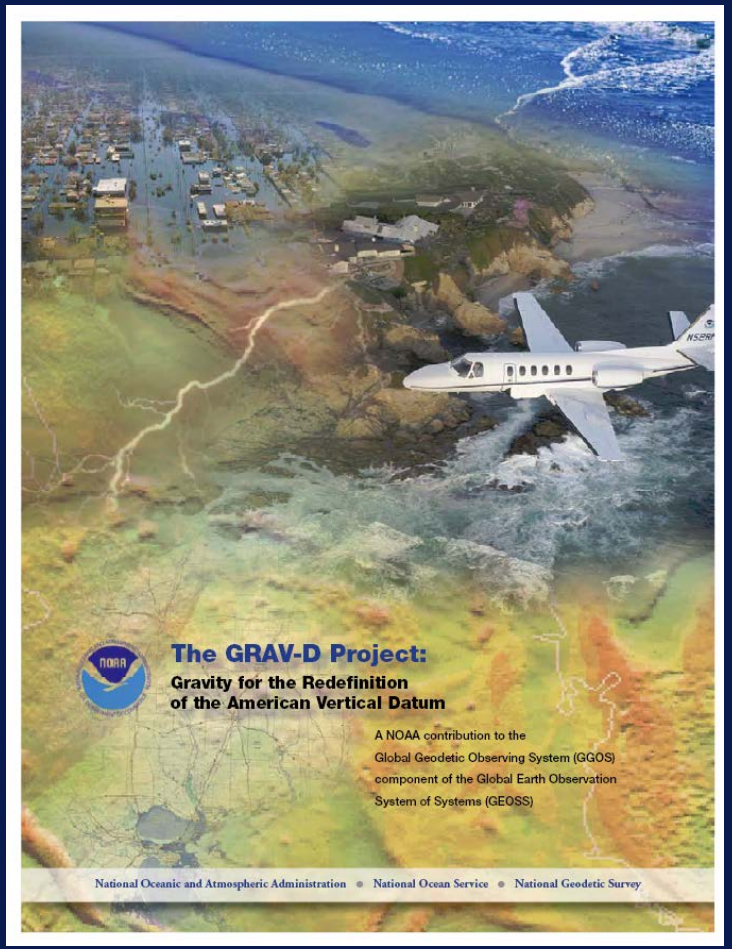
Background

- The GRAV-D (Gravity for the Redefinition of the American Vertical Datum) project is collecting airborne gravity data to support a new vertical datum (reference surface for heights)
- Accurate heights are critical to many applications
  - Ex. transportation and infrastructure development, floodplain mapping, coastal resilience, precision agriculture

- Supports NOAA goals:
  - Coastal resilience
  - Safe and efficient marine transportation
- Supports NOS goals:
  - Safe and efficient transportation and commerce
  - Preparedness and risk reduction

Background

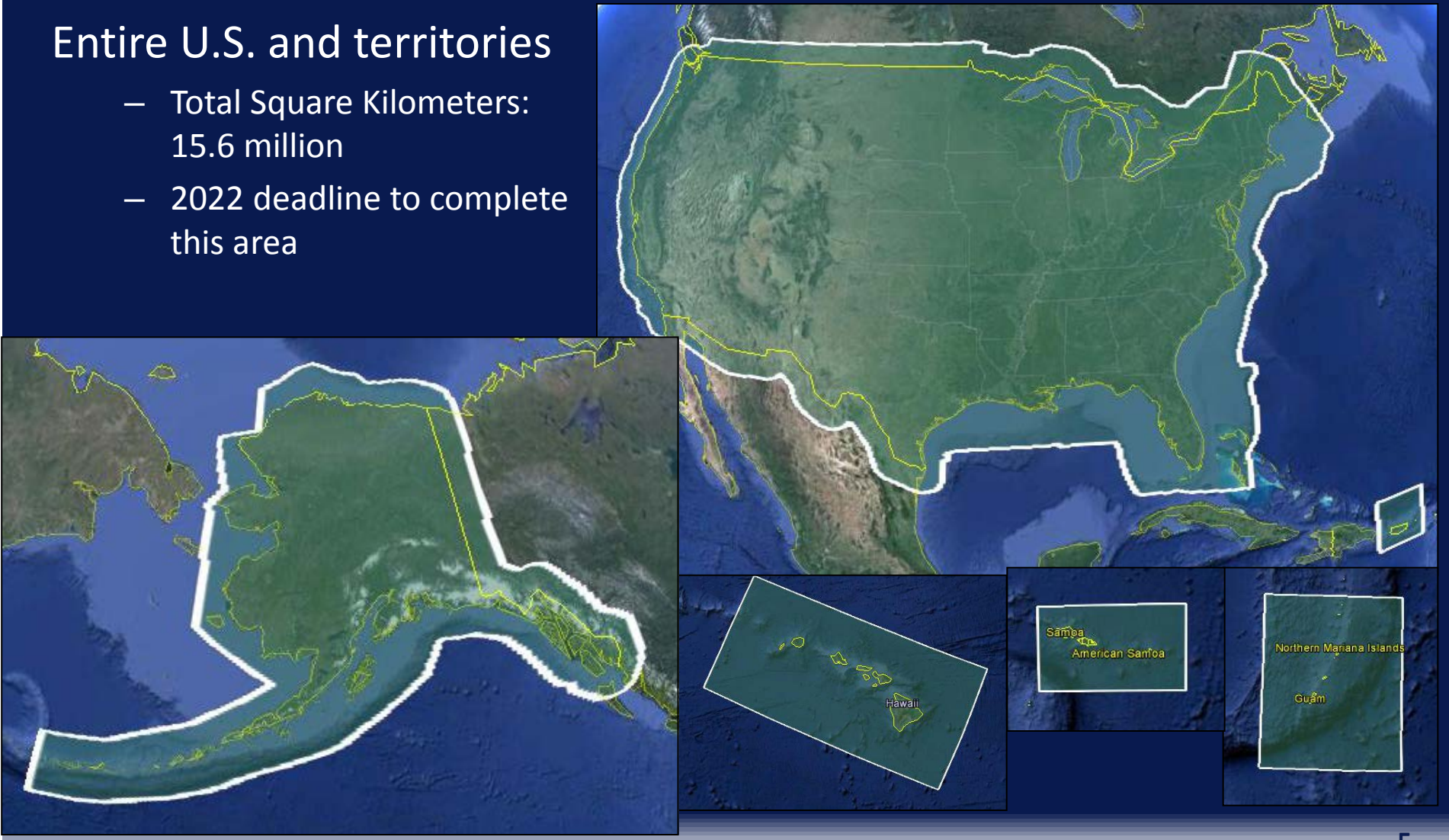
- **Overall Target**: 2 cm accurate orthometric heights from GPS and a geoid model
- **GRAV-D Goal**: Create gravimetric geoid accurate to 1 cm where possible using airborne gravity data
- **GRAV-D**: Two thrusts of the project
  - Airborne gravity survey of entire country and its holdings
  - Long-term monitoring of geoid change



Background

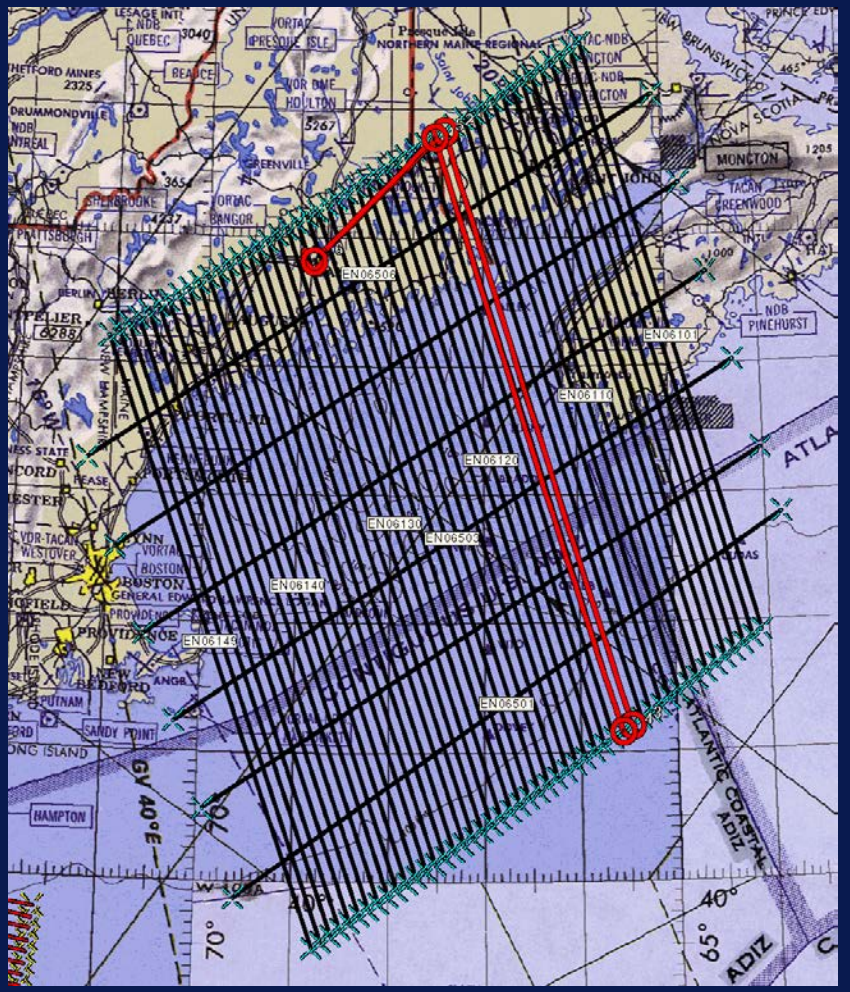
Entire U.S. and territories

- Total Square Kilometers: 15.6 million
- 2022 deadline to complete this area



Project Challenges

- Operational
  - Long, boring flights
  - Large area to cover with some long distances (Aleutians, Pacific Islands)
  - Aircraft stability critical for good data
- Management
  - Efficiently covering the entire country in terms of cost and time
- No known research or operation with gravity on a UAS



SBIR – Phase I

- Small Business Innovation Research (SBIR) Grant
  - Goal to collect airborne gravity data from a UAS
  - Request for proposals and award in 2013
  - Aurora Flight Sciences was selected to with support from Micro-g Lacoste
  - Phase I was a feasibility study

SBIR – Phase I

- Centaur OPA
  - Optionally Piloted Aircraft with three modes (manned, unmanned, and safety pilot)
  - 44 ft wingspan x 28 ft length
  - Ceiling of 27,500 ft
  - 24 hour flight endurance with 200 lb payload
  - Top speed of 175 KTAS, 135-160 typical

SBIR – Phase II

- Phase II involved performing field tests of the instrument/aircraft suite
- Conducted in April 2016 in Manassas, Virginia
  - 5 flights over existing data for comparison
  - Combination of East/West and North/South flights
  - Operated with a safety pilot

SBIR – Phase III

- Phase III is transitioning the technology to operations funded by the project
- A contract is in place to use this technology for operational surveying for the GRAV-D project
  - The first full survey will start March 13th and be the final test
  - Surveying from Winston-Salem, NC over western NC/eastern TN

SBIR – Commercialization

- Benefits to the public
  - Improving airborne gravity surveying through higher quality data, potential cost savings, and lower environmental impact and pilot fatigue
  - Industry uses in Transportation and Oil/Mineral/Gas Exploration
- Example of commercial use
  - Used for a commercial survey for the California Department of Transportation

Collaborators

- SBIR
  - Aurora Flight Sciences
  - Micro-g Lacoste
- NOAA
  - OAR/UASPO
  - OAR/TPO
  - NOS/NGS

Collaboration with UASPO

- Support from UASPO includes
  - Guidance through SBIR process
  - Identifying funding for SBIR Phases I & II
  - Knowledge of UAS capabilities and opportunities
  - Development of transition plan

Scientific/Technical Challenges

- Automation
  - Gravimeter needs to be automated for recording data
  - At a minimum proving to connect and operate from a ground station
- Aircraft range
  - Researching options for longer range aircraft

Future Directions

- Operational Surveys
  - Evaluate first full survey test
  - Incorporate into regular surveying based on results
- Long Range UAS
  - Identify potential opportunities to integrate and test on a longer rather UAS