The Latest Airship Technology From Near Space Corporation

Airships: A New Horizon for Science
Keck Institute for Space Studies
Cal Tech
1 May, 2013

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Unpowered Airships, Tactical Balloons, Return Vehicles, and Some Good Places to Fly

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FOCUS

Briefing Focus:

- HOW
- WHERE
- WHEN
- ~~WHY~~

Bridging The Gap To Space

Lightweight Science Payloads on High Altitude Long Duration Balloons and Airships

Provider of Near Space Solutions

HISTORICAL NOTE

LCANS 2009 - NCAR Mesa Lab, Boulder, Colorado

SOME INITIAL OBSERVATIONS

Bridging The Gap To Space - Lightweight Science Payloads on High Altitude Long Duration Balloons and Airships

Everything is Relative:

- Gap to Space
- Lightweight ('PongSAT', 6 lbs, 80 lbs, 2000 lbs)
- Science
- High Altitude (60-70kft, 100kft, 130kft, 170kft)
- Long Duration (2 days, 60 days, 100 days, several months, 744 days)
- Balloons and Airships (weather balloons, polyethylene zero-pressure, polyethylene superpressure, zylon, re-usable multi-layer envelopes)

SOME INITIAL OBSERVATIONS

Bridging The Gap To Space - Lightweight Science Payloads on High Altitude Long Duration Balloons and Airships

Everything is Relative…. Including:

- Costs ($2,500, $100k,$3M, $25M, $200M+)
- Performance (“let’s see what happens”, 95% success rate)
- Schedule (few months, few years, “sometime during my career”)

FOCUS OF PRESENTATION

NSC's Part of High Altitude Ballooning:

- Background
- Experience
- Markets/Customers
- Core Capabilities
- Applicable Technology/Systems


Space
Defense
Climate
MARKETS
Technology Development
Concept Evaluation
NSC
Near Space Corporation
SERVICES
Platforms
Test Facilities
Flight Ops

CAPABILITIES

Engineering

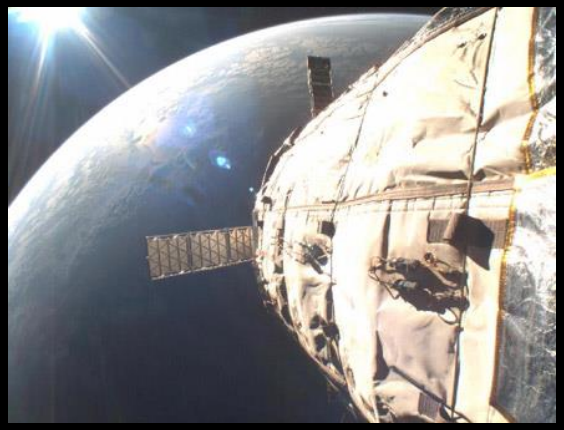
- Design
- Analysis
- Integration
- Testing

Manufacturing

- Prototyping
- Fabrication
- Assembly

Flight Operations

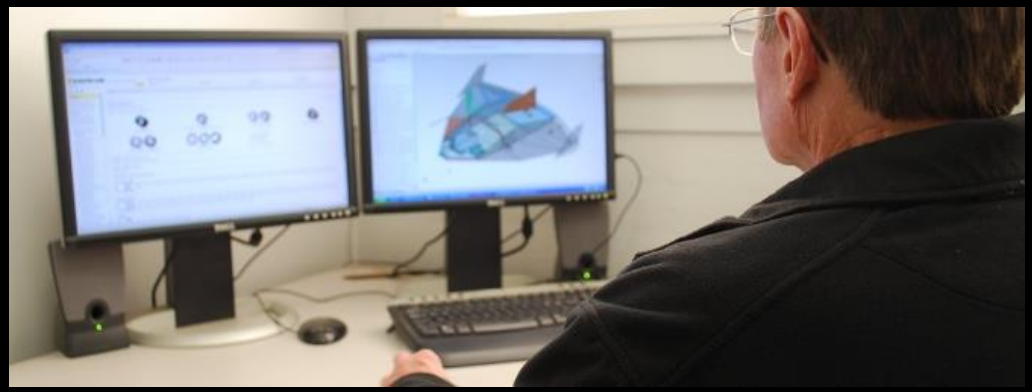
- FAA Coordination
- Mission Planning
- Balloon Flights



CAPABILITIES

Engineering

- Specialize in custom inflatable, balloon, material, and mechanical engineering
- Balloon design and analysis using custom tools and software
- Flight train hardware design, testing, and certification
- In-house testing capabilities
    - Materials characterization
    - Elevated and cold temperature testing
    - Altitude chamber testing (pressure, density, and temperature up to 130,000 ft std atm)
    - Hangar Inflation tests



CAPABILITIES

Manufacturing

- Fabrication
  - Hot wheel, band, impulse, and RF sealers
  - Computer controlled and manual sewing machines
- Assembly
  - On-site staff skilled in handling inflatable articles & vehicles

Assembly / Inflation / Integration

Versatile Sealer Technology

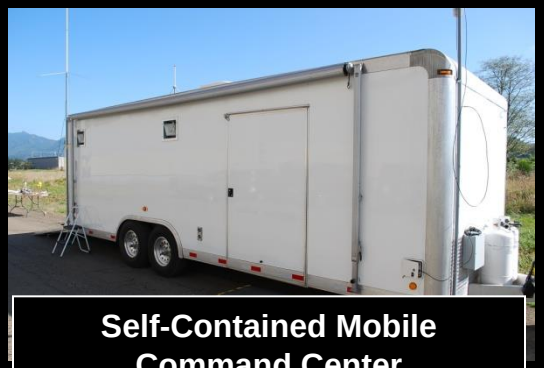
CAPABILITIES

Flight Operations

- FAA coordination, mission planning, & operations oversight
- Equipment on-site: 25 ton crane, service truck (“dually”)
- Tracking aircraft for airspace de-confliction, telemetry, filming, etc.
- Self Contained (air-conditioned) Mobile telemetry & command trailer

25 Ton Crane

Tracking Aircraft



Self-Contained Mobile Command Center

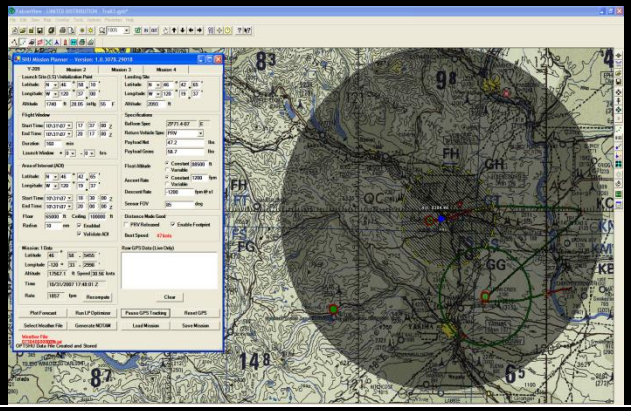
Recovery Vehicles

CAPABILITIES

Flight Operations

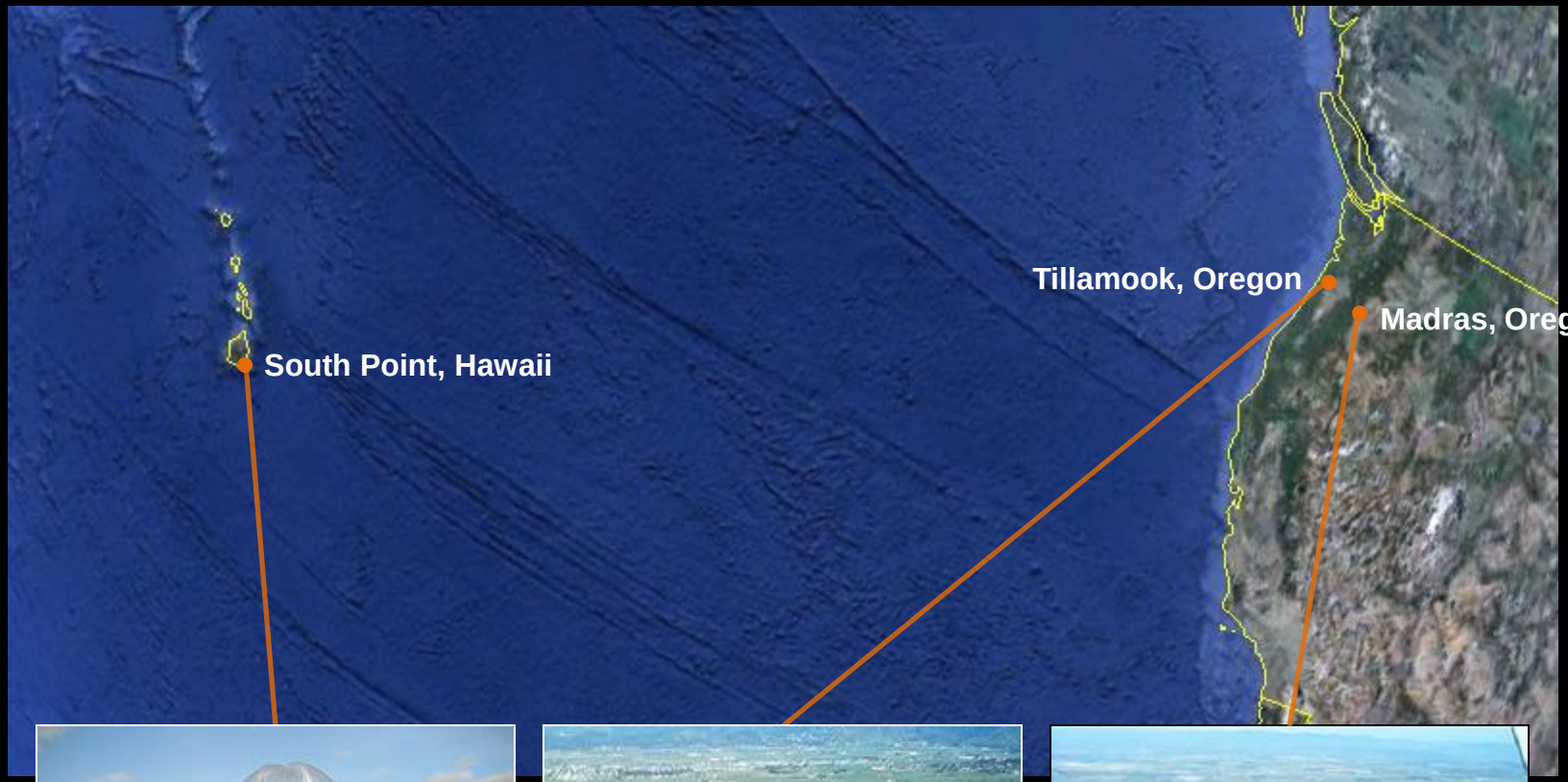
- Mission planning and tracking software
  - Trajectory forecasts and real-time monitoring
- Portable situational awareness system
  - VHF GPS beacons and multi-target tracking software
  - Displays target locations on Google Earth
  - Tracks multiple air and ground assets simultaneously with continuous range, bearing, course and speed data
  - Stand alone units located in tracking aircraft, recovery vehicles, etc.

NSC Telemetry Trailer Command Center



NSC Mission Planning Software

ESTABLISHED NSC LAUNCH LOCATIONS



TILLAMOOK FACILITIES

WWII Blimp Hangar

- 1,072 ft Long x 296 ft Wide x 192 ft High
- Ideal for prototype inflation
- Balloons inflated inside, moved out

Tillamook Airport

- Low use, good for balloon launches
- Blimp mooring areas for operations
- Low population density area

W-570 Special Use Airspace

- 24 miles off coast of Tillamook
- Ocean surface to 50,000 ft.
- NSC is member of Western Air Defense user's group (same priority as DoD members)


WWII Blimp Hangar


Tillamook Airport

NEW TILLAMOOK FACILITY – INTEGRATED OPERATIONS

Highly Integrated Facility

- Engineering
- Production
- Payload/Platform Integration & Testing
- Currently completing construction (Initial Operating Capability Scheduled for April 2013)

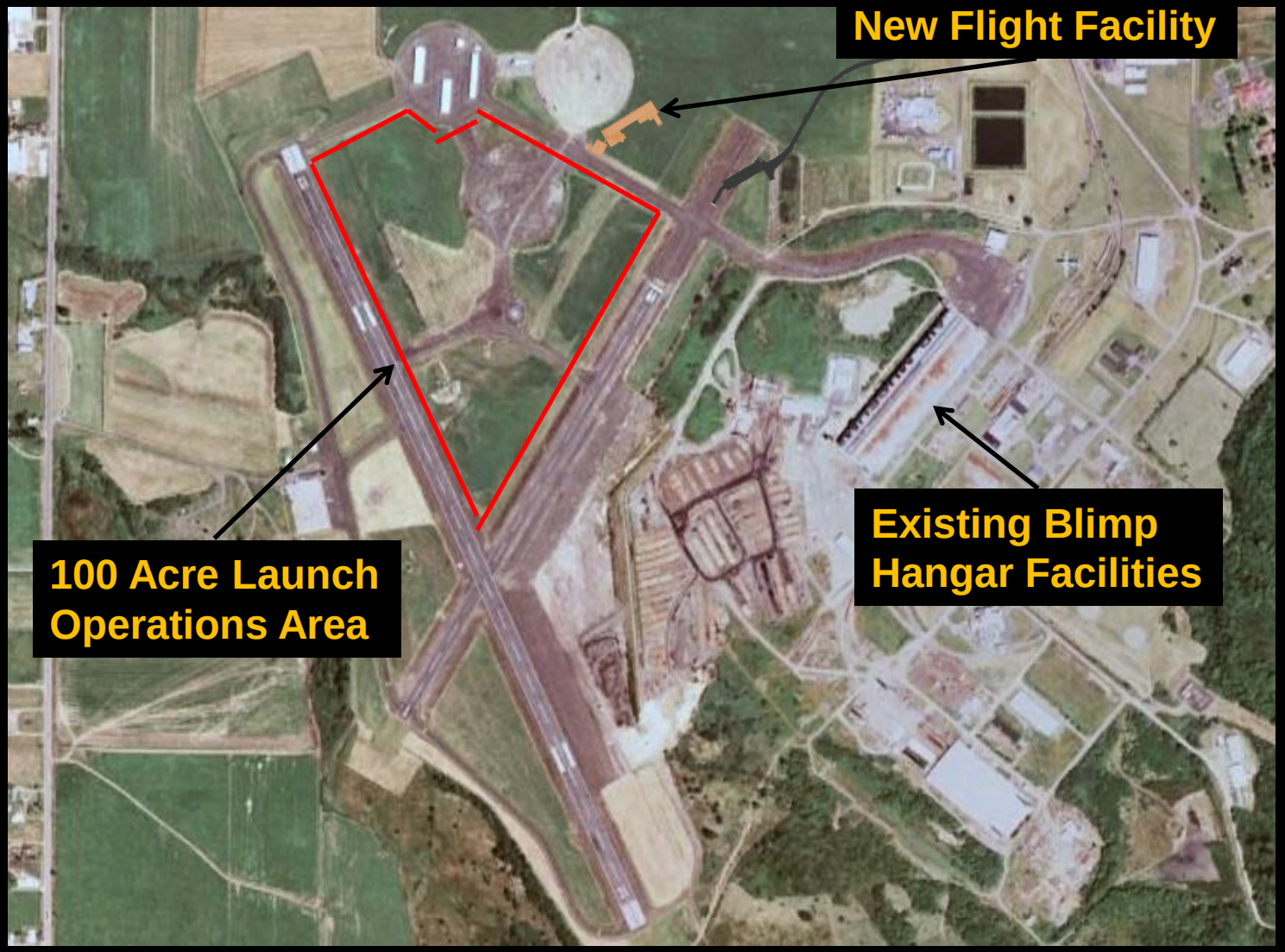
NEW TILLAMOOK FACILITY – AIRSIDE OPERATIONS

Through the Fence Operations

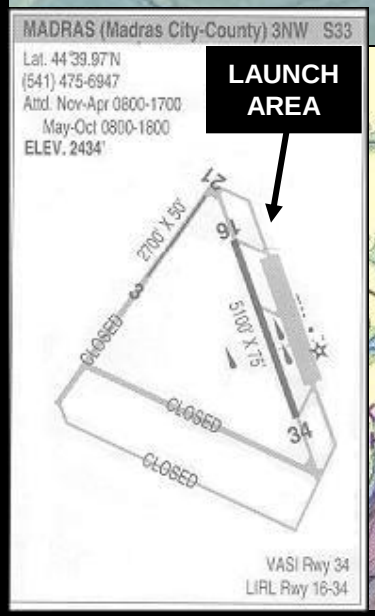
- Large Integration Hangar
- Command Center/Observation Tower
- Direct Access to Launch & Recovery Areas

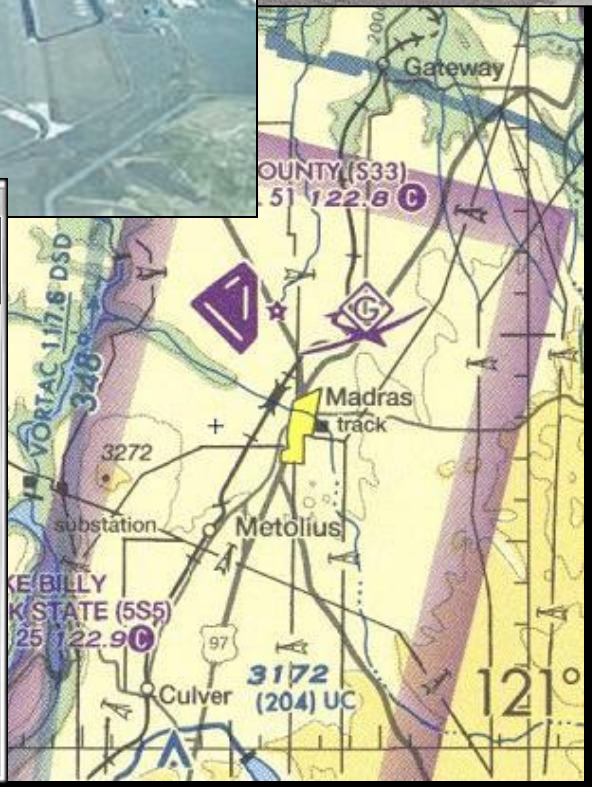
Johnson Near Space Center (JNSC) – Initial Operations May 2013

JNSC SITE Map



MADRAS LAUNCH SITE





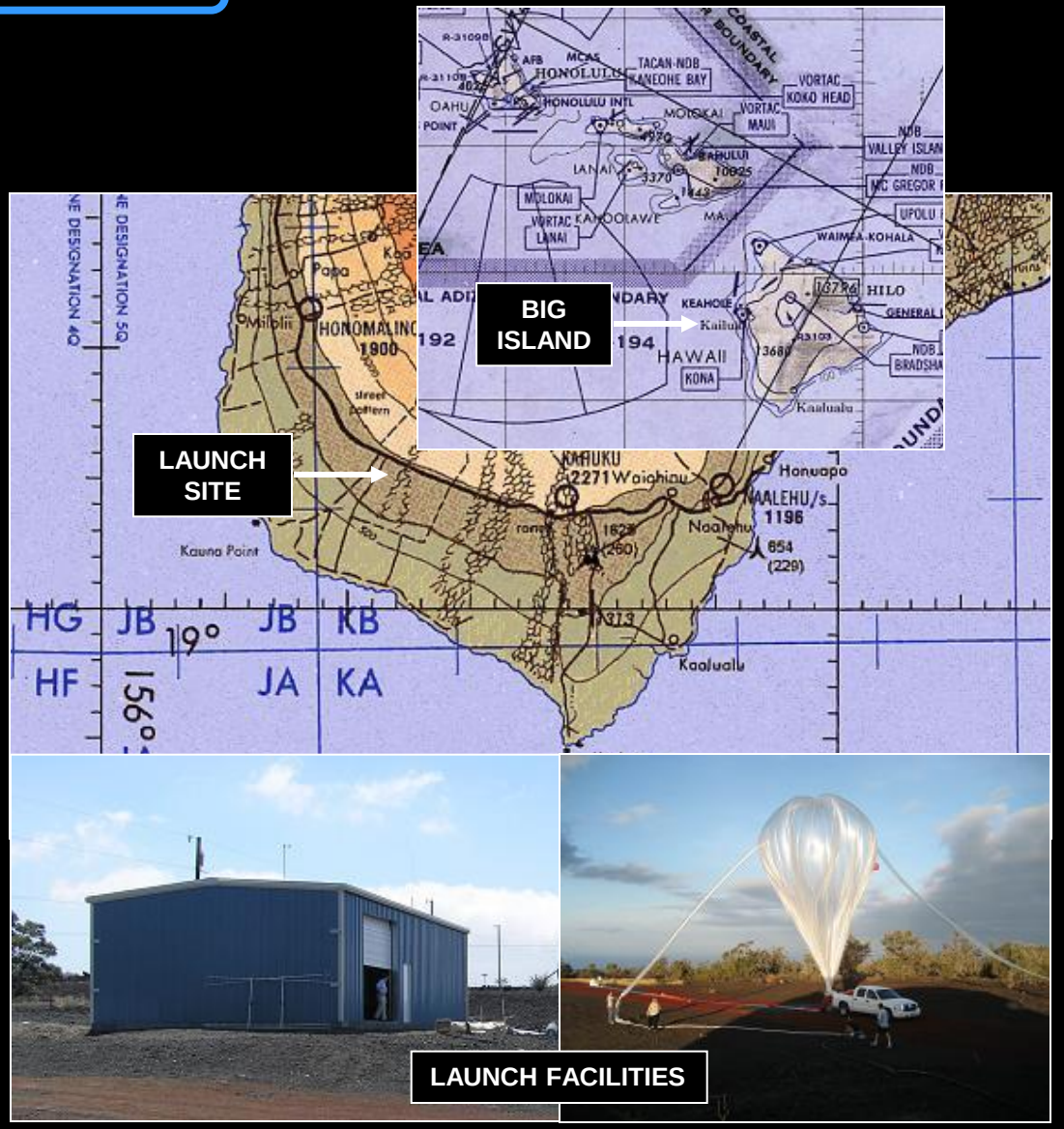
Madras Airport, Madras, Oregon

- 117 miles SE of Portland
- Low-use public airport
- Low use, good for balloon launches
- Low population density area

HAWAII LAUNCH SITE

South Point, Hawaii

- Island of Hawaii (“Big Island”)
- 47 miles South of Kona
- Moderate climate
- Fly over open ocean
- Moderate climate
- Low population density area



COMMERCIALLY OFFERED NANO BALLOON SYSTEM (NBS)

- Standard Service
  - Payload Mass:1 kg (2.2 lbs)
  - Payload Size: 10 cm x 10 cm x 10 cm (0.4” x 0.4” x 0.4”)
  - Services To Payload: Passive Payloads Standard
  - Float Altitude: Up to 30 km (98 kft)
  - Duration at Float Altitude: Up to 3 hours
  - Location: Tillamook, Oregon
  - Benefits:
    - Rapid Integration
    - Operates Under Minimal FAA Regulations
    - Offers Longer Duration than Neoprene Balloon

- Non-Standard Services
  - Greater Payload Masses
  - Higher Float Altitudes
  - Longer Durations at Float Altitude
  - Remote Launch Locations
  - Payload Thermal Insulating Containers for Different Payload Volumes
  - Command Signals and Onboard Data Storage

NBS Polyethylene Balloon

NBS Avionics Housing

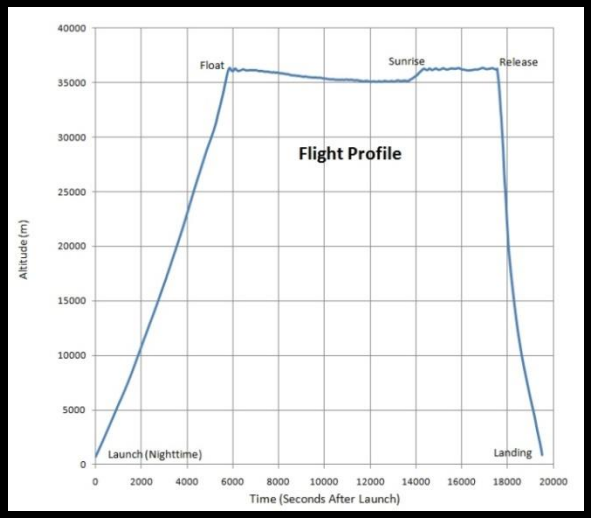
NBS Payload Thermal Insulating Container

COMMERCIALLY OFFERED SMALL BALLOON SYSTEM (SBS)

Features:

- Command, Telemetry, & Onboard Data Storage
- Float Altitude: Up to and Beyond 35 km
- Duration at Float Altitude: Up to 24 hrs
- Standard Interfaces for Streamlined Integration
- Payload User's Handbook Available
- Rapid Payload Change-Out for Rapid Re-Flight

SBS Prototype Flight – Nighttime Launch



Time (seconds) vs. Altitude (m) of Example SBS Mission

SBS Avionics Housing

RECENT NASA FOP NMT SBS FLIGHT

NASA Flight Opportunities Flight for NMT:

- Flown 20 January 2013 from NSC Madras Launch Site
- New Mexico Tech Payload
- Payload Sponsored by FAA AST (Commercial Space)
- Flight Sponsored by NASA OCT FOP
- Prototype Technologies for Structural Health Monitoring
- Provided relevant environment (~101,500 ft)
- Float Duration (~1hr)
- Multiple Experiments

NMT SBS PAYLOAD CHECKOUT

NMT SBS FLIGHT TRAIN (Post Launch)

NMT SBS PAYLOAD (Post Landing)

HASS Hybrid Platform – Stratospheric Balloon/Return Vehicle

Tactical Launch

Stratospheric Operations

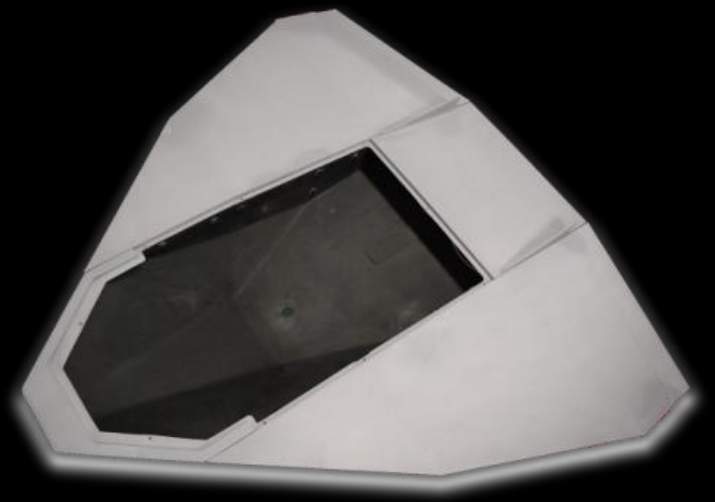
Payload Return

Demonstrated HASS Capabilities

10+ kg payloads
- Shuttle has been demonstrated w/ 15 kg science payload
- Tactical launch system currently handles up to 45 kg (w/ parachute recovery instead of glider)

20-30 km altitudes
- Up to 40 km possible with custom balloon envelope & larger launch bag

6 to 24+ hour flight durations
- Extended time at altitude
- Ballast required to fly through sunset



Streamlined operations
- Flexible Payload Bay Provides Easy Integration
- Rapid Payload Changeout
- Launched with 3 man crew in up to 30 kt winds
- Autonomous flight and landing capability
- Radar/RF Transparent Shell
- Non-turbulent Flight Environment

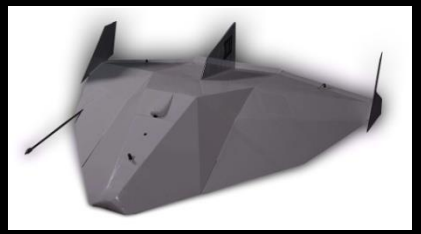
High-speed Descents
- .8 Mach max design speed (have demonstrated transonic flight)

Autonomous Return and Landing

HASS Persistence

Persistence Through Constellation Replenishment

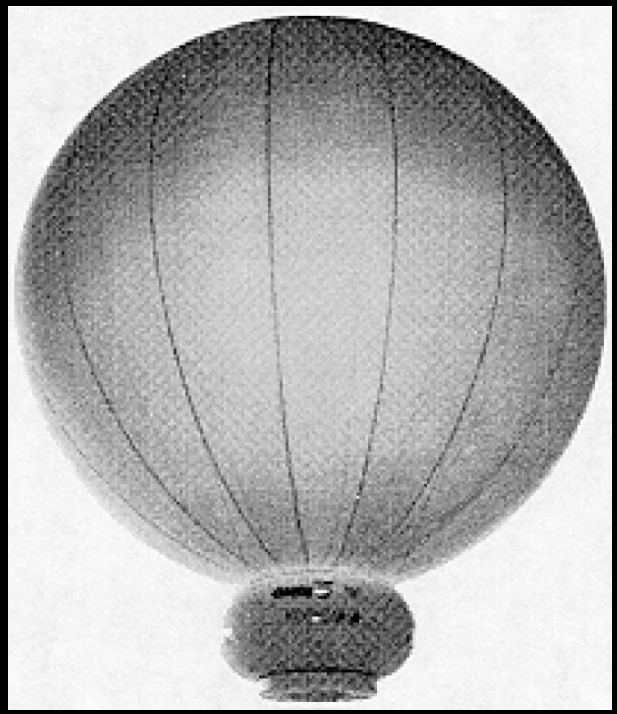
- Platform uses tactical balloons which allows:
  - Launch in up to 30 knots from austere location and minimum launch crew
  - Altitude tuned immediately prior to flight for best duration over target (slowest wind speeds)
  - New platform is launched to maintain desired effect
  - Multiple platforms can provide spatial observations and provide line of sight data relay



NSC WindStar Balloon Technology

Long Duration – Altitude Control

- NOAA GAINS Program (Planned for a Constellation of 400 platforms)
- Global Capability
- Can Modify Flight Trajectory (via Altitude Control)
- Up to 150kg Payload
- Up to 80kft Altitude
- 100 day duration



NOAA Smart Balloon

Composite Spectra Shell, Polyethylene Bladder and Polyurethane Helium Cell (Based on NSC Windstar Technology)

- Iridium C3 System
- Battery Powered Pump
- Low Altitude Tracer

DRIFTSONDE

Driftsonde Balloon Platform

- Stratospheric balloon lifts 50+ sounding devices to ~100 kft
- 23 Launched from NSC Hawaii Facility as part of TPARC
- Balloon drifts over Pacific toward Southeast Asia
- Sounding devices (dropsondes) drop to measure temperature, pressure, moisture, position, time, and velocity
- Partnership with NCAR, (part of NSF) & CNES (French space agency)
- In situ measurement data used to create more accurate weather models, validate satellite data

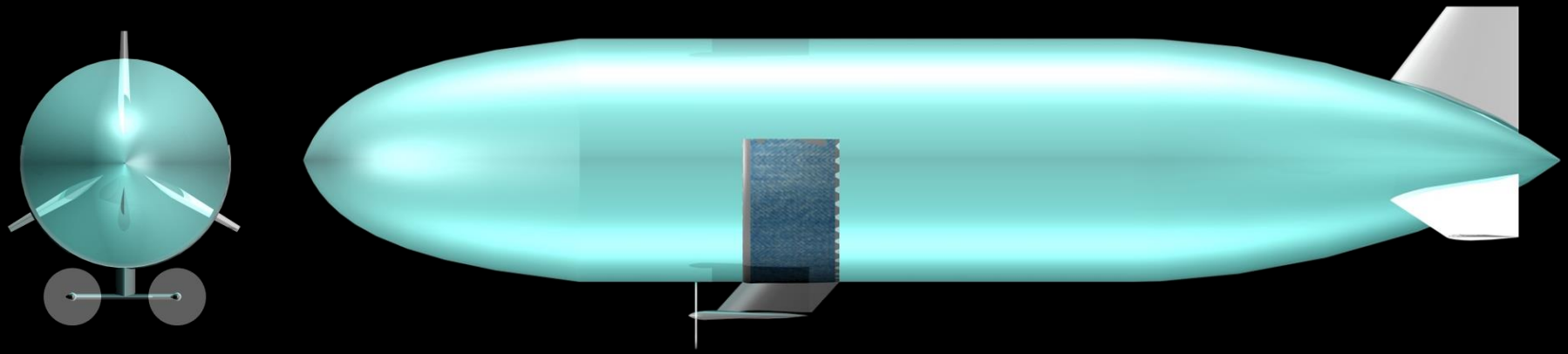
Driftsonde Balloon Inflation

Dropsonde

STRAT

Stratospheric Reconfigurable Airship Testbed (STRAT)

- Expendable – Mission Customized Envelope
- Powered Payload Return Vehicle
- Hangar Inflated and Tested
- Multi-day Duration
- Relative Persistence/Maneuverability
- <100kg to <80kft
- NDA required to learn more



WHEN

When?

- Most stuff off the shelf or within a few (couple) months
- HASS – flying end of May from Tillamook
- Tactical Balloons – >75lbs on the shelf
- Windstar systems 3-6 months
- STRAT – 12 to18 months for initial demo (pending funds)

CONCLUSION

Questions?

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