FLOATing DRAGON Balloon Challenge

Q&A Session #1
April 29, 2022

https://floatingdragon.nianet.org

(please mute your mic)

National Institute of Aerospace

FLOATing DRAGON is managed by the National Institute of Aerospace on behalf of NASA's Wallops Flight Facility's Balloon Program Office.

AGENDA

- Welcome & Introductions
- Context for the Challenge
- General Technical Remarks
- General Programmatic Remarks
- Questions
- Wrap Up

NIA PROGRAM TEAM

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Program Coordinator

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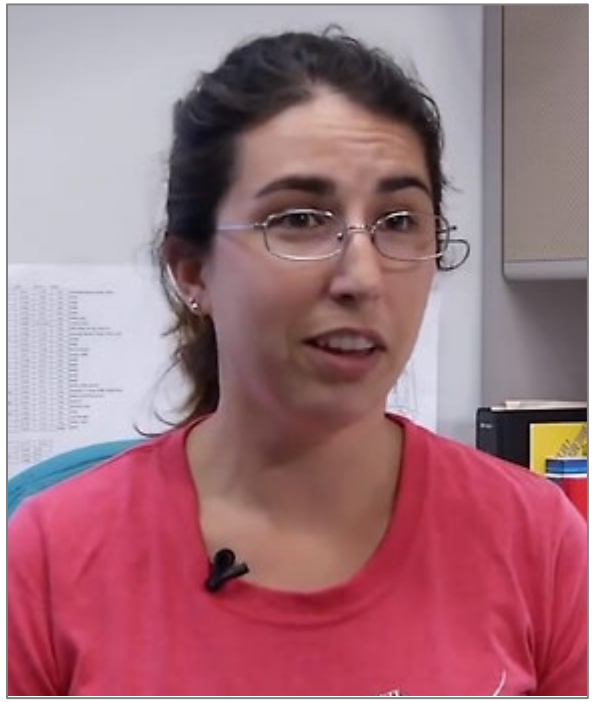

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FLOATing DRAGON: Formulate, Lift, Observe, And Testing; Data Recovery And Guided On-board Node

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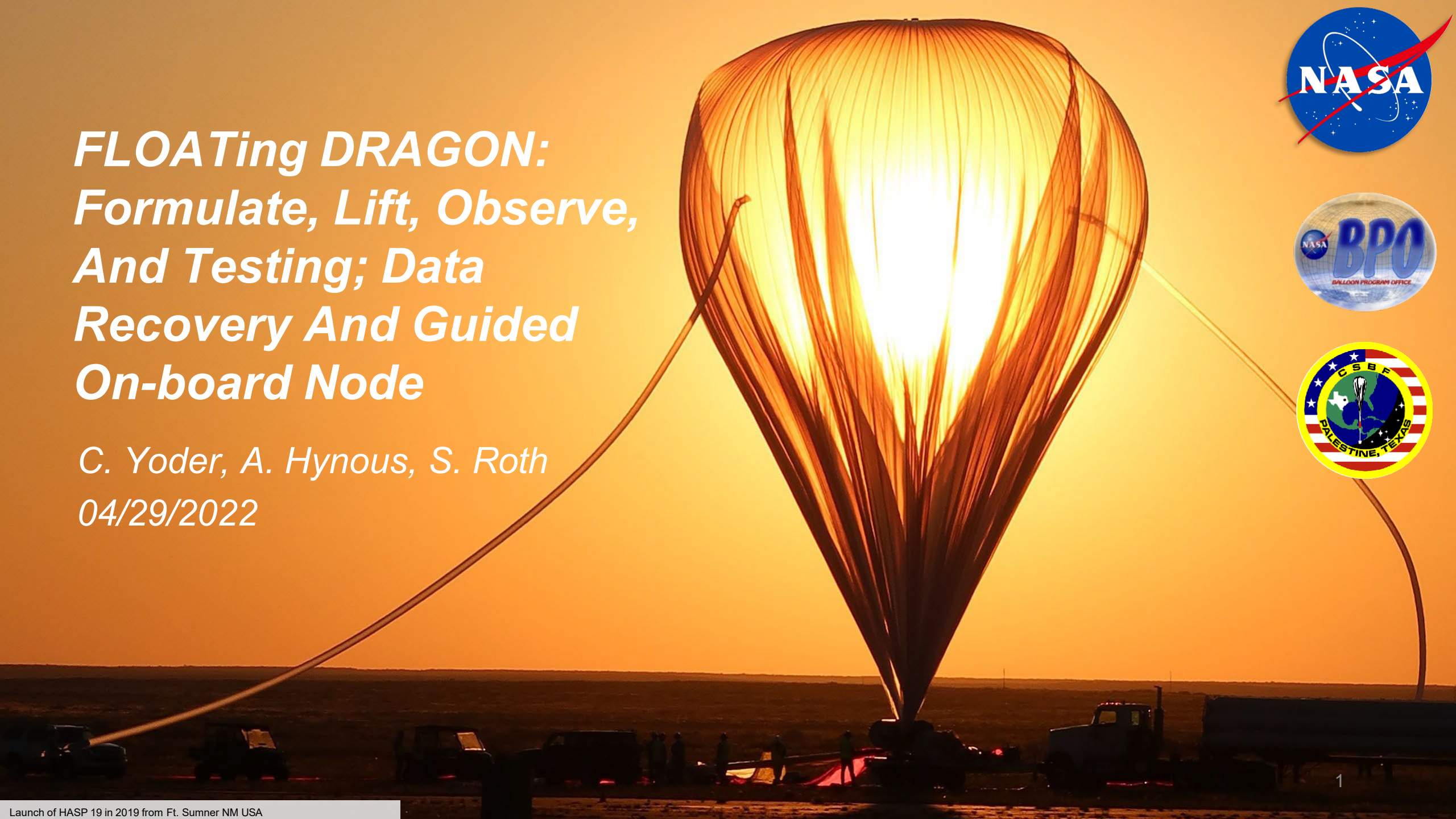
04/29/2022



Launch of HASP 19 in 2019 from Ft. Sumner NM USA

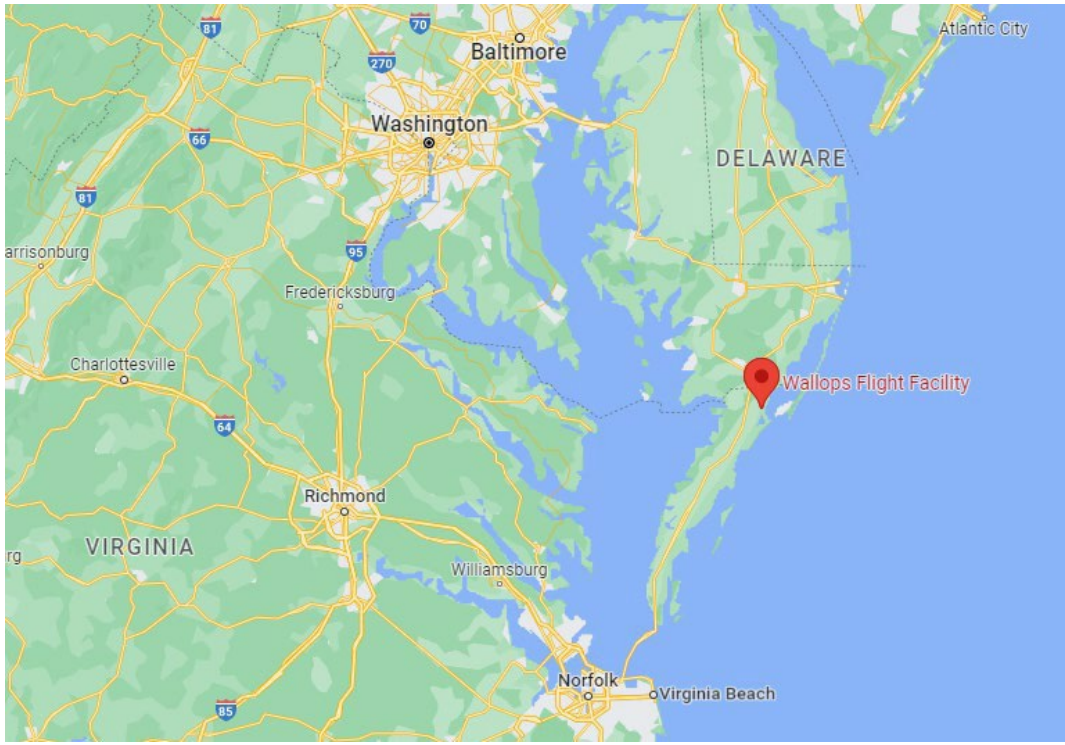
Agenda

- *Background*
  - *Balloon Program Office overview*
  - *Balloon sizes*
  - *Challenges with large datasets*
- *DRAGON overview*
  - *Overview of the challenge*
  - *CONOPS of the flight demonstration*
  - *Preliminary timeline*

Inflation of a ZPB bubble at Ft. Sumner, NM, USA.

Balloon Program Office

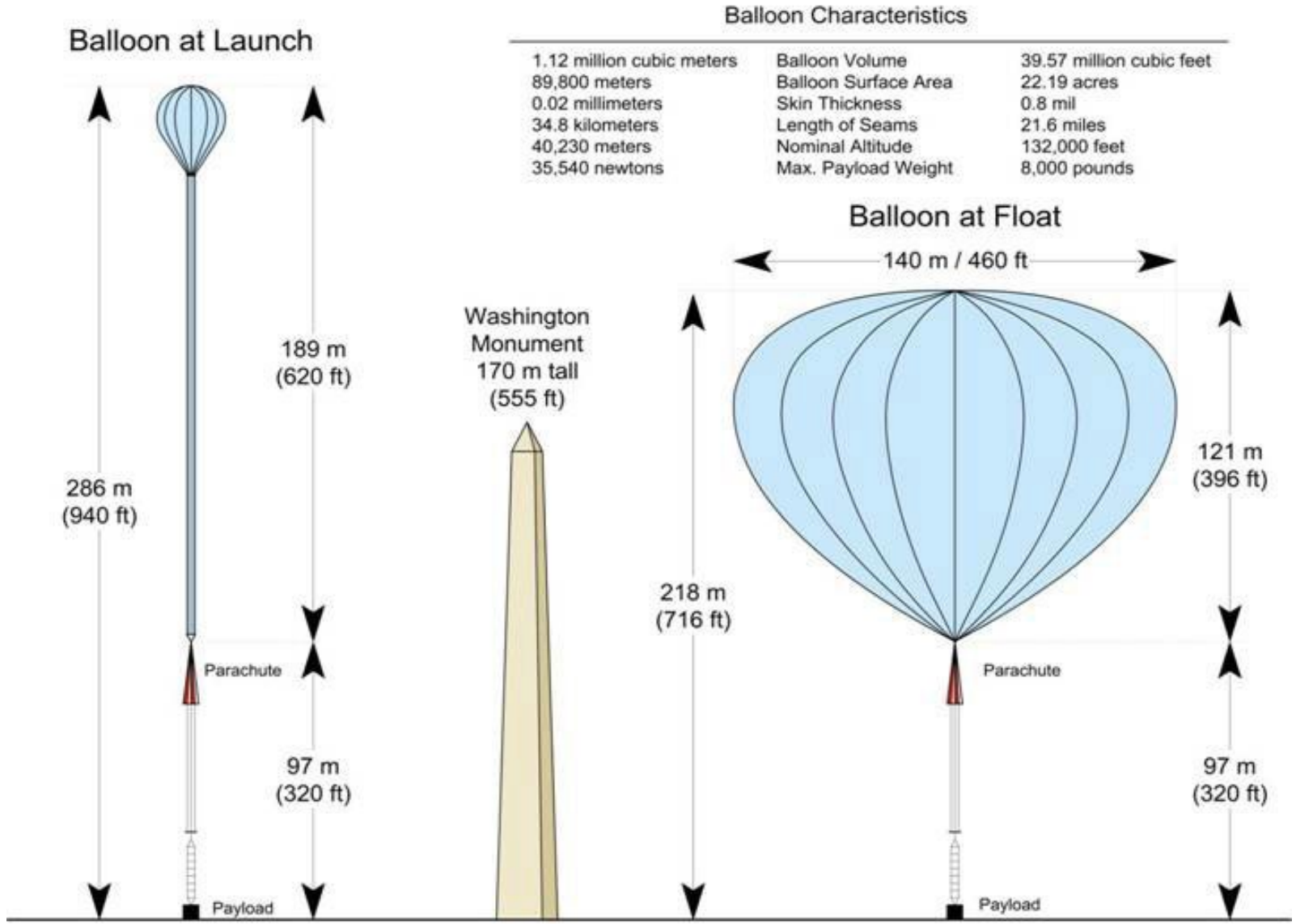
- *NASA's Balloon Program Office is managed by Goddard Space Flight Center (GSFC) out of Wallops Flight Facility (WFF).*
- *Launch 10-20 scientific balloon missions every year from all over the world, including:*
  - *CONUS (Texas, New Mexico)*
  - *Long Duration Balloon (Sweden, Antarctica)*
  - *Ultra Long Duration Balloon (New Zealand)*
- *Two types of balloons*
  - *Zero Pressure Balloon*
    - *Helium lift gas, open at the base, limited by diurnal cycles due to venting lift gas*
  - *Super Pressure Balloon*
    - *Helium lift gas, closed volume, good altitude stability over diurnal cycles, longer duration*



Map screenshot showing Wallops relative to other well-known locations.

Balloon sizes

- *These balloons are large*
  - *Volumes range from 1 mcf (0.028 mcm) to 60 mcf (1.7 mcm)*
  - *Altitudes from 90 kft (27.4 km) to 160 kft (48.7 km)*
  - *Payload weight from ~500 lbs (227 kg) to 8000 lbs (3629 kg)*
- *Payloads are designed, delivered by scientists*
  - *Telescopes, particle physics, coronagraphs, etc.*



Comparison of a 39mcf balloon during launch and inflation to the Washington Monument.

Data collection – the issue

- *Upcoming missions are proposing to collect **A LOT** of science data during flight.*
  - *100 TB of data is prohibitively large to telemeter, especially in over-the-horizon mode.*
  - *Mitigate the risk: loss of the balloon or experiment can imply loss of data for science*
- *Science teams are requesting alternate methods for data retrieval*
  - *Common idea: drop data "vaults" from the balloon during flight.*
  - *Periodic data recovery, analysis during an LDB/ULDB mission.*
- *This type of system is coming.*
  - ***It is a question of when, not a question of if.***
  - *BPO wants to get out ahead of the need and be proactive in the design, development, testing, and implementation of such a system.*

Layout of a ZPB prior to launch in Antarctica.

Challenge overview

- *FLOATing DRAGON: Formulate, Lift, Observe, And Testing; Data Recovery And Guided Onboard Node*
  - ***Goal: to design and prototype ideas for data vault recovery systems.***
  - *Desire: a guided system which can "gracefully fall" to a pre-determined,* ***safe*** *waypoint for recovery by a ground team.*
  - *https://floatingdragon.nianet.org/*
- *Student groups have heritage flying on balloons*
  - *Cubes in space, HASP fly routinely for CONUS mission*

An image of Cubes In Space above Ft. Sumner, NM.


HASP pre-launch in Ft. Sumner, NM.

CONOPS – always fly with safety in mind

- *Issue a challenge to college student teams*
  - *Groups propose, WFF down-selects to four based on design, performance, creativity, etc.*
  - *Review team will include a collaboration between BPO, ETD, and Wallops Safety.*
  - *Prototypes have both deployer and node for flight.*
- *Deployer*
  - *Mounts to a HASP-type gondola, receives a signal from CSBF to drop node. Houses all supporting hardware.*
- *Node*
  - *Released from the deployer with data vault.*
  - *Autonomously selects waypoint, travels to the ground.*
- *In flight, teams have 1-hour post-float to release their node*
  - *We (BPO/CSBF) provide trajectory predict and sounding file, they tell us when to drop*
  - ***Waypoints are predetermined and approved by Flight Safety***

Schedule – organized around the school year

- *04/29/2022:* *Virtual Q&A sessions for students with BPO*
- ***09/15/2022 NOI:*** ***Notice Of Intent (to participate), initial concept details***
- *10/20/2022 PDR:* *Preliminary Design Review and review package*
- *01/08/2022 CDR:* *Conceptual Design Review and review package*
- *01/30/2023:* *WFF will down-select to four teams, construction begins*
- *05/18/2023 SDR‡:* *Software Design Review and review package*
- *07/02/2023 MRR:* *Mission Readiness Review and review package*
- *08/15/2023 INT:* *Integration and Testing at Ft. Sumner, NM*
- ***10/16/2023:*** ***Flight complete, data returned to students***
- *12/03/2023:* *Closeout and final report with experimental results*

‡SDR requires a demonstration of 95% confidence in finding best waypoint subject to real, WFF-provided balloon trajectories.

Questions?

Requirements – given as design requirements

Deliverables:	**1x deployment subsystem, 1x node**
1. Weight:	10 kg (22 lbs) or less, total system mass
2. Shock:	Survive 10g shock or higher without yielding, both subsystems
3. Environment:	-70C to +65C, -30C nominal at 33.5 km (120 kft)
4. Dimensions:	Deployment subsystem must fit within 120 cm x 45 cm x 45 cm and house the node subsystem until deployment
5. Payload:	1x data vault, 12.5mm x 75mm x 100mm, 1 kg
6. Deployment:	Deploy when receiving 5-28 VDC from the gondola via pigtails, must deploy within five minutes of receiving signal.
7. Mounting:	Mount vertically to 2” Aluminum ‘L’ channel with 3x ¼-20 bolts on 100mm (~4-inch) spacing
8. Descent time:	1.5 hours or shorter
9. Accuracy:	Land within 0.25 km (820 ft) radius of the targeted coordinate
10. Communications:	If using a computer or microcontroller, one physical point of communication (e.g. USB port, Ethernet port, etc.) required on the outside of the deployment subsystem to verify operation post compatibility test.
11. Safety:	Must fail safe in the event of loss of power (to the system) **Must retain the node in the event of a failure to drop** (i.e. an attempted deployment of the node which results in the node staying attached to the deployer).
12. Prohibited items:	Thrusters, rocket motors, liquid propellants and rocket engines (i.e. no SpaceX-style or JPL sky-hook landing systems), compressed gasses (i.e. no balloons or blimps attached to the node), high-voltage sources, excessively large magnets (electromagnetic or otherwise), batteries without UL certification, or deployable objects from the node (e.g. cut lose a parachute).

13. Compliance:	• Structure
	  ○ **Must comply with the Gondola Structural Design Requirements** PG (820-PG-8700.0.1) design requirements for piggybacks (MOOs), see https://www.csbf.nasa.gov/docs.html.
	• Software
	  ○ **Must demonstrate the ability to autonomously find and guide to the selected waypoint** for simulated balloon trajectories and wind profiles (provided to the team) with >95% confidence (see SDR).

Trident TRIG trackers

- *Iridium-enabled GPS trackers*
  - *Receive GPS position, velocity and transmits at a periodic interval via Iridium network*
- *GOAL: To provide a "NASA standard" tracking capabilities for recovery operations.*
  - *Also serves as a redundant GPS dataset in the event science has a GPS failure*
  - *Utilized by SRPO for water recovery items for several years*
    - *Modification with pin used to trigger AutoStart during the descent case*
- *Plan to purchase 2-3 units for initial verification (with CSBF)*
  - *One unit will be sent to each student group to confirm no interference with the student-provided instrumentation*

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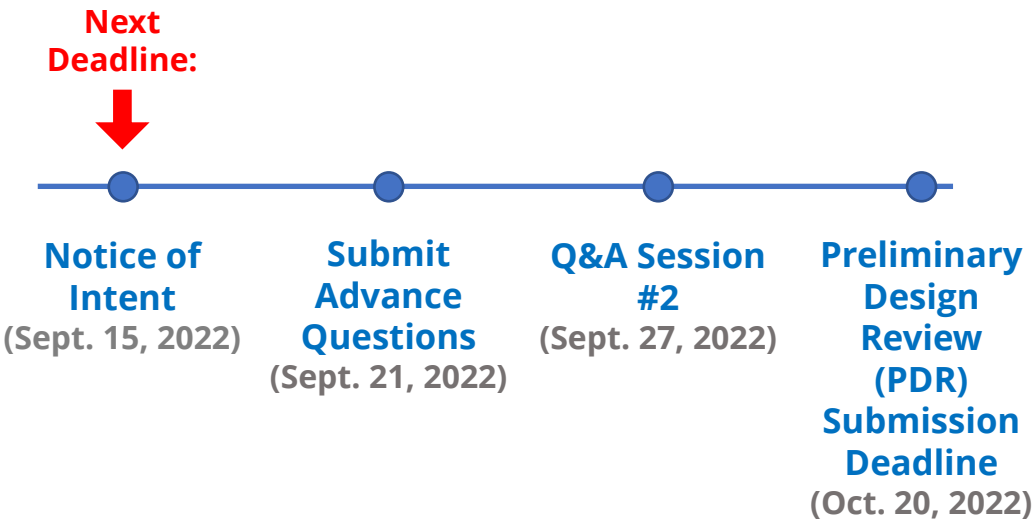
PROGRAMMATIC REMARKS (NIA)

- Ensure that your team meets the eligibility requirements.
  - **At a minimum, teams must contain one (1) faculty advisor** at an accredited U.S.-based academic institution, **and two (2) students from that institution** who work on the project and are able to participate in the on-site testing activities in Ft. Sumner, NM in August 2023.
  - There is no limit to the number of participants on each team, however, **a maximum of four (4) students and one (1) advisor can attend the on-site testing activities in Ft. Sumner, NM.**
  - Please note that due to prohibitive restrictions and ever-changing security regulations, **foreign nationals will not be able to attend the on-site activities at Ft. Sumner, NM.** There will be no exceptions to this policy.
  - One faculty advisor is **required** to attend the on-site testing activities in Ft. Sumner with each team and is a condition for acceptance into the FLOATing DRAGON Balloon Challenge. Teams who do not have a faculty advisor present during the testing will be disqualified from competing and stipends will be subject to return to NIA.



PROGRAMMATIC REMARKS cont'd…

- Thoroughly review the Challenge Guidelines.
- Carefully proof-read all of your submissions!
- Pay attention to all of the design design guidelines and constraints
- Start early and plan ahead to have all of the supplemental elements required for each deliverable's submission form.
- A picture is worth a thousand words! Consider the use of graphs, charts, and images when appropriate.
- All deadlines are firm deadlines. No extensions will be granted.

Challenge Guidelines PDF

FUTURE QUESTIONS?

PLEASE SEND ALL FUTURE QUESTIONS TO:

robin.ford@nianet.org

Each question will be responded to directly, as well as posted on the website for everyone to see.

We encourage you to visit the website frequently for updates:
https://floatingdragon.nianet.org

View the complete
FLOATing DRAGON Balloon Challenge Guidelines PDF