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- Helps ensure a clean recording

The recording will be posted online

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- Resources menu
- Community of Practice webinars

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- Post your questions in the chat

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ABOUT THE COMMUNITY OF PRACTICE WEBINAR SERIES

An opportunity to hear from subject matter experts on best practices for preparing for suborbital flight tests

Researchers, program staff, and flight providers

Connecting and sharing information and lessons learned to:

- Increase the impact of suborbital flight tests
- Transfer best practices
- Optimize the experience of current and prospective program participants

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- Webinars are usually held 1st Wednesday of each month at 10 a.m. PT.
- Topics are announced in the Flight Opportunities newsletter and website.
- Session recordings are posted on the Flight Opportunities website.
- Let us know session topics you would like to see covered.

National Aeronautics and Space Administration 4

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TODAY'S SPEAKERS

Louis Nguyen
Research Computer Engineer,
NASA's Langley Research Center

Joshua Frock
Program Manager,
Aerostar

Amanda Cook, Ph.D.
Instrument Scientist and Project Engineer,
NASA's Ames Research Center

John Dykema, Ph.D.
Project Scientist,
Harvard University

Anh Nguyen, Ph.D.
Program Portfolio Integrator,
NASA's Flight Opportunities program

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NASA Langley

Satellite Data Fusion

Jan 7, 2026

Louis Nguyen, Bill Smith, Anthony DiNorscia, and SatCORPS Team

NASA Langley Research Center

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Satellite Data Fusion

- Geo-spatial Compositing
  - SatCORPS Global Cloud Composites (GCC)
    - Optimally combines GEO and LEO radiances and derived products into a seamless unified global dataset
  - DSCOVR EPIC
    - Orbit: L1 Lagrange point
    - Earth Polychromatic Imaging Camera (EPIC): only visible RGB channels; observes full disk sunlit side of the Earth
    - Fuse observations from IR sensors onboard GEO and LEO to EPIC footprint to improve cloud retrievals and scene identification
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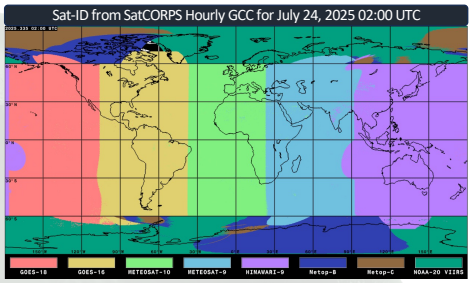
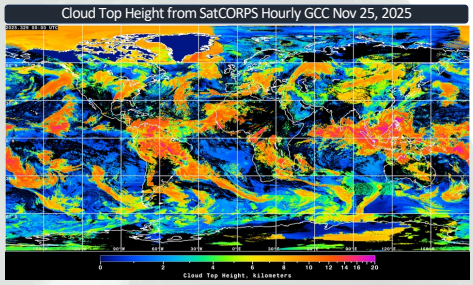
- AI/ML Assisted Fusion using KD-Tree Search
  - Maintaining Instrument/Algorithm Continuity
    - Construction missing VIIRS IR absorption bands
  - Geo-Leo Atmospheric Sounding System (GLASS)
    - Fusion of Polar hyperspectral IR, MW and GEO sounders to create 4D atmospheric profile dataset





SatCORPS GCC: https://satcorps.larc.nasa.gov/new/products/global-cloud-composite/

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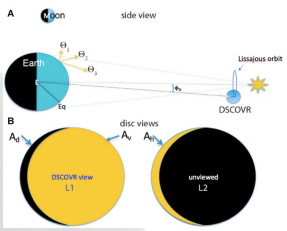
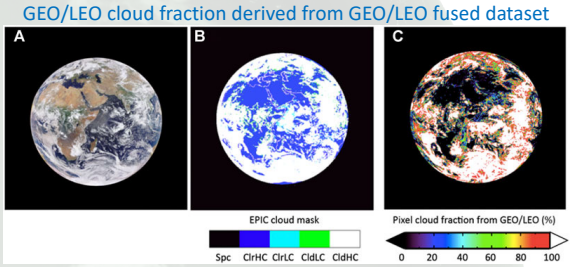


GEO/LEO cloud fraction derived from GEO/LEO fused dataset



Images Credit: F. Valero, A. Marshak, P. Minnis, "Fusion of satellite-based imager and sounder data to construct supplementary high spatial resolution narrowband IR radiances," Front. Remote Sens., Vol. 2. https://doi.org/10.3389/frsen.2021.745938

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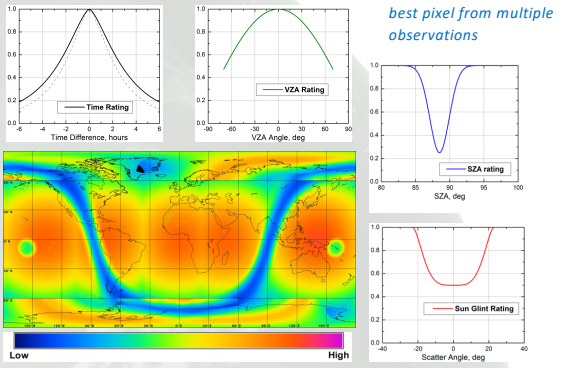
Pixel Rating and Resampling System (MOSAIC)

$$R = F_{\text{resolution}}\ F_{\text{terminator}}\ F_{\text{glint}}\ \frac{F_{\text{VZA}}}{\left(1+(\Delta t/\tau)^{1.5}\right)^2}$$

Composite rating combines the time diff., pixel res., solar terminator, and sun glint factors to determine best pixel from multiple observations



Pixel rating from an hourly SatCORPS GCC. High rating values (orange/red colors) signifies very good optimal matches.

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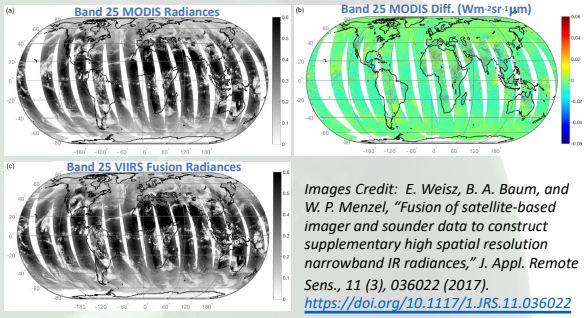
Construction of missing VIIRS IR Bands from CrIS Data

Table 2 MODIS, AIRS, VIIRS, and CrIS instrument specifications.

Instrument	IR spectral range (μm)	# of IR bands/ channels	Swath width (km)	Scanning angle (deg)	Nadir FOV size (km)
MODIS	3.6 to 14.4	16	2300	±55	1
AIRS	3.7 to 15.4	2378	1650	±49.5	13.5
VIIRS	3.6 to 12.5	7	3000	±56	0.75
CrIS	4.6 to 15.4	1305	2200	±50	14



Images Credit: E. Weisz, B. A. Baum, and W. P. Menzel, "Fusion of satellite-based imager and sounder data to construct supplementary high spatial resolution narrowband IR radiances," J. Appl. Remote Sens., 11 (3), 036022 (2017). https://doi.org/10.1117/1.JRS.11.036022

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Geo-Leo Atmospheric Sounding System (GLASS)

GLASS system fuses Polar Hyperspectral Sounding (PHS) and Microwave (MW) soundings with GEO soundings is to produce a **Hi-Res 4D Fusion Sounding with 56 vertical levels at 2km spatial and 30min temporal res.**

GEO Satellite	Instrument	#Bands	Nadir FOV(km)
GOES-West	ABI *	16	2km IR
GOES-East	ABI *	16	2km IR

* High spatial & temporal res; Low vertical & Spectral

PHS Satellite	Instrument	#Bands	Nadir FOV(km)
MetOp-A/B/C	IASI **	8461	12
SNPP	CrIS **	2211	14
NOAA-20/-21	CrIS **	2211	14
AQUA	AIRS **	2382	13.5
Feng-Yun-3	HIRAS **	3053	16

** High vertical & Spectral res; Low spatial & temporal

MW Satellite	Instrument	#Bands	Nadir FOV(km)
MetOp-A/B/C	AMSU-A ***	15	48
MetOP-A/B/C	MHS ***	5	16
SNPP	ATMS ***	22	32
NOAA-20/-21	ATMS ***	22	32

*** MW Can Penetrate through clouds

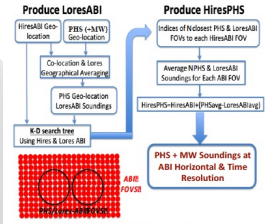
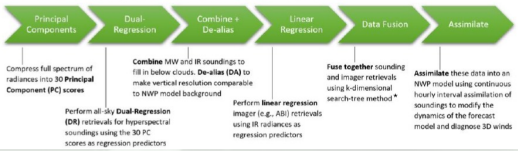


Figure 2. Schematic of the fusion process used to combine polar satellite soundings observations with geostationary satellite observations

A Simplified View of the Observation Retrieval & Data Fusion Technique

Polar hyperspectral IR sounders + polar MW sounders + geostationary imagers



GLASS Doc: https://www.ssec.wisc.edu/hufusion/images/PHSnMWnABI_Users_Guide.pdf
SatCORPS GLASS: https://satcorps.larc.nasa.gov/cgi-bin/site/showdoc?mnemonic=phs

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Satellite Data Fusion

- Data Fusion Considerations
  - No one size fits all
    - Designed and developed for specific application especially with AI/ML assisted fusion
  - Standard data formats, projection, access
    - Helps with data wrangling
  - Need Commonality
    - Spectral band overlap
    - Geo-spatial overlap
- Future of sensor fusion for exploration
  - ?? Can we leverage any of these technologies?

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NASA Flight Opportunities Community of Practice Webinar

7 January 2026

Josh Frock
Aerostar Program Manager – Stratospheric Operations
josh.frock@aerostar.com

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AEROSTAR: Company Overview

With nearly 70 years of lighter-than-air innovation and expertise, we're dedicated to solving challenges in Aerospace and Defense

>2 Million Flights Hours in Stratosphere
>10,000 Operational Flights
>200 Technology Patents
70 yrs Years Designing Balloon Systems
>200,000 sqft Manufacturing and Lab Space
275 Employees
336 days World Record Balloon Flight Days
>1000 days Consecutive days of balloon flight

STRATO SOLUTIONS
Thunderstorm
Thunderhead
Lightning
Cyclone

RESEARCH BALLOONS
Launch Services
NASA Large Super Pressure Balloon Program
Large Zero Pressure Balloons

SPACE INFLATABLES
Habitat Interiors
Materials Testing
Uprighting Bags
Planetary Balloons

RADAR SOLUTIONS
Vista F25
Vista F50 ER-I
HiPointer 100
HiPointer 150
HiPointer 250
Multi-INT Mobile Towers

Tillamook, OR
Sioux Falls, SD
Arlington, VA
Norfolk, VA
Stanley, NM
Sulphur Springs, TX

1956 Raven founded as manufacturer of high-altitude research balloons
1956 USAF projects Manhigh and Excelsior utilize balloon systems for space and high-altitude flight tests
1986 Aerostar International founded as a subsidiary of Raven
2010 Hi Sentinel Successful sustained, powered stratospheric airship flight
2012 Project Loon initiated with Google X to provide high-speed Internet to Rural Areas using balloons
2018 DARPA ALTA program selects Thunderhead system as sole platform
2018 Aerostar Cyclone Balloon System selected for NASA "Flight Opportunities" program
2021 Aerostar Launches 18 flights across 6 sites for 5 programs in 2 weeks.
2022 Aerostar separates from Raven, becomes stand-alone entity held by TCOM Holdings
2024 Aerostar acquires Near Space Corporation

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Capability Overview

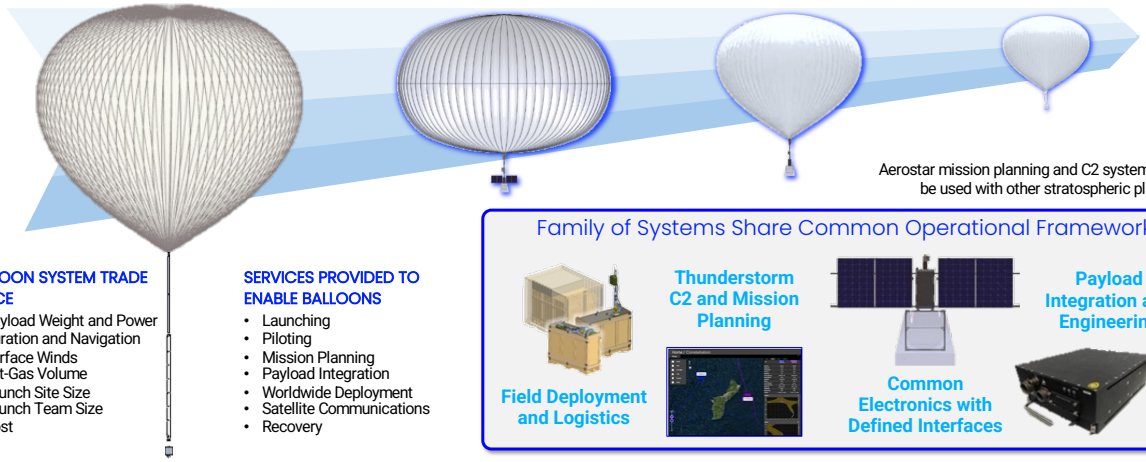
AEROSTAR FAMILY OF SYSTEMS

HURRICANE
Large Zero-Pressure Balloon System

THUNDERHEAD
Super-Pressure Balloon System

CYCLONE
Zero-Pressure Balloon System

LIGHTNING
Tactical Zero-Pressure Balloon System



Aerostar mission planning and C2 systems could be used with other stratospheric platforms

BALLOON SYSTEM TRADE SPACE
- Payload Weight and Power
- Duration and Navigation
- Surface Winds
- Lift-Gas Volume
- Launch Site Size
- Launch Team Size
- Cost

SERVICES PROVIDED TO ENABLE BALLOONS
- Launching
- Piloting
- Mission Planning
- Payload Integration
- Worldwide Deployment
- Satellite Communications
- Recovery

Family of Systems Share Common Operational Framework

Field Deployment and Logistics

Thunderstorm C2 and Mission Planning

Common Electronics with Defined Interfaces

Payload Integration and Engineering

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Thunderhead Flight System

SYSTEM OVERVIEW

The Thunderhead Balloon System is a low-cost, long-duration, expeditionary, and navigable stratospheric asset with a wide range of mission sets. That provides many advantages for a range of complex missions by providing a uniquely high-SWaP platform. Aerostar has integrated over 100 payloads and packages for stratospheric operations, including SIGINT, SATCOM, SAR, EO/IR, secured comms and comms relays. At 60,000ft, the functional range of sensors on a Thunderhead platform extends well beyond terrestrial or typical fixed wing limits and often extends all the way to or beyond the horizon.

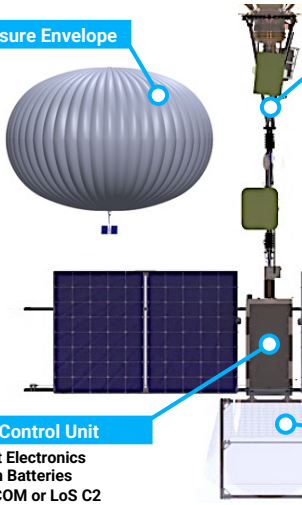
Current Operational Focus:
- Maritime Domain Awareness (MDA)
- Hypersonic missile detection and tracking
- Air Launched Effects (ALE)
- Emergency/Natural Disaster response and observation services

Standard Balloon System Package

Super Pressure Envelope
- 50 – 75kft
- 60+ days

Down Connect
- Altitude Control System
- Termination System
- Parachute Pack

Solar Array
- Auto Solar-Tracking
- GNSS Antennas



Flight Control Unit
- Flight Electronics
- Li-Ion Batteries
- SATCOM or LoS C2
- ADS-B (Mode S)

User Payload Budget
- 125 – 200lb
- 42ft^3
- 2,400 – 5500Whr/day
- 600-1200W

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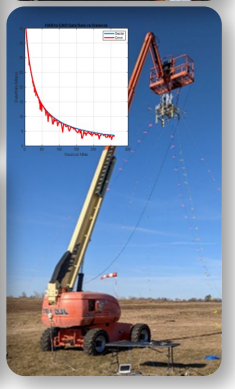
Payload Integration

ON-SITE ENGINEERING AND TEST CAPABILITIES

- TVac Testing & Thermal Design
- Electronics Lab
- Hangar and Launch Site
- Hi Bandwidth Data Links
- Mechanical Integration
- Power Management
- In-Flight Video
- RF Modelling and Testing

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Harvard – Xiomas – NASA Ames Flight

AEROSTAR MISSION PLANNING

- Flight Planning
  - Using Aerostar's Thunderstorm mission planning models, provide customer with flight projections for potential launch days
  - Coordinate with local fire stations for controlled burn locations
  - Coordinate with county Emergency Management offices on burn ban status
  - Provide local launch weather conditions for all potential launch days
  - Provide FAA with campaign overview, tentative launch dates, Flight Information Sheets
  - Create launch NOTAMs
- Pre – Launch Coordination
  - Coordinated controlled burn locations at the launch site and along the flight path with landowners
  - Submit updated Flight Information Sheets
  - Call Watch Desk for final launch notice, obtain traffic advisories

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Harvard – Xiomas – NASA Ames Flight

AEROSTAR MISSION PLANNING

- In-Flight Coordination
  - Check/confirm transponder operation
  - Notify Watch Desk of any schedule change
  - Communicate with appropriate ARTCC's while transitioning between airspaces
  - Provide 24/7 flight monitoring and on-call flight engineers
  - Provide password-protected website that displays balloon position, relevant flight details
- Termination Coordination
  - At least 1 hour prior to termination, notify FAA
  - 5 minutes prior to termination, provide final notification of termination, obtain traffic updates
  - Provide position updates as requested throughout descent
  - Upon landing, notify FAA
- Coordinate with landowners for the retrieval of balloon and payload hardware after flight

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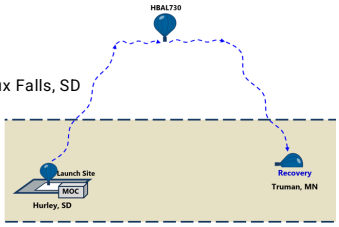
Harvard – Xiomas – NASA Ames Flight

MISSION SUMMARY

- **Location:**
  - Launch Location: Hurley, SD
  - MOC Location: Hurley, SD
  - Mission Area: 100nmi radius of Sioux Falls, SD
- **Mission Schedule:**
  - Readiness Review: 18 April 2025
  - Launch Window: 22-25 April 2025
  - Go/No-Go: 22 April 2025
  - Mission Window: 23 April 2025
- **Mission Objectives:**
  - Launch HAB from Hurley, SD
  - Fly over and collect data on fires
- **Communications:**
  - HAB C2 – Aerostar Iridium
  - Payload - Customer Iridium Solution
- **Stakeholders Involved:**
  - Sponsor: NASA
  - Platform and Integration: Aerostar
  - Payload Team: Harvard, Xiomas and NASA Ames



Parameter	Flight
Flight ID	HBAL730
Mission ID	171
Balloon Type	Thunderhead 200
Launch Datetime (GMT)	23 April 2025 12:53
Launch Location (Decimal Degrees)	43.335, -97.059
Landing Datetime (GMT)	23 April 2025 22:37
Landing Location (Decimal Degrees)	43.853, -94.518
Mission Elapsed Time (HH:MM)	9:43

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EXPLORE SPACE TECH
NASA Flight Opportunities Community of Practice
January 2026 | Dr. Amanda Cook

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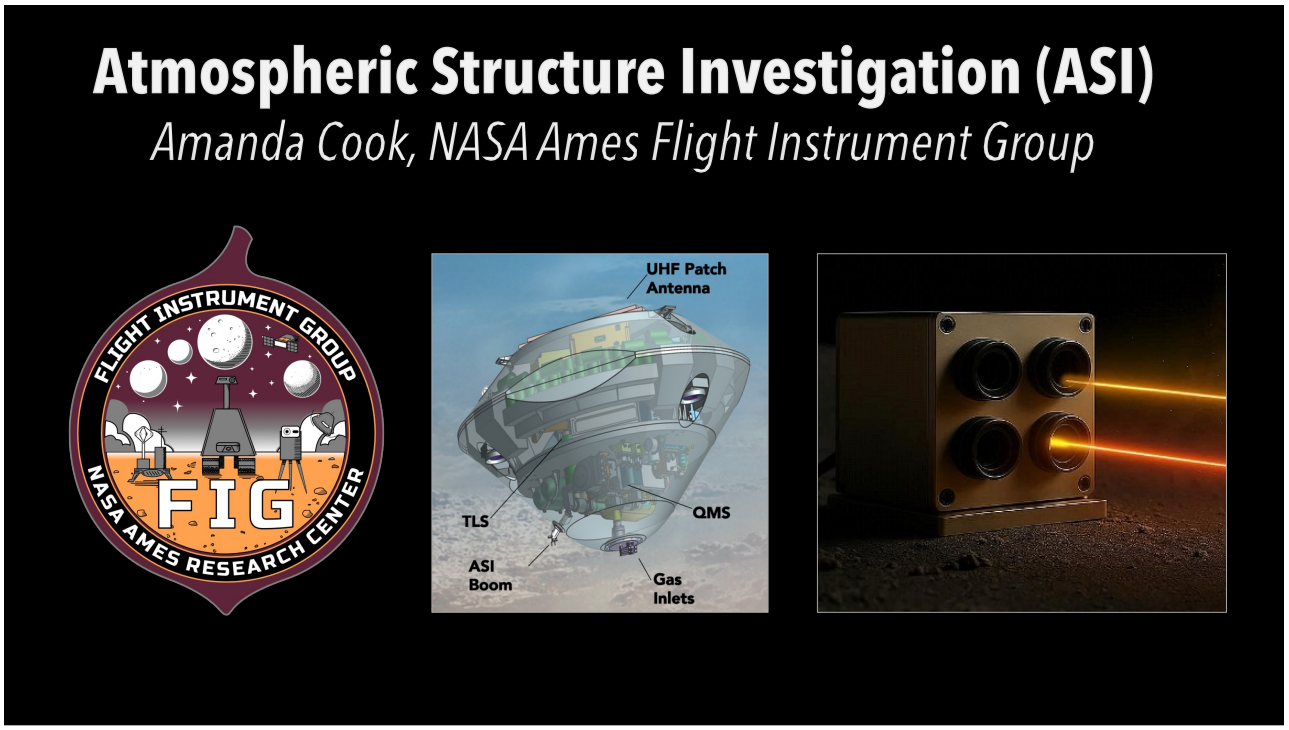
Atmospheric Structure Investigation (ASI)
Amanda Cook, NASA Ames Flight Instrument Group
FLIGHT INSTRUMENT GROUP
FIG
NASA AMES RESEARCH CENTER
UHF Patch Antenna
TLS
QMS
ASI Boom
Gas Inlets

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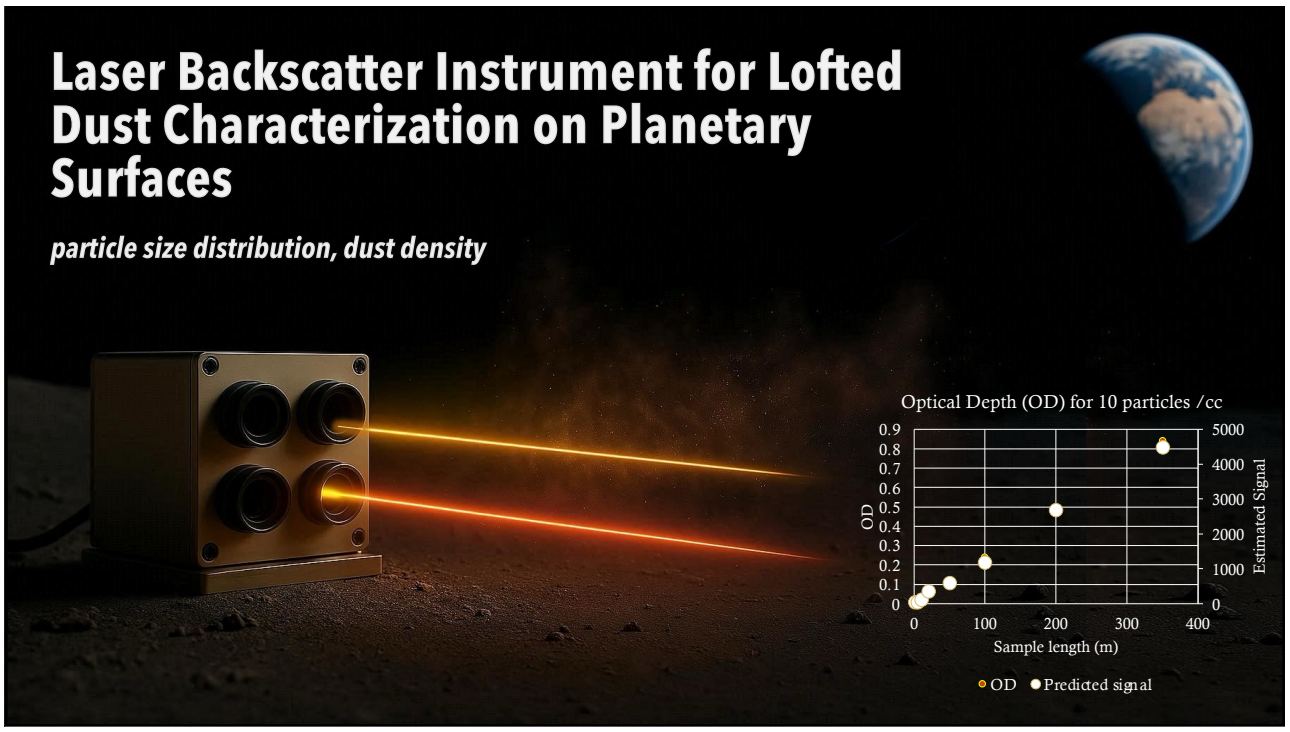

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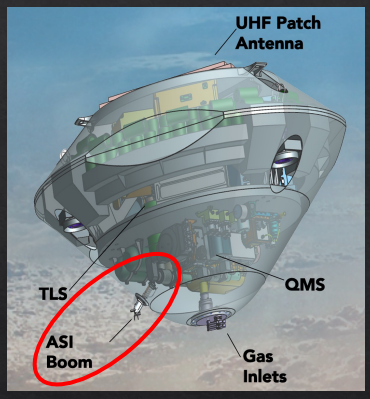
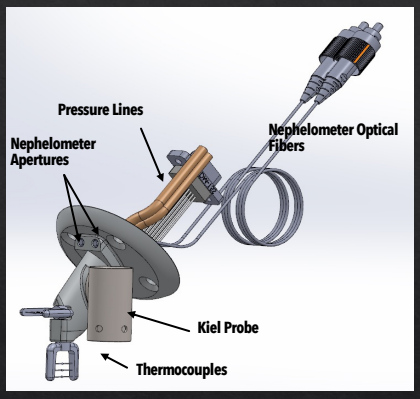
Atmospheric Structure Investigation (ASI) for Descent Probe





	ASI Hardware
Atmospheric Temp	In-flow Thermocouples
Static and Dynamic Pressure	Keil Probe + Pressure Transducers
Descent Turbulence and Orientation	3-axis accelerometer
Cloud Density and Particle Size Distribution	Laser Backscatter Nephelometer
Custom Electronics	FIG Brain Coard, Power Board, Neph Board

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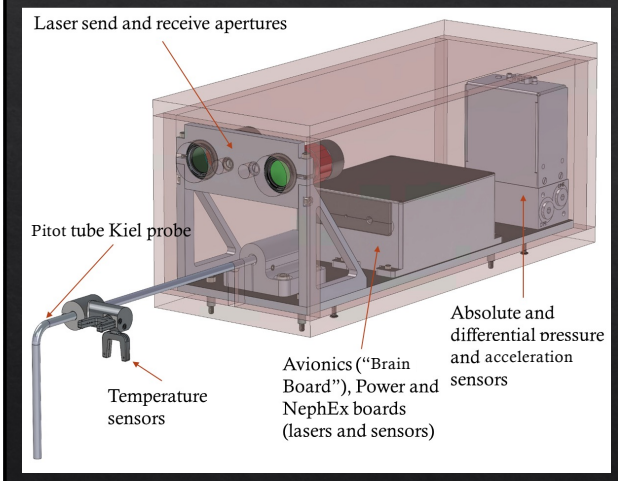
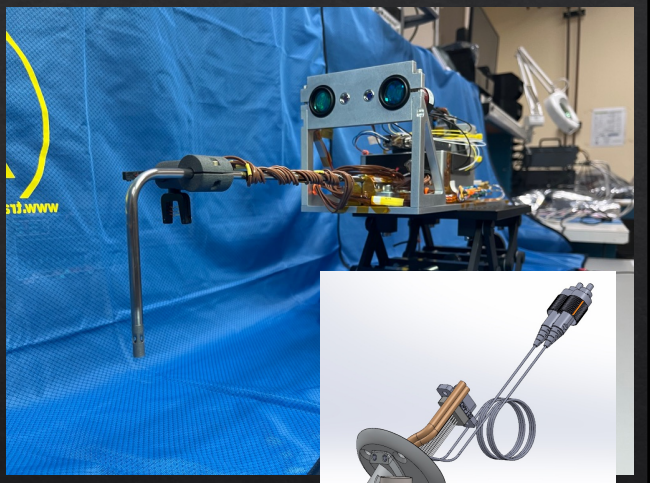
Atmospheric Structure Investigation – Balloon Demo Unit





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ASI Team at Launch Site in North Dakota with Aerostar, Harvard, & Xiomas Collaborators

ASI

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Lessons Learned

- "Build, break, build again" or "fly, fix, fly"
- Vast improvements in SWaP from Gen 1 NephEx
- Excellent performance from first flight of ASI
  - pressure ☑
  - temperature ☑
  - acceleration ☑
  - cloud particle detection ☐
  - integrated electronics ☑

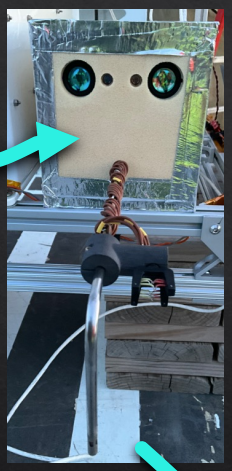
Future Flight

- NephEx Gen3:cloud particle detection
- ASI v2: pressure, temp, acceleration
- Mars Sonic Anemometer (low pressure)
- Ophelia: Speed of sound for H Ortho-Para fraction, and He abundance applications
- SuRSeP: 8-channel radiometer
- Maverick: Mars Climate Sensor Suite

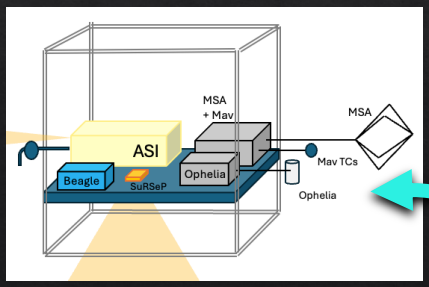
NephEx Only, Gen 1, 2022

more...?

NephEx Gen2 with ASI, 2025



Future Flight: NephEx Gen3 with ASI v2 + 4 new FIG payloads, 2026?



MORE!!!

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HARVARD UNIVERSITY

Coordinated Multi-sensor Observations and Platform-Agnostic Interfaces for Planetary and Wildfire Applications

John Dykema, Mike Greenberg, Norton Allen, Frank Keutsch
School of Engineering and Applied Sciences, Harvard University

January 7, 2026

*dykema@huarp.harvard.edu

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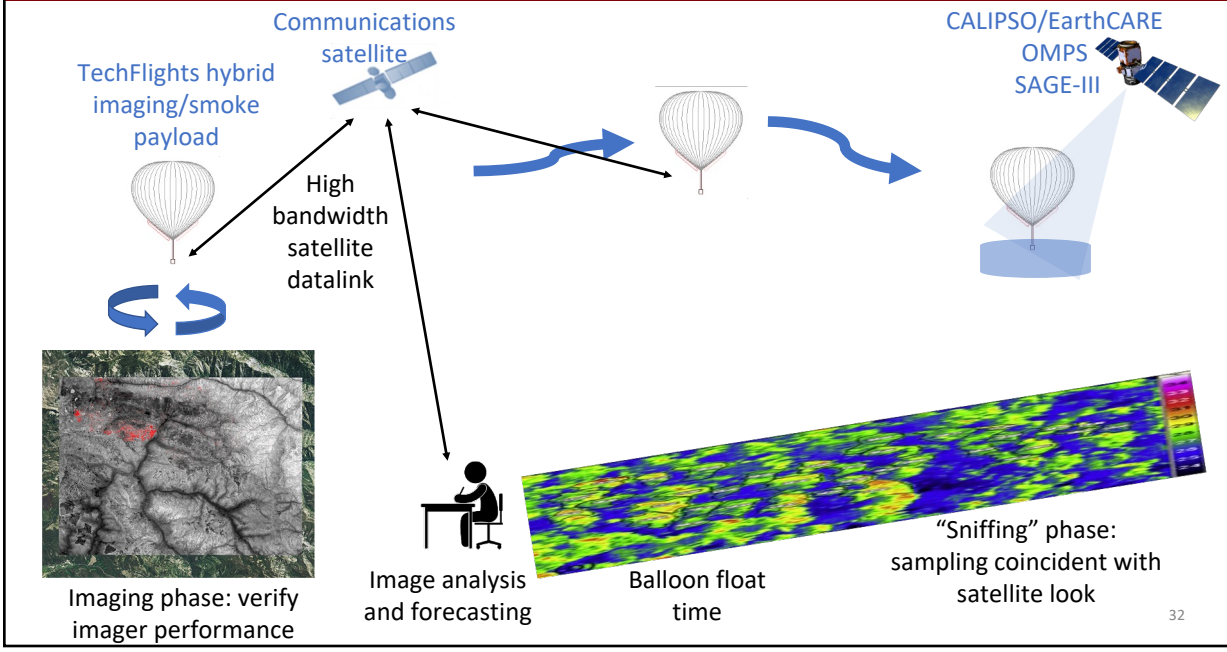
Multi-platform Interface Demo on HAPS



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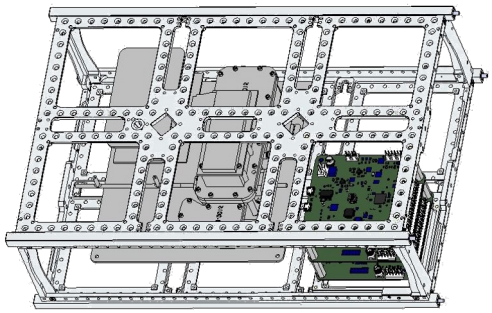
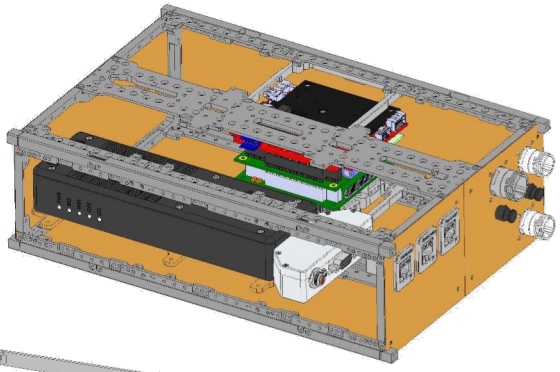
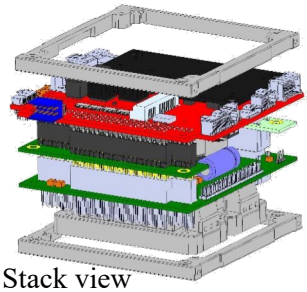
Modular Equipment Design, Tested on Stratospheric Balloon





- Universal payload structure: standard 6U Cubesat chassis
- Avionics include:
  - DC/DC power conversion
  - Power distribution
  - Ancillary I/O and comms



Stack view

- Satellite datalink
- single board computer
- power conditioning and distribution

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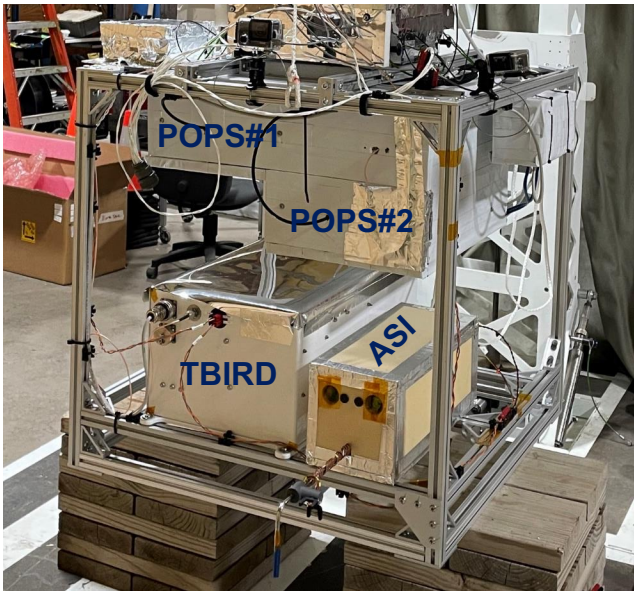
Technology Overview: An Adaptive Stratospheric Fire Observatory

- Demonstrate a scalable, hybrid remote sensing/in situ payload compatible with multiple emerging stratospheric platforms
- Remote sensing: Xiomas TBIRD for Fire Radiative Power
- In situ:
  - Printed Optical Particle Spectrometer (POPS) for optical particle sizing
  - NephEx/ASI for multi-wavelength particulate backscatter measurements



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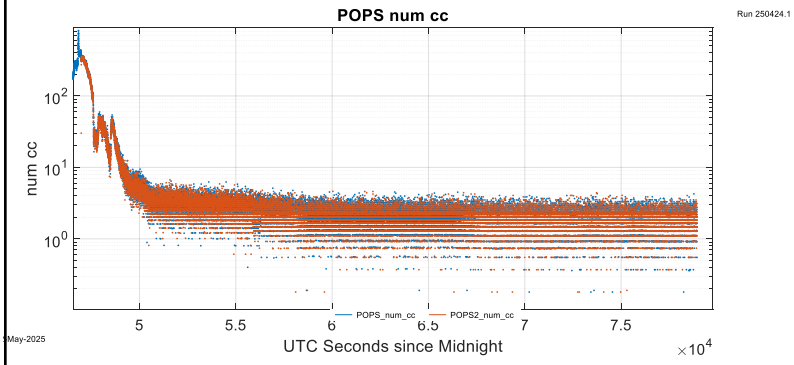
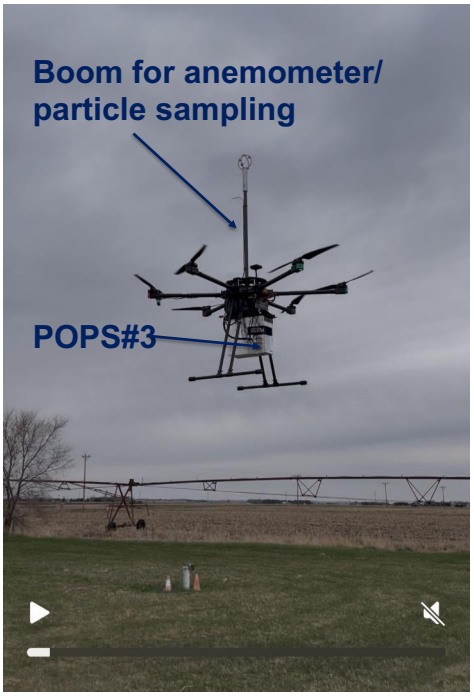
Actual Results





- Particle size data for POPS#1 and POPS#2 agree to 6% throughout flight
  - Provides a novel dataset to understand single particle sampling
  - Important for particles with varying composition
- Modular avionics demonstrated on quadcopter (POPS#3)
- Smoke plume structure from prescribed burn detected and mapped

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Actual Results, Payload Technical Performance, Differences from Expectations

Flight Objective	Actual Outcome	Status	Gap / Next Action
Validate payload during ascent, tropopause, float	All instruments nominal until commanded power-off just prior to descent	✓	None
Verify TBIRD & ASI stratospheric functionality	Both sensors produced fulldata during 8-h float	✓	None
Characterise satellite datalink bandwidth & error rate	Uplink nominal; **final downlink failed after full integration**	✗	Root-cause under review; larger antenna + end-to-end test planned
Cross-check in-situ aerosol data with satellite / airborne data	POPS agrees with 2022 ER-2 statistics	⚠	Finish satellite match-ups (ETA Q4 2025)
Demonstrate platform-agnostic interface & avionics	Balloon integration met thermal/mech./electrical specs; concept also proven on quadcopter	✓	Extend interface to support powered-descent data logging

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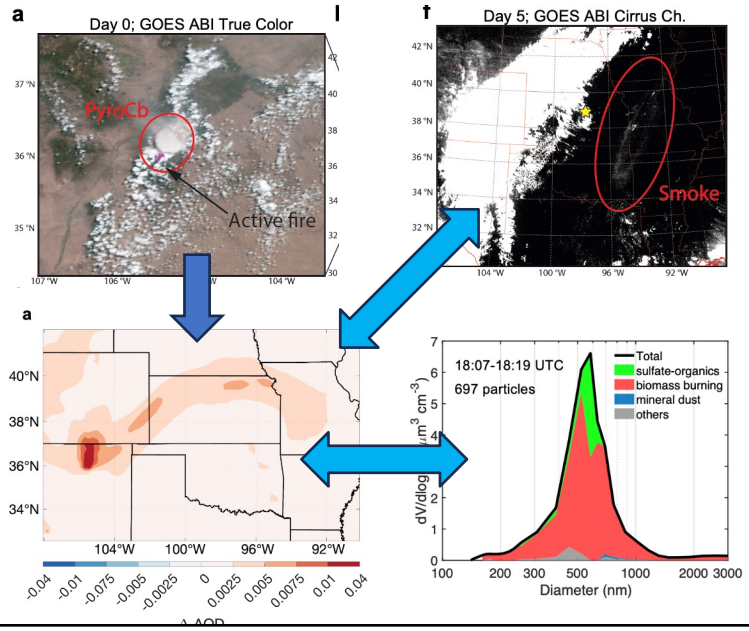
Technology Transition: Path to Operational, Multi-platform Wildfire Monitoring

- DCOTSS data + WRF-GC modelling confirm viability of hybrid payload (in review at Science Advances)
- POPS proposed for NASA INSPYRE (EVS-4)
- Negotiating Aerostar "ride-along" balloon this summer to sample anomalous UTLS smoke layer
- Building cloud-hosted pyroCb-smoke forecast tool; early prototype Q4 2025



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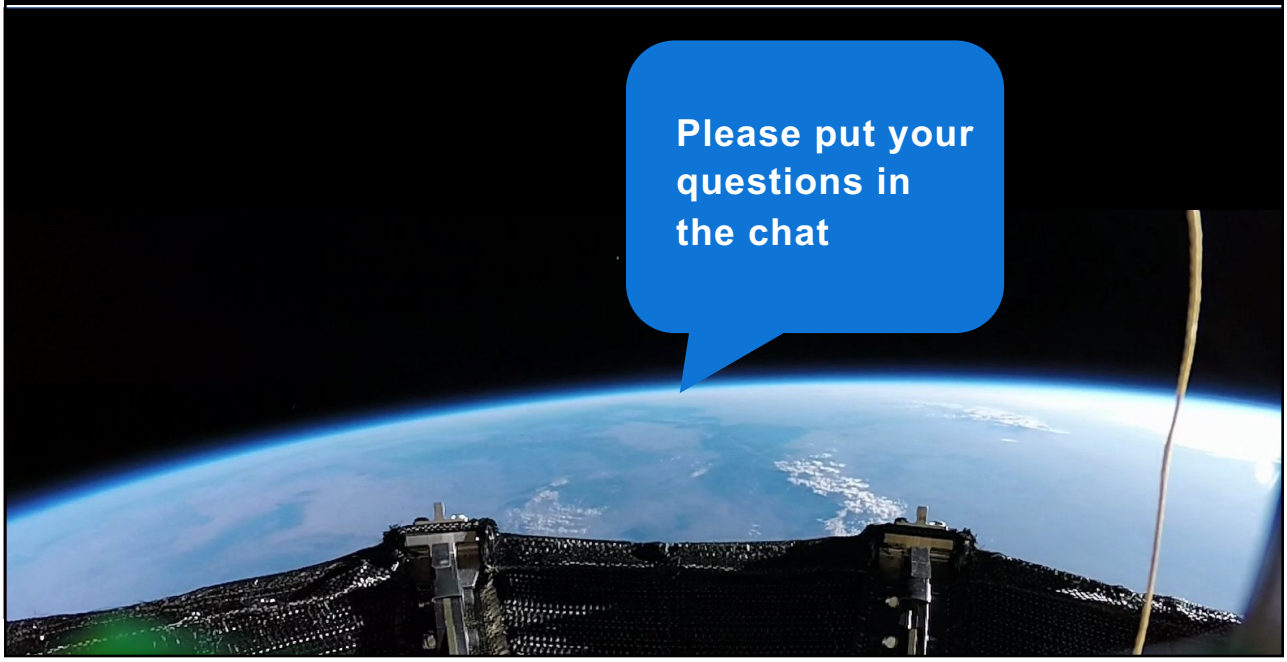
WHAT QUESTIONS DO YOU HAVE?



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