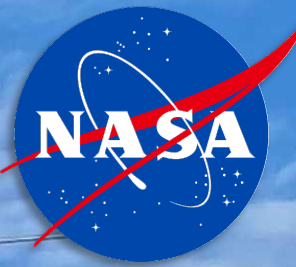
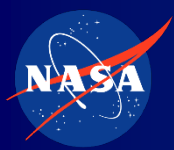


Balloon Capabilities at NASA

Dr. Sarah Roth
February 2025



XL-Calibur payload in 2024 launched from Sweden cr: XL-Calibur Collaboration



Mission of NASA's Balloon Program



Goddard Space Flight Center

Wallops Flight Facility

Strategic Objective: The primary objective of the NASA Balloon Program is to provide high altitude scientific balloon platforms for scientific and technological investigations. These investigations include fundamental scientific discoveries that contribute to our understanding of the Earth, the solar system, and the universe. Scientific balloons also provide a platform for the demonstration of promising new instrument and spacecraft technologies that enable or enhance the objectives for the Science Mission Directorate Strategic Plan.

Annual Program Snapshot

10-16 Missions

3+ Campaigns

300+ Students

40+ Research Institutions

Balloons provide low-cost, quick response, near space access for:

- Conducting cutting-edge research.
- Developing technologies to enable future spacecraft science missions.
- Advancing lighter-than-air platform technologies.
- Providing calibration and validation of on-orbit instrumentation.
- Enabling hands-on training of the next generation of scientists and engineers.

SPB SN/08



SUNRISE III

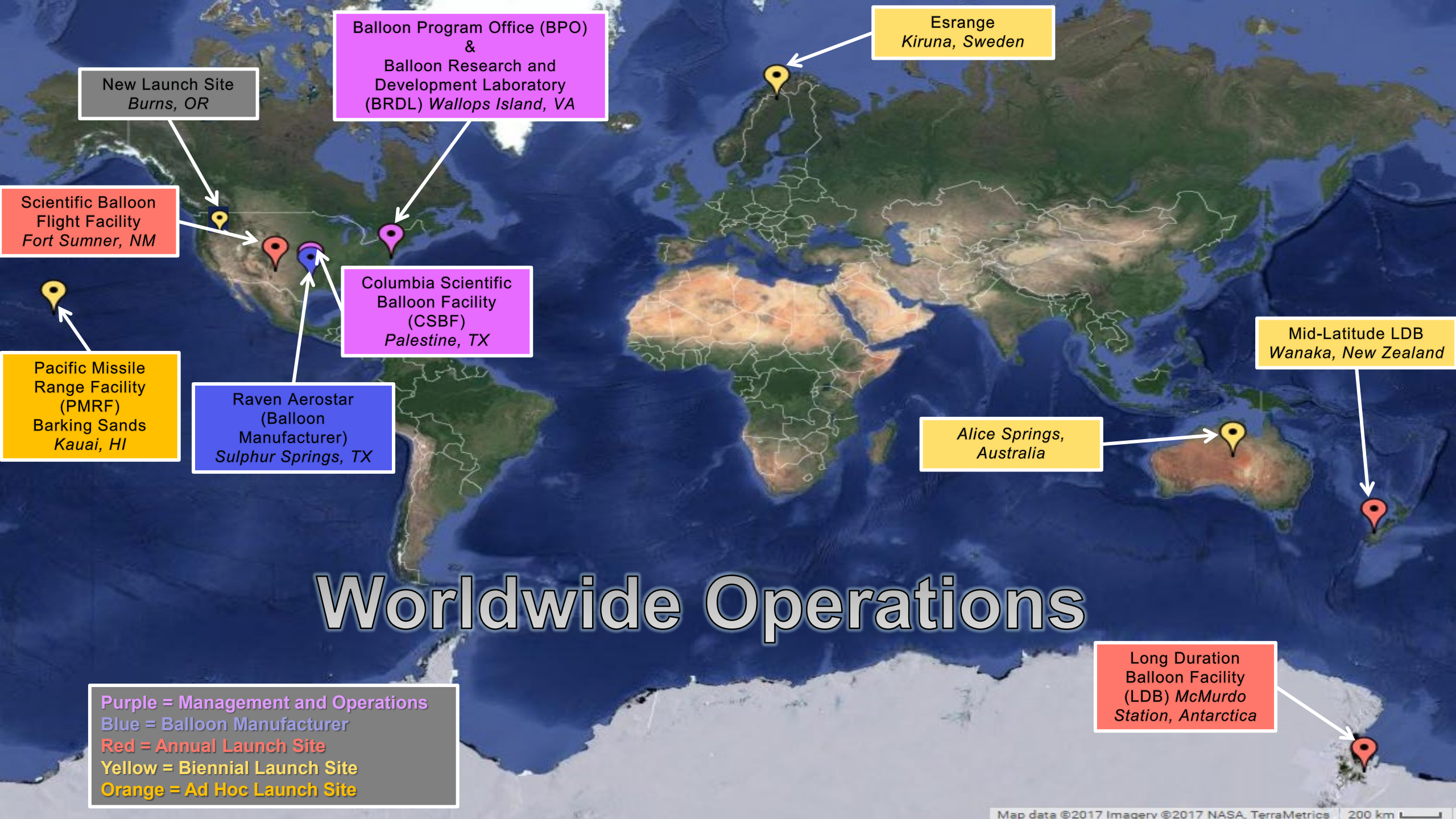


XL-Calibur/WASP



GUSTO





Worldwide Operations

Purple = Management and Operations
Blue = Balloon Manufacturer
Red = Annual Launch Site
Yellow = Biennial Launch Site
Orange = Ad Hoc Launch Site



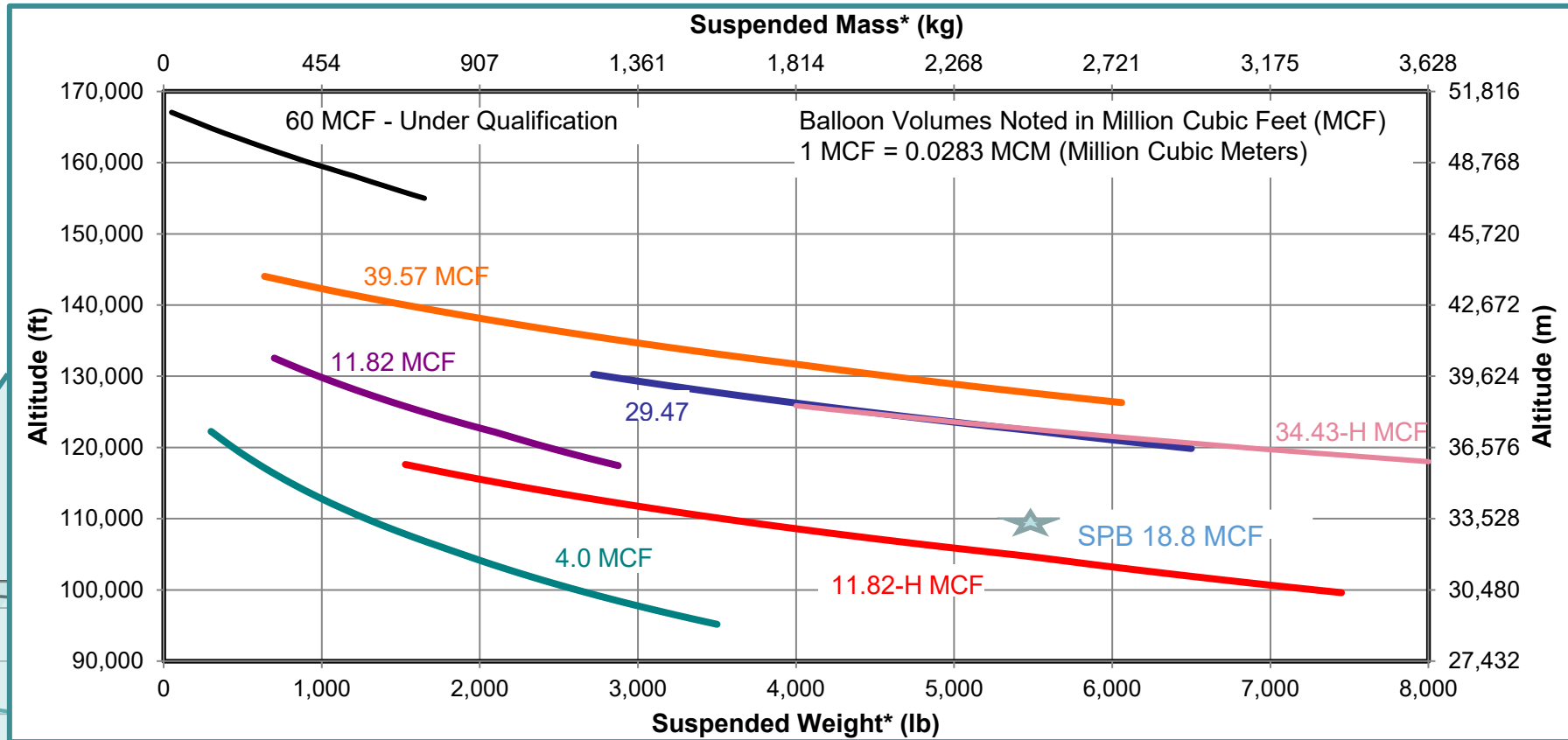
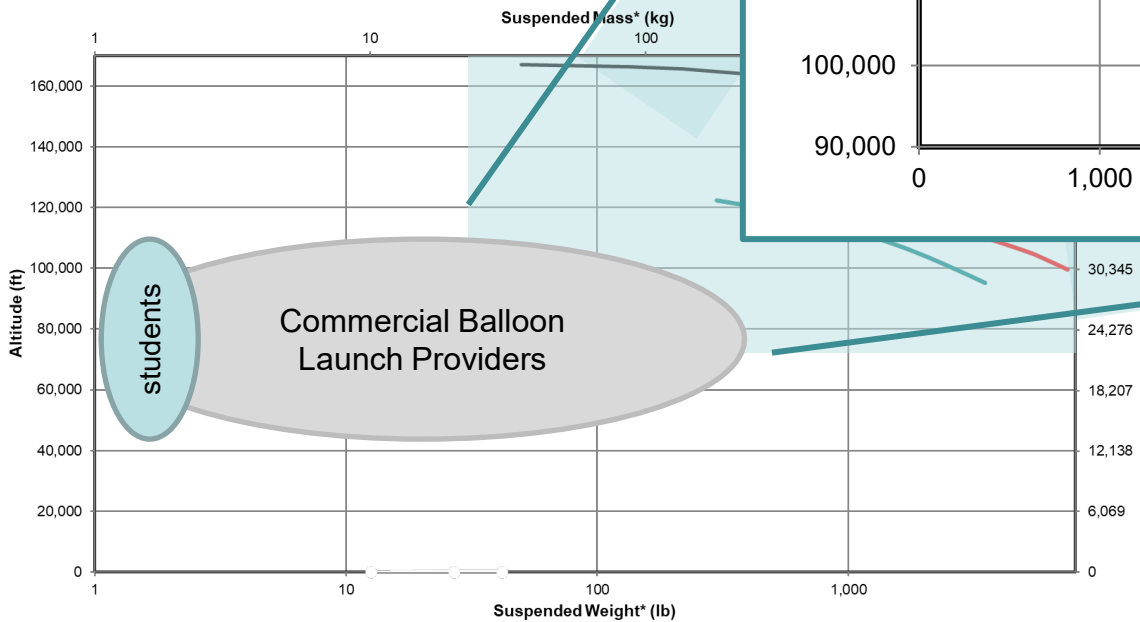
Programmatic Details: Balloon Capabilities



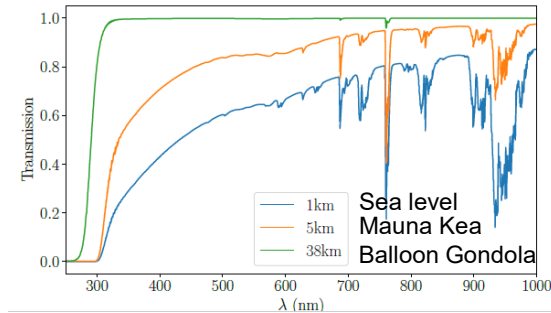
Goddard Space Flight Center

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NASA BPO provides the scientific community with suspended mass and altitudes that student balloon launches, and commercial balloon providers cannot achieve with their current infrastructure.



Uniquely situated for astrophysics.



*Totals include CSBF support systems and are not science allocations.



NASA Support Systems



Goddard Space Flight Center

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Balloon Type	Zero Pressure (ZP)	ZP	Super Pressure (SP)
Mission Type	Conventional	LDB	ULDB (In development)
Duration	Fort Sumner, NM for 2 hours to 1 day Palestine, TX for 2 hours to 12 hours (Small launch or up to 11 MCF*) Alice Springs, AUS for 2 hours to 3 days	4-6 days for Sweden 7-15 for Antarctica up to 55+ days	Wanaka, New Zealand Up to 100 days 2016 Mid-Latitude Flight = 46 Days
Science Payload Weight	Up to 2,948 kg (Up to 6,500 lbs)	Up to 2,948 kg (Up to 6,500 lbs)	18.8 MCF* – 907 kg (2,000 lbs)
Typical Float Altitude	29.2 to 38.7 km (96 to 127 kft)	36.5 to 38.7 km (120 to 127 kft)	18.8 MCF – up to 34 km (~110 kft)
Support Package	Consolidated Instrumentation Package (CIP) <ul style="list-style-type: none"> Line of Sight (LOS) <ul style="list-style-type: none"> Up to 12 Mbps direct return (with EVTM system) 	Support Instrumentation Package (SIP) <ul style="list-style-type: none"> Line of Sight (LOS) - Up to 12 Mbps direct return (with EVTM) Over The Horizon (OTH) <ul style="list-style-type: none"> 6 kbps / 92 kbps TDRSS Downlink** 80 kbps Iridium option*** 15 – 80 Mbps Starlink 	
	Small Launch Package <ul style="list-style-type: none"> Stand alone package for small payload support LOS and OTH TM & Command (Iridium) 255 byte/min packets Up to 12 Mbps LOS option System without batteries ~20 lbs (9 kg) 		
<p>* MCF – Million Cubic Feet **300kbps/1Mbps in development ***Iridium – limited support</p>			



Technology Roadmap



Goddard Space Flight Center

Wallops Flight Facility

Expand Science Data

- Increase science data rates (comm, processing, C&DH)
- Modernize outdated, costly support systems (avionics, power, GNC, GSE, etc.)

High Data Rate Telemetry (40Mbps) ---- (300-400 Mbps)

Starlink

Ethernet via Telemetry (EVTM)

Optical Communication System for all platforms

Ai/ML/Autonomous Efficient Processing

Cross-platform Avionics System Development and Testing

Wallops Integrated Star Tracker (WalST)

Neural Net Controllers

Expand Science Data

- Reduce size, weight, & power of support systems

Suborbital Product Platform Architecture Study

Small High-Power (kW) High-Efficiency EPS/Solar Panels/Batteries

New Balloon Resin and Manufacturer Investigation

Printed Hybrid Electronics

Balloon Trajectory Control – Propeller Development

Cultivate the Range of the Future

- Autonomy
- Space-based range

Hydrogen as an Alternative Lifting Gas

Balloon Termination and Recovery Enhancements

Enable Future Missions

- Grow capabilities & features of the platform to enable missions currently not possible

60 MCF Qualification

18 MCF Super Pressure Balloon Qualification

FY24 and Earlier

FY25

FY26

FY27

FY28 and Beyond



Dance Card – FY25 to FY29



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Campaign Site	FY25	FY26	FY27	FY28	FY29
McMurdo Station Antarctica (Austral Summer)	GAPS (Hailey) Salter TF-U (Salter)	GAPS (Hailey) PUEO (Vieregg) HiCal [H/L] (Vieregg)	TIM (Vieira) GRIPS (Saint-Hilaire) EXCITE (Nagler)	B-SoLitARe (Janches) WASP/XL-Cal (Krawcz.)	WASP / CORSAIR (Samra) GRAPE (McConnell) AESOP-Lite (Clem)
Wanaka New Zealand (Austral Fall)	HIWIND (WU) SPB TF (Fairbrother)		TAURUS (Benton) WASP / PBR (Olinto)		TBD SPB TBD SPB
Esrang Sweden (Boreal Summer)				BALBOA (Zhou) TBD ZPB	
Palestine, Texas (Boreal Summer)		Fairbrother SPB CCT 2(+) Orr ZP CCT (34H, 39)			
Burns, Oregon (Boreal Summer)	CDCP (Fries) ELVES (Tsai)	TBD Hand Launch TBD Hand Launch	TBD Hand Launch TBD ZPB	TBD ZPB TBD ZPB	TBD ZPB TBD ZPB
Fort Sumner New Mexico (Boreal Fall)	JPL Remote (Kleinboehl) WASP/PIC-D (Mendillo) HASP (Granger) Salter Test Flight (Salter) THAI-SPICE (Young) BOOP! (Roth)	WASP/PIC-D (Mendillo) LSPE-SWIPE (Volpe) MATTADOR-TF (Boering) QRR (Arumugam) WASP / CORSAIR (Samra) EXCLAIM (Switzer) B-SoLitARe (Janches) BOOP! (Roth)	WASP / CORSAIR (Samra) EXCLAIM (Switzer) BOOP! (Roth) TBD #4 TBD #5 TBD #6 TBD #7	POEMM (Stacey) WASP / CORSAIR (Samra) WASP / SHERO (Thomas) BOOP! (Roth) TBD #5 TBD #6 TBD #7	BOOP! (Roth) TBD #2 TBD #3 TBD #4 TBD #5 TBD #6 TBD #7

- *The NASA Balloon Program provides low-cost, stable platforms for NASA science and technology in the stratosphere.*
- *Balloons provide an excellent training ground for scientists and engineers.*
- *The Program continues to push to break records in altitude and mission duration to enable more extraordinary scientific achievement.*

