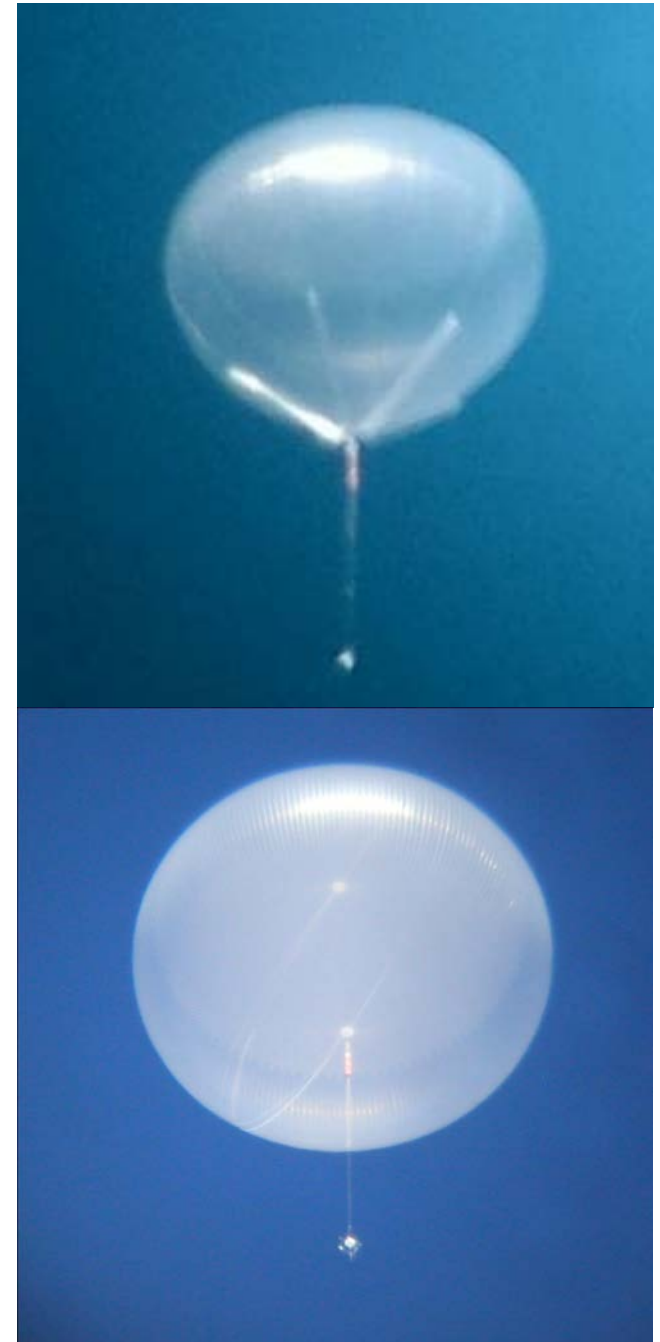


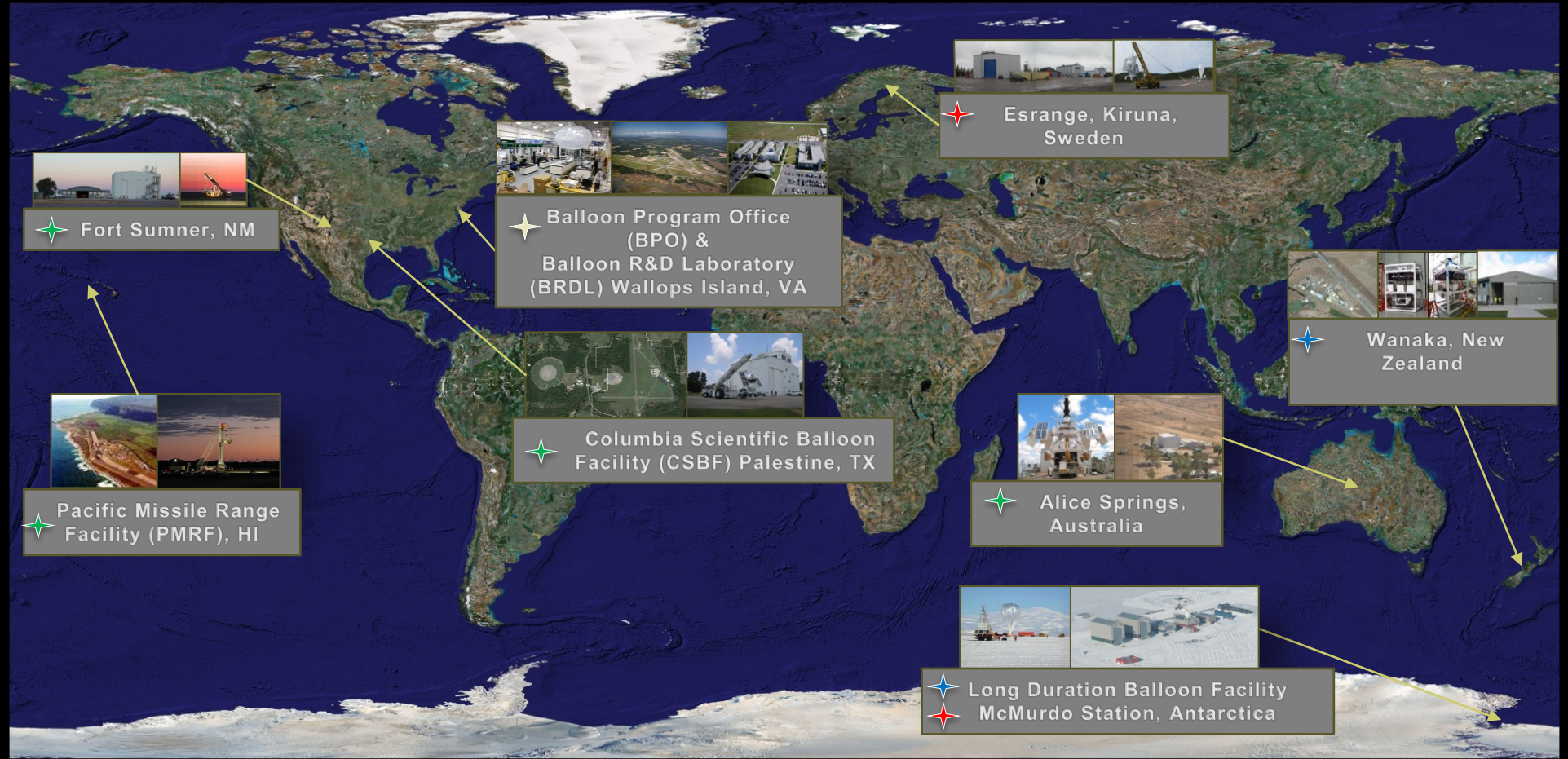
Scientific Balloon Missions of Opportunity

Debora A. Fairbrother, Chief, NASA Balloon Program Office





SCIENTIFIC BALLOON LOCATIONS



Color Key

- ★ Super Pressure Balloon Launch Location
- ★ Conventional Launch Location
- ★ Long Duration Balloon Launch Location
- ★ Program Management

Conventional Balloon Missions

- NASA supports “conventional” missions launched from Palestine, TX and Fort Sumner, NM and other locations world-wide depending upon requirements.
- “Conventional” missions are those that are maintained within line of sight of the launch site or via downrange stations and typically last a few hours to typically less than forty eight hours duration.
- For new scientific balloon missions, a “conventional” test flight may be required prior to approval for an Long Duration Balloon or Super Pressure Balloon Mission.
- NASA supports limited conventional missions from Palestine during the summer, and Fort Sumner during the fall around the stratospheric wind turnaround periods. Other conventional mission launch sites supported on case by case basis.

Long Duration Balloon Missions - Sweden

- 2-3 Missions during campaign from Esrange, Sweden to Northern Canada when requested by science.
- Range services provided by Swedish Space Corporation at Esrange
- Duration 4-6 days (currently there is no Russia overflight agreement with NASA).
- Launch window second week in May through middle July.
- Payload and balloon recovered same season, usually with helicopter.



Esrange Balloon Launch Facilities

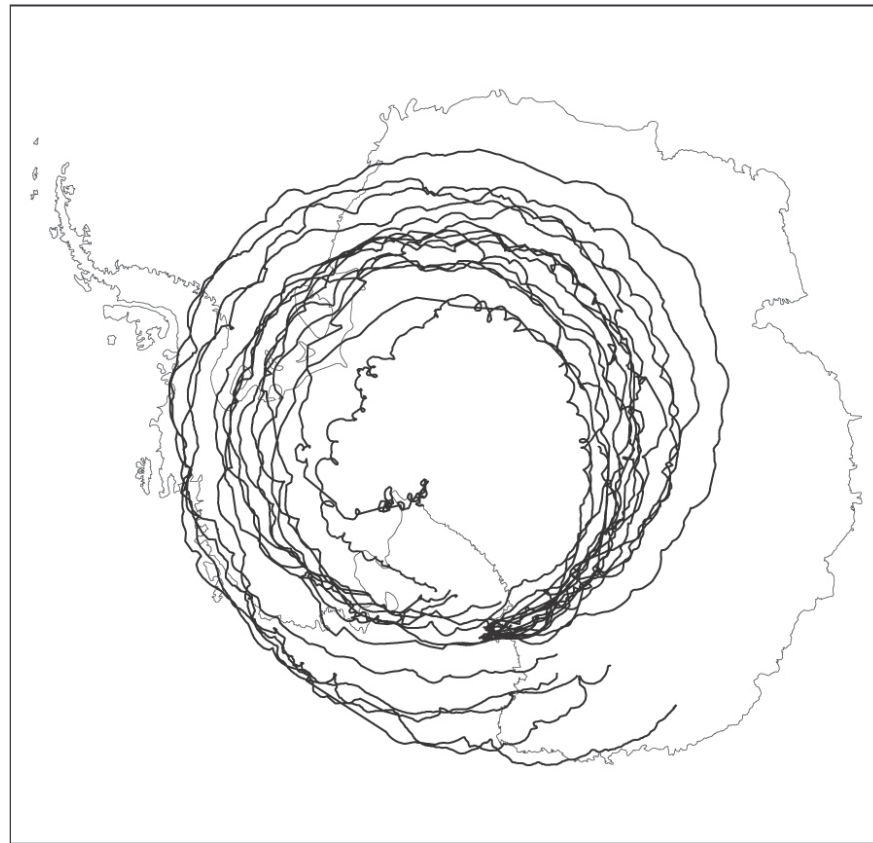


Swedish Space Corporation Facilities

LDB/SPB Missions - Antarctica

- 2-3 LDB missions launched annually from McMurdo, Antarctica (one of which can be SPB).
- Durations upwards of 55 days, 21 days nominal. Determined by time of launch, trajectory, and NSF resources for support and recovery.
- Launch window is typically December 1 through January 10, each year.
- Arrive on site to perform pre-flight preparations ~ October 28.
- Proposers should plan at least one personnel to support recovery at end of flight.
- Same season recovery of payload contingent on location, NSF asset support, and time in season. Circumstances possible where recovery can't be accomplished until the following year (or year after).

Antarctica LDB Trajectories - Composite



Antarctica Balloon Launch Facilities

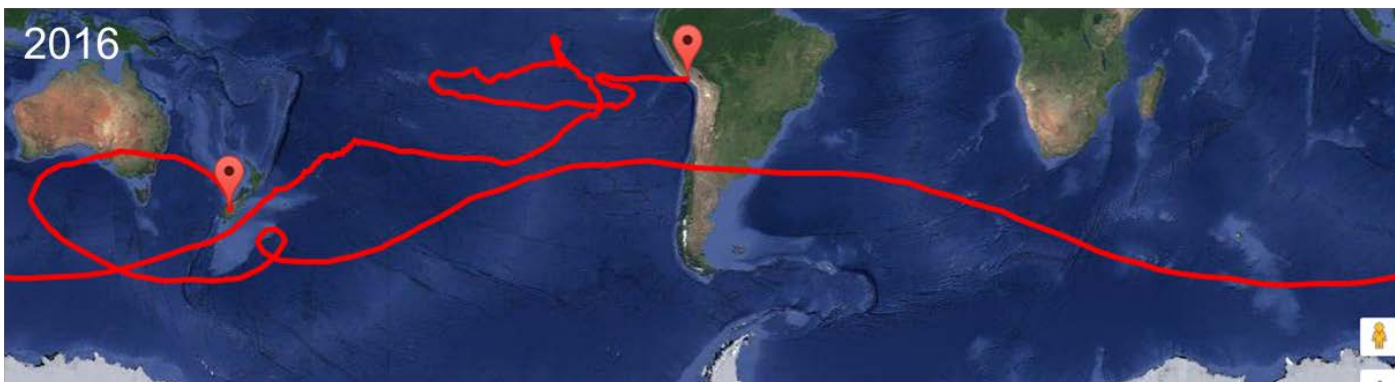
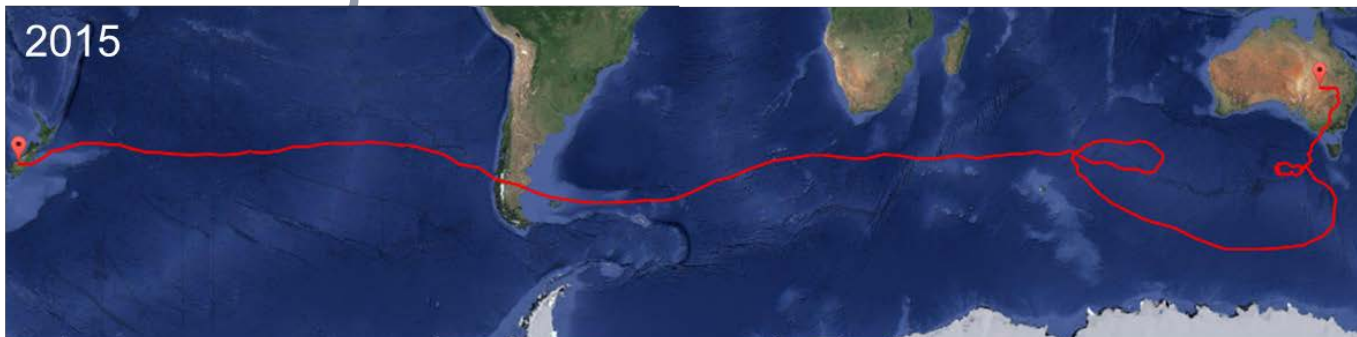


SPB New Zealand Balloon Launch Site

- 1 SPB Mission Launched ~Annually from Wanaka, New Zealand. If other foreign campaign (Sweden or Australia) has higher priority in a given year, there will be no launch from New Zealand.
- Durations of 32 days in 2015, 46 days in 2016, and 12 days in 2017 achieved
- Launch window is March 25 to May 31, each year.
- Arrive on site to perform pre-flight preparations ~ Feb 10.
- Non-recovery of Payload and balloon possible due to ocean termination.
- Current environmental assessment does not allow for flotation of system.



NZ SPB Trajectories



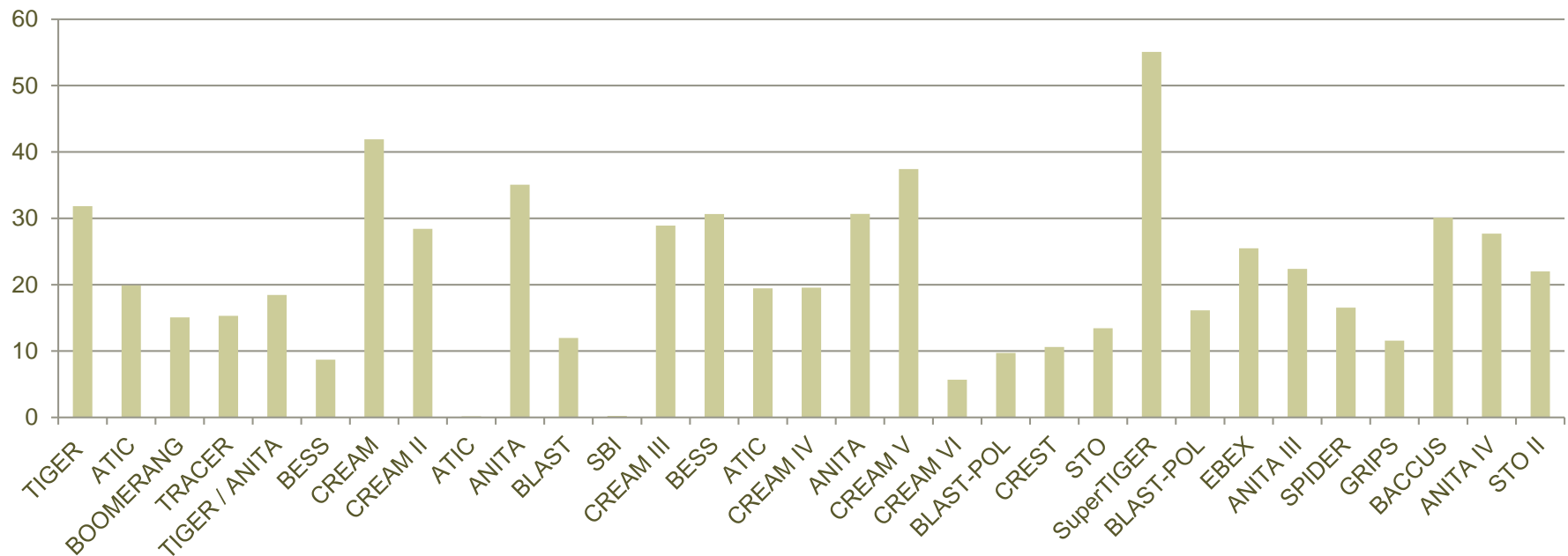
Typical ZP Balloon / Altitude Capabilities

- 29 MCF Balloon
 - Carry ~4,000 lb science (1,814 kg) to 120,000 feet nominal altitude
- 34 MCF Heavy Lift Balloon
 - Carry ~6,000 lb science (2,268 kg) to 117,000 feet nominal altitude
- 40 MCF Balloon
 - Carry ~4,000 lb science (1,814 kg) to 126,000 feet nominal altitude



Duration of Antarctic LDB Science Missions

FY'02 to FY '17



- 31* long-duration balloon (LDB) Antarctica science flights since December 2001
 - * Does not include Engineering Science or Vehicle Test Flights
 - Average Duration is 22.8 days (does not include failures)
 - 1 Balloon Failure – Wefel (ATIC) Dec 2005
 - 1 Instrument Failure – Rust (SBI) Dec 2006
 - 1 Balloon/System Failure – Seo (CREAM VI) Dec 2010

Super Pressure Balloon Capability

- The Super Pressure Balloon Development has taken a stair step approach. The 18.8 MCF is the mid-range Super Pressure Balloon for Science that is intended to be qualified for Explorer type missions.
- Science allocation mass dependent upon specific mission profile. (~2,000+ pounds)



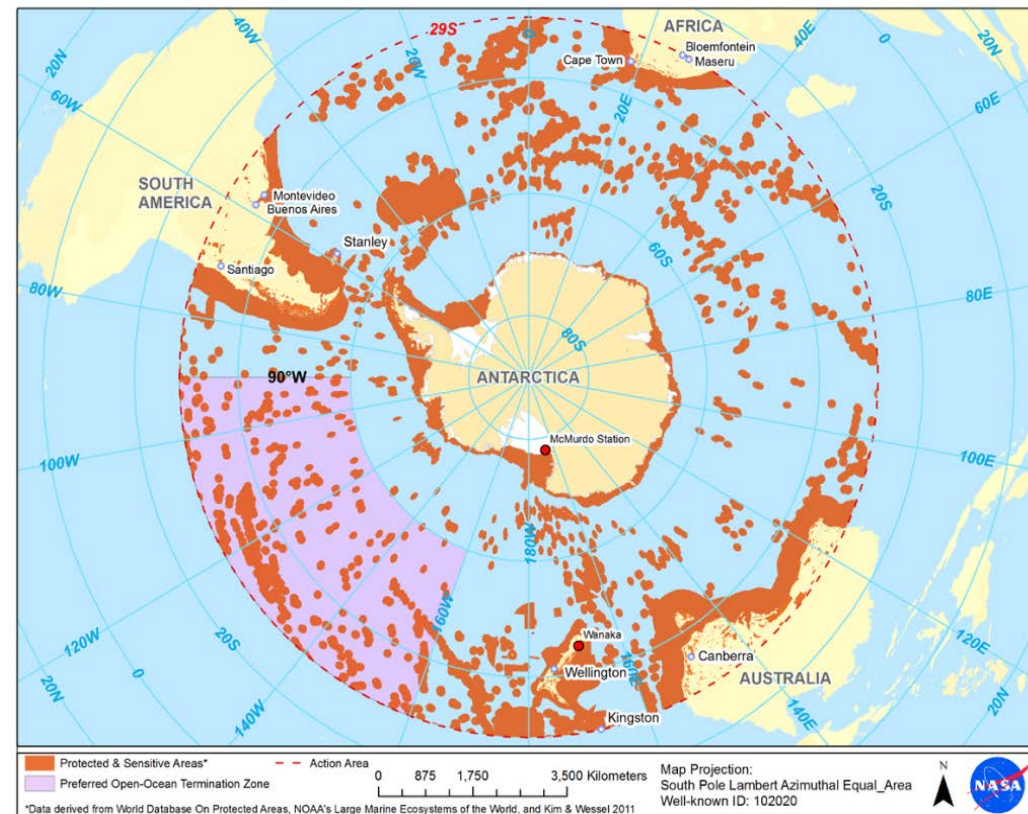
Volume	Suspended Weight	Altitude	Flight Number	Duration	Launch Date	Landing Location
7 MCF	1,500 Lbs	~110 KFT	591 NT	54 days	Dec 28, 2008	Antarctica
14.9 MCF	4,000 Lbs	~110 KFT	599 NT	4.2 hours	June 22, 2009	Sweden
			608 NT	2.8 hours	Dec 10, 2009	Antarctica
			616 NT	22 days	Jan 9, 2011	Antarctica
18.8 MCF <i>Primary Science Interest</i>	5,000 Lbs	~110 KFT	631 NT	6.5 hours	Aug 14, 2012	Sweden
	5,000 Lbs		659 NT	43 hours	Dec 28, 2014	Antarctica
	5,000 Lbs		662 NT	32 days	Mar 26, 2015	Australia
	5,000 Lbs		669 NT	46 days	May 16, 2016	Peru
	5,500 Lbs		679 NT	12 days	April 24, 2017	Pacific Ocean

Ultra Long Duration Balloon Missions

- NASA is progressing to fully qualify the Super Pressure Balloon (SPB) for support of missions up to 100 days duration. Five missions have been flown of the 18.8 MCF SPB which supports 5,000 (to 5,500) pounds suspended to ~110,000 feet.
- NASA expects that the SPB will become a qualified vehicle by the time that a balloon investigation selected from this solicitation would be launched.
- Next flight of 18.8 MCF SPB scheduled for late March/early April 2019 from New Zealand.
- Those missions requesting total suspended of 5,500 pounds will fly at lower float altitude (~108,000 feet).

Antarctic Off Continent and New Zealand

- WFF Completed a Biological Evaluation and Environmental Assessment for SPB (ULDB) Program Southern Hemisphere Flight Operations covering Antarctica and New Zealand-launched SPBs.
- The Program received a **Finding Of No Significant Impact** and has received approval from NASA and concurrence from NOAA and NSF to proceed with Operations.
- The stratospheric anticyclone over Antarctica provides a stable balloon trajectory, once the anticyclone breaks down trajectories are highly variable.



Non-recovery due to ocean termination is potential and must be accepted prior to launch by PI and NASA HQ.

NASA Provides:

- Overall management of the balloon flight program
- Project planning support and management
- Requires operational and science performance and readiness reviews
- Approval of the mission for flight
- Authorize financial expenditures
- Maintain Inter-Agency Agreements
- Request Balloon Risk Analysis and coordinate with the WFF Safety Office when required
- Request Nuclear Launch Safety Approval (NLSA) per NPG 8715.3
- Works with NASA Safety to coordinate Ground Safety and Flight Safety Plans
- Solicit customer feedback

NASA Provides via CSBF:

- Technical support for project formulation, planning, & preparation
- Flight and ground support systems, including integration, testing and safety
- Balloon vehicle
- Launch support systems
- Coordinate launch site facilities
- Adherence to flight safety criteria
- All flight operations support elements
- Requirements reviews, flight readiness reviews, and post-flight reviews
- Mechanical certification of all flight hardware including pressure vessels

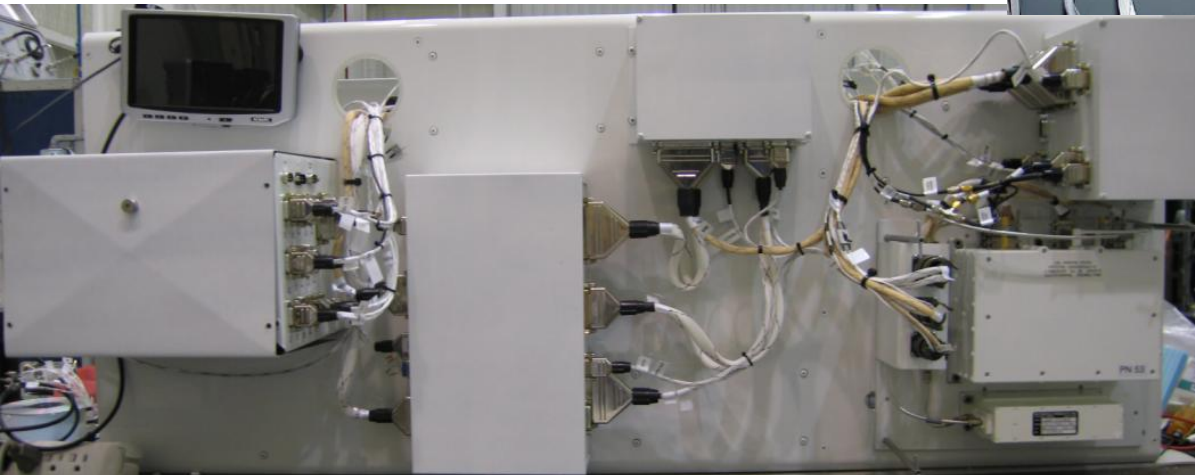
LDB Flight Systems

- Standard Flight Systems Provided by NASA / CSBF
- Support Instrumentation Package (SIP)

TDRSS or Iridium

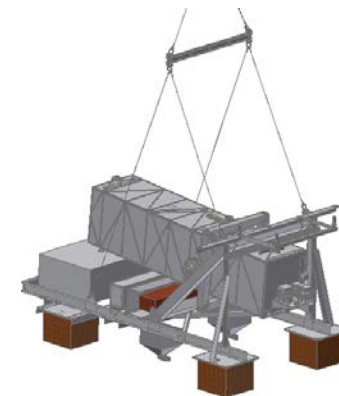
- Coarse azimuth rotator upon science request

<http://www.csbf.nasa.gov/docs.html>



Wallops Arc Second Pointer

- WASP is an operational control system capable of pointing balloon-borne instruments at targets with arc second accuracy.
- Proposal budget must include cost for WASP
- For additional information on the system go to:
https://sites.wff.nasa.gov/balloons/technology_wasp_details.html
- WASP POC: David Stuchlik (David.W.Stuchlik@nasa.gov) 757 824 1115



Typical LDB/SPB Balloon Mission Timeline:

- Contact BPO/CSBF once funded to schedule NASA Science Requirements Review
- NASA Science Configuration Review ~2 years prior to mission
- NASA Science Critical Configuration Review ~ 1 year prior to integration
- NASA/WFF led Project Initiation Conference ~one year prior to mission.
- Pre-Deployment I&T with CSBF support systems in Palestine, Texas ~six months prior to mission.
- Arrive launch site and commence pre-flight readiness preparations 2-4 weeks prior to planned launch date.
- Antarctica requires 6 month lead times for processing of personnel planning to travel to Antarctica.

First Point of Contact for Proposers Seeking BPO Support:

- Contact the NASA Balloon Program Office

Ms. Debora Fairbrother

Chief, Balloon Program

Wallops Flight Facility

757-824-1453

Debora.A.Fairbrother@nasa.gov

