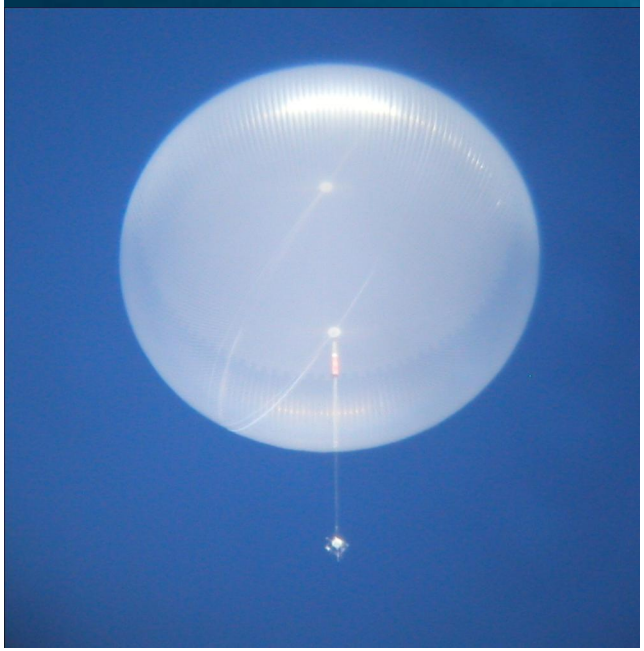
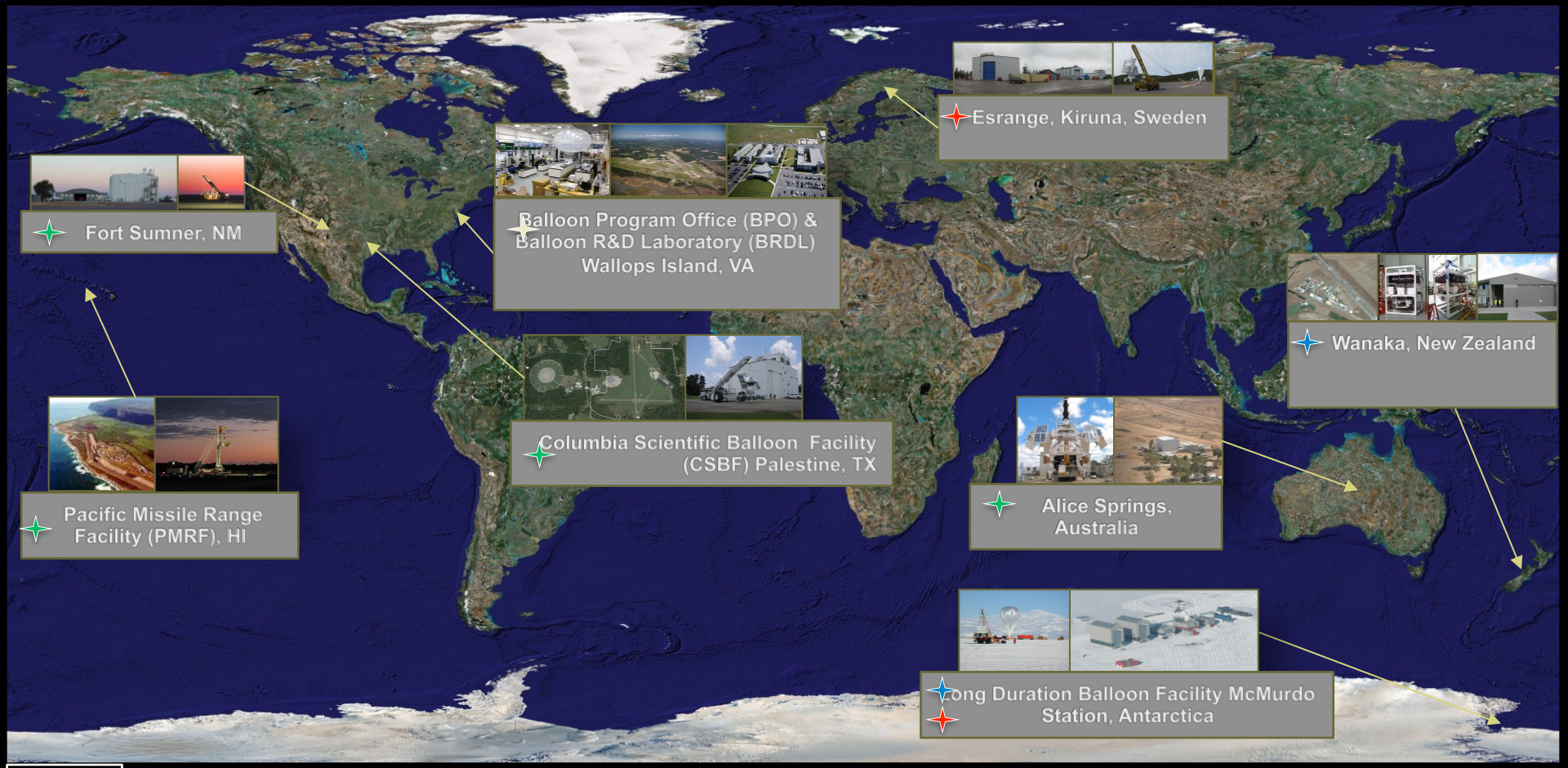
National Aeronautics and Space Administration

Scientific Balloon Missions of Opportunity

Debora A. Fairbrother, Chief, NASA Balloon Program Office



SCIENTIFIC BALLOON LOCATIONS

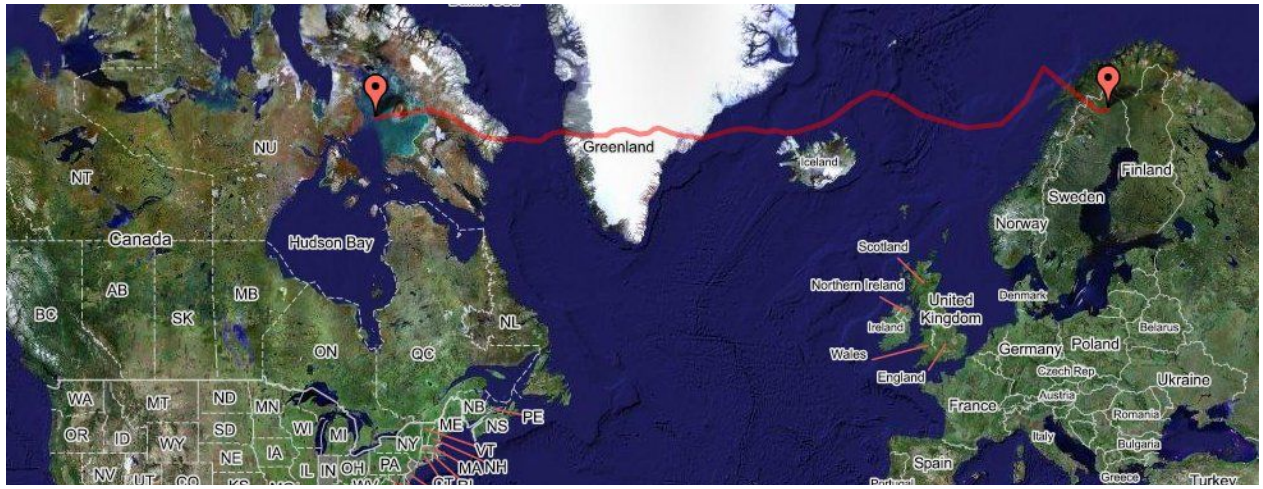


Conventional Balloon Missions

- NASA supports “conventional” missions launched from 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.
- Conventional missions are supported with the Consolidated Instrument Package (~26 kg) or the Micro Instrument Package (~12 kg), both of which support up to about 1 Mbps return data bandwidth.
- NASA supports conventional missions from Fort Sumner during spring and 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 5-6 days (currently there is no Russia overflight agreement with NASA).
- Launch window third week in May through middle July.
- Payload and balloon recovered same season, usually with helicopter.



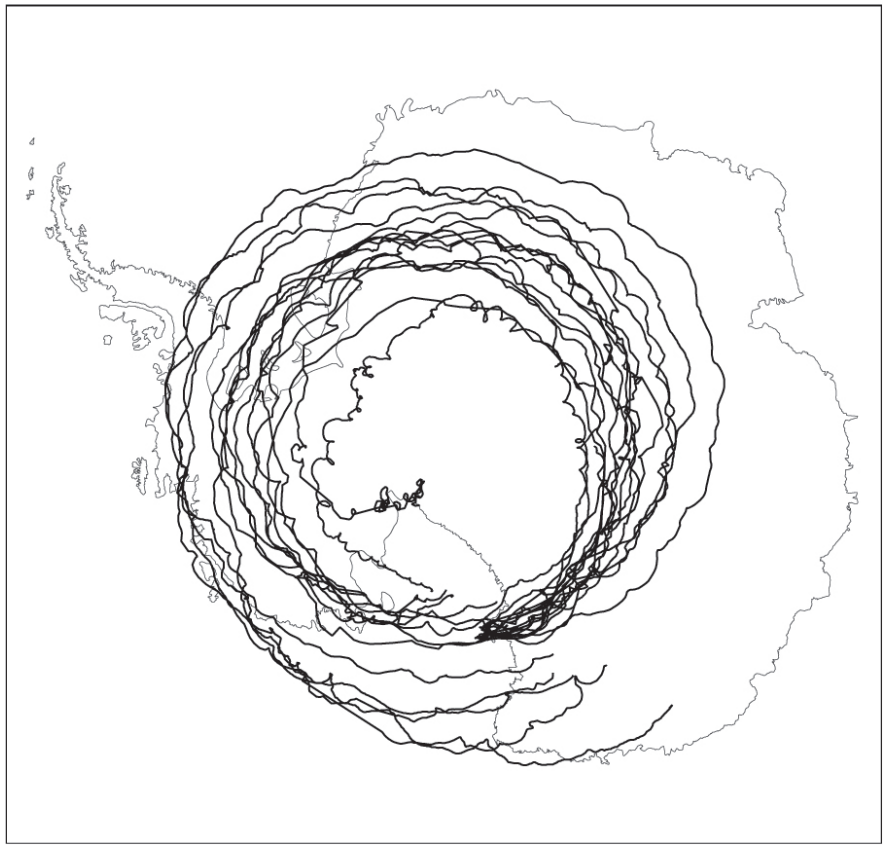
Esrange Balloon Launch Facilities

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 December 1 through January 10, each year.
- Arrive on site to perform pre-flight preparations ~ October 28.
- Proposers should plan one to three 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 and 46 days in 2016 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

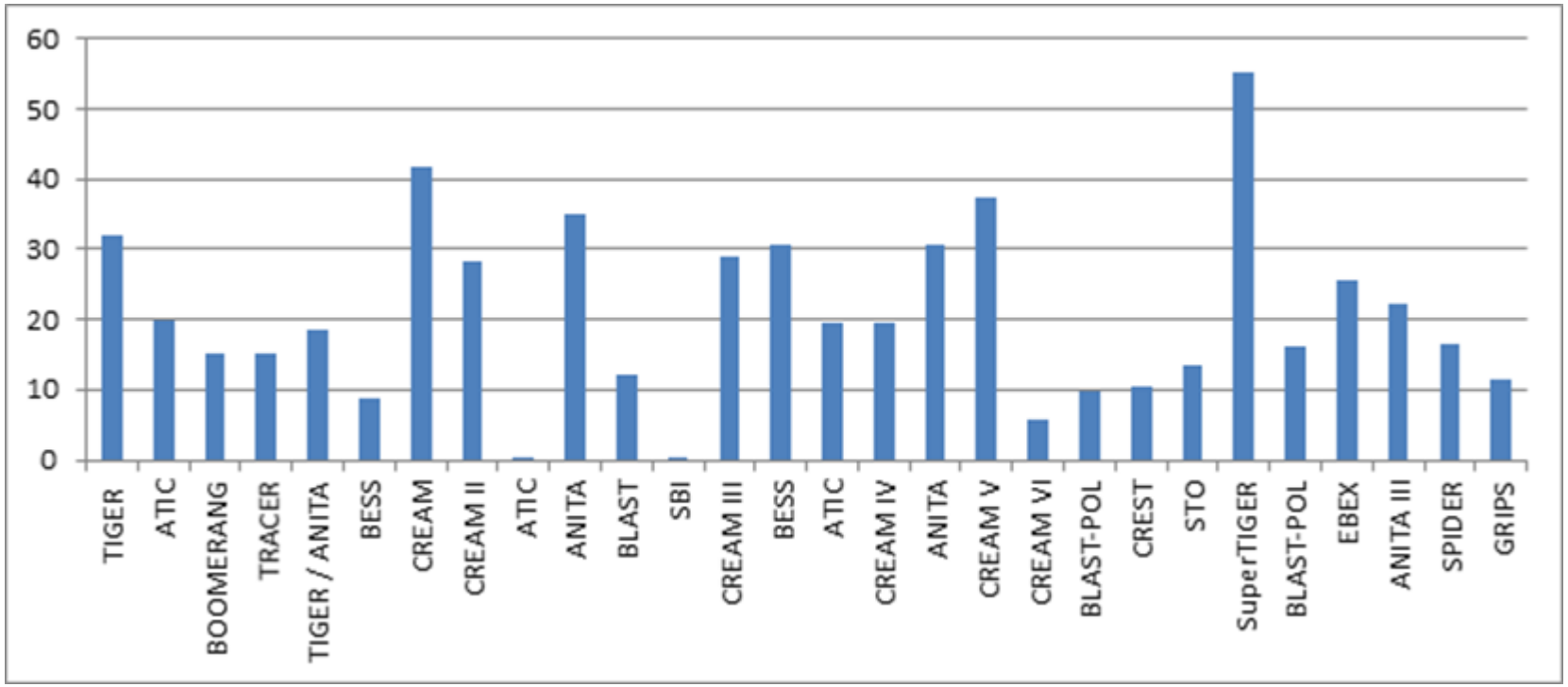
  Carry ~4,000 lb science (1,814 kg) to 120,000 feet nominal altitude
- 34 MCF Heavy Lift Balloon

  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

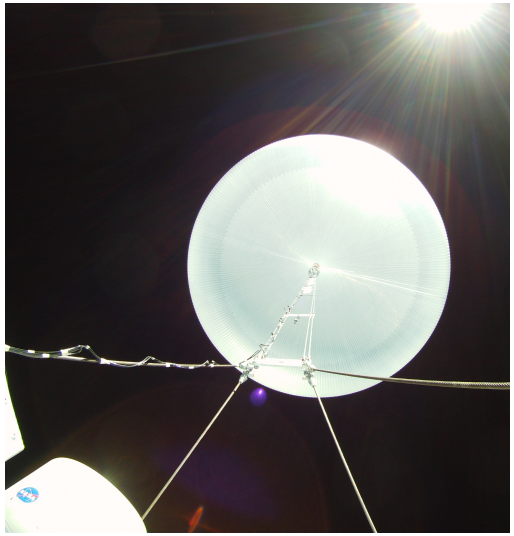
FY'02 to FY '16



- 28* long-duration balloon (LDB) Antarctica science flights since December 2001
  - * - Does not include Engineering Science or Vehicle Test Flights
  - Average Duration is 20 days
  - 1 Balloon Failure – Wefel(ATIC) Dec 2005
  - 1 Instrument Failure – Rust (SBI) Dec 2006

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)



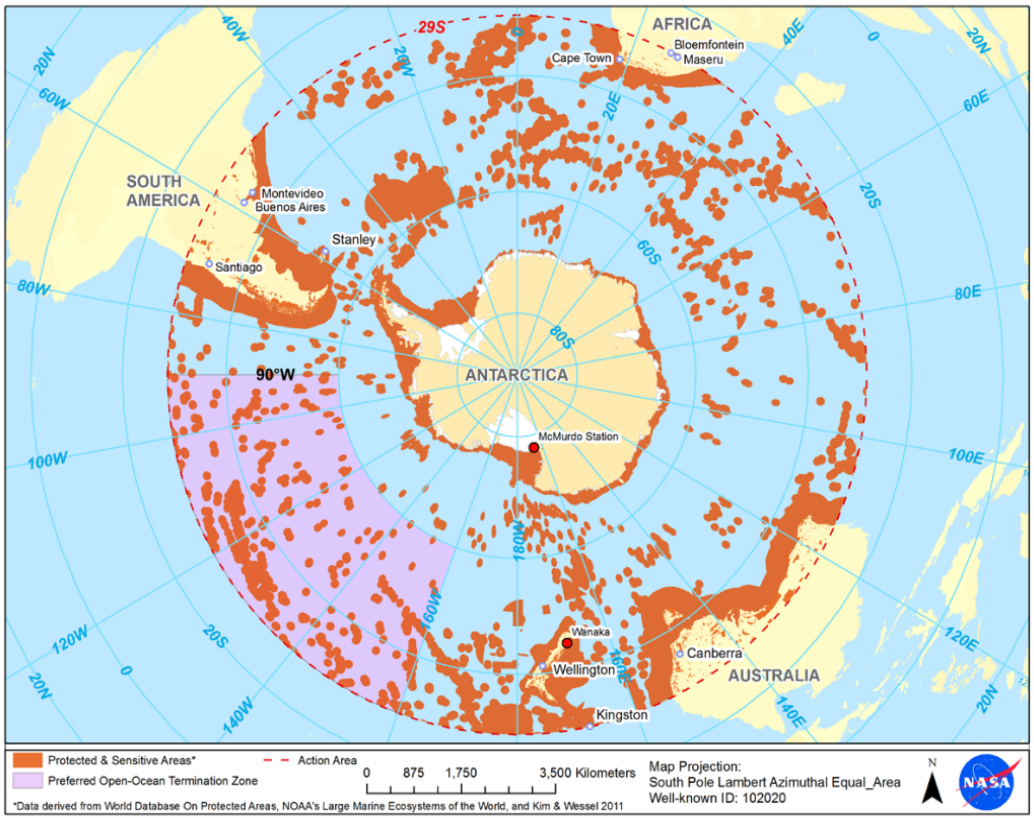
Volume	Suspended Weight	Altitude	Flight Number	Duration	Launch Date
7 MCF	1,500 Lbs	~110 KFT	591 NT	54 days	Dec 28, 2008
14.9 MCF	4,000 Lbs	~110 KFT	616 NT	22 days	Jan 9, 2011
18.8 MCF	5,000 Lbs	~110 KFT	631 NT 659 NT 662 NT 669 NT	6.5 hours 43 hours 32 days 46 days	Aug 14, 2012 Dec 28, 2014 Mar 26, 2015 May 16, 2016
26 MCF	4,000 Lbs	~117 KFT			

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. Four missions have been flown of the 18.8 MCF SPB which supports 5,000 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 2017 from New Zealand.
- Some missions requesting total suspended of 5,500 pounds to ~108,000 feet. Balloon can support but has not been flown in that configuration to date.

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.

NASA Provides:

- Overall management of the balloon flight program
- Project planning support and management
- Requires operational and science performance and readiness reviews
- Approve 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
- Solicit customer feedback

NASA Provides via CSBF:

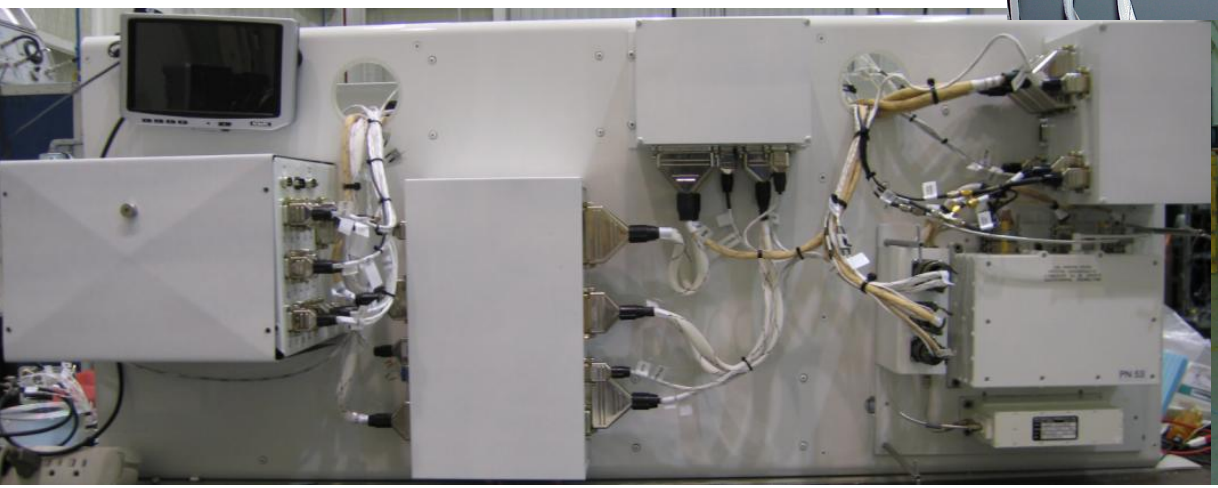
- Technical support for project formulation, planning, & preparation
- Flight and ground support systems, including integration, testing and safety
- Balloon vehicle
- Launch support systems
- Coordinate launch site facilities
- Adhere to flight safety criteria
- All flight operations support elements
- 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



Typical LDB/SPB Balloon Mission Timeline:

- Submit CSBF Flight Application Form two years prior to planned mission.
- 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. BPO is evaluating possibility of compatibility at Plum Brook facility.
- 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

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  Chief, Balloon Program

  Wallops Flight Facility

  757-824-1453

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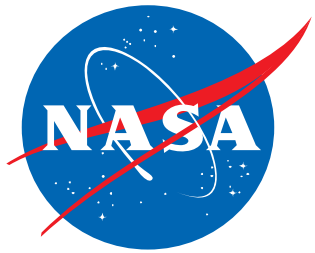
NASA