

## 2016 Scientific Ballooning Technologies Workshop

# ***NASA Super Pressure Balloon***

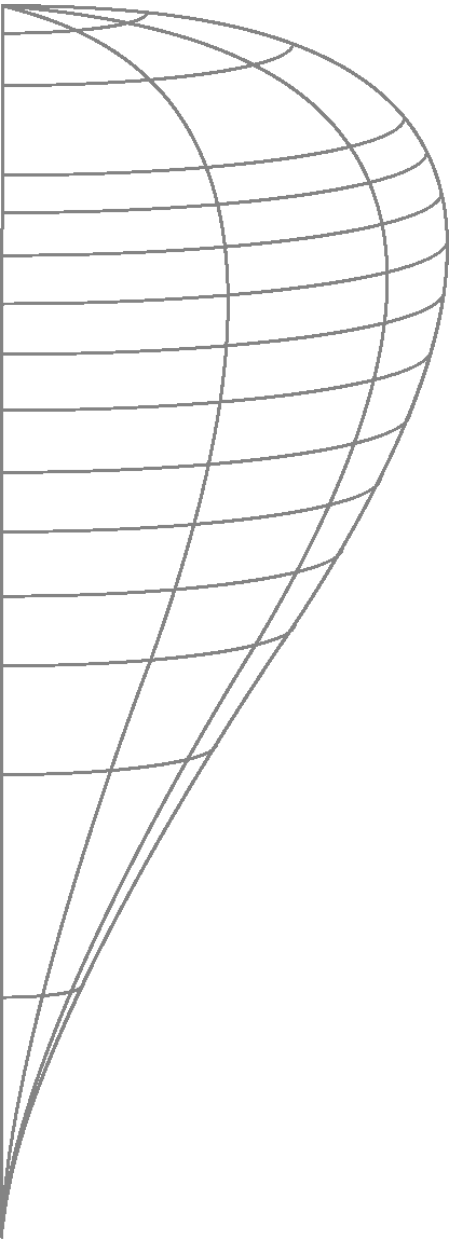
*Debbie Fairbrother*

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*Suborbital and Special Orbital Projects Directorate*

*Wallops Flight Facility*

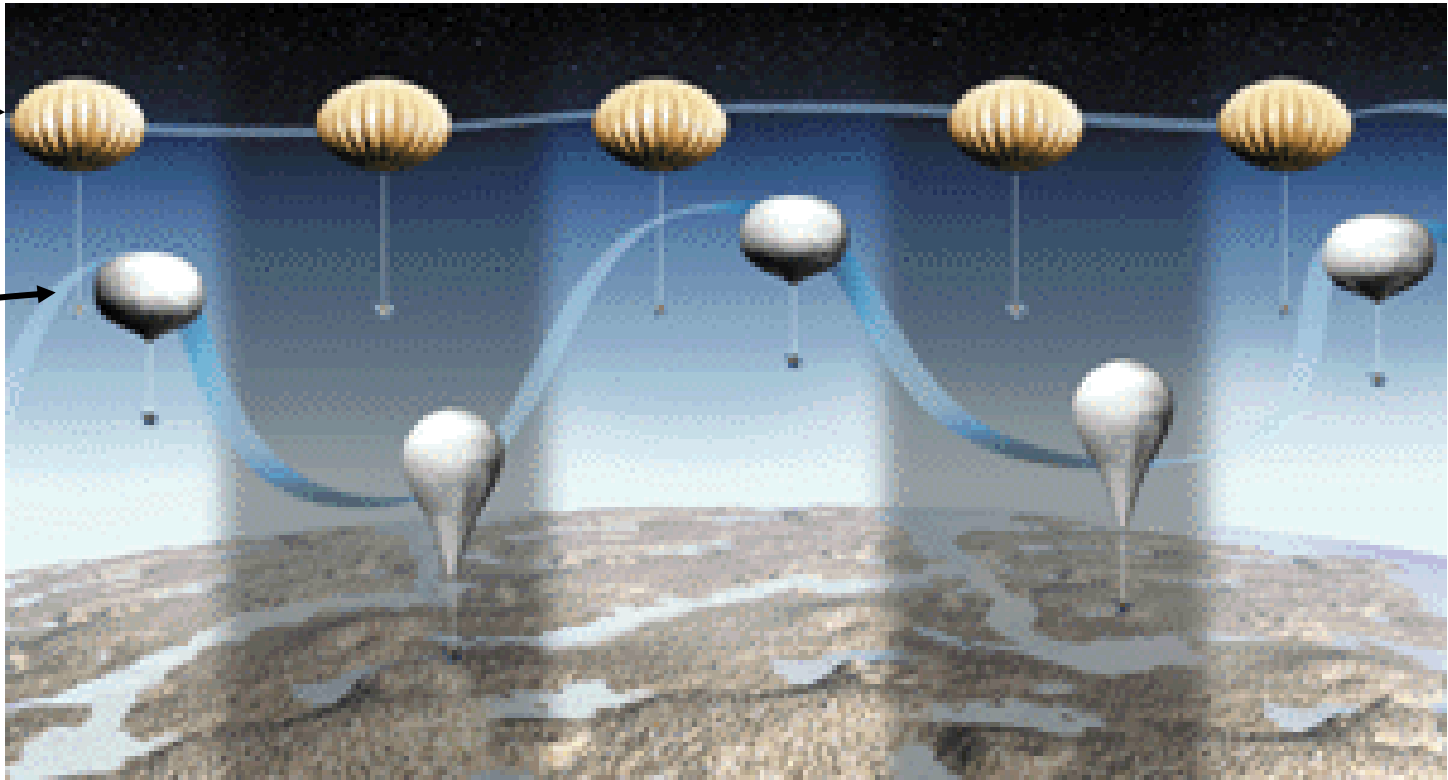
*May 9, 2016*



# Two Types of Balloons

**Super Pressure Balloon maintains nearly constant volume – *under development***

- Allows Ultra Long Duration Balloon (ULDB) Flights
- Provides stable altitude Long Duration Balloon (LDB) flights at mid-latitudes



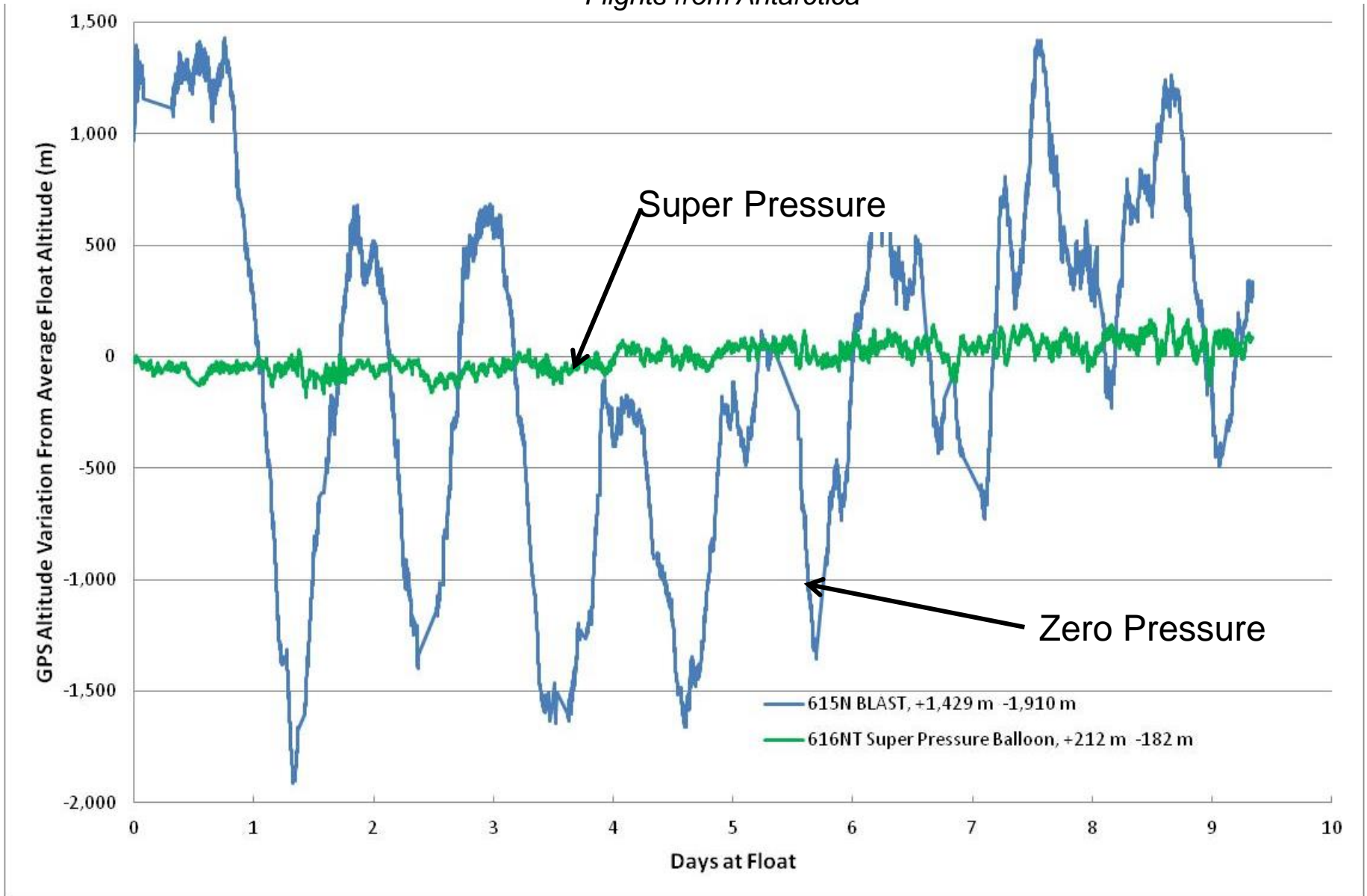
**Zero-Pressure (ZP) Balloon changes volume due to radiative input**

- Used for Conventional Flights and Polar LDB Flights

# Altitude Stability Comparison



Flights from Antarctica



- The NASA SPB is being developed to provide a stable platform at constant density altitude for extended duration science investigations at polar and mid-latitudes
- An incremental approach has been applied to the development.

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 TBD	Aug 14, 2012 Dec 28, 2014 Mar 26, 2015 TBD
26 MCF	4,000 Lbs	~117 KFT			

***Several science groups are requesting a suspended weight of 5,500 pounds on the 18.8 MCF; therefore, some future test flights will have higher suspended weights when appropriate.***

# 7 MCF SPB



- Launch Site: McMurdo Station, Antarctica
- Volume: 200,684 m<sup>3</sup> (7,089,000 ft<sup>3</sup>)
- Launch Date: December 28, 2008
- Suspended Load: 682 kg (1,500 lbs)
- Flight Time: 54 Days, 1 hour, 29 minutes
- Near constant altitude for the flight duration

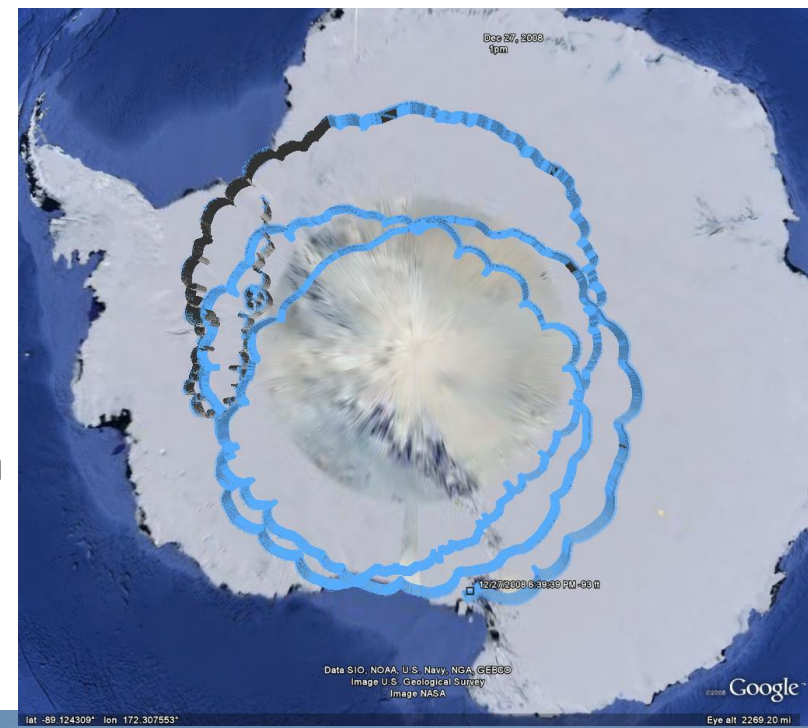


Photo by Rich Joss

# 14.9 MCF SPB

- Launch Site: McMurdo Station, Antarctica
- Volume: 422,352 m<sup>3</sup> (14,915,000 ft<sup>3</sup>)
- Launch Date: January 9, 2011
- Suspended Load: 1,818 kg (4,000 lbs)
- Flight Time: 22 Days, 2 hours
- Near constant altitude for the flight duration

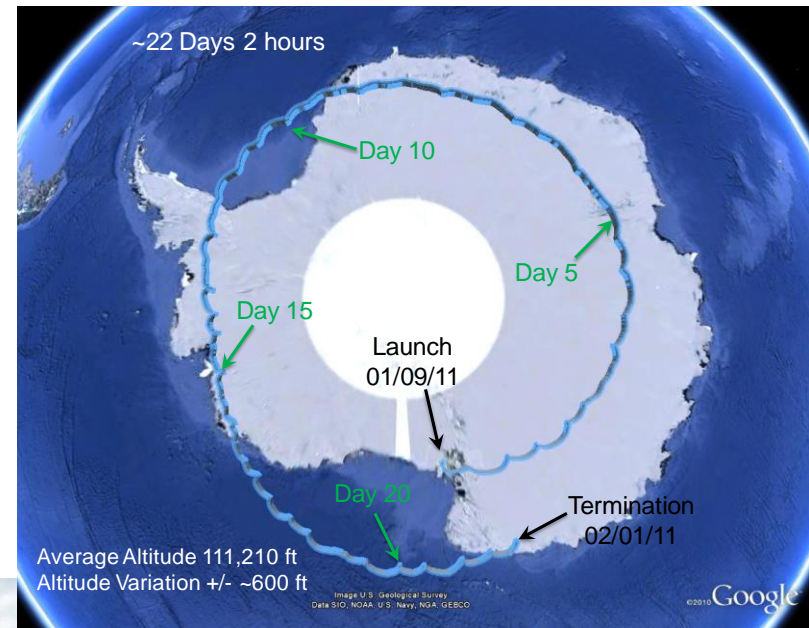


Photo courtesy of Matthew Truch

# Mid-Latitude Location for SPB



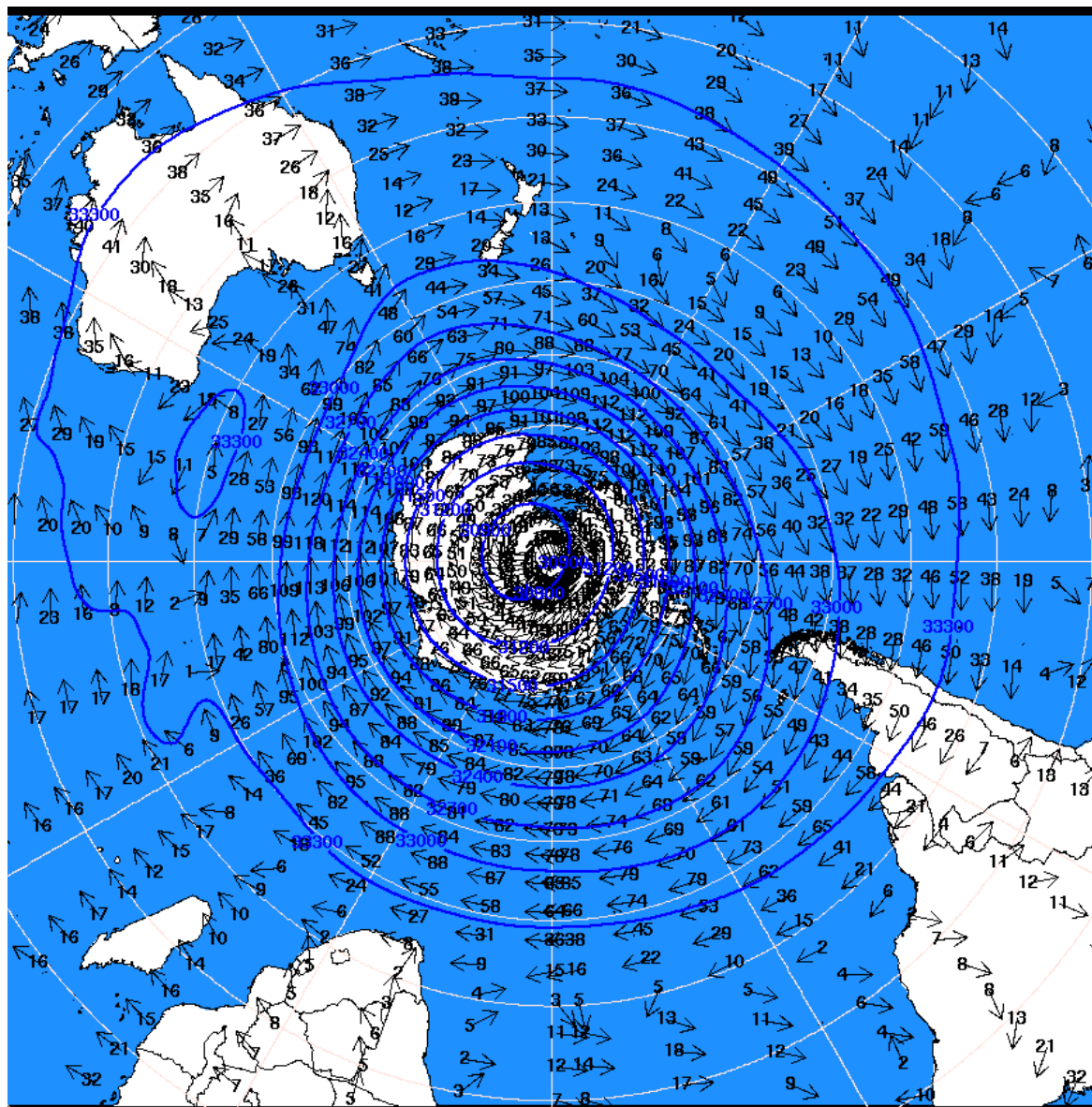
# Wanaka, New Zealand

- Far Enough North
- Far Enough South
- Airport Location
- Geography
- Low Populations
- Stratospheric Trajectories
- Infrastructure
- Accommodations

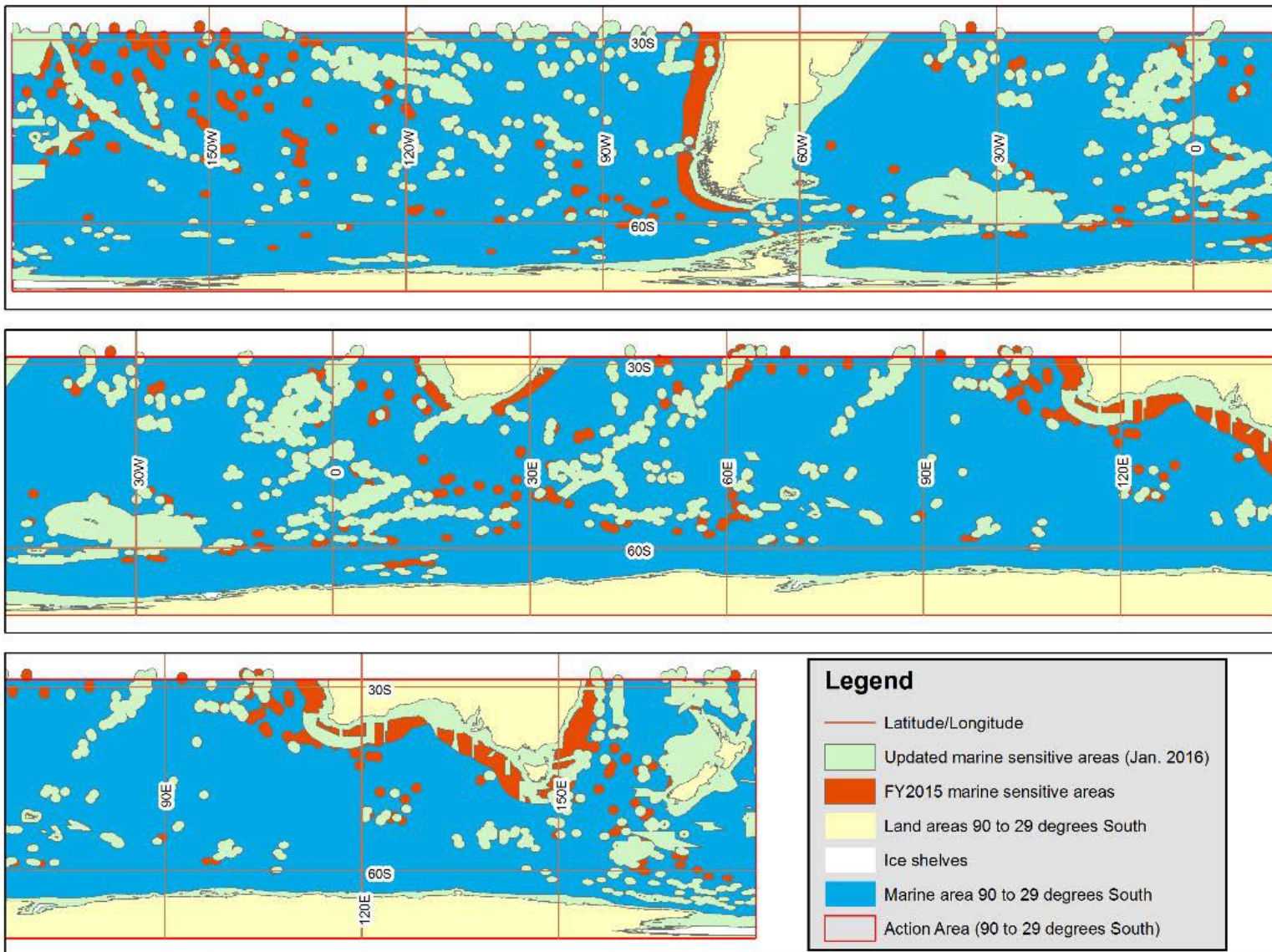




# Stratospheric Winds



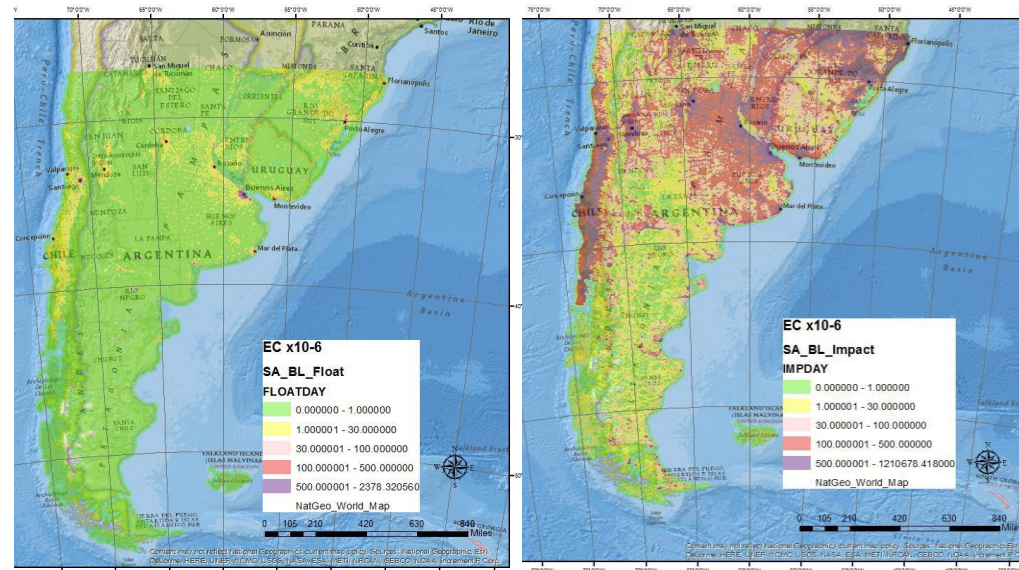
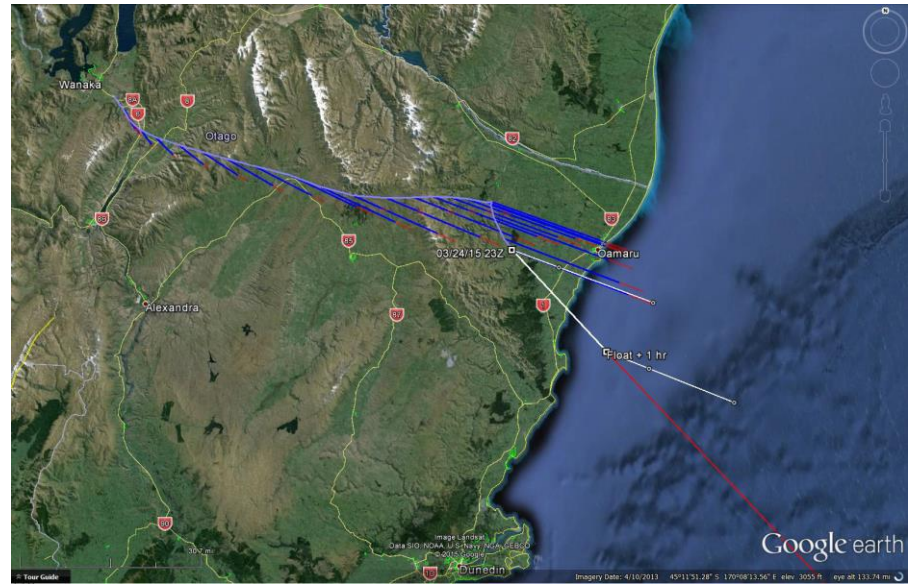
# Environmental Considerations



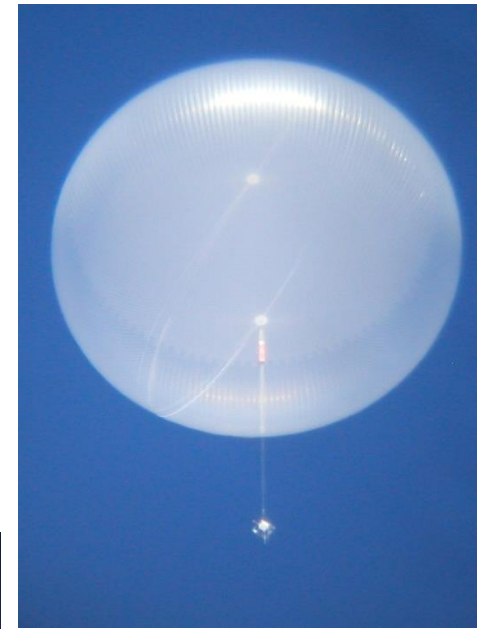
Data derived from the World Database on Protected Areas (January 2016), the General Bathymetric Chart of the Oceans (The GEBCO\_08 Grid, version 20091120, <http://www.gebco.net>, updated October 2010), NOAA's Large Marine Ecosystems of the World, and Kim & Wessel 2011.

# Safety Considerations

- Trajectory Analysis Pre-Launch
- Airport Closed During Launch Operations
- Roadblocks
- Go-No Go prior to Land Mass
- Go-No Go ~ every 24 hour when over land

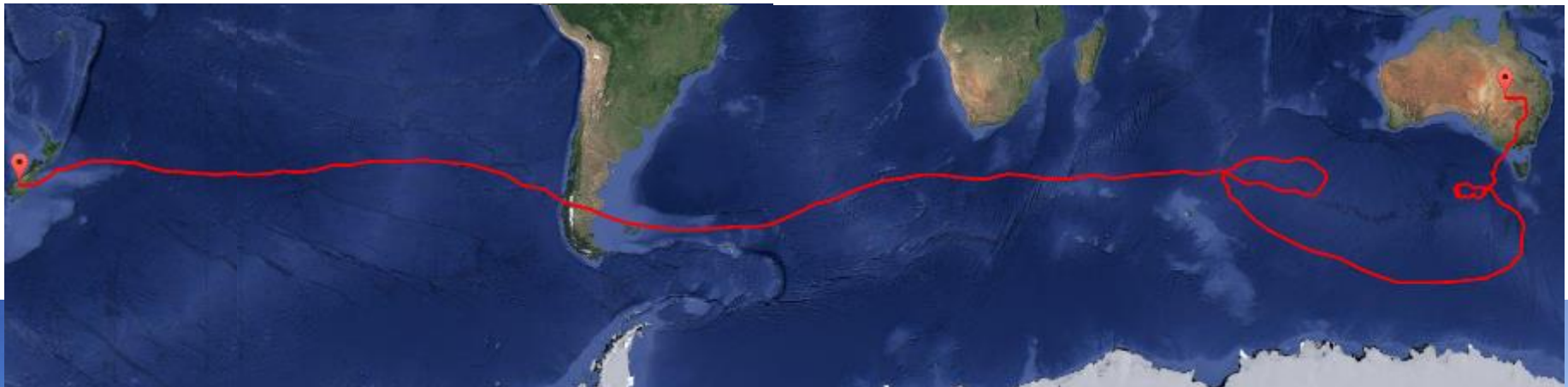
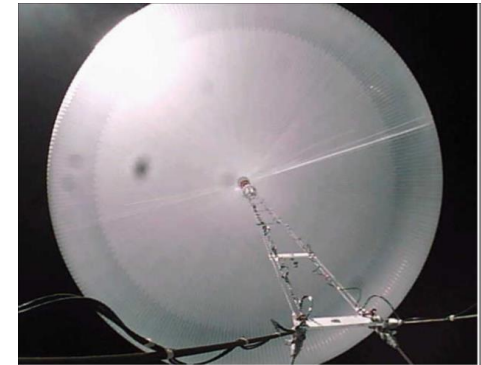


- Wanaka team will monitor and support flight from launch pre-ops to end of LOS
- Palestine Operations Control Center will be online at launch and take over after leaving LOS capabilities in Wanaka
- SPB team will monitor the entire flight remotely
- Palestine Operations Control Center will be manned 24 hours from launch until termination
- Science typically monitors from home institution

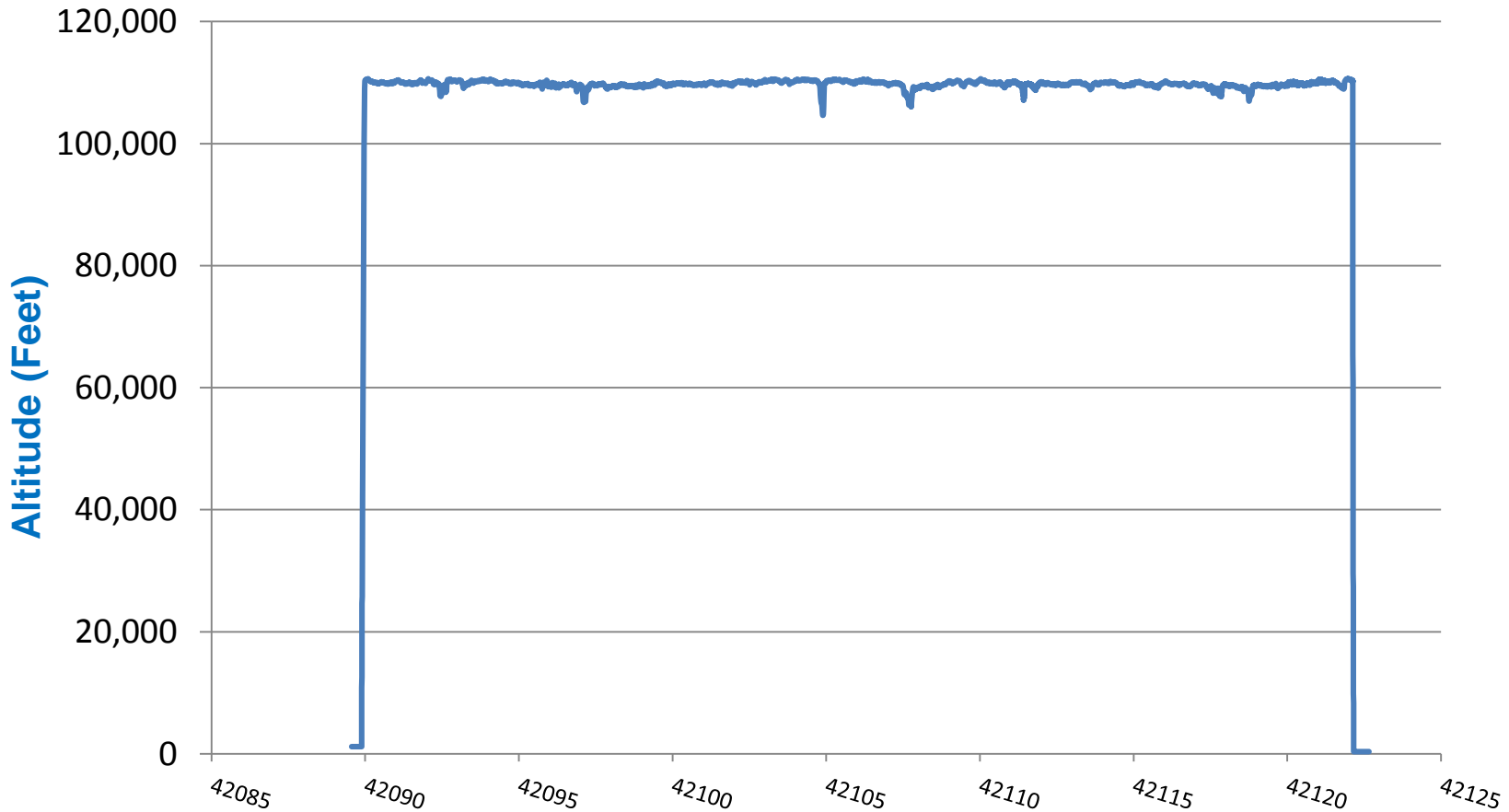


# 2015 - 18.8 MCF SPB

- Launch Site: Wanaka, New Zealand
- Volume:  $\sim 532,152 \text{ m}^3$  ( $\sim 18,793,000 \text{ ft}^3$ )
- Launch Date: March 26, 2015
- Suspended Load: 2,268 kg (5,000 lbs.)
- Flight Time – 32 Days, 5 hours, 51 minutes
- First multi-day diurnal flight!

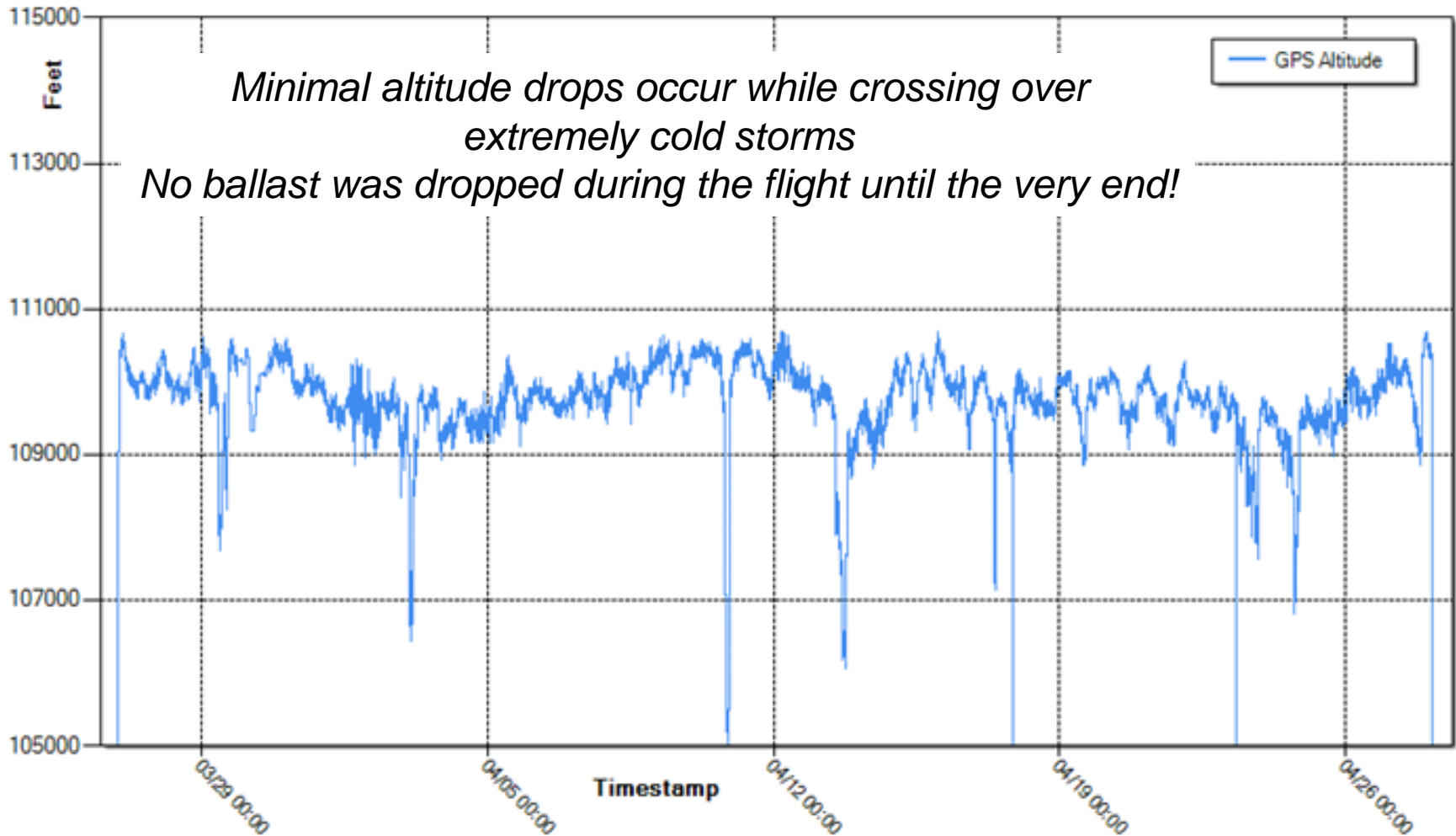


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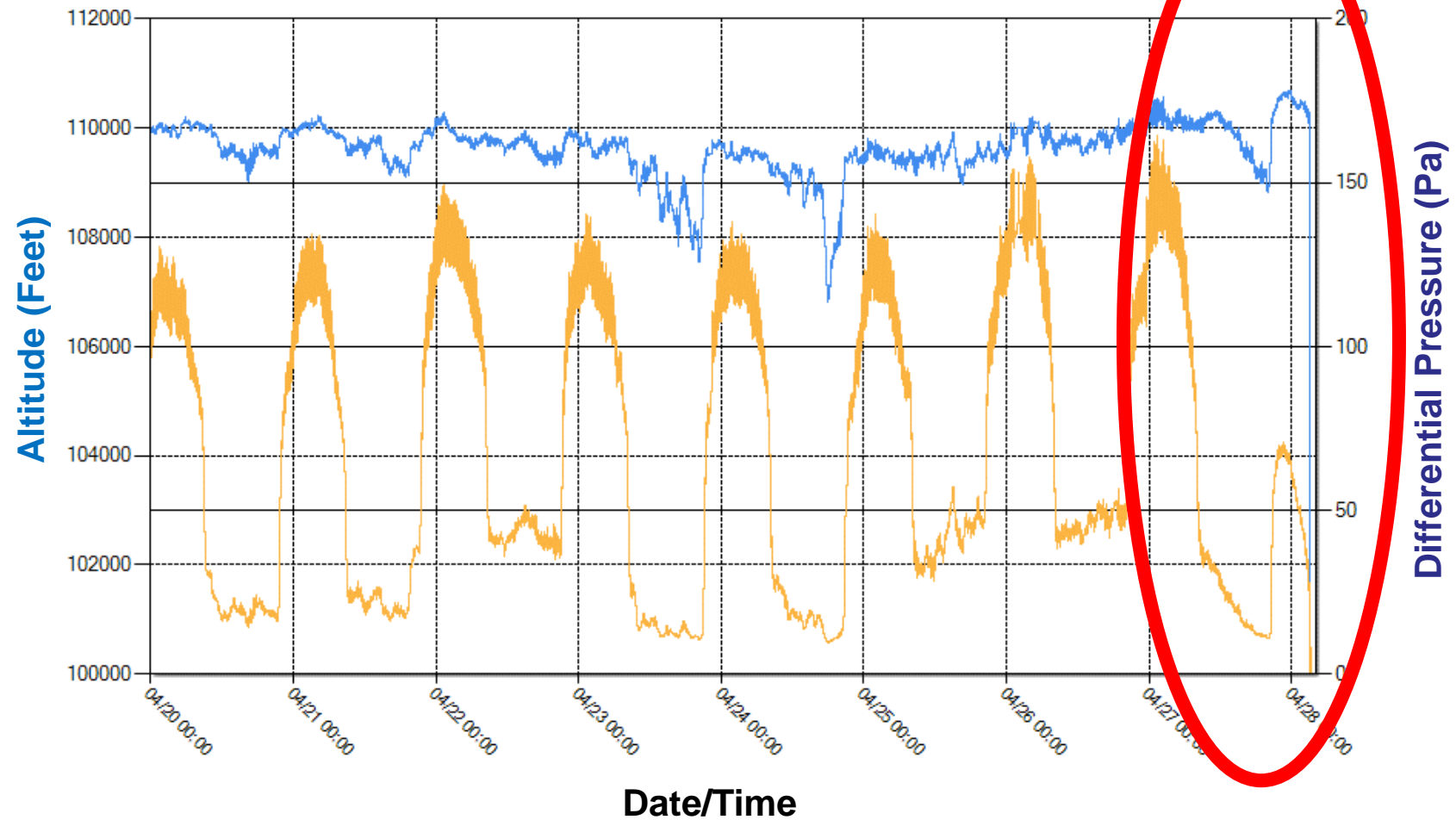
*Flight performance of this balloon was exceptional  
Total flight time was 32 days 5 hours 51 minutes, a record for this size  
balloon at these altitudes at these latitudes for this duration*

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## Flight 662 NT – Last 8 days



## Waiting on weather!!!!

- Launch Site: Wanaka, New Zealand
- Volume:  $\sim 532,152 \text{ m}^3$  ( $\sim 18,793,000 \text{ ft}^3$ )
- Launch Date: Flight Ready
- Suspended Load: 2,268 kg (5,000 lbs.)
- Flight Time – TBD
- Flying the Compton Spectrometer and Imager (COSI) as a Mission of Opportunity



# SPB Fun Facts

- Inflated volume = 18.8 million cubic feet
- Number of Gores = 280
- Number of Gore Width Measurements = 6,440 (23 per gore)
- Amount of Load Tape Tendon in Balloon=137,760 feet (26 miles)
- Amount of film visually inspected, re-rolled and dispensed for this balloon > 1.3 million square feet - over 30 acres of film
- Minimum amount of walking just to seal balloon = 55 miles
- Balloon shipping box 16 ft. x 6 ft. x 5.3 ft.
- Gross Weight of Balloon in Box = 8,832 pounds

