National Network of Total Solar Eclipse High Altitude Balloon Flights

Edge of Space Eclipse Project

Academic High Altitude Conference

June 26th, 2014

Overview

- Background: dancing and physics
- Big picture: perfectly poised
- Project details: ideas

Eclipse Science History

- Chinese 2800 BC
- Kepler 1605
- Helium 1868
- Einstein's theory of general relativity 1919

Eclipse geometry: rarity and types

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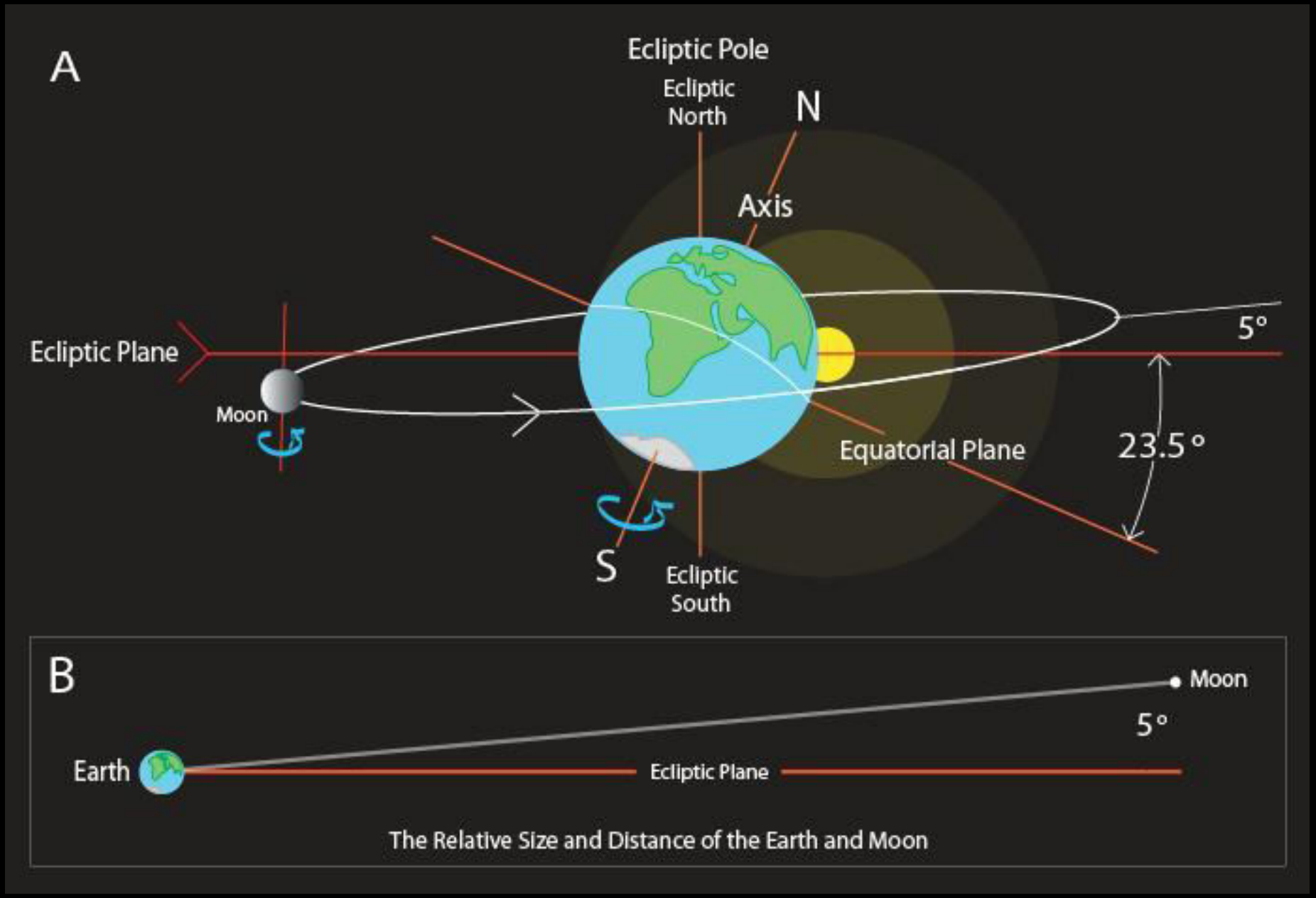
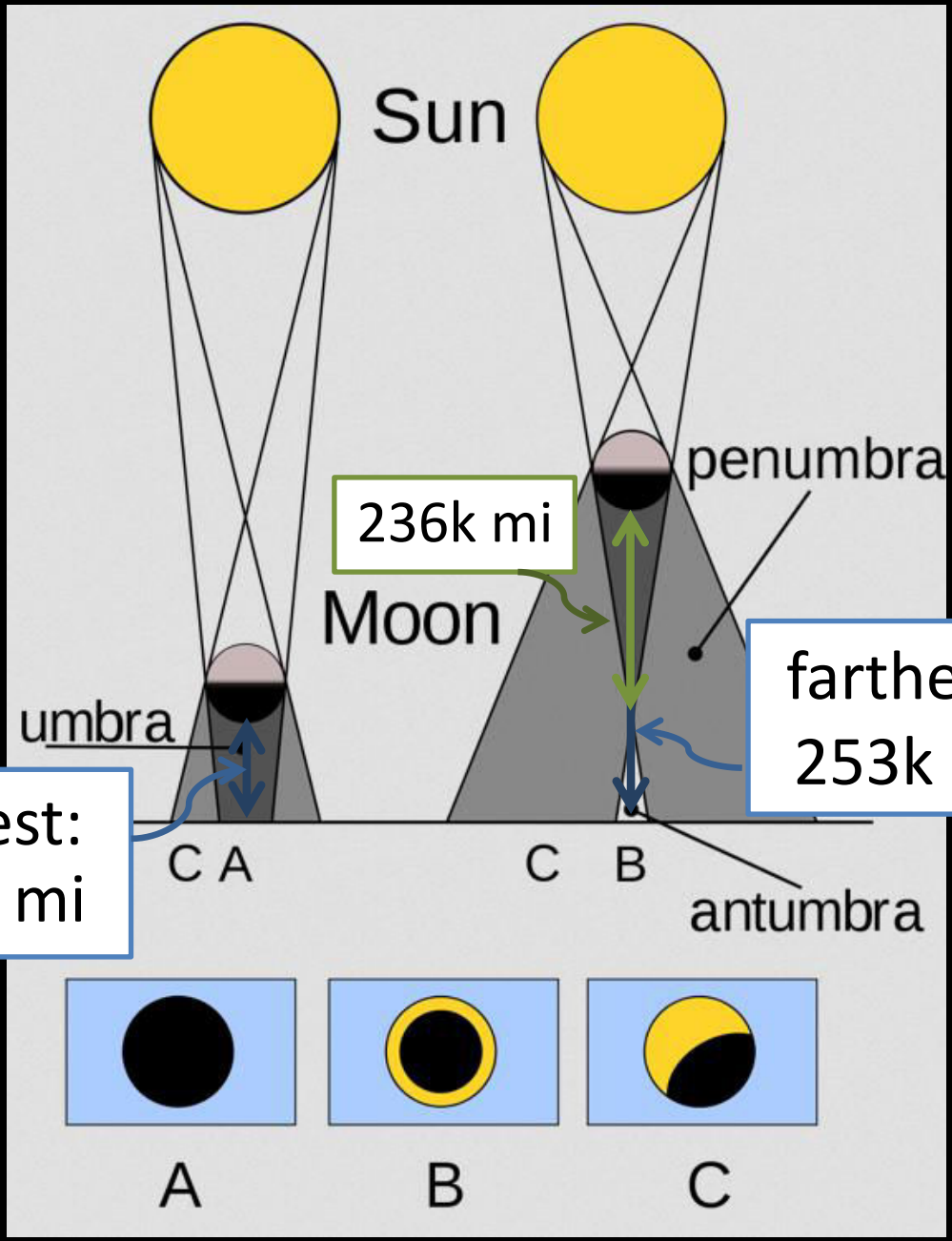
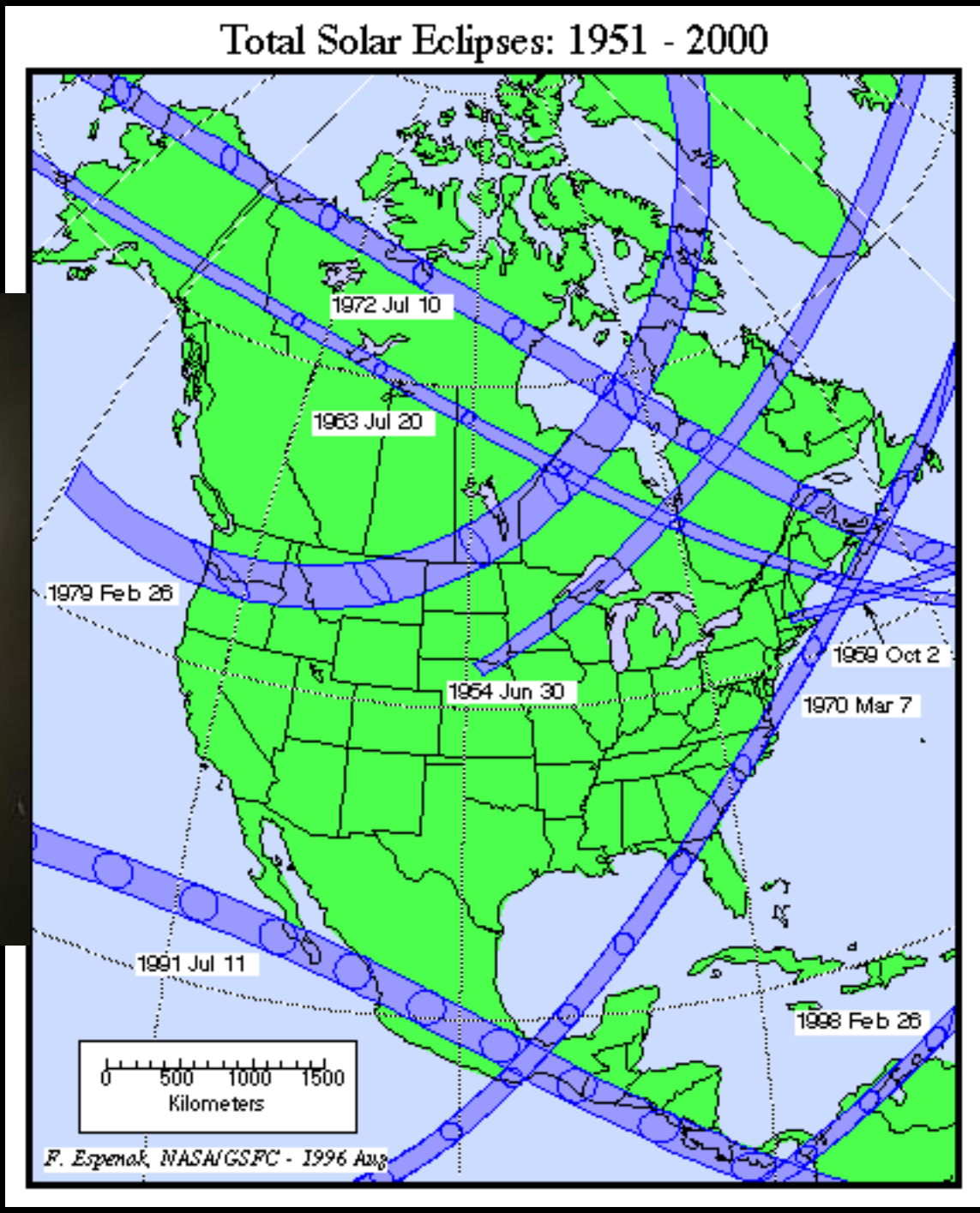


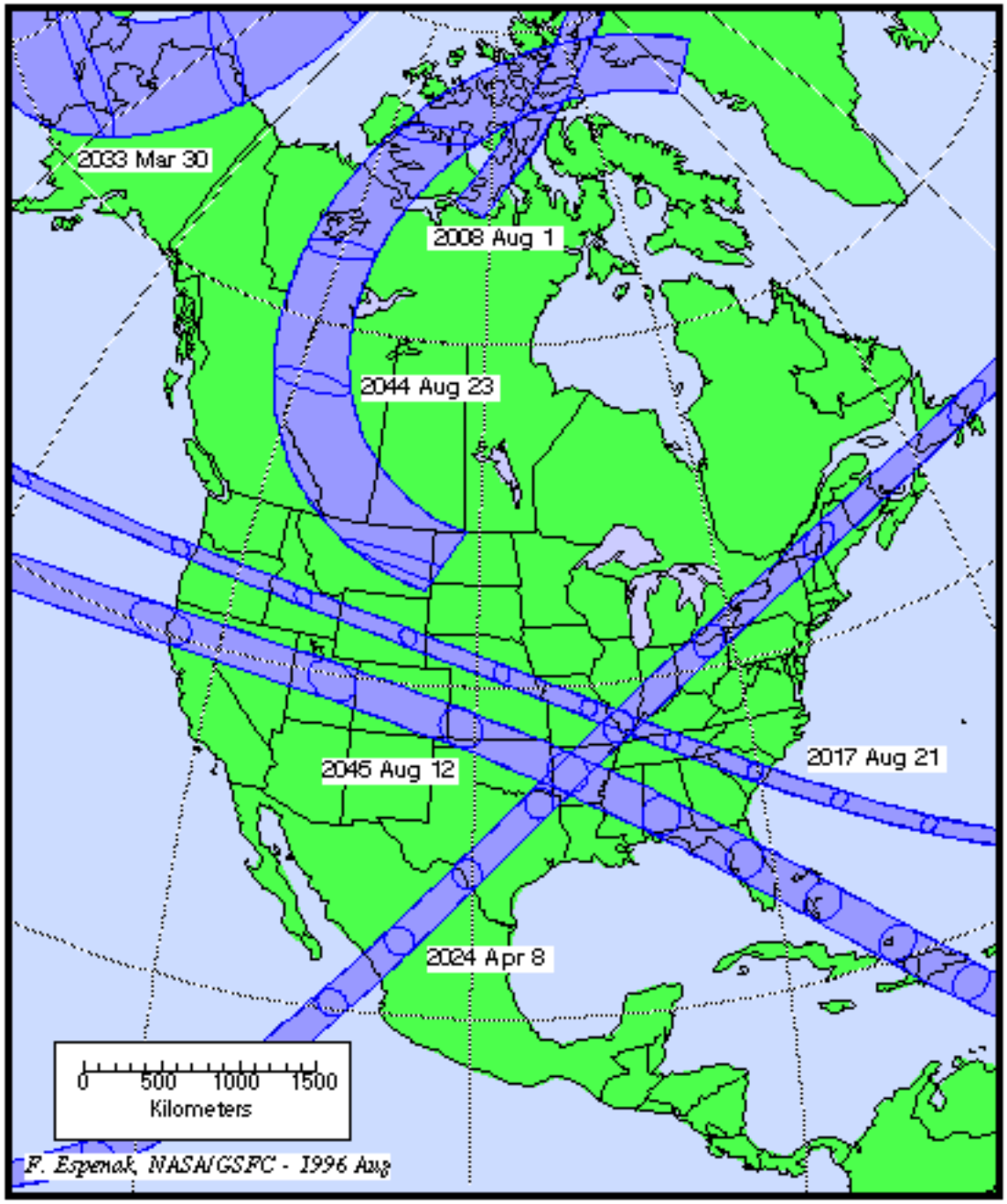
Eclipse geometry: rarity and types



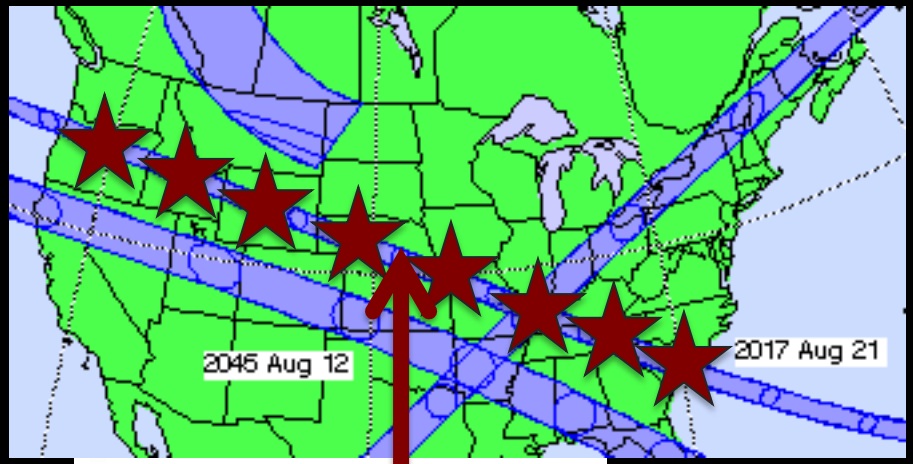

Total Solar Eclipses: 1951 - 2000
1972 Jul 10
1963 Jul 20
1979 Feb 26
1969 Oct 2
1954 Jun 30
1970 Mar 7
1991 Jul 11
1998 Feb 26
0 500 1000 1500
Kilometers
F. Espenak, NASA/GSFC - 1996 Aug


km (82,000 feet)

Total Solar Eclipses: 2001 - 2050



Edge of Space Eclipse Project: big picture



NATIONAL SPACE GRANT COLLEGE AND FELLOWSHIP PROGRAM
NASA

WHY

- Public engagement
  - Incredible learning moment opportunity
  - Millions can view live from anywhere in world
- Workforce development
  - Highly collaborative, mission-like
  - Multidisciplinary
- Science (solar) and Technology (space communications)
- Collaborations and partnerships
  - Inter-agency
  - industry

TIMELINE

- 2014 – 2015: fundraise, organize, develop common camera payload, advertise and select teams
- December 2015: distribute primary common camera payload kits and assembly instructions
- Summer 2016: virtual/regional workshops to verify each primary payload functionality; testing
- AY 2016 – 2017: build and test secondary payloads
- Summer 2017: June: dry run, at least one flight for each launch location. August: Eclipse totality starts in Oregon at 1:20 PM Eastern on August 21st, 2017 and ends at 2:50 PM Eastern in South Carolina.
- Fall 2017: Students present at national meeting

COSTS – very rough estimates

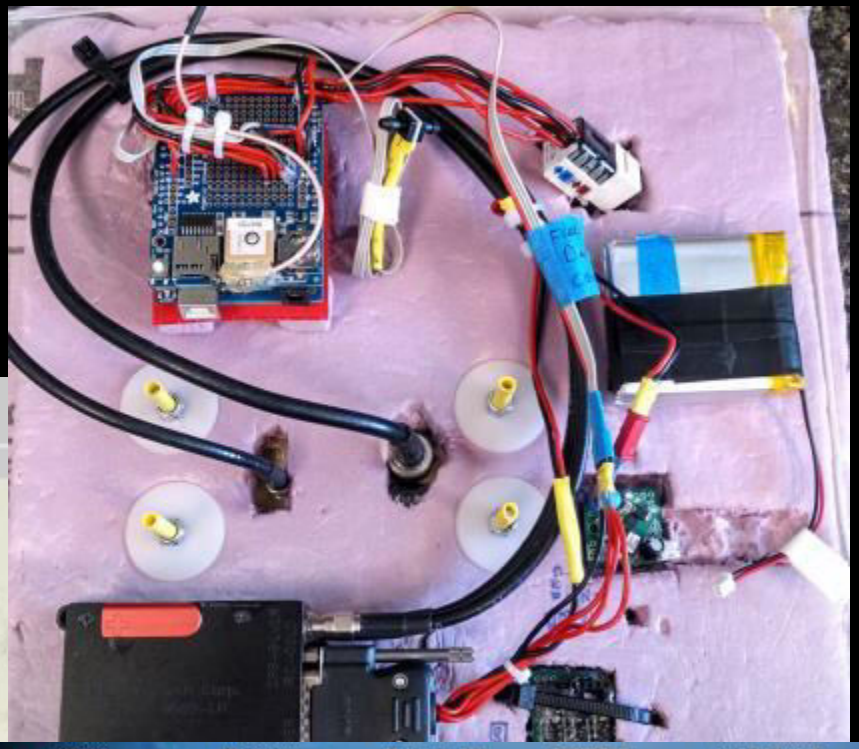
- Primary payload with camera, satellite modem/communication device: $1,500 - $2,500
- Secondary payload: $50 - $1,000
- Balloons, helium/hydrogen, basic flight supplies (some times two including dry run): $1,500 - $3,000
- 2016 regional/virtual workshop: $0 – $3,000
- Travel to launch and recovery sites (some x2): $2,000 – $10,000
- Data download fees: $500 – $5,000

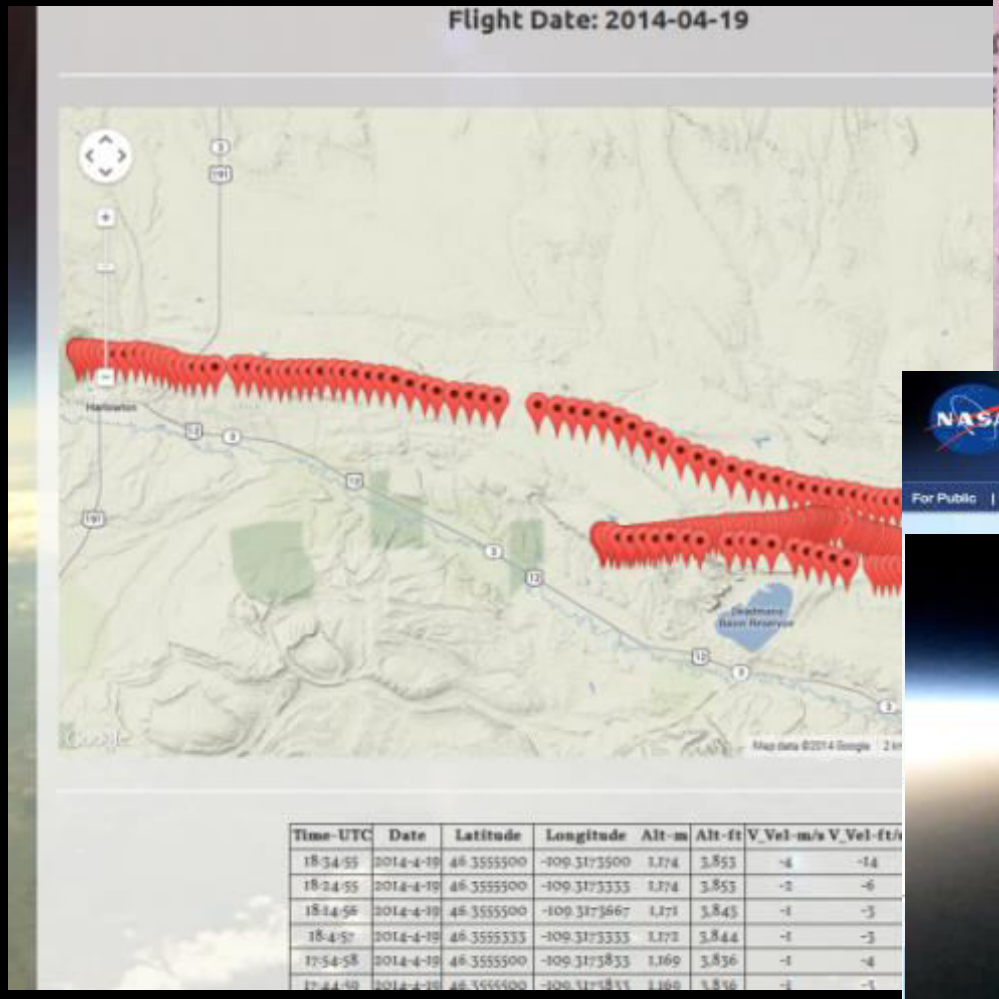
Total estimate for supplies, travel, and fees: $6,000 - $25,000 over two years. WORKING ON SUPPORT!

Planning teams

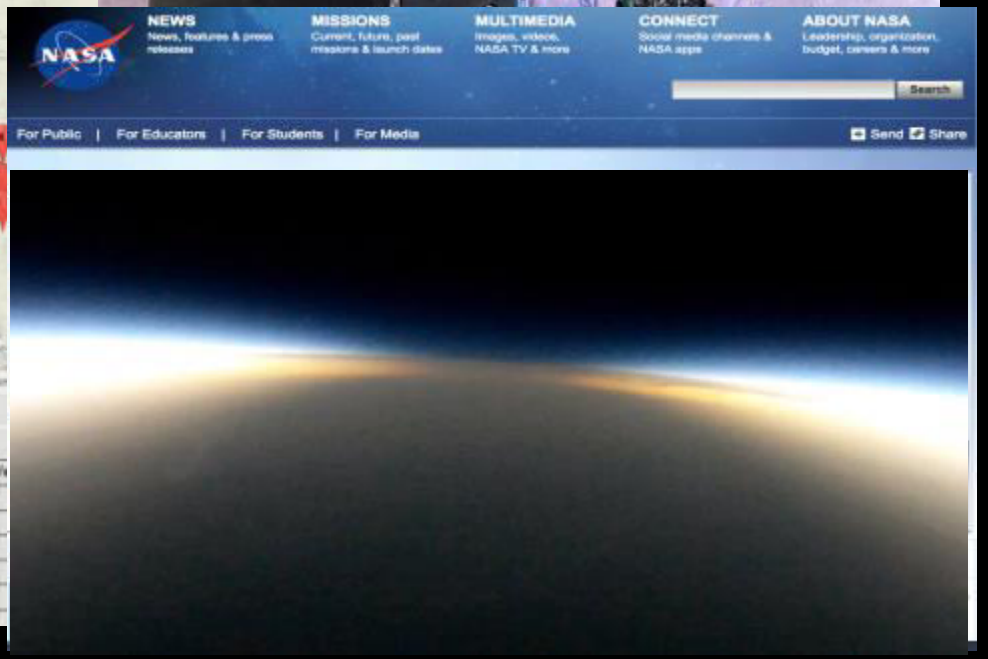
- Primary payload and kit design
- Launch cites
- Participating teams
- Science

Primary payload (kit)

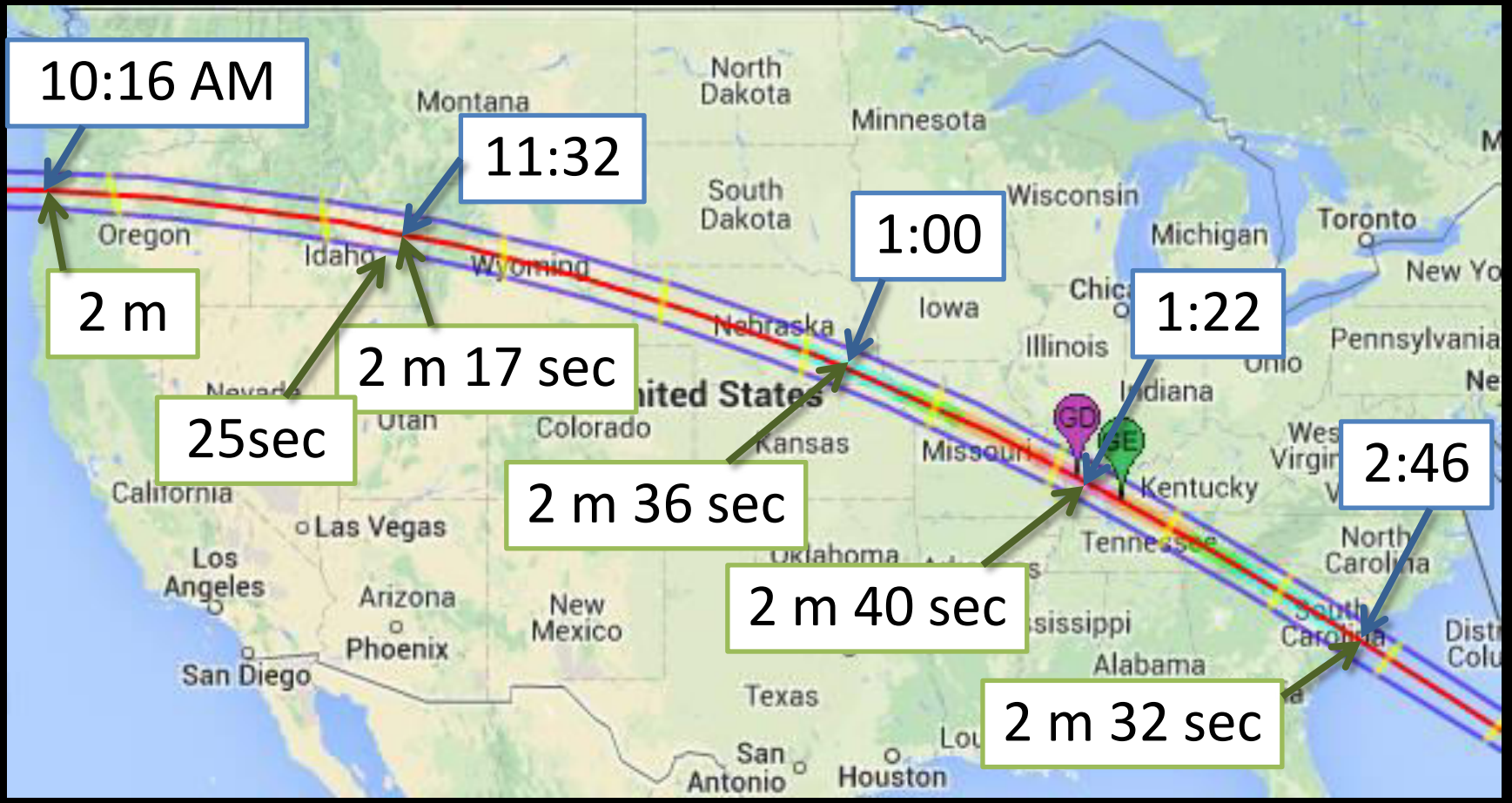




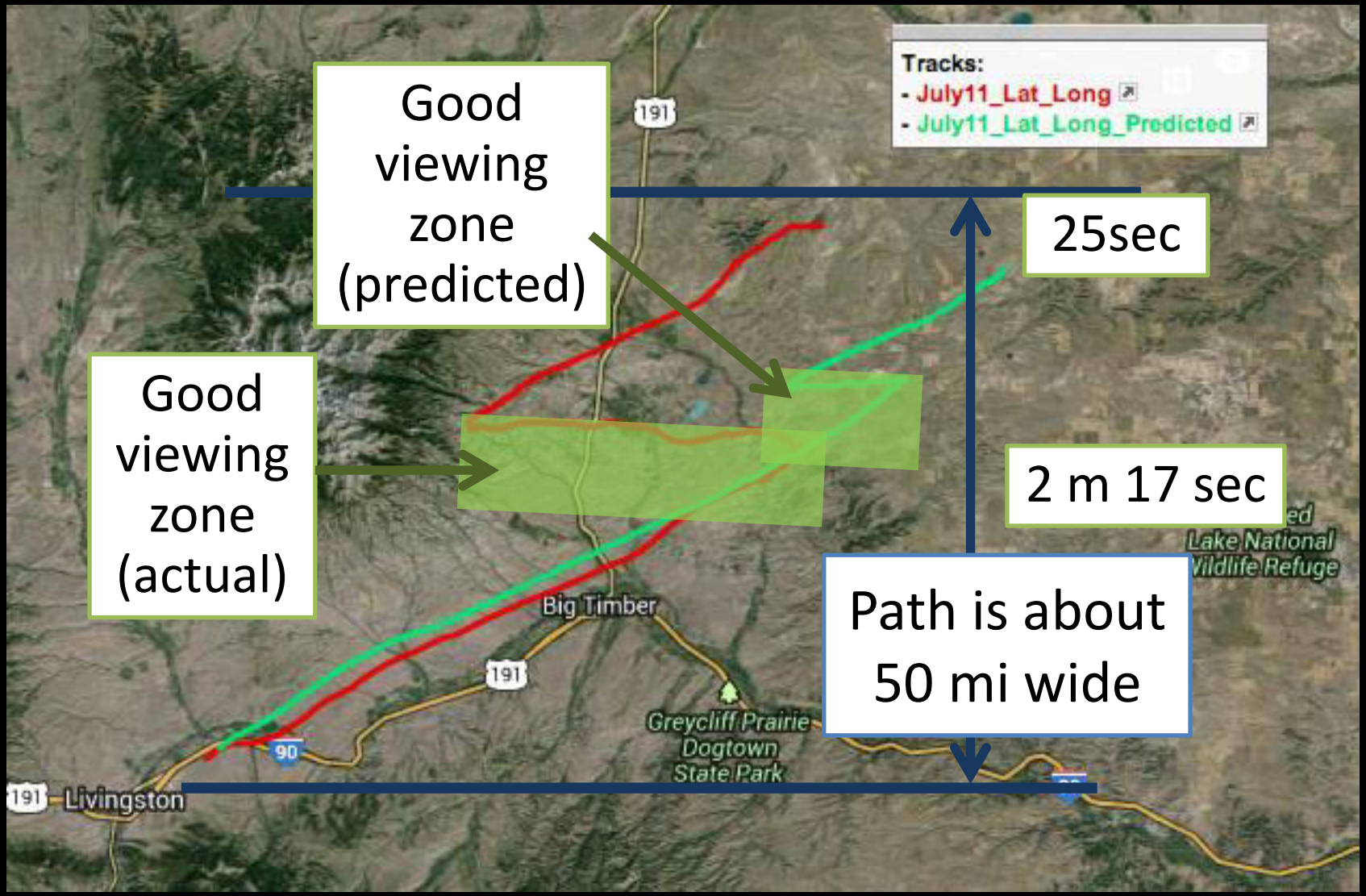
Time-UTC	Date	Latitude	Longitude	Alt-m	Alt-ft	V_Vel-m/s	V_Vel-ft/s
18:34:55	2014-4-19	46.3555500	-109.3173500	1,174	3,853	-4	-14
18:24:55	2014-4-19	46.3555500	-109.3173333	1,174	3,853	-2	-6
18:14:56	2014-4-19	46.3555500	-109.3173667	1,171	3,843	-1	-3
18:4:57	2014-4-19	46.3555333	-109.3173333	1,172	3,844	-1	-3
17:54:58	2014-4-19	46.3555500	-109.3173833	1,169	3,836	-1	-4



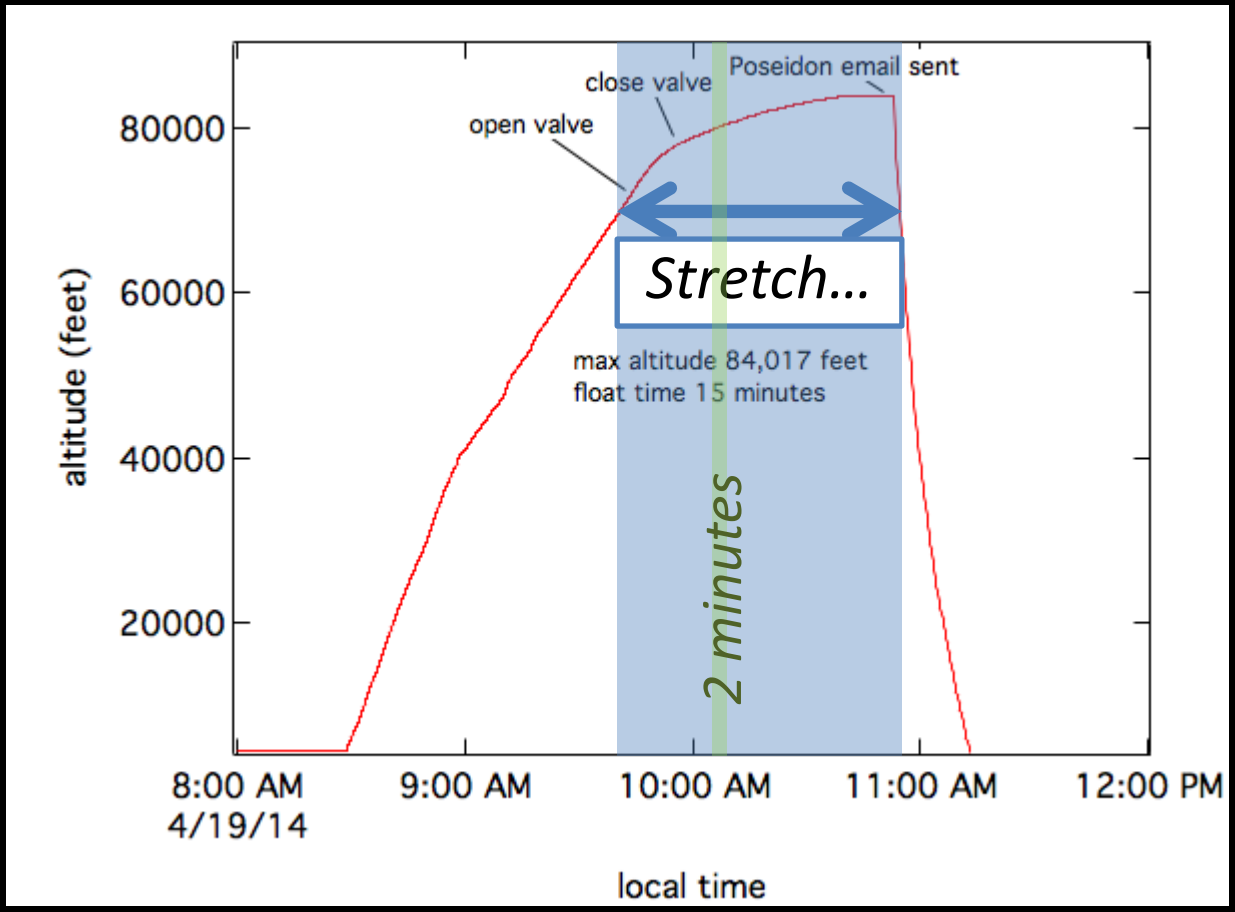
Duration and timing (local)



Flight path predictions



Long duration flights

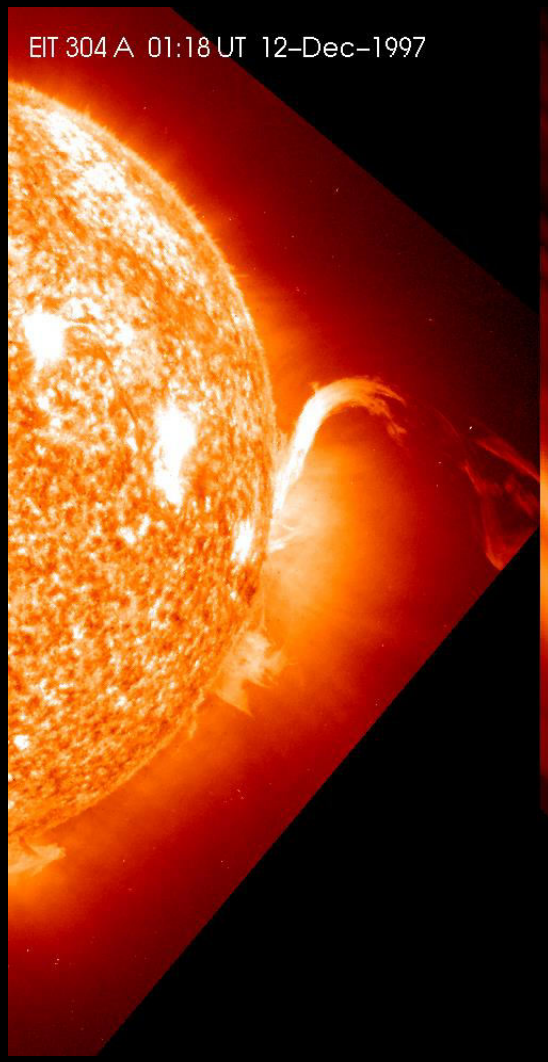


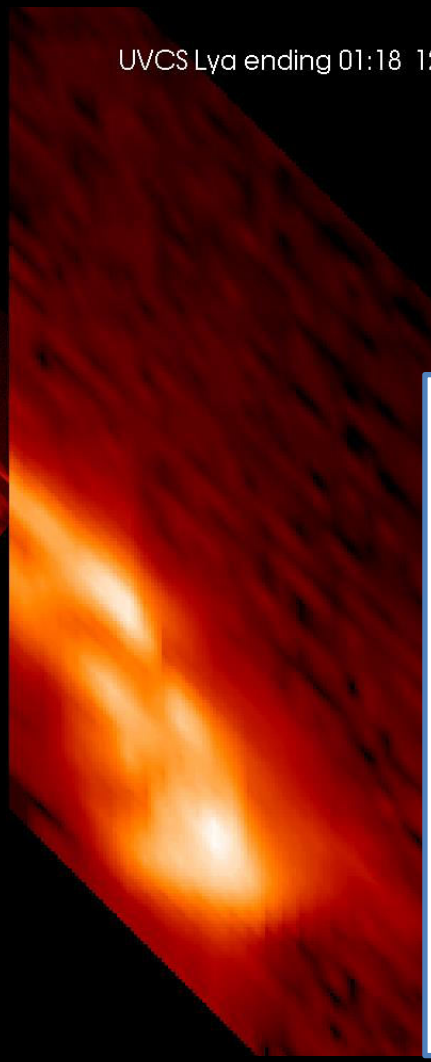
Live images

Live *video…?*

- Wide bandwidth and large amounts of data required
- How to transmit? Much discussion: analog vs. digital (all or nothing; compression algorithms key)
- 1 or 2 live video with dozens of live images, quickly uploaded video?
- Fun challenge

Science





"Due to the difficulty in making reliable and timely four-dimensional observations of atmospheric temperature in the vicinity of the path of the total solar eclipse, direct measurements of temperature changes from the troposphere to the stratosphere during a total solar eclipse still haven't been reported before." Hmm…

Signing up and next steps

- Register this academic year
- In progress: funding for primary payload kits
- *Participating teams* team will define application process
- High level of partnering with other teams (payloads, launch cites, etc.)
- In progress: seeking partnerships with other federal agencies, industry
- Let me know if want to be part of organizing teams

Fall 2017 National Space Grant Meeting, HI

- Total solar eclipse theme with student presentations of ballooning results
- Invited talk by a solar physicist who observed the event
- Tours of telescopes

Don’t forget

8-21-2017

Watch for updates as we move forward