Amateur Radio and High Altitude Balloons

The Great American Solar Eclipse

Sea Pac 2018

The Most Interesting Place on Earth Is Accessible From Any Place on Earth

Near Space

Four STEM Challenges Facing the US

- Women and minorities are underrepresented in the STEM workforce
- Baby-boomer STEM workforce is aging and nearing retirement
- Number of STEM workers has tripled in China and doubled in South Korea
- We Live in a Changing Technological World

Science and Engineering Indicators 2012

One Solution to the Challenges

Increase STEM Education in all Educational Settings

One Example: Robotics

A Historic Approach to STEM Education

Four Reasons to Use Robotics

Affinity and Interest

Immediate Feedback

Learning STEM Concepts

Attitude Toward Science

Melchior, A., Cohen, F., Cutter, T. and Leavitt, T.

Nugent, G., Barker, B., Grandgenett, N., and Adamchuk V.

Welch, A.

But Does Robotics Fire on all Four STEM Cylinders?

- Science Yes?
- Technology Yes
- Engineering Yes
- Mathematics Yes?

So what could be used in addition to robotics?

Does Space Exploration Fire on all Four STEM Cylinders?

- Science Yes
- Technology Yes
- Engineering Yes
- Mathematics Yes

Public Access To Space?

- Access to space is becoming less costly
- But still not cheap nor quick

Virgin Galactic

SpaceX

If Not Space, Then Near Space

- Motivating
- Accessible
- Inexpensive
- Quick
- Unlimited

Where is Near Space Located?

- Tallest Building: 2,722 feet tall
- Highest Mountain: 29,028 feet high
- Top of Controlled Air Space: 60,000 feet
- Spaceflight becomes possible: 328,000 feet

Near Space

Between 60,000 and 328,000 feet

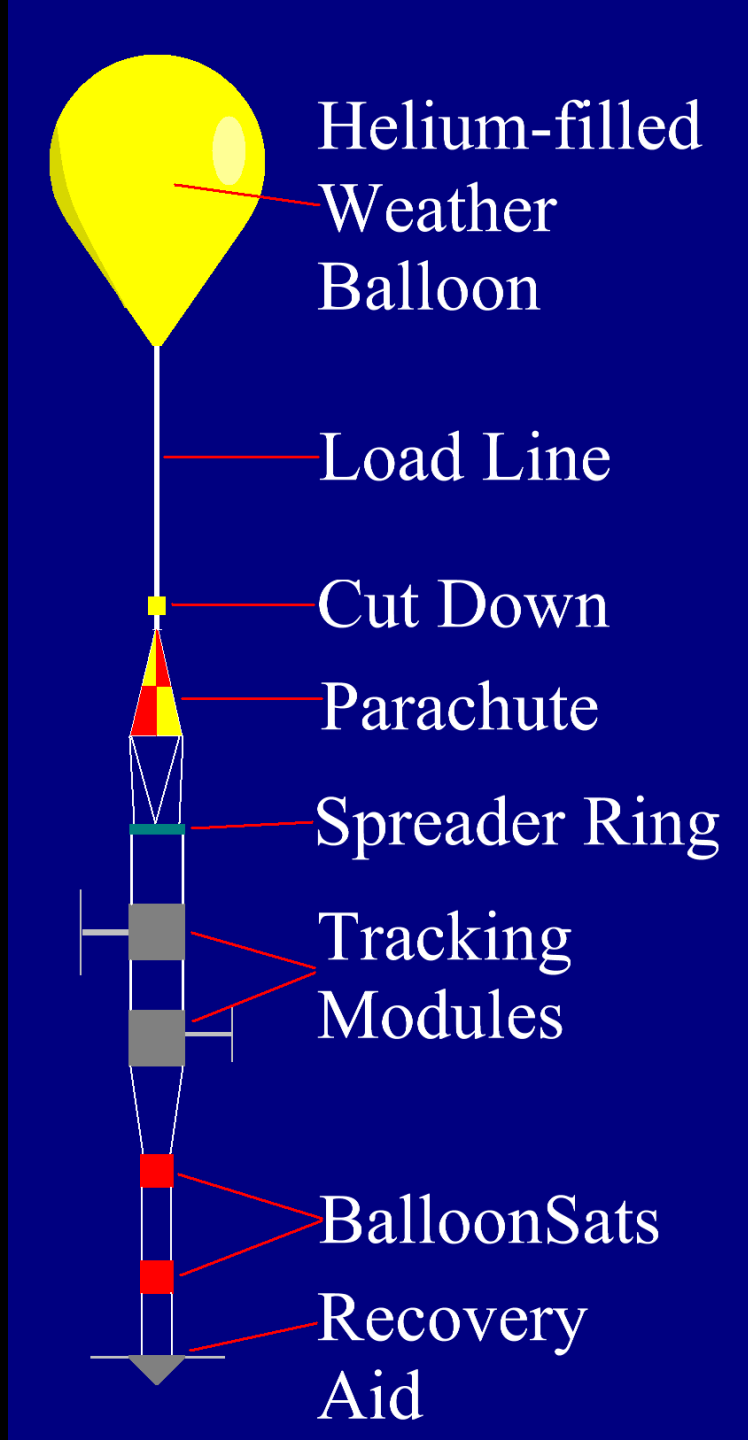
What's It Like In Near Space?

- < 5% Sea Level Pressure
- 0° to -60° F
- Very Low Humidity
- Cosmic Ray Flux 100X Greater Than Sea Level
- >300 Mile To The Horizon

Black Skies, Curved Horizon, and Cosmic Rays
It Looks and Feels like Space in Near Space

The Near Spacecraft

- Height: 30 - 50 ft
- Climb Rate: > 1,000 ft/min
- Max Altitude: > 100,000 ft



The Typical Near Space Mission

- Building and testing BalloonSats
- Purchase balloon and arrange for gas
- Predictions made several days prior to launch
- Tether together near spacecraft components
- Early Saturday morning launch
  - 30 minute fill time
  - 90 minute ascent
  - 45 minute descent
  - Done by lunch
- Typical 85,000 foot altitude
- Complete near space unit by analyzing data

Typical Near Space Costs

- 1200 g Weather Balloon: $75
- Lifting Gas: $75
- Parachute: $50+
- Radio Tracking Modules: $200+
- BalloonSats: $10 - $200

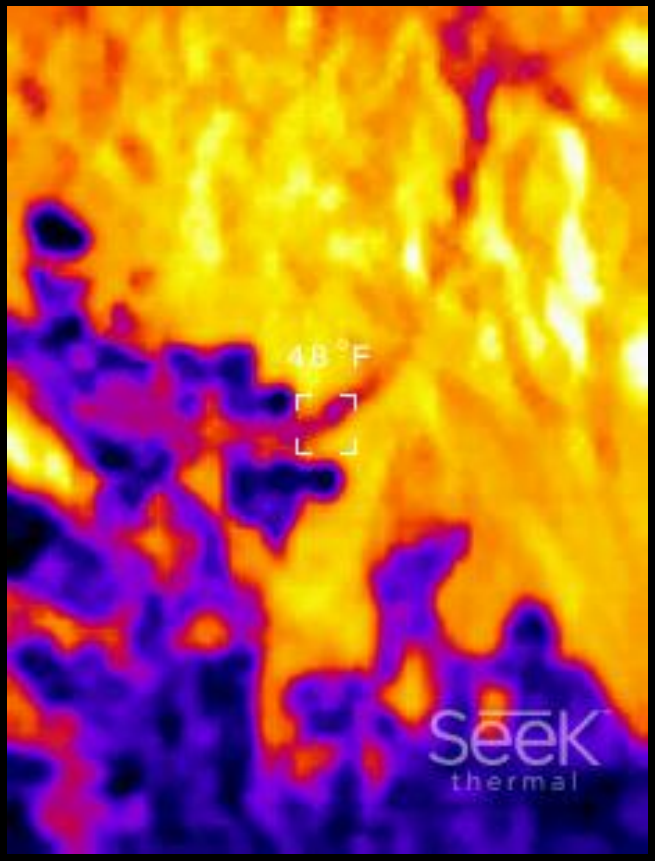
The parachute and tracking modules can be provided by the amateur radio operators helping you launch

Lifting gas can be donated

Parachute can be hand-made

Near Space Data

Imagery



The Evolution of Near Space Data

NearSys 13D BalloonSat Data - Notepad

File Edit Format View Help

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2,150,68,164,78,3514.5
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5,149,64,175,84,7493.25
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11,144,47,177,86,15450.75
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13,142,40,79,24,18103.25
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16,138,26,129,55,22082
17,137,22,131,57,23408.25
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19,134,12,106,41,26060.75
20,133,8,95,34,27387
21,132,5,91,32,28713.25
22,131,1,92,32,30039.5
```

Microsoft Excel - NearSys 13D BalloonSat Data

File Edit View Insert Format Tools Data Window Help

S35

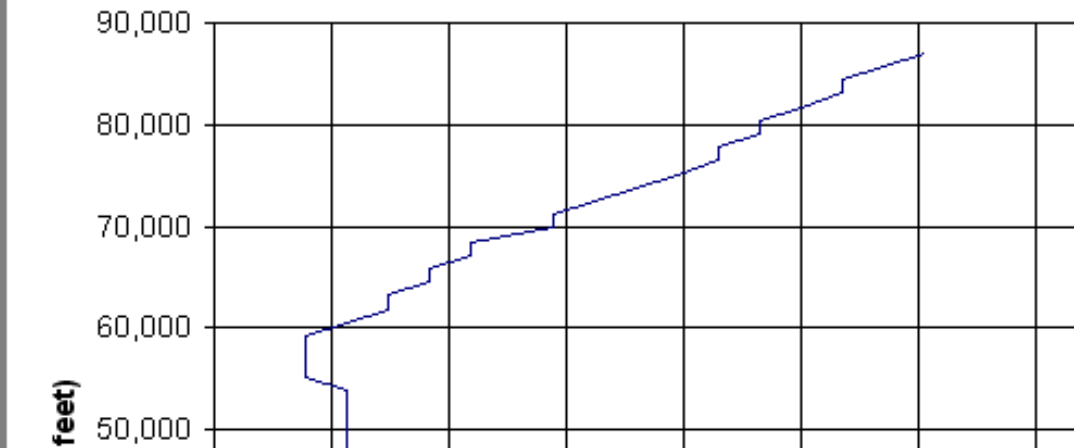
	A	B	C
1	MET	Temperature	Temperatur
2	minutes	8-bit	*F
3	0	152	7
4	1	151	7
5	2	150	6
6	3	150	6
7	4	150	6
8	5	149	6
9	6	148	6
10	7	147	5
11	8	146	5
12	9	145	5
13	10	145	5
14	11	144	4
15	12	143	4
16	13	142	4
17	14	141	3
18	15	140	3

Microsoft Excel - NearSys 13D BalloonSat Data

File Edit View Insert Format Tools Chart Window Help

Air Tempe

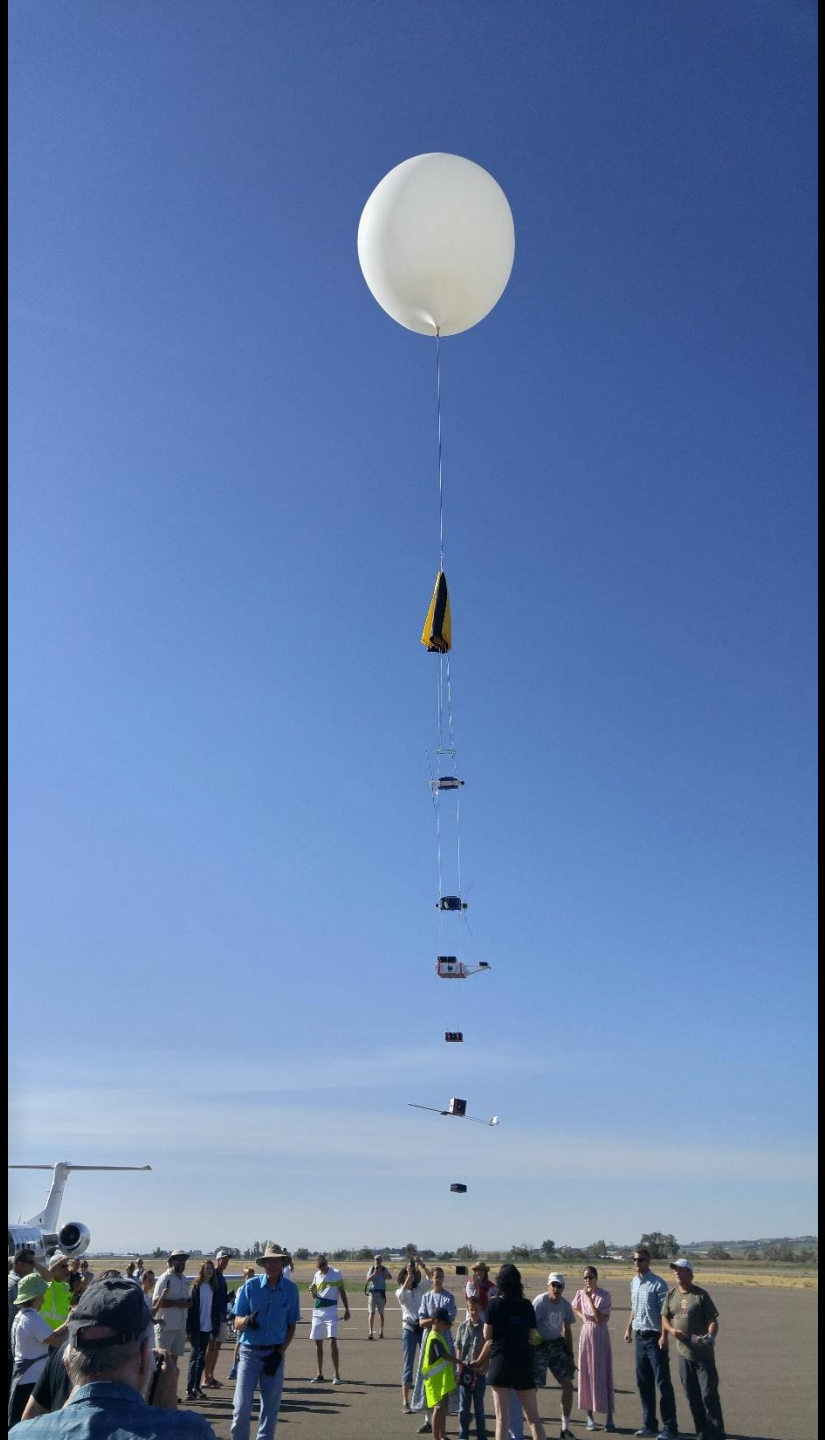
NearSys



The Take Home Message

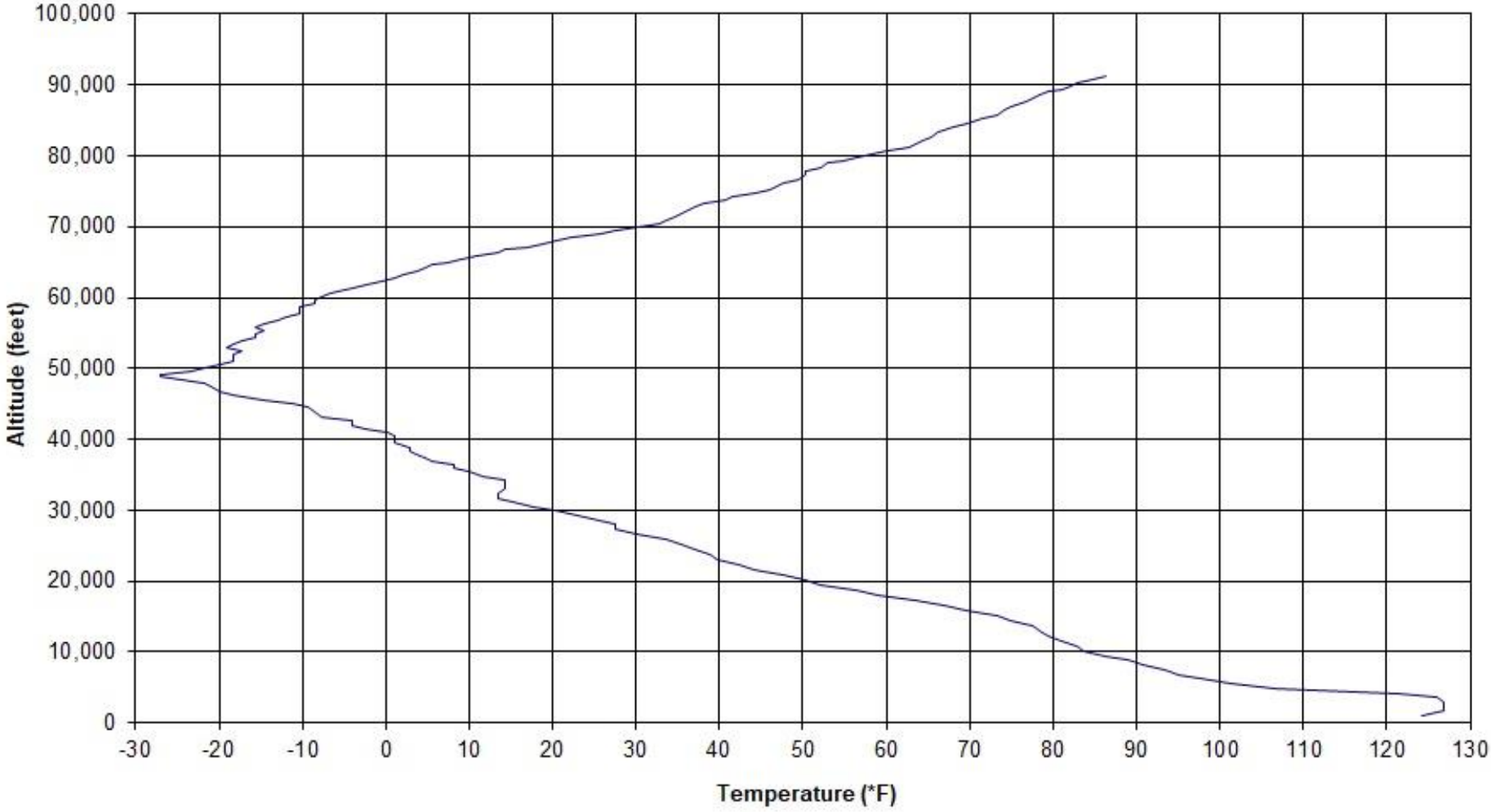
- Space motivates students and near space is cheap
- BalloonSats cover all four facets of STEM
- BalloonSats are a project-oriented activity
- Results of a 2012 University of Kansas Study
  - Measured seven attitudes towards science
  - 3% increase in student interest in science as a hobby activity
  - No gender effect

Actual Data From the Great American Solar Eclipse



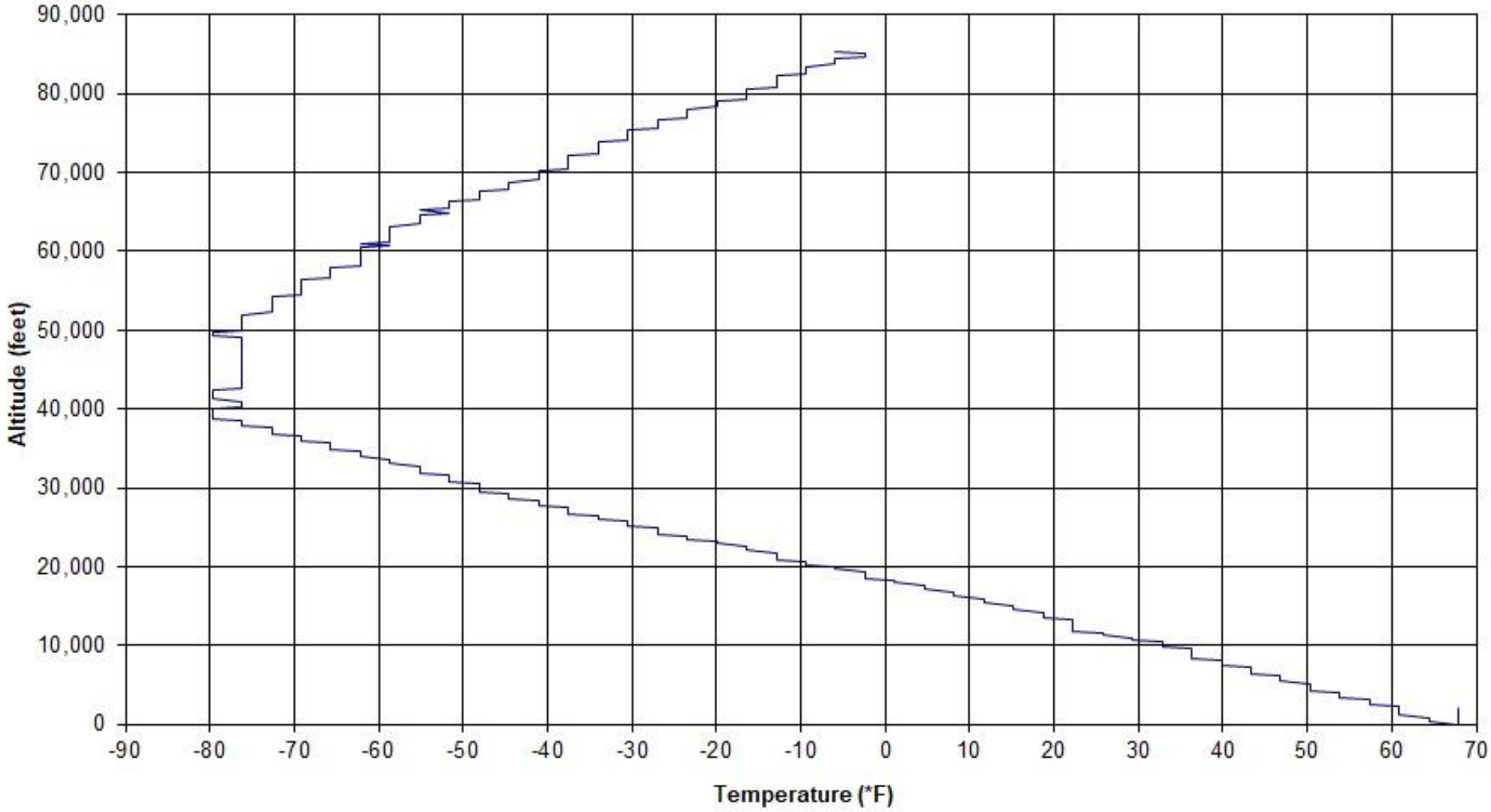
Air Temperature

NearSys 16D



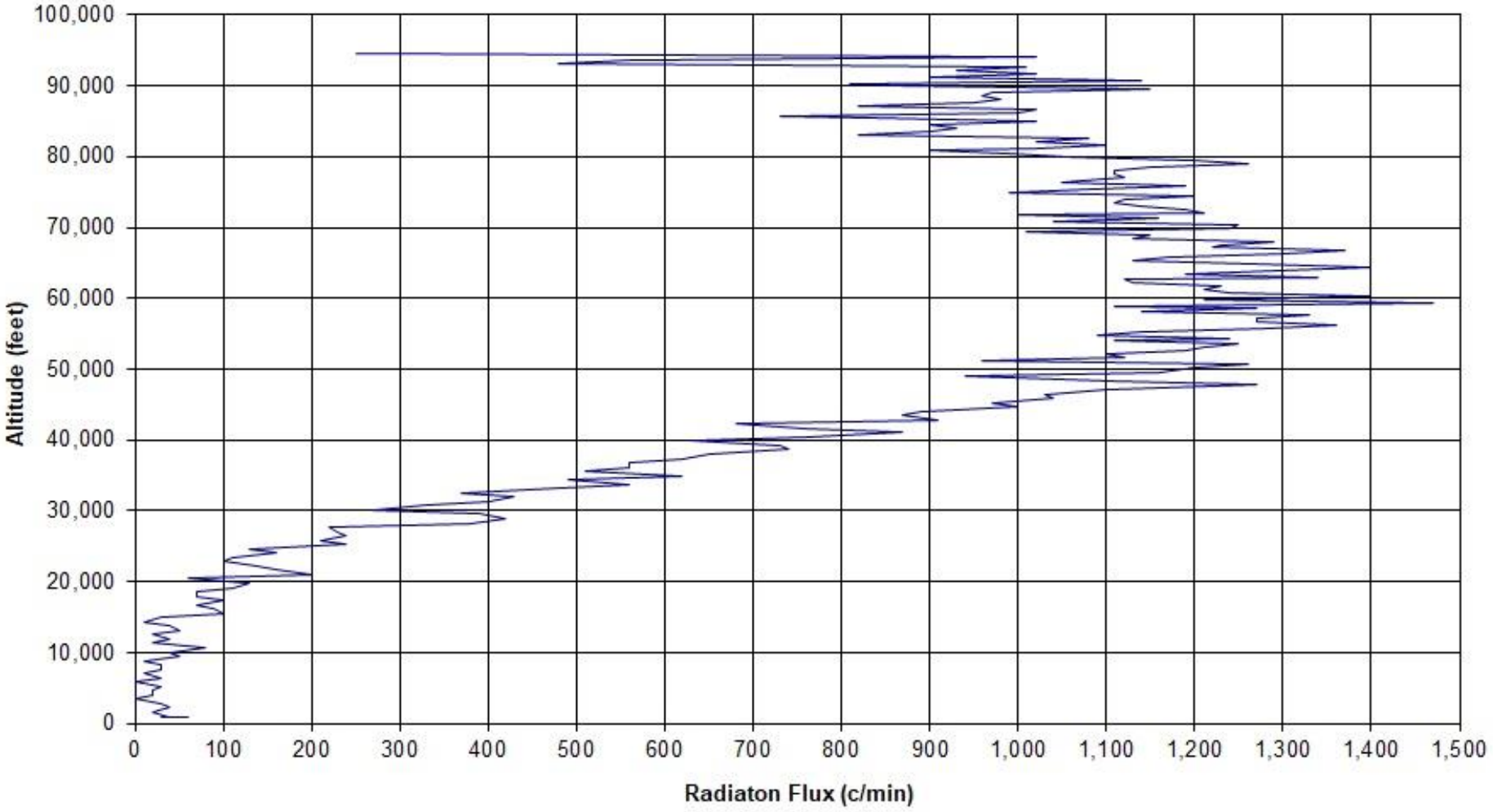
External Temperature

NearSys 17I



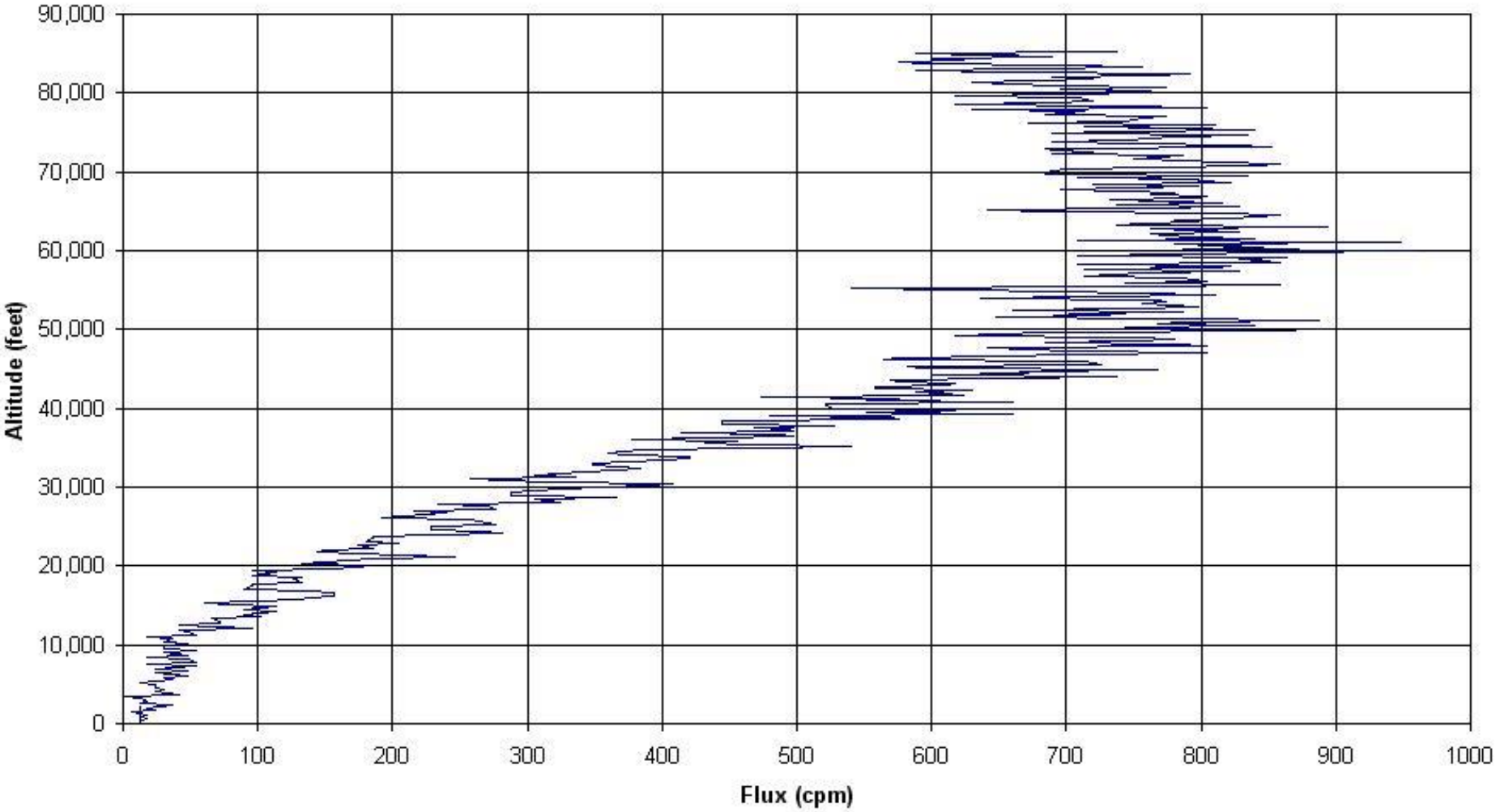
Cosmic Rays

NearSys 17F



Cosmic Ray Flux

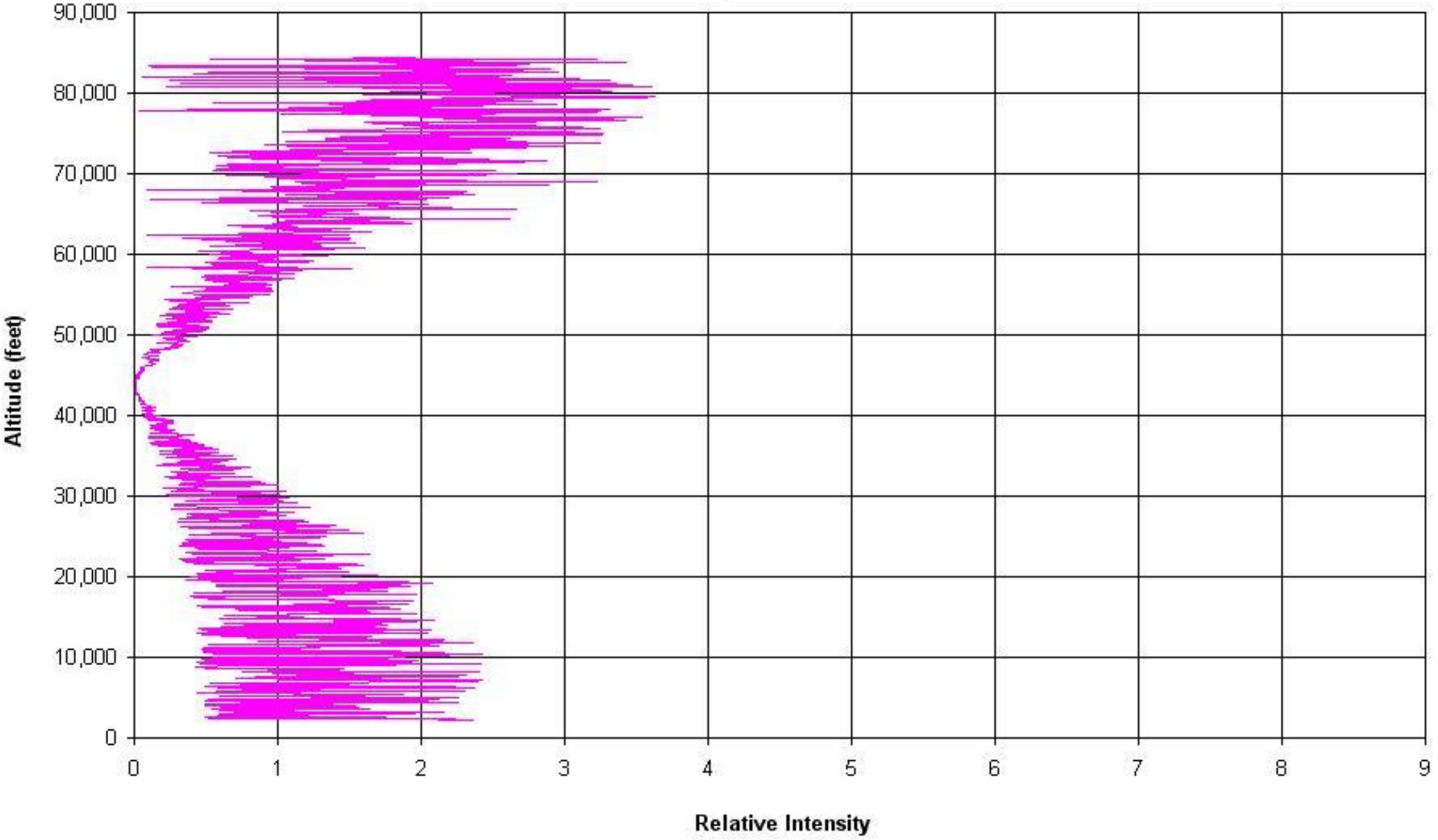
NearSys 17I



39.29 Bubbles (s.d. 2.61)
1.96 mrem (s.d. 0.13)

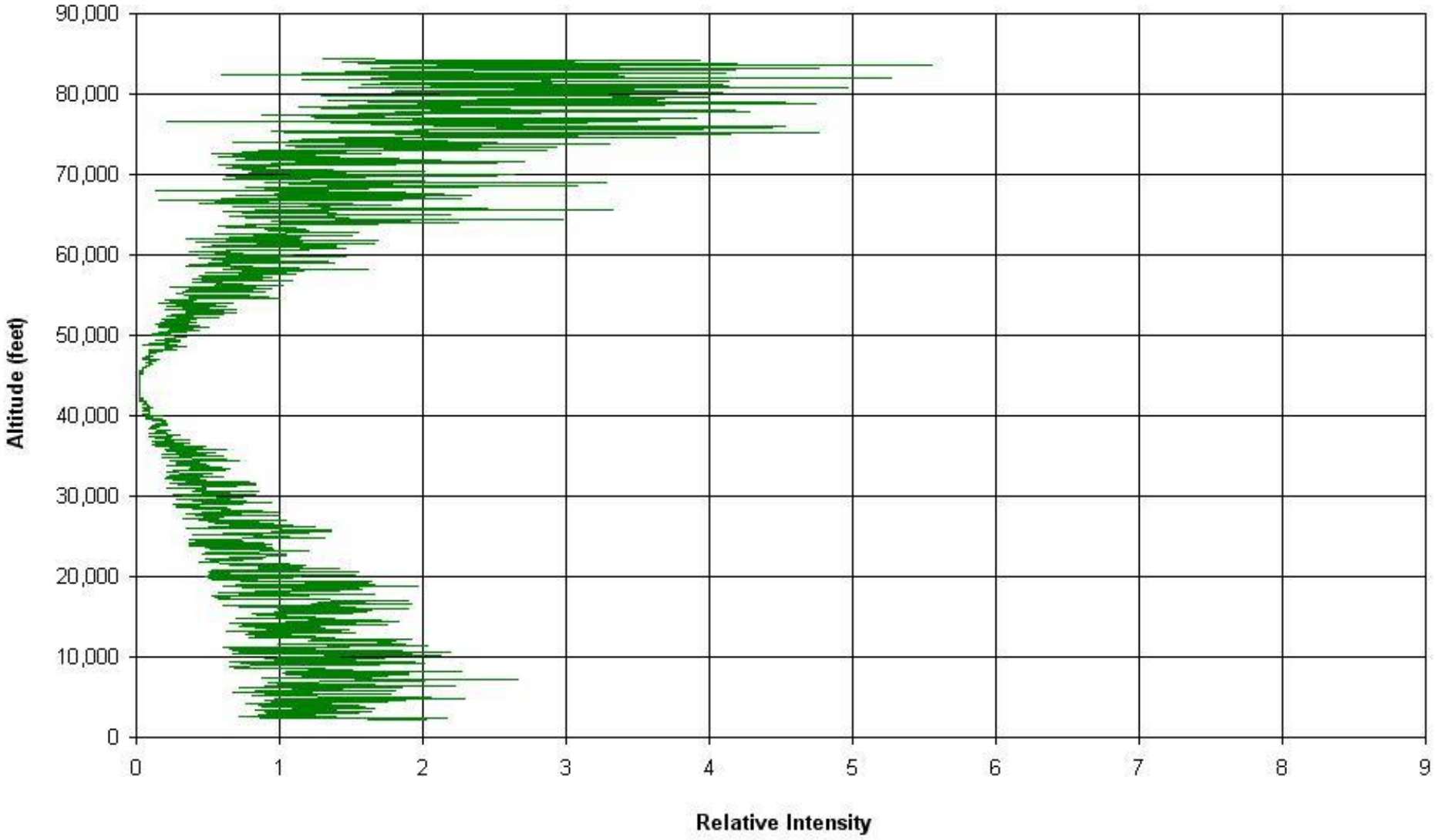
Infrared (940 nm)

NearSys 17I



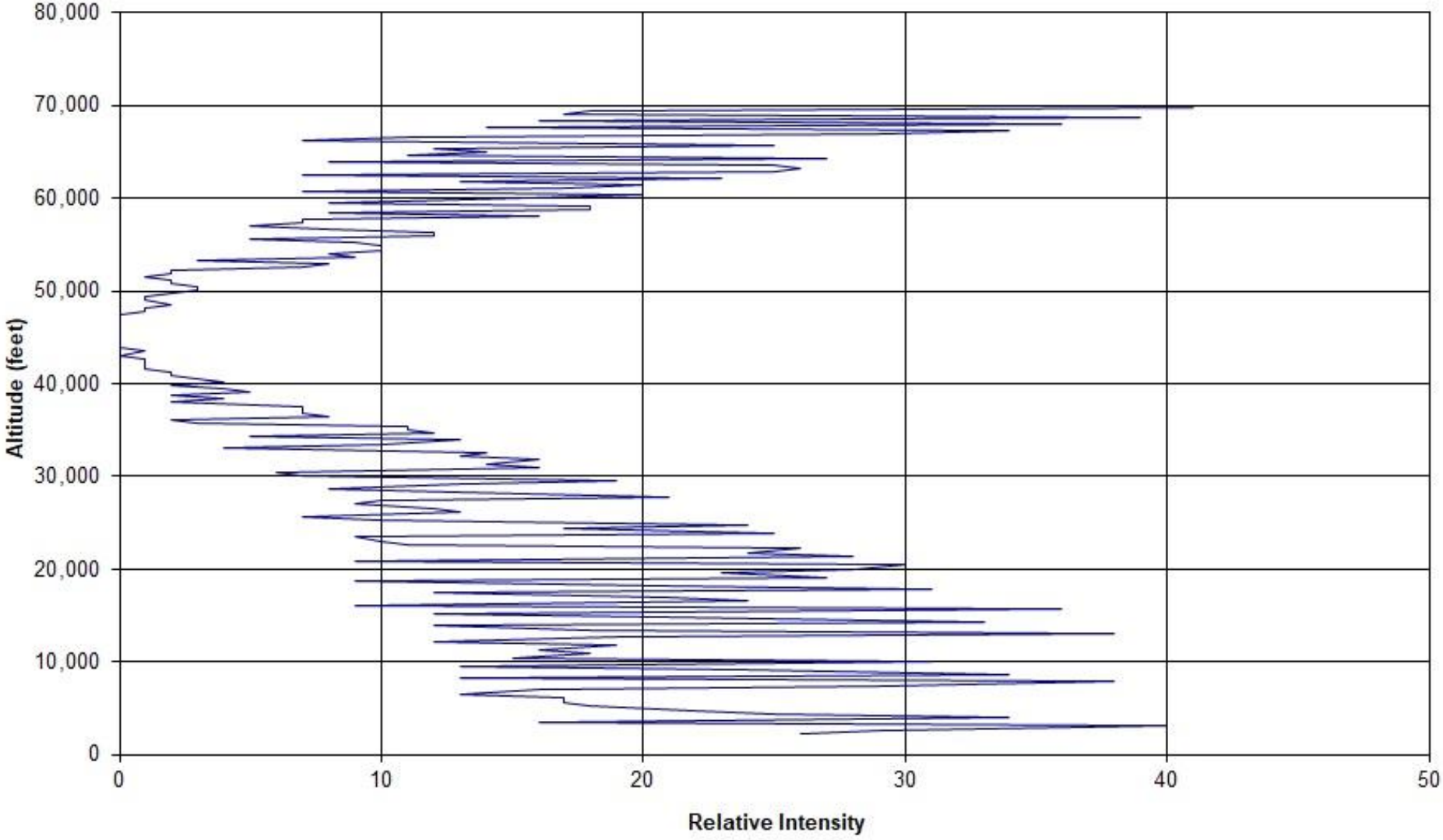
Green

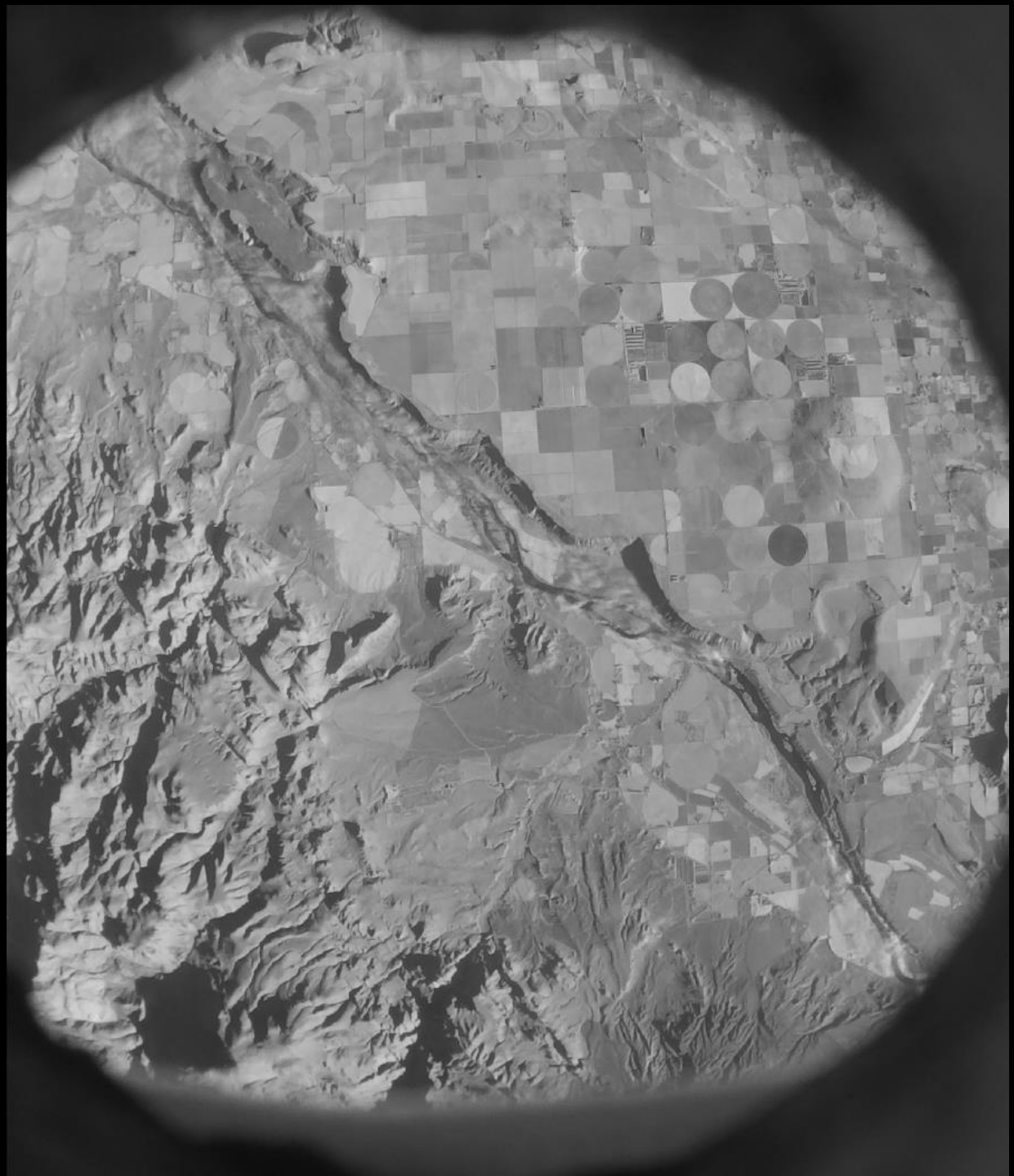
NearSys 17I

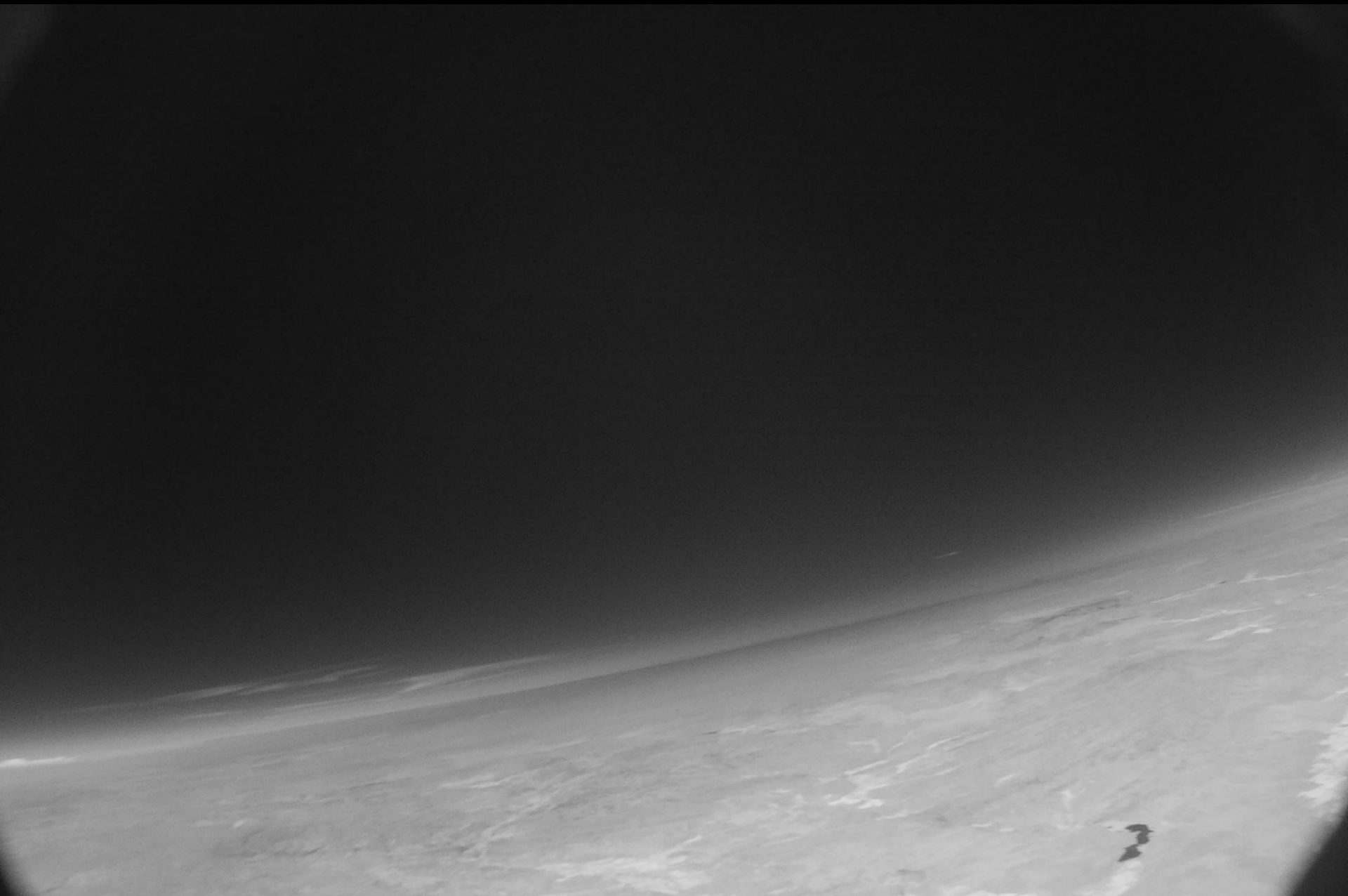


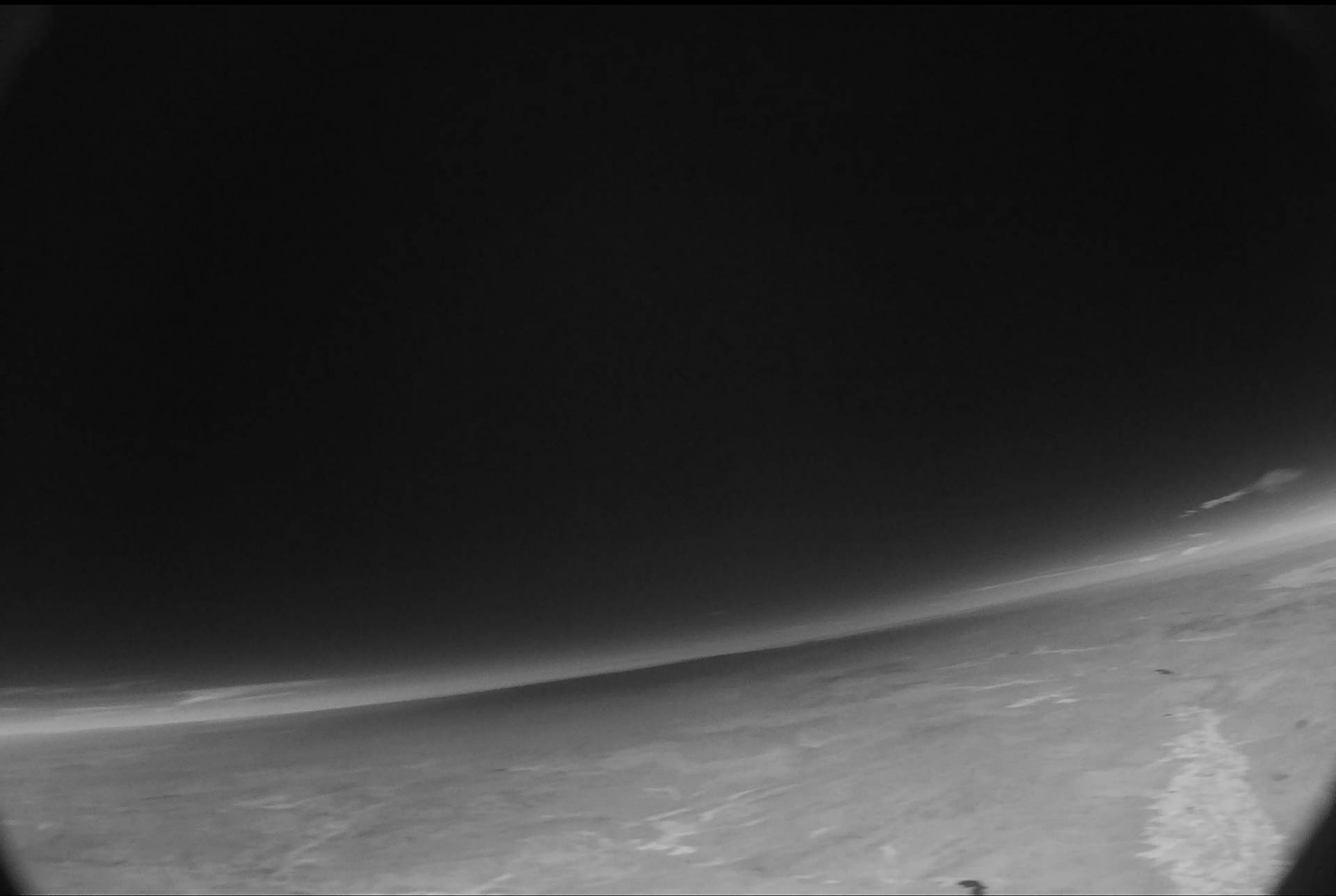
Ultraviolet-B

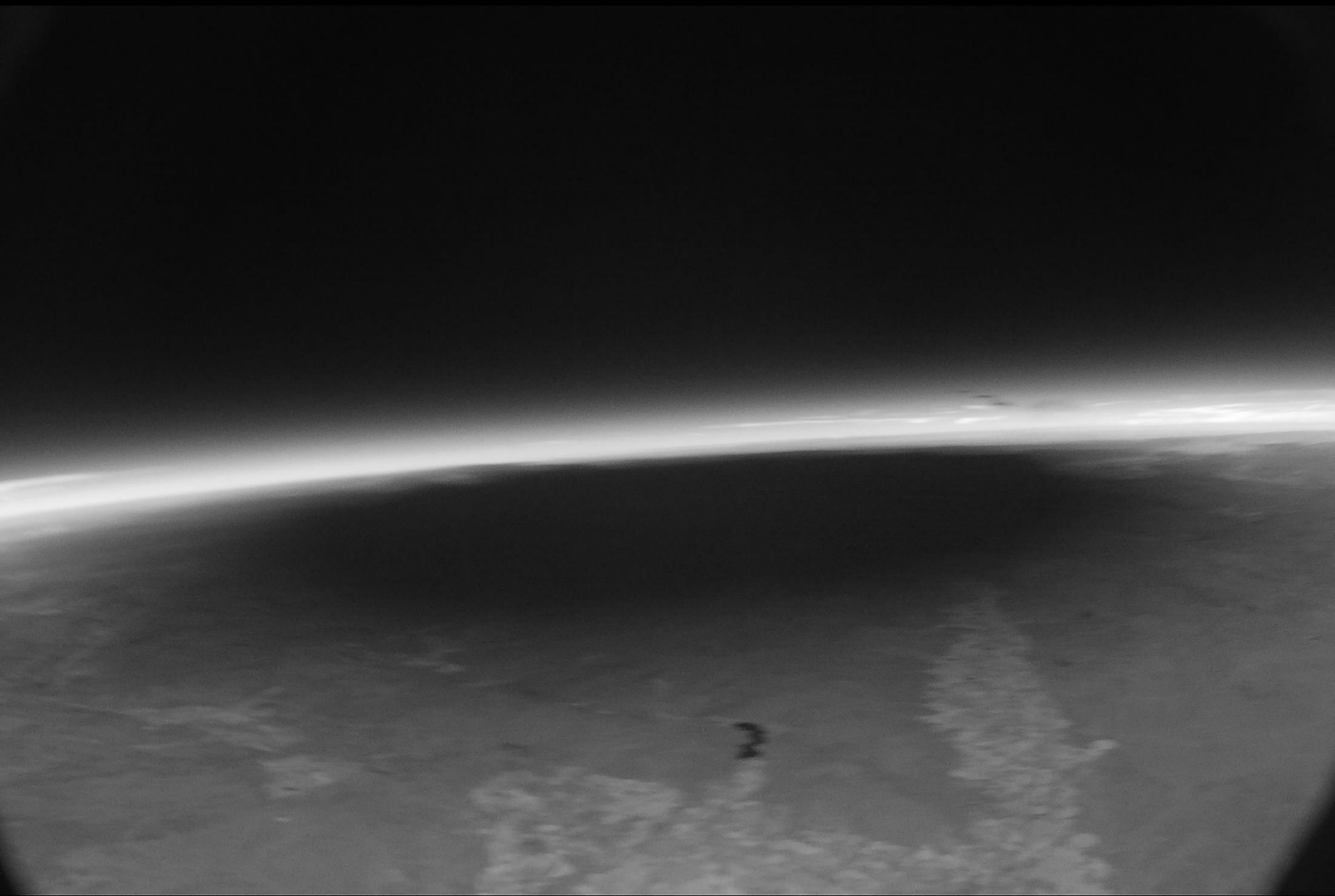
NearSys 17I

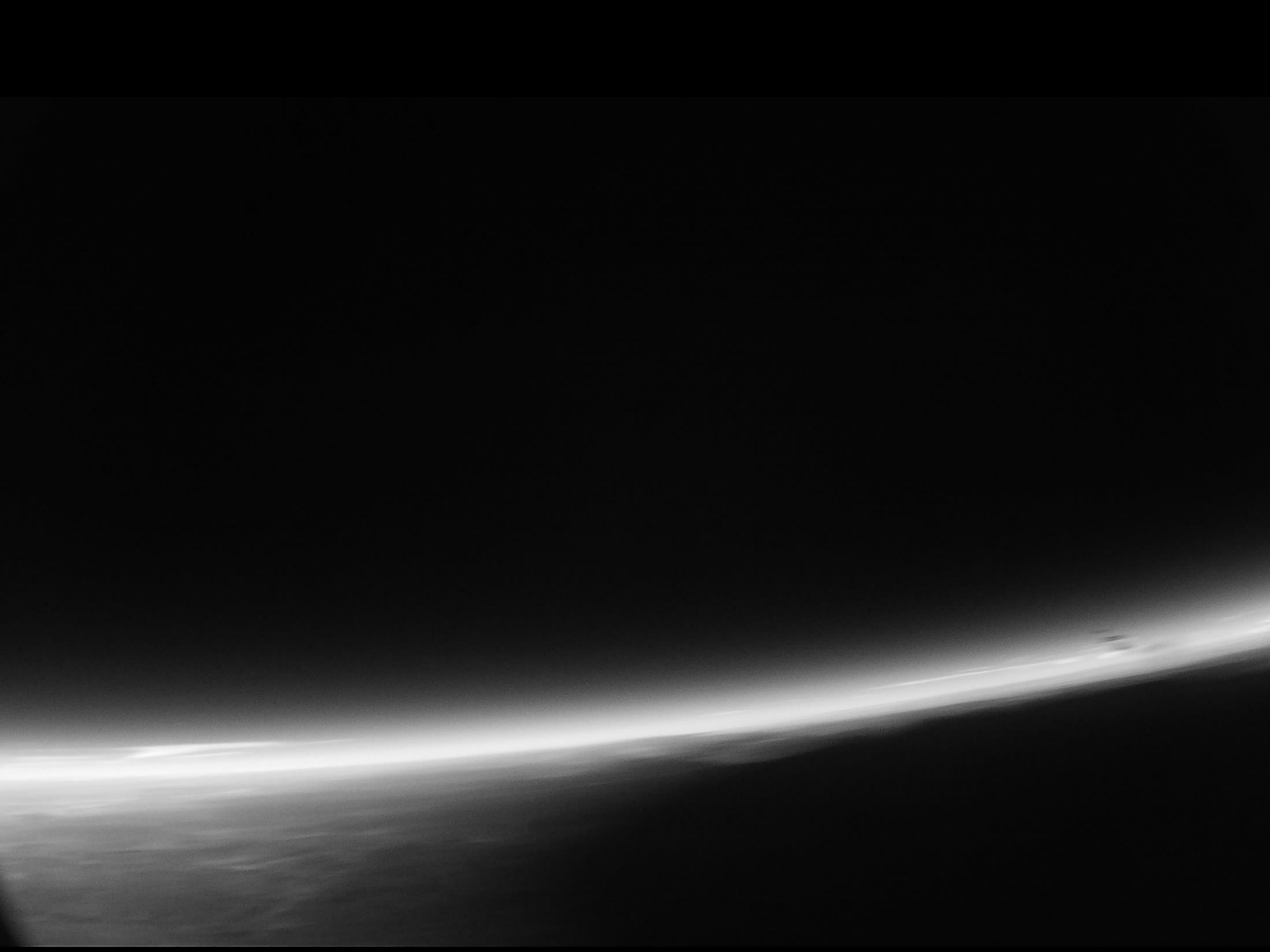


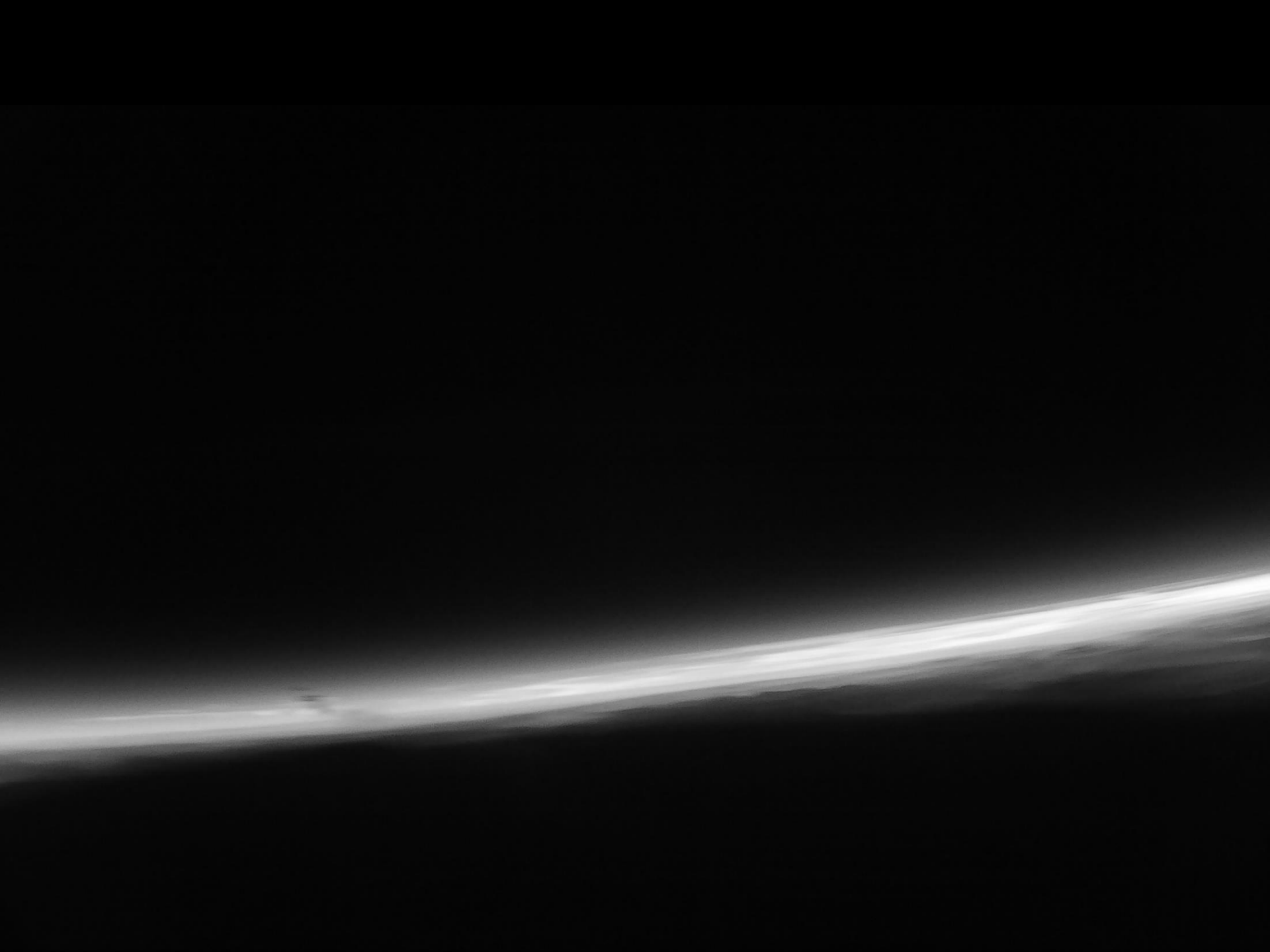


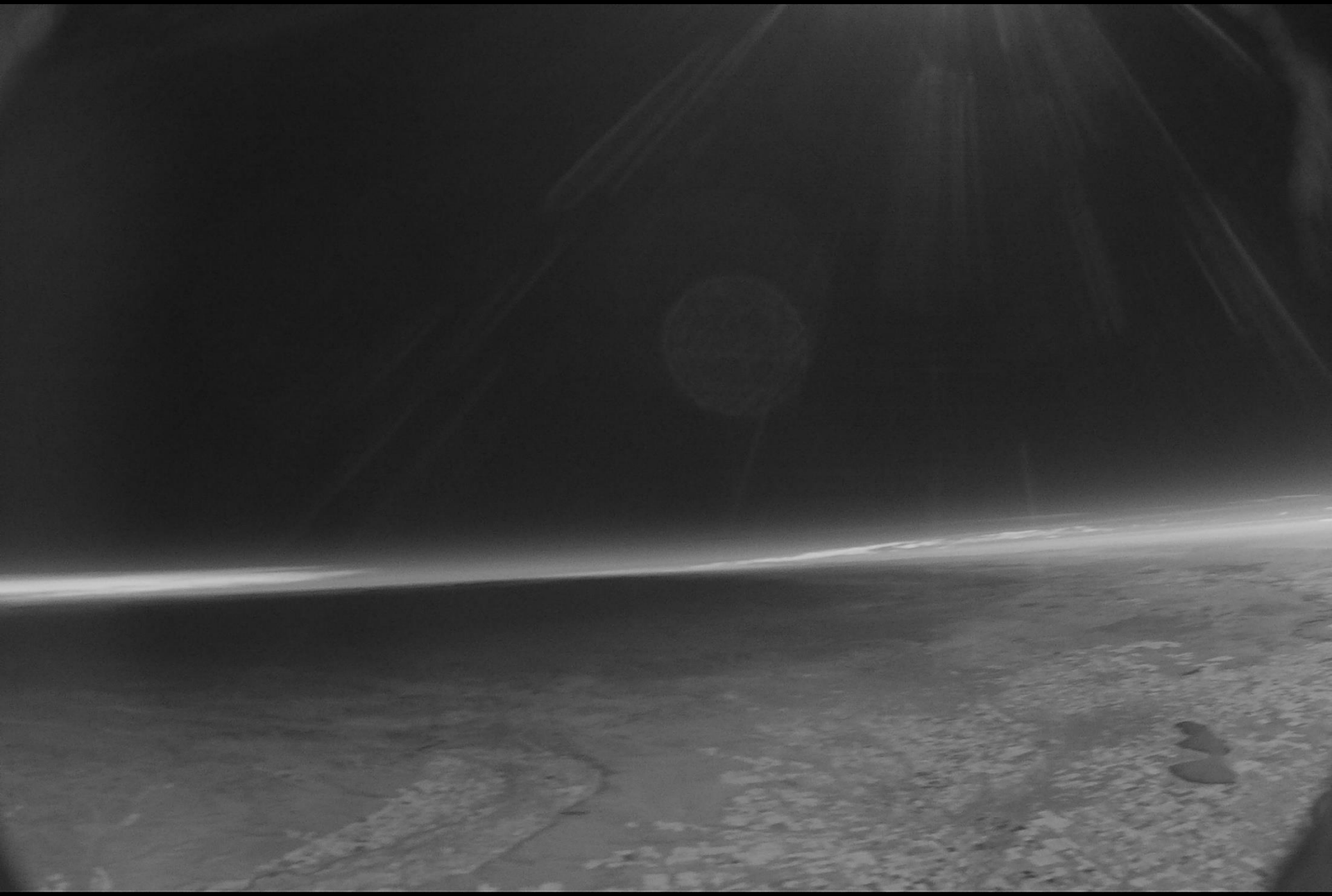


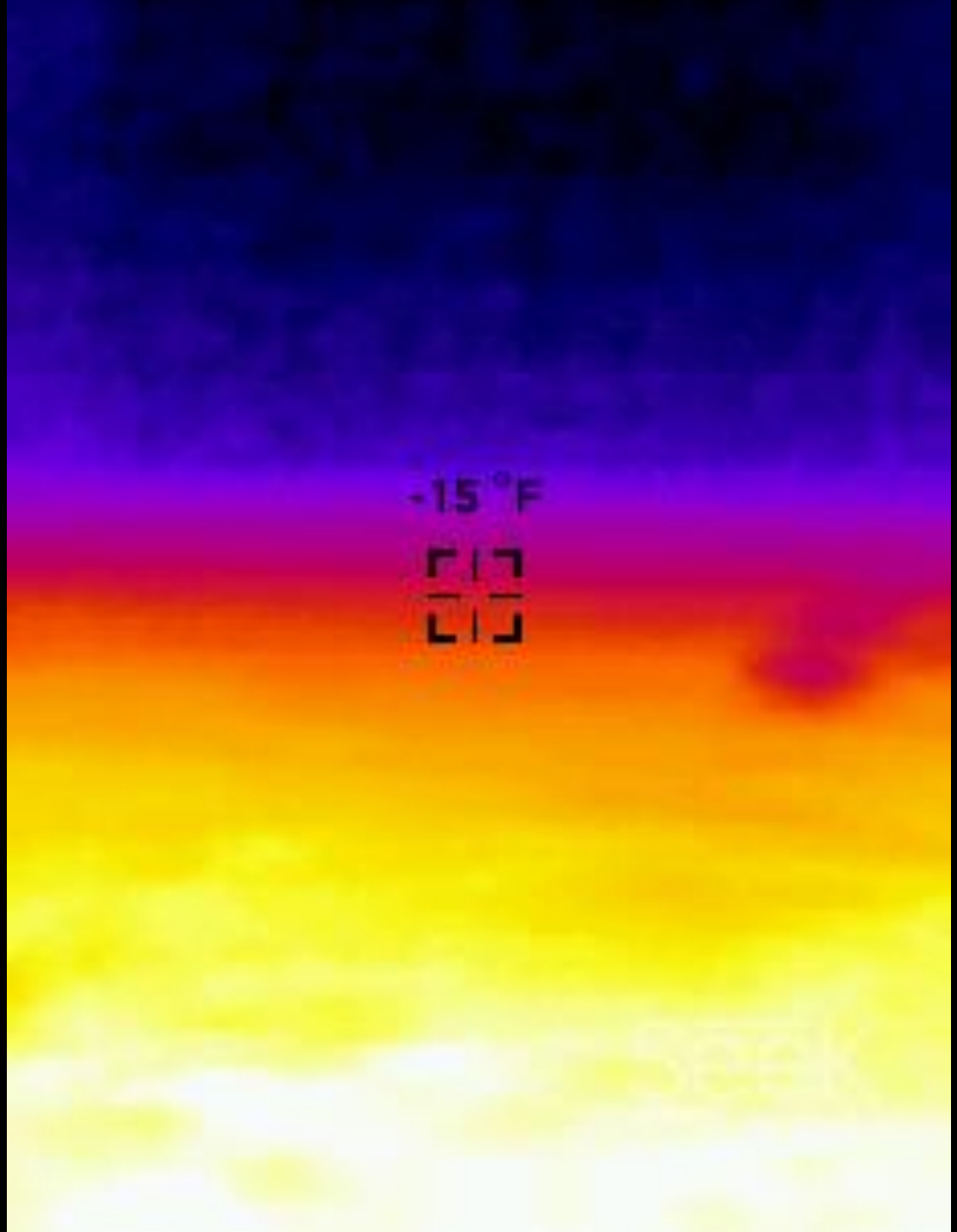











-15 °F

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