NASA SPACE APPS CHALLENGE 2026 · JAKARTA (VIRTUAL)



Apollo 8, 1968 (AS08-14-2383). Credit: NASA

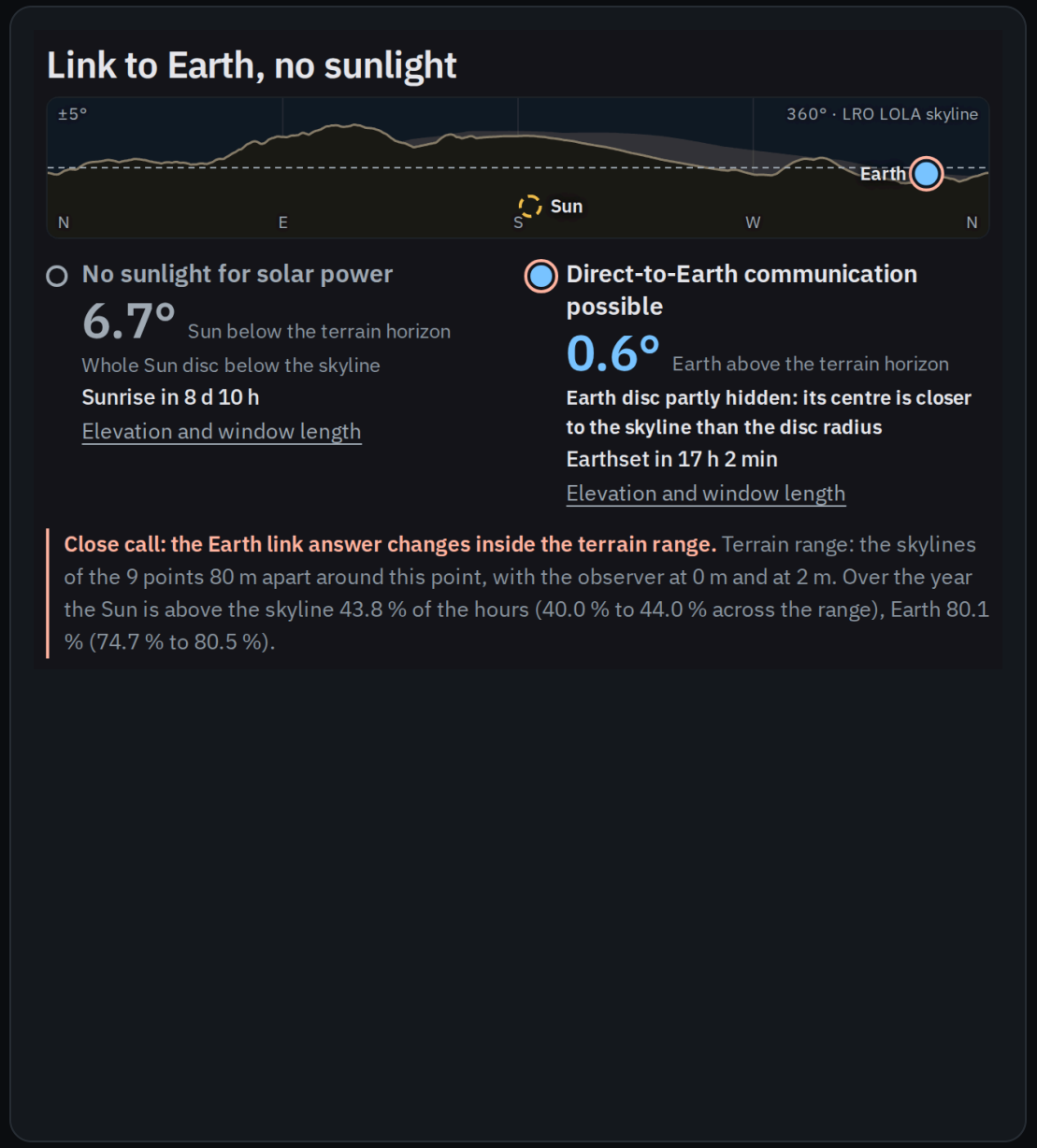
# Still in View

Launch slipped or site changed? See at once whether a lunar landing site still has sunlight for power and a direct line to Earth.

**It says when an answer is not certain.** An answer that would change within 80 m is marked on the card, and the terrain skyline matches NASA's PGDA maps within **0.1** percentage points at IM-1 and IM-2.

**One kilometre can decide.** At the IM-2 site Earth's centre is above the skyline **80.1 %** of the year, and **64.4 %** one kilometre east.

Challenge: Lunar Landing Site Navigator · Team: Aiman Malib · Member: Muhammad Aiman Bin Malib

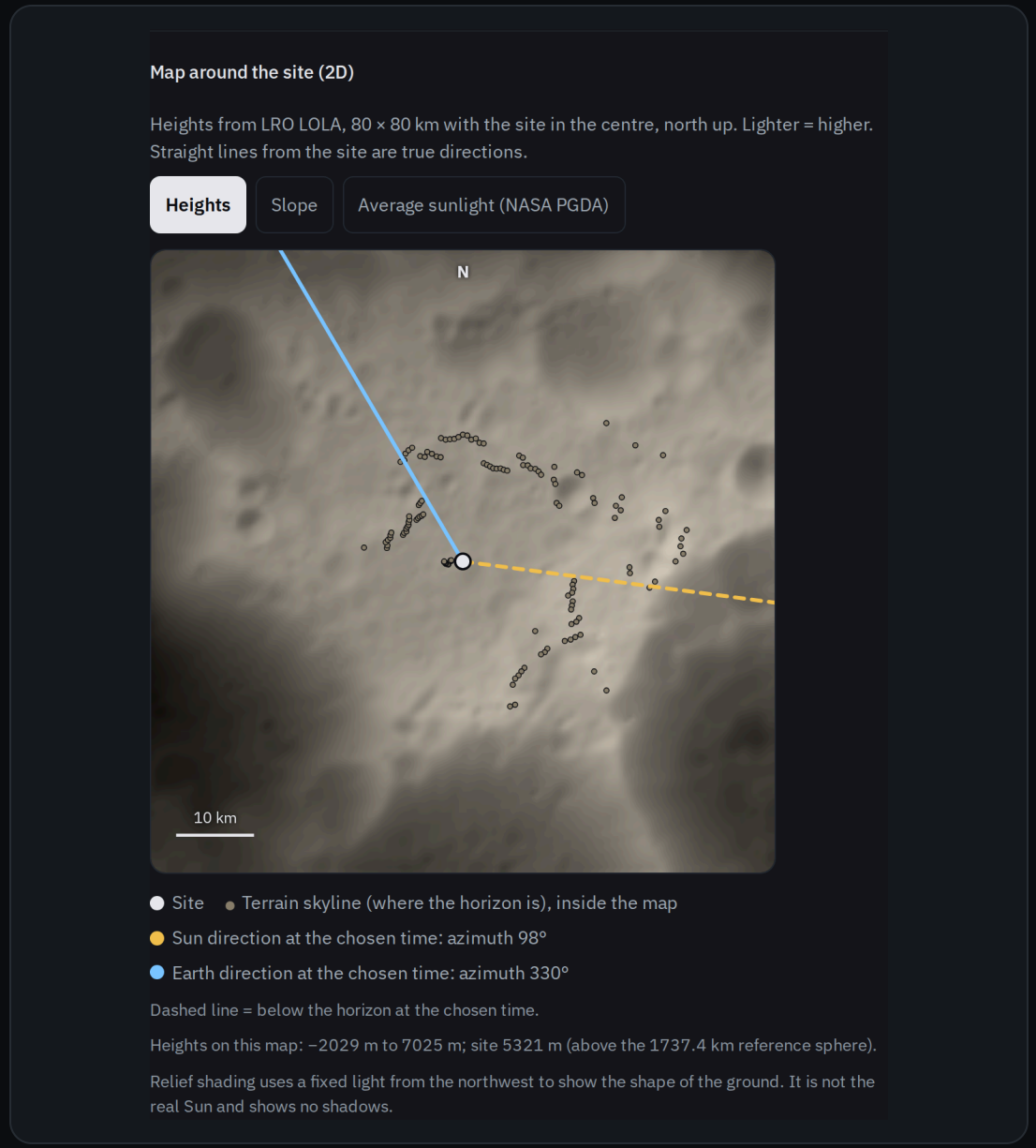



Try it: aimanmalib.github.io/spaceapps26 · Code: github.com/aimanmalib/spaceapps26 · Images: real screenshots of the app, and one NASA photo.

## THE PROBLEM

> "Hardware development challenges, launch delays, or other factors often force mission planners to reconsider their original landing date and location." (challenge text, NASA Space Apps Challenge 2026)

- Two things decide whether a site still works: sunlight for power, and Earth in view for a direct radio link.
- Near the south pole both stay low. At IM-2, Earth moves between **2.3°** below and **10.8°** above the ideal horizon all year. Ridges decide the rest.
- NASA reported that IM-2 touched down more than 400 meters from its intended site, inside a crater. Its batteries were depleted and the mission ended less than a day later.

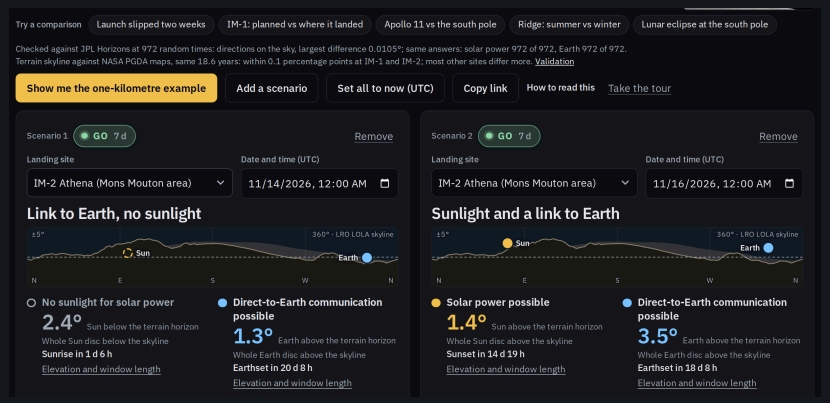



IM-2 landing: NASA news release, 7 March 2025.

FOR PLANNERS

# A GO / RISKY / NO-GO line for each plan, and the two answers behind it.

- Mission check: GO, RISKY or NO-GO for a stay of 7, 14 or 29.5 days, with the longest night, an example battery size for it and a panel estimate in W/m². The limits are settings.
- Every card opens with one verdict and the whole horizon in one strip: the Sun, Earth and the LOLA skyline. Its hourly table downloads as CSV.
- Lunar eclipses: when Earth hides the Sun from a lit site, the card says so.
- Ready comparisons such as "Launch slipped two weeks" and "IM-1: planned vs where it landed". Up to four scenarios side by side.
- Eighteen sites, seven of them future south polar targets (six Artemis III candidate regions), or your own coordinates, with terrain south of 75°S. Any time to the end of 2070 (UTC).




Example: IM-2 at 2026-11-14 00:00 UTC and two days later.

WHY SMALL SHIFTS MATTER

# One kilometre east, and the direct line to Earth is gone.

- IM-2 site, 2026-11-14 00:00 UTC: Earth is **1.3°** above the terrain horizon.
- 1 km east: **1.5°** below. 1 km south: **2.6°** below.
- On an ideal sphere, 1 km tilts the horizon by only **0.033°**. The rest is terrain.
- The 80 m terrain grid does not resolve small craters such as the one where the IM-2 lander stopped.
- Over a whole year of hourly steps, Earth's centre is above the skyline **80.1 %** of the time at the site, **56.6 %** 1 km south.
- Every card lists these shifts: 6 hours and 1 day either way, 1 km in four directions.

**Small shifts in location or date**

The same two answers when the time moves a little, or the point moves 1 km. Numbers = degrees above (+) or below (–) the horizon used for this scenario.

| Shift | Sun (power) | Earth (link) |
|---|---|---|
| As chosen | No –2.4° | **Yes** +1.3° |
| 1 d earlier | No –4.2° | **Yes** +0.4° |
| 6 h earlier | No –2.6° | **Yes** +1.0° |
| 6 h later | No –1.9° | **Yes** +1.5° |
| 1 d later | No –0.8° | **Yes** +2.4° |
| 1 km north | No –2.3° | **Yes** +1.1° |
| 1 km east | No –2.6° | No –1.5° |
| 1 km south | No –2.4° | No –2.6° |
| 1 km west | No –2.3° | **Yes** +0.8° |

2 of 8 shifts change at least one answer.

Nearby points: terrain horizon from LRO LOLA (same method as this site). Sun and Earth positions there: computed in browser, validated against JPL Horizons.

**Over the whole year**

| Point | Sun centre above skyline | Earth centre above skyline |
|---|---|---|
| This point | 43.8 % | 80.1 % |
| 1 km north | 42.7 % | 78.2 % |
| 1 km east | 35.1 % | 64.4 % |
| 1 km south | 45.7 % | 56.6 % |
| 1 km west | 42.8 % | 81.6 % |

Earth's centre clears the skyline 80.1 % of the year here and 56.6 % 1 km south (Sun: 43.8 % and 45.7 %).

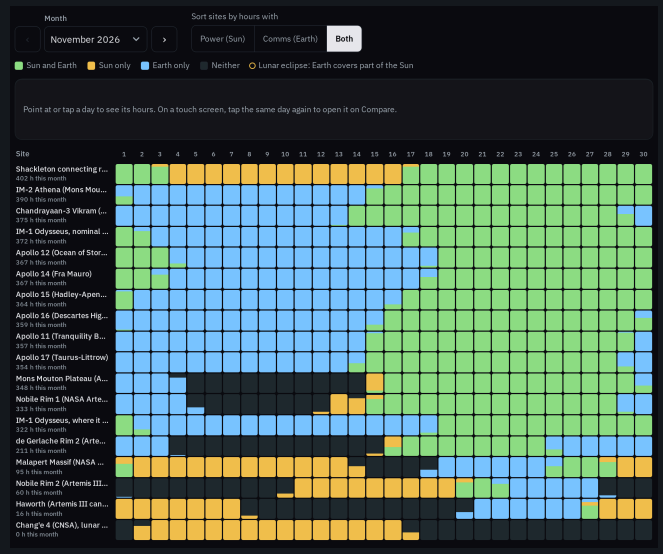
Share of the 8761 hourly steps from 2026-11-01 to 2027-11-01 (UTC), same yes/no rule as the cards. This point: JPL Horizons angles. Nearby points: angles from the in-browser engine; using this point's Horizons angles there instead changes no share by more than 0.5 percentage points.

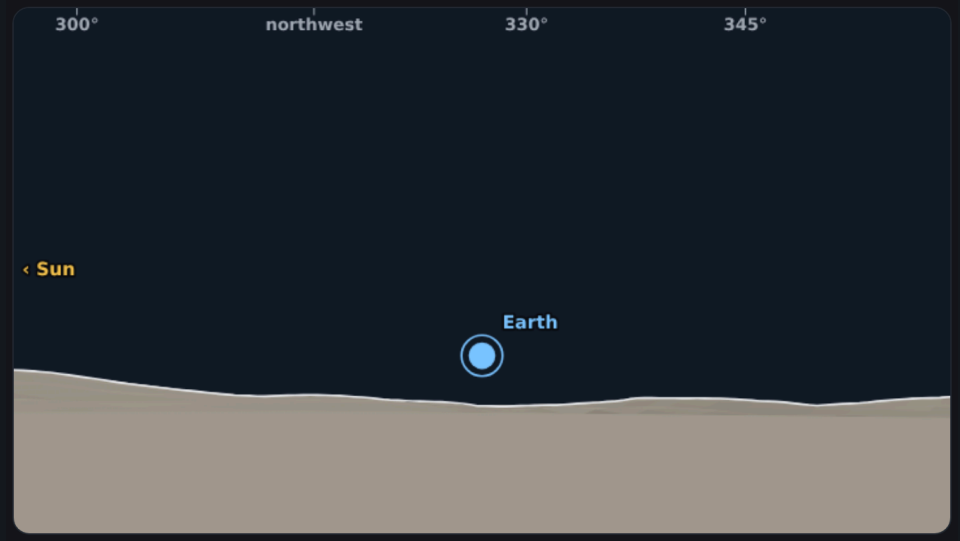
Measured with the terrain horizon from LRO LOLA. Open this case: aimanmalib.github.io/spaceapps26/?s=im-2,2026-11-14T00:00

EVERY SITE, EVERY DAY

# A calendar of the year, and the view from the lander.

- Overview: every listed site by UTC day, coloured by the hours with the Sun and Earth both in view, the Sun only, Earth only, or neither. Any day opens on Compare.
- From the lander: the ground, the LOLA skyline and the Sun and Earth at their true size, heights not stretched.
- At ten south polar sites the horizon is traced from LRO LOLA heights, one ray every 0.5°, out to 300 km or the edge of the grid.
- Also on every card: a timeline of one lunar day or one year, a 2D map and a 3D surface.



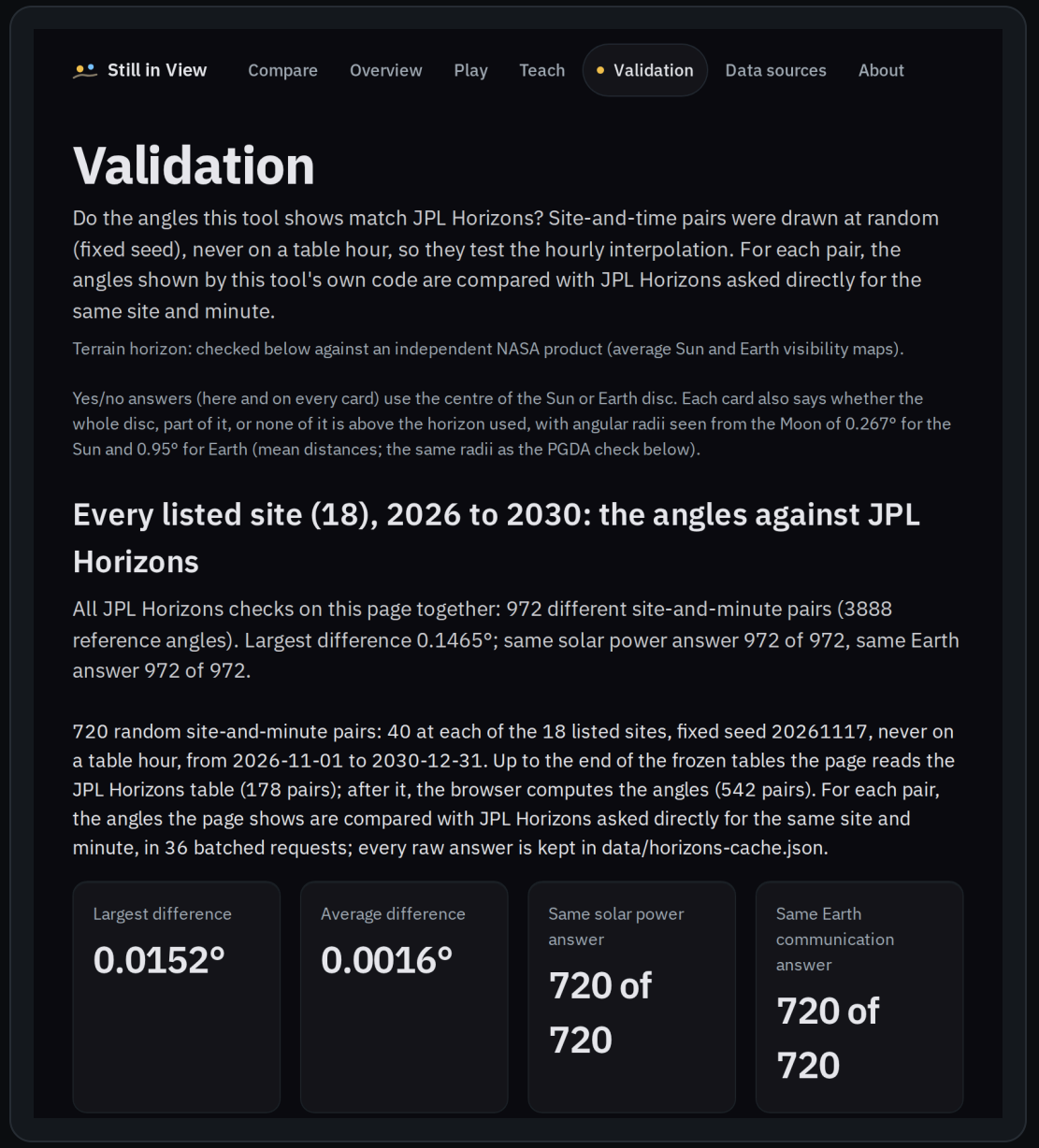




Lander view: IM-2, 2026-11-16 00:00 UTC, facing Earth. Relief in the 3D surface uses a fixed light, not the real Sun.

## NASA DATA, AND HOW I CHECKED IT

- **JPL Horizons**: Sun and Earth, hourly. **LRO LOLA**: terrain. **GSFC PGDA**: an independent check.

| | |
|---|---|
| Horizons, 972 random pairs, 2026 to 2070 | **0.0105°** largest difference on the sky, same answers 972 of 972 |
| NASA GSFC lunar eclipse list to 2030 | **142** eclipse stretches at 18 sites, each within 2 hours of a listed eclipse |
| Own-point terrain against the 80 m skylines | both answers agree in **97.2 %** to 99.9 % of hours at 9 sites, 93.4 % at one |
| PGDA at IM-1 and IM-2, same 18.6 years | Sun within **0.1** percentage points, Earth within **0.1** |
| PGDA, ridge point 0.55° from the pole | Sun differs by **17.6** points; the tool gives 57.2 % with the observer on the ground, 85.3 % at 2 m; NASA 67.7 % |
| PGDA, 100 random points south of 80°S | Sun median difference **0.9** points (largest 10.7), Earth **1.1** (largest 21.8) |




Every number: Validation page and data/validation.json.

## WHO IT IS FOR, AND ITS LIMITS

- For mission planners, educators and the public.
- Limits: terrain at ten listed south polar sites and, from a coarser grid, at own points south of 75°S; geometry only, no power or link budgets; the one-year numbers cover the first year of dates.
- Next: the terrain horizon for any point south of 75°S, and more years of dates.
- Since that line was written: own points south of 75°S get a coarser LOLA skyline and dates run to the end of 2070. Still to do: the full 80 m grid at any point.
- SI (Claude Code) generated the code, tests and layout under my direction; no SI images. I chose the challenge, the audiences and the features; some were suggested by SI, some I asked for after seeing other entries.
- Try it: aimanmalib.github.io/spaceapps26 · Code (Apache-2.0): github.com/aimanmalib/spaceapps26

> I hope that the next time a landing date slips, someone can open this page and see what changed: is there still sunlight, is Earth still in view. And I hope a teacher can use the one-kilometre example to show a class why the Moon's south pole is hard.