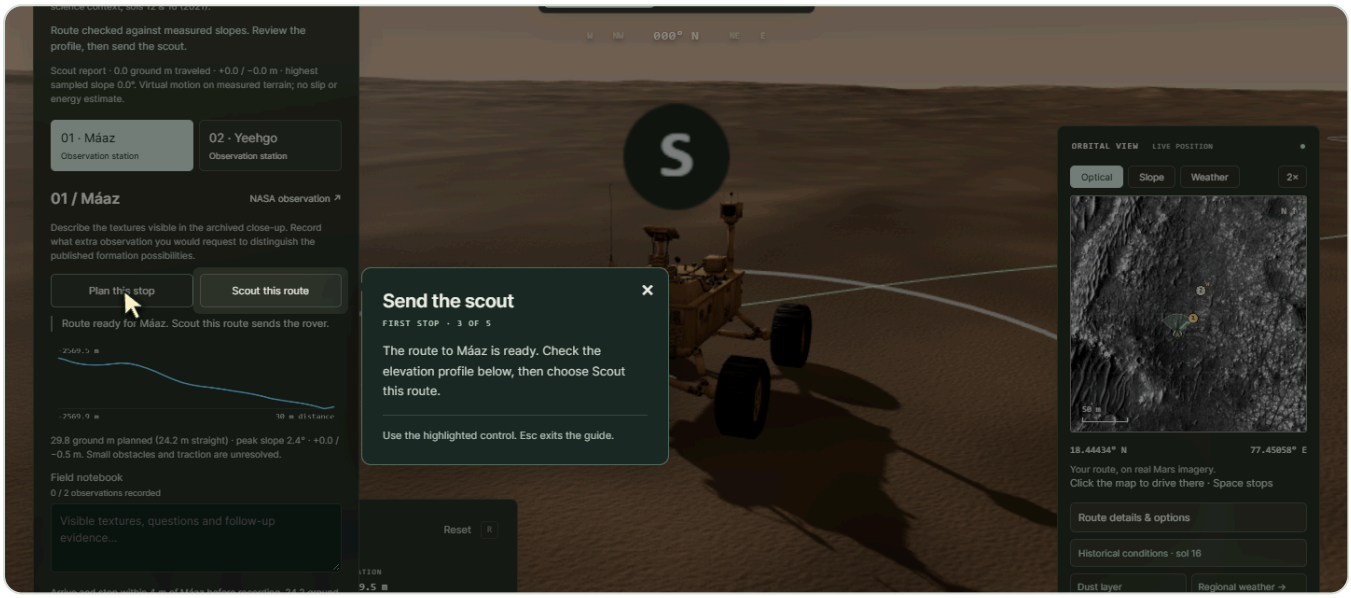
PROJECT BRIEF & USER GUIDE / 15 NOVEMBER 2026

# Plan the walk.
# Understand the ground.

A rover-assisted Marswalk planner that connects a local 3D view, an orbital map, science observations and historical conditions.




Actual application view. The rover, route, map position and travel feedback share one coordinate system.

## Why it is useful

An orbital image can show where a destination is without making its approach easy to understand. Terrain Surf lets a user inspect measured relief, compare a direct approach with a gentler proposal, scout a science station, and keep the evidence behind that decision in a mission brief.

## For the planner

Choose science stops, review distance and climbing, adjust slope and timing assumptions, and examine what historical environmental evidence actually covers the area.

## For the explorer

Follow a virtual scout in Chase or Rover camera view, inspect original NASA observations, record a field note at arrival, then return and export the plan and report.

### Challenge connection

For Interplanetary Survival Guide: Martian Map, the focus is a human science excursion. Mars Reconnaissance Orbiter terrain and dust context connect with Perseverance science and weather observations. The rover makes those layers navigable and understandable.

Built proof of concept: two Jezero terrain fields; science visits at Máaz and Yeehgo in the landing field; route comparisons; historical conditions; guided use; and a downloadable mission record. Measured data, derived results and user assumptions stay distinguishable.

A COMPLETE MISSION

# Your first Marswalk, end to end

Start with **Tutorial → Guide my first stop**. The guide highlights the next control and waits for the real action. After your recorded observation, choose **Review regional weather**. Then continue the second stop, return and export through the planner.

### Choose the field and declare your start.

Open **Plan a Marswalk**. Load the landing field if prompted, move to your intended start if needed, then press **Begin excursion here**. The S marker is your declared return point. The North field supports free exploration; the two science stations belong to the landing field.

### Select a science stop, then plan it.

Choose **01 · Máaz** or **02 · Yeehgo**; a numbered map marker also selects a stop. Read the science task, then press **Plan this stop**. Selecting a stop alone does not send the rover.

### Inspect the route and assumptions.

Review the elevation profile, distance, ascent/descent and maximum sampled slope. Under **Excursion plan & assumptions**, choose a slope limit, assumed travel speed and time at each science stop. Use **Recheck full excursion** after changes.

### Review the available conditions.

Use **Regional weather** for dated regional dust maps and history. Use **Historical conditions** for MEDA station readings and departure A/B comparisons. Page 4 explains where these observations apply and what they cannot establish.

### Send the scout and stop at the station.

Press **Scout this route**. Watch the live position, travel report and route. Switch cameras without changing location. Space brakes; manual driving interrupts automatic navigation. Resume or replan from the current position.

### Inspect evidence and record an observation.

Open **NASA observation** to see the original image, instrument, sol and source context. Write a texture comparison or follow-up science question. **Record observation** requires a begun excursion, a non-empty note and the rover stopped within 4 m of the station. A typed draft is not yet recorded.

### Review weather, visit the second stop and return.

The first-stop completion card offers **Review regional weather** without losing your position or note. Repeat planning, scouting and recording for the other station. Select **Plan return to start**, inspect it, then scout the return leg.

### Export the mission brief.

**Export mission brief** downloads JSON containing routes, virtual travel, notes, events, assumptions, selected conditions and source references/hashes. An unfinished excursion can also be exported after beginning it.

**If a control is unavailable:** read its adjacent prerequisite or the planner's **Next step** card. Begin first; plan before scouting; arrive and stop before recording. Notes are held in the current page: export before reloading. Closing a panel retains them.

CONTROLS & INTERPRETATION

# Navigate the map and the rover

| Map / route control | What it does and how to read it |
|---|---|
| **Measured field** | Switch between two Jezero crops. Changing field resets the rover and driving route; notebook records remain. Return to the landing field for its science stops. |
| **Optical / Slope / zoom** | Compare registered orbital imagery with DEM-derived slope. Zoom cycles 1×, 2× and 4×. North arrow, scale bar, coordinates, heading marker and trail help locate the rover. |
| **Click the orbital map** | With automatic driving enabled, an unnumbered destination plans and starts a traverse. A new click retargets from the current pose. Numbered station markers select science stops instead. |
| **Route details & options** | Turn off **Drive automatically on map click** to inspect first; use **Drive to destination** when ready. Pause navigation or clear the route here. |
| **Slope limit & profile** | Choose an assumed limit of 5°, 10°, 15° or 25°. Compare the route's elevations, length, climbing and sampled slopes. A red direct line is shown when the sampled straight approach exceeds that limit. |
| **Weather / Dust layer** | **Weather** locates the historical MEDA station and measurement gaps. **Dust layer** colours the full terrain footprint using its regional source bin. They are different products (page 4). |
| **Granular shading** | Toggle illustrative surface grain. It changes appearance, not the measured heights, soil properties or route collision evidence. |




A gentler proposal can be longer. Slope checks do not prove clearance from individual rocks or establish a safe astronaut/vehicle operating limit.

## Driving, feedback and viewpoints

| | |
|---|---|
| **Drive / steer / brake** | W / S forward/reverse; A / D steer; Space brake independently. Arrow keys also work. Touch buttons are held to drive, with a separate brake. Click the terrain to restore driving focus after using a menu. |
| **Speed / Reset** | **Explore speed** selects a faster virtual traverse; it is separate from assumed crew speed in the plan. **Reset**/ R returns to the field's initial pose and clears driving trail/distance, retaining the notebook. Use **Plan return to start** for your declared S point. |
| **Live telemetry** | Speed, travelled distance, pitch/roll and elevation describe the virtual rover. The heading strip is chassis heading, not independent mast aim. The motion follows measured terrain using kinematics. |
| **Chase / Rover camera** | 1 Chase; 2 Rover camera; C switches. Drag to orbit in Chase and scroll to zoom. In Rover camera, drag to aim the mast; choose Traverse, Inspect ground or Level horizon. |
| **Camera panel** | Navcam-inspired 96° horizontal view. Select 1280 × 960 preview or 5120 × 3840 full image; adjust exposure. **Capture** saves a 5120 × 3840 virtual image. Extra pixels do not add measured terrain detail. |

ENVIRONMENTAL EVIDENCE

# What does the weather map tell you?

Use regional dust for broad historical context, and MEDA for weather measured at a particular rover station and time.

## Regional weather / Dust layer

Browse 26 dated dust maps from **20 February to 20 March 2021**. Each source cell covers **6° longitude × 5° latitude**. At Jezero, that is roughly 337 × 296 km: both small terrain fields lie in the **same cell**.

The value is infrared column dust optical depth, normalized to 610 Pa. It is dimensionless and represents dust through the atmospheric column, not wind speed or dust concentration at the wheels.

## Historical conditions / Weather

Review Perseverance **MEDA sol 16**, 6–7 March 2021. The imported stationary interval is **00:00–13:45 local mean solar time**. Pressure is in Pa; local mast air temperature is shown in °C and K.

The W marker is the observing station. Its position/time offsets from your plan are visible. A grey W indicates a missing time slot; surrounding hatching means unmeasured weather, not a storm type.

### Why the overlay is uniform across this terrain

The loaded ground is only about half a kilometre wide. A regional dust cell is hundreds of kilometres wide. One colour across the field is the honest coverage of that product; there are no measured weather hotspots between the two science stops.

## Review regional history

Turn on **Dust layer**, then open **Regional weather**. Choose a date, step Previous/Next or Play. Click a source-grid bin or use the bin selector. **Whole Mars** shows broader context; selecting the active map's bin returns to local coverage. Read the history, change comparison, reliability, uncertainty and effective observation dates. The terrain-catalog section checks coverage for every loaded field, independently of any route.

Hatching, missing values and broken history segments mean **no estimate**. The gridded product uses overlapping multi-sol time windows; adjacent dated maps are not independent daily measurements. Do not infer fine spatial patterns or a trend through a gap.

## Compare historical departure times

After beginning a landing-field excursion, open **Historical conditions**. Set departure A with the time control and departure B in the comparison selector. Review the arrival, science-stop and return timeline under the **same assumed route, speed and dwell time**. Read the actual observation timestamp and coverage beside each value. Events beyond the imported interval or without a matching observation remain unavailable.

### A useful decision rehearsal

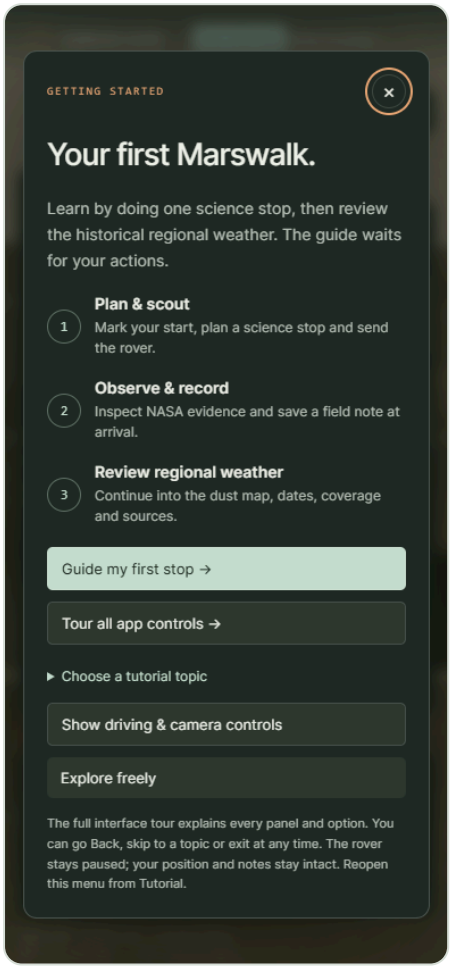
Ask: “How long is this excursion under my assumptions, and what evidence is available at its planned times?” Compare historical contexts, identify missing evidence, and export the assumptions with your plan. This supports learning and preparation; it does not produce a weather forecast, personal radiation dose or a certified safe departure time.

Sources: NASA PDS MEDA archive; Montabone et al. regional dust climatology, MY36 v2.5, using NASA MRO/MCS v5.2 observations. Direct source/method/credit controls are available in each app panel.

TUTORIAL DIRECTORY

# Learn the whole interface

Open **Tutorial** in the top bar at any time. Start with the guided task, take the full orientation, or jump straight to a topic.




Actual tutorial menu. Topic shortcuts are inside “Choose a tutorial topic.”

**Guide my first stop**
Learn by doing: begin, select, plan, scout, inspect NASA evidence and record. At completion, continue into **Review regional weather**.

**Tour all app controls** gives a 55-step orientation. It explains the interface; it does not complete a science mission for you.

### Map & route options

Measured fields; position, north, scale and coordinates; optical/slope/zoom; map destinations; grain shading; route panel; automatic versus inspect-first driving; slope limits; route comparison, warnings and environmental availability.

### Regional weather

Whole-field dust overlay; historical dates and playback; source-grid bins and missing coverage; bin history/change; all-field coverage; provenance, methods, credits and closing the panel.

### Historical conditions

Regional context and MEDA station overlay; observation time and actual timestamp; pressure/temperature and gaps; location/time offsets; departure A/B and prerequisites; arrival/stop/return context; NASA PDS provenance and quality.

### Driving, telemetry & cameras

Speed, distance, attitude and elevation; keyboard/touch driving and brake; exploration speed; reset; Chase/Rover views and heading; mast aim; preview/full resolution; exposure; full-size camera capture.

### Marswalk planning & notebook

Planner and Next step; load field/begin; select stops; plan then scout; profile/travel report; NASA evidence; draft versus recorded notes and proximity; slope/speed/science-time assumptions; recheck, return, export and closing without losing work.

### Data, sources & help

Terrain and orbital imagery; camera references; science-station provenance; challenge and missing layers; manifests; panel closing; tutorial replay and help.

**Back / Next / Exit:** review at your pace; Esc or the close button exits. The orientation pauses the rover and retains current position and notes. Missing prerequisites are explained beside the relevant task. **Show driving & camera controls** opens the compact reference; **Explore freely** closes the menu for manual use.

EVIDENCE & SCOPE

# Follow each decision back to its data

| Layer / resource | Used for |
|---|---|
| MRO / HiRISE 1 m DTM<br>25 cm orthomosaic | Registered local ground geometry and orbital map. Slope/profile are derived from elevation. Ground scale is corrected for the source projection; relief is not exaggerated. Credits: NASA/JPL-Caltech/University of Arizona/USGS. |
| Máaz / PIA24493<br>Yeehgo / PIA24492 | Original Perseverance close-ups for comparing rock textures and choosing follow-up questions. Sol 12/16 and source image identity are retained. Credits: NASA/JPL-Caltech/LANL/CNES/CNRS; ASU/MSSS for Yeehgo context. |
| PDS SuperCam log<br>PDS PLACES | Observation identifiers, clocks and approximate observing-station localizations. Station markers represent rover observation locations, not surveyed coordinates of the pictured rocks. |
| PDS MEDA | Historical pressure and local air temperature for the verified stationary sol-16 interval. Gaps and time/location separation stay visible. |
| Regional dust / MY36 v2.5<br>Methods · NASA aerosol context | Montabone et al. (2020), LMD/Space Science Institute, using NASA MRO/MCS v5.2 observations; MY36 v2.5 (2023). Date subset converted from NetCDF to JSON with source values/gaps retained. CC BY-SA 3.0. |
| JPL Mars 2020 imaging<br>NASA Navcam reference | Reference for virtual camera field of view and image dimensions. This is a Navcam-inspired view, not a calibrated flight-camera model. |

## What is established

A browser user can plan, navigate and inspect sourced local terrain, visit two science stations, record notes, compare historical conditions and export a source-bearing report. Existing browser proofs cover those actions; the v013 update passed 85 app checks and 8 media/playback checks.

## What still needs validation

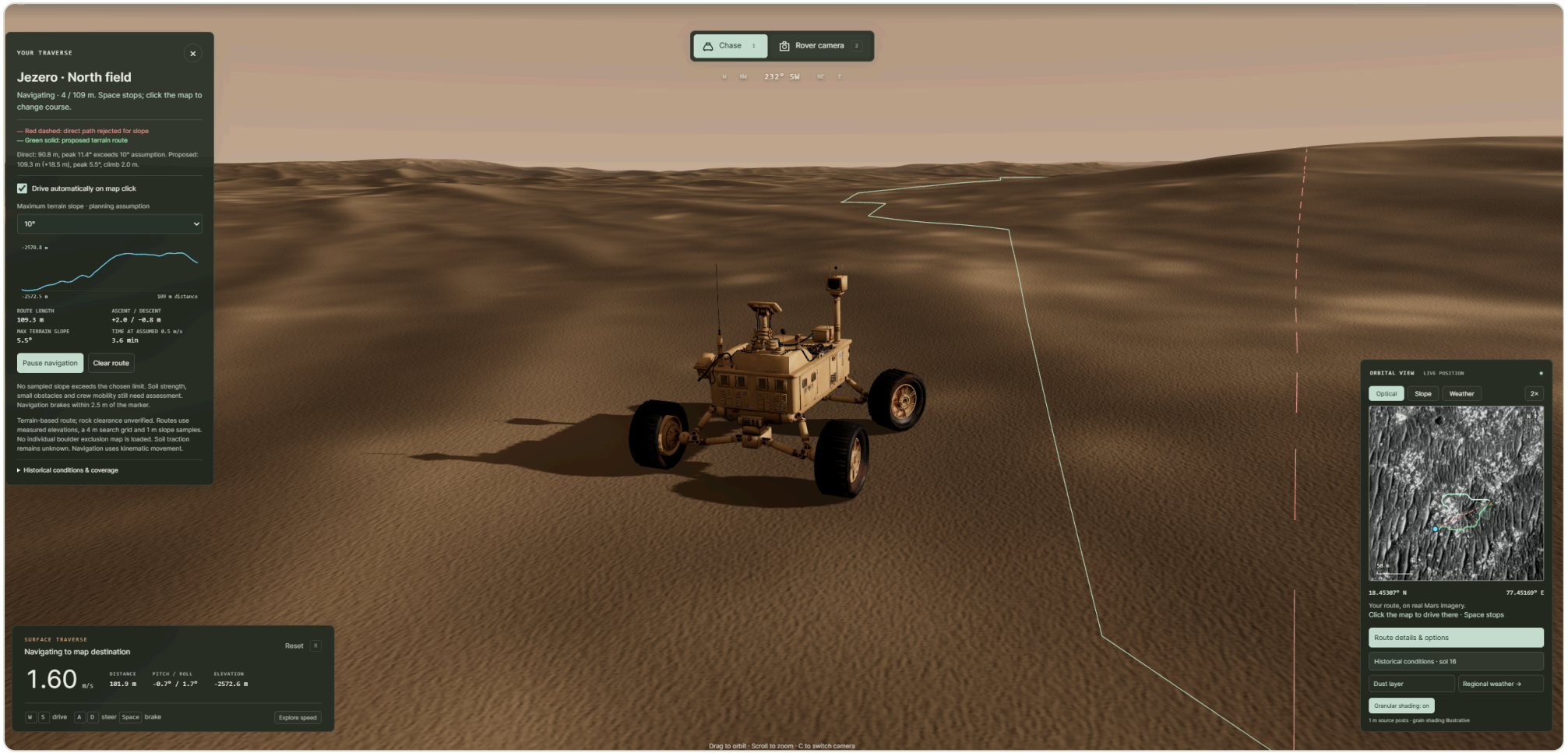
Motion is terrain-following kinematics. Individual rock clearance, wheel slip, soil forces, energy, radiation exposure and astronaut safety are not validated. Fine grain, colour and lighting are illustrative. New measured layers require their own provenance and checks.

## Built for the web, with room to extend

JavaScript/HTML/CSS and Three.js provide the 3D explorer; Driver.js supplies guided highlights. Python handles terrain/data preparation; Playwright checks browser workflows. A pre-existing BlenderKit rover was converted to GLB. Exported plans preserve assumptions and source identity so later work can be compared honestly.

Development disclosure: Henri defined the concept and workflow. Codex assisted research, code, debugging, verification, writing and recording/edit automation. NASA imagery and measurements come from the cited archives; derived layers and illustrative rendering are identified. The 30-second overview compresses actual app actions and travel; this guide supplies the slower explanation.

# See why a different route is proposed




**Red dashed / direct route rejected**

**90.8 m** direct distance / **11.4°** peak sampled terrain slope

The direct approach exceeds the selected **10° planning assumption**.

**Green solid / proposed terrain route**

**109.3 m** route / **5.5°** peak sampled terrain slope

About **18.5 m farther**, with **2.0 m** ascent in this example.

Actual screenshot supplied by Henri; values shown in the capture. The 10° limit is an assumption. This terrain-slope comparison does not validate rock clearance, soil traction or astronaut/vehicle safety.