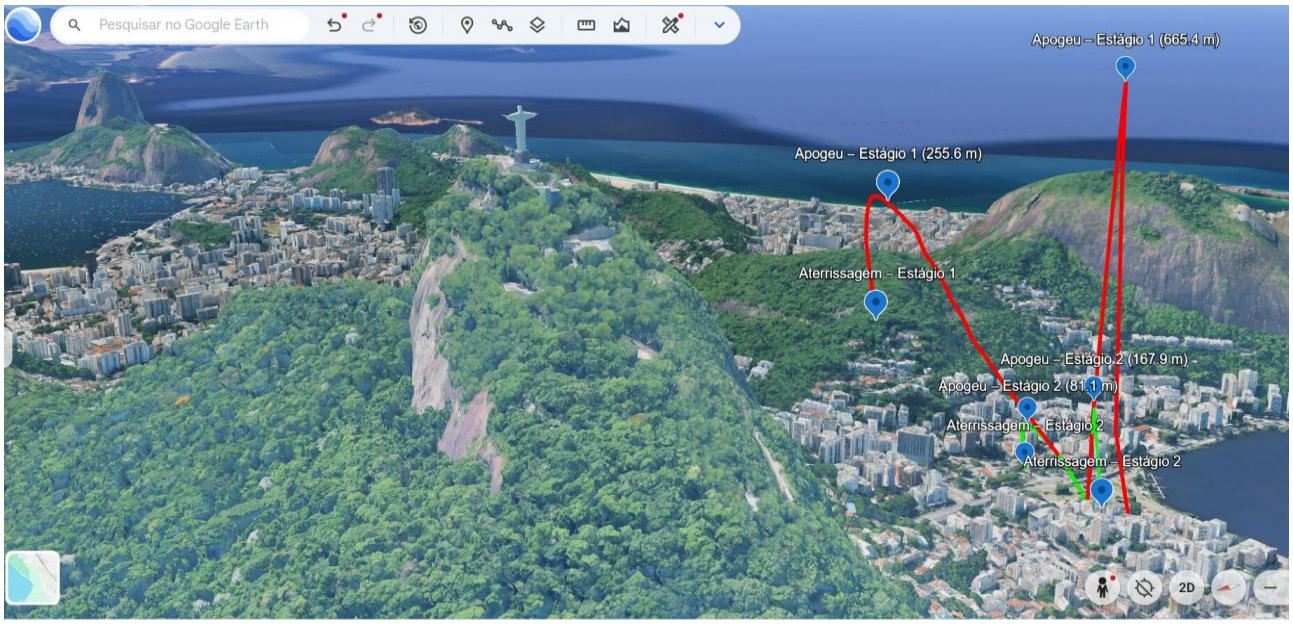


Tool Operation Tutorial

OpenEarth

3D Visualization of Rocket Trajectories in Google Earth

OSIFOG **Georeferenced** **Multi-stage**

Introduction

The **OpenEarth** is a tool developed by **BIRST** that converts the simulation data from **OpenRocket** into a **KML**, enabling you to visualize your rocket's trajectory in **3D in Google Earth** — positioned exactly at the launch site.

With OpenEarth you can:

- **Visualize in 3D** the rocket's actual trajectory over the satellite map
- **Study the terrain** and identify real obstacles at the launch site
- **Predict and reference** the rocket's landing point with geographic precision
- **Define the safety perimeter** based on the simulated trajectory
- **Present results** in a visual and professional manner
- **Support multiple stages** with a separate CSV per stage

> **100% Local Processing**
> No data is sent to external servers. All KML file processing happens directly in your browser.

How to Access OpenEarth

Access the site osifog.com.br and follow the steps below:

1. **Access:** osifog.com.br
2. **Click on "Simulators"** in the navigation menu
3. **Open the "Open Simulator" section**
4. **Click on "OpenEarth"**
5. **Close or open the tutorial summary** as needed

> **Tutorial Summary**
> On the OpenEarth page there is a quick summary with the main steps. Use it as a quick reference during operation. This document is the complete and detailed version of that summary.

Before You Begin — Study the Launch Site in Google Earth

Before running any simulation, it is essential to know the launch site precisely. Google Earth Web allows you to obtain exact coordinates and study the terrain.

Accessing Google Earth Web

Access earth.google.com in your browser.

Creating a Project on Google Earth

Projects allow you to save markers, lines, and annotations on the map. Follow the steps:

- **Click the ☰ Menu icon** (three lines) in the upper left corner
- **Click on "Projects"**
- **Click on "New project"**
- Choose **"Create project in Google Drive"** to save automatically, or **"Create local project"** to save on your computer
- Give the project a name, for example: **"Launch Field X — 2025"**

Adding a Marker at the Launch Site

To record the exact launch point, add a marker:

- With the project open, click on **"New feature"** inside the Projects panel (pin + pencil icon)
- **Click on "Add marker"**
- Click on the map at the exact launch location
- Give the marker a name, such as **"Launch Pad"**
- **Click on "Save"**

Obtaining Geographic Coordinates

OpenEarth requires the latitude, longitude, and altitude of the launch site in decimal format. Here is how to obtain each one:

Latitude and Longitude

- In Google Earth Web, navigate to the launch site
- Right-click on **the exact marker point on the map**
- **Click on "What's here?"** (What's here?)
- A panel will appear at the bottom of the screen with the coordinates in **decimal format**, for example: **-21.783000, -46.566000**
- Copy the values carefully: use a period as the decimal separator

Coordinate Format

Latitude: positive = North, negative = South. Example: -21.783000

Longitude: positive = East, negative = West. Example: -46.566000

Absolute Altitude

The absolute altitude (above sea level) is essential for the correct georeferencing of the trajectory:

- In the **"What's here?"** panel, look for the **elevation**
- If not visible, right-click the marker you created and select **"Properties"**
- In the properties, under the **"Altitude"**, select the mode **"Absolute"** (instead of 'Relative to ground'). This ensures the altitude value is relative to sea level, not the terrain
- The displayed value will be in meters. Note it down to enter into OpenEarth

Why Use Absolute Altitude?

The 'Relative to ground' altitude is always 0 m at the launch point, since it is calculated relative to the terrain itself. OpenEarth requires the altitude above sea level (absolute) to correctly position the trajectory in relation to the Earth.

Identifying the Launch Direction with the Compass

If your rocket's launch guide determines an oblique launch, the launch direction determines which way the rocket will tilt. In Google Earth Web:

- Locate the **compass** in the **lower right corner** of the screen
- Click and drag the compass to **rotate the map**. The **N** arrow always points to geographic north
- To identify the launch direction: **position the map so you are 'looking' in the direction the rocket will be launched — that will be the launch axis direction**
- Note the **angle in degrees** relative to North. Example: launch to the northeast = **45°**

Compass Orientation

The direction you are looking in Google Earth — that is, where the map is 'facing' — corresponds to the rocket's launch direction. If you rotate the map so that east is 'in front of you', the rocket will be launched eastward (90°). Use this visual reference when setting the angle in OpenRocket.

Step 1 Simulate the rocket in OpenRocket

With OpenRocket open and the rocket modeled, configure and run the simulation:

Configuring the Simulation for an OBLIQUE Launch

- Click on the **"Simulations"** tab in the OpenRocket top toolbar
- Select the desired simulation and click on **"Edit Simulation"**
- In the configuration window, **uncheck** the option **"Always launch directly upward"** (Always launch directly upward). This enables direction and inclination fields

Configuring Direction and Inclination for an OBLIQUE Launch

- In the **"Launch rod direction"** field: enter the launch direction angle in degrees

Angle System in OpenRocket

0° = North 90° = East 180° = South 270° = West

- In the **"Launch rod angle"** field: set the tilt angle of the launch rod relative to vertical. 0° = vertical, 5° = slightly tilted

Running the Simulation

- Confirm the remaining settings (motor, atmospheric conditions, wind)
- **Click on "Simulate & Plot"** to run the simulation
- Wait for it to be completed.

Step 2 Export the CSV data for each stage

OpenEarth uses CSV files exported directly from OpenRocket. You must select exactly the four correct variables.

Exporting the CSV

- After the simulation, click on **"Export Data"**
- In the export window, **uncheck all variables** and select **only these four:**

Variable in OpenRocket	Variable Name	Unit
Time	Flight time	s (seconds)
Altitude	Altitude	m (meters)
Position East of launch	Position east of launch	m (meters)
Position North of launch	Position north of launch	m (meters)

- Choose the separator format: **comma (CSV)**
- **Click on "Export"** and save the file with an identifiable name, such as **"stage1.csv"**

Multi-Stage Rockets

Export a separate CSV file for each rocket stage. OpenEarth supports multiple files simultaneously — one per stage. Name the files clearly: stage1.csv, stage2.csv, etc. For multi-stage rocket analysis, generate the KML file only after uploading all CSV files for all rocket stages.

Step 3 Upload the CSV files to OpenEarth

With the CSV files exported, access OpenEarth at osifog.com.br and upload them:

- Na seção **"CSV File Upload"**, locate the indicated upload area (with a cloud icon or dashed box)
- Drag and drop the CSV files directly onto the indicated area, OR click on the area to open the file selector
- Select all files at once (one per stage) — multiple files are supported simultaneously
- Wait for the upload confirmation. The file names will appear listed in the interface

Data Privacy

All processing is 100% local in your browser. The CSV files and entered coordinates are never sent to external servers.

Step 4 Enter the Launch Site Coordinates

Fill in the georeferencing fields with the data obtained from Google Earth:

Field	Description	Example
Latitude (°)	Positive = North · Negative = South	-21.783000
Longitude (°)	Positive = East · Negative = West	-46.566000
Site Altitude (m)	Absolute elevation above sea level	1180

Quick Tip — Google Earth

In Google Earth Web: right-click on the location → **"What's here?"** → copy the decimal coordinates shown in the bottom panel.

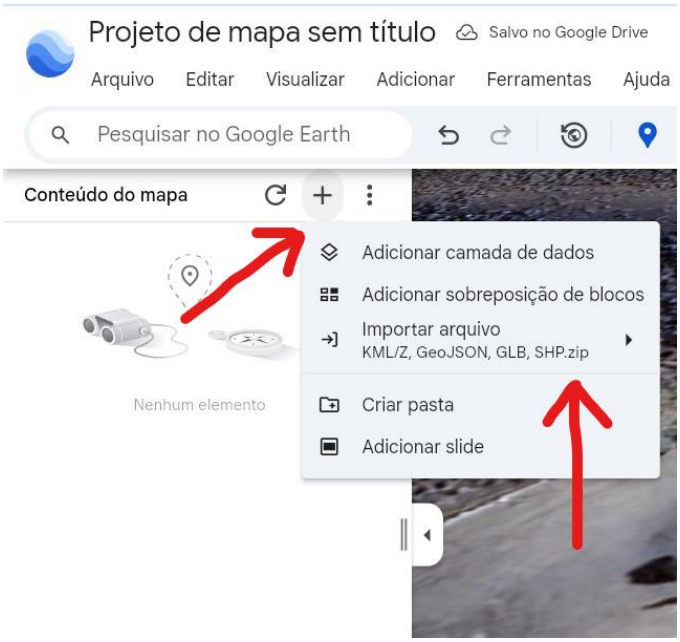
Step 5 Generate the KML and Visualize in Google Earth

With the CSVs uploaded and coordinates filled in, generate the KML file:

- **Click on "Generate KML file"**
- The download of the **.kml** file will start automatically — it will be saved to downloads

Importing the KML in Google Earth Web

1. Access earth.google.com
2. Click the ☰ **Menu** (three lines) → **"Projects"**
3. **Click on "New project"** or open an existing project
4. **Click the + symbol**
5. Inside the project, click on **"Import KML file"**



6. Select the **.kml** file generated by OpenEarth
7. Google Earth will automatically **fly to the launch site** and display the 3D trajectory

What You Will See in Google Earth

3D Trajectory: colored line showing the complete rocket flight path over the satellite map
Apogee Marker: highlighted point at the highest point of the trajectory
Landing Marker: highlighted point at the predicted rocket landing site

Viewing in 3D Perspective

- To view the trajectory in tilted perspective: **click and drag with the right mouse button**, holding either Shift or Ctrl for different movements (or two fingers on touch screens)
- Use the **mouse scroll wheel** to zoom in or out
- Click on the apogee or landing markers to see **detailed information** for each point
- Use the **compass** in the lower right corner to reorient the map to North

Quick Summary — Operation Checklist

	Study the site in Google Earth: create a project, add a marker at the launch point
	Obtain decimal Latitude and Longitude (right-click → 'What\'s here?')
	Obtain absolute site Altitude (marker properties → 'Absolute' mode)
	Identify launch direction (compass in the lower right corner)
	OpenRocket: uncheck 'Always launch directly upward', configure direction and inclination
	Run simulation with 'Simulate & Plot'
	Export CSV with Time, Altitude, Position East, Position North (one per stage)
	Upload CSVs to OpenEarth (osifog.com.br)
	Fill in Latitude, Longitude, and Altitude in OpenEarth
	Click 'Generate KML file'
	Import KML in Google Earth: Projects → New project → Import KML file

Ready!

By following these steps, you will have your rocket's complete trajectory visualized in 3D in Google Earth, positioned with real precision at the launch site. Happy launching!

Questions or suggestions: osifog.com.br