

Astrarium for macOS — User Manual

For version 1.3

7 September 2026

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1. Introduction

Astrarium is a planisphere and astronomical simulator for the Mac. It shows the sky as it is now, but it also lets you drive the clock freely — back into the past, forward into the future — and it puts planetary phases, eclipses, meteor showers, satellites and comets on the same chart.

Positions come from the JPL DE421 ephemeris, the IAU precession and nutation models and IERS Earth-orientation data, and are accurate enough to plan real observing sessions with. The Mac app carries the same compute core as the iOS app, so the two agree to the last digit.

1.1 Requirements

Machines

Any Mac running macOS 13.0 or later
(Apple silicon and Intel)

Window	Resizable; the minimum is 1000 × 700
Price	Free. No in-app purchases, no advertising
Network	The chart and all the astronomy run on your Mac — it works offline
Data collection	None. Your site and settings stay on the machine

An internet connection is needed only to **update** three things:

- satellite orbital elements (TLEs),
- comet and asteroid elements (from the MPC and JPL),
- your current position (this uses location services, not the network). Where Precise Location is switched off, the app asks for it once, for that single fix: an approximate position can be kilometres out, and that changes what is visible near the horizon.

The Mac and iOS apps are a universal purchase: getting one gets you the other.

1.2 First steps

1. On launch, the app shows the sky over Tokyo at the present moment.
2. Press  in the top bar and allow the use of your location. Astrarium switches to your position and tells you the nearest registered site and how far away it is. If you would rather not share your location, pick a site from the list or type in coordinates (chapter 3).
3. Outdoors, press  (night vision). The whole interface turns red so that it does not spoil your dark adaptation.

2. The screen

The window is divided into four regions. Unlike the iOS app, the detail panel is always open along the right-hand edge — there is no  button to open it — and there is no quick bar under the chart; the **View** tab does that job.

Region	Where	What it does
Top bar	Top	Clock, observing site, location, language, night vision
Chart	Centre left	The sky itself, driven with the mouse or trackpad

Region	Where	What it does
Side panel	Right	Six tabs: View, Info, Bodies, Satellites, Events, Voice
Time bar	Bottom	View mode, grids, moving and playing the clock
Signature	Below that	Logo and author, both links

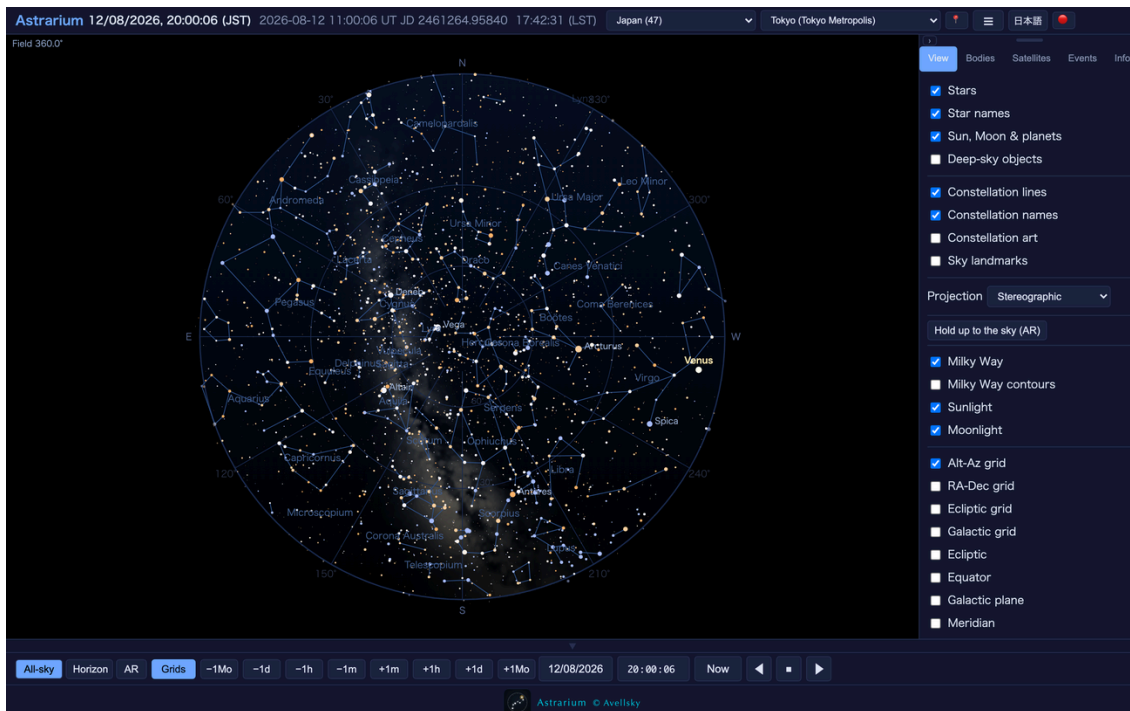


Figure 1. The all-sky view (Tokyo, 12 August 2026, 20:00)

2.1 The top bar



Figure 2. The top bar: clock, site category and site, location, language, night vision

- **Clock** — local time at the observing site, Universal Time (UT), the Julian Date (JD) and Local Sidereal Time (LST) side by side. LST tells you which right ascension is on the meridian right now, which is what you need when pointing a telescope.
- **Site category** — Japan (the 47 prefectural capitals), Japanese dark-sky sites, observatories, major cities other than capitals, the capitals of each continent, and the Antarctic research stations. Observatories at home and abroad are one list. Each menu is named for exactly what is in it: “Asia ·

capitals” holds one national capital per country. Choosing observatories adds a second **Region** menu so you can narrow the list down by continent.

- **Site** — the place itself. The prefectures and the dark-sky sites run north to south; the world cities are alphabetical.
-  — use your current position.
- **EN / 日本語** — switch language. Object names, constellation names and every description change with it.
-  — night vision; press again to return to normal colours.

2.2 The side panel

Switch between the six tabs along its top edge. Their contents are described from chapter 6 onwards.

Tab	What is in it
View	What the chart draws. Magnitude limit, FOV frames, PNG/PDF export, demo and recording
Info	Tonight’s sky, credits and sources
Bodies	Meteor showers, comets and asteroids
Satellites	Fetching TLEs, which groups to show, visible passes
Events	Eclipses, planetary events, shower maxima and the rest
Voice	Spoken summaries

2.3 The signature line

The logo at the bottom opens the Astrarium home page and © Ave11sky opens the author’s page — both in **your normal browser**, never inside the app.

3. Choosing where you are

Pick a place from the category and site menus in the top bar, or press  to open the **site screen**, which holds a map, coordinate entry and your saved places on one panel.

Pick it from the list

Use the category and site menus in the top bar. The app carries the capital of each of the 47 Japanese prefectures, recommended dark-sky sites in

Japan ordered by prefecture from the north, the major cities of the world and the world's observatories with their MPC codes.

Open the site screen

Press . Nothing moves the moment you press it.

- **Get current position** — allow the location request. A Mac works its position out from the Wi-Fi networks around it, so away from towns the answer can be some kilometres out; use the map or the coordinates when it matters.
- **Map** — drag the map (OpenStreetMap) until the centre mark is on the spot.
- **Latitude, longitude, altitude** — type degrees, minutes and seconds, and the altitude; the arrows step one unit at a time. “Use this position” applies it.
- **List** — save up to **ten** places by name and click a row to go there.

Changing the site updates the clock, the rise and set times and the whole geometry of the chart together.

4. Driving the chart

4.1 All-sky and horizon views

Switch with **All-sky** and **Horizon** at the left of the time bar.

- **All-sky** — the whole sky as a circle centred on the zenith, north up and east to the left, exactly as on a cardboard planisphere. The Milky Way is drawn in this view.
- **Horizon** — part of the sky drawn as you would actually see it looking out. The menu that appears beside the button chooses which way you face: **N**, **E**, **S**, **W**.

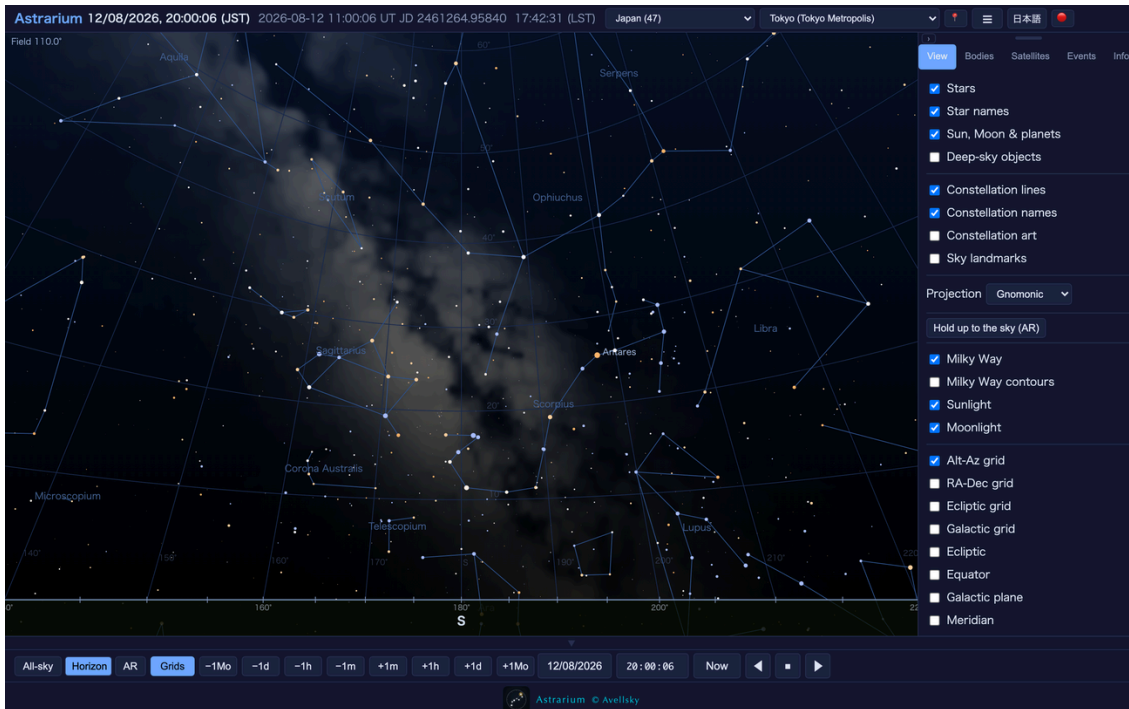


Figure 3. Horizon view, facing south

4.2 Mouse and trackpad

Action	All-sky	Horizon
Drag	Diurnal rotation — the sky turns about the celestial pole and the clock follows the pointer	Pans the view
Scroll (wheel or two fingers)	Zoom about the pointer	The same
Pinch on a trackpad	Zoom	The same
Double-click	Recentre on the zenith	—
Click an object	Opens its information popup	The same
Shift + drag	Pans the view centre without rotating	—

Dragging in all-sky view is the planisphere gesture: the dial turns and the simulated time turns with it, so you can feel out how high Orion will be in two hours' time.

The keyboard moves the clock too: ← and → by ± 10 minutes, with `shift` ± 1 day, with `option` ± 1 minute, and `↑ ↓` by ± 1 hour.

4.3 What a click tells you

The popup gives the name, right ascension and declination, azimuth and altitude, the magnitude and the rise, transit and set times, with buttons underneath. **The readings follow the clock while the card is open.** Azimuth and altitude are recomputed twice a second, α and δ , distance, elongation and phase angle each time the sky is refreshed, and the rise, transit and set times when the local date turns over. “(below the horizon)” is added once the object has set.

The Sun, the Moon, the planets and the moons drawn in the zoom view also carry a sentence or two on what they are, and every card gives the **distance** — in astronomical units for the solar system (kilometres for the Moon) and in light years for the stars, from the Hipparcos parallaxes.

Close a card with the **pin** (📌) in its **top-right corner**. Clicking the body of the card does not close it, so a long description can be read without it vanishing under your finger.

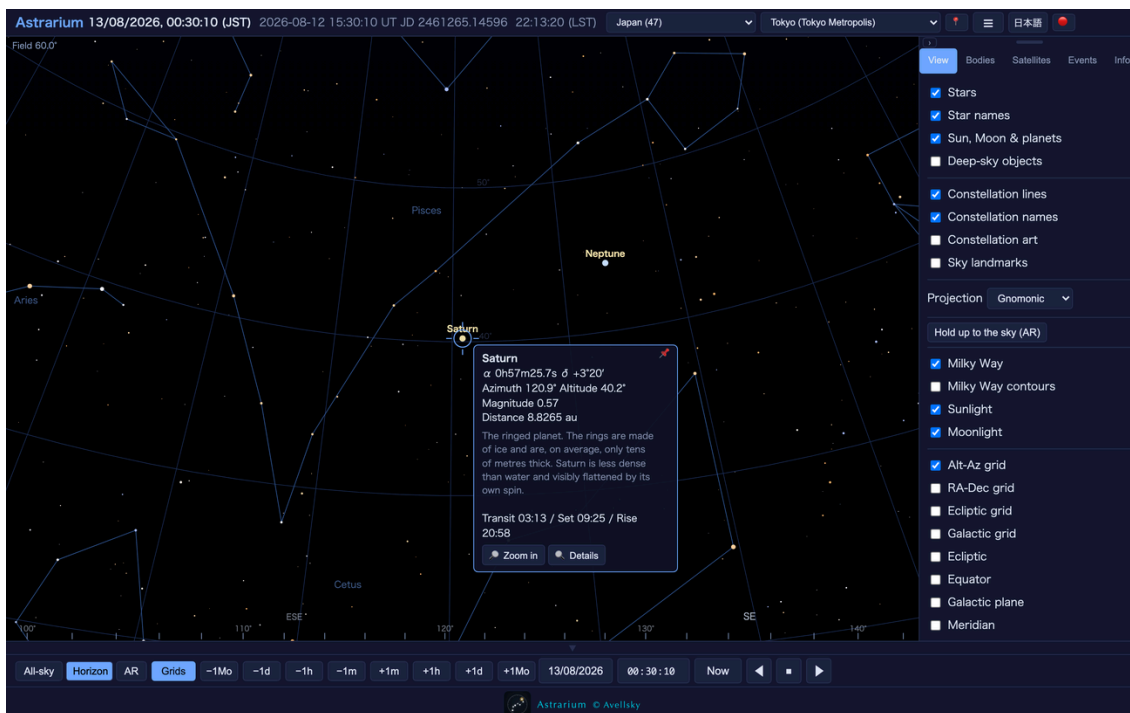


Figure 4. Saturn clicked: coordinates, magnitude, rise and set, and two buttons

- **🔍 Zoom in** — puts the object in the middle of the chart, zooms in and starts **tracking** it. While tracking, the object stays centred as the clock runs. Release it with the **Release** button on the chart or the `Esc` key; panning the view does not break the tracking.
- **🔍 Details** (Sun, Moon and planets) — opens a window that draws the body as a disc, recomputed every five seconds so its distance, elongation, phase

angle and libration follow the clock too. The figures include the **physical data** — diameter, mass, mean density, rotation period, axial tilt and surface gravity — and scroll inside the window when there are more than it can show.

-  **Polar alignment** (Polaris only) — opens the polar scope's field, with Polaris on an hour-angle ring that follows the clock. The red button in that window switches night vision on and off. The Moon comes with its age, illuminated fraction, libration and popular name (Pink Moon, supermoon and so on); Jupiter with the four Galilean moons; Saturn with the rings and Titan; Mars with Phobos and Deimos. You can drag inside the window, and **Close** returns you to the chart.

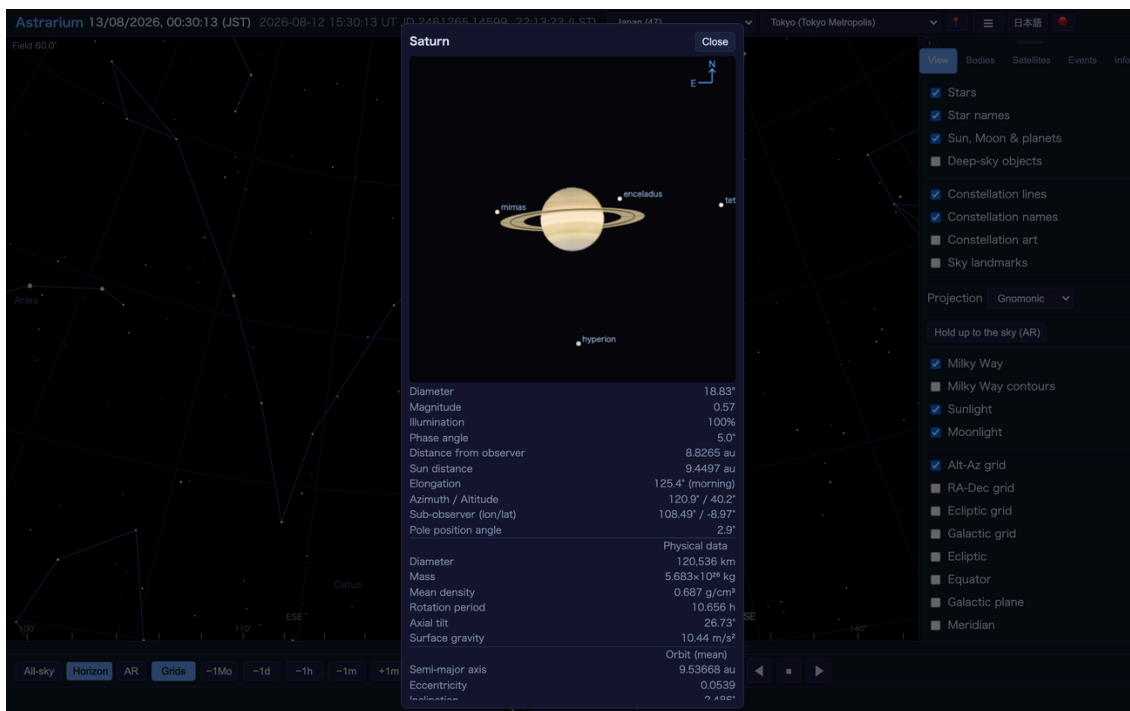


Figure 5. The zoom view of Saturn: the rings, its moons, and the figures below

Picking a deep-sky object brings up a photograph and a short description; a comet or asteroid brings up its orbital elements and estimated brightness; a satellite brings up its range, height, apparent magnitude and its coming visible passes. Deep-sky names, constellations and descriptions are available in both languages; an object with no Japanese name is listed by its catalogue number in Japanese, with the English name beside it.

Clicking a meteor shower's radiant gives its azimuth and altitude as well as its coordinates, and these follow the clock — so you can see at a glance whether the radiant is up yet.

With constellation art switched on, clicking one of the twelve zodiacal constellations shows the corresponding astrological sign and its birth dates,

together with a note that precession has moved the signs about a month away from where the Sun really is.

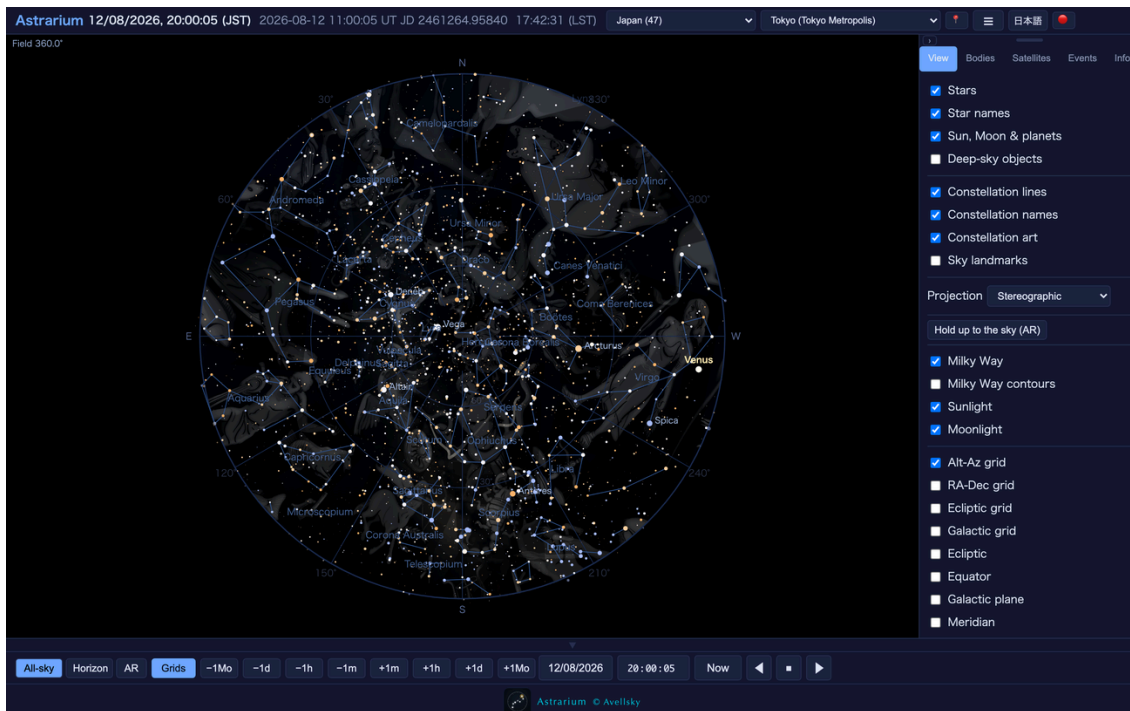


Figure 6. The whole sky with the constellation figures drawn

5. Moving through time

Everything is in the time bar along the bottom.



Figure 7. The time bar: view mode, grids, time steps, the date field, playback and speed

5.1 Steps and playback

Control

-1d / -1h / -1m

+1m / +1h / +1d

+1Mo

Date-time field

Now



What it does

Back one day, hour or minute

Forward one minute, hour or day

Forward one synodic month (29.53 days) — jumps to the same lunar phase

Go straight to a date and time

Return to the present

Play backward / forward; each press steps $\times 1 \rightarrow \times 60 \rightarrow \times 600 \rightarrow \times 6000$ and round again

Control

What it does



Rate

Hold the clock still; press again and it runs from where it stopped

The speed it is running at — “stopped” when held, “real time” when idle

While it runs the arrow carries the rate in its heads: ► ×1, ►► ×60, ►►► ×600, ►►►► ×6000, and a minus sign on the rate when running backwards. At ×600 one second of yours is ten minutes of sky.

■ **also detaches the chart from real time.** Idle, the sky still moves at the rate the real sky moves; ■ stops it dead. Stepping the clock still works while it is held, and it stays wherever you step it to.

In the horizon view the altitude lines run all the way to **90° (the zenith)**, numbered like the rest. In the whole-sky view 90° is a point, not a line.

5.2 Grids

Grids in the time bar turns the overlaid lines on and off as a whole. *Which* lines are drawn is chosen with the checkboxes in the middle of the **View** tab, and you can have several at once.

Line

What it is

Alt-Az grid

The horizontal grid: azimuth and altitude

RA-Dec grid

The equatorial grid — the coordinates catalogues use

Ecliptic grid

The ecliptic grid; the planets and the Moon travel along this belt

Galactic grid

The galactic grid; the Milky Way lies along galactic latitude 0°

Celestial equator

Drawn as a single emphasised great circle

Galactic plane

The great circle at galactic latitude 0° — the centre line of the Milky Way

Ecliptic

The same, for the Sun's path

Meridian

The great circle from north to south, where objects transit

The spacing of the lines and the detail of their labels change automatically with the zoom.

6. What the chart shows

6.1 The View tab

Everything the chart draws is decided here. This tab replaces the quick bar of the iOS app.

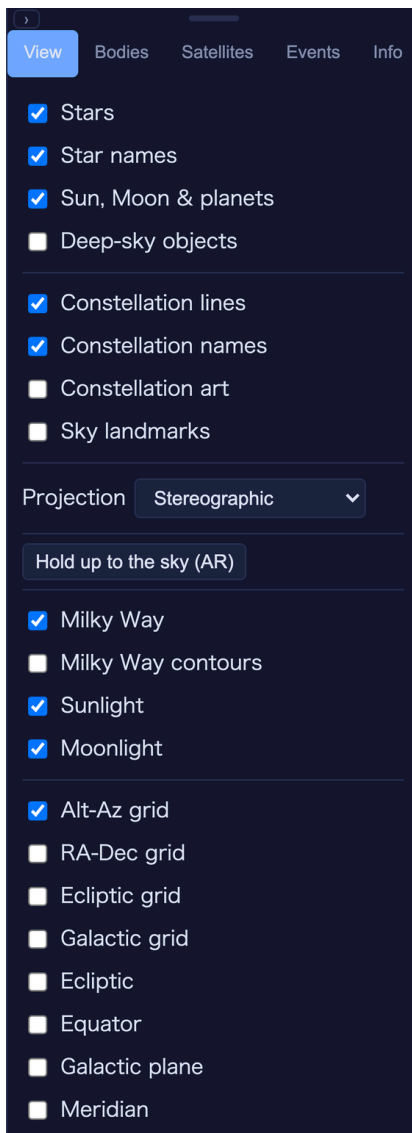


Figure 8. The View tab

The groups run down the tab in this order: bodies, constellations, the state of the sky, the grids, and how it is drawn.

First group: bodies

Item**What it draws**

Stars

The stars themselves; switch them off and the constellation figures stand alone

Star names

The proper names of the brighter stars

Sun, Moon & planets

The Sun, the Moon and the planets

Deep-sky objects

The Messier and Caldwell objects

Second group: constellations**Item****What it draws**

Constellation lines

The joined figures of the 88 constellations

Constellation names

Their names

Constellation art

The classical figures (86 of them; drawn whatever the magnitude limit)

Third group: the state of the sky**Item****What it does**

Milky Way

The Milky Way, drawn unbroken down to the horizon in all-sky view

Sunlight

Daylight and twilight. Switch it off to draw the sky as if it were always dark, which is how you check where the stars are in the daytime

Moonlight

The sky brightness from the Moon. It switches separately from the sunlight, so the daytime sky can stay as it is while the moonlight comes out

Fourth group: the grids — see section 5.2.**Fifth group: how it is drawn****Item****What it does**

Mirror

Flips the image for a telescope finder that inverts

Star trails

Leaves a trail behind moving objects during playback, so diurnal motion and satellite passes are drawn as lines

Item**What it does**

Long exposure

Keeps the trails instead of letting them fade, so the tracks build up as they would on film (switching it on switches trails on too)

FOV frames — rectangles for a camera field or circles for an eyepiece, laid over the chart. “Add frame”, then give it a sensor size and focal length, or an apparent field and a magnification. Drag the centre to move the frame, click the centre to zoom to it, drag a corner to rotate. Useful for framing a photograph, or for seeing what will fit in the field.

Mag limit — lower it and the faint stars go, which is closer to what a town sky really shows; raise it and the chart goes to magnitude 6.5, the naked-eye limit.

6.2 Export as PNG or PDF

Saves the chart for the current time and site as an image; a save dialog asks where to put it. Because these are meant to be printed and taken outside:

- the background is white paper and the stars and lines are black,
- sky brightness (sunlight and moonlight) is left out,
- the Milky Way is drawn **as contours only**, not filled,
- the date, time and Astrarium © Avellsky appear in the bottom right corner.

Field 360.0°

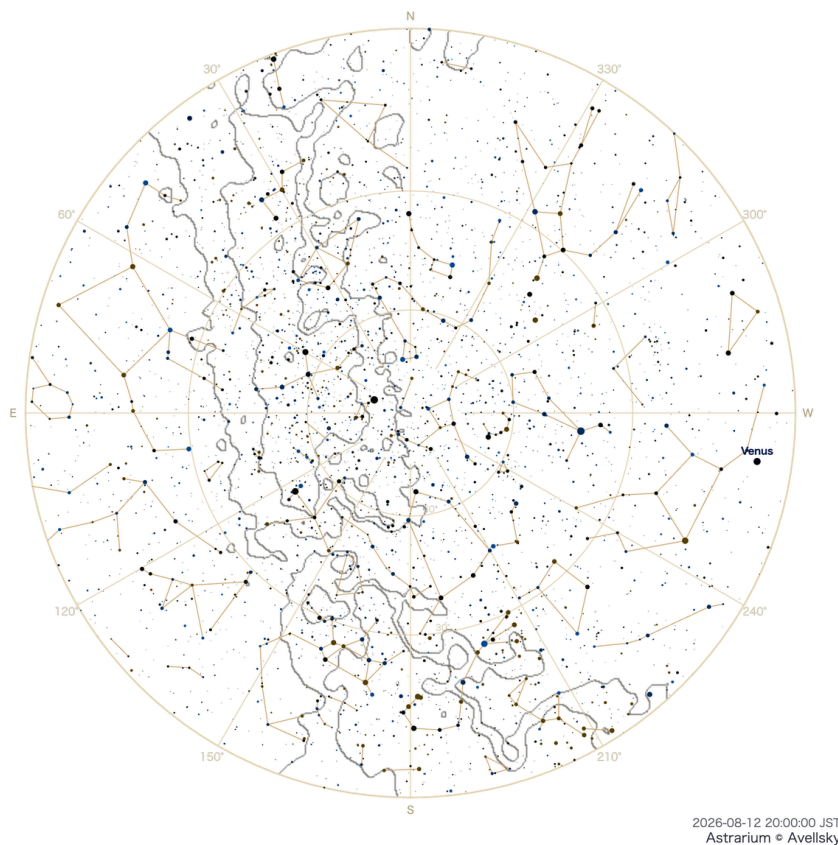


Figure 9. An exported chart: the Milky Way drawn as contours on white paper

6.3 Demo and recording

Demo is a tour of about four minutes. It plays without sound; each scene is described in captions below the chart. It runs through twilight, the Milky Way, a planet, Saturn's rings, FOV frames, the Moon, a meteor shower, an ISS pass, two Messier objects (M3 and M16, with photograph and description), a simulated ISS flight, a long exposure, the event list, the language switch, the spoken summary and diurnal motion. Clicking the chart ends the tour and restores what you had.

It takes a moment to get ready before the first scene appears — a note under the button says so. While it runs, the button turns red and reads **Stop demo**, so you can end it at any point.

Record saves the moving chart as a video. Start recording during the demo and the file saves itself when the tour ends. Only the chart canvas is captured — the side panel and time bar stay out of it — but the demo captions are drawn into the chart, so they survive into the file.

7. Meteor showers

The upper half of the **Bodies** tab.

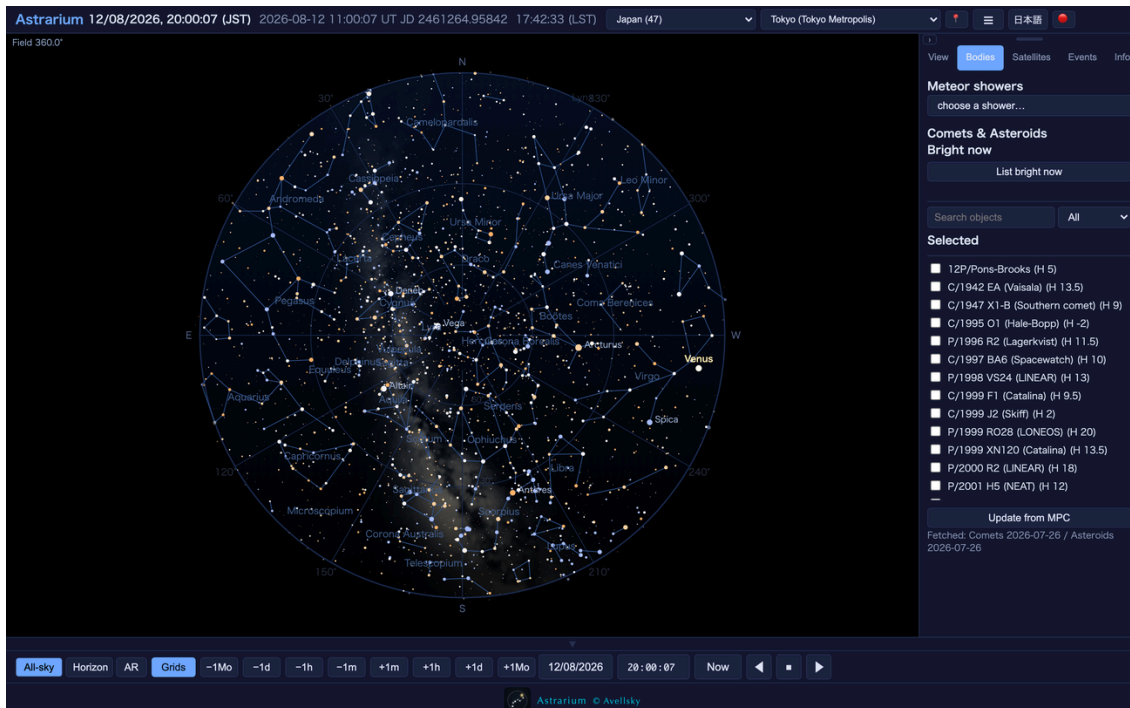


Figure 10. The Bodies tab: meteor showers above, comets and asteroids below

7.1 The list

The menu holds the principal showers of the year, sorted by **how close their maximum is to the date on the chart**. Choosing one moves the clock to **the moment of that maximum** and opens the details; where the maximum falls in daylight, it moves to about 1 a.m. that night instead. Clicking the radiant on the chart itself leaves the clock where it is.

Field	Meaning
Maximum	Given both in Universal Time and in the local time of your site
Radiant	Right ascension and declination, with its altitude at maximum and now
Entry speed	How fast the meteoroids meet the atmosphere
Population index r	The proportion of bright meteors; the smaller, the brighter
Parent body	The comet or asteroid the stream came from
Expected rate	Meteors per hour, from the model below

7.2 How the rate is worked out

The figure in “per hour” is not the ideal ZHR — it is **what you can expect from your site at that moment**. Four factors are multiplied together:

1. **Distance from the maximum.** A Gaussian profile: about a day either side the rate has fallen to the sporadic background, and outside the activity period nothing is shown at all.
2. **Radiant altitude.** The lower the radiant, the fewer meteors; below the horizon, none.
3. **Twilight.** Zero between sunrise and sunset, reduced during twilight in proportion to how bright the sky is.
4. **Moonlight.** Reduced according to the Moon's phase and altitude.

Active showers are also listed in an orange box at the top of the chart. Clicking a name in the box opens its details; **Release** clears the box.

8. Comets and asteroids

The lower half of the **Bodies** tab.

- **Brightest now** — lists the comets and asteroids in the sky, brightest first.
- **Search** — by name or designation. Anything not in the local data is fetched from JPL automatically (this needs the network).
- **All / Comets / Asteroids** — filters the list.
- **Selected** — the objects the chart draws.
- **Fetch from MPC** — comet elements from the Minor Planet Center and asteroid elements from JPL. The date of the last fetch is shown underneath.

Clicking a comet on the chart shows its distance from the Sun and from Earth, the phase angle, an estimated diameter, the orbital elements, the period and the epoch.

9. Satellites

The **Satellites** tab.

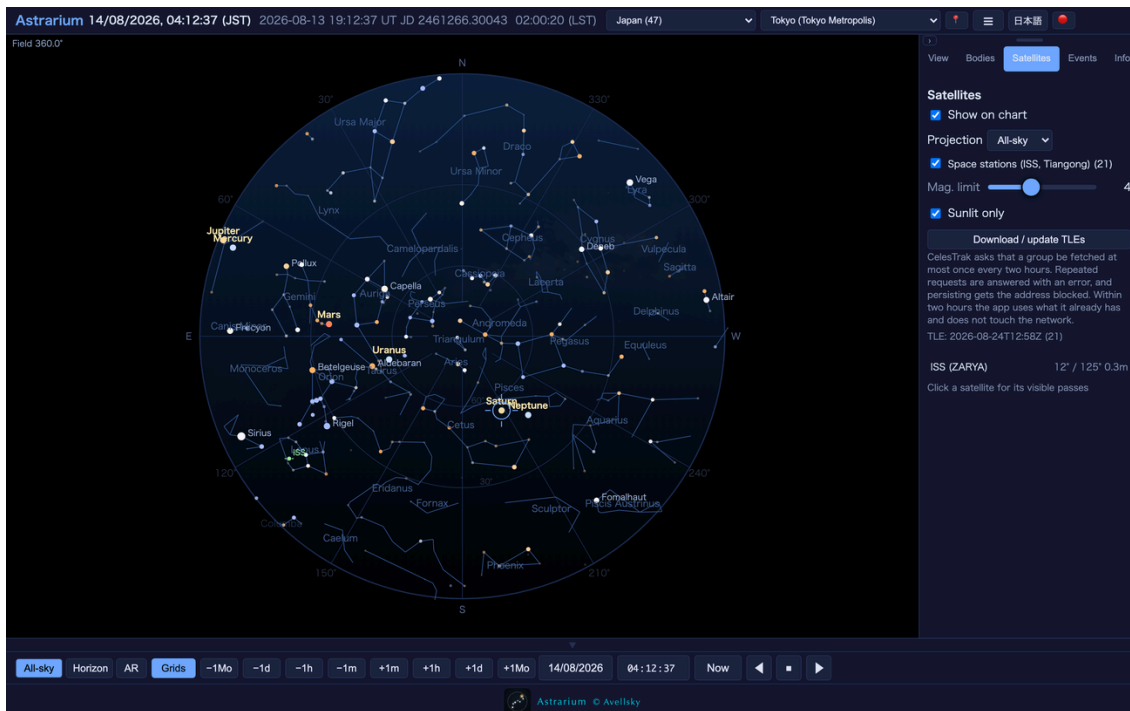


Figure 11. The Satellites tab

What this covers are the **space stations** — the International Space Station (ISS) and Tiangong, together with the craft docked to them.

1. Press **Download / update TLEs** first (this needs the network). Until you do, the tab says the elements have not been fetched. Within two hours of a fetch it tells you they are current instead of downloading them again. The seconds are counted out while it runs; if nothing has answered after 25 seconds it stops and says so.

How often you may fetch. CelesTrak asks that a given group be fetched at most once every two hours — that is how often the elements are regenerated. Requests at shorter intervals are answered with an error, and persisting gets the address blocked altogether. Astrarium records when each group was fetched and, within two hours, answers from what it already has without touching the network. That is not thrift: it is what keeps you from being blocked.

2. Switch **Show on chart** on and the stations move across the sky.
 - **Projection** — all-sky or horizon. These are the chart's own two views, the same ones the time bar carries.
 - **Mag limit** — 4 by default, which keeps the list to what the eye can see.
 - **Sunlit only** — shows only the satellites outside the Earth's shadow, that is, the ones actually reflecting sunlight. Those are the only ones you can see.
 - Clicking a satellite gives its range, height, apparent magnitude, the age of its orbital elements and its coming visible passes.

- Above $\times 600$ the satellites are paused, because the computation cannot keep up.

10. Events

The **Events** tab lists eclipses, oppositions and conjunctions, the solstices and equinoxes, shower maxima, close approaches of the Moon and the planets, and occultations.

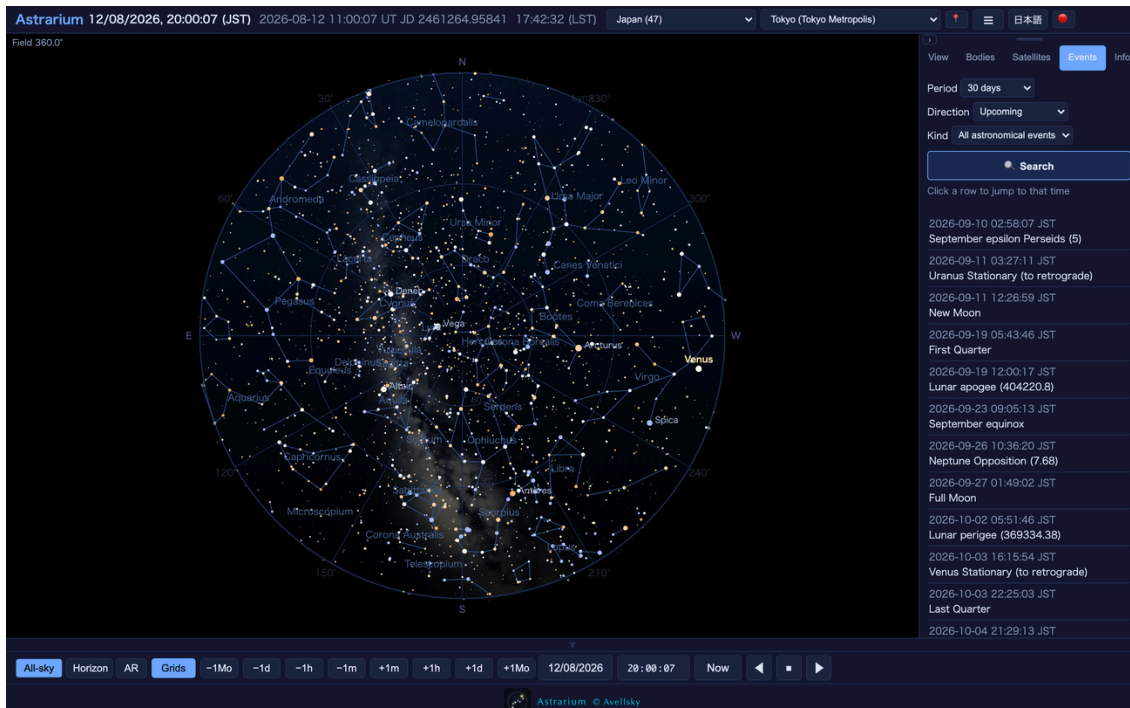


Figure 12. The Events tab

- **Period** — what is next, the next 7 days, 30, 90 or 180 days, 1, 5 or 10 years. “What is next” looks up to 90 days ahead and shows **the next event only**.
- **Direction** — upcoming, past, or both (fixed to upcoming for “what is next”).
- **Kind** — one at a time:
 - **All astronomical events** — eclipses, oppositions, conjunctions and stations, the solstices and equinoxes, the Moon’s phases, perigee and apogee, the meteor maxima.
 - **Occultations** — the Moon passing in front of a star, with immersion or emersion, dark or bright limb, and the star’s magnitude.
 - **Naked-eye satellites** — visible passes of the ISS and the CSS.
 - **Eclipses** — with local circumstances (magnitude and times for your site). The last three list only what can actually be observed from your site — above the horizon and in a dark enough sky. Where nothing

qualifies, the tab says how many fell in daylight or below the horizon.

“All astronomical events” is not filtered.

-  **Search** starts the scan. While it runs the button reads “ searching 12s — press to stop” and pressing it does stop; the list below is dimmed so that the previous answer is not mistaken for this one.
- Clicking a row and **the chart jumps to that moment**; the panel closes so the chart is in front of you.

11. The Info tab

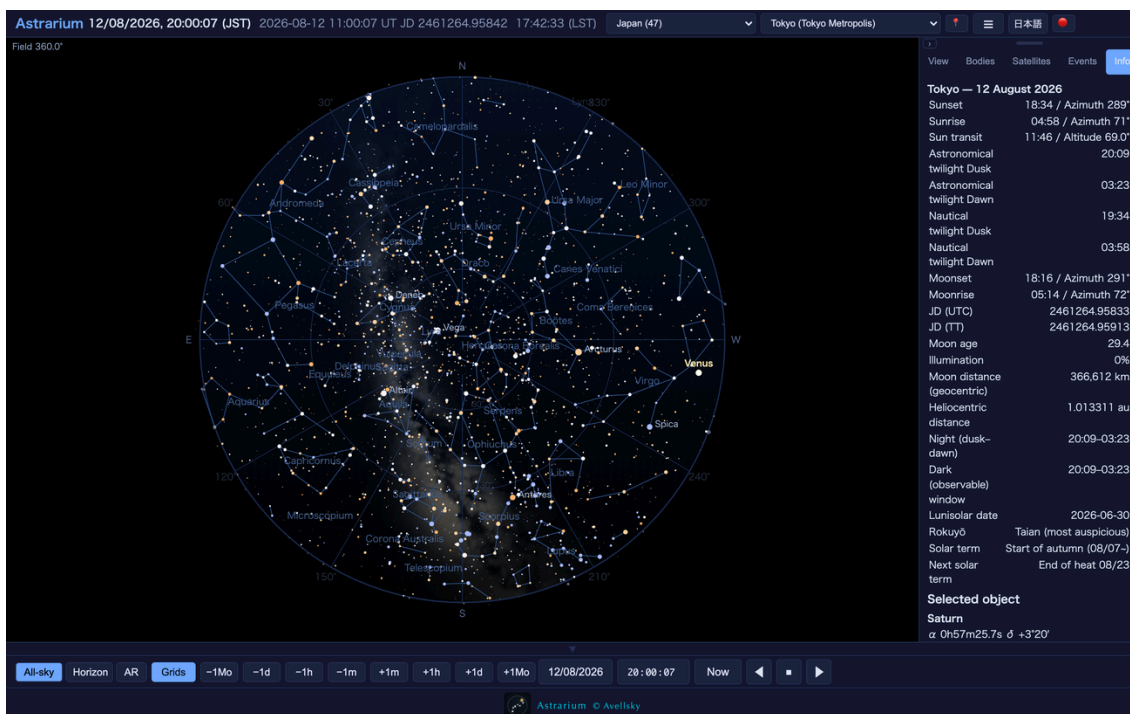


Figure 13. The Info tab, “Tonight’s sky”

- **The sky for the date and place you have chosen** — sunset and sunrise, the Sun’s transit, the beginning and end of astronomical and nautical twilight, moonrise, moonset and the Moon’s transit, its age, illuminated fraction and distance, the hours of true darkness, the Julian Date, and the Japanese lunisolar calendar with its rokuyō and solar term. The heading names them both — “Tokyo — 22 August 2026” — and moving the clock to another date changes the table with it.
- **Selected object** — whatever you last clicked on the chart, with its position and rise and set times.
- **Credits and sources** — every catalogue, ephemeris, photograph and piece of software the app uses, with its source, licence and the date it was checked.

12. The Voice tab

Spoken summaries. The speaking language is chosen separately from the interface language.

- **Speak tonight's highlights** — what is worth looking at tonight.
- **Speak selected object** — the position and rise/set times of the object you picked on the chart.
- **Rate and volume** — sliders.
- **Stop speaking** — interrupts it.

Useful at a dark site when you would rather not look at a screen, or when you cannot take your eye off the eyepiece. Note that the demo tour itself has no narration (section 6.3).

13. If something looks wrong

It cannot find my position

Open System Settings → Privacy & Security → Location Services and allow Astrarium. If you would rather not, type the coordinates into the Info tab instead. A Mac locates itself from the Wi-Fi networks around it and is not precise; for an observing site, typing the coordinates in is better anyway.

A credits link opened my browser

That is deliberate. Opening an outside page inside the app would replace the chart and leave no way back, so every external link is handed to the browser.

No satellites appear

Either the TLEs have never been downloaded or the playback speed is above $\times 600$. With “Sunlit only” on, satellites in the Earth’s shadow are not drawn.

TLEs will not download, or the address has been blocked

CelesTrak answers a caller that fetches the same group more often than every two hours with an error, and blocks the **IP address** if it continues. The block is against the connection, not against your device or Apple ID, so:

1. Stop fetching and leave it alone for a while. Astrarium does not touch the network within two hours of a fetch, so ordinary use will not get you blocked.
2. Switching networks (Wi-Fi to mobile data, or the other way) changes the address and often works. On shared Wi-Fi the cause may be someone else on the same connection.
3. If it does not clear, ask CelesTrak (celestrak.org) to lift it.

While blocked, **the elements you have already fetched still work**. They lose accuracy over a few days, but the chart and the pass predictions keep running without a connection.

No comets appear

Nothing is drawn when no comet is brighter than the limit you set. Fetching fresh elements needs the network.

The shower rate is blank

You are more than about a day from the maximum, or outside the activity period. It is also zero in daylight.

Too few or too many stars

Move the magnitude limit. As a rough guide: about 4 in a city, 5-something in the suburbs, 6.5 in dark mountains.

The event list takes a long time

Only the first five- or ten-year calculation does; the result is kept.

The window feels cramped

It goes down to 1000 × 700, but the chart reads best when it is close to square. On a wide display, allow for the side panel and give the window some width.

14. Glossary

Term	Meaning
Magnitude	Brightness; smaller is brighter, and one magnitude is a factor of about 2.5
Azimuth / altitude	Direction from your site (north 0°, east 90°) and the angle above the horizon
RA / Dec	Coordinates fixed on the celestial sphere — what catalogues use
Local Sidereal Time	The right ascension on the meridian now; where to point a telescope
Universal Time	The time at longitude 0°
Julian Date	Days counted from 4713 BC, so a moment is a single number
Lunar age	Days since new moon; 0 is new, about 14.8 is full
Illuminated fraction	How much of the Moon's disc is lit
Air mass	The thickness of the atmosphere, 1 at the zenith; larger low down, and the seeing is worse

Term	Meaning
ZHR	Meteors per hour with the radiant overhead under a magnitude-6.5 sky
Radiant	The point the meteors of a shower appear to come from
TLE	Satellite orbital elements; they go stale in days and need refreshing

15. Credits and contact

Every source is listed in the app under **Info** → **Credits and sources**. The principal ones are:

- Planetary ephemeris: JPL DE421
- Stars: Yale Bright Star Catalogue, Tycho-2
- Deep sky: the Messier and Caldwell catalogues; photographs from Wikimedia Commons (freely licensed ones only)
- Satellites: Celestrak (TLEs), SGP4/SDP4
- Comets and asteroids: Minor Planet Center, JPL Small-Body Database
- Earth orientation: IERS finals2000A

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