Reading the Sky

A Weather Guide for Astronomers

Seeing, transparency, cloud cover, dew, wind — and how to forecast them.

The chapter that ties it all back to **whatsuptonight.ca**

Why astronomy weather is its own thing

Regular weather forecasts answer the question "will it rain?" Astronomy forecasts have to answer something much more nuanced: **will the sky cooperate with what I'm trying to see tonight?** That's a different question, and the tools to answer it are different too.

A perfect cloudless night with 60% humidity and unstable upper-level winds is a frustrating night for planetary observers — the air is bouncing the planet around at every magnification. A partly cloudy night with clear gaps and dry stable air can be excellent for catching specific targets between cloud breaks. **Astronomy weather has four core variables** — cloud cover, seeing, transparency, and humidity — and learning to read all four is what separates the observer who frustrates themselves driving out for nothing from the one who consistently picks the right nights.

> **This chapter ties the book back to the website**
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> **whatsuptonight.ca** exists specifically to solve the 'five apps for a simple question' problem — putting all the weather and observing-condition data on a single page so you can decide in seconds whether tonight is worth setting up. **This chapter teaches you how to read what the website shows you**, plus the other forecasting tools that complement it. Both the book and the site exist for the same purpose: helping you not waste clear nights and not waste energy on cloudy ones.

The four core conditions

What you actually need to know about the sky tonight

A sample night, hour by hour

Below: how a typical evening's astronomy forecast might look as a colored grid. Green = great. Blue = good. Amber = fair. Red = poor. Dark = before astronomical twilight or after dawn.

This is the type of summary every good astronomy forecasting tool produces. Your job as an observer is to learn to read it quickly and decide.

The four conditions, ranked by importance

1. Cloud cover

The obvious one. No clear sky = nothing to see. Forecasts use percentages: 0% = totally clear, 100% = solid overcast. **For visual: under 30% is usually workable. For imaging: under 10% on the target's part of the sky.** Cloud type matters too (see Cloud Types section).

2. Seeing

How stable the atmosphere is. Determines the maximum useful magnification, the sharpness of planetary detail, and how round your stars look in long-exposure images. Measured on the Pickering scale (1=terrible, 10=perfect) or as 'arc-seconds.' **Critical for planetary observing and high-resolution imaging.**

3. Transparency

How clear (vs hazy) the air is. Affects how faint a target you can see — high transparency means deep contrast and faint star reach; low transparency washes out everything. Often measured as **limiting magnitude**. Critical for deep-sky observing and faint object photography.

4. Humidity / dew point

Determines whether your equipment will fog up during the session. Doesn't directly affect what you can see, but ends sessions when it goes wrong. **If air temperature drops to within 3–5°C of dew point, expect heavy dew on optics within 60–90 minutes.**

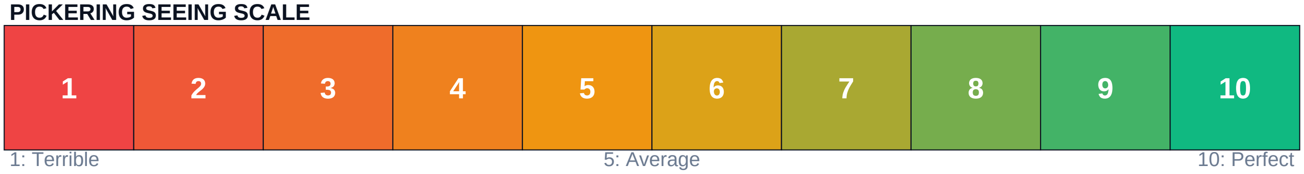
Seeing — atmospheric stability

Why your stars twinkle, and what to do about it

Seeing is atmospheric turbulence — pockets of air at different temperatures and densities passing in front of your view. **Twinkling stars are bad seeing**; stars that look like steady pinpoints are good seeing. The eye and the brain average over the twinkle, so it's not always obvious, but the camera always captures it as star bloat and detail loss.

The Pickering scale

PICKERING SEEING SCALE



1–2 (terrible)	Stars boil and shimmer constantly. Higher magnifications useless. Planetary detail invisible. Good only for low-power deep-sky observing or just looking at constellations.
3–4 (poor)	Strong constant motion. Saturn's rings sometimes blur. Useful magnification capped around 100×.
5–6 (average)	Most nights. Bursts of decent moments separated by waves of distortion. Useful magnification 150-200×. Most amateur observing happens here.
7–8 (good)	Mostly steady with occasional shimmer. Planetary detail visible. Useful magnification 250-300×. Worth bringing out the high-power eyepieces.
9–10 (excellent)	Rare. Image looks etched. Useful magnification up to 500× or more. Planetary observers' dream nights. Most amateur sites get 3–10 nights a year at this level.

Where seeing comes from

Jet stream	**The biggest contributor to bad seeing.** When the jet stream is directly overhead, upper-atmosphere turbulence wrecks image quality regardless of how clear the ground-level air is. Jet stream forecasts (jetstream.eu, Meteoblue) are essential for planetary observers.
Ground-level heat	Pavement and roofs radiate heat into the night for hours after sunset. Observing from over asphalt or near a heated building gives worse seeing than observing over grass. Wait at least an hour after sunset for surfaces to cool.
Local thermals	Lakes, rivers, and forest canopies have different cooling rates than surrounding land. The boundary between them is turbulent. Avoid downwind of significant water bodies.

Tube currents (telescope-internal)	A warm telescope tube in cold air creates air currents inside the optical path. Closed-tube designs (SCT, Mak) are worst. **Cool down for 30-60 minutes** before expecting maximum performance.
Time of night	Seeing often improves through the night as everything reaches thermal equilibrium. The best seeing of the night is usually 2-5 AM, not at sunset.

Transparency — how clear the air is

Why some clear nights are deeper than others

Two clear nights can look identical to the naked eye and yet reveal completely different deep-sky views. The difference is **transparency** — how much atmospheric haze, humidity, dust, and pollution sits between you and space. Bad transparency dims faint objects without obscuring bright ones, so the sky looks fine but your galaxies are gone.

What affects transparency

Humidity	Water vapor scatters light. Even 'invisible' water vapor reduces transparency by half a magnitude or more. Dry air = better transparency. Best transparency nights are typically cold, dry, post-cold-front nights.
Particulates	Smoke, dust, pollen, wildfire haze. Recent forest fires (becoming more frequent) can reduce transparency dramatically for weeks. Saharan dust events affect Eastern North America in summer.
Cirrus clouds	Thin high clouds reduce transparency without being obviously visible. The sky looks clear, but faint objects disappear. Look at bright stars near the horizon — if they appear softened or have a slight halo, cirrus is present.
Light pollution	Light pollution interacts with high humidity and clouds. The same Bortle-5 site is darker on a dry winter night than a humid summer night because the moisture amplifies city glow.
Atmospheric depth	Looking near the horizon goes through more atmosphere than looking overhead — about 30× more at 5° altitude. **Always observe near the zenith** when transparency matters. A target at 30° altitude is significantly fainter than the same target overhead.

How to estimate transparency

Naked-eye limiting magnitude	Count the visible stars in the Little Dipper or another known asterism. If you can see the 5th-magnitude stars, you have decent transparency. The faintest naked-eye star you can detect tells you the limit. Apps like 'Loss of the Night' help.
Cloud-edge clarity	Look at the edges of any clouds at sunset/twilight. Sharp, well-defined edges = good transparency. Soft, fuzzy edges = atmospheric haze.
Distant lights	If distant city lights look clear and crisp at 20+ km away, transparency is good. If they look hazy, humidity is reducing transparency too.
Color of the Moon	A white-white Moon means good transparency. A yellow or orange Moon (especially when high) indicates significant atmospheric haze or dust.

Cloud types and what they mean

Not all clouds end an observing session

Knowing which clouds you can observe through (or work around) and which guarantee you're going home is one of the more useful skills an experienced observer develops.

Cirrus (high, thin)	**The sneaky enemy.** Wispy clouds 6+ km up. Look like 'mare's tails' or thin streaks. Often invisible at night against a dark sky. Reduce transparency by 1-2 magnitudes without blocking anything obvious. **Forecasts often say 'clear' when cirrus is present.** Check satellite imagery.
Cirrostratus (high, sheet)	Thin uniform veil covering the whole sky. Produces a faint halo around the Moon if it's up. Reduces transparency significantly but rarely ends a session — you can still see brighter targets. Photometric/scientific observers reject these nights; visual observers can work with them.
Altocumulus / altostratus (mid-level)	2-6 km up. Patchy or sheet-like. Usually opaque enough that whatever's behind them is gone. If they're moving fast, you can work in gaps. If they're stationary, the night is probably done.
Cumulus (low, puffy)	Daytime clouds. Usually dissipate within an hour or two after sunset as the ground cools. If you arrive at dusk to a sky full of cumulus, give it 60-90 minutes before deciding to leave.
Stratus / fog (low, dense)	Sets in at night, especially in valleys and near water bodies. Nothing visible. **Move to higher ground** if possible — fog often clears 100-200m up and a hilltop can stay clear all night while the valley is socked in.
Marine layer	Coastal phenomenon. Low fog that pushes inland with sea breeze and retreats overnight. If you're observing within 50 km of an ocean, learn your marine-layer forecasts (the National Weather Service in the US, Environment Canada in Canada, publish these as 'marine layer'/'sea fog').
Smoke / haze (variable altitude)	Forest fire smoke can sit anywhere from 1 to 12 km altitude. Lower-altitude smoke is obvious (smell, taste). Higher-altitude smoke is invisible and just kills transparency. Check fire/smoke maps before driving to a 'clear' site.

Reading cloud forecasts skeptically

Most weather forecasts report 'cloud cover %' as an average. **50% cloud cover could mean** half the sky perfectly clear and half overcast (workable — set up under the clear half), **or** thin uniform clouds across the whole sky at 50% opacity (might be unworkable). The percentage alone doesn't tell you. **Satellite imagery is the gold standard** — Environment Canada, GOES, or your country's equivalent. Look at the actual cloud pattern, not just the forecast number.

Dew, humidity, and equipment

The session-ender most beginners don't see coming

On a clear night, exposed optics radiate heat into space and cool below the surrounding air temperature. Water vapor then condenses on them — that's dew. **Dew on a lens or corrector plate ends your night.** The session might be perfect otherwise; if your scope is fogged, it's done.

The dew point rule

> **Dew forms when surface temperature ≤ dew point temperature**

Weather forecasts include dew point as a separate number from temperature. When the air temperature drops to within 3-5°C of the dew point, expect dew on exposed optics within 60-90 minutes. **If the temperature reaches the dew point**, dew is forming everywhere right now.
Example: forecast shows 12°C temperature and 9°C dew point at 8 PM. Air temperature drops to 8°C by midnight. **You'll have dew by 11 PM.**

Protection strategies

Dew heater band	**The standard solution.** Resistive heating element that wraps around the front of the scope tube. Heats the corrector plate or lens objective by 2-3°C above ambient — just enough to prevent condensation. Powered by 12V or USB battery. $20-60. Astrozap, Kendrick, Lacerta brands. **Essential equipment for any imaging session.**
Dew shield	Long extension on the front of the scope that reduces radiative cooling of the optics. Effective for refractors, less so for SCTs and Maks. Cheap (often made from foam or plastic). Combine with dew heater for best results.
Pointing strategy	Stop observing when the dew point is reached if you don't have heating. Pack up before the equipment is soaked. **A wet scope brought into a warm car will fog the inside of the optics too** — much worse than just external dew.
Indoor warm-up	If equipment is dewed, point the scope at a clear sky for 15-30 minutes to let the corrector or lens re-equilibrate. Don't wipe it — wiping spreads the moisture and can scratch coatings. Patience or a hairdryer (held far back, brief blasts) works.

> **The hidden cost of humidity**
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> Beyond dew, high humidity affects observing in less obvious ways. Sound travels better in humid air, so distant noise is more distracting. Your skin radiates heat slower in humid air, making it harder to stay warm. Star color appears slightly altered because moisture preferentially scatters blue light. **Cold, dry winter nights are universally preferred by serious observers** for these reasons — even when they're physically less pleasant to be outside in.

Forecasting tools

Where to actually look for astronomy weather

Regular weather sites (Environment Canada, Weather.com, AccuWeather) tell you about precipitation and temperature. Astronomy-specific tools tell you about seeing, transparency, and the cloud cover at the specific altitudes that matter for observing. Use both.

Tier 1 — start here

whatsuptonight.ca	**The companion to this book.** Built specifically to consolidate all the astronomy-weather information you need on a single page. Live cloud cover, moon phase, ISS passes, aurora forecast, planet visibility, dew point, jet stream — all together. No app-hopping required.
Clear Sky Chart (Attila Danko)	**cleardarksky.com** — long-running North American service that produces the iconic colored grid forecast for thousands of specific observing locations. Free. Shows cloud, transparency, seeing, dew point, wind, smoke, ECMWF data, all at hourly resolution for 48 hours. **The reference standard for North American amateur astronomers.**
Meteoblue Astronomy	**meteoblue.com/en/weather/outdoorsports/seeing**. Global coverage with more detail than Clear Sky Chart. Separate seeing forecasts at multiple altitudes, jet-stream data, dew point progression. Free with optional paid tier.
Astrospheric	**astrospheric.com**. North American focus, similar concept to Clear Sky Chart with more modern interface. Tracks satellite passes, ISS transits, and weather together. Available as mobile app.

Tier 2 — for specific cases

Clear Outside (UK)	**clearoutside.com**. UK and European focus. Similar grid format to Clear Sky Chart. Run by First Light Optics.
Jet stream forecasts	**netweather.tv/charts/jetstream-forecast** or **earth.nullschool.net**. Visualizes upper-atmosphere winds. Bad jet stream overhead = bad seeing even when sky is clear.
Satellite imagery (Environment Canada / NOAA / GOES)	Current satellite views of cloud cover. Better than forecast percentages because you see the actual cloud distribution. For predicting which way cloud bands are moving.
Aviation TAFs (Terminal Area Forecasts)	**aviationweather.gov**. Pilot weather forecasts often include cloud-base altitude (in 100-foot intervals) and visibility — more precise than general weather forecasts. Read the encoded format with a TAF reference card or use a decoder tool.

AAVSO observer reports	**aavso.org**. Variable star observers report current conditions at their locations. Real-time peer reports of what conditions actually look like, not just what was forecast.

How forecasts actually work

Most astronomy forecasts are **derived from NWS (National Weather Service) or ECMWF (European) numerical weather models** — the same data driving the regular weather forecast you see on TV. The astronomy sites add interpretation: 'this much cloud at this altitude = this much obstruction', 'this jet stream speed = this seeing rating', etc. **The underlying forecast accuracy is the same as the regular weather forecast** — typically reliable to ~24 hours, less reliable 48-72 hours out, and unreliable beyond that. Plan loosely a week out, commit firmly 24 hours out, adjust based on satellite imagery the day-of.

Reading a Clear Sky Chart

Decoding the colored grid that defines a generation of astronomy weather forecasting

The Clear Sky Chart (CSC) format has been the gold-standard astronomy forecast in North America since Attila Danko launched the service in 2001. The colored grid is instantly recognizable. Here's how to read it:

The rows

Cloud cover	Row 1. White/light blue = clear, blue gradient = partially cloudy, dark blue/black = overcast. Time runs left to right. **Read it like a movie of the next 48 hours.**
Transparency	Row 2. Blue = excellent, gray = mediocre, brown/khaki = haze/poor. CSC's transparency is derived from humidity and lower-atmosphere model data.
Seeing	Row 3. Same blue-to-gray-to-brown scale. Derived from jet stream and upper-atmosphere stability.
Darkness	Row 4. Shows what part of each 24h period is astronomical darkness vs twilight vs daylight. Critical for understanding when your observing window actually opens.
Smoke	Row 5 (added in 2020+). Now essential in many regions. Brown/yellow = smoke is in the air. CSC integrates fire monitoring data.
Wind	Row 6. Green = calm, yellow = breezy, red = windy. High wind shakes telescopes and dries equipment but also blows away clouds — mixed blessing.
Humidity / temperature	Rows 7-8. Numbers across the bottom showing forecast humidity percentages and temperatures. Use to estimate dew point.

Reading strategy

Don't just look at cloud row	A row of white in the cloud row means clear, but if seeing is brown and transparency is brown, you'll have clear-but-bad observing. Look at all the rows together.
Find the column with the best alignment	The best time to observe is the column where cloud, transparency, and seeing are all blue/clear simultaneously. Often there are 1-3 such columns in a 48-hour window.
Pay attention to smoke and wind	These can turn an otherwise 'clear' night unworkable. If the cloud row is clear but wind is red, you have a clear-but-shaky night. If smoke is brown, transparency will be ruined regardless of what the transparency row says.
Note dewpoint vs temperature	Subtract dew point from temperature. If the gap is less than 5°C, expect dew issues. CSC shows this as numerical rows at the bottom.

Seasonal patterns

Why each season has its own astronomy character

Winter (Dec–Feb in N. Hemisphere)

Transparency	**Best of the year.** Cold dry air, minimal humidity, no haze. Limiting magnitudes 0.5-1.0 deeper than summer at the same site.
Seeing	**Worst of the year on average.** Jet stream is at its strongest, polar air masses bringing turbulence. Most planetary observing in winter happens between fronts, not during them.
Cloud cover	Variable — depends heavily on regional weather patterns. Many North American sites have clear-but-cold periods between storms.
Practical	Best for deep-sky visual (clear faint sky) and wide-field imaging. Worst for high-resolution planetary.

Spring (Mar–May)

Transparency	Improving as winter fronts subside. Galaxy season — Virgo/Coma Cluster well-placed, transparency matters for faint galaxies.
Seeing	Often improves through spring as jet stream weakens. Late spring nights can be quite steady.
Cloud cover	Variable — convective afternoon clouds clear at dusk, then the night is often workable.
Practical	**Often the best balance** of conditions. Aurora season at equinox. Galaxy hunting prime time.

Summer (Jun–Aug)

Transparency	**Worst of the year.** Humid air, hazy skies, wildfire smoke increasingly common. Limiting magnitudes shallowest of the year.
Seeing	**Best of the year** in many locations. Slow jet stream, warm stable air. Best planetary nights happen here when transparency is decent.
Cloud cover	Daytime convective storms common, often clearing by 10-11 PM. Marine layers in coastal regions.
Practical	Best for planetary, lunar, and double stars (transparency doesn't matter). Worst for faint galaxies and deep nebulae. Milky Way core is up — great for nightscape.

Fall (Sep–Nov)

Transparency	Improving rapidly as humidity drops and wildfire season ends. Late fall transparency rivals winter.
Seeing	Often very good through October. Jet stream returning by November.
Cloud cover	Variable — sometimes the most stable observing weather of the year is late September-October.
Practical	**Often the best overall season** in many regions. Andromeda Galaxy, Pegasus, and Cassiopeia well-placed. Late-fall transparency for deep-sky.

The decision framework

Should I go out tonight?

Putting it all together. Use this framework to make the actual call — should you set up, drive to a dark site, or stay in and watch the forecast for tomorrow?

Quick decision matrix

Cloud cover >50% predicted, no clear gaps	**Stay in.** No amount of patience saves a heavily-overcast night.
Clear forecast + great transparency + great seeing	**Go everywhere.** Drive to your darkest site if you have time. Long imaging session. Highest-magnification planetary work. These nights are rare — don't waste them.
Clear forecast + great transparency + poor seeing	**Stay local; deep-sky.** Galaxies, faint nebulae, wide-field imaging. Skip planetary work tonight (bad seeing kills it).
Clear forecast + poor transparency + good seeing	**Stay local; planetary.** Moon, Jupiter, Saturn, double stars, lunar. Skip deep-sky tonight (poor transparency kills it).
Partly cloudy with breaks	**Depends on equipment portability.** Tripod-and-camera setup (10 min): worth setting up to catch breaks. Full imaging rig (60 min setup): probably not worth it.
High humidity, dew point within 3°C of temperature	**Only with dew protection.** If you have a heater band, go. If not, expect a short session.
High wind (>30 km/h)	**Stay in (imaging).** Long-exposure imaging is impossible. Visual observing of bright targets through a heavy mount only.
Bright Moon (gibbous through full)	**Lunar/planetary night.** Skip deep-sky entirely. Moon and planets are unaffected by lunar interference (the Moon doesn't compete with itself, after all).
New Moon ± 5 days + good transparency	**Plan the year around these.** ~12 windows per year. The serious imaging happens in these windows. Travel to dark sites if at all possible.

The 'don't second-guess clear nights' rule

Experienced observers learn that clear nights happen on schedules that don't align with your energy levels, your work schedule, or how comfortable bed feels at 9 PM. **The single biggest predictor of how much astronomy you actually do is how often you say 'yes, tonight' when it's clear.** Cloudy weeks teach you not to waste clear nights. Build the habit: if it's clear and you're not exhausted, go out, even briefly. Even 30 minutes with binoculars is more than the 0 minutes you'll get the next four cloudy nights.

Pulling it together with the website

The whole point of **whatsuptonight.ca** is to put cloud cover, seeing, transparency, dew point, wind, moon phase, satellite passes, planet visibility, and tonight's best targets on one screen. Use this chapter to learn what each of those numbers actually means; use the site to read them quickly any clear evening you're considering setting up.

Both exist for the same purpose: to help you stop wasting the clear nights, and stop chasing nights that aren't worth it.

Know before you set up.