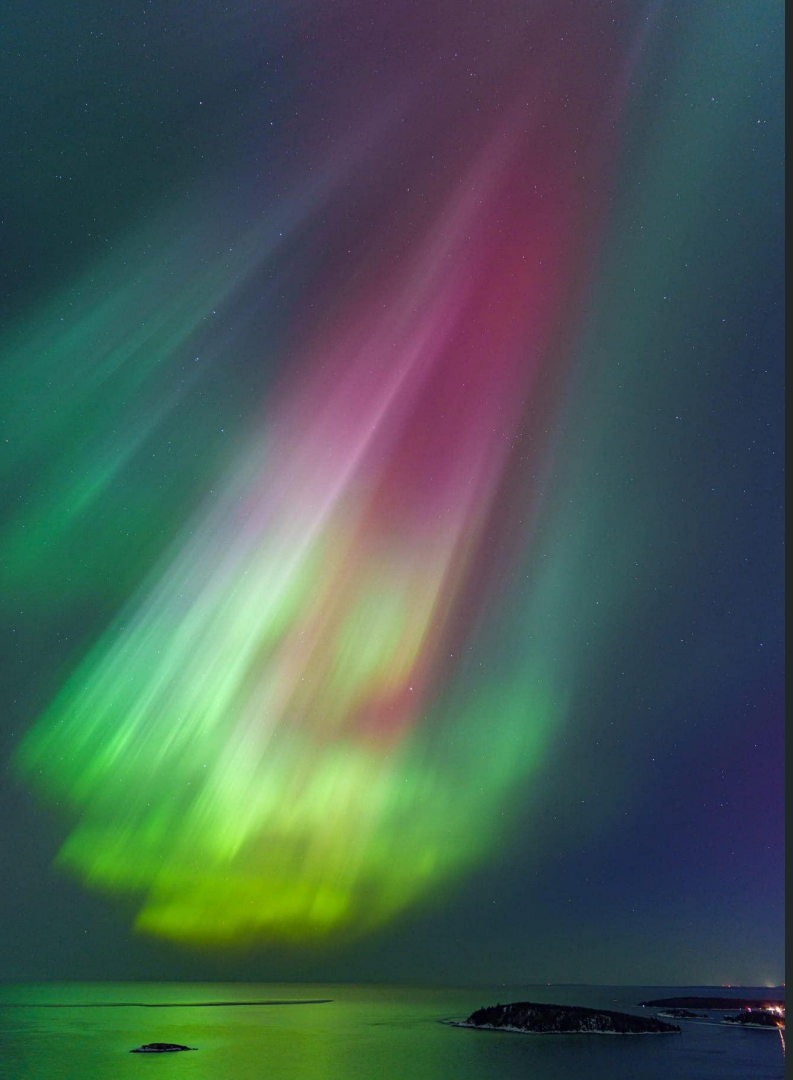


Chasing the Aurora Beyond the 45th Parallel

Melissa F. Kaelin | KaelinArt.com
Founder of the Michigan Aurora Chasers

Photo by Shannon Kivi

About the Author

- Chasing the Aurora for over 13 years
- Wrote “Beyond the 45th Parallel: The Beginner’s Guide to Chasing Aurora in the Mid-latitudes,” 2nd Edition
- Aurora Columnist, Amateur Astronomy Magazine, 2025
- Tour Guide for U-M Alumni Association, 2024-2025
- Founder of Michigan Aurora Chasers, est. January 2021
- NASA Social Media Ambassador, Solar Orbiter, 2020
- Writer at heart, lover of nature
- Currently reside in Ann Arbor, Michigan
- B.A. in Journalism, Miami University, Ohio
- Co-Founder of annual Aurora Summit: Celebrating the Art, Culture, Science and Photography of the Aurora, 2017

Melissa F. Kaelin
KaelinArt.com

THE NIGHT AURORA CHASED ME

Driving home from the Inaugural Upper Peninsula Dark Sky Festival along Lake Superior's Shore in Michigan's Upper Peninsula, April 23-24, 2023.

Photo by Jessica Ellis Rorman

Human to @ElioTheSunDog
Elio, Derived from Helios

Michigan’s New International Dark Sky Sanctuary

One of only 23 Dark Sky Sanctuaries in the world: Beaver Island, Michigan, Photo by Justin Miller.

Notice Aurora on the left, the Milky Way in the center, and Light Pollution on the right.

“Northern Dawn”

Sept. 17, 2024 | About 6am | Photo by Christina Cantu Sharp | Mackinaw City, MI

Corona

Photos by Nate Stovall, October 10-11, 2024

Flat Rock, Grindstone City, Michigan

F.A.E.

Photos by Christina Cantu Sharp, October 10, 2024

“SAR,” the Stable Aurora Red Arc

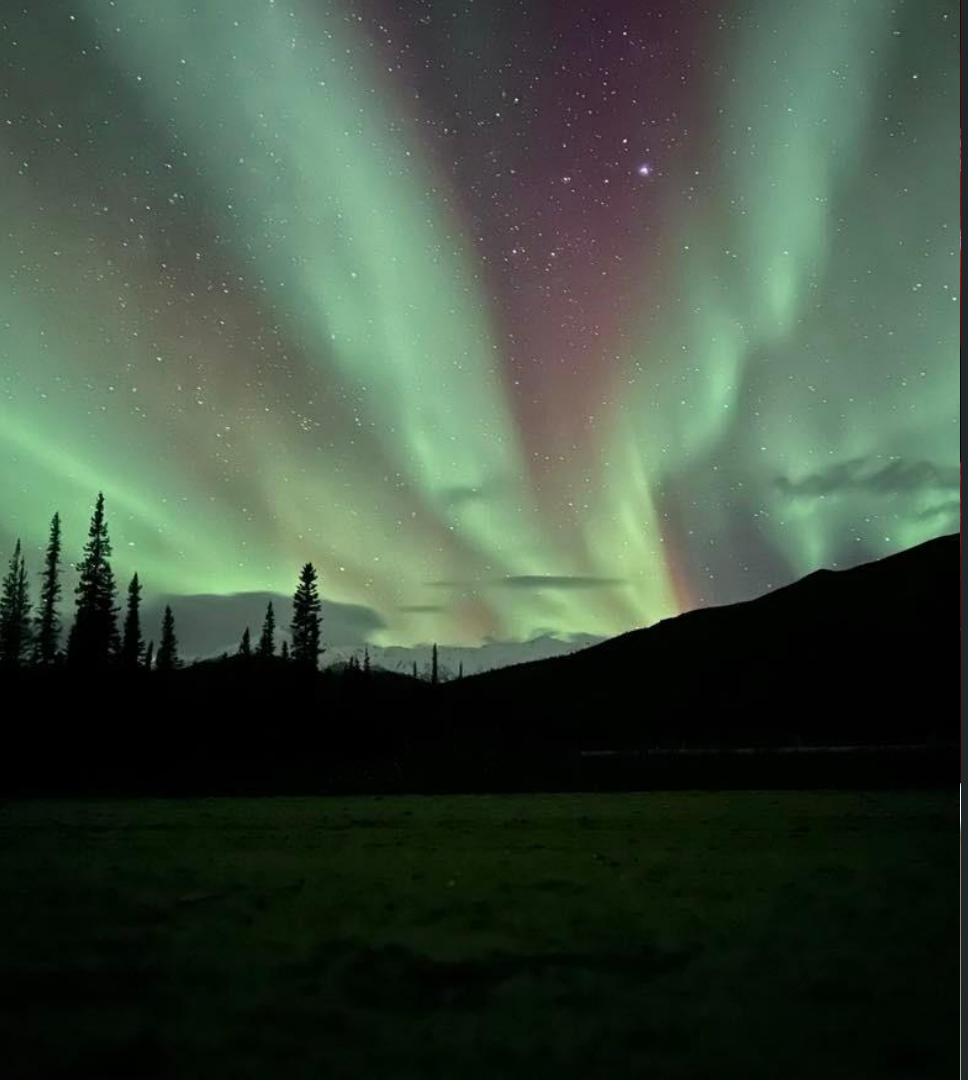
Photo by Patrick Grubba, 2024

STEVE with the “Picket Fence”

Photo by Cherie Wagensomer, Munising, MI

Photo by Kim Masters Acker, Onekama, MI

How to Catch the Northern Lights



Things to Consider

- Scout Out a Location
- Light Pollution or Dark Sky Maps
- Cloud Cover & Weather
- Sunset, Twilight & Moonrise
- Reliability of the Forecasts
- Patterns of the Northern Lights
- Safety, Sleep & Sanity

Number #1 Tip: Plan something exciting in case you get aced!

What it takes to see Aurora

Many factors have to align to create the Northern Lights, on Earth and in Outer Space!

The Right Conditions in Space

- Solar activity
- Direction of the solar wind
- Solar wind composition: Speed, Density, Bt, Bz
- A favorable Bz: This is essentially the gatekeeper
- Conditions can change instantly

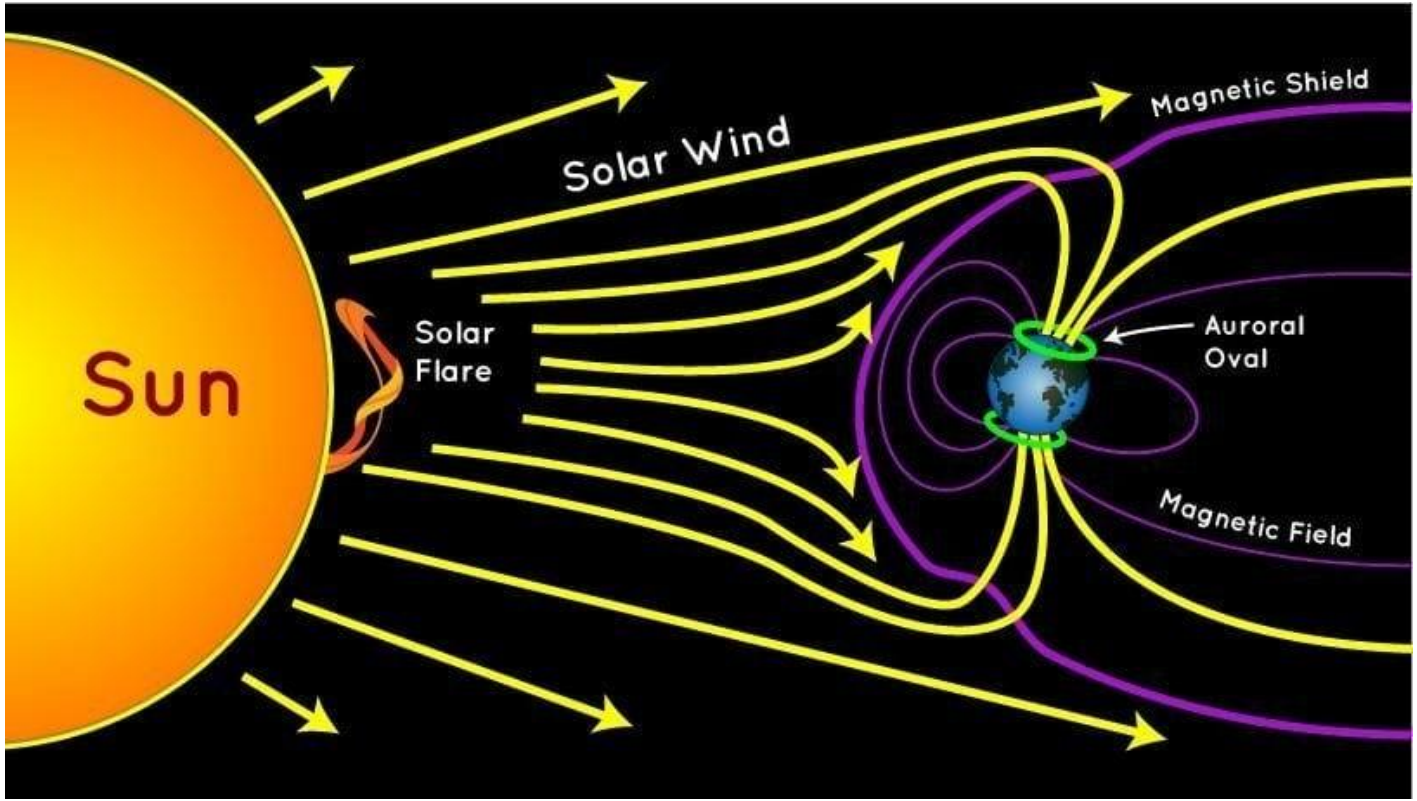
The Right Conditions on Earth

- Starry nights
- Dark skies
- Moon phase & obstacles
- Northern location
- Eyesight visibility

Understanding What Causes Aurora: The Solar Wind

Solar Activity

- Solar Plasma
- Eruptions
- CMEs
- Coronal Holes
- Filaments
- Glancing Blow
- Co-rotating Interactive Regions
- Ever Present Solar Wind



Source: Space Weather Prediction Center

Particles Collide with Air Molecules to Emit Light

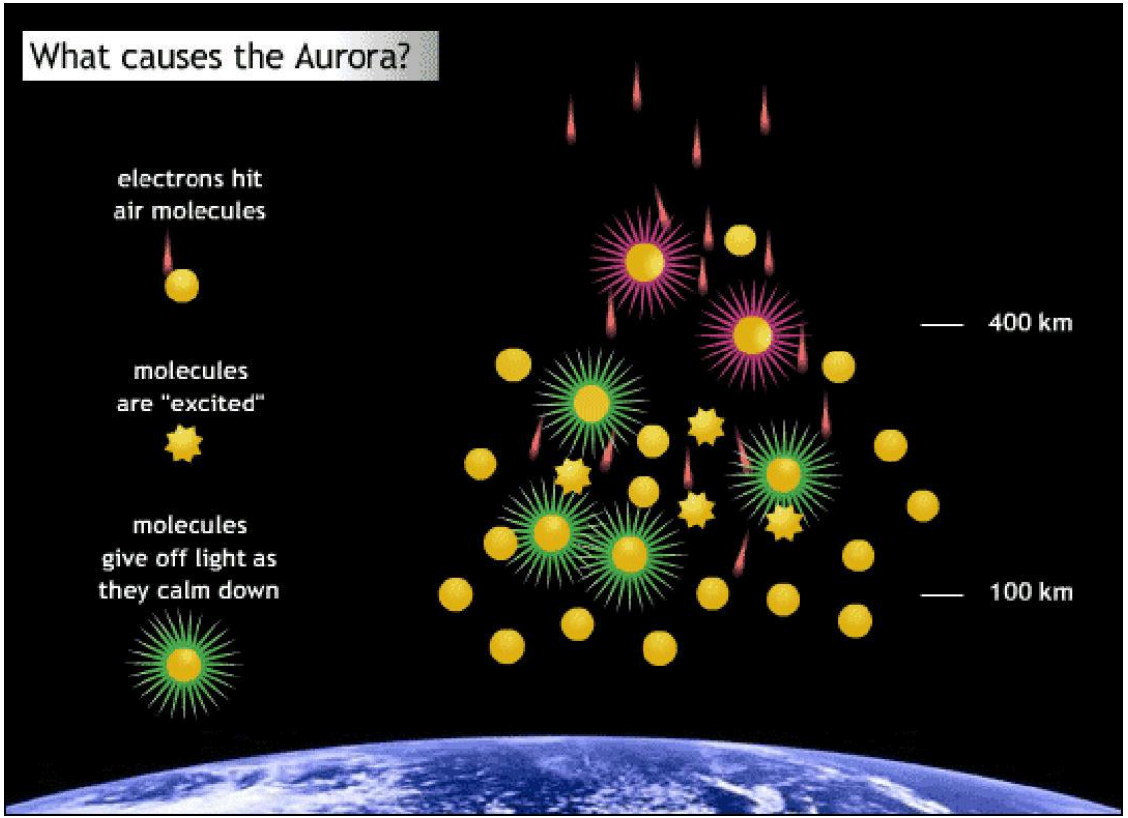
Colors are created when excited particles entering Earth's atmosphere interact with molecules like oxygen, hydrogen and nitrogen to emit light.

Oxygen - High Altitude: Red

Hydrogen, Helium: Purple, Pink

Oxygen - Low Altitude: Green

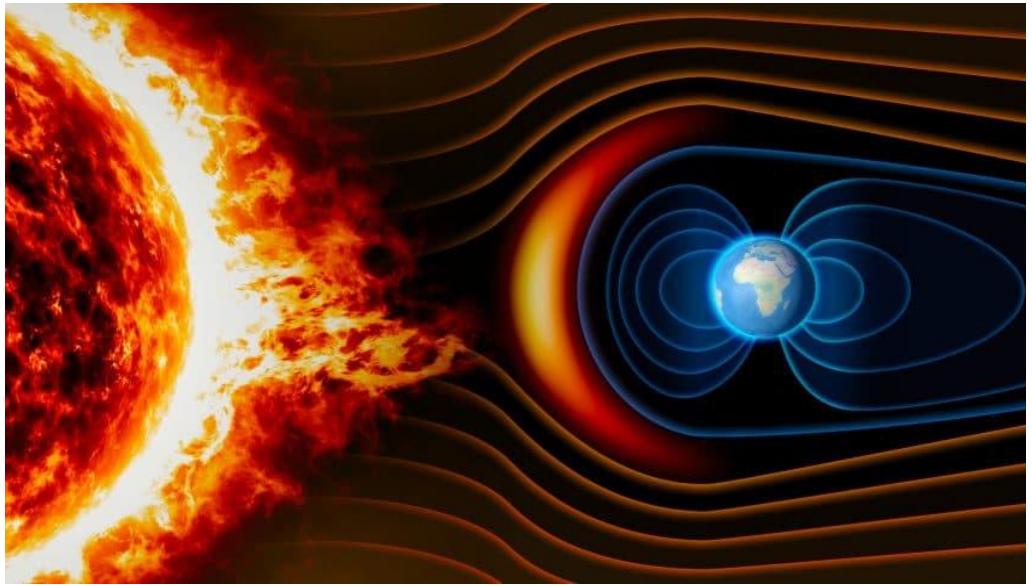
Nitrogen: Blue



The Solar Wind’s Journey to Earth’s Magnetic Field

Weather Traveling in Space

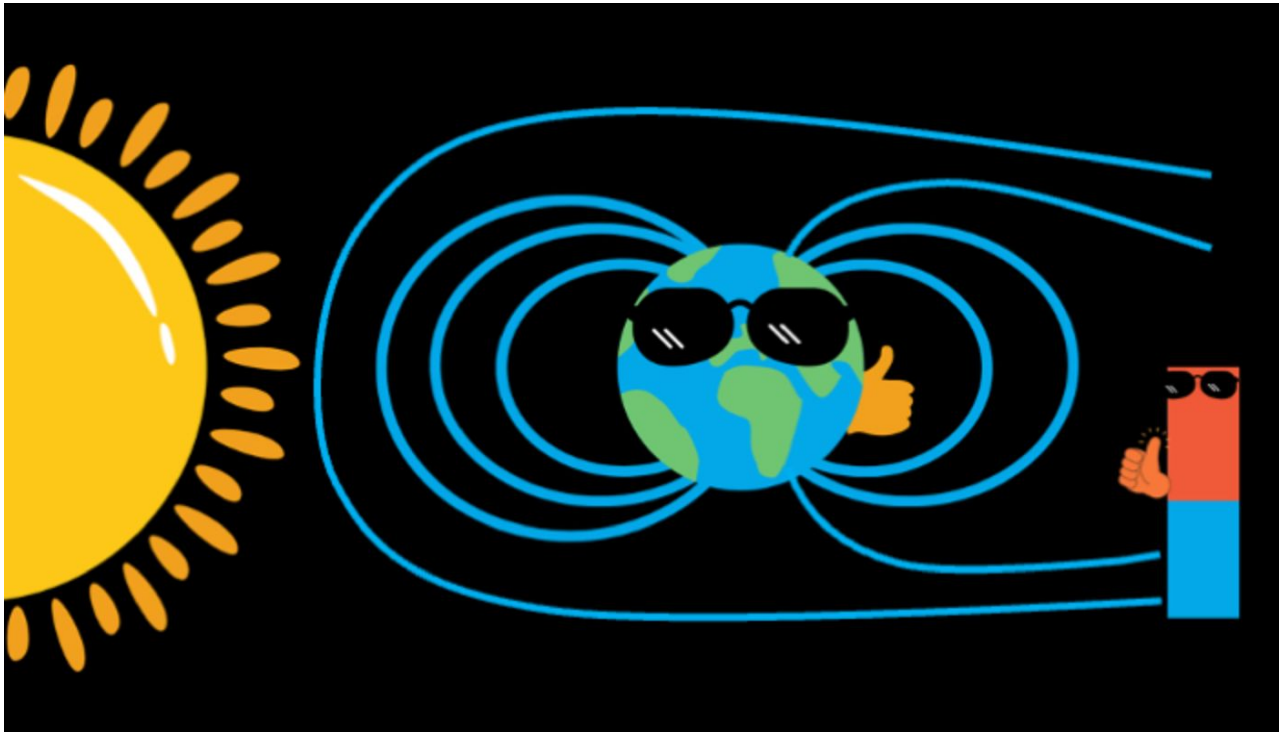
- Monitor the Sun
  — Parker Solar Probe
  — Solar Orbiter
- Monitor the Earth
  — Solar Dynamics Observatory SDO
  — Advanced Composition Explorer ACE
  — Solar and Heliospheric Observatory SOHO
- Many types of data
- Magnetic Field Impacts
- The dreaded dud



Source: Earth.com

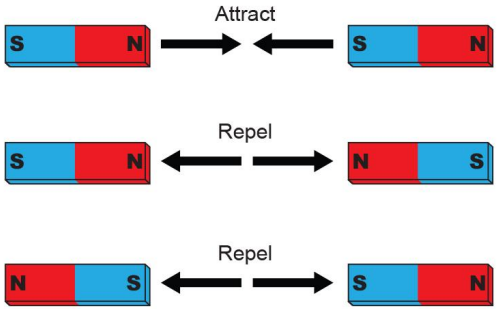
Did you know the Bz naturally protects us?

What is the “Bz”? Meet the “Gatekeeper”



- Southward Bz
- More Negative
- Oscillate back and forth
- Like an open door

#ThatPeskyBz

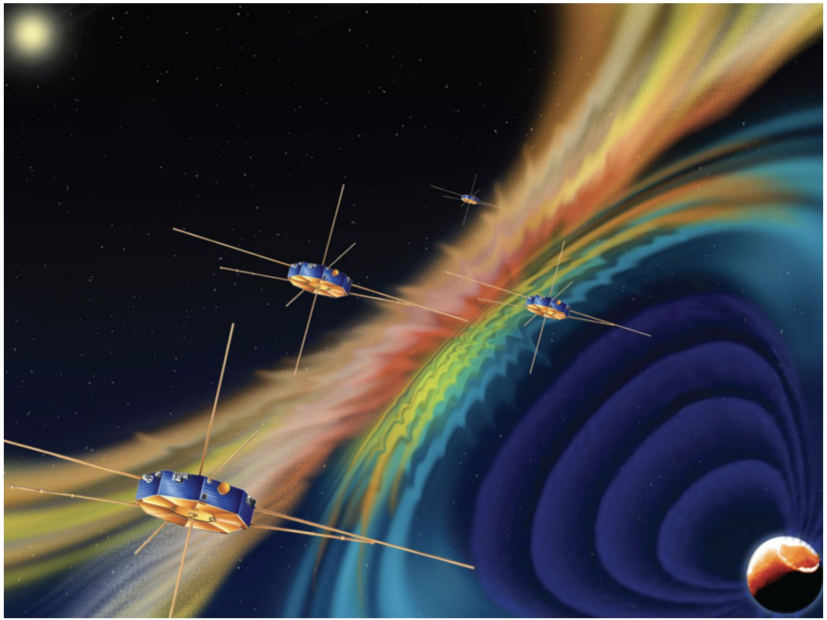


Award-winning image courtesy of EGU Blog

Visualization of the Bz component
— The polarization of the Interplanetary Magnetic Field

Are there peak times?
- Hours
- Season
- Solar Cycle

Creating a flow of energy



Reconnecting magnetic field lines, which accelerate energetic electrons, are illustrated here along with the spacecraft of NASA's Magnetospheric Multiscale mission. Credit: Southwest Research Institute, CC BY 2.0

Many Methods for Predicting Aurora

Beginner	Apps, Kp Alerts, Webcams
Beginner	K-Index, Predictions, Ovation Model, HPI
Intermediate	Space Weather Live, Real Time Solar Wind
Intermediate	Coronographs, SolarHam, Ap-Index
Advanced	WSA-Enlil, CME Scoreboard, Magnetometer Plots
Advanced	Analyzing CMEs, Understanding Flux Ropes

Quick Forecasting Tools

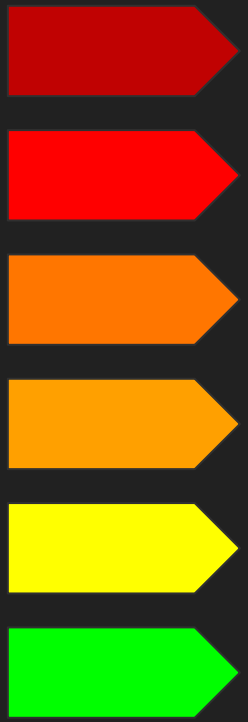
Beginner	Webcams
	Telegram Alerts (Both Michigan & Glendale)
Intermediate	“Glendale App” (Aurora Alerts UK)
	Solar Wind Parameters
	SpaceWeatherLive.com
	SWPC Warnings & Watches

How to Monitor Activity & Solar Wind

Solar Activity
Location on the Sun
Type/Class/CME
Earth-Directed
Polar Orientation

Real-Time Solar Wind
Speed: 500 km/s
Density: 10 p/cm3
Bt: 10 nT
Bz: - 10 nT (Southward)
“The Gatekeeper”

K-Index & Geomagnetic Storm Scales



Kp 9 • G5 Storm	Extreme Geomagnetic Storm
Kp 8 • G4 Storm	Severe Geomagnetic Storm
Kp 7 • G3 Storm	Strong Geomagnetic Storm
Kp 6 • G2 Storm	Moderate Geomagnetic Storm
Kp 5 • G1 Storm	Minor Geomagnetic Storm
Kp 4 or Less	Below Storm Levels

Geomagnetic Storm Impact Scale

G1
Minor
Weak power grid fluctuations and minor impacts on satellites are possible.

Migratory animals are affected at this and higher levels.

Aurora is commonly visible at high latitudes.

G2
Moderate
Transformer damage is possible with long duration storms.

Corrective actions to spacecraft orientation may be required; may affect orbit predictions.

Aurora may be seen as low as New York and Idaho.

G3
Strong
Power system voltage corrections may be required.

Satellite and LF radio navigation problems may occur. HF radio may be interrupted.

Aurora may be seen as low as Illinois & Oregon.

G4
Severe
Possible widespread voltage control problems on the power grid.

HF radio sporadic, satellite navigation degraded for hours, LF radio navigation issues.

Aurora may be seen as low as Alabama and northern California.

G5
Extreme
Blackouts or complete collapse of power grids possible.

Navigation systems may be out for hours or days.

Aurora may be seen as low as Florida and southern Texas.

spaceweather.gov

The Limitations of the K-Index: Be Weary of Kp

The K-Index actually describes the strength of geomagnetic activity associated with Aurora. When referred to as a “planetary average,” this is called Kp. Kp is not a perfect tool.

Aurora Chasing

The Pros and Cons of Relying on Kp

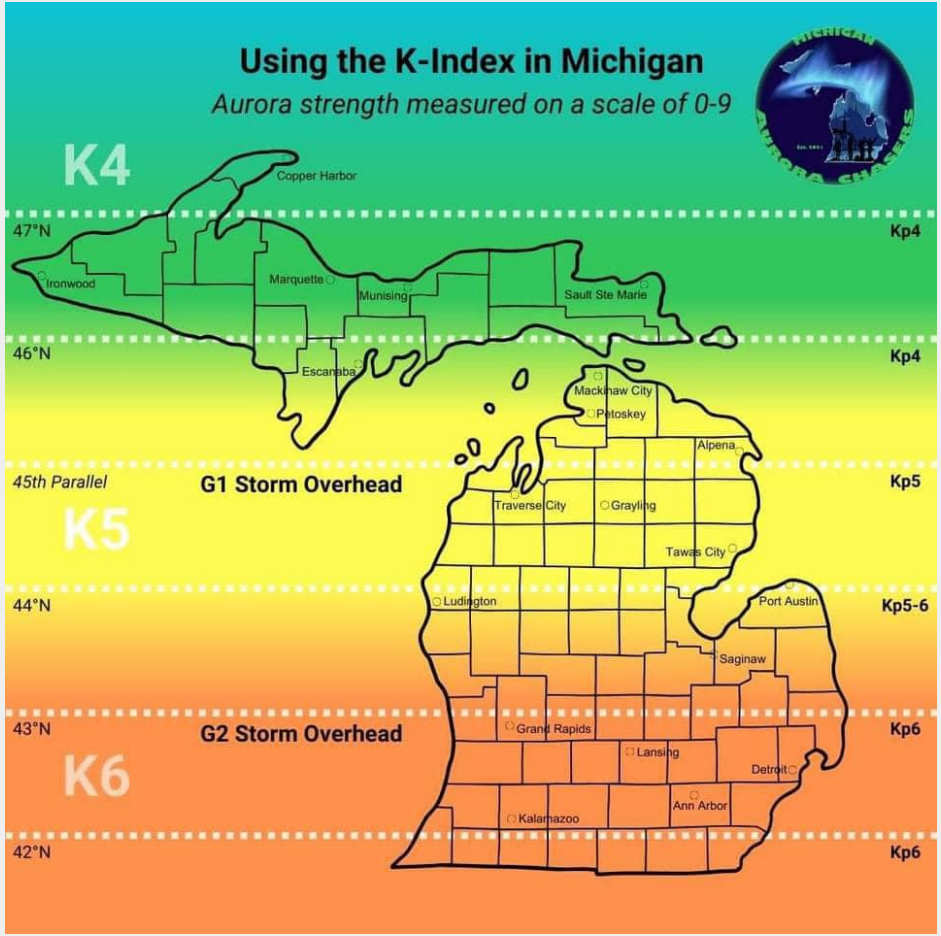
When you’re trying to catch the Northern Lights for the first time, it’s natural to wonder when you can see them and where. The answer to these questions, it turns out, is not so easy.

- The national forecasting standard
- A forecasting tool, not a good real-time tool
- Data from magnetometers across the world
- An average over 3 hours
- Often refers to the past
- Apps can lag
- Not an exact science

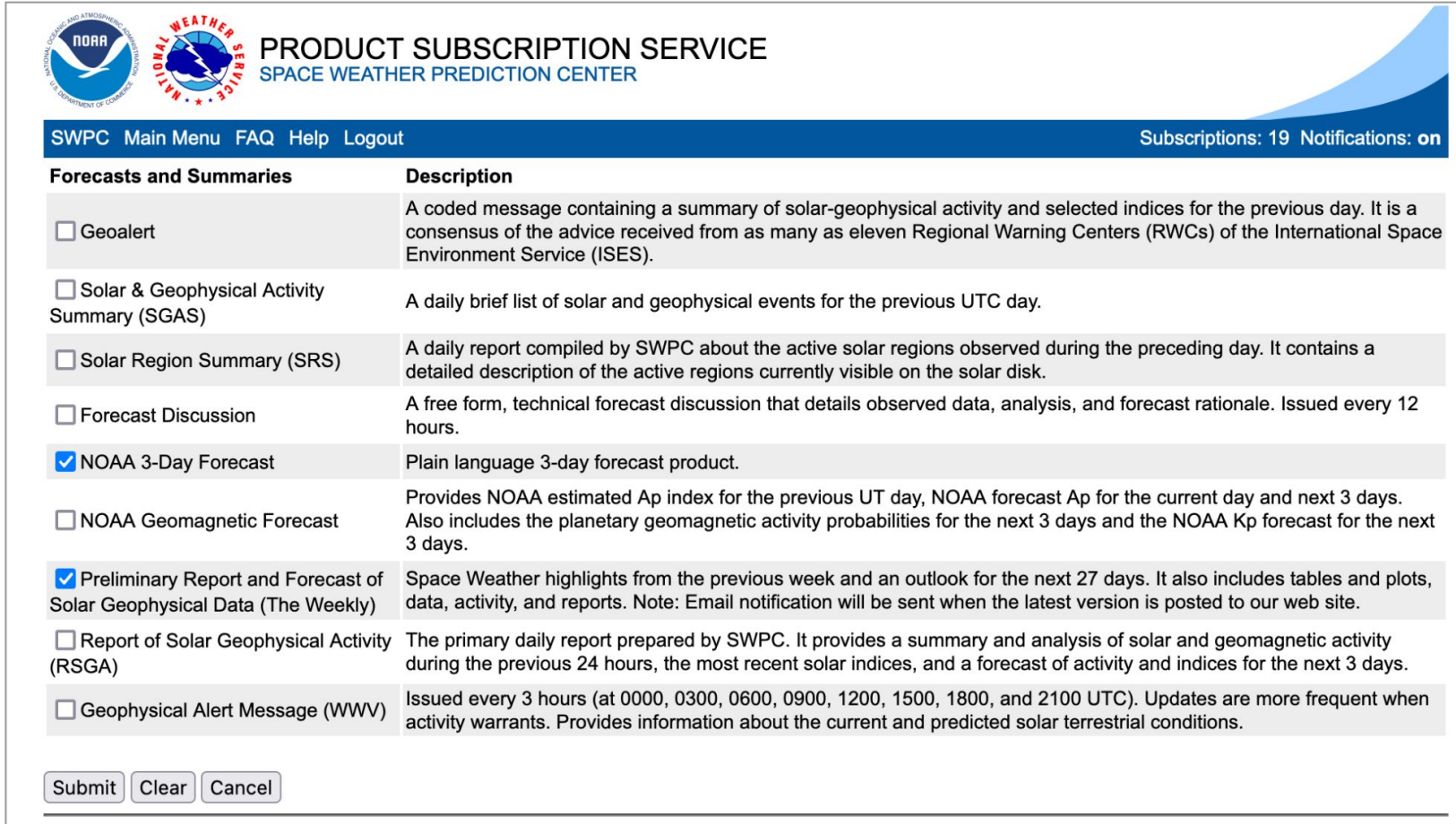
Forecasting by Latitude

The K-Index can be used to understand how far south Aurora may appear based on anticipated conditions. It also works well to compare displays with historic data.

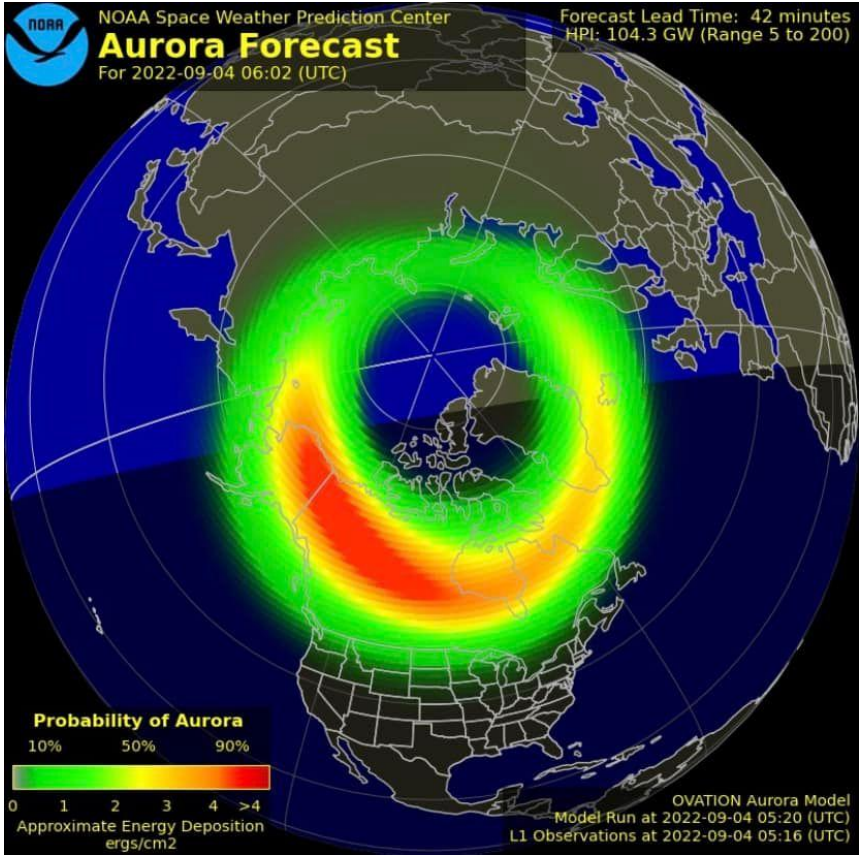
In real time, Kp is not a good indicator of Aurora activity.



How to Subscribe to SWPC Alerts



Ovation Model



Source: Space Weather Prediction Center

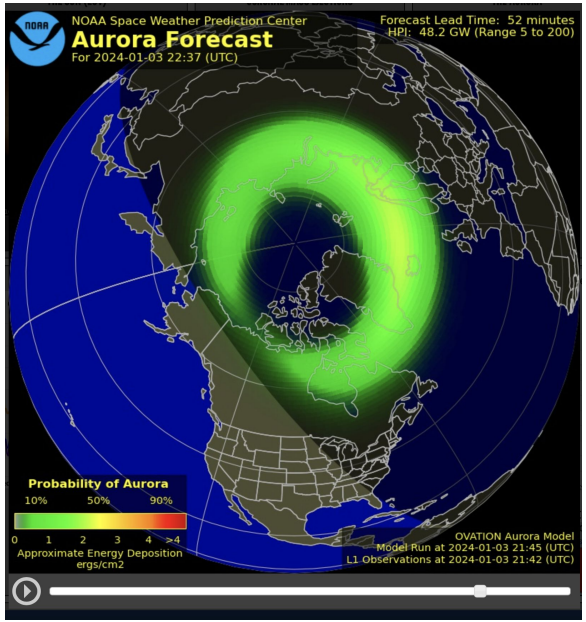
Components of the Ovation

The model uses the solar wind velocity and interplanetary magnetic field measured at the L1 orbit position, located one million miles from Earth, to calculate three types of electron precipitation and proton precipitation which strongly correlate with the aurora. (SWPC)

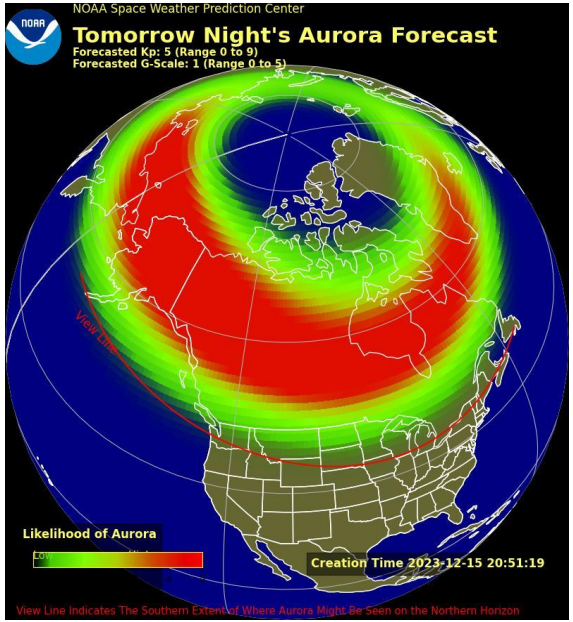
- Simpler than it looks, beginning with labels & dates
- Top left: Agency name, Forecast, Date of Forecast
- Top right: Covers important aurora strength details
- HPI (Hemispheric Power Index) — Hemispheric Power is another measure of aurora strength.
- Lead Time
- Bottom right: Times of the last model run and actual observations
- Bottom left: Legend with colors showing the probability
- Energy Deposition: Measures the energy flux or amount of energy Aurora is putting into the atmosphere

Variations of Ovation

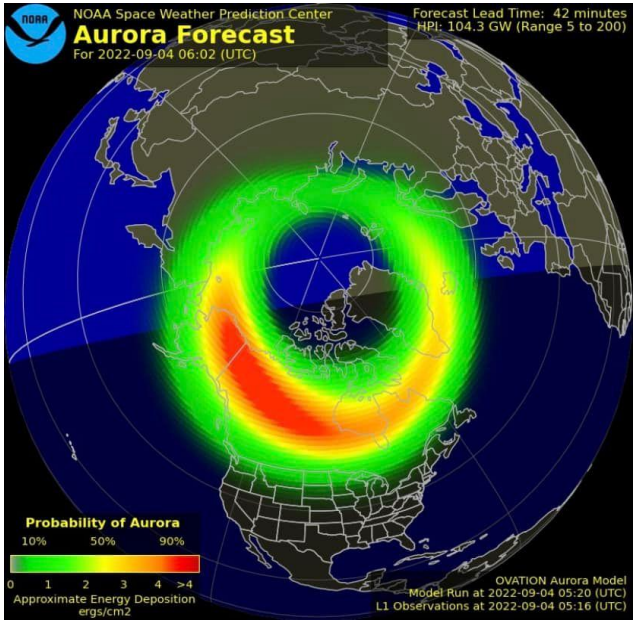
Many sources give you the Ovation Model in a video loop, but only the last second or so refers to the forecast. The new “Aurora Forecast” version is overstated. The still image forecast model is more reliable.



Video



Tomorrow Night’s Forecast Version

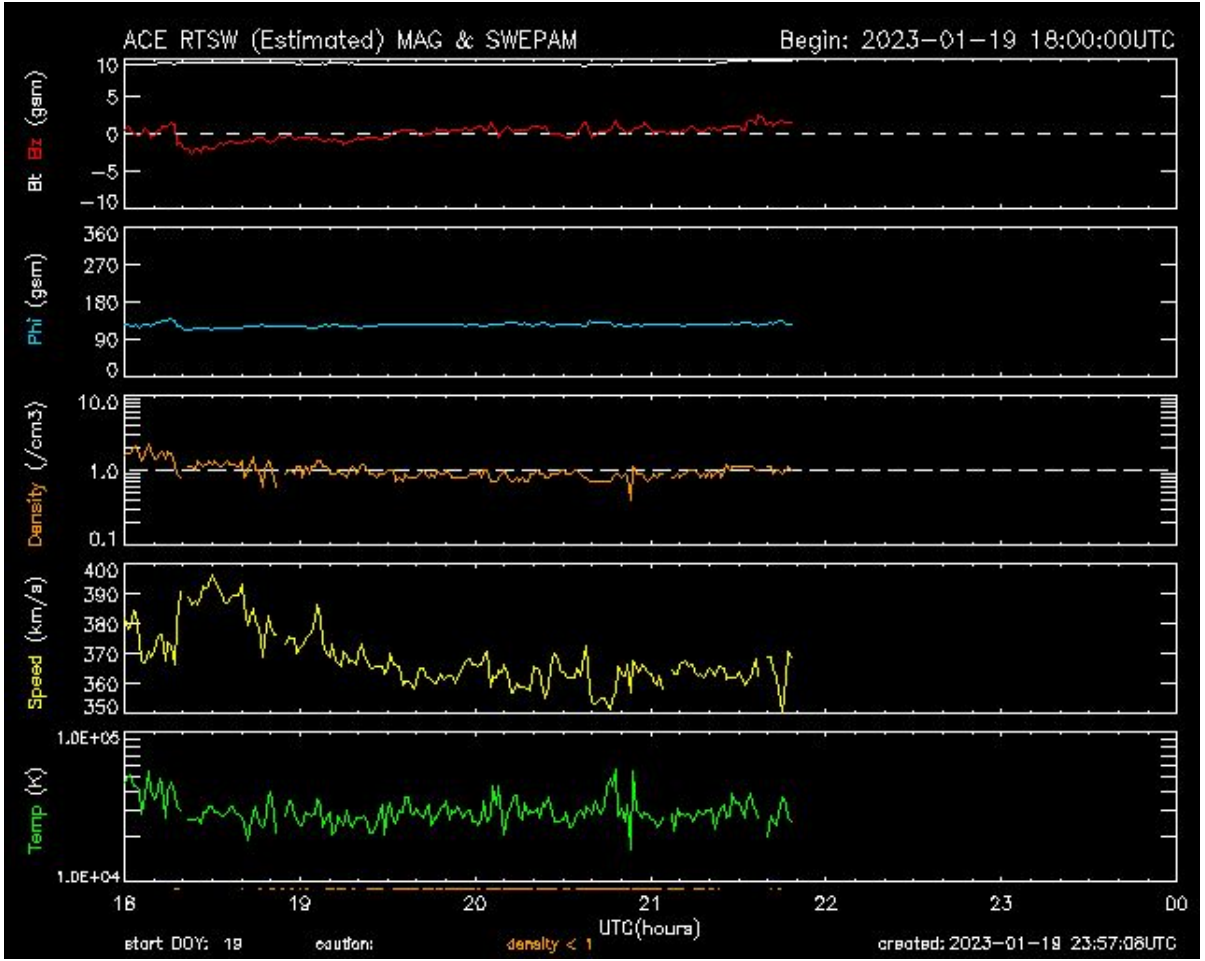


30-Minute to Real-Time Model

Source: Space Weather Prediction Center

What's trending?

The NASA Advanced Composition Explorer (ACE) satellite enables the SWPC (Space Weather Prediction Center) to give advance warning of geomagnetic storms. This 6-hour plot shows the conditions of the solar wind, from speed, density and temperature to Phi, Bz and Bt.



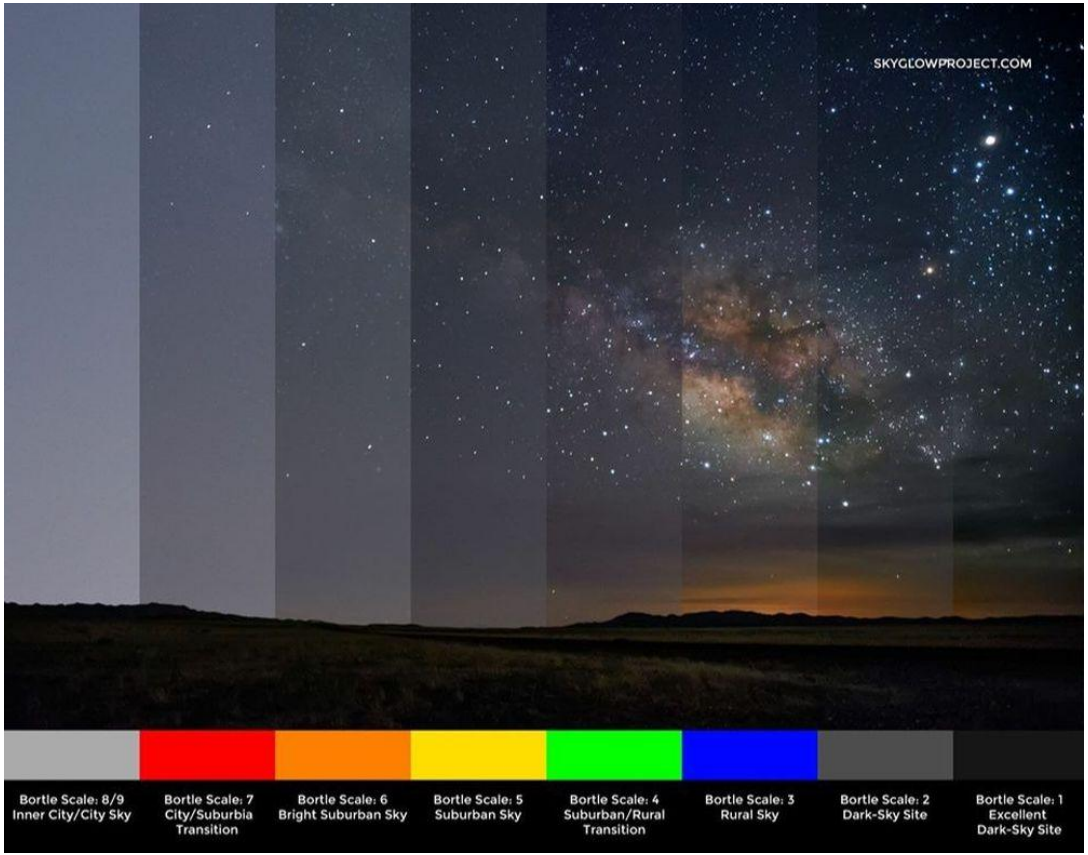
Source: SWPC

Darker Skies, Better Aurora

Using the Bortle Scale

Light pollution could be the only thing stopping you from catching the Aurora.

Q: How dark are your skies?

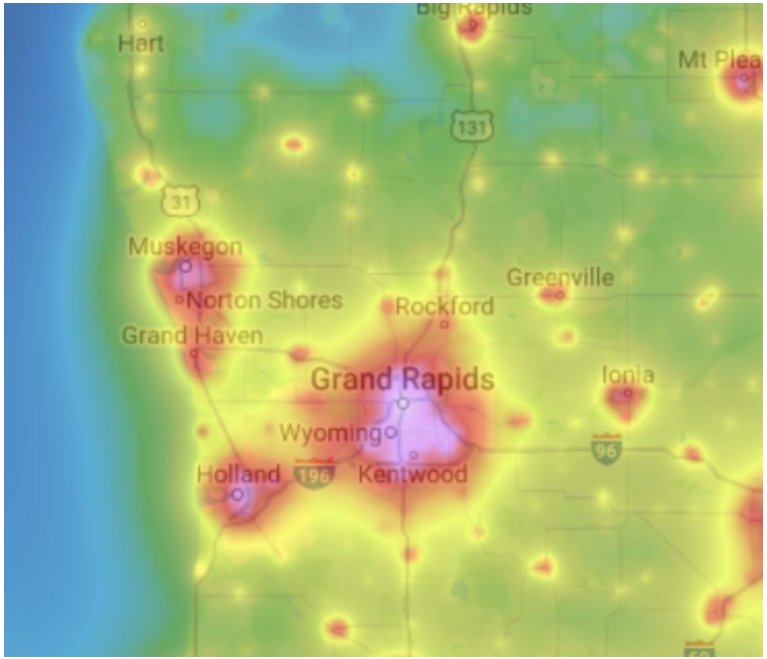


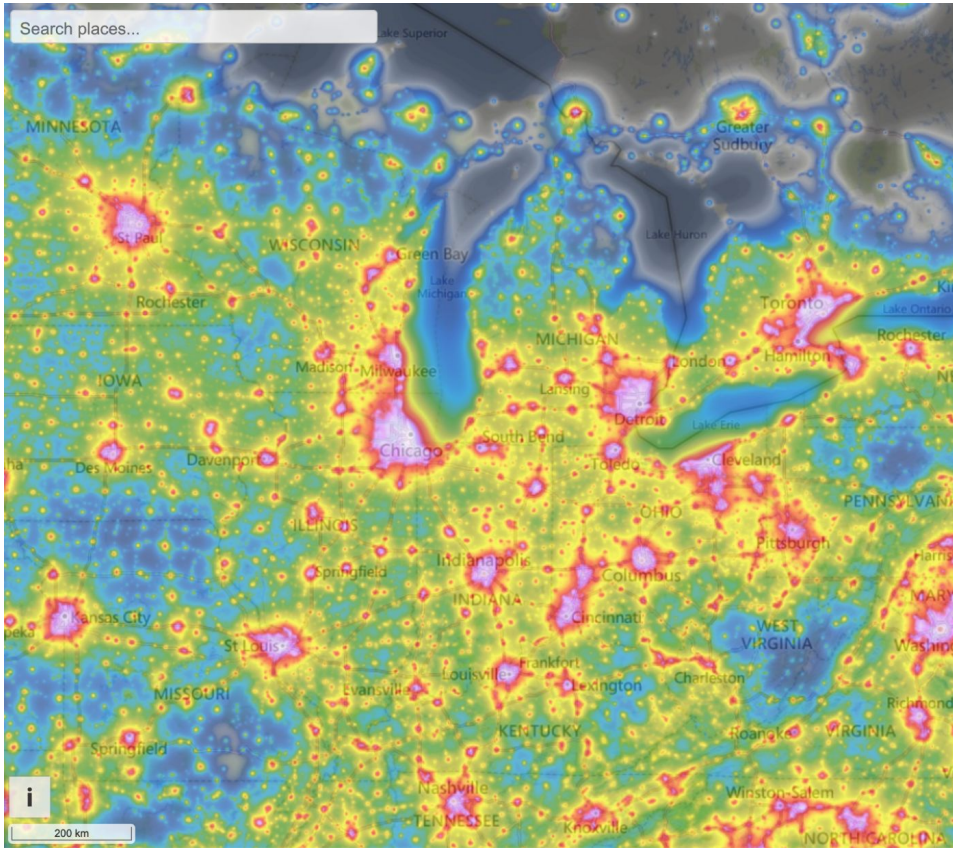
Overcoming Light Pollution

Light pollution by Location

Search your area at

www.LightPollutionMap.info



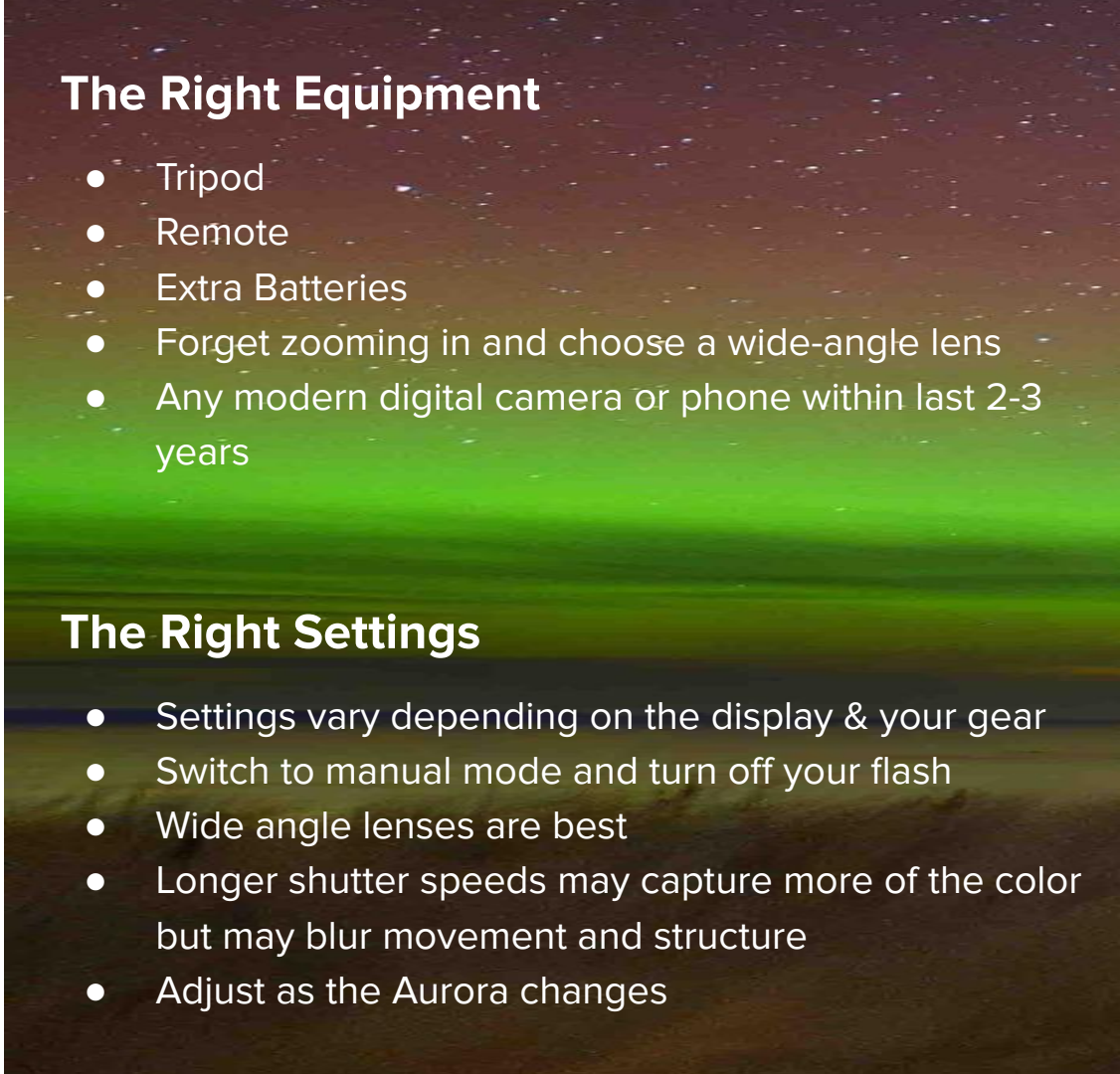


How to Photograph the Northern Lights

What it takes to photograph Aurora

Aurora photography is subjective: it's an art form. Camera settings will vary with each display.

Use the Exposure Triangle:
- Aperture
- Shutter Speed
- ISO

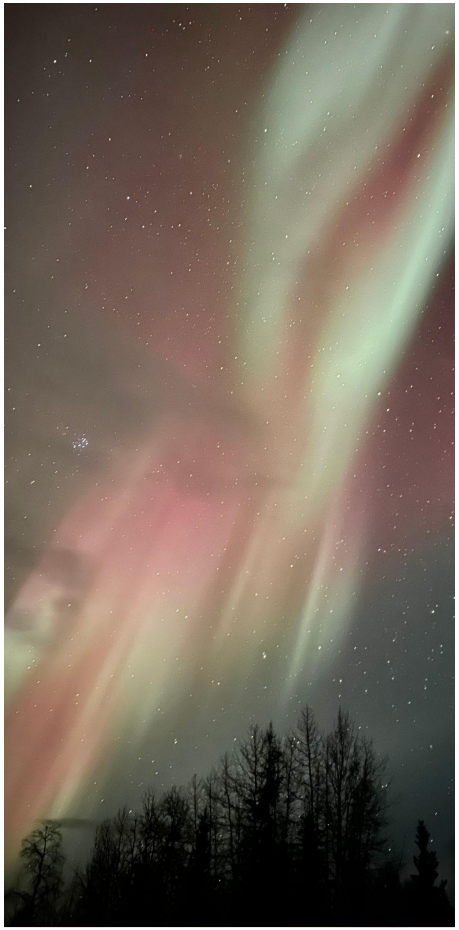


The Right Equipment

- Tripod
- Remote
- Extra Batteries
- Forget zooming in and choose a wide-angle lens
- Any modern digital camera or phone within last 2-3 years

The Right Settings

- Settings vary depending on the display & your gear
- Switch to manual mode and turn off your flash
- Wide angle lenses are best
- Longer shutter speeds may capture more of the color but may blur movement and structure
- Adjust as the Aurora changes

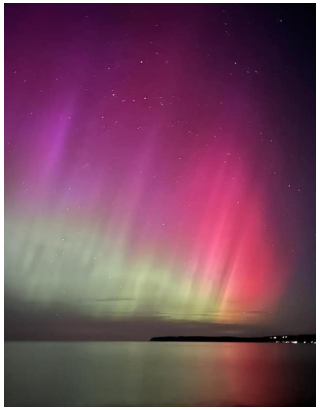


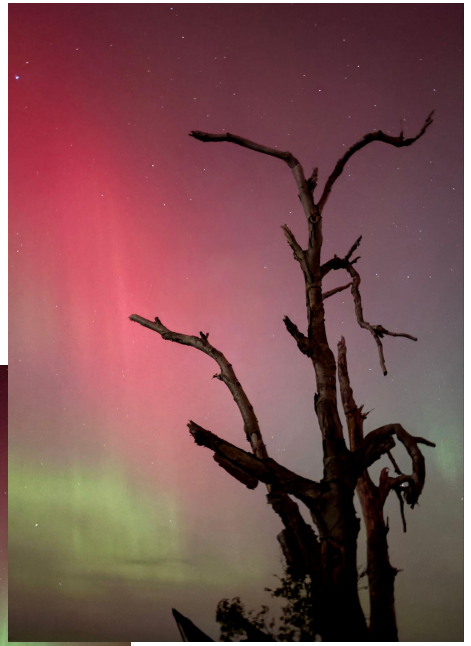
Alaska Aurora Photos Taken on iPhone 14

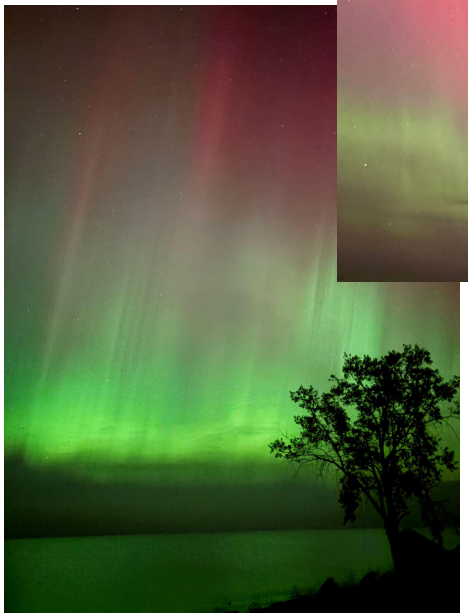
Camera Note Card

Northern Lights in Michigan

iPhone Photography

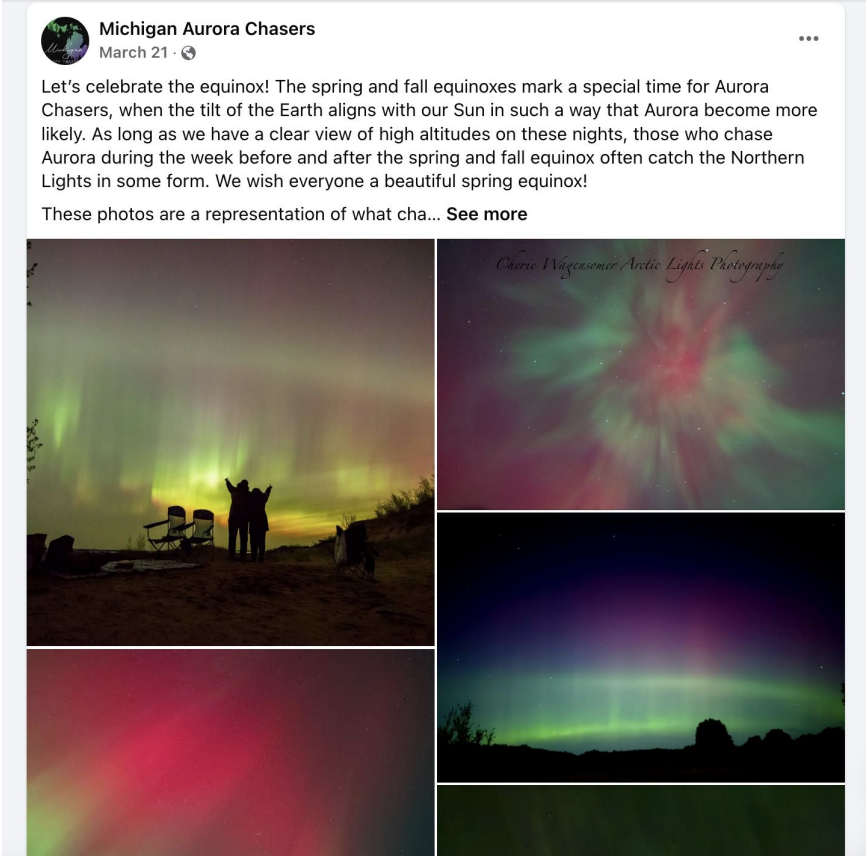






Northwest Territories

Featuring the Michigan Aurora Chasers



Get the Most Out of the Chase

What did the Ovation Model Show on May 10, 2024?

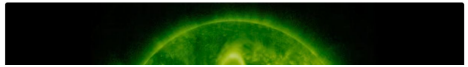
CLICK ON DETROIT

Join Insider Sign In

SPORTS FEATURES LIVE IN THE D ANN ARBOR CONTACT US NEWSLETTERS

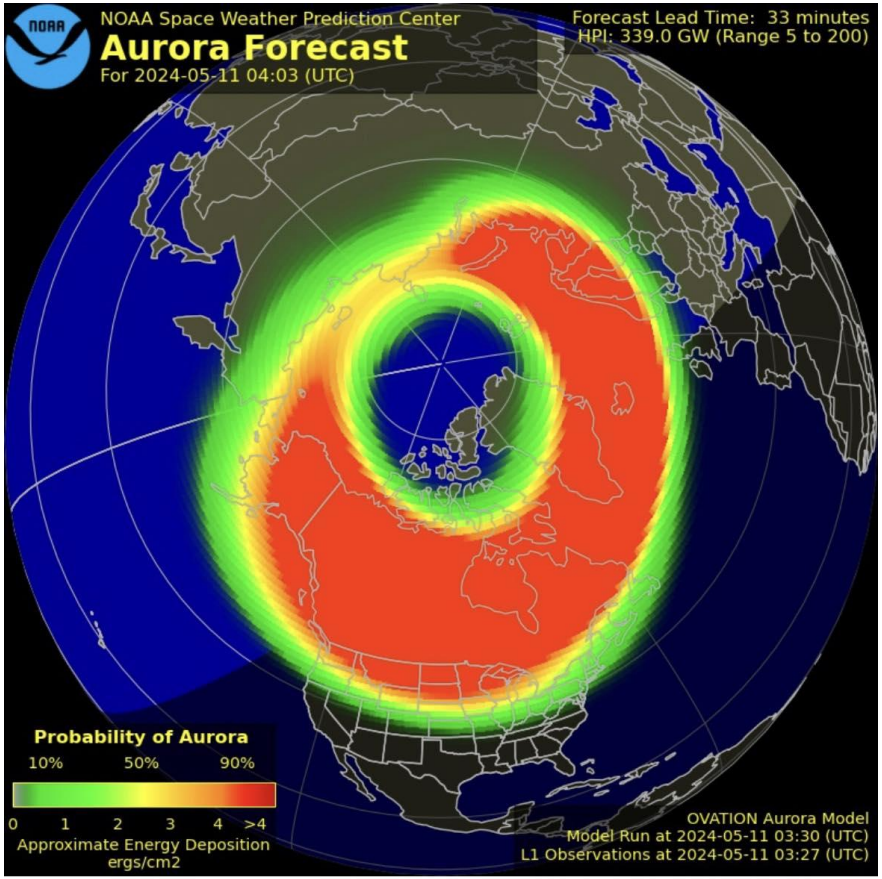
Severe geomagnetic storm watch issued for first time in nearly 20 years: What to know

CMEs expected to arrive midday Friday, May 10



USATODAY.COM

One week ago, the northern lights stunned America. When will it happen again?



The #LiveChase!

- Live Chase on May 10, 2024, historic G5 Storm in Dexter, MI
- Live Chase on June 10, 2024, Pentwater, MI
- MI Aurora Experience on May 3, 2025, Glen Haven, MI

Photo by Jen Boss Mainka

Photo by Lauren Kovich

Photo by Karen Serwatowski

My Favorite Aurora Chasing Hacks

Techniques, tools & tips

Find a Viewing Location

Get tips to find the best viewing locations near you

Aurora Alerts Only

- Download the Free Telegram App
- Subscribe to @MichiganAuroraAlerts

Photo by Michele Duff Aucello

How to find us

Get Updates:

- Facebook Group & Page
  Michigan Aurora Chasers
- Wordpress
- Telegram Alerts Only
  @MichiganAuroraAlerts
- Instagram
  @MiAuroraChasers
- Website, Subscribe via Email

MichiganAuroraChasers.com

Join in!

We lead an engaged and active community!

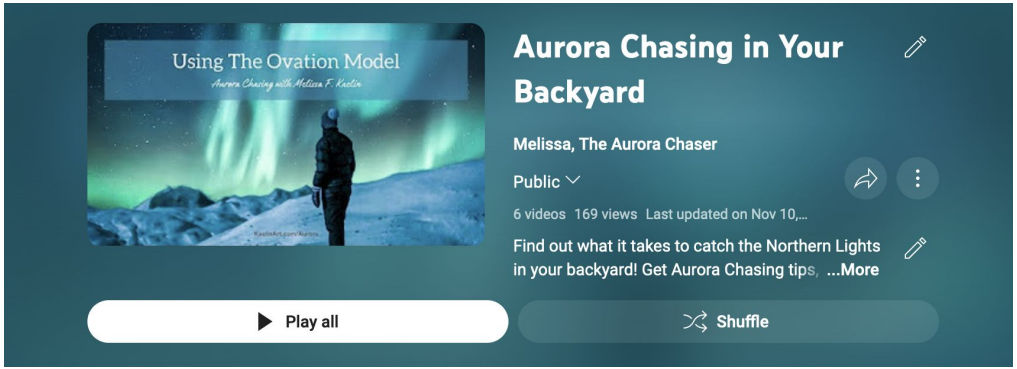
- MI Aurora Experience
- Annual MI Aurora Workshop
- MI Aurora Socials
- Live Chase
- Summits & Festivals

MichiganAuroraChasers.com/events

#MIAuroraChasers

Guides to the Night

- An Empowered Guide to Viewing Locations
- MI Aurora Resource List
- Advice Blog: Aurora Chasing in the U.S.
- YouTube: Aurora Chasing in Your Backyard



Aurora Chasing

Seven Ways to Find an Aurora Viewing Location

So, you want to see the Aurora! Here are seven ways to find a great Aurora Viewing Location, which are included in my new Empowered Guide.

Aurora Chasing

Five Simple Steps for Tracking Solar Flares

As Aurora Chasers, we love hearing about new solar flares. But many things have to happen for a solar flare to have any visible impact on our night skies.

Aurora Chasing

Make or Break Your Shot: The Beauty of Night Sky Etiquette

Take a few easy steps to ensure everyone around you can enjoy the night sky.

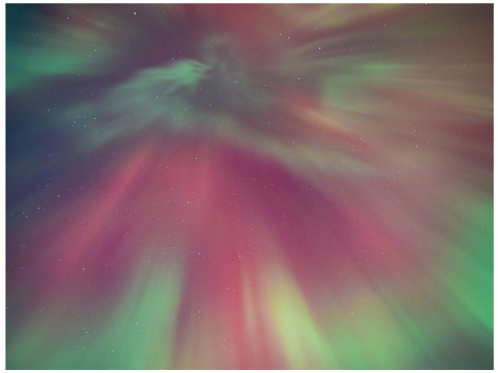
Aurora Chasing

Ask How, Not Where to View Aurora

Often, people who chase the Northern Lights can become too focused on WHERE

Aurora Advice Blog

Aurora Chasing in the U.S.



Aurora Chasing

Catch the Corona in the Mid-Latitudes

Aurora Chasing

A Unique Viewing Location for Everyone

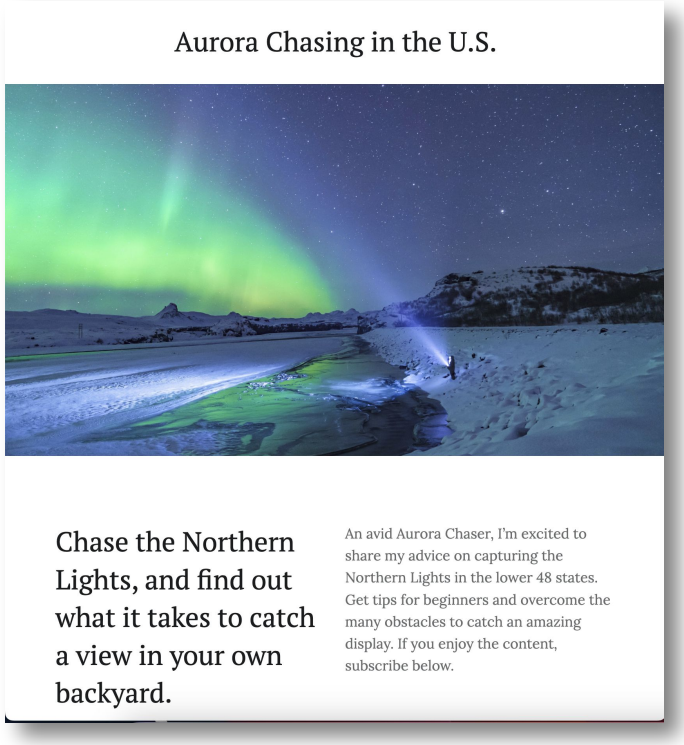
Aurora Chasing

Train Your Eyes on the Sky: A Field Guide

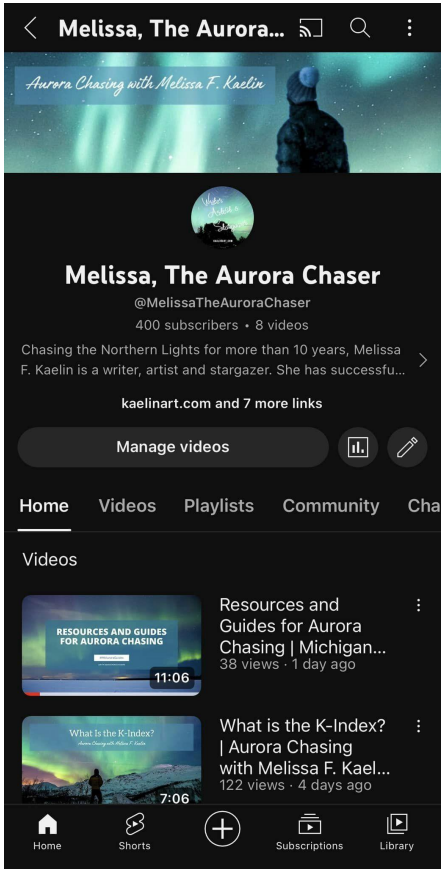
Aurora Chasing

The Pros and Cons of Relying on Kp

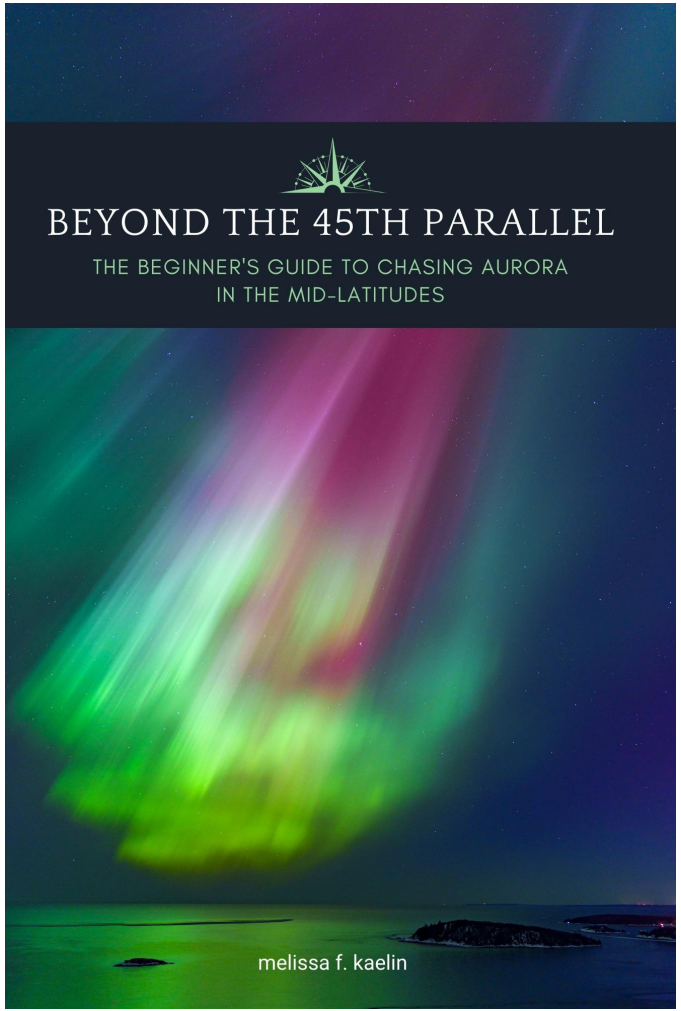
Blog > Book > YouTube



45TH PARALLEL SERIES



Explore: KaelinArt.com



Books on Aurora Chasing

1st Edition

Below the 45th Parallel:
The Beginners Guide to Chasing the Aurora in the Great Lakes Region

2nd Edition

Beyond the 45th Parallel:
The Beginner's Guide to Chasing Aurora in the Mid-latitudes

Annual Aurora Summit

- Camera Clinics
- Educational Sessions
- Panel Discussions
- Diverse Speakers
- Aurora Chasing

Photo by Greg Ash

Melissa's Official Website

- YouTube Tutorials
- Aurora Advice Blog
- Programs & Events
- 45th Parallel Series Books

Connect

Follow @mfkaelin
FB.com/KaelinArt

Photo by Cristiano Saturno


Thank you! Happy Chasing!
coff.ee/mfkaelin
© nate stovall