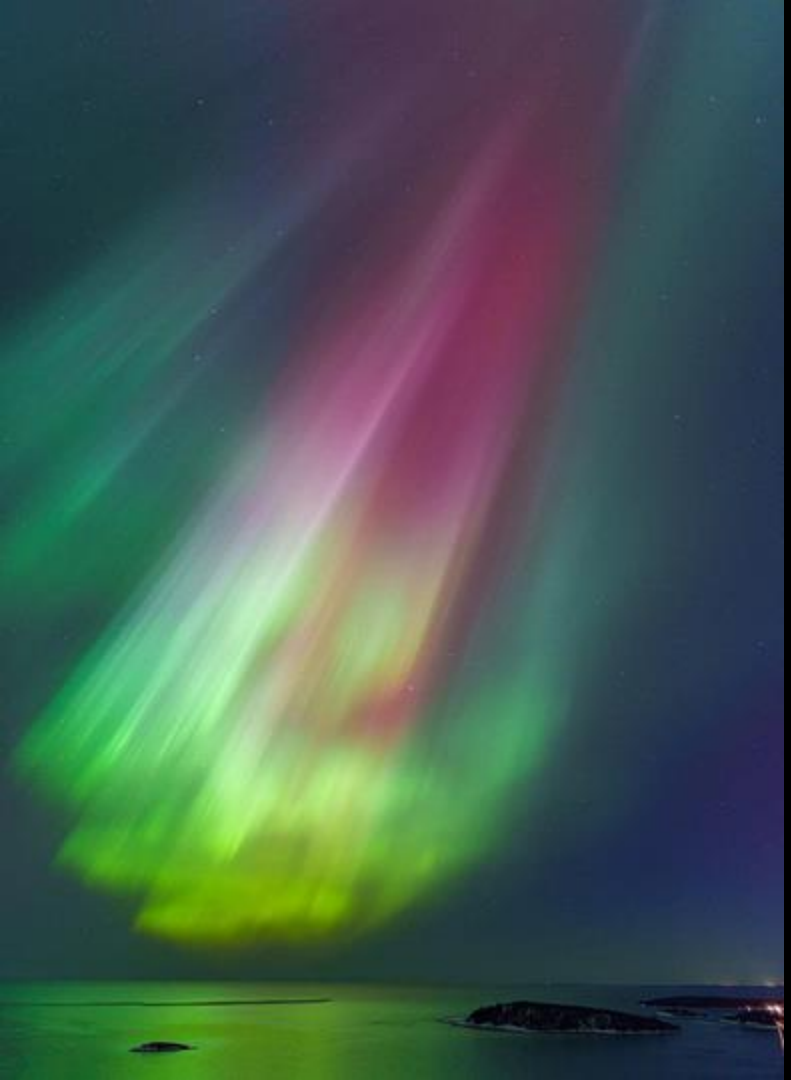


# Chasing the Aurora Beyond the 45th Parallel

*Melissa F. Kaelin,*
*Founder of the Michigan Aurora Chasers*

*Photo by Shannon Kivi*

# About Melissa

- Chasing Aurora for 12 years
- Co-founder of the Aurora Summit
- Wrote four books, including “Beyond the 45th Parallel,” a beginner’s guidebook
- Interviewed for USA Today and NPR
- Book includes excerpt of fiction
- Cover story on rare atmospheric phenomena published in “Minnesota Monthly”
- Interviewed for the new book “Magnificent Aurora: A comprehensive guide to nature’s greatest light show” by Bob King

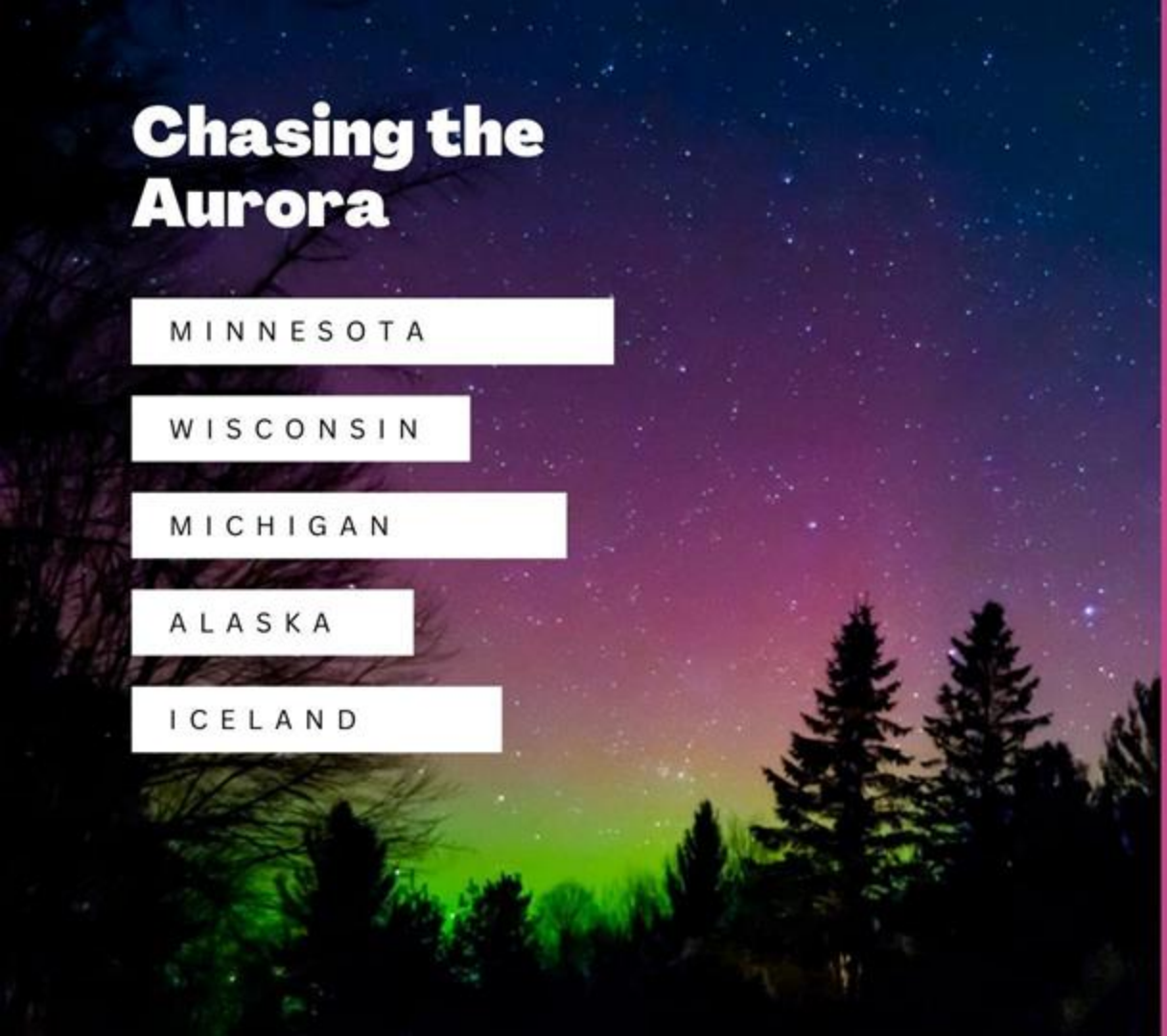
# … and Science Communicator!

In the office, Melissa works as Manager of Marketing & Communications for the **University of Michigan Department of Climate and Space Sciences.**

- Interviews researchers in fields of space weather & climate change
- Writes breaking news in partnership with NASA, NOAA and other agencies
- Manages websites, social media, marketing and press relations at U-M



# Human to @ElioTheSpunkyPup
# Elio, Derived from Helios, Meaning Sun


# THE NIGHT AURORA CHASED ME

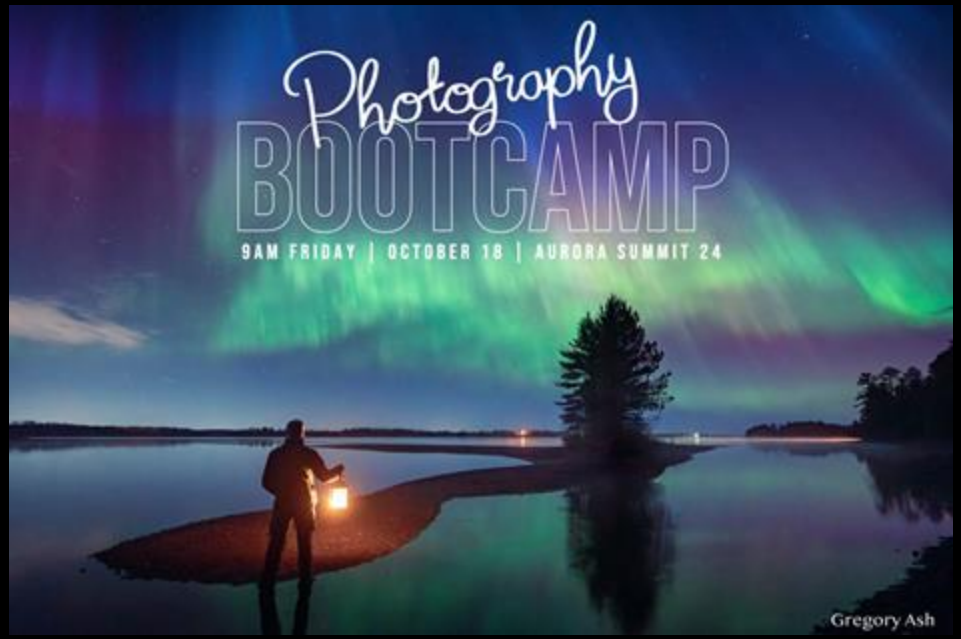
Driving home from the Inaugural Upper Peninsula Dark Sky Festival along Lake Superior's Shore in the Upper Peninsula of Michigan, April 23-24, 2023.

Photo by Jessica Ellis Rorman

# The Aurora Summit

- Founded in 2017 by a team of three: Dixie J. Burbank, Melissa F. Kaelin & Dr. Mike Shaw
- Celebrating the Art, Culture, Science & Photography of the Aurora
- Registration launches each June
- Sign up by October 1
- Open to the public

TheAuroraSummit.com




**Aurora Summit 24**

*Featuring Dr. Elizabeth MacDonald*

**October 18-20, 2024 | Red Cliff, Wisconsin**

# Michigan Aurora Chasers


- Founded January 20, 2021
- Over 114,000 members
- High engagement & sell-out events
- Featured often in the news
- Logo created by Admin Patrick Grubba
- MI Aurora Workshop, MI Aurora Social & the #LiveChase
- Collaborate with and donate to International Dark Sky Parks

MichiganAuroraChasers.com

# The 45th Parallel Series

- The 45th Parallel Series: Aurora Chasing Guidebooks expanded from Great Lakes to anywhere in the Mid-latitudes
- Cover Photos feature Shannon Kivi of 906 Images, and Michele Aucello in a professional collab
- Seven new chapters
- Advice Blog: Aurora Chasing in the U.S.

# Michigan Aurora Chasers

Thank you for sharing your talents!

Photo by Gary Syrba, Little Sable Point, Lake Michigan

Photo by Jen Selwa, Fremont, Michi

# Preserving Our Dark Skies

- Turn out the lights!
- Be kind to living beings and our natural spaces
- Keep it sustainable & fun:
  Learn Night Sky Etiquette
- Beat Light Pollution:
  Use dark sky maps: lightpollutionmap.info

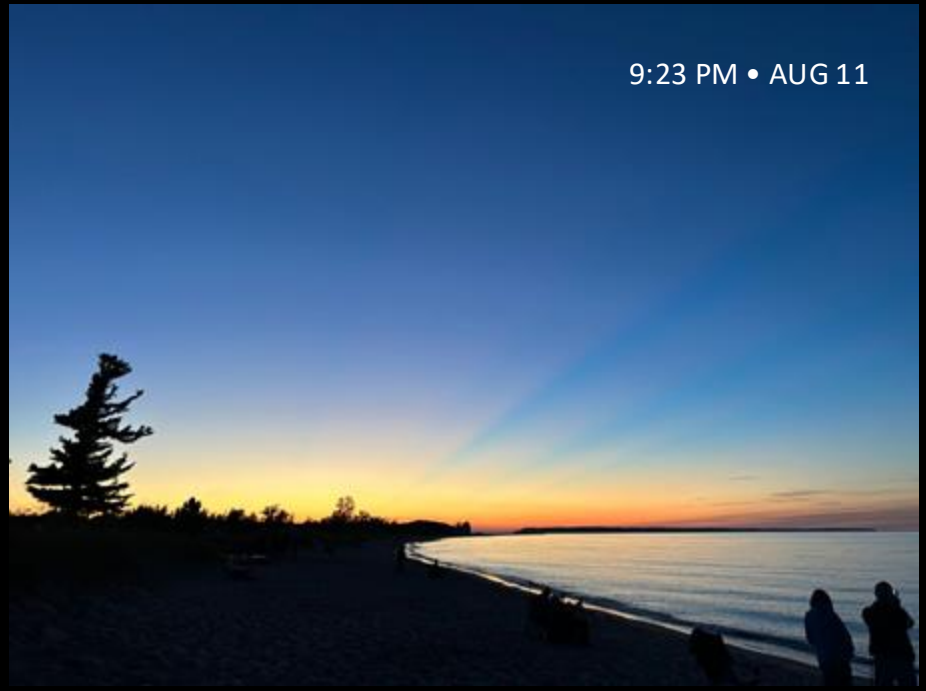
# Progression of a #LiveChase

## Embarking on the Chase

- Scout out locations in advance
- Safety, Sleep & Sanity: Start at sunset
- #1 Piece of Advice: Plan one exciting attraction, so you don't get aced!

## What you'll see

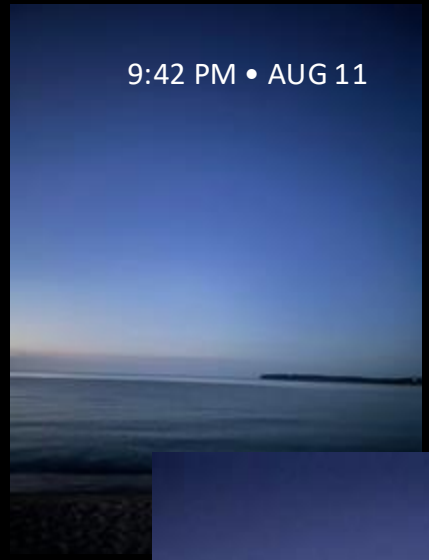
- Cloud forecasts, satellite maps & reality
- Rare Atmospheric Phenomena
- Twilight
- Moonlight
- Light Pollution & the Unexpected
- Shooting stars, ISS, StarLink

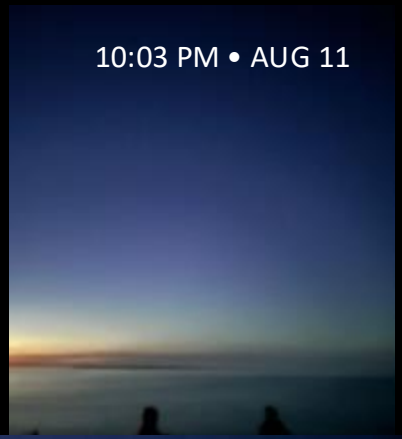



**TinyURL.com/MACLiveChase**

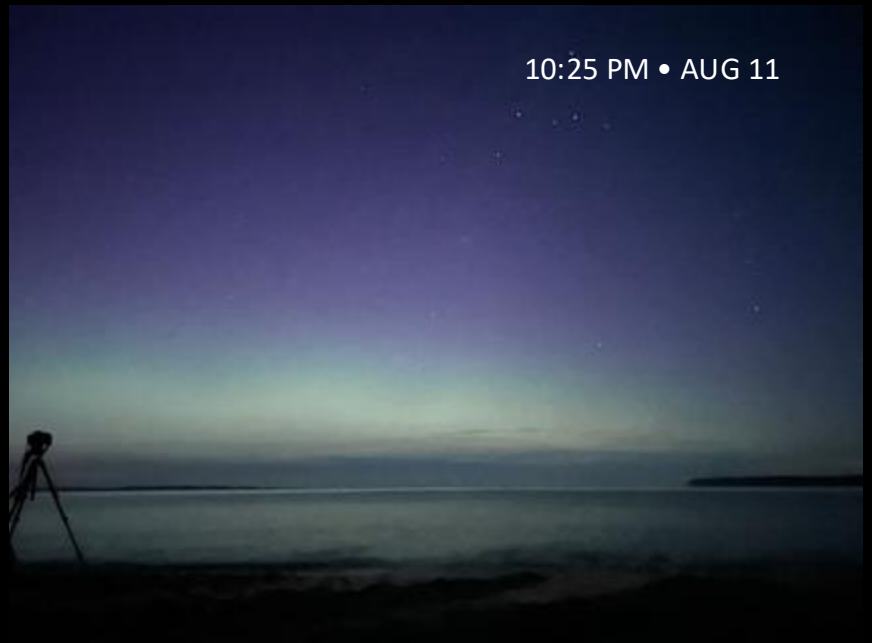
# Progression of a #LiveChase

- Where to look: Metaphorically, Aurora rises in the east and sets in the west, opposite of sunlight
- When to look: Camera vs. Eyesight
- What to look for
  - First signs
  - Confirmed sightings
  - Onset, expansion, recovery
- How long to expect it to last
- Knowing when the show's over




# Progression of a #LiveChase




**Surefire Signs of Aurora**

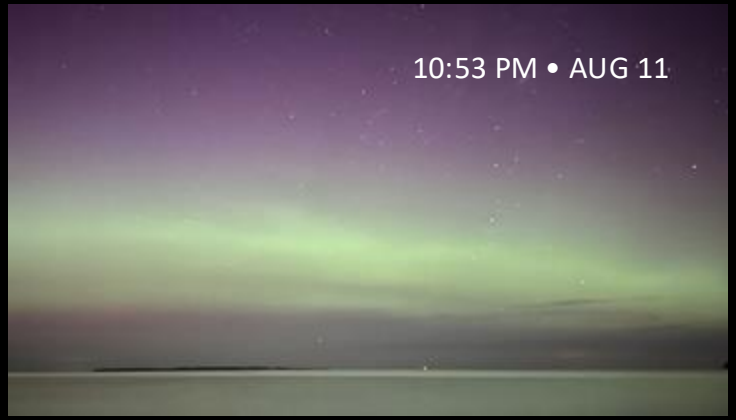
- It moves
- Changes shape
- Classic formations:
  Auroral arc, pillars, veils, corona
- Colorful, at least on camera

**Can you see color in the Great Lakes Region?**

- Our own unique human eyesight
- Camera sensors capture all light & color in the sky
- Allows us to see phenomena as they exist, i.e. Milky Way or Nebula
- What's the point of camera viewing? It's often a preview…

# Progression of a #LiveChase

- Auroral arc
- Expansion
- Substorms: Northern Lights reach higher in sky; push farther south
- Eyesight visible color
- Comes in waves; Timing

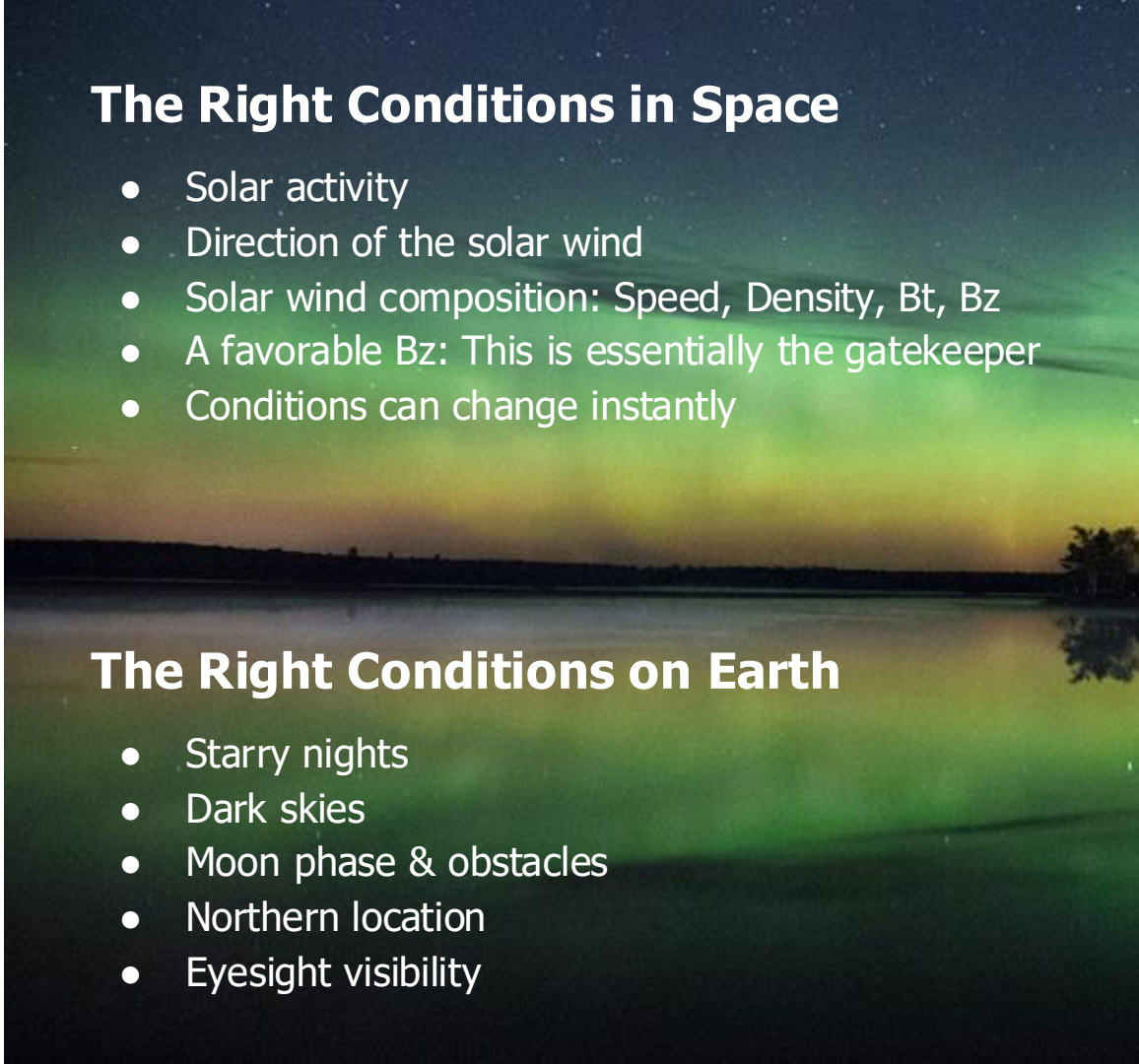




# What it takes to see Aurora

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

Photo by Luke Tanis



## 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

# 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!

# Aurora Photography

A Good Starting Point is:

- Aperture f/2.8 or widest possible
- ISO 3200-8000
- Shutter speed of 1-12 seconds depending on movement and activity
- Modern phone cameras can also capture the Aurora on Night Mode with Long Exposures

Source: Capture the Atlas

# Aurora Photography

Featuring the Michigan Aurora Chasers

Photo by D.J. Brown, Marquette, MI

Photo by Patrick Grubba, Mackinac Co., MI

# Aurora over the Grand Canyon

Photo by Jessica Miller,
from Portland, MI
May 10, 2024

# Michigan’s New International Dark Sky Sanctuary


Photo by Justin Miller,
JM Naturescapes
Beaver Island, MI

# STEVE with the “Picket Fence”

Photo by Cherie Wagensomer, Munising, MI

Photo by Kim Masters Acker, Onekama, MI

# “SAR,” Sub-Auroral Arc abbreviated for Stable Aurora Red


Photo by Patrick Grubba, Wilderness State Park, Michigan

# “STEVE,” the Sub-Thermal Emission Velocity Enhancement


Photo by Justin Miller, JM Naturescapes, Beaver Island, MI, Sept. 19, 2023, Silver Lake Dunes

# “Northern Dawn”

Photo by Christina Cantu Sharp,
Mackinac Bridge, Michigan
Sept. 17, 2024, around 6am


# Corona

Photo by Justin Miller
JM Naturescapes
Lansing Area
May 10, 2024

# CULTURE

# Meaning Across Cultures

Finland — Fur of arctic fire foxes
Japan — Fertility, prosperity
China — Fire-breathing dragons
Sweden — Bountiful fishing
Bavaria —Warriors in battle
Vikings — Fire that burns at the end of the Earth
Medieval Europe — Omen of war
Aboriginal Tribes — Anger of the Great Man
Maori, New Zealand — Fires lit by ancestors

Photo by Debbie Schwartz Maciolek, MI

# Expedition Journals

“The dead suffer no hardship, wherever they may go, but most prefer nevertheless to dwell in the Land of Day, where the pleasures appear to be without limit.”

— Rasmussen, 1929

Photo by Dawn Waite, Mecosta County, MI

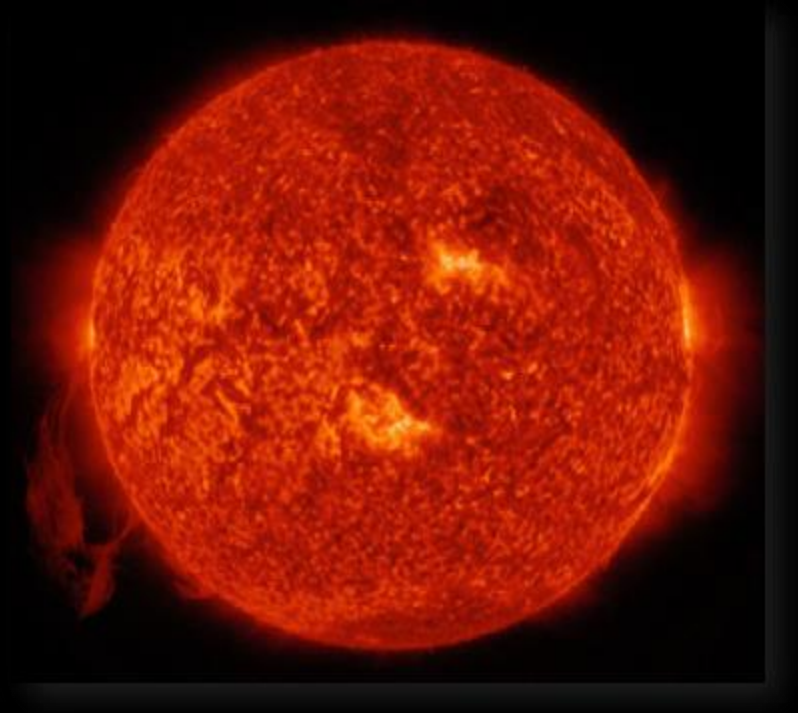
# “Revontulet,” *Fox Fires*

"Revontulet, the Finnish name for the Northern Lights, can literally be translated as ‘firefox.’ To explain the beautiful lights displayed in the sky, that was only visible during the winter months, it was believed that Finnish Arctic foxes were responsible. They either ran across the snowy mountains so fast that their tails swept snowflakes into the sky, which reflected the light from the moon and stars creating colourful lights in the sky, or their large furry tails brushed against the mountains and created sparks that lit up the sky."

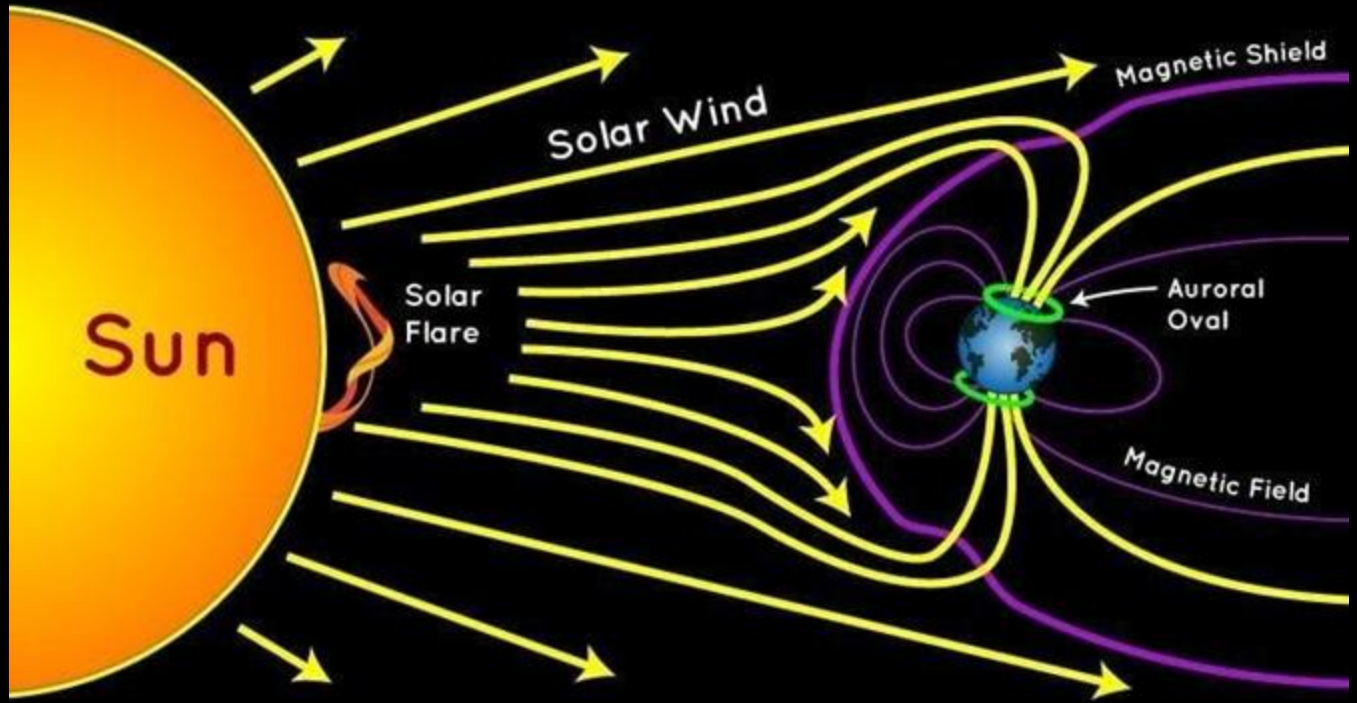
# SCIENCE

# Origins on the Surface of the Sun

Now we know Aurora is solar matter or plasma that originates from sun spots, solar flares, filaments and coronal holes on the sun’s surface.

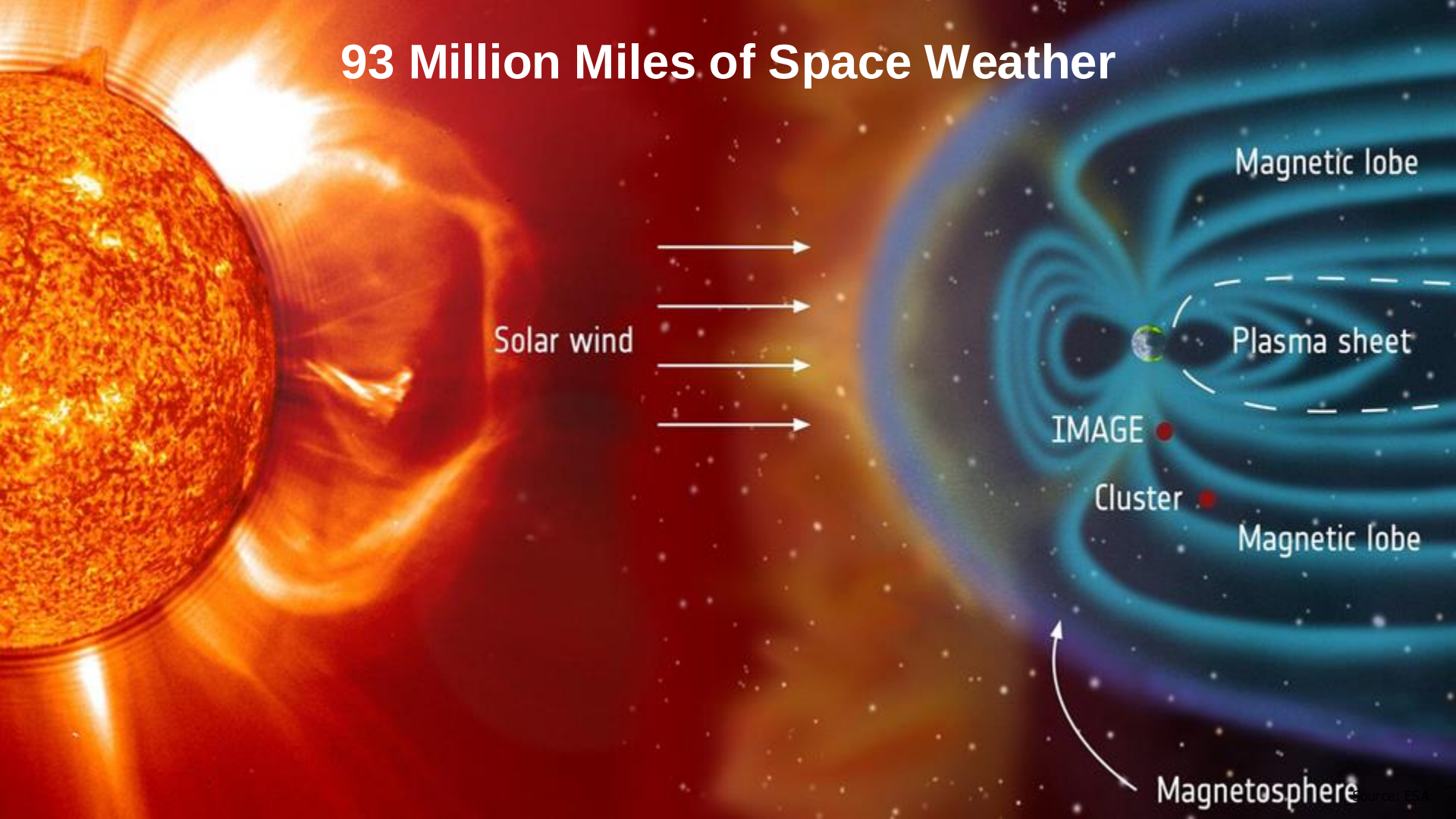


# Understanding What Causes Aurora




- Solar Flares
- Eruptions
- CMEs
- CH HSS: Coronal Hole High Speed Stream
- Filaments
- Co-rotating Interactive Regions
- The Ever Present Solar Wind

# 93 Million Miles of Space Weather



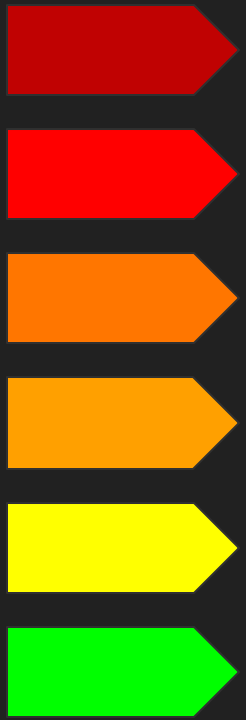

Source: ESA

# 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 |

# K-Index & Geomagnetic Storm Scales

The K-Index measures geomagnetic activity on a scale of 0-9.



| | |
|---|---|
| **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

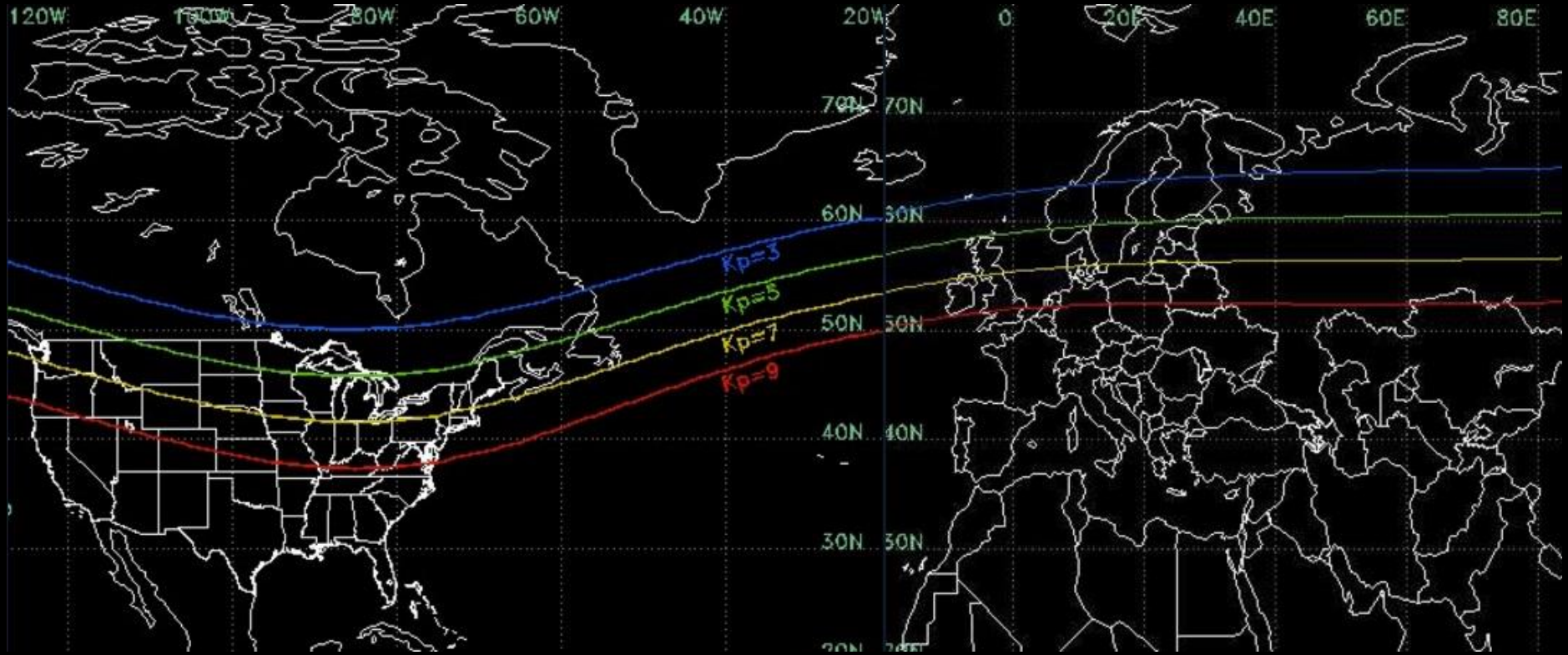
**The Pros and Cons of Relying on Kp**

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.

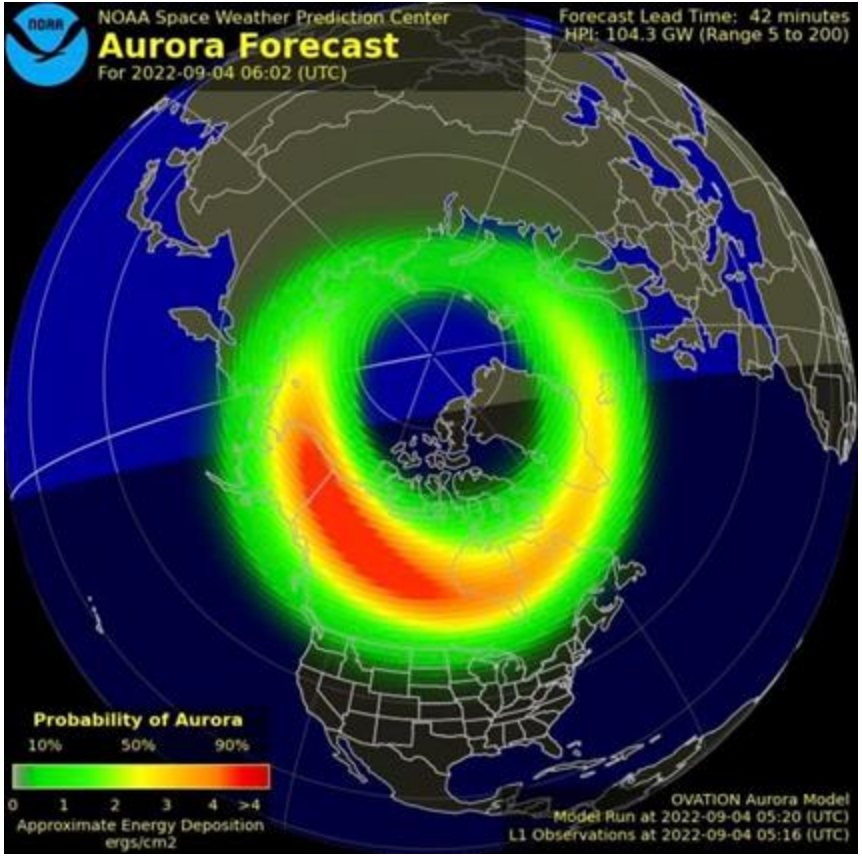
- The national forecasting standard
- A forecasting tool, not a good real-time tool
- Data from magnetometers across the world
- An average over 3 hours
- Often refers to the past
- Available on many apps, which may lag
- Not an exact science
- Other data becomes more important

# The K-Index

Evaluating average planetary geomagnetic activity and G-Storms by latitude



## Ovation Model




Source: Space Weather Prediction Center

# Components of the Ovation

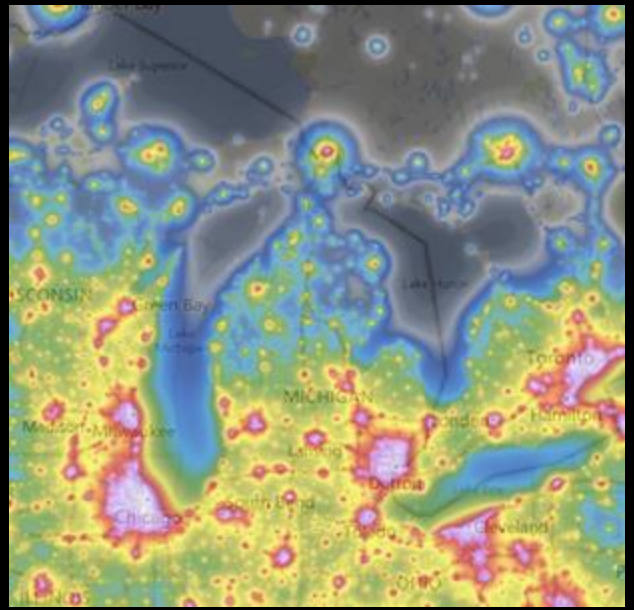
The model uses the solar wind velocity and interplanetary magnetic field measured at the L1 orbit position, located one million miles from Earth, to calculate three types of electron precipitation and proton precipitation which strongly correlate with the aurora. (SWPC)

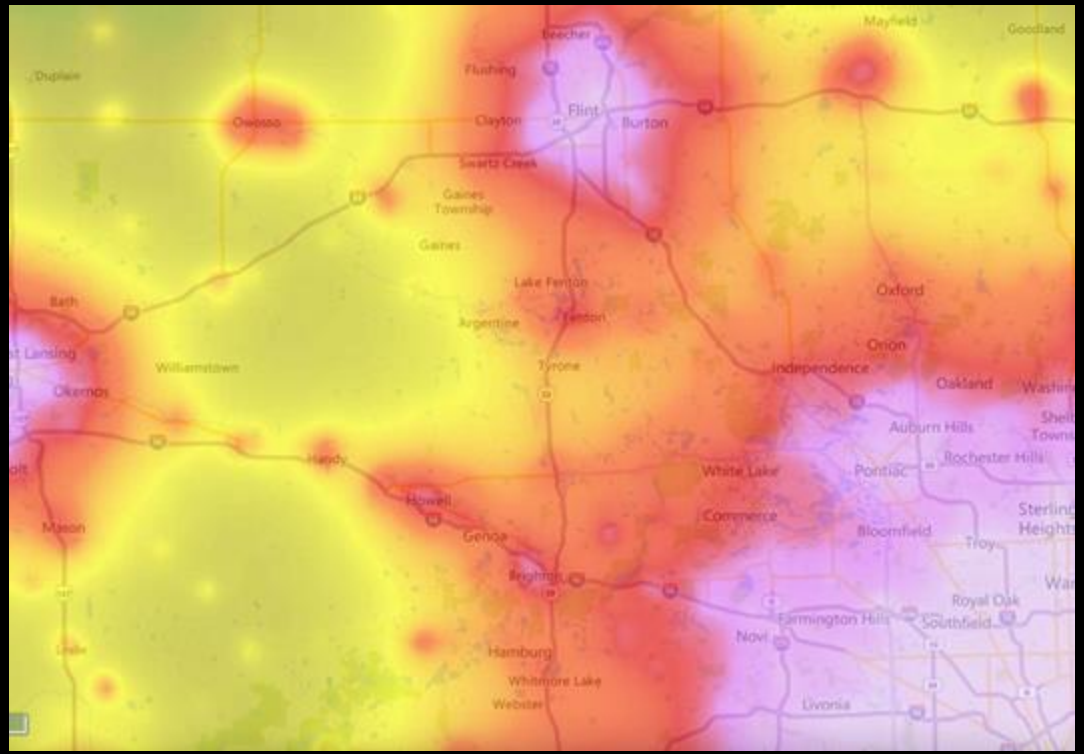
- Simpler than it looks, beginning with labels & dates
- Top left: Agency name, Forecast, Date of Forecast
- Top right: Covers important aurora strength details
- HPI (Hemispheric Power Index) — Hemispheric Power is another measure of aurora strength.
- Lead Time
- Bottom right: Times of the last model 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

# Overcoming Light Pollution to View the Aurora

**Light pollution by Location**

Search your area at
www.LightPollutionMap.info

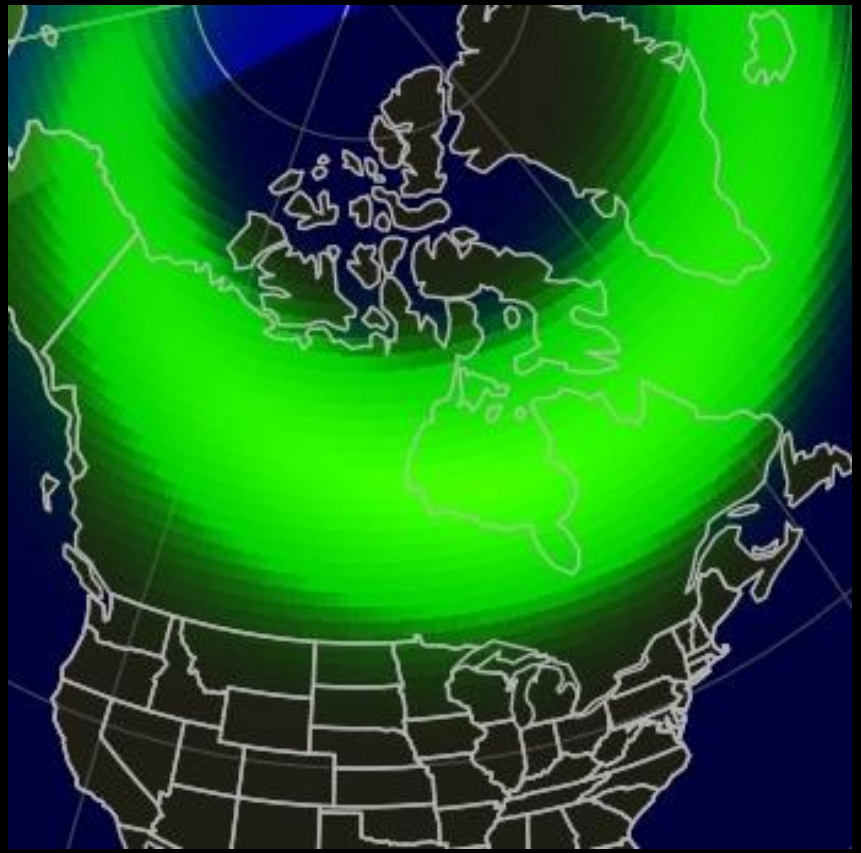


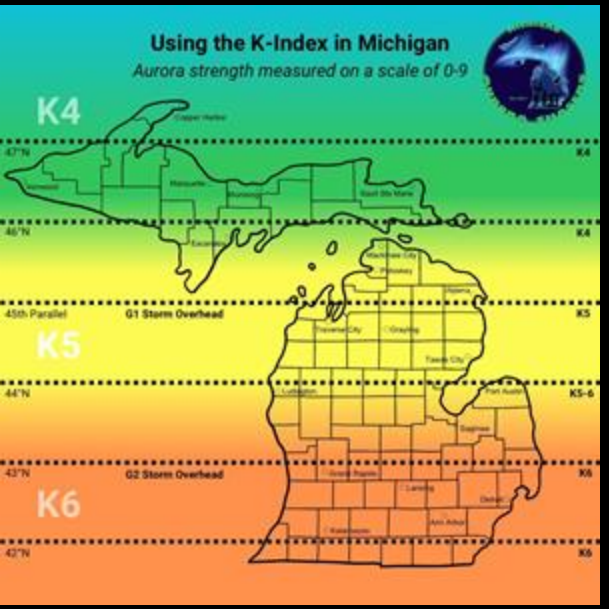
# Chasing at the Peak

- Years: Solar Maximum is a time at the height of the 11-year solar cycle
- Season: September to April
- Hours: Two hours before and after local magnetic midnight*

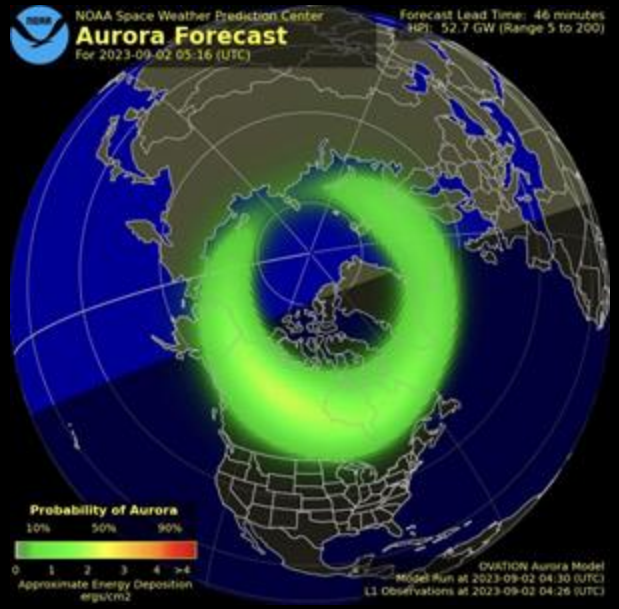
* When solar wind is detected at satellites and observatories stationed 1 million miles upstream of Earth, this gives us about one hour of notice to favorable Aurora conditions.



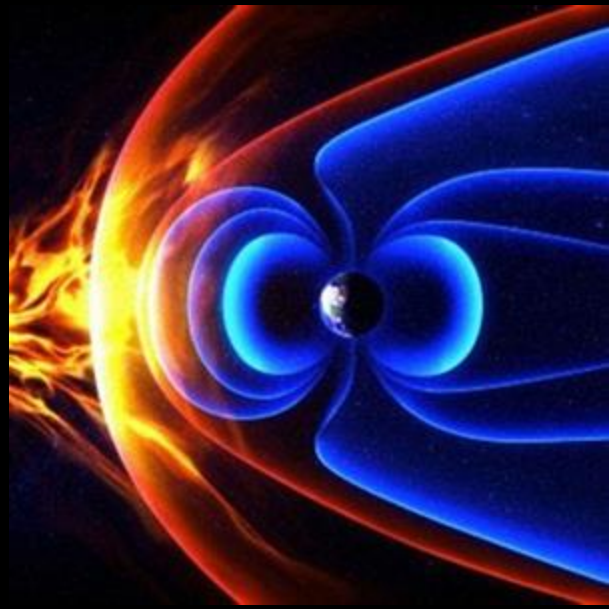
# Signs of Aurora Activity Across Entire State of Michigan




K6 Warnings/Watches
(G2 Storm)




60-90 Gigawatts of Hemispheric Power
(at least 30gw)



Extremely Low Bz at -10/-15
(at least -4 or -5 usually)

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

CLICK ON DETROIT

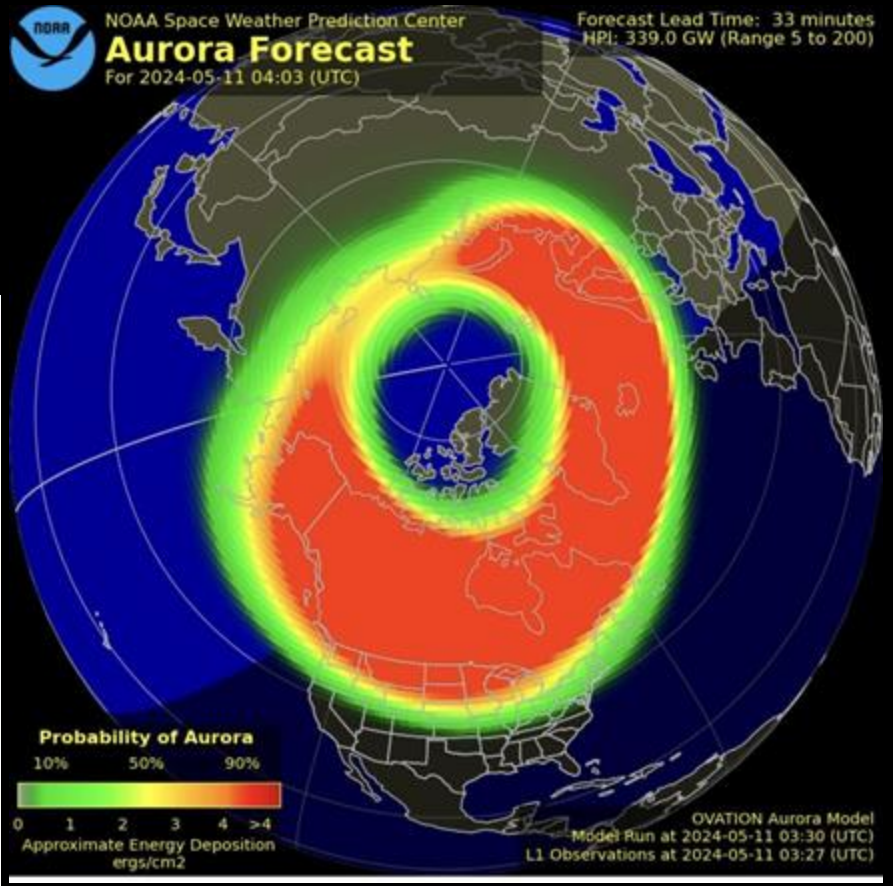
SPORTS FEATURES LIVE IN THE D ANN ARBOR CONTACT US NEWSLETTERS

**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?



# #LiveChase

Led a Live Chase on May 10, 2024, during historic G5 Storm. We celebrated 100K with a Statewide Live Chase, June 10, 2024!

*Photo by Patricia Parker*

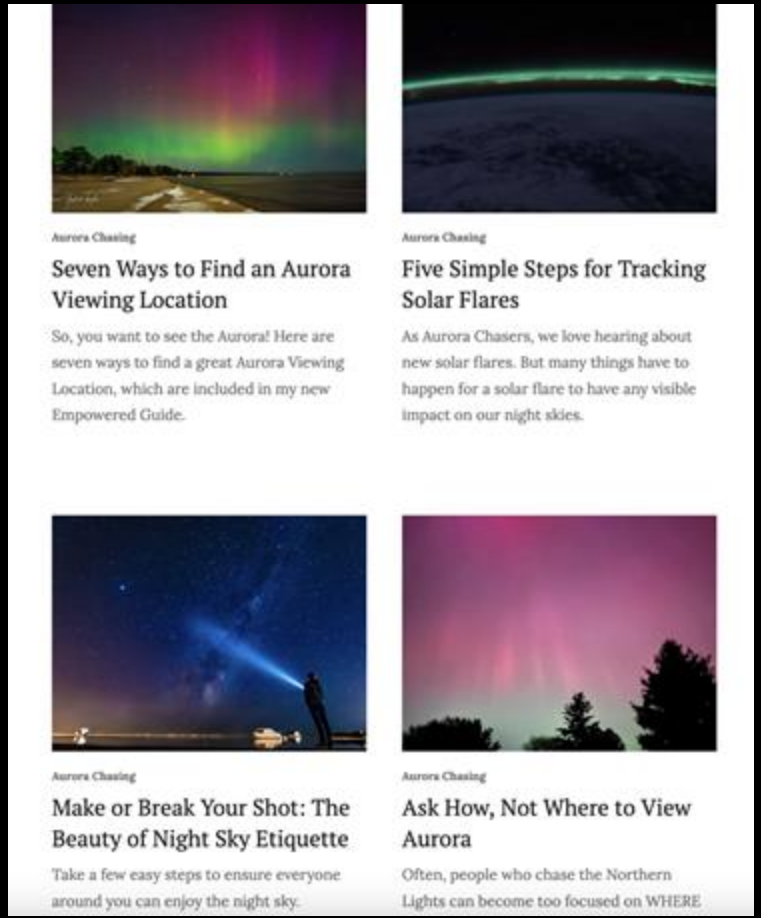
*Photo by Lauren Kovich*

*Photo by Karen Serwatowski*

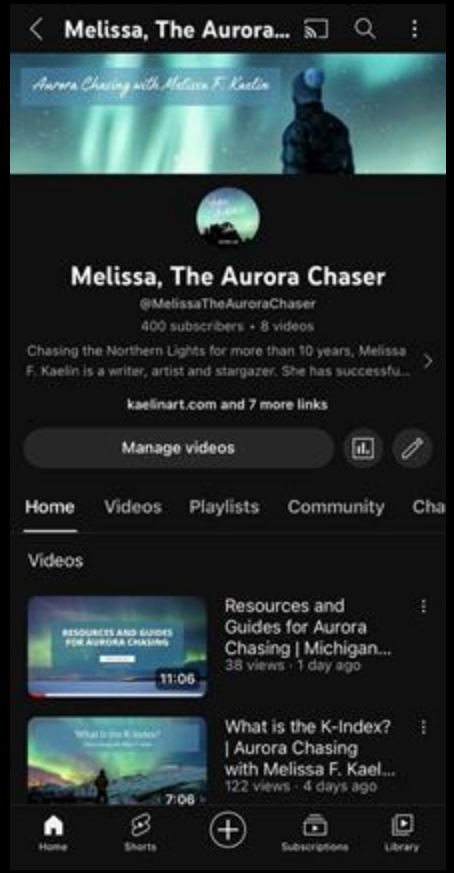
# MORE

# Guides to the Night & Etiquette

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

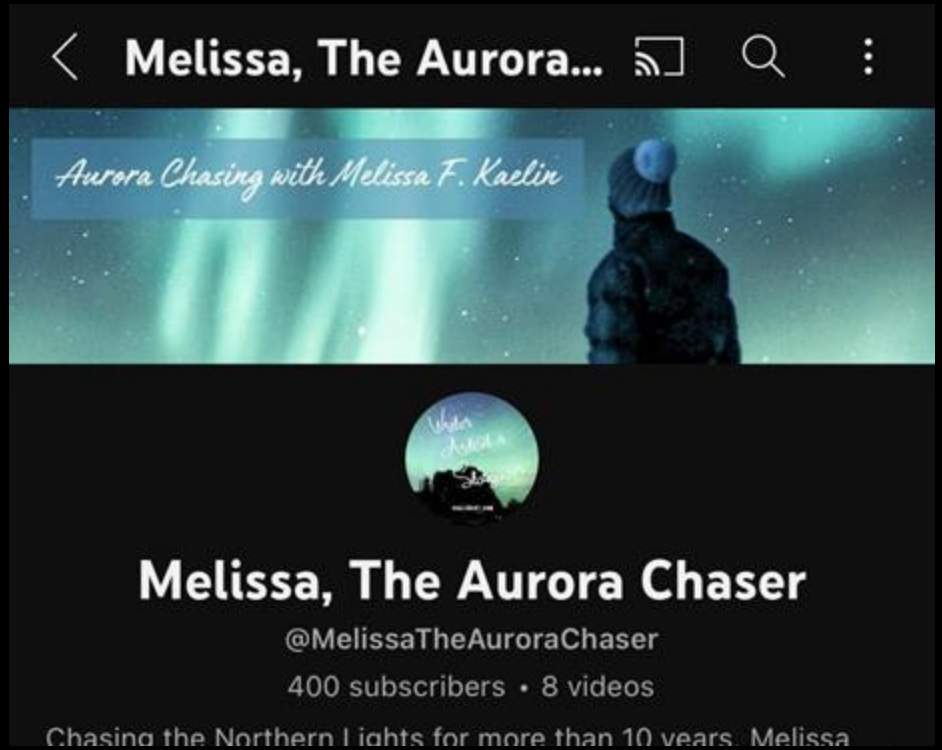



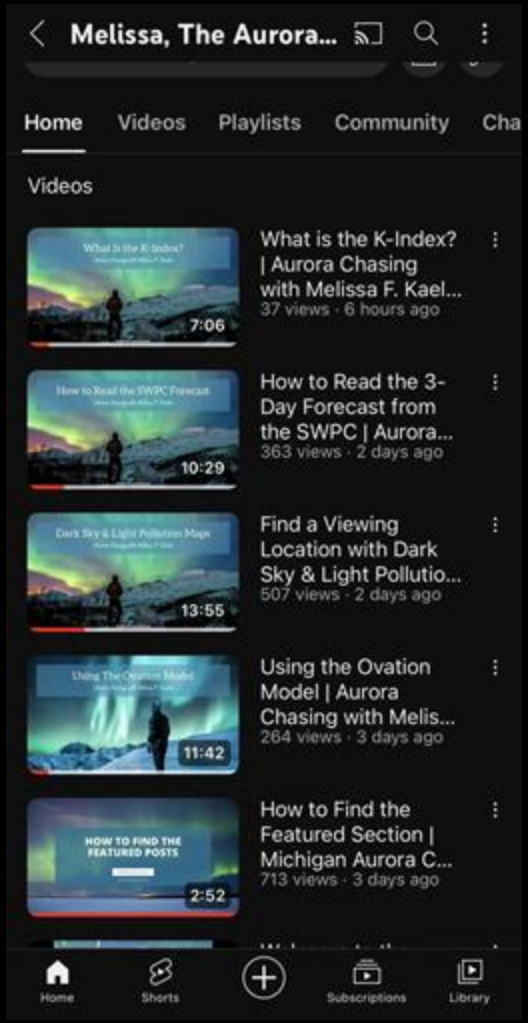

45TH PARALLEL SERIES




**Explore: KaelinArt.com/Aurora**

# Tutorials on YouTube



# Making the Dream a Reality

Find upcoming events, advice, tools, techniques, videos, books and more!

Visit: KaelinArt.com