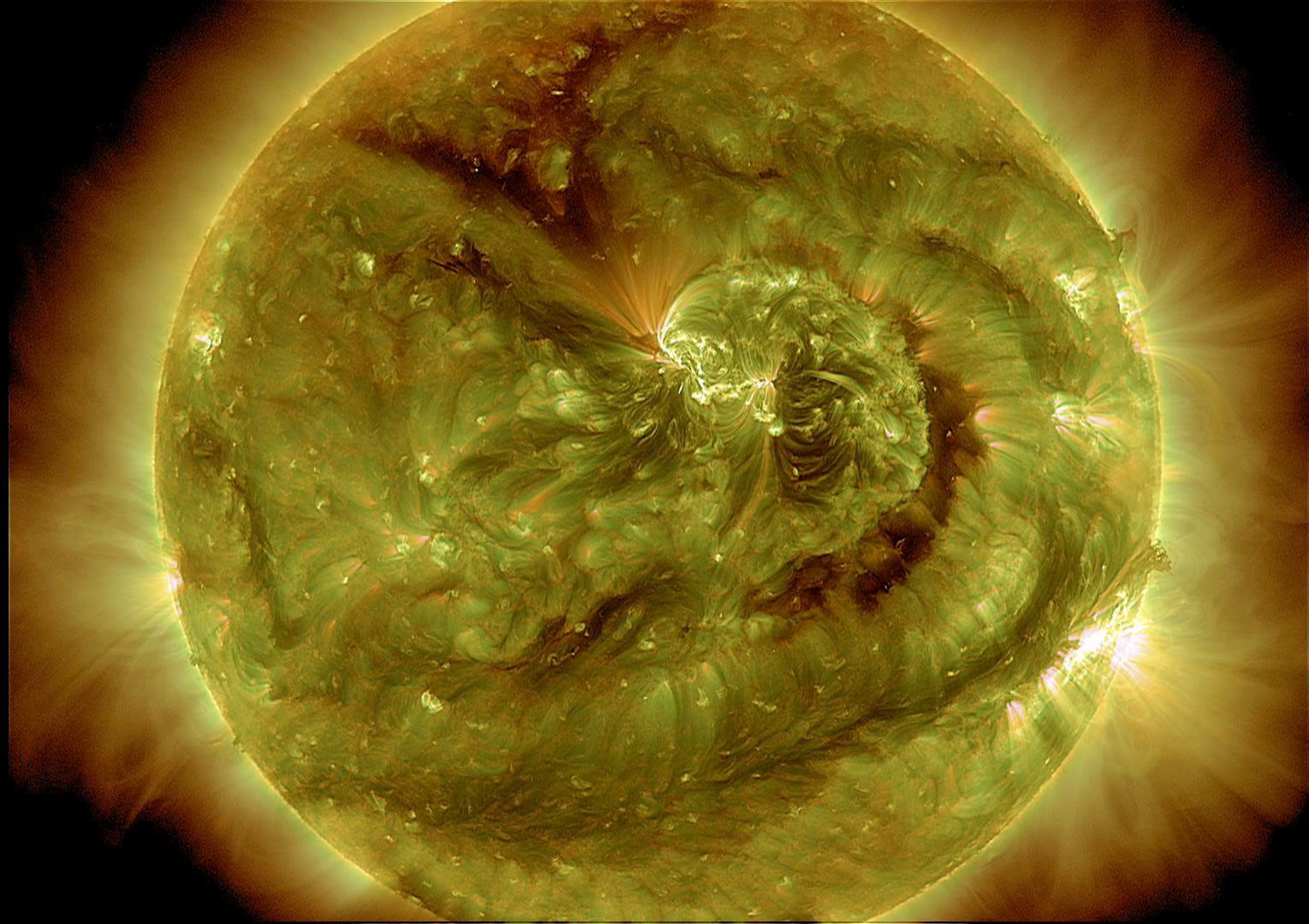


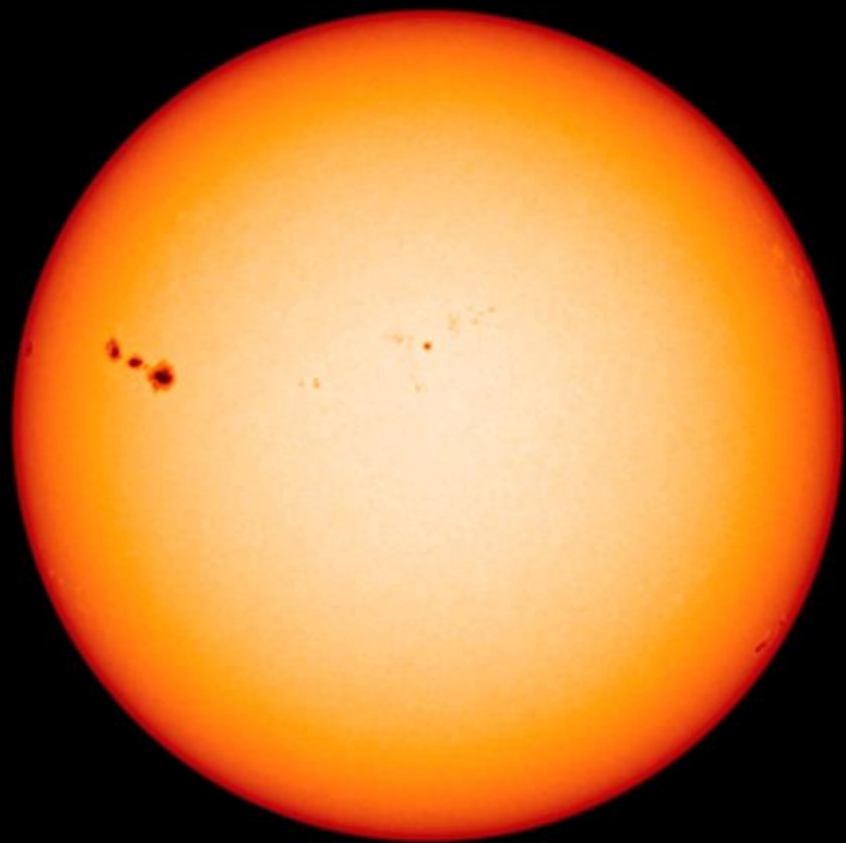


2017 ECLIPSE ACROSS AMERICA THROUGH THE EYES OF NASA

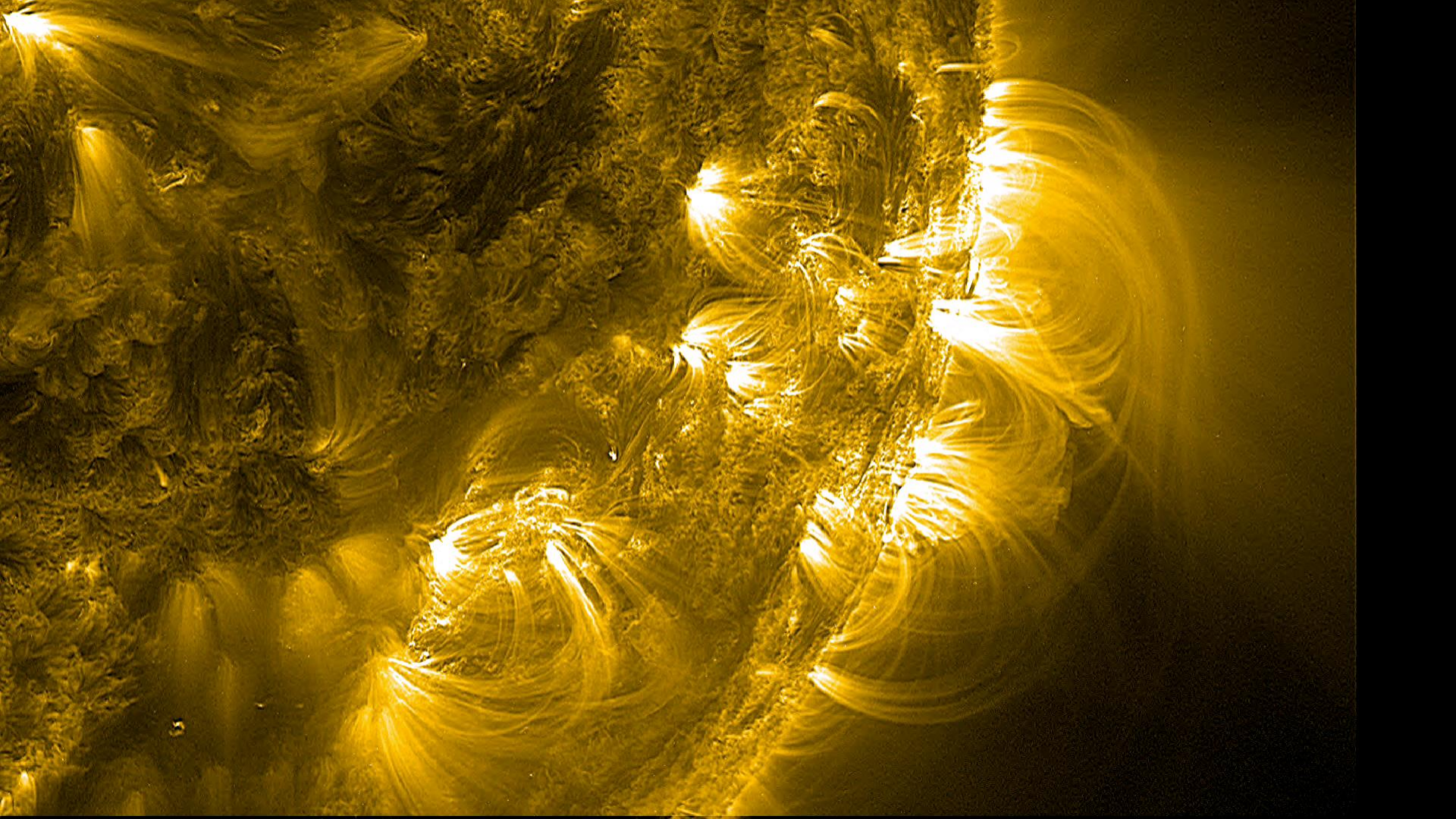
James Spann
NASA MSFC Chief Scientist
Science & Technology Office

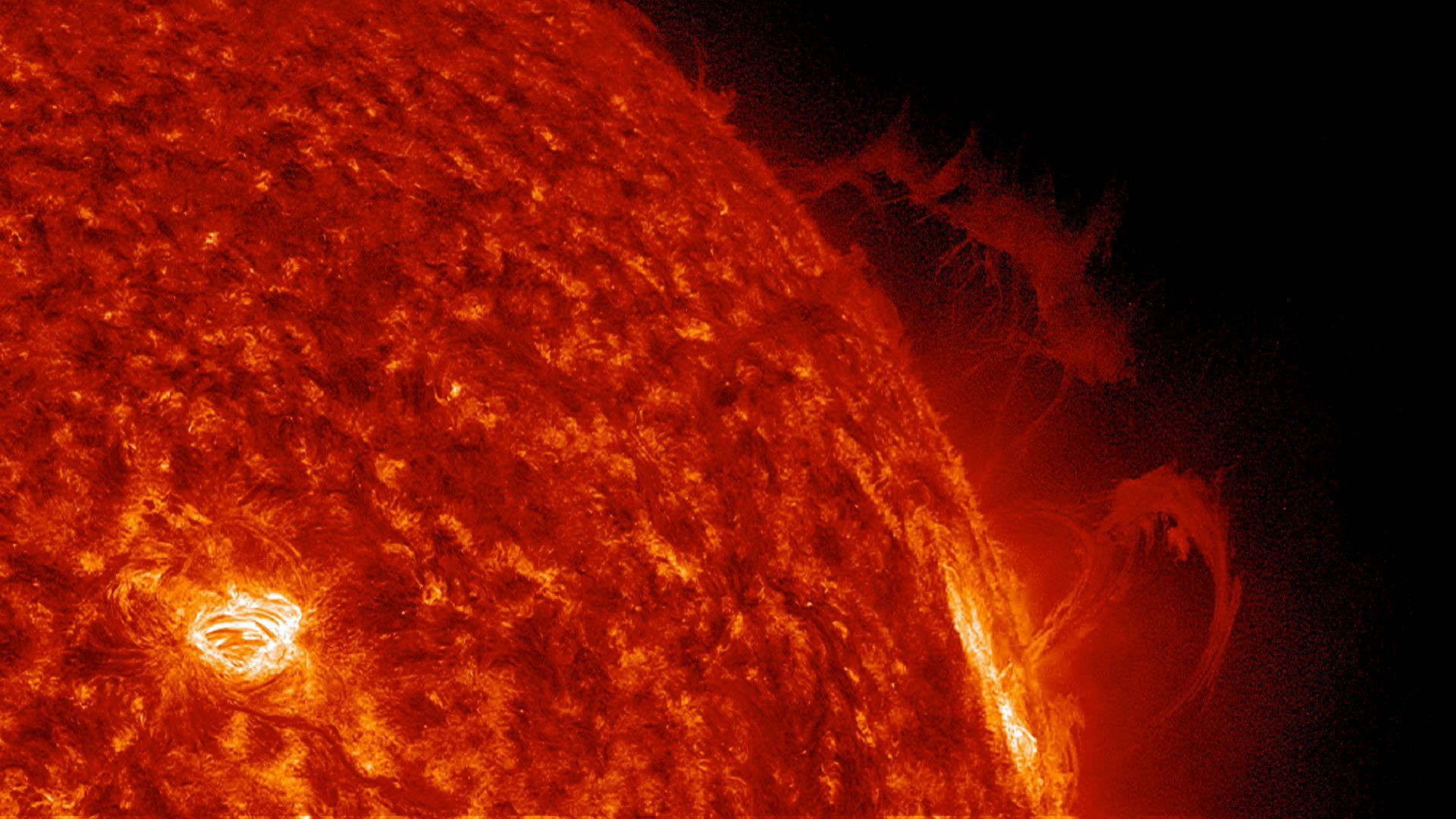






2011 Sep 25 07:32:20



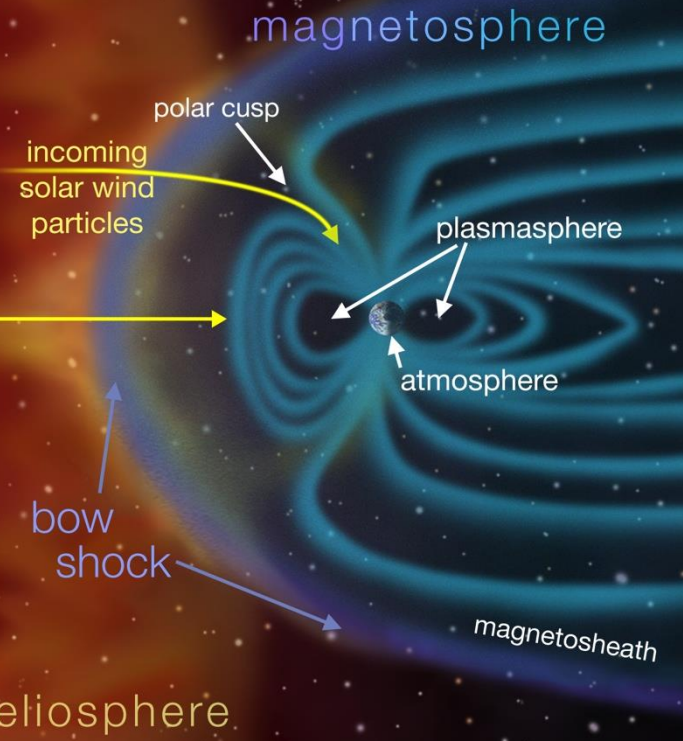
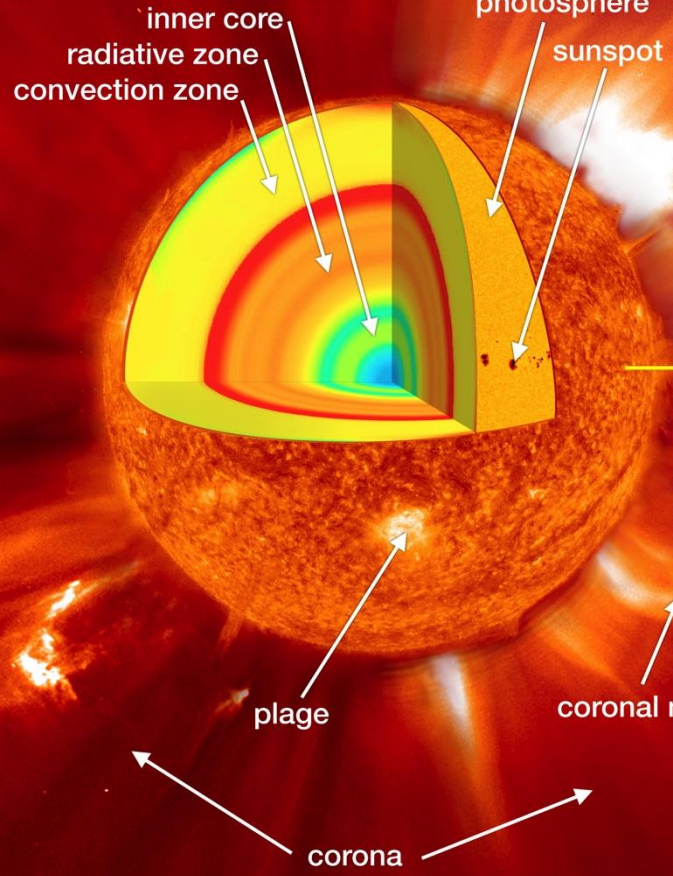


Safeguarding and Improving Life on Earth

Sun

Earth

Internal Structure:



photons

solar wind

Magnetic Storms at Earth

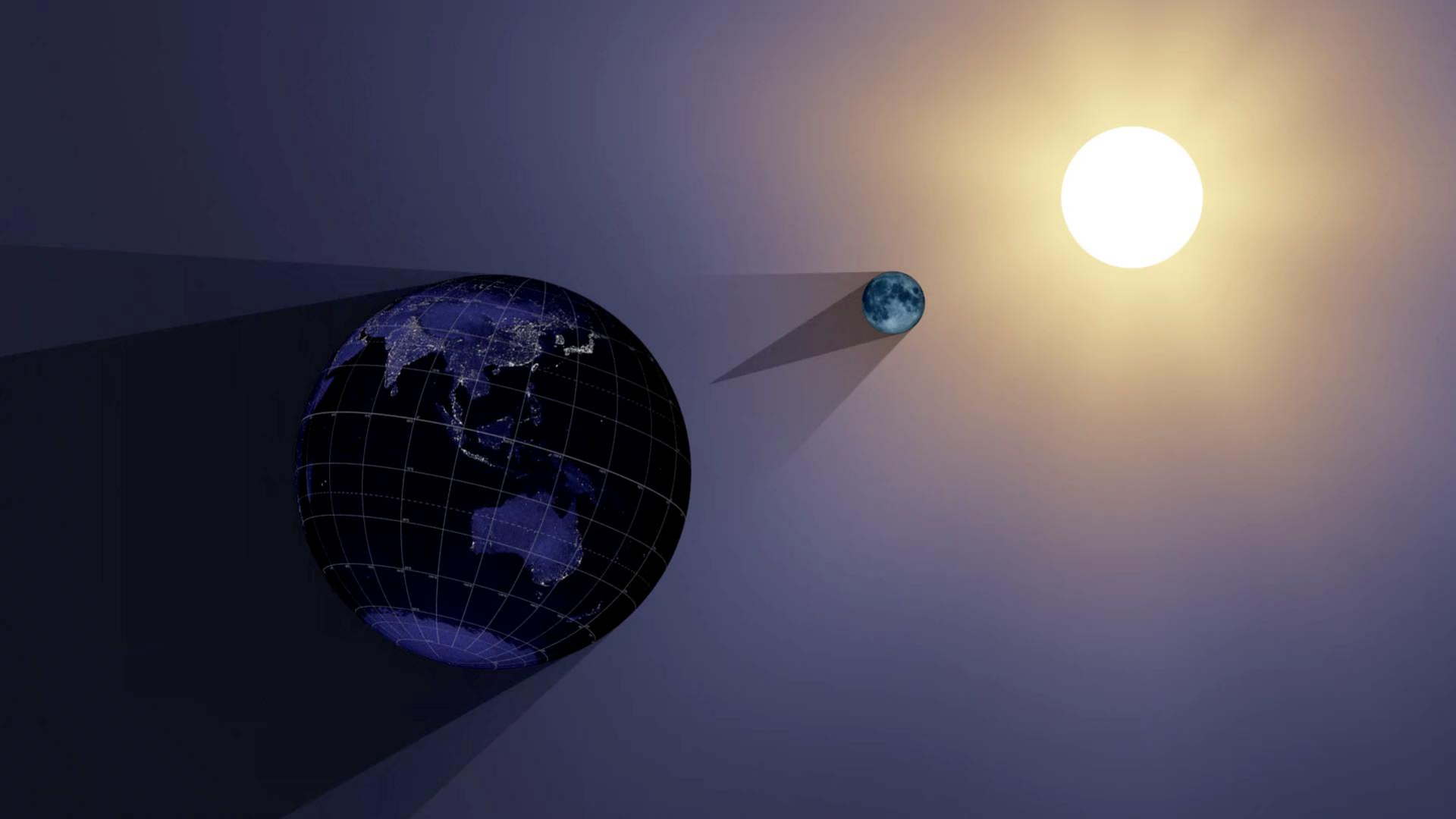


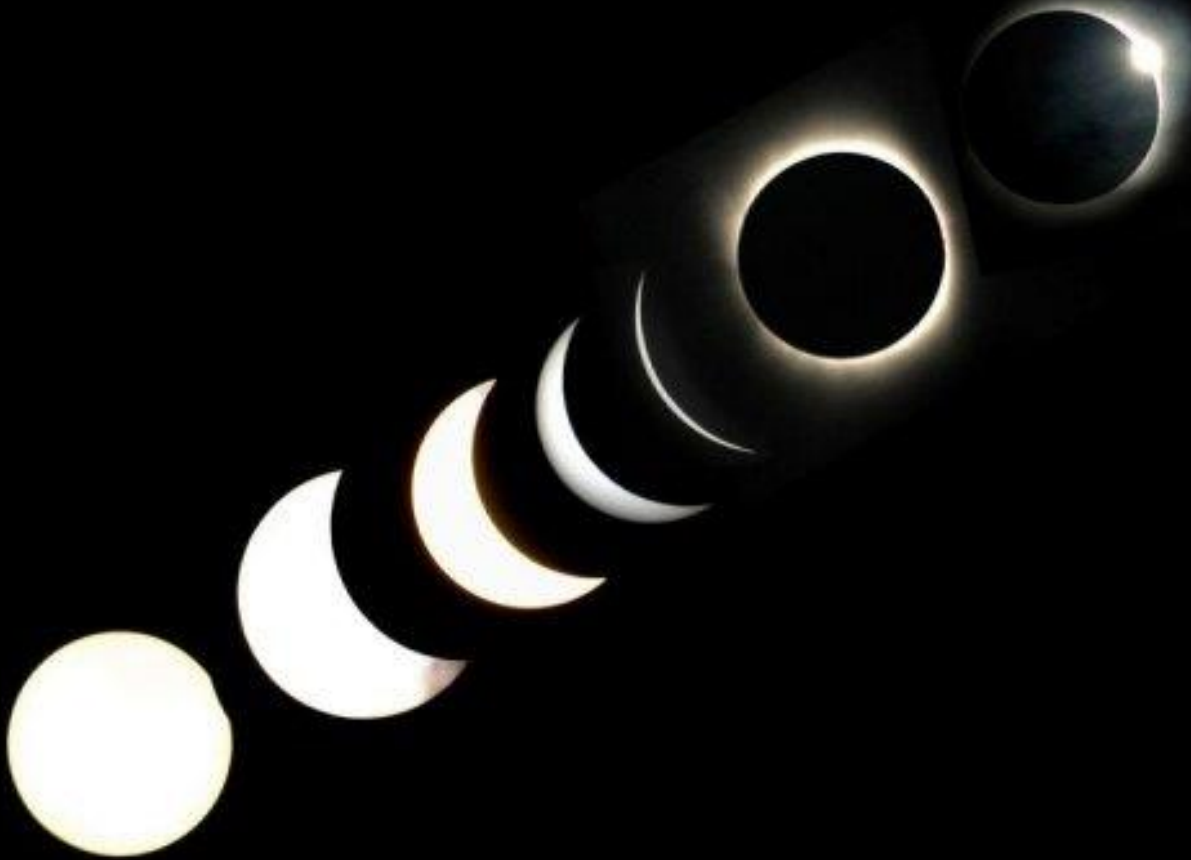
IMAGE-FUY-2000/07/15-14:00:39.U1

th39 Safeguarding and Improving Life on Earth







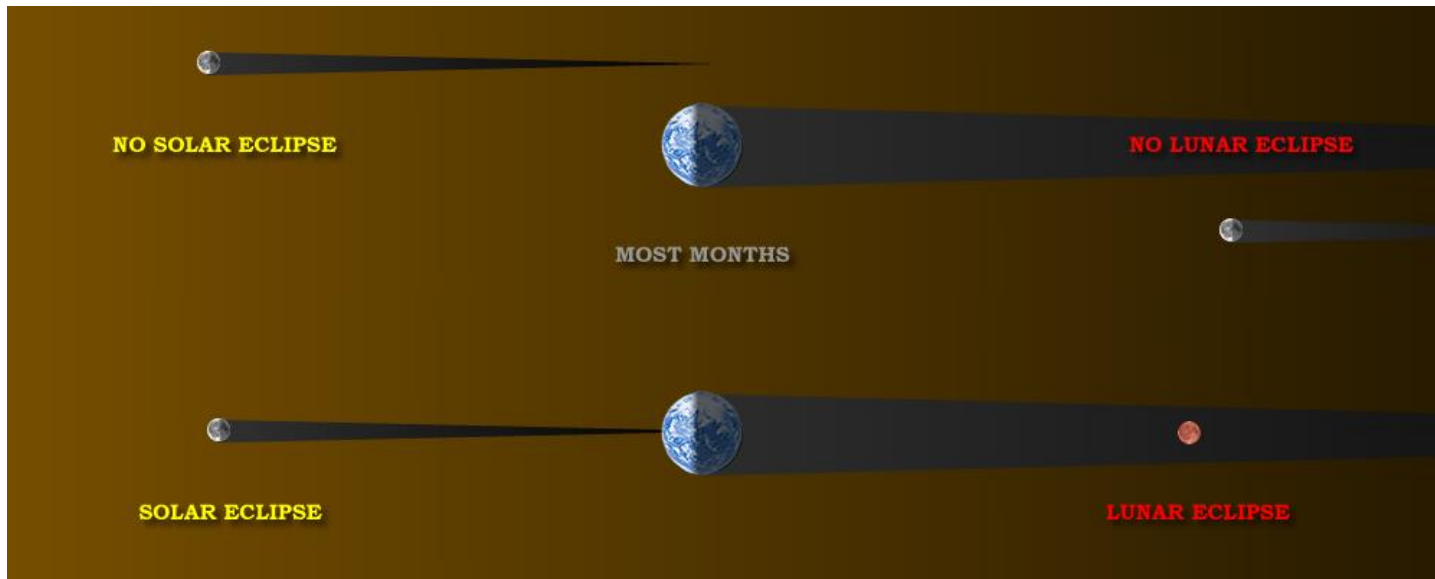


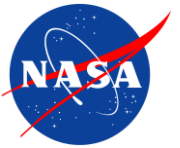
2017 ECLIPSE ACROSS AMERICA
Through the Eyes of NASA



Image Credit: S. Habbal, M. Druckmüller and P. Aniol

WHY ARE ECLIPSES SO RARE?





WHY DOES NASA CARE?

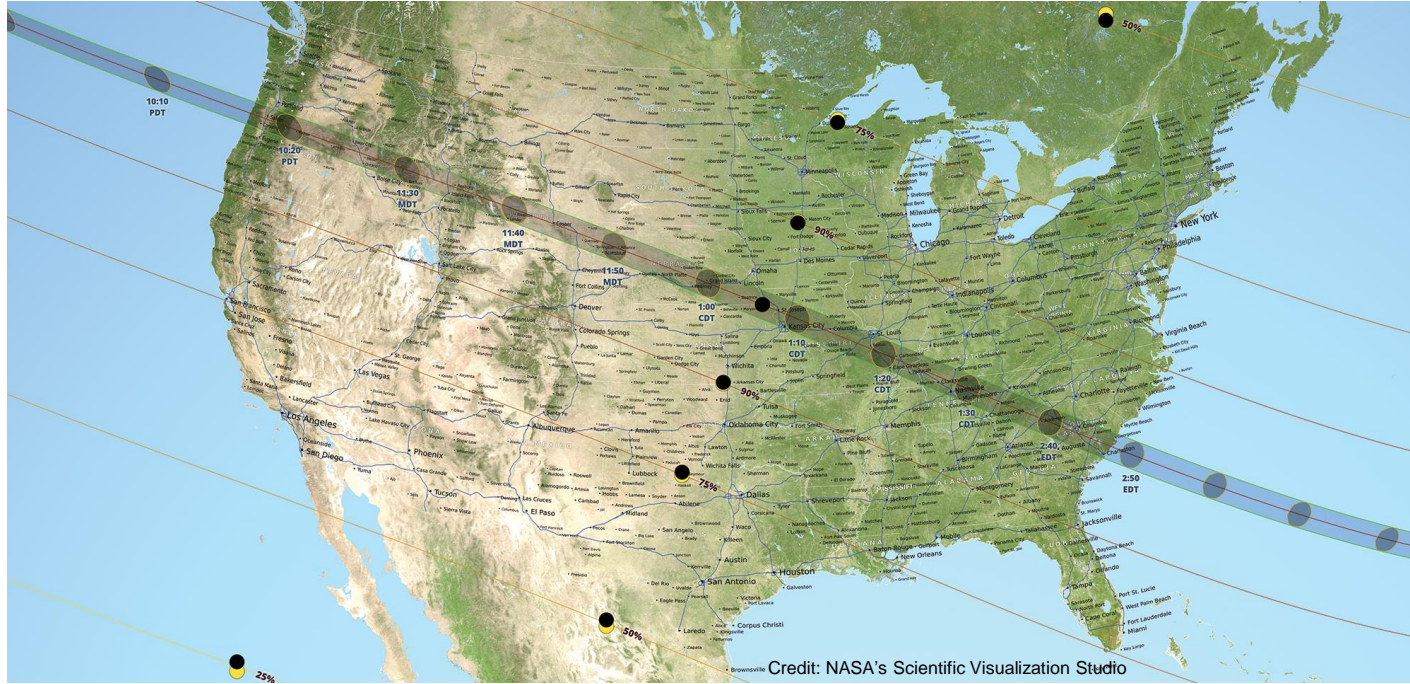
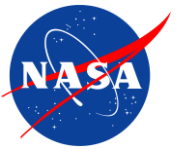
“...The expansion of human knowledge of the Earth and of phenomena in the atmosphere and space...” and to “provide for the widest practicable and appropriate dissemination of information concerning its activities and the results thereof...”

– 1958 NASA Space Act, as amended

1. Safety – NASA’s #1 core value and the #1 priority during any event
2. Science – Awareness of missions, science and return on investment
3. Education – Fundamental learning opportunity of nature’s processes
4. Public Engagement – Unique opportunity for all U.S. to participate
5. Citizen Science – Several apps for citizens to gather data on nature’s processes



**AUGUST 21, 2017: First total solar eclipse visible in the contiguous United States in 38 years.
First coast-to-coast since 1918.
First just in the USA since 1778.**



2017 ECLIPSE ACROSS AMERICA
Through the Eyes of NASA

PAST ECLIPSES



DENVER POST—FIRST IN EVERYTHING

THOUSANDS POINT GLASSES AT SUN TO WATCH ECLIPSE

MAP SHOWING PATH TOTAL ECLIPSE OF THE SUN ACROSS THE UNITED STATES, JUNE 8, 1918.

TOTAL ECLIPSE OF THE SUN, MAY 18, 1900, PHOTOGRAPHED AT WADESBORO, N.C., BY THE YERKES OBSERVATORY.

AMERICANS PUSH GERMANS BACK IN

Police Enforce Quiet So Astronomers at University May Make Priceless Observations—Movies to Be Taken—Throngs Seek Vantage Points.

1918

Section 1 "All the News That's Fit to Print" THE WEATHER Section 1

VOL. LXXIV No. 2471 NEW YORK, SUNDAY, JANUARY 20, 1925 FIVE CENTS

The New York Times.

ECLIPSE FOUR SECONDS LATE HERE, BUT A BRILLIANT SHOW; SEEN FROM LAND, SEA AND AIR, IT THRILLS MILLIONS; CITY HALTS TO GAZE; SCIENTISTS NOW STUDY THE DATA

CORONA DIMLY BEAUTIFUL

Dr. Luyten, The Times Observer, Describes the Scene From Airplane.

MULTITUDE ON WATCH HERE

Awed by Jewel of Light Hanging From Luminous Ring.

PROGRESS OF THE ECLIPSE.

MOON BLACK IN TOTALITY

Its Brownish Tinge and the Shadow Bands Assent Above Dense Atmosphere.

SUN AFFECTS RADIO, OBSERVATIONS SHOW

Short Waves From Schenectady Become Inaudible and Long Waves Steadied in Eclipse.

EXPERTS OFFER IN VIEWS

One Seen Threaten of the Influence of Light Gloomed, but Others Deny It.

SKYSCRAPERS BLINK IN EMPTY STREETS

Downtown Like Sunday—Both Celestial Visibility Zone Are Clouded With Gases.

CITY MIGRATES TO NORTH

Perfect Weather Alikes Young and Old, Teachers and Out, in Sun Spectacles.

EARLY MOON LIKE TWILIGHT

Mayor Views Spectacle From City Hall Steps—Thousands Gather at Battery Park.

THE GLORY OF THE ECLIPSE

The Moon as It Was Observed Being Observed by Scientists on Los Angeles Praise First Dirigible Eclipse Flight

Photograph Spicily at 8,500 Feet by Old Woman From L. I.—Discovery of New Element Held Possible—Anchovy Back in Hunger After Protein Diet.

4 SLAIN IN HERRING; CLEAN YOUNG VICTIM

Klein "Dry" Rider and "Man-Killer" Shot Down by Deputy Sheriff Thomas.

LATTER KILLED IN TUN

Man Organized to Give in Educational Movement—War Peace Advocacy in Movement.

WOMEN PLAN CAMPAIGN

More Organizations to Give in Educational Movement—War Peace Advocacy in Movement.

WIDE-BOTTOM COLLEGE TOWERS ARE FRAMED ON BY COLLIER

Report in The New York Times

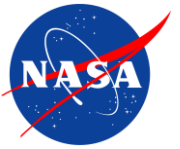
WIDE-BOTTOM COLLEGE TOWERS ARE FRAMED ON BY COLLIER

Report in The New York Times

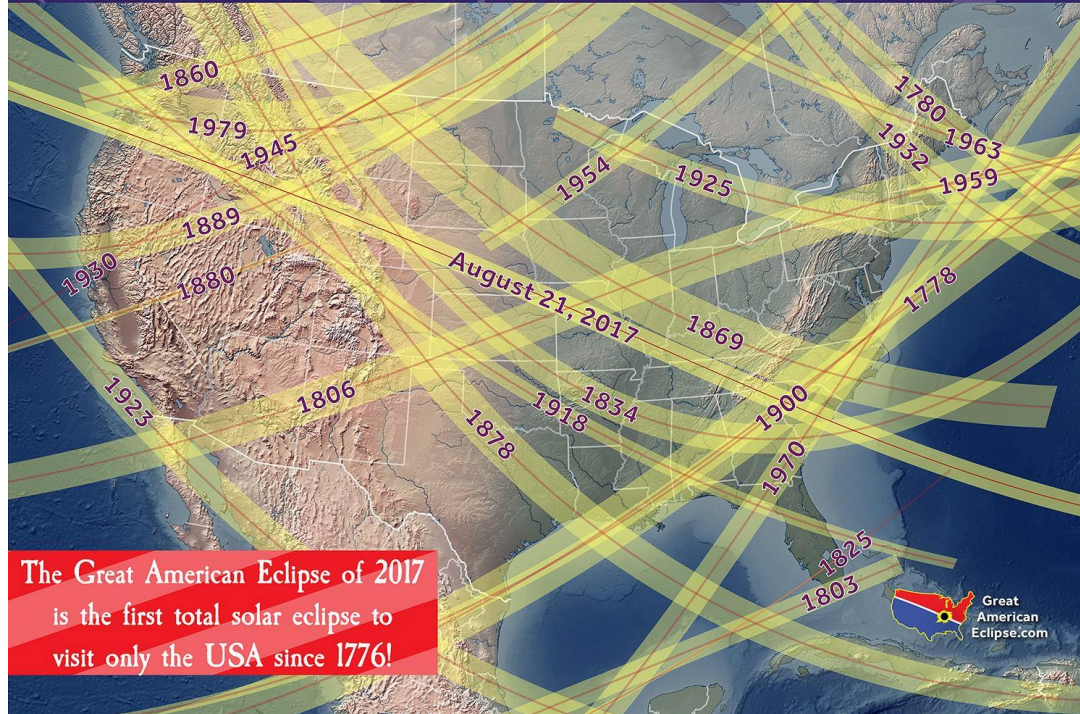
1925



2017 ECLIPSE ACROSS AMERICA
Through the Eyes of NASA

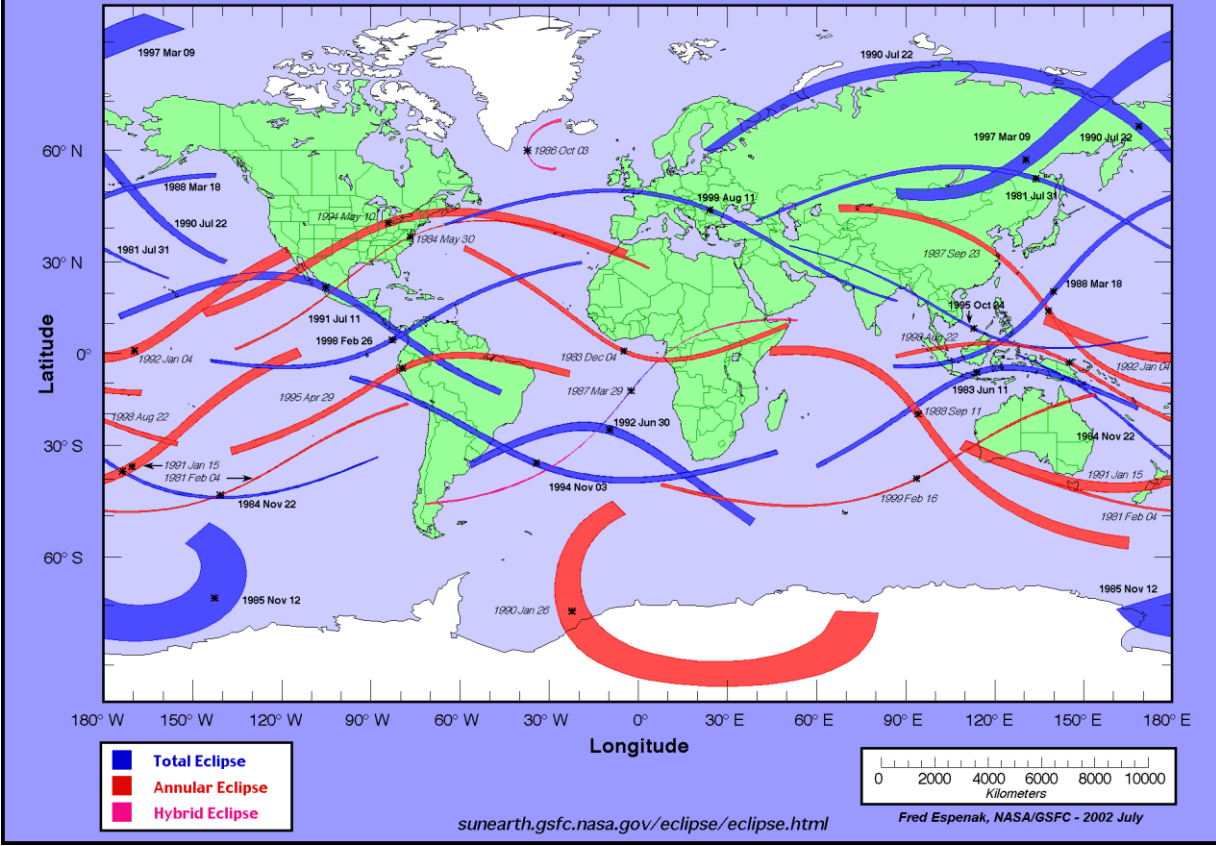


All the total solar eclipses across the United States of America from 1776 to 2017





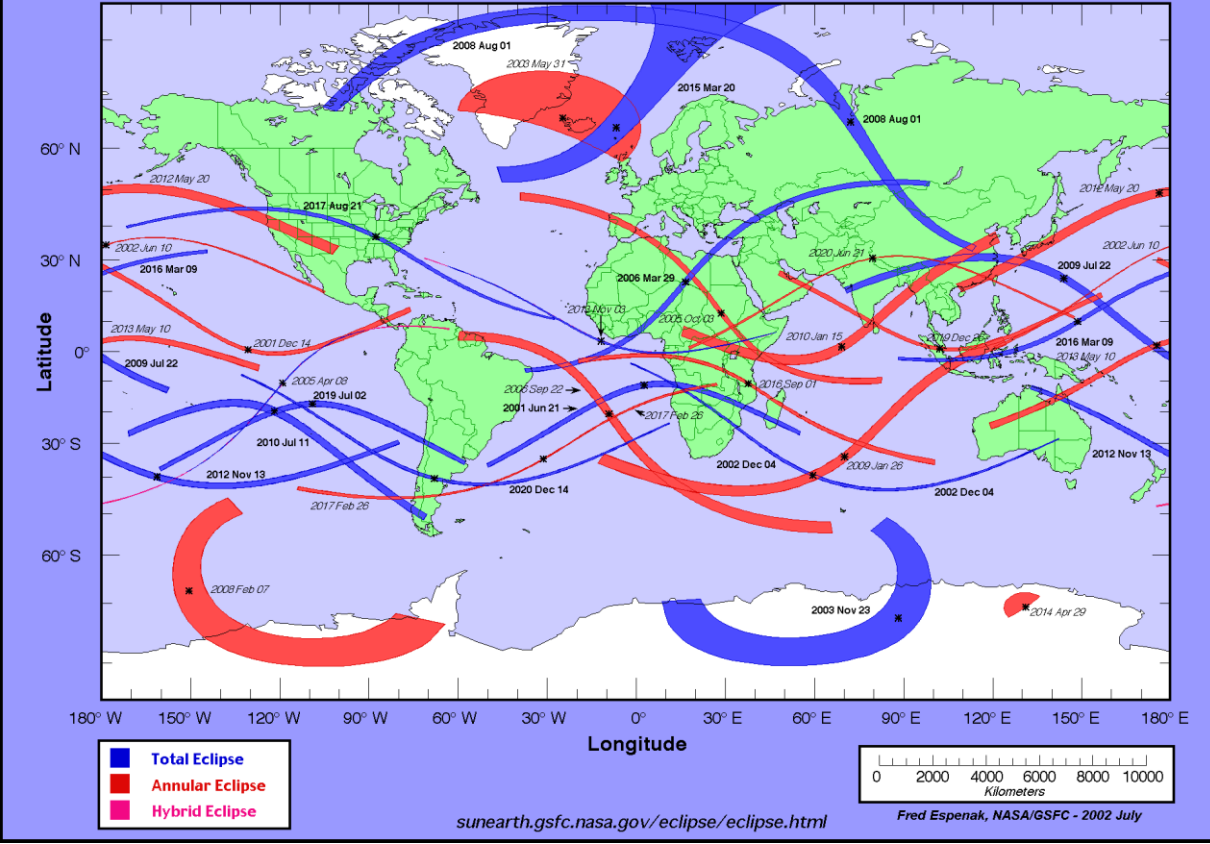
Total and Annular Solar Eclipse Paths: 1981-2000



2017 ECLIPSE ACROSS AMERICA
Through the Eyes of NASA

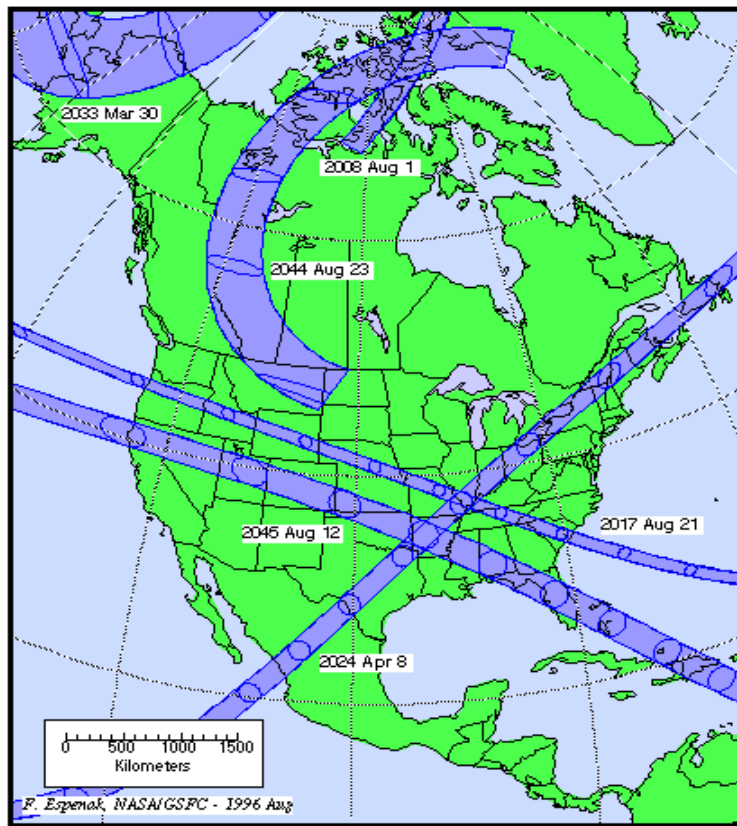


Total and Annular Solar Eclipse Paths: 2001 – 2020



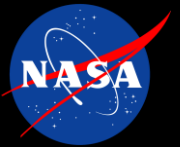
2017 ECLIPSE ACROSS AMERICA
Through the Eyes of NASA

TOTAL SOLAR ECLIPSES ACROSS NORTH AMERICA 2001 - 2050



2017 ECLIPSE ACROSS AMERICA
Through the Eyes of NASA

What You Can See: Shadow Bands



Light shines through air, creating a wavy pattern similar to light through water in a pool

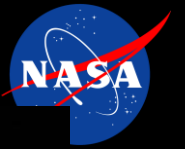




What You Can See: Diamond Ring and Bailey's Beads



What You Can See: The Corona and Prominences

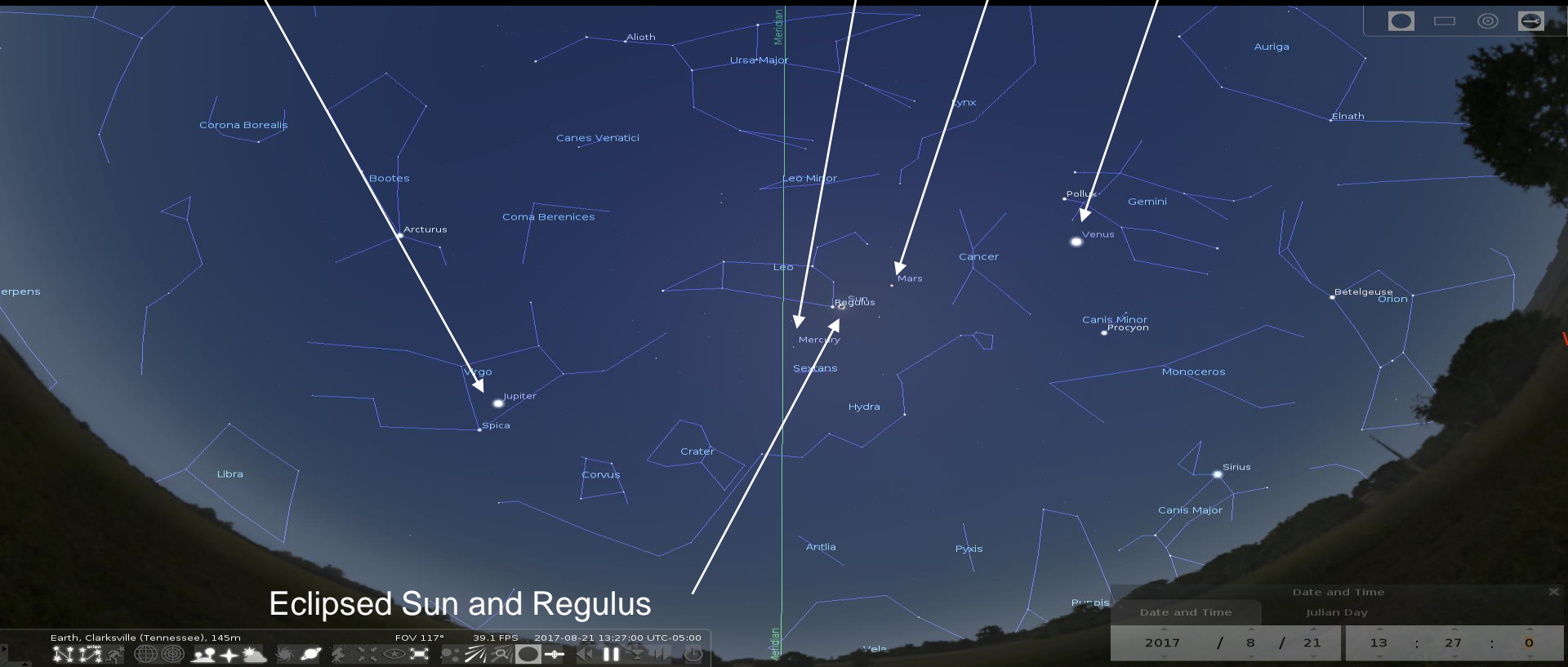


Rob Lucas, with Jay Pasachoff's 2013 Eclipse Expedition
Image Used With Permission

What You Can See: The Sky During Totality



Jupiter is to the east of the Meridian (left), Mercury, Mars, and Venus to the west.



Eclipsed Sun and Regulus

Earth, Clarksville (Tennessee), 145m FOV 117° 39.1 FPS 2017-08-21 13:27:00 UTC-05:00



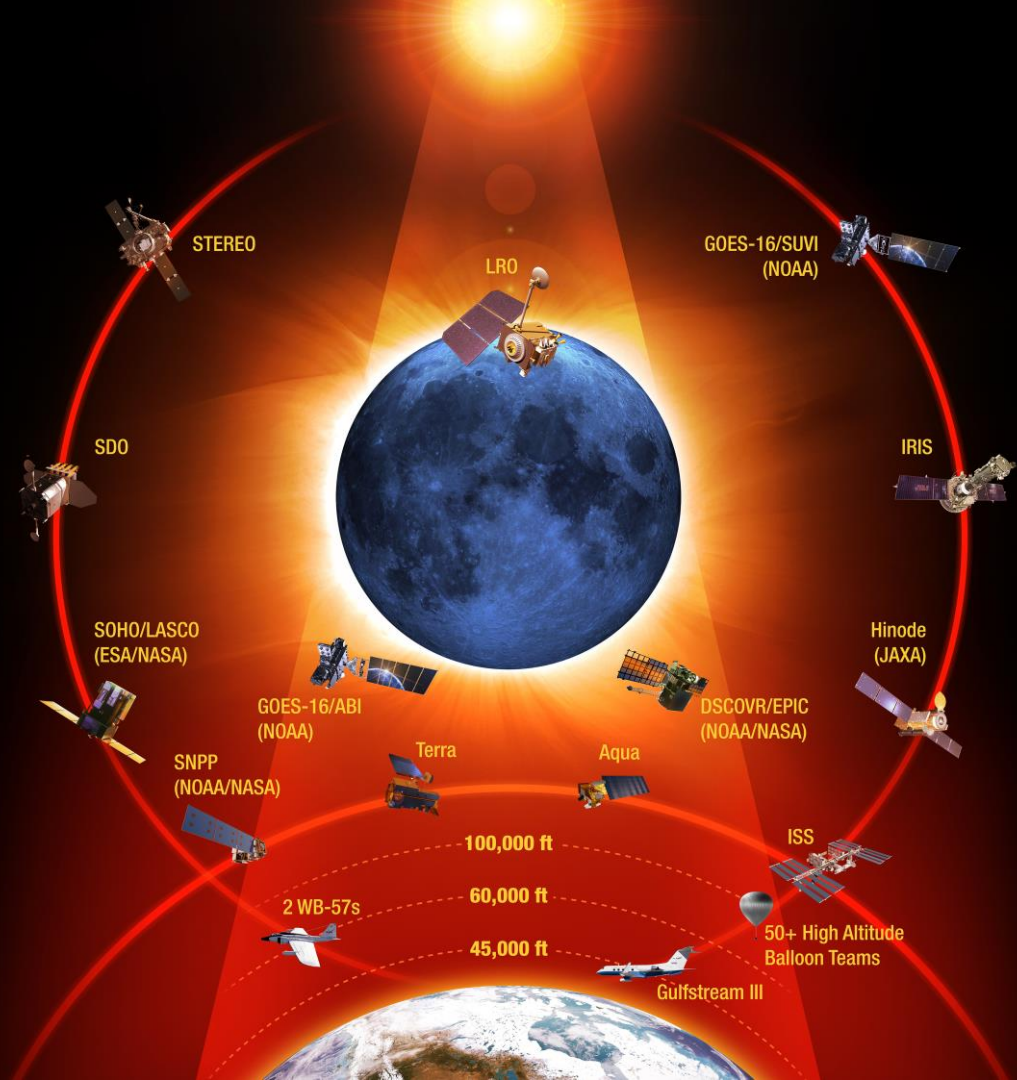
Date and Time

Date and Time	Julian Day
2017 / 8 / 21	13 : 27 : 0

Awareness of missions, science and return on investment:

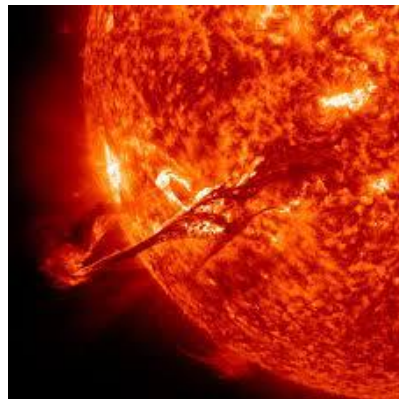
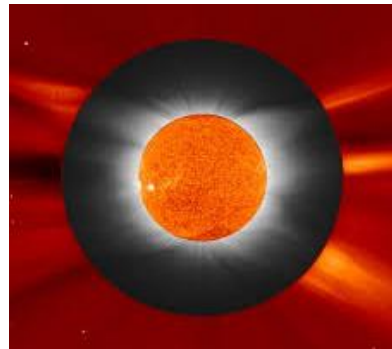
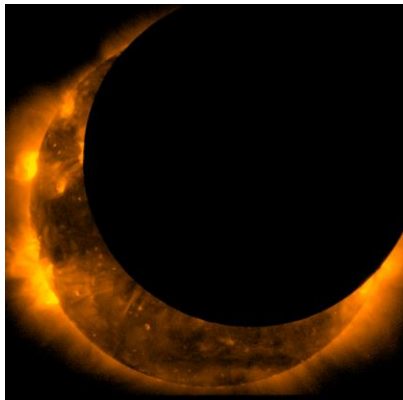
- NASA science missions and programs
- Seeing the sun
- Observing from the ground
- Observing Earth
- Studying the Moon
- Tracking planetary eclipses
- Finding exoplanets

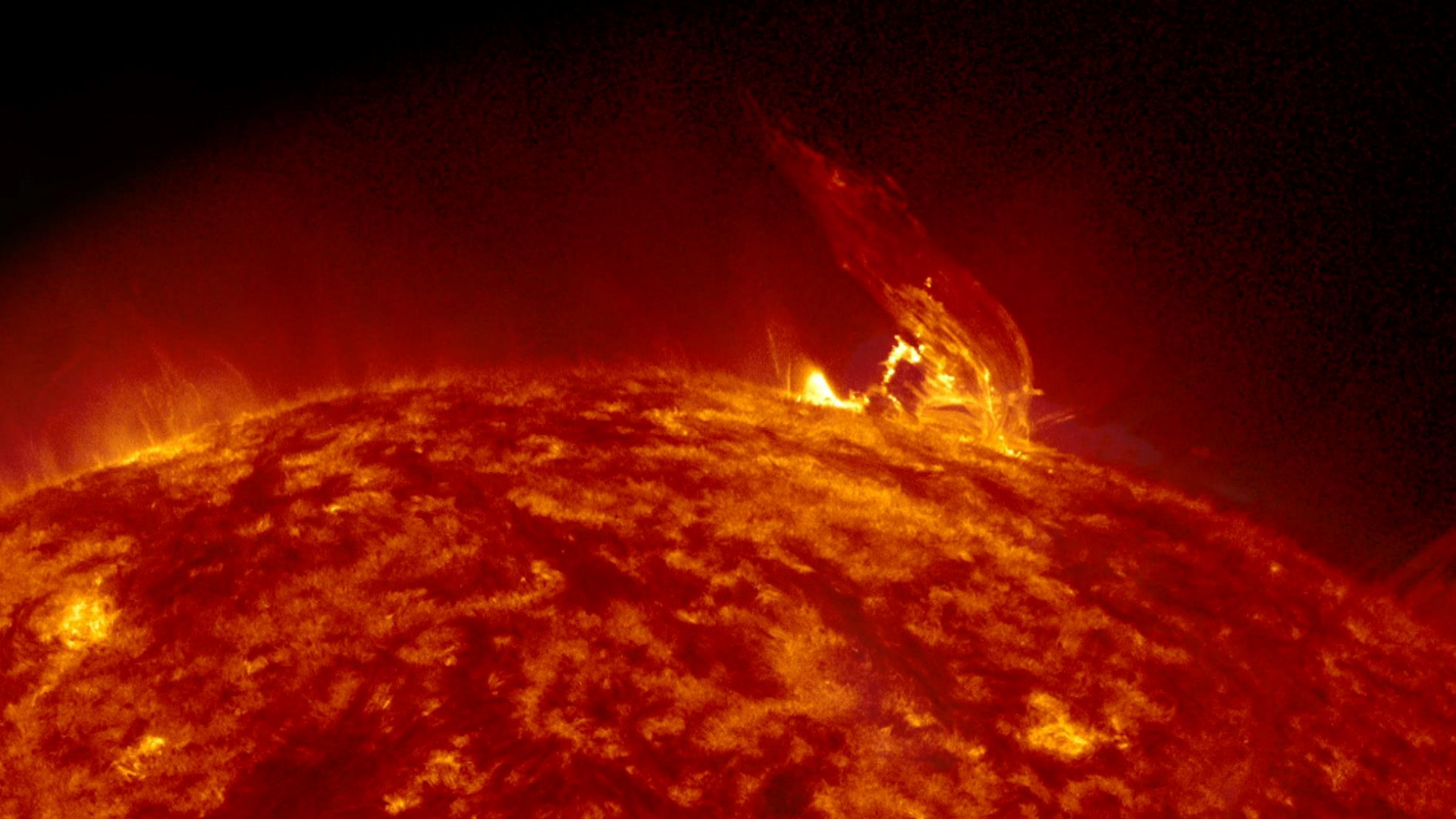


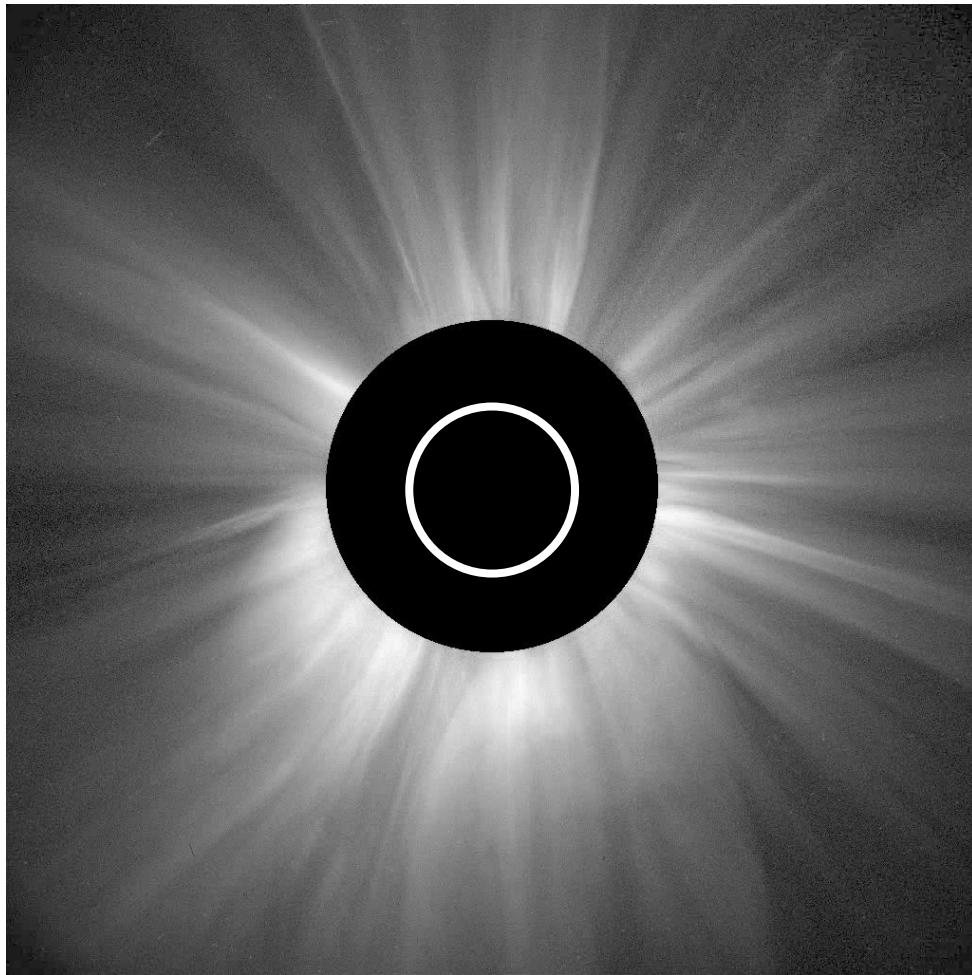
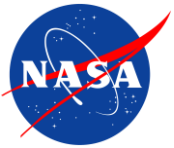


Awareness of missions, science and return on investment:

- NASA science missions and programs
- **Seeing the sun**
- Observing from the ground
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2017 ECLIPSE ACROSS AMERICA
Through the Eyes of NASA



Image Credit: S. Habbal, M. Druckmüller and P. Aniol

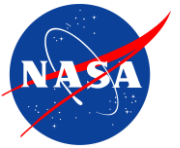
Awareness of missions, science and return on investment:

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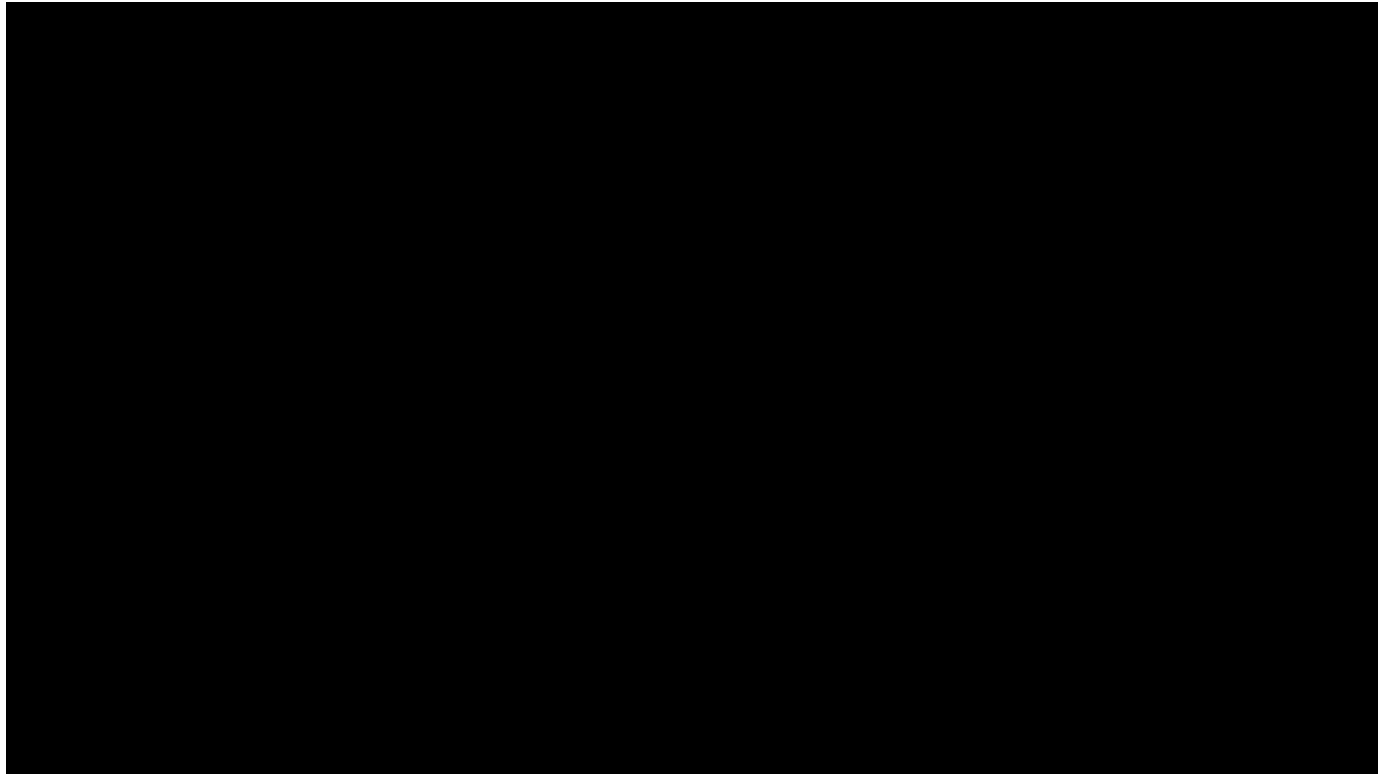
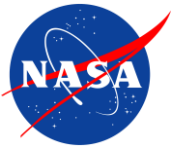
NASA funded a team to train volunteers to collect images of the eclipse for the Citizen Continental-America Telescopic Eclipse (CATE) Experiment to study the dynamics of the inner solar corona.



The GLOBE community contributes scientific data to NASA and GLOBE, your local community, and students and scientists worldwide



SPACE GRANT SUPPORTED SCIENCE



2017 ECLIPSE ACROSS AMERICA
Through the Eyes of NASA

Awareness of missions, science and return on investment:

- NASA science missions and programs
- Seeing the sun
- Observing from the ground
- **Observing Earth**
- Studying the Moon
- Tracking planetary eclipses
- Finding exoplanets



EPIC

March 09 0040 UT

Himawari-8





Monday, August 21, 2017

09:25:40 a.m. PDT

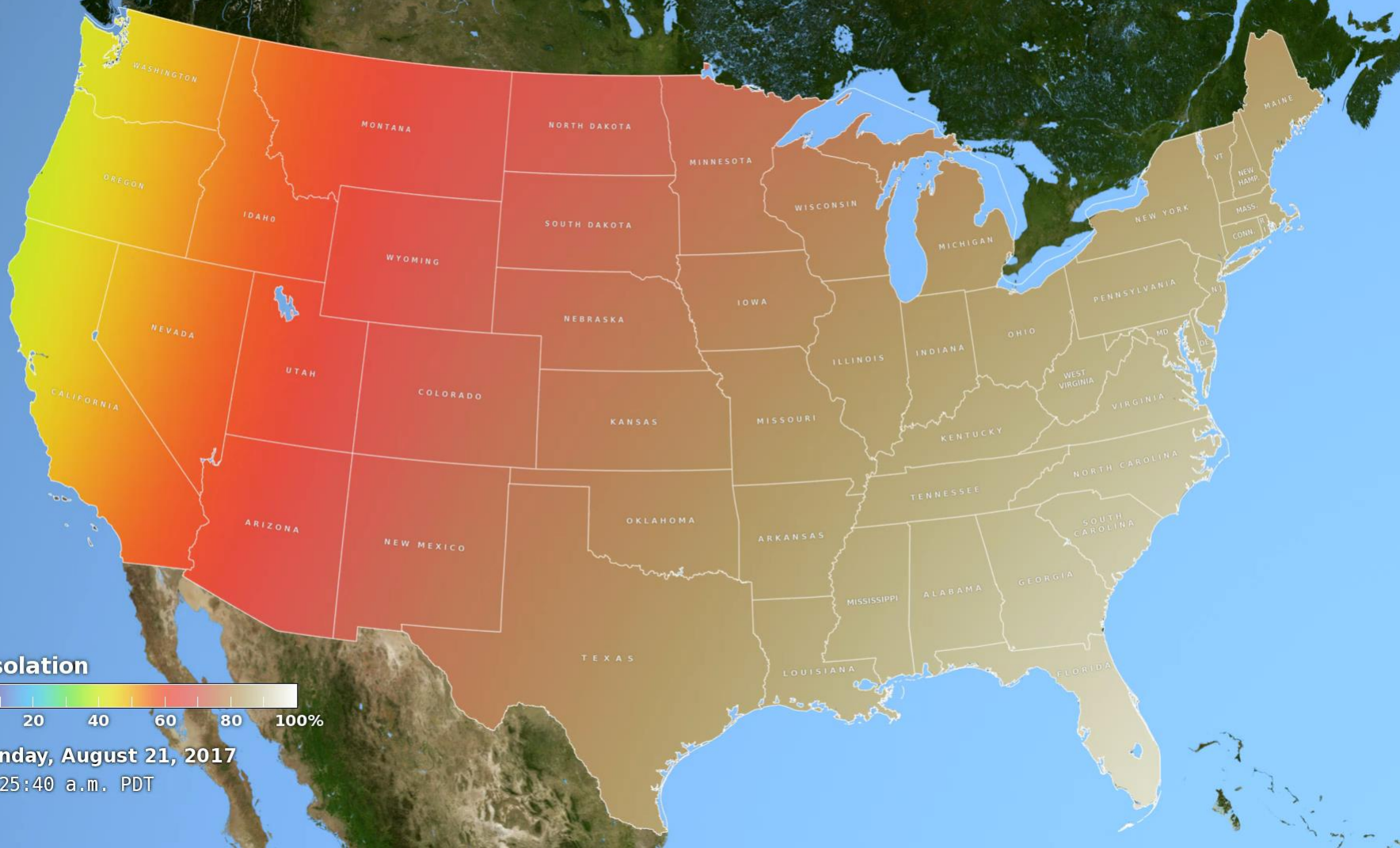
**Time
Center
Duration
Sun Altitude**

Insolation



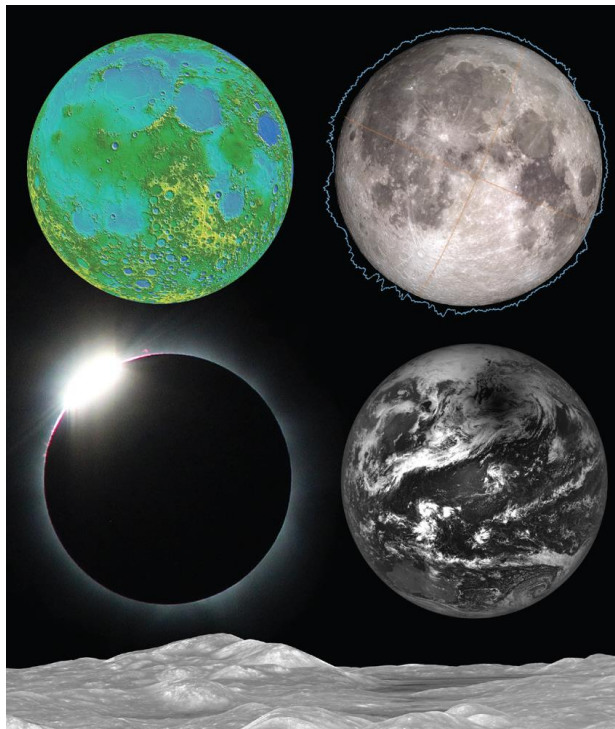
Monday, August 21, 2017

09:25:40 a.m. PDT



Awareness of missions, science and return on investment:

- NASA science missions and programs
- Seeing the sun
- Observing from the ground
- Observing Earth
- **Studying the Moon**
- Tracking planetary eclipses
- Finding exoplanets





• Merna

• Broken Bow

• Arcadia

• Scotia

• Wolbach

• Belgrade

• Genoa

• Columbus

• Callaway

• Ansley

• Loup City

• Elba

• St. Paul

• Fullerton

• Silver Creek

• Bellwood

• David City

• Oconto

• Mason City

• Litchfield

• Dannebrog

• Central City

• Osceola

• Brainard

• St. Joseph

• Cozad

• Sumner

• Pleasanton

• Ravenna

• Cairo

• Chapman

• Benedict

• Staplehurst

• Seward

• Lexington

• Amherst

• Wood River

• Grand Island

• York

• Utica

• Goehner

• Milford

• Eustis

• Elwood

• Bertrand

• Kearney

• Trumbull

• Henderson

• Friend

• Crete

• Kenesaw

• Hastings

• Sutton

• Geneva

• Wilber

• Oxford

• Holdrege

• Minden

• Roseland

• Clay Center

• Geneva

• De Witt

• Bridge

• Atlanta

• Hildreth

• Blue Hill

• Fairfield

• Edgar

• Shickley

• Ohio

• Western

• De Witt

• Oxford

• Campbell

• Nelson

• Davenport

• Daykin

• Alexandria

• Beaver City

• Hebron

• Fairbury

SUN AND EARTH SCIENCE SUPPORTED THROUGH AO



Total solar eclipses help us understand the sun-Earth connection. NASA is funding 11, sun-focused and Earth-focused, studies:

- Physics of the coronal plasma
- Measuring temperature and flow speed in the solar corona
- Interdisciplinary airborne science from NASA's WB-57
- Measuring the infrared solar corona
- Citizen science: measuring the polarization of solar corona
- Rosetta-stone experiments at infrared and visible wavelengths
- Induced changes in the ionosphere over the continental U.S.
- Contributions of ionization sources on the ionosphere
- Empirically-guided solar eclipse modeling
- Using spacecraft and ground-based instruments for radiative transfer
- Land and atmospheric responses



Credit: Marla Hladiuk



August 21, 2017



12.2
MILLION
AMERICANS

3.8% OF
THE NATION

LIVES WITHIN
THE PATH OF
TOTAL SOLAR
ECLIPSE

The sight of a lifetime!



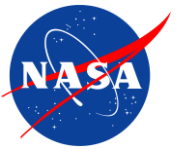
ON THE DAY OF THE ECLIPSE



- Safety first!!
- Plan!
- Watch
- Enjoy



eclipse2017.nasa.gov



The screenshot shows a web browser window displaying the NASA website for the 2017 Total Solar Eclipse. The browser tabs include 'ITCD - LARGE FILE TR...', 'NOMAD Large File Tra...', 'Total Solar Eclipse 201...', 'OpenDrive', 'New Tab', and several 'Access Launchpad' tabs. The address bar shows 'Secure https://eclipse2017.nasa.gov'. The website header features the NASA logo, the 'total Eclipse' logo, and navigation links for 'ECLIPSE 101', 'EVENTS', 'SCIENCE', 'ACTIVITIES', 'EDUCATION', and 'RESOURCES'. The main banner image shows a city skyline at night with silhouettes of people looking at the sun, with the text 'EXPERIENCE THE 2017 ECLIPSE ACROSS AMERICA AUGUST 21, 2017' and a 'Read More' button. Below the banner is a yellow bar with an 'Eclipse Countdown Until First Contact in Oregon August 21, 2017 UT:' and a digital timer showing '28:00:14' (Days: 28, Hours: 00, Minutes: 14). To the right of the timer are social media icons for Facebook, Twitter, YouTube, Instagram, and Snapchat. The main content area has a white background with a paragraph about the eclipse and six icons representing different categories: Science (atom symbol), Safety (glasses), Public Engagement (group of people), Citizen Science (group of people with a magnifying glass), Education (classroom building), and Events (calendar). At the bottom, there is a dark blue bar with a series of sun icons and the text 'ECLIPSE EVENTS'.



2017 ECLIPSE ACROSS AMERICA
Through the Eyes of NASA



Thank you!

More on eclipses | <http://eclipse2017.nasa.gov>
<http://www.nasa.gov/eclipse>

More on safe viewing of eclipses | <http://eclipse2017.nasa.gov/safety>
<http://go.nasa.gov/2evRZBG>

We welcome questions and comments at
<https://eclipse2017.nasa.gov/contact-us>
jim.spann@nasa.gov
c.alex.young@nasa.gov

Eclipse Photography

Gordon Telepun, M.D.



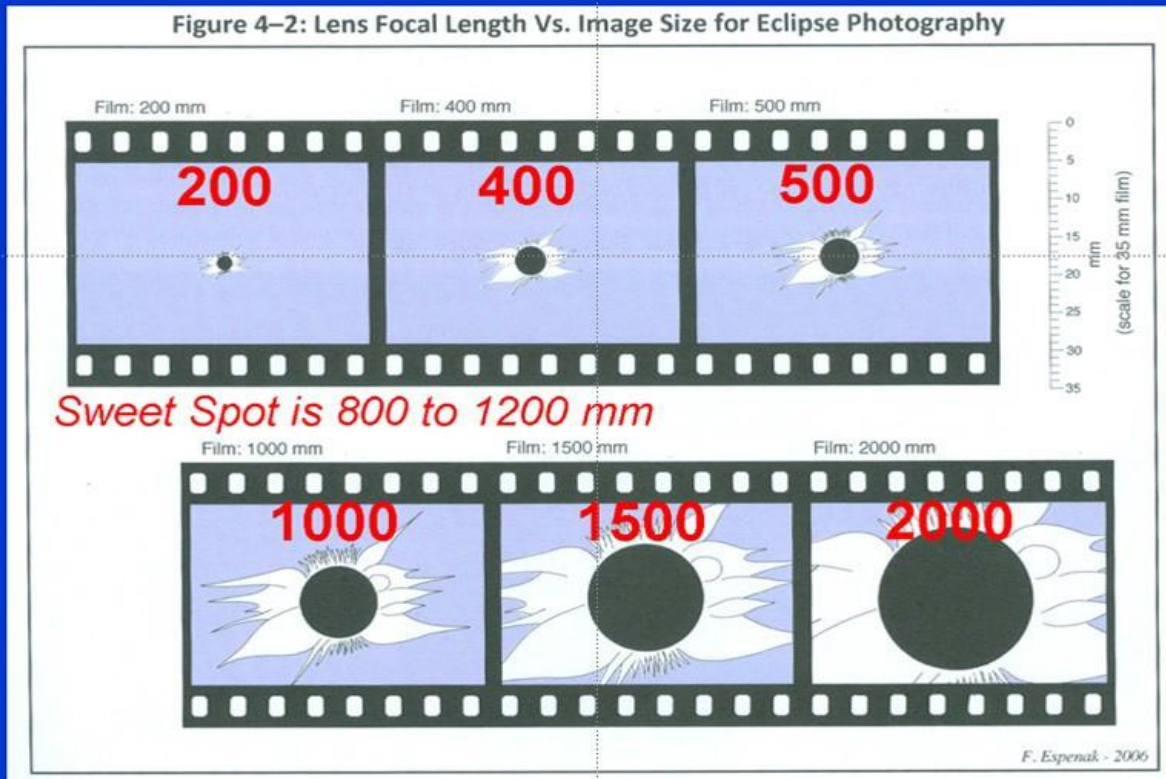
Image: M.L. Adams, 2001 -- Lusaka, Zambia

Where Do You Start To Get Ready For A Total Solar Eclipse

1st Thing: Focal Length / Field Of View / Sun Disk Image Size

This is NOT a high power big aperture event. This is the end point Sun disk image size with or without a camera chip crop factor. Check your gear soon. (1.0 to 1.5 disk diameter padding)

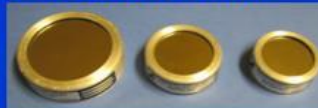
Figure 4-2: Lens Focal Length Vs. Image Size for Eclipse Photography



2nd Thing: Full Sun Disk Exposure With a Glass Full Aperture Solar Filter

This is your starting exposure for everything. ISO and f-stop won't change.

Final crescents will be a little longer. This will also start to set you up for totality images



Your Yellow Full Sun Disk Image Exposure Will Be An Exposure That Will Be Good For the Inner Corona in Totality (2001)

(you have the ability to bracket)

f 12.6 ISO 200 1/60s



f 12.6 ISO 200 1/60 s



Review Of These Crucial Steps – 1 and 2

Determine Your Gear - focal length (800 to 1200 mm / f-stop / meter setting / solar filter type)

Camera Tripod or Motor Drive - affects ISO selection a little. Make sure your tripod can point to 63 degrees without obstruction

Practice Now - Take a Range of Exposures By Varying the Shutter Speed of a Full Sun Disk Image with Your Exact Gear Set-up After You Have Selected an ISO

Pick a Shutter Speed of a Nice Exposure of the Full Disk That is Yellow
Your final crescents will need a slightly Slower Shutter Speed to Stay the Same Tone Yellow.

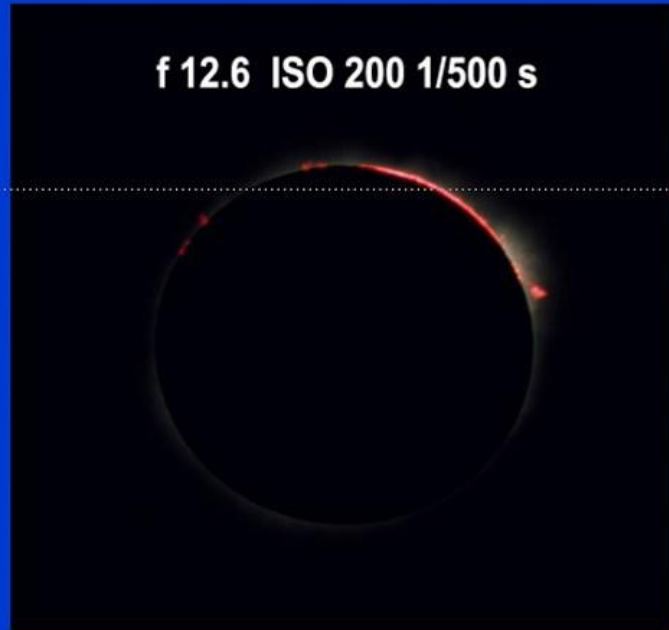
Your Yellow Full Sun Disk Image Exposure Will Be An Exposure That Will Be Good For the Inner Corona in Totality (you have the ability to bracket)

3rd Thing: Diamond Ring and Baley's Beads (2001)

Take Your Final Crescent Image 2 Minutes Before 2nd Contact. Then change your Shutter Speed to a Faster Speed for Points of Bright Light.

This is Going to Be Relative To YOUR Set-up for The Full Disk Image

I Missed Beads and Diamond Ring in 2001 at 2nd Contact. My Timing Was Off At C2



4th Thing: Totality Exposures (2001)

During Totality You Will Take Range Of Exposures. (f 12.6 ISO 200)



1/250 s



1/125 s

4th Thing: Totality Exposures (2001)

During Totality You Will Take Range Of Exposures. (f 12.6 ISO 200)



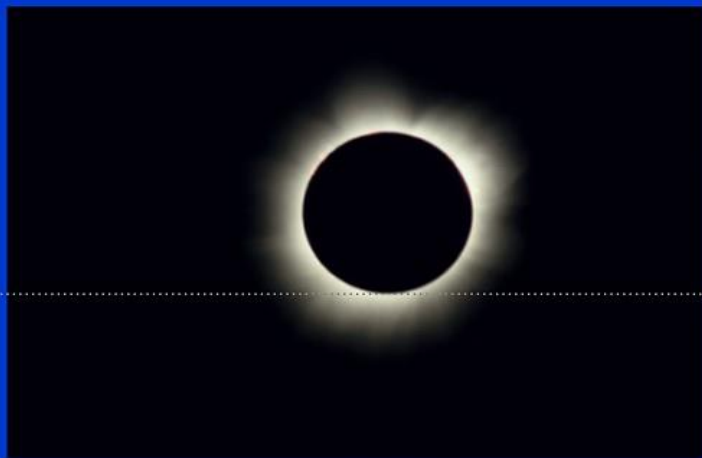
1/60 s



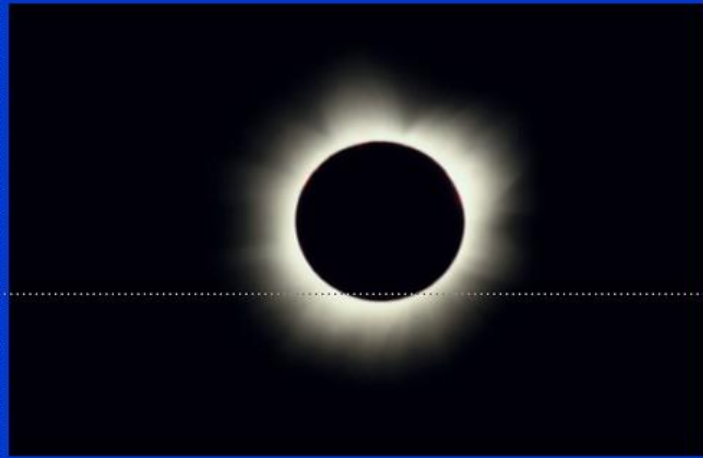
1/30 s

4th Thing: Totality Exposures (2001)

During Totality You Will Take Range Of Exposures. (f 12.6 ISO 200)



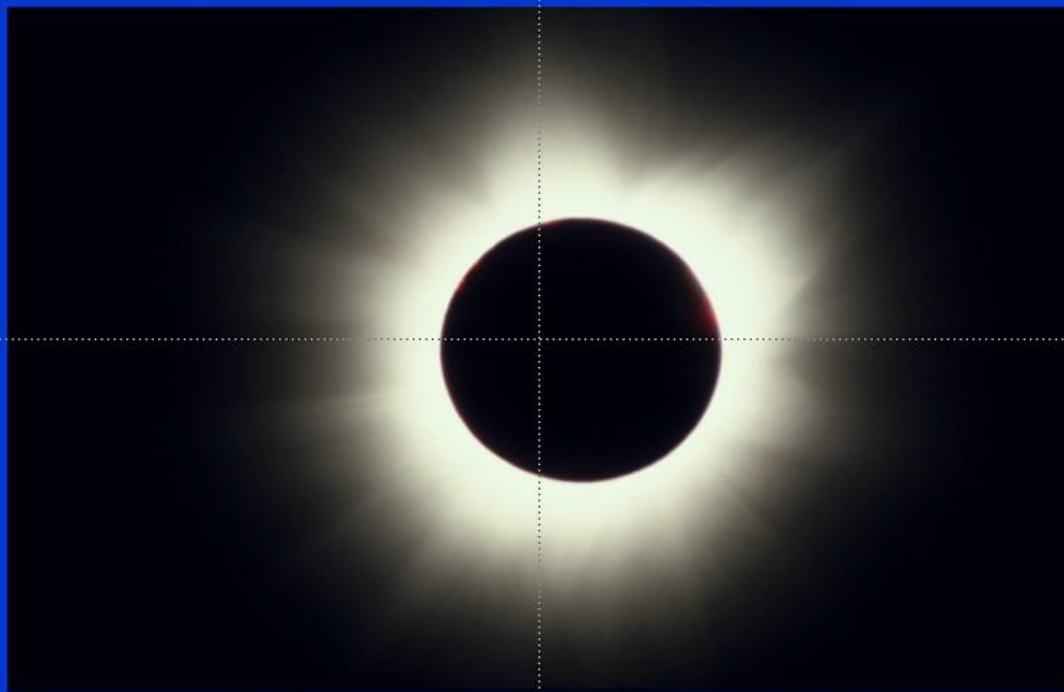
1/15 s



1/8 s

4th Thing: Totality Exposures (2001)

During Totality You Will Take Range Of Exposures. (1000mm, f 12.6, ISO 200)



1/2 s (un-guided, no motion blur)

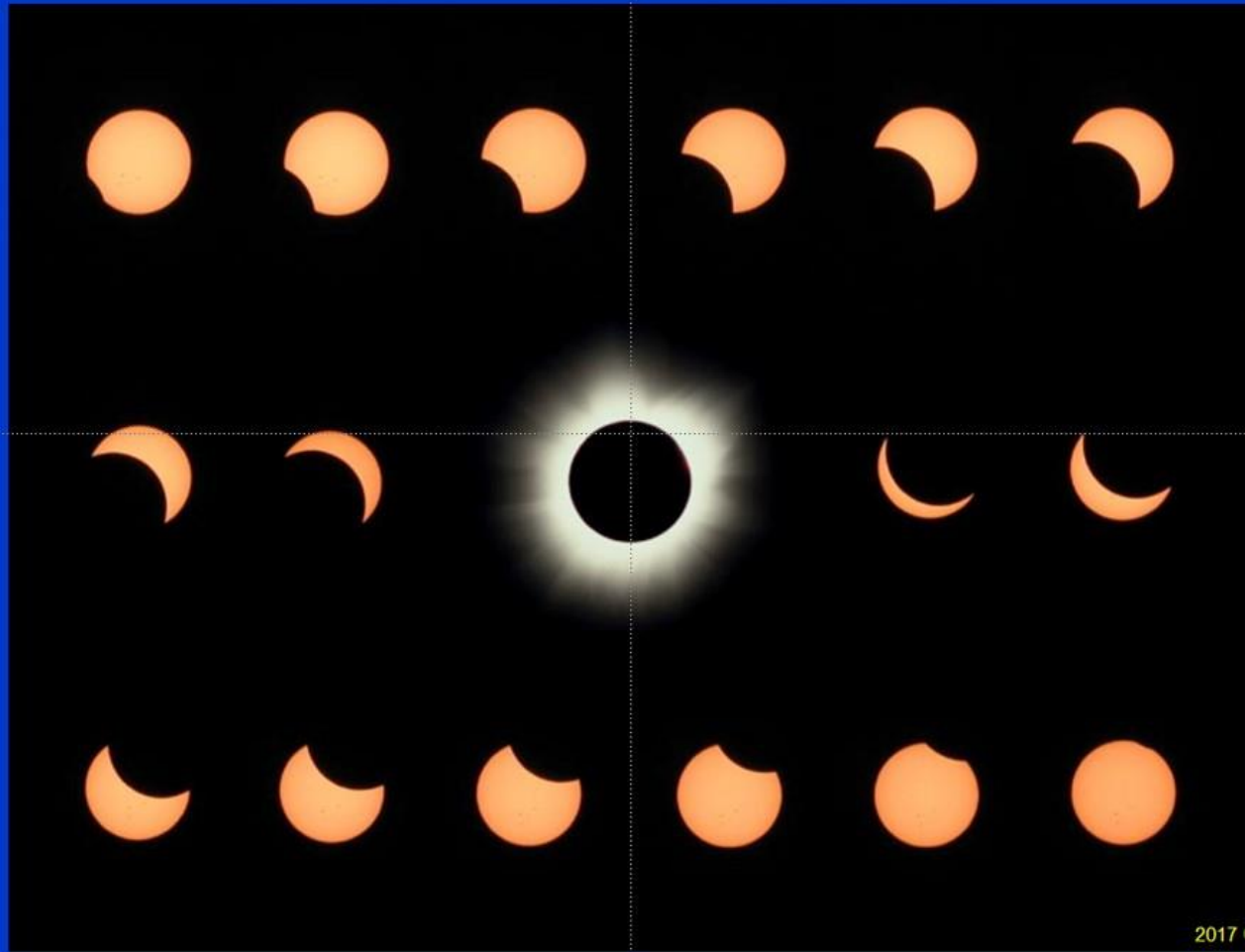
3rd Thing Again: Baley's Beads and Diamond Ring (2001)

After You Take Your Totality Exposures, Change your Shutter Speed to a Faster Speed for Points of Bright Light. This is Going to Be Relative To YOUR Set-up for The Full Disk Image (my yellow disk image was 1/60, {1/125, 1/250} **1/500**)

Got The Diamond Ring in 2001 at 3rd Contact. 1/500 s



Partial Phase Image Sequence Photography – How To Plan It?



You Could Do The Calculations

Rt. 65 and CL

Take the time between C1 and C2 and convert to seconds

C1 11:58:33

$$1\text{h } 28\text{m } 18\text{s} = 88\text{m } 18\text{s} = 5298\text{s}$$

C2 1:26:51

Now subtract 240 seconds, because we really don't want C1 and C2, we want C1 plus 120s and C2 minus 120s. $5298 - 240 = 5058$ That means we have a span of 5058s

C3 1:29:31

C4 2:53:38

Take the span seconds and divide by 9 to get the gaps = 562s

Convert that back to minutes and seconds; $9\text{m} = 540\text{s}$ leaving 22s

Now we have to add back 9m and 22s, 10 times, starting at C1 plus 2m

C1 is 11:58:33 plus 2 minutes is 12:00:33

$$11:58:33 + 2\text{m } 00\text{s} = 12:00:33 - \text{image 1}$$

$$12:00:33 + 9\text{m } 22\text{s} = 12:09:55 - \text{image 2}$$

$$12:09:55 + 9\text{m } 22\text{s} = 12:19:17 - \text{image 3}$$

$$12:19:17 + 9\text{m } 22\text{s} = 12:28:39 - \text{image 4}$$

$$12:28:39 + 9\text{m } 22\text{s} = 12:38:01 - \text{image 5}$$

Do that 5 more times

Then start over and do it again because C3 to C4 (5107s) is going to be different from C1 to C2 (5298s)

Or, use "PPISC" in Solar Eclipse Timer. One tap and it is all calculated

Review Of These Crucial Steps – 3 and 4

Prepare For the Diamond Ring Effect and Baley's beads Before 2nd Contact - After your final crescent phase picture set your camera to the faster shutter speed (range 1/500 to 1/2000; depends on your set-up)

Have a Plan For Removing Your Solar Filters and Where You Are Going To Lay Them Down! Don't bump your tripod!

Timing Is Absolutely Critical! *Our 2nd Contact Time Will Now Be So Much Better Than What I had In Africa*

At the 20 second mark before 2nd contact have your hands on your solar filters. Pull them off at that point, but certainly earlier than 10 seconds before 2nd contact. Remove the solar filters and start taking repeat exposures. Your camera view finder will look blown out with light, it's still bright. You can't pull filters too early because you don't want to ruin your sensor, but you have to be early enough. Auto-bracket if possible with your camera.

When Totality Occurs Take Your Range of Exposures - Then Look With Your Eyes and Binoculars - Enjoy the View

Take Wide Angle and Horizon Images, Automate If Possible - NO FLASH

Change Shutter Speed Back To Fast For Baley's Beads and Diamond Ring

2017 - USA - Solar Eclipse Timer



Two Tap Set-Up

1 - Location 2 - Load Times



Get "Talked" Through The Eclipse

Attention

I have presented a wide range of things that I have done to document and enjoy a total solar eclipse

But the things I have discussed are a combination of things that I did at 3 different eclipses, each time trying something new or adding something different

If this is your first eclipse do not make it too complicated! Keep it simple! Enjoy it with your eyes! Out of everything I have presented pick a couple of imaging ideas that you think are interesting and do those.

You may not have a lot of set up time. We may not have stable weather and be able to set up 2 hours before C1 and have everything ready.

Have a plan for this: What if you are driving to get to a patch of clear skies and you jump out of your car and you only have 10 minutes before C2, what are you going to do? What is your minimum set up?