Image Credit: Landon Noll

Image Credit: VanGorp Used by permission

Image Credit: Brin, Myronuk, Noll, Page, Templeton

The Great American 2017 Eclipse

(yea!)

The return of totality to the continental US after 38 years

Landon Curt Noll

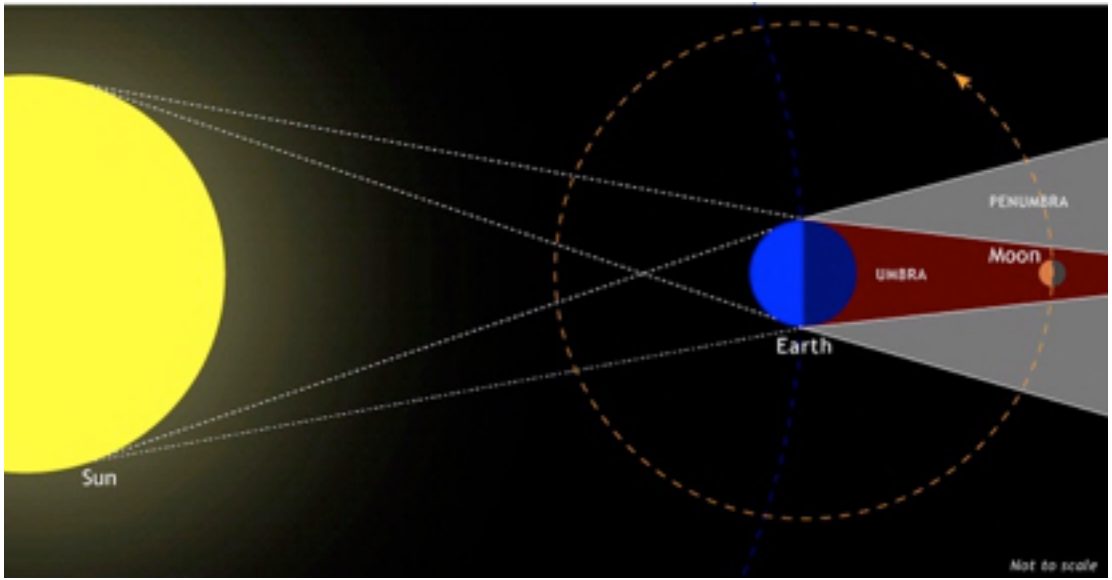
twitter: @landonnoll

http://www.isthe.com/chongo

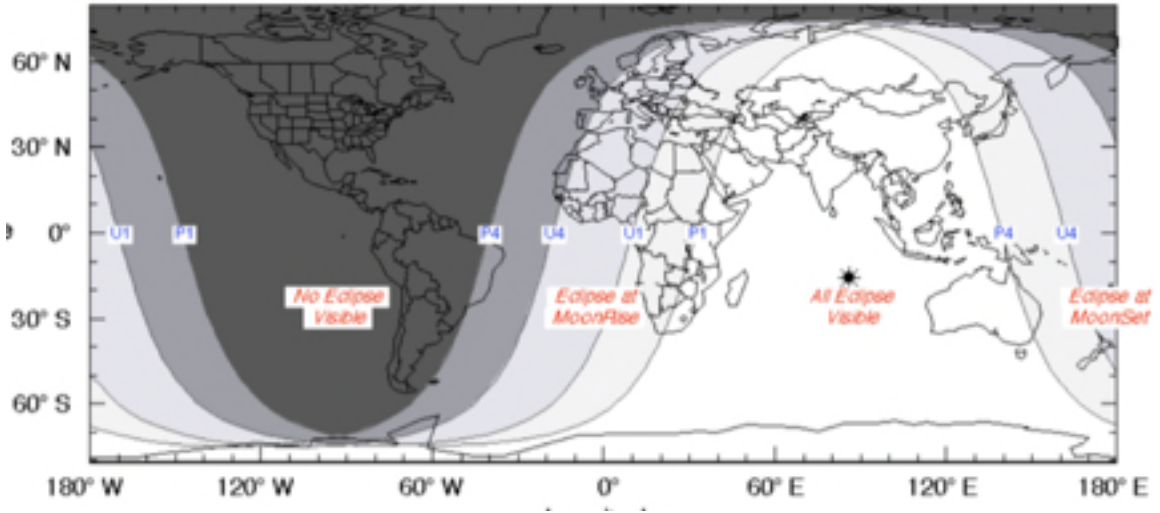
v1.00 - 2016 Sep 06

What is a Lunar Eclipse?

- Earth cases a shadow on the Moon



Partial Lunar Eclipse - 2017 Aug 07



Total Lunar Eclipse - 2018 Jan 31

Total Lunar Eclipse of 2018 Jan 31

Ecliptic Conjunction = 13:27:53.0 TD (= 13:26:42.5 UT)
Greatest Eclipse = 13:31:00.1 TD (= 13:29:49.6 UT)

Penumbral Magnitude = 2.2941 P. Radius = 1.2978° Gamma = -0.3014
Umbral Magnitude = 1.3155 U. Radius = 0.7567° Axis = 0.3058°

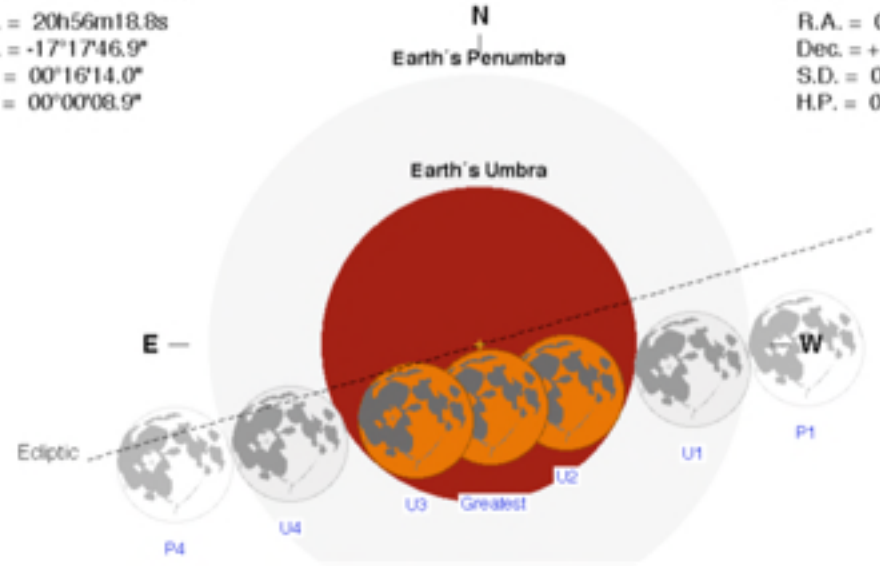
Saros Series = 124 Member = 49 of 74

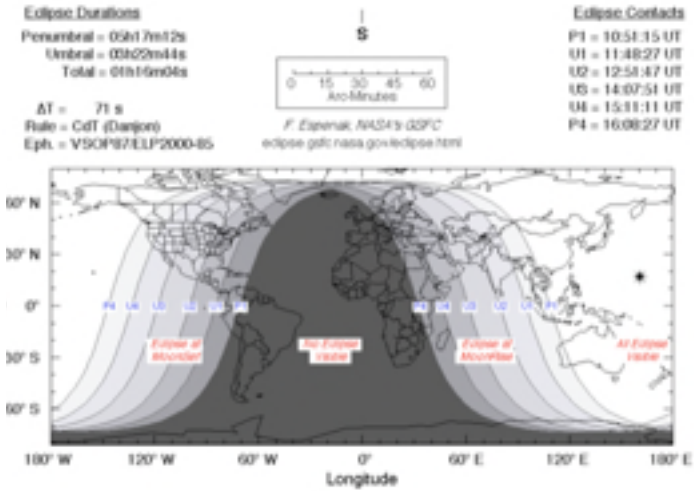
Sun at Greatest Eclipse
(Geocentric Coordinates)

R.A. = 20h56m18.8s
Dec. = -17°17'46.9"
S.D. = 00°16'14.0"
H.P. = 00°00'08.9"

Moon at Greatest Eclipse
(Geocentric Coordinates)

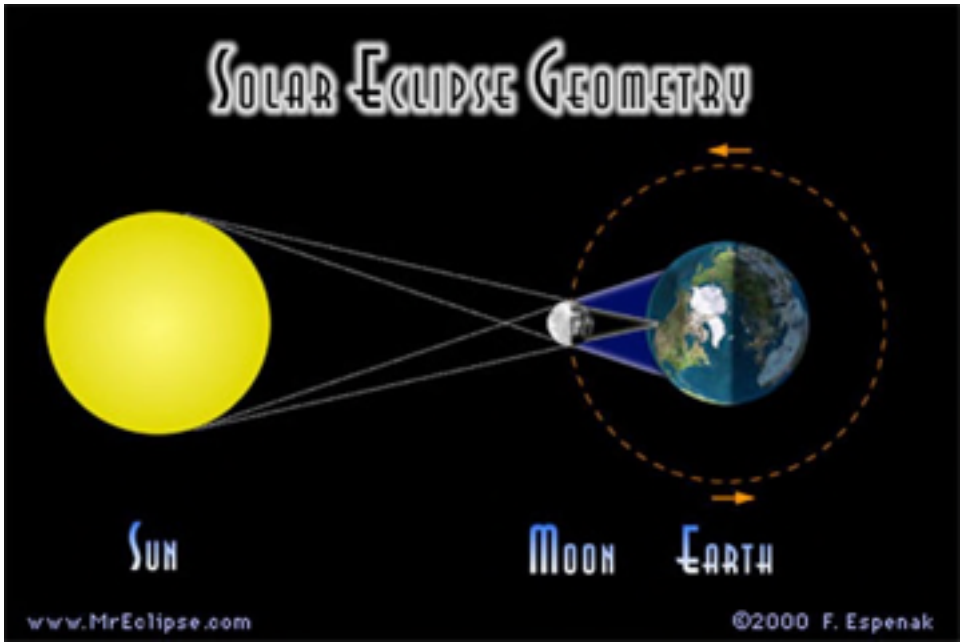
R.A. = 08h56m05.0s
Dec. = +16°59'44.1"
S.D. = 00°16'35.2"
H.P. = 01°00'52.5"





Solar Eclipse Background Material

- When the Moon passes between the Sun and the Earth



- Image Credit: Fred Espenak www.MrEclipse.com

The Special Size-Distance Relationship

- The cover about the same area in our sky
  - About 1/2 degree

- While the Sun is about 390 times larger than the Moon ...
- ... it is also about 390 times farther away!

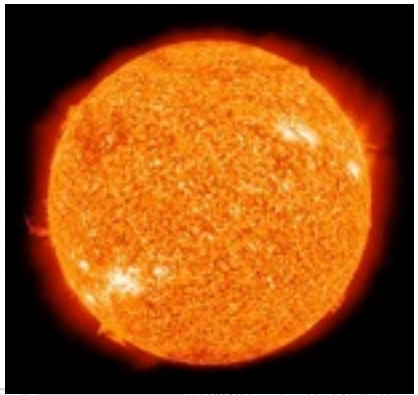


Image Credit: Wikipedia
Creative Commons License

Partial and Total Solar Eclipse

- Partial Solar Eclipse
  - Moon only partially obscures the Sun

- Total Solar Eclipse
  - Moon completely covers the Sun

Image Credit:
Brin, Myronuk, Noll, Page, Templeton

Annular Solar Eclipse

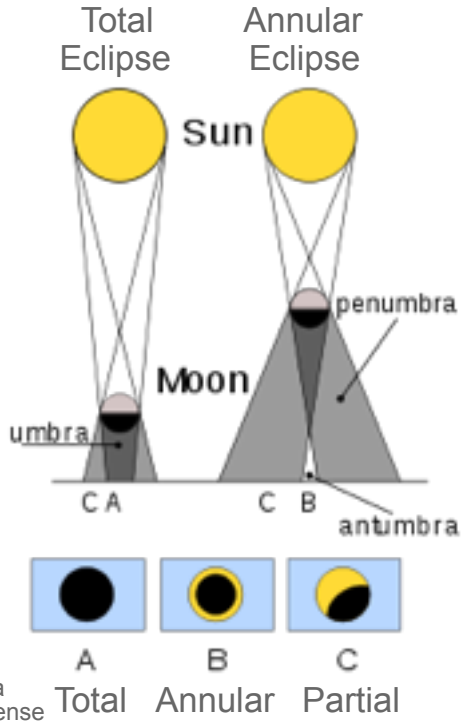
- Sun and Moon are exactly in line but ...
  - ... the Moon appears to small to cover the Sun
- The word Annular refers to Annulus or Ring
  - ... not once a year (annual)

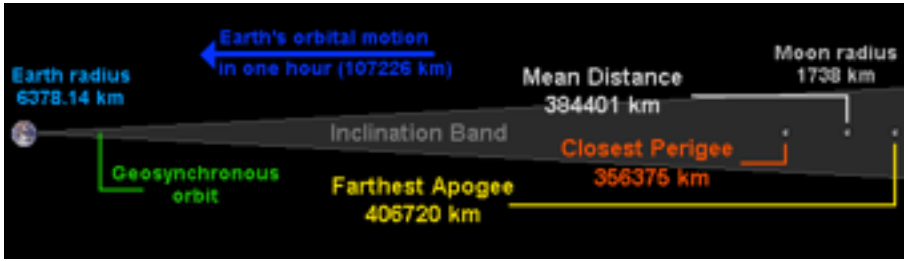
“Ring of Fire” 2005 Oct 3

Image Credit: Wikipedia
Creative Commons License

Total vs. Annular Eclipse

- The Moon's distance from Earth varies by 14% each month!





Close moon Far moon

Image Credit: Wikipedia
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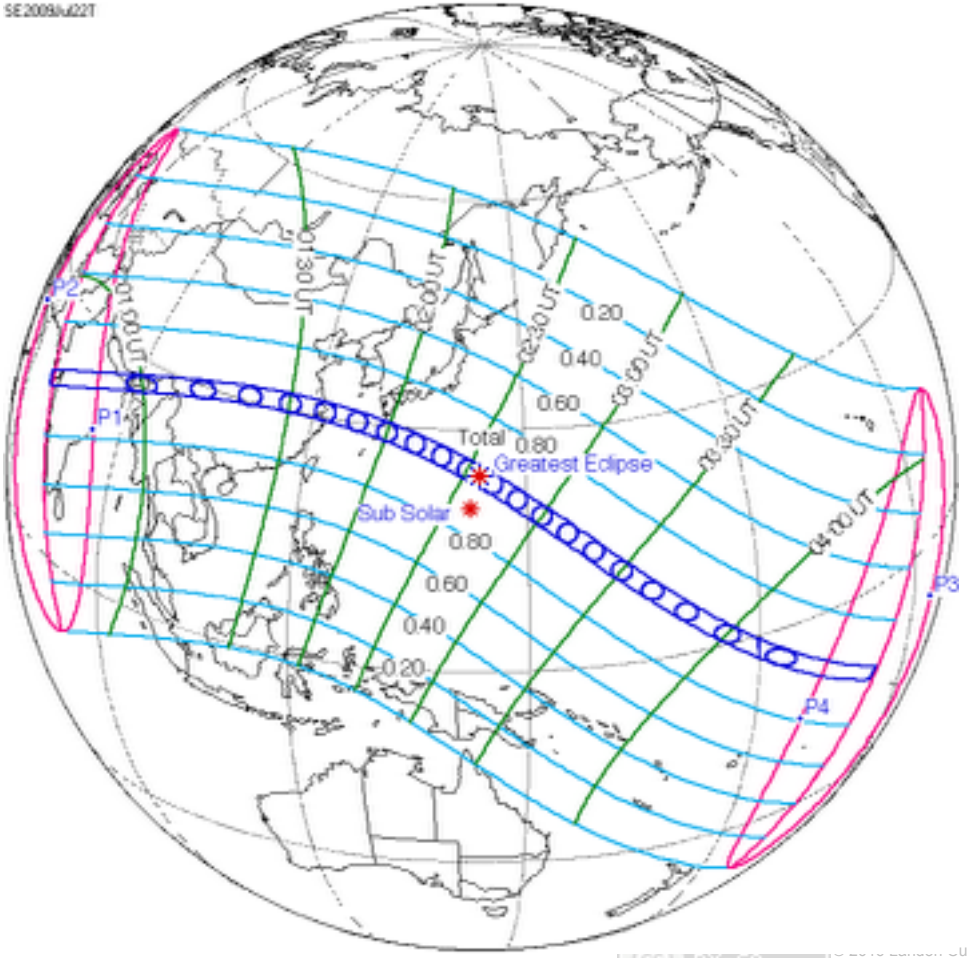
When the Moon completely covers the Sun

- Amazing!
  - You really should make an effort to see one or more TOTAL Solar Eclipses

Enewetak - 2009 July 22




Digital
Model GCA-04
Geiger Counter
mSv/hr
mR/hr
1 Sec.
1 Min.
5 Min.
Backlight
On
Off
Power
On
Off
Audio
On
Off
IMAGES SCIENTIFIC INSTRUMENTS, INC.

GARMIN

Image Credit: VanGorp
Used by permission

2012 Nov 14 Eclipse Photo Set

The Right place at the Right Time

- The typical total eclipse shadow is about 160 km (100 miles) wide
  - Covers less than 1% of the surface

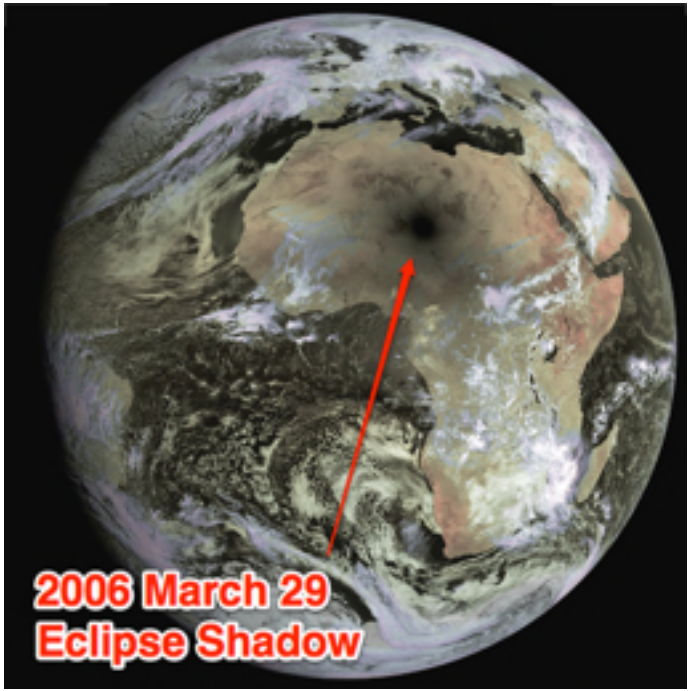


Image Credit:
Meridian Satellite

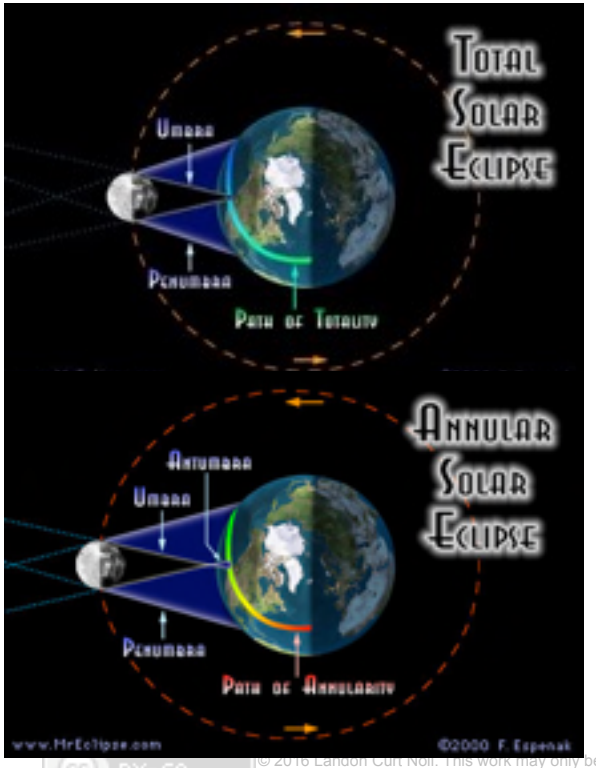


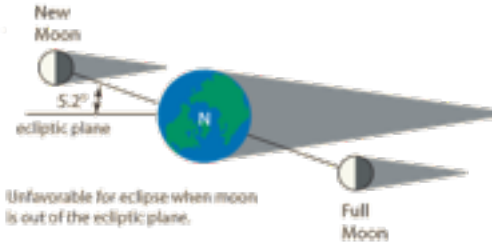
Image Credit:
Fred Espnak

Why don't we get a Solar Eclipse every month?

- Earth and Moon to size and distance scale

Image Credit: Wikipedia
Creative Commons License

- Moon's orbit is inclined 5.2º with respect to Earth's orbit about the Sun
  - Need a new Moon AND the Moon to be within 1/4º of the the Earth solar path



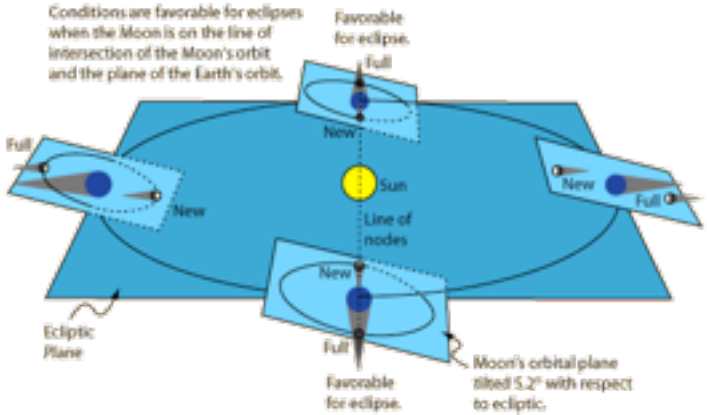


Image Credit: Dr. Carl R. (Rod) Nave
Department of Physics and Astronomy
Georgia State University

http://hyperphysics.phy-astr.gsu.edu/hbase/hph.html

The Fast Moving Shadow

- The Shadow moves fast
  - Typically moves between 0.5 km/sec (1120 MPH) and 2 km/sec (4480 MPH)
- If you are standing still
  - The Sun will be covered anywhere up to about 7.5 minutes (typical is 2-3 minutes)

2017 Aug 21 Eclipse Shadow - Max Time 2 min 40 sec

Image Credit: Andrew Sinclair
www.eclipse2017.org

How often is there an Eclipse somewhere?

- On average: 1 Total Eclipse every 19 months
- On average: 1 Annular Eclipse every 15 months
- On average: 1 Partial Eclipse every 14 months

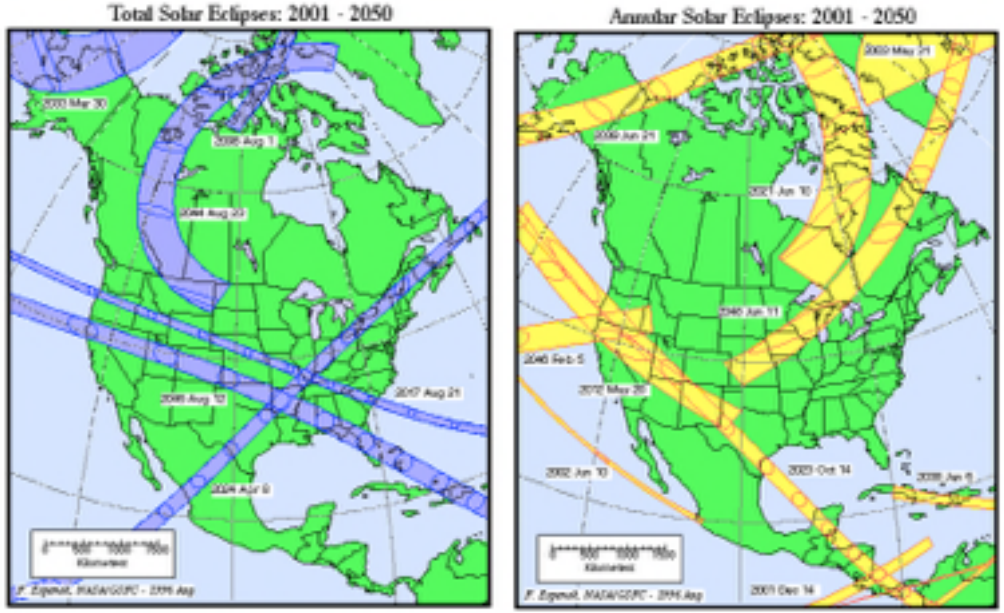


Image Credit: Fred Espenak
www.MrEclipse.com

Total Solar Eclipses: 2001-2025

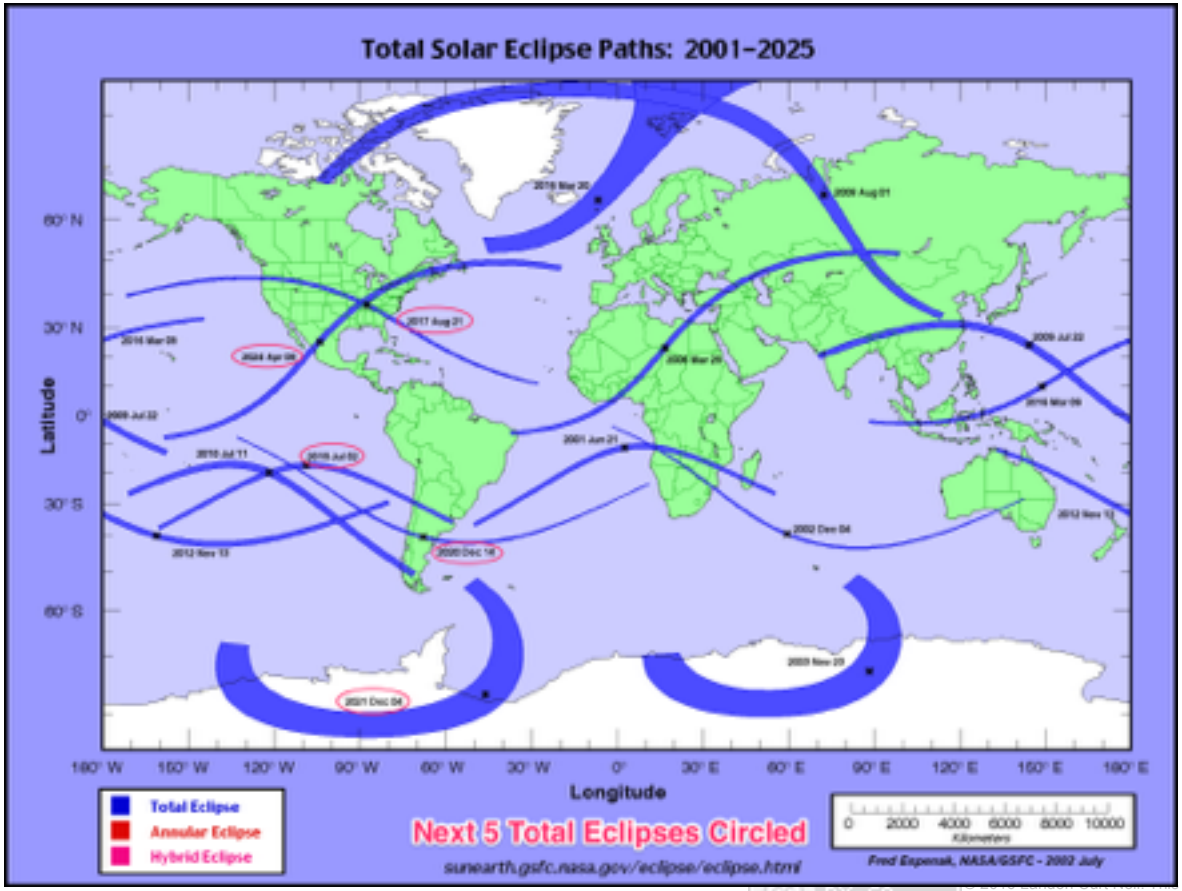


Image Credit: Fred Espenak
www.MrEclipse.com

Annular Eclipses - 2001 to 2025

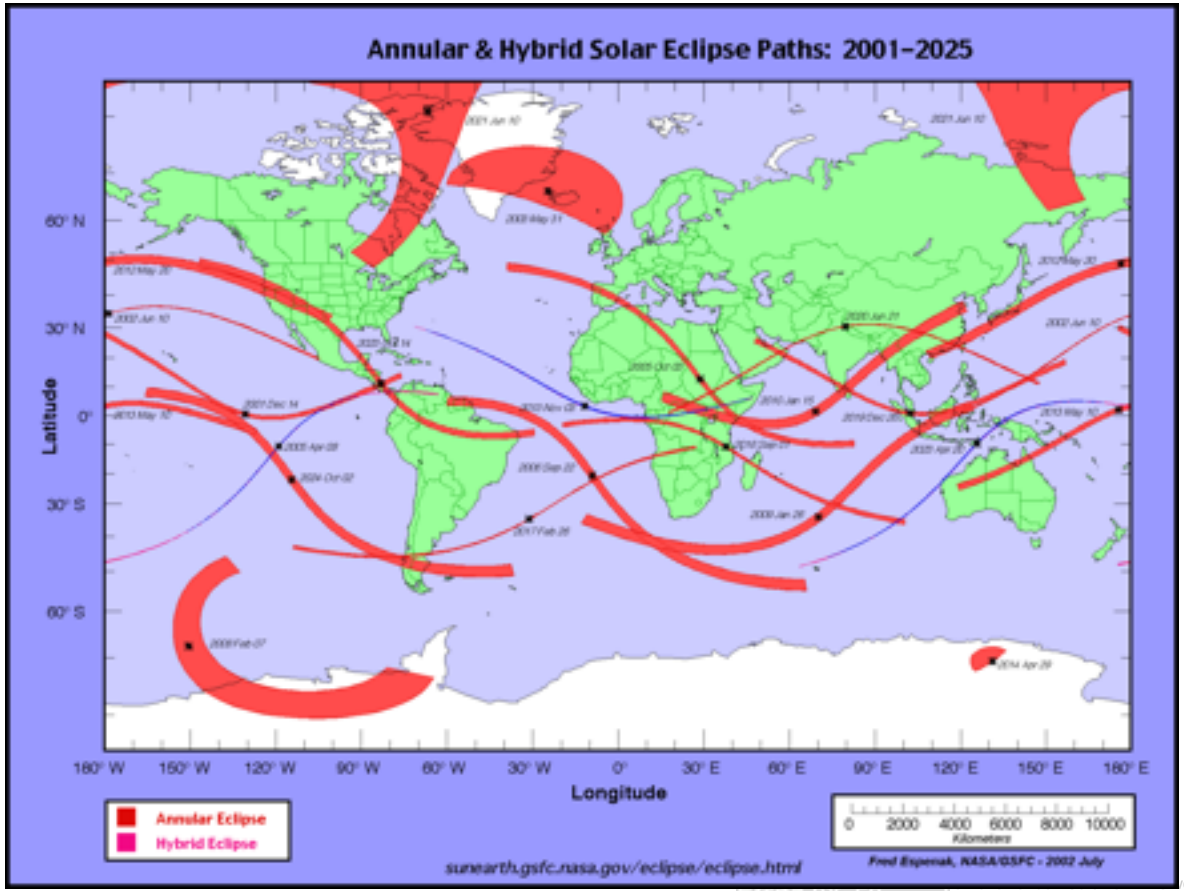
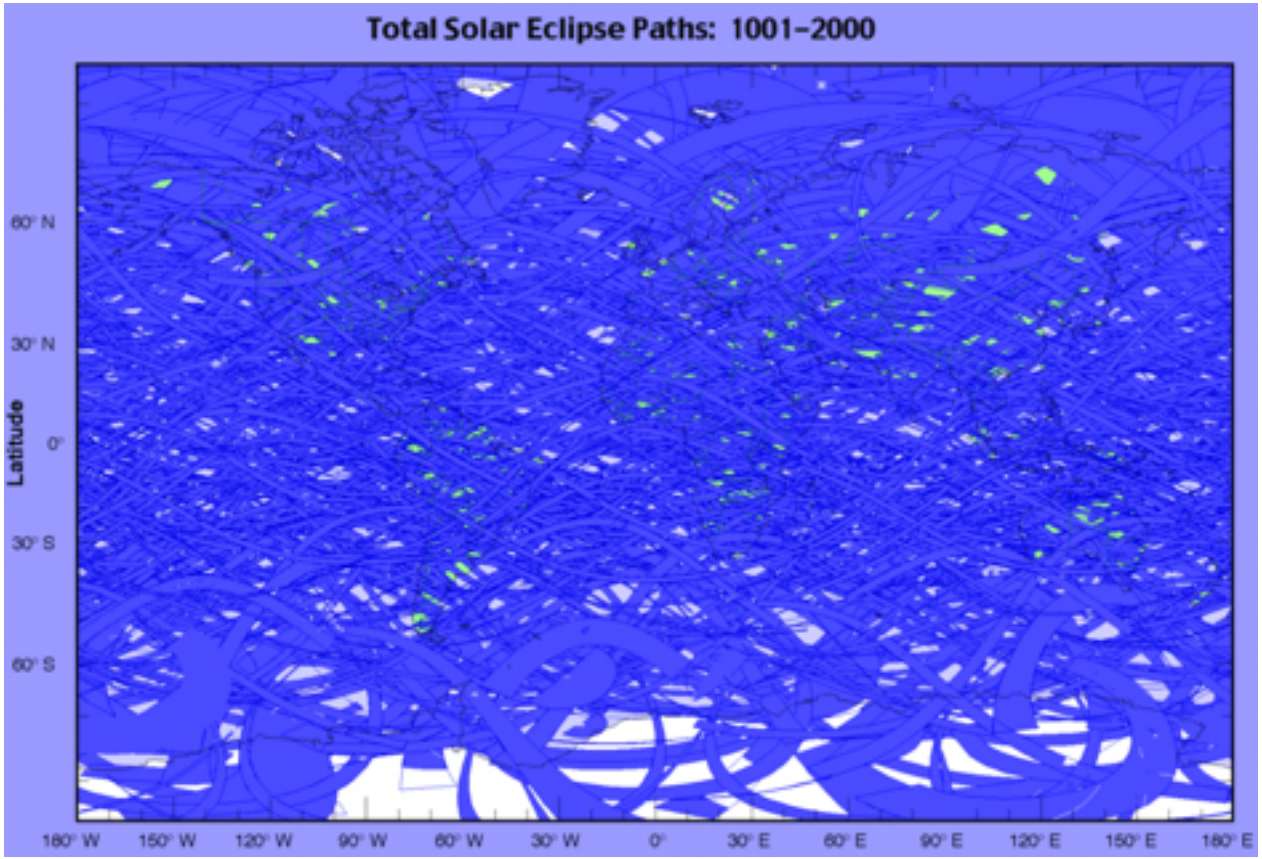


Image Credit: Fred Espenak
www.MrEclipse.com

Some places have to wait a long time ...



Some places have several in a short period

- Australia region 2023 thru 2038

Other places are not so lucky

- You have to wait on average 375 years for a Total Eclipse to come to you

- Pimpmunk's location: 757 year gap!
  - 575 year wait until next eclipse

```
 436 Jul 29   3m 37s
 504 May 29   6m 44s
1079 Jul 01   5m 12s
1834 Nov 30   2m  2s
2591 Apr 14   5m 19s
2992 Sep 17   4m 16s
```

- Sketchy's location: 780 year gap!
  - 191 year wait until next eclipse

```
 987 Jan 02    5m 23s
1313 Nov 18    2m 37s
1397 May 26    5m  1s
1427 Jun 26    4m 14s
2207 Nov 20    3m 56s
2451 May  1    3m 28s
2938 Aug 16    4m 42s
```

- Nerdy's location: 601 year gap!
  - 63 year wait until next eclipse

```
 664 May  1    3m 50s
 957 Jul 29    5m 46s
1142 Aug 22    3m 36s
1349 Dec 10    3m  6s
1478 Jul 29    5m 18s
2079 May 01    2m 55s
2144 Oct 26    4m 5s
2200 Apr 14    1m 23s
2866 Jul  3    4m 59s
```

Other places are moderately lucky

- Lizz's location: 420 year gap!
  - 29 year wait until next eclipse

```
 204 Jul 14   6m 27s
 364 Jun 16   4m  2s
 711 Oct 16   4m 21s
 943 Jun 18   3m  6s
1259 Oct 17   3m 30s
1325 Apr 13   4m 50s
1600 Jul 10   2m 8s
1625 Mar  8   3m 50s
2045 Aug 12   6m  6s
2259 Aug 19   3m 49s
2317 Jul  9   3m 32s
2992 Sep 17   4m 16s
```

- Galen's location: 178 year gap!
  - 62 year wait until next eclipse

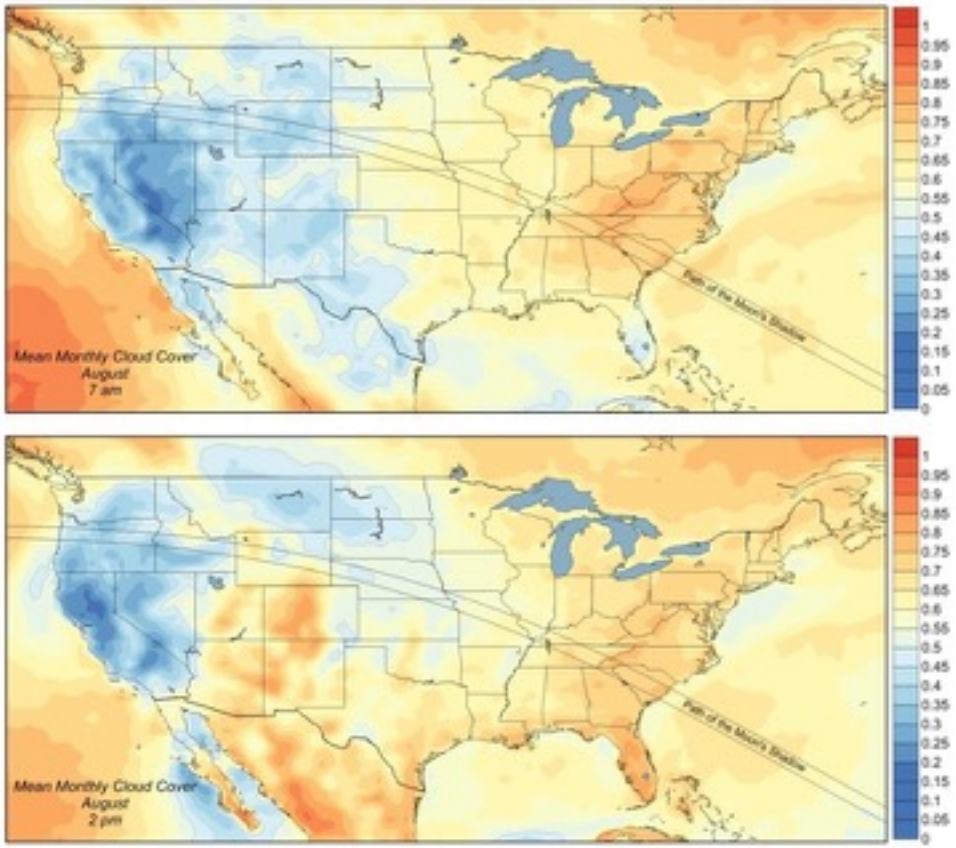
```
   9 Jul 10   6m 25s
 502 Jan 24   3m  6s
1259 Oct 17   3m 30s
1618 Jul 21   2m 13s
1778 Jun 24   5m 52s
1900 May 28   2m 10s
2078 May 11   5m 40s
2345 Jun 30   6m  7s
2782 Dec 26   4m 10s
```

Don’t wait that long!

- Go to where the Shadow is!

Image Credit: Xavier Jubier

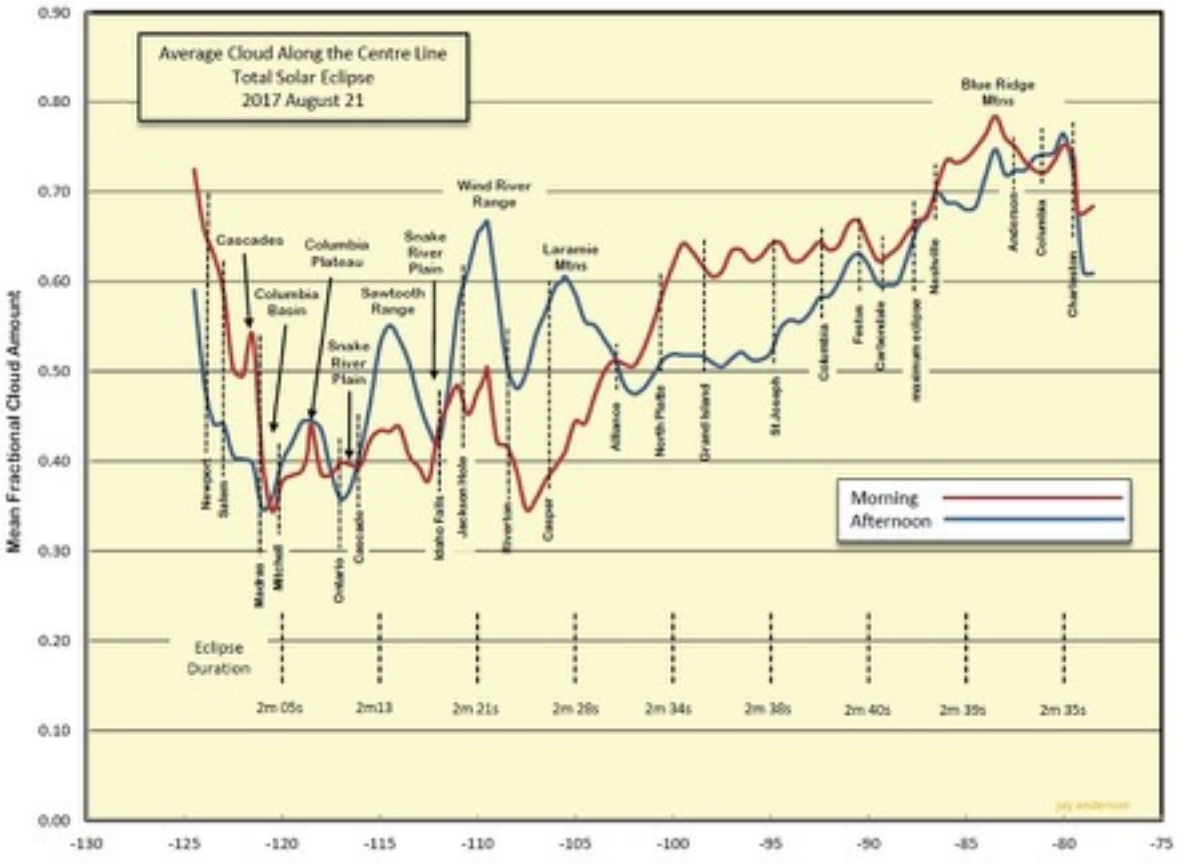
Eclipse day - Morning and Evening



Bluer (lower) is better

Image Credit:
www.eclipser.ca

Eclipse Day Cloud Coverage Model



Lower is better

Eye safety

- The Sun is no more or less dangerous during an Eclipse
- It is never safe to look directly at the Sun except during a total eclipse
- A partial or annular eclipse, even when the Sun is mostly covered ...
  - Can still cause permanent eye damage!
- You might not feel any discomfort as the eyes are being cooked
  - There are no pain nerves at the back of your eye

Safe methods of directly viewing the Sun

- Must block 99.999% or more of the Visible light!
- Must block 99.99999% of UV and Infrared light!

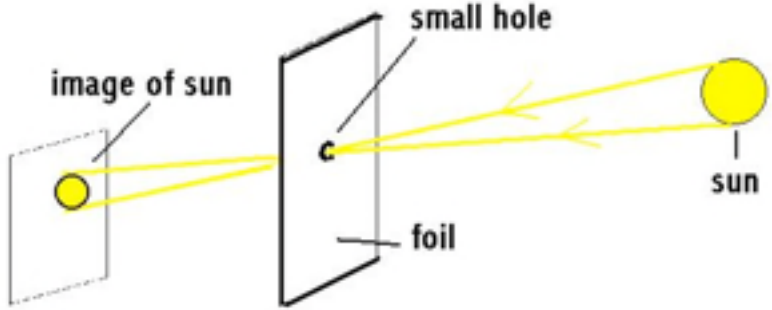
- "CE" Certified Eclipse Shades

- #14 Welder's Glass
  - Standard #12 Arc Welder glass is NOT dark enough!!!

- Front Binocular / Telescope filters

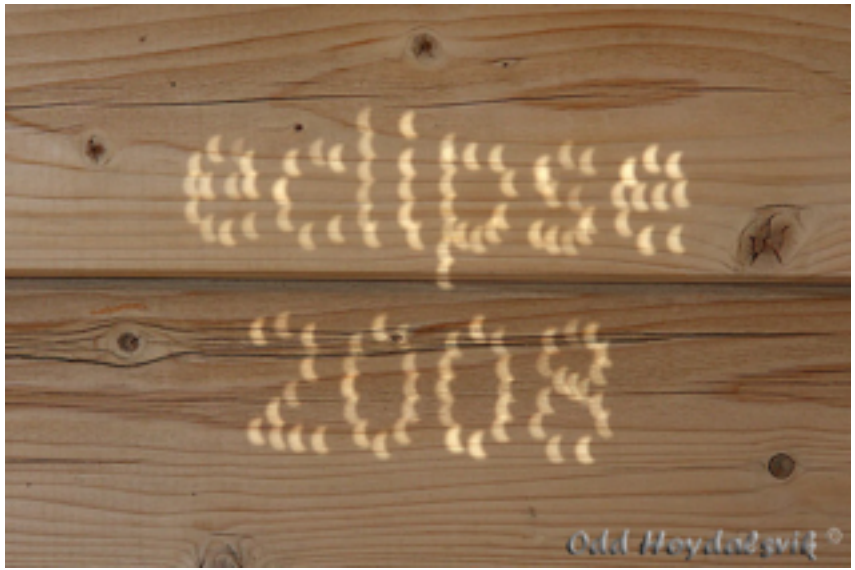
Safe indirect viewing of the Sun

- Pinhole projection



Fun Views

- Make your own message



Bottom of talk.

Any Questions?

Thank you.

Landon Noll Touching the South Geographic Pole ± 1cm
Antarctica Expedition 2013