The CWOP solar radiation data archive

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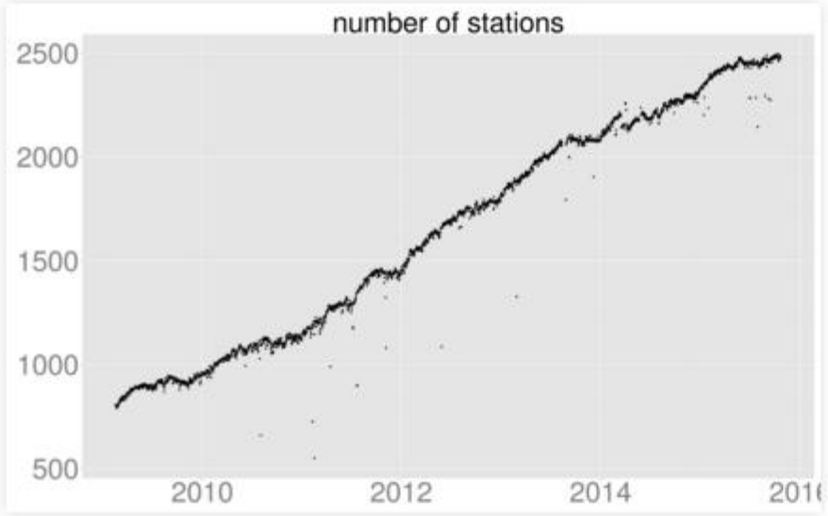
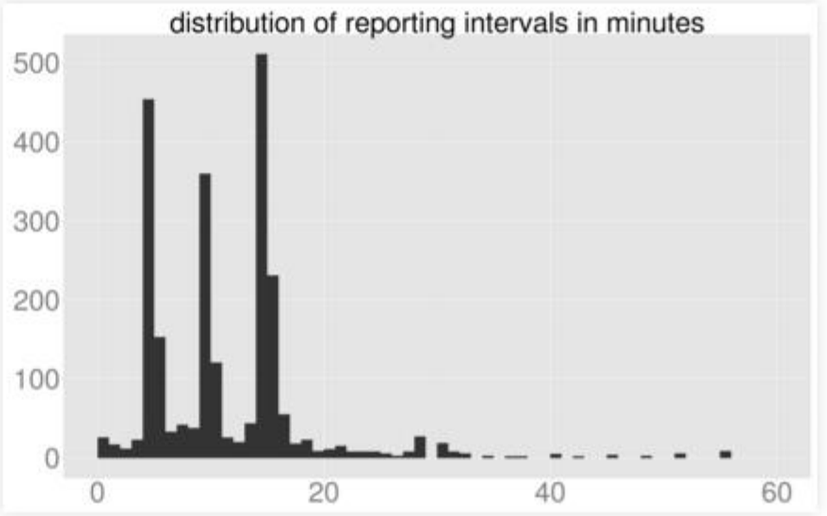
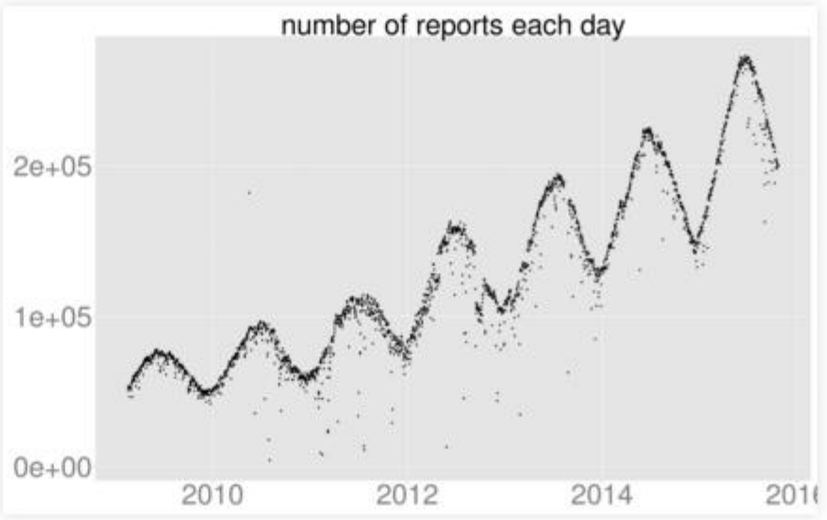
basic unit of the network

EW2020>011245z
3849.62N/07647.89W_171/
000g000t025 r000p000P000
h69b10235 L016.DsIP-V

network dimensions







the archive of parsed data

On 2015-10-23 the total number of observations in the archive:

304,411,969

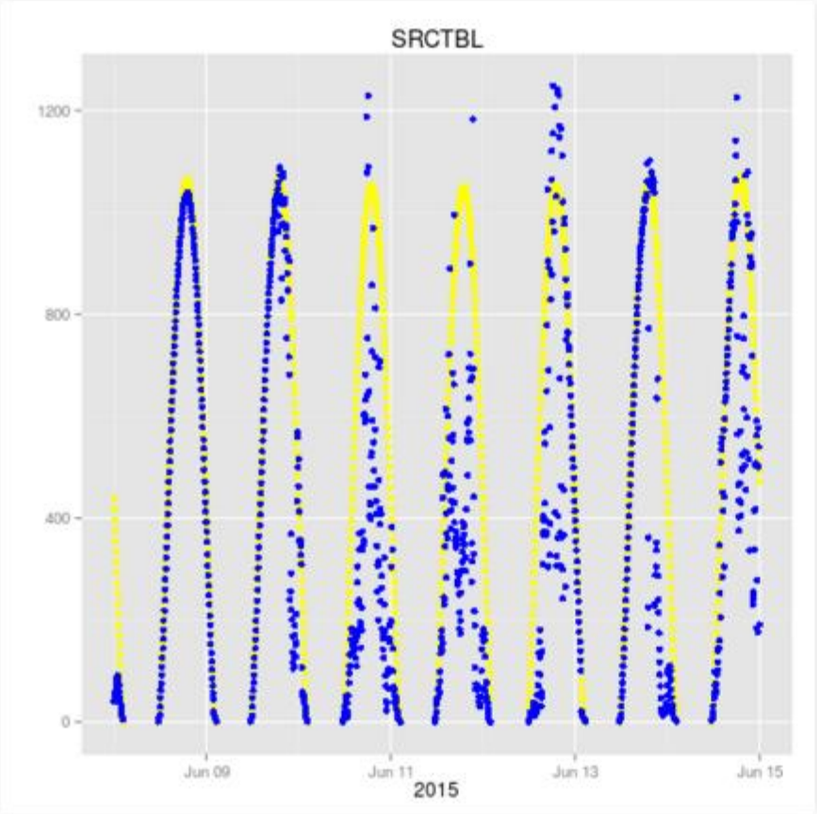
The number of stations that have ever reported:

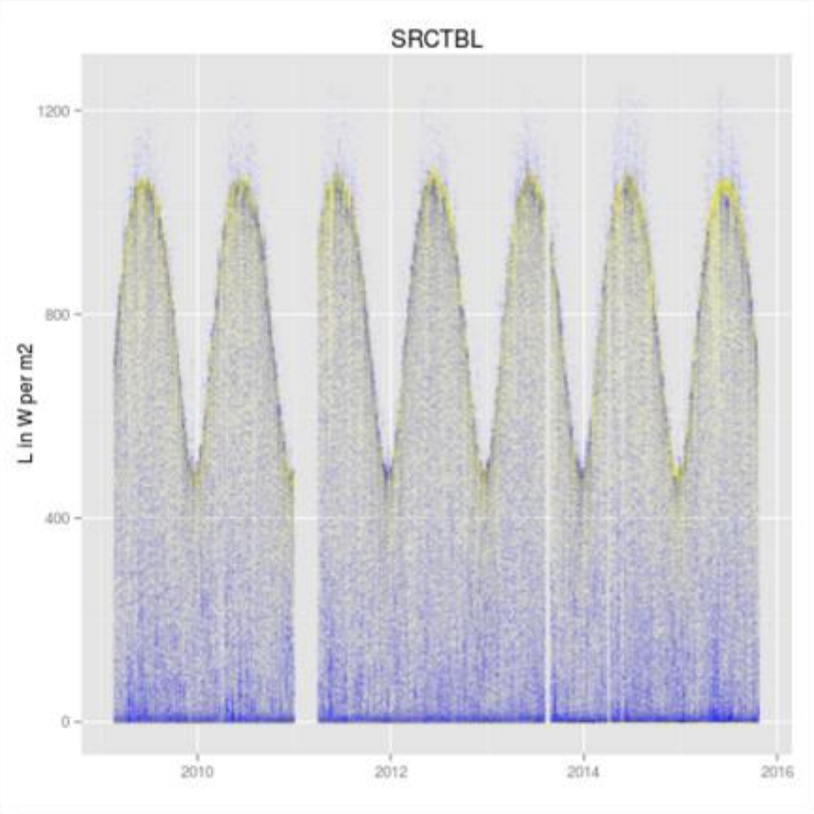
5,534

The number of station-days:

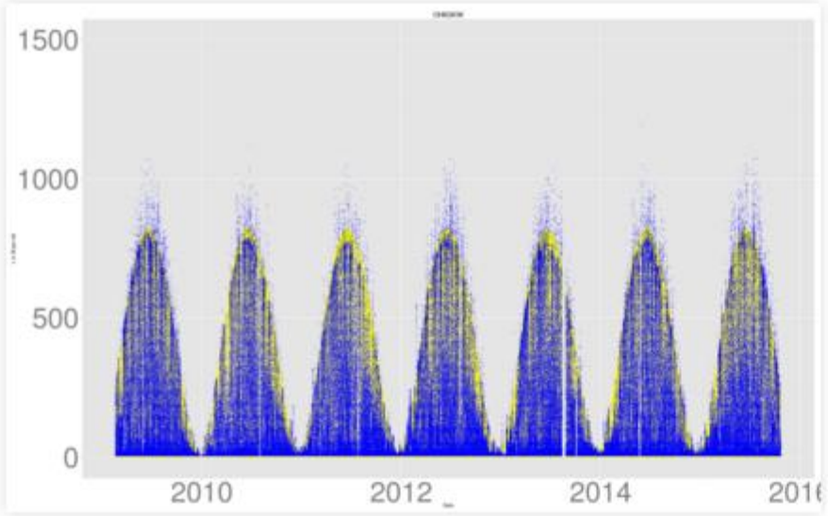
3,958,476

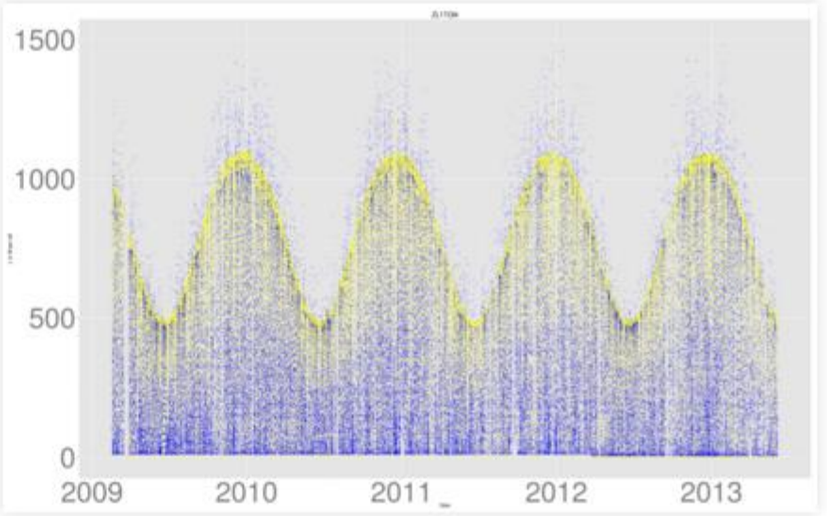
clear sky model added to archive

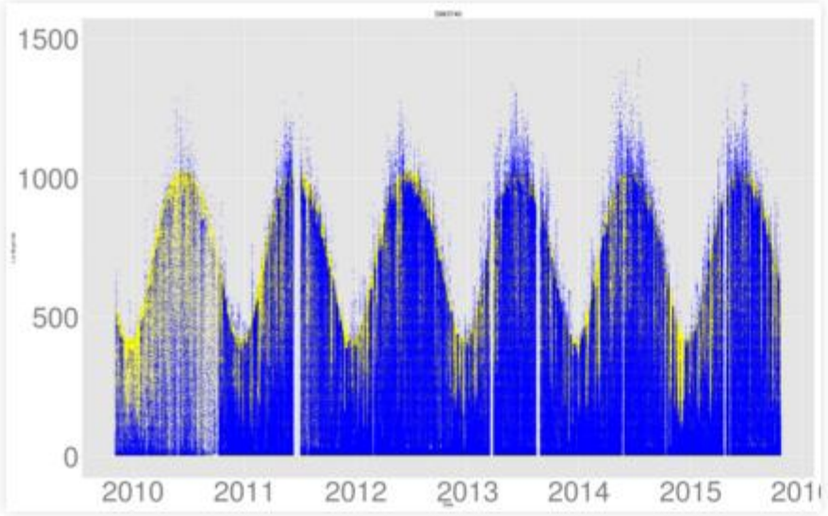


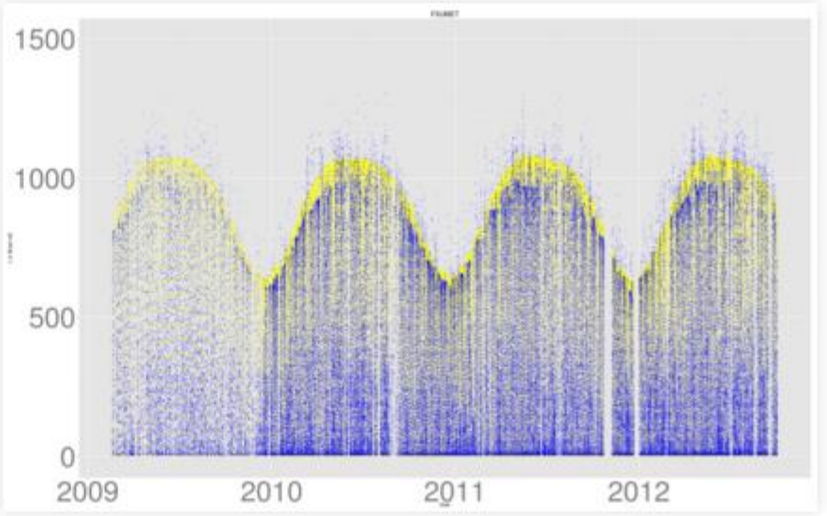


archived time series with data and model

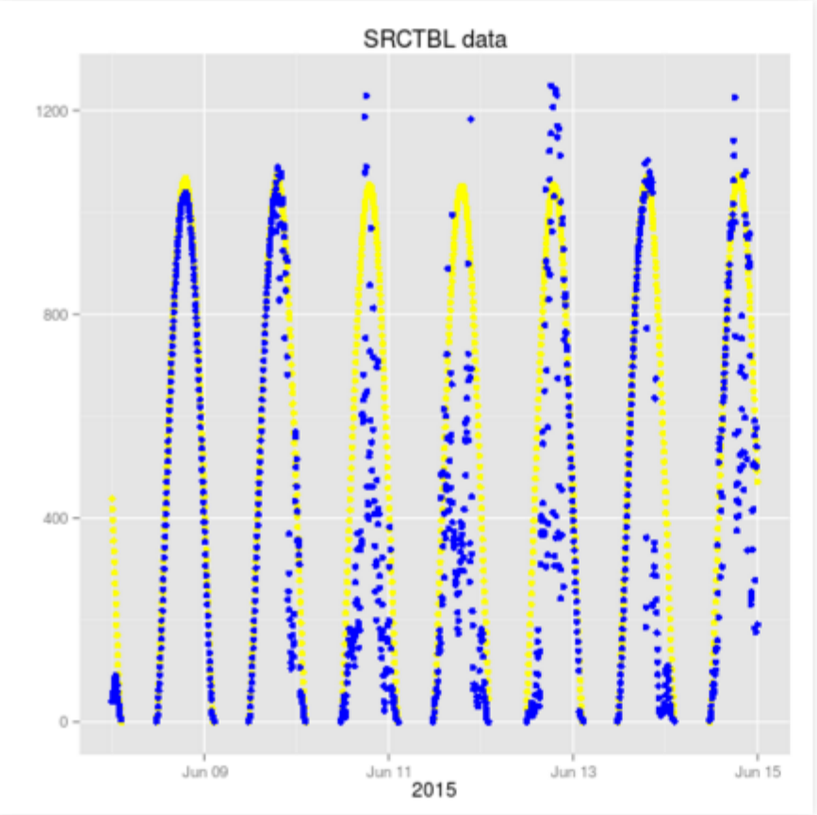


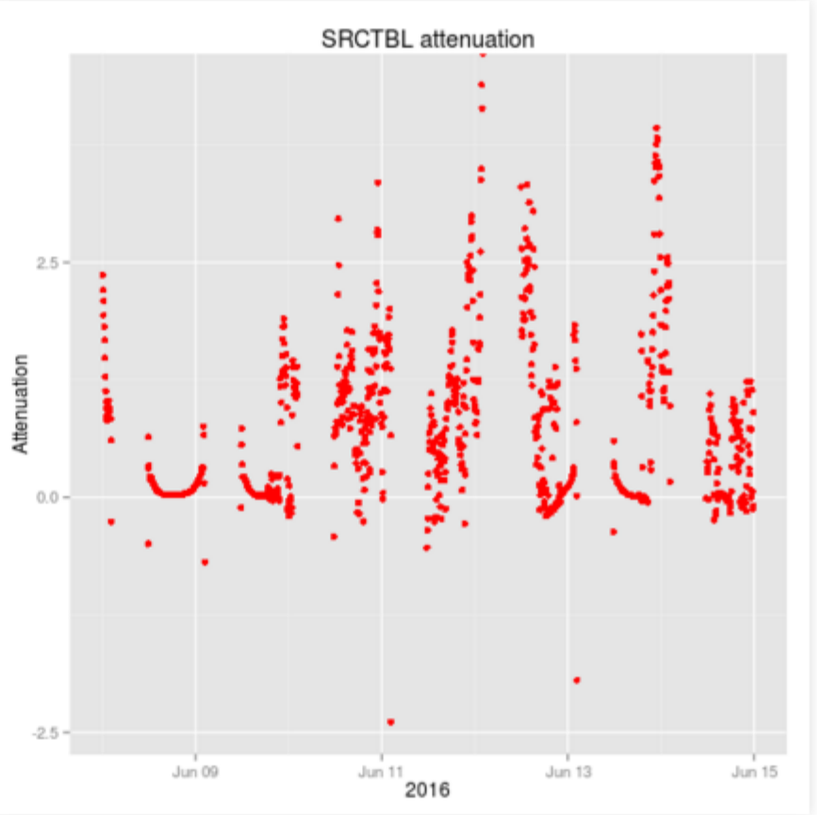






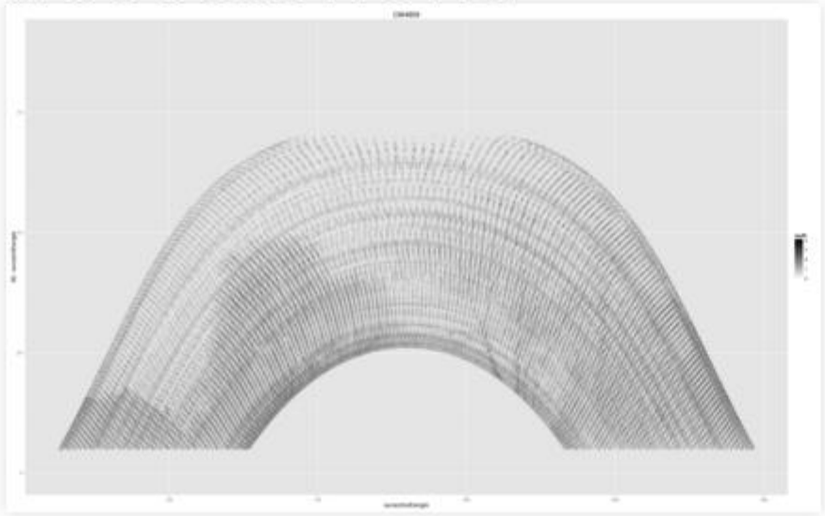
attenuation added to archive

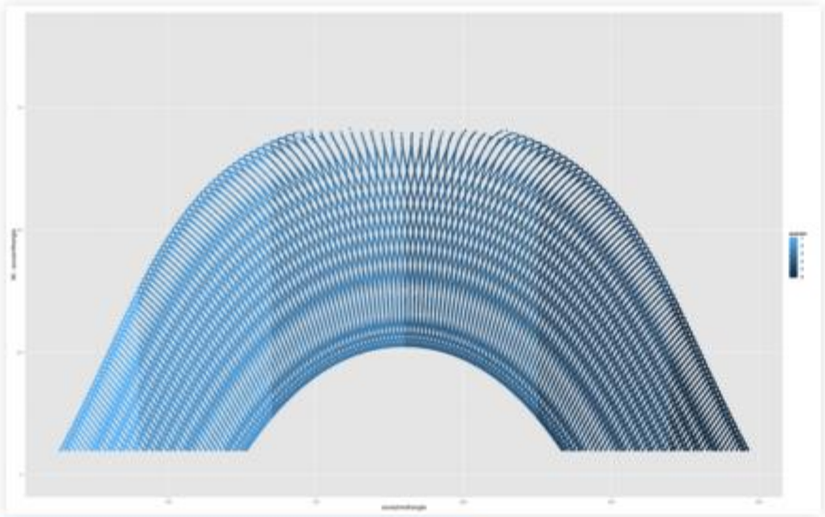


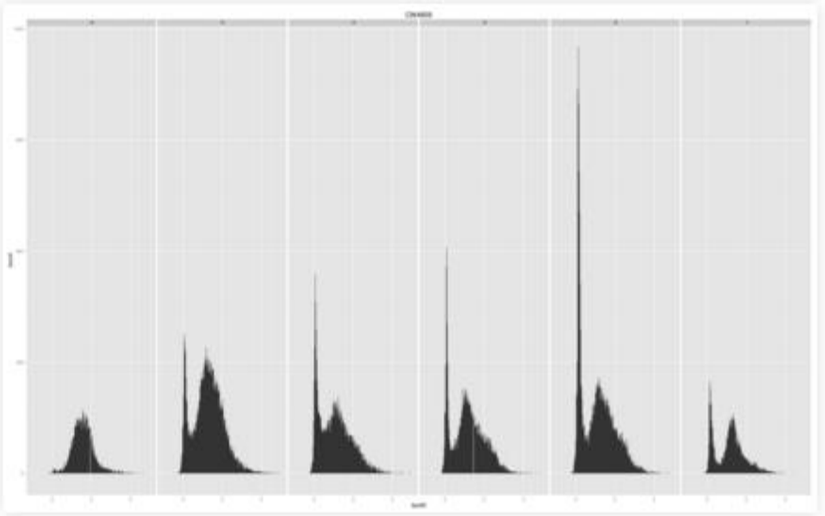


$$\tau \equiv -\ln\left(\frac{L_{obs}}{L_{modeled}}\right)$$

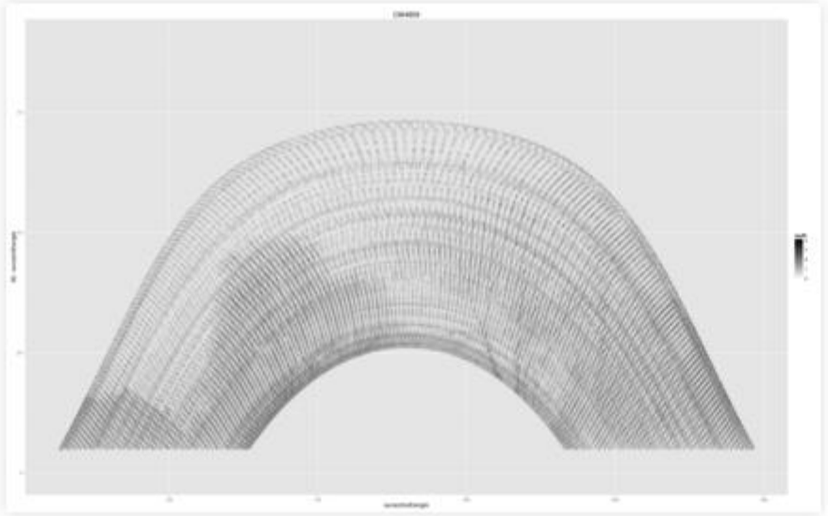
attenuation used as site shading assessment

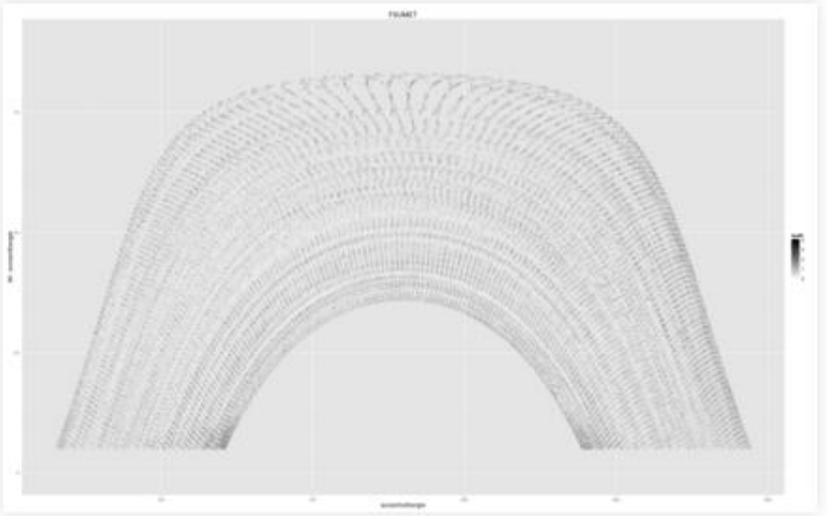


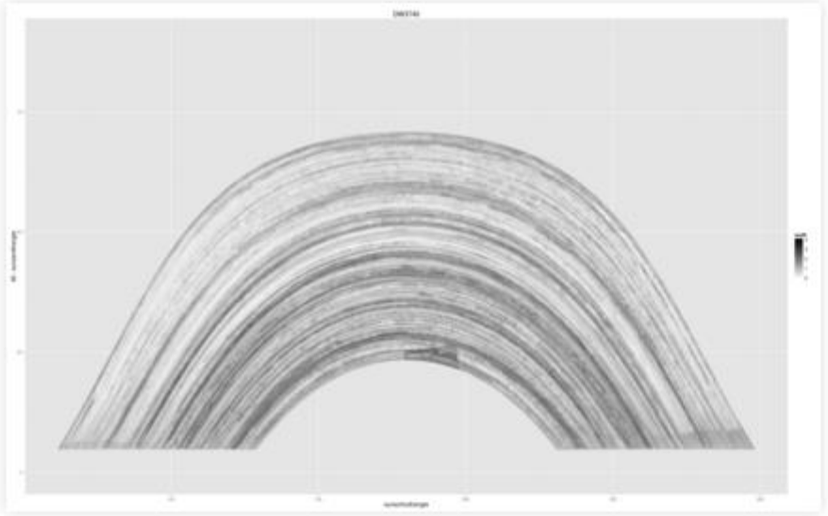


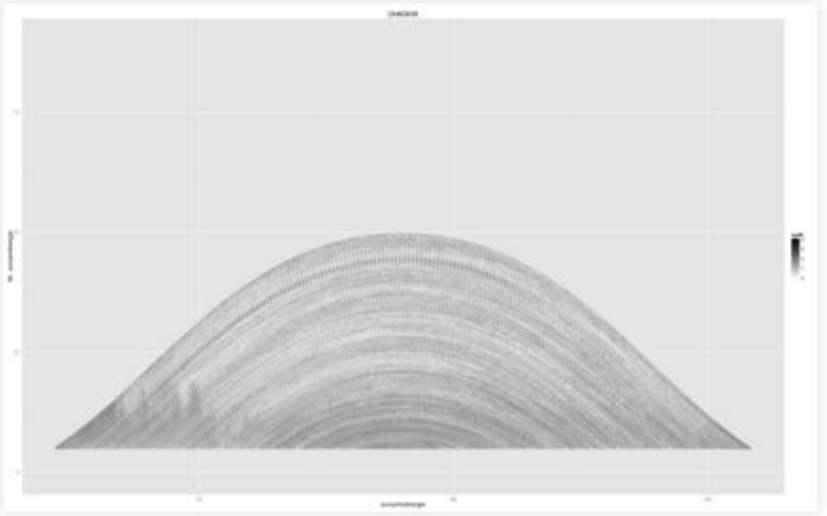


four skies from the archive

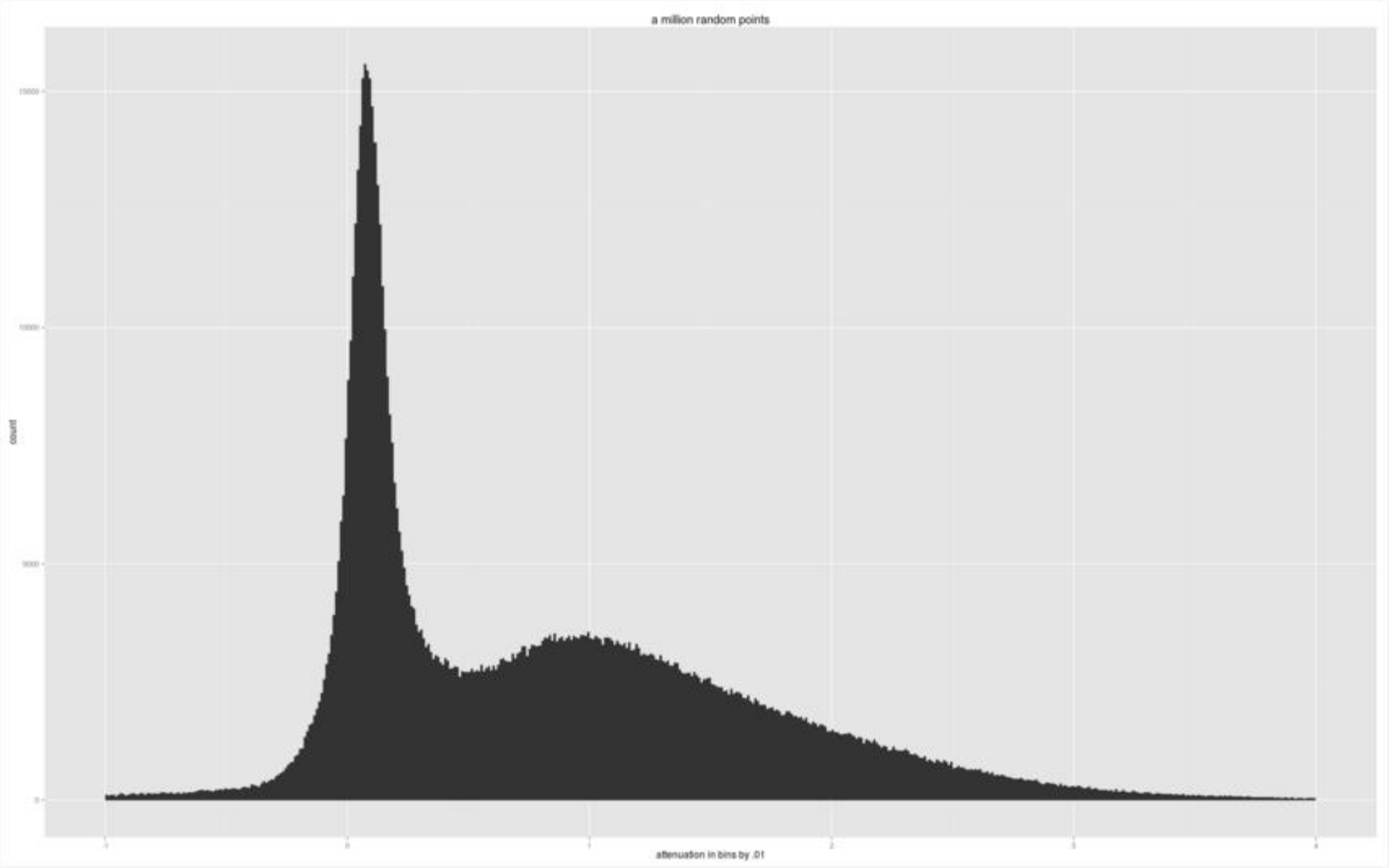




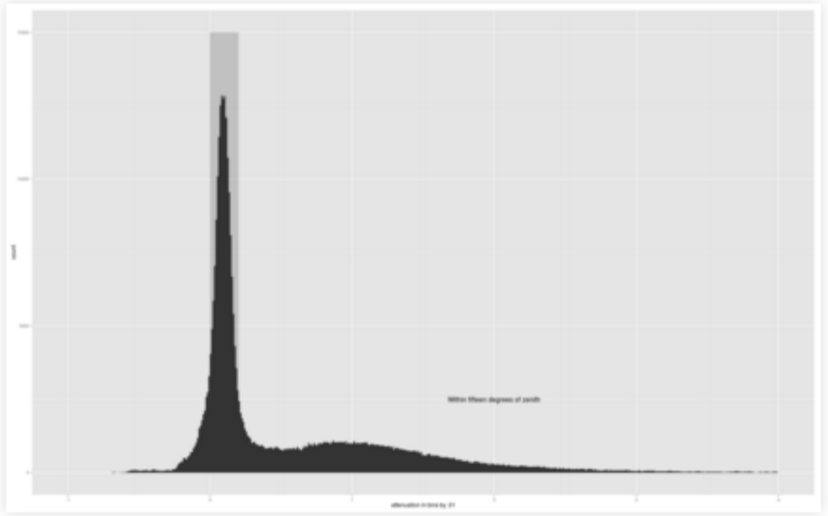


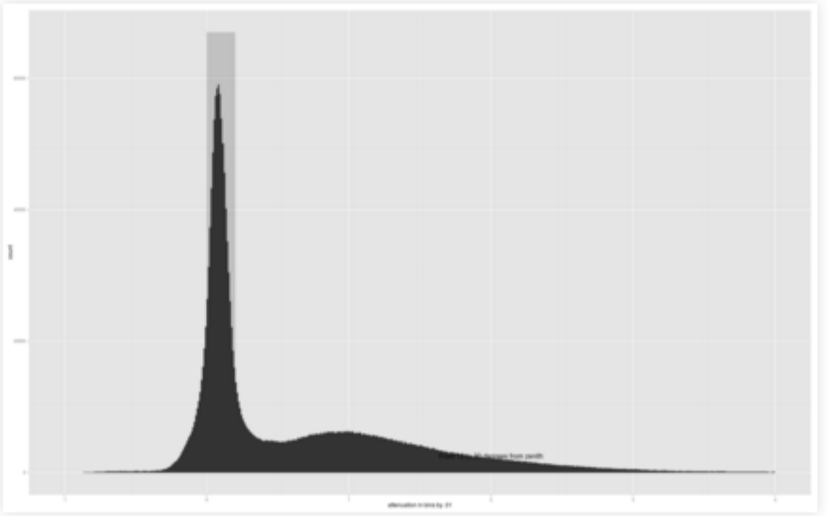


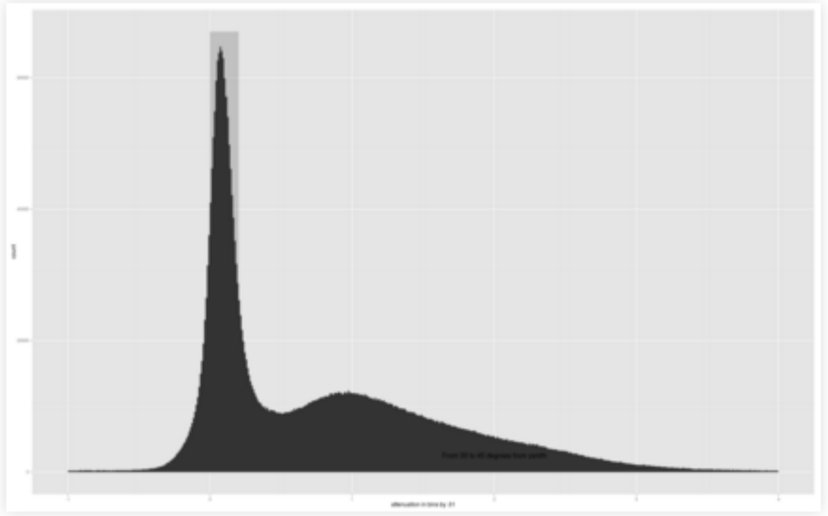
histogram of attenuation

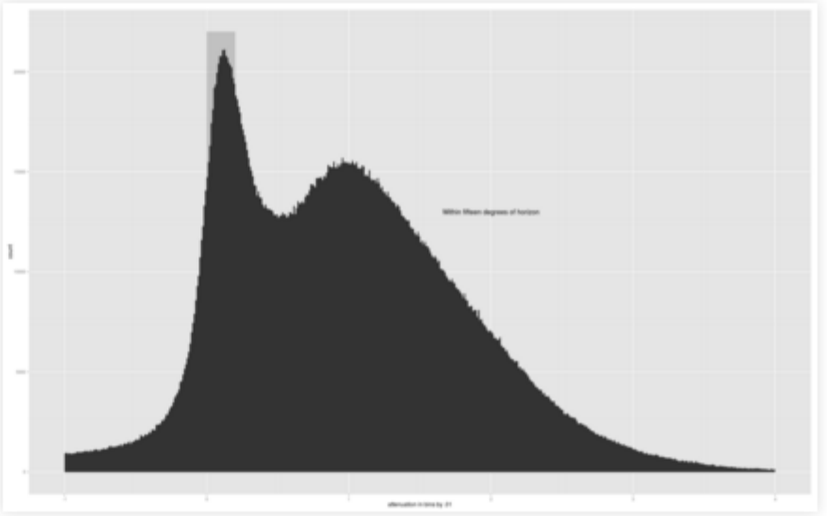


attenuation as function of zenith angle









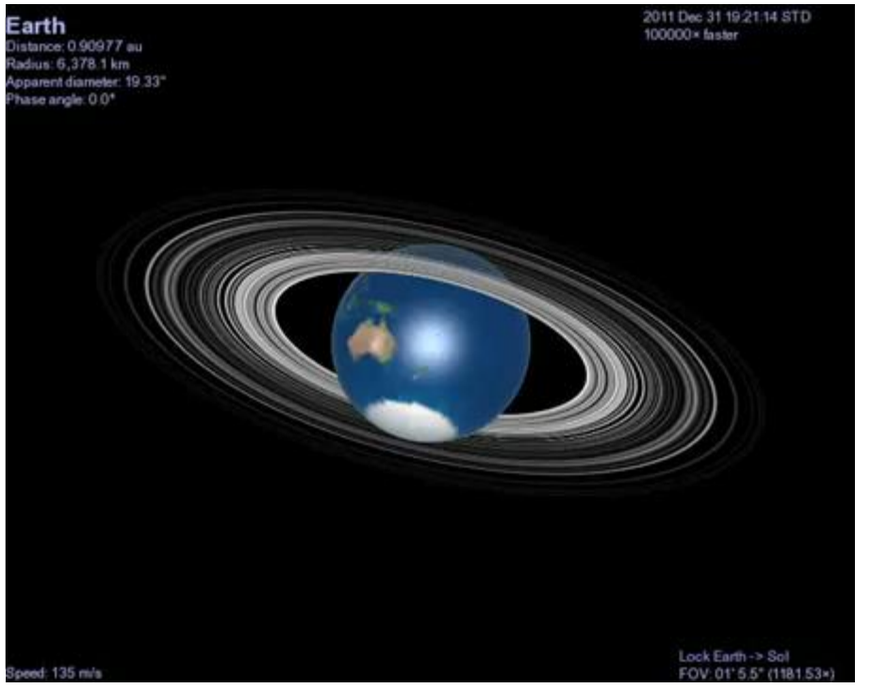
known limitations of the parsed data

- - Metadata sometimes has typos. **Errors most affect tropics.**
- Two different sampling strategies are in use. **Effect on stats.**
- Archive intervals are not reported. **Would affect glinting stats.**
- Sensors may tilt. **Overbright nearer meridian - noon and winter?**
- Protocol for reporting L>999 is used inconsistently. **Midsummer.**
- L values above 2000 are outside the range of most stations. **Midsummer glinting.**

project: can there be a planetary ring

WHAT TO LOOK FOR:
equatorial orientation is usual
therefore annual cycle
usually densest around 1.5-3 R(planet)
fuzzy structure for a rocky planet
composed of typical aeolian sediments

REASONS TO NOT DO THIS:
a ring would decay very rapidly
only the moon could make it persistent
but moon was long thought dead



Q: On a winter day, solar declination = δ, the sun for some observer has zenith angle ZA at transit (ZA is the angular distance from the zenith to the sun's position).

What is the radius R of the orbit of material in an equatorial ring that shades the sun at transit for this observer?

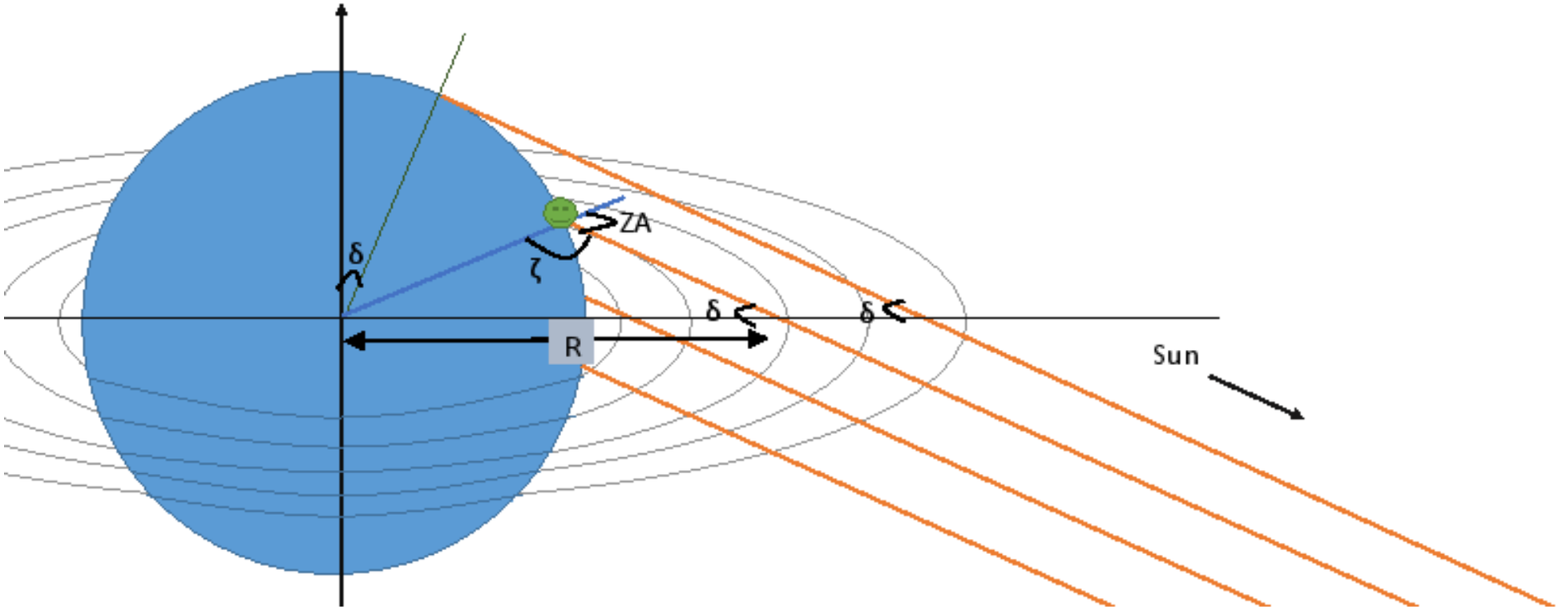
A: In the figure below, the blue line extends from the center of the earth to the observer in question. Orange lines depict incoming solar radiation. The angle ζ is the supplement of ZA; that is, ζ=180-ZA. Observer position is denoted thus:

By the Law of Sines,

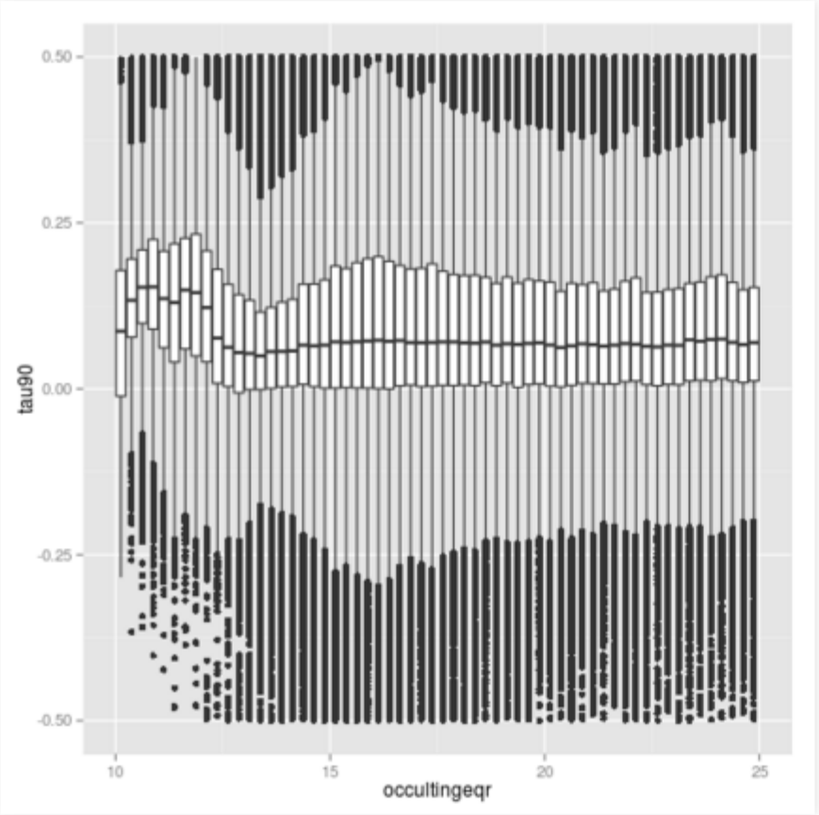
$$\frac{\sin\delta}{r_{earth}} = \frac{\sin\zeta}{R}$$

Furthermore, sin ζ = sin ZA

R = sin ZA * $\frac{r_{earth}}{\sin\delta}$.



attenuation as a function of attributed ring



- densest at about 16K km from center of Earth, about 2.5R(Earth),
- $\tau ring_{edge-on} \approx 0.1$ (taken as the anomaly above average value of τ),
- $\tau_{ring} \approx 0.02$ if the above is scaled by sin of ten degrees (i.e., half of 23.5).

In closing...

The CWOP Solar Radiation database is publicly available
-in raw form
-in parsed form

Enjoy the new opportunities it provides -

Thank you for your attention.

acknowledgments

CWOP Volunteers

Steve Dimse, Philip Gladstone,Ted Lum, Davis Instruments, Weather Display

Postgres community, Aginity, R Community, RStudio Community,
Javier Corripio (insol), Hadley Wickham (ggplot, dplyr, stringr, inter alia), Coursera and JHU, Celestia Community, Amazon Web Services, Lewis Aslett for AMI, Stack Overflow community

links

- CWOP generally: http://wxqa.com
- CWOP solar radiation archive: http://wxqa.com/lum_search.htm
- Parsing routine: www.github.com/lohancock/solardataparser
- Markdown for this presentation: https://github.com/lohancock/solar-data-parser/blob/master/ams2016.Rpres
- To clone the database of parsed solar radiation data, contact either author (russ4cwop@gmail.com,lohancock@aol.com)

annex: details of clear sky model

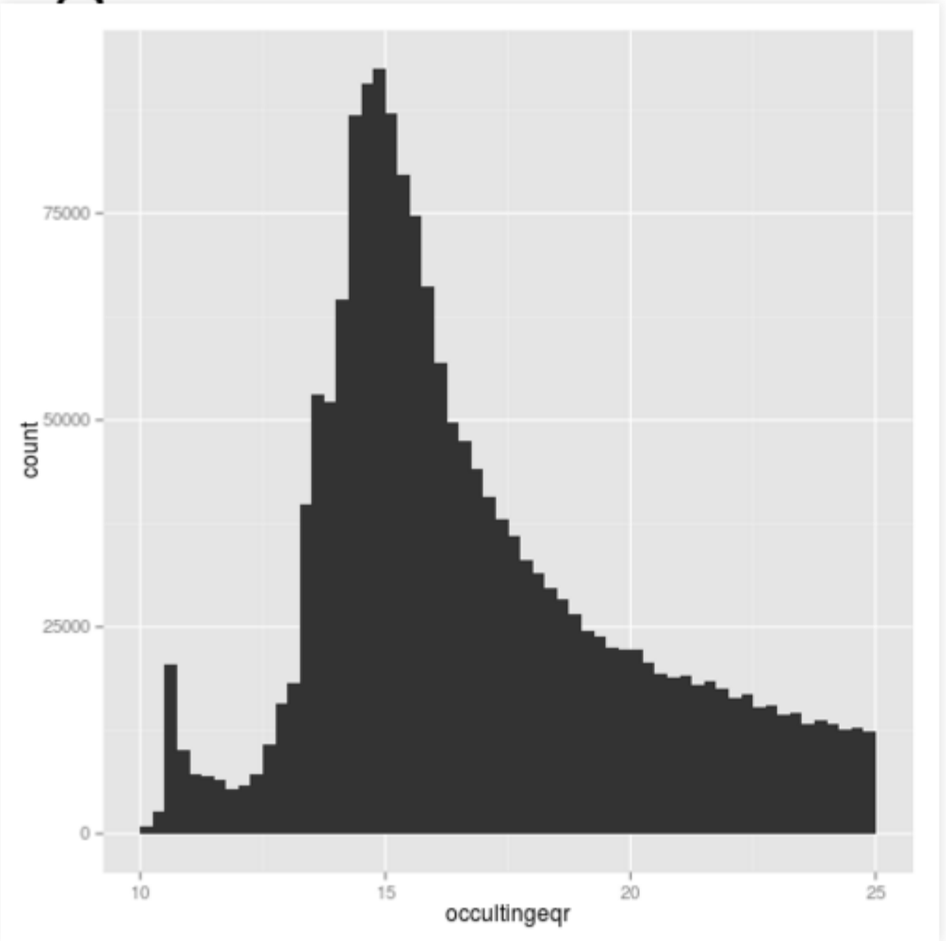
Used insol routine by Javier Corripio
https://cran.r-project.org/web/packages/insol/insol.pdf

Used latitude, longitude, z and relative humidity supplied in observations
Used temp(F) supplied in reports, converted to tempK
Used height looked up at gpsvisualizer.com
Applied to all calculations: visibility = 90 km, albedo 0.5, ozone=.02

annex: variables in the archive

each observation comprises 34 variables including: **parsed data: 23 variables** original report, station name, archive date, date/time as extracted from report, dateflag to highlight nominal dates out of range, calculated date and time z, latitude, N/S, longitude, E/W, wind direction, wind speed, wind gust, temperature (F), rain this hour, rain last 24 hours, rain today, relative humidity, barometric pressure, solar radiation measurement as given in report, solar radiation as interpreted, flag for number of characters in report, tech suffix providing some description of hardware and software **from model: 8 variables** julian day,sun azimuth angle, sun zenith angle, modeled solar insolation, diffuse component of modeled insolation, day length, solar declination, equation of time **from lookup:** station height **computed** attenuation **computed** occultingeqr

annex: how much data in the attenuation figure



annex: geometry of occulting ring

$$R_{\varnothing} = sin(ZA) * \frac{R_{\oplus}}{sin(\delta)}$$

where

$R_{\varnothing} \equiv$ radius of ring;
$R_{\oplus} \equiv$ radius of Earth;
ZA $\equiv$ zenith angle of sun;
$\delta \equiv$ solar declination angle.

R as function of yearday and lat