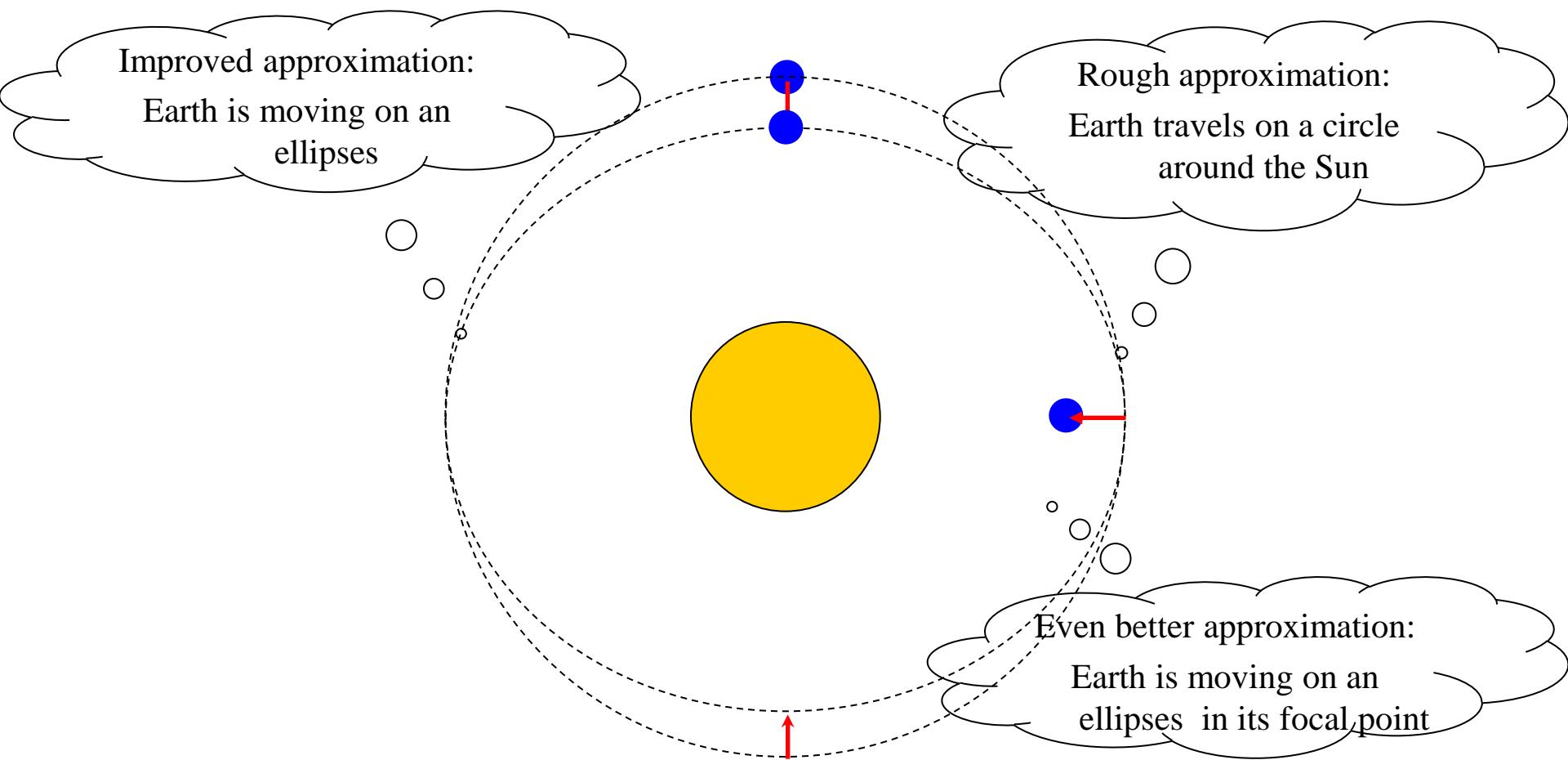


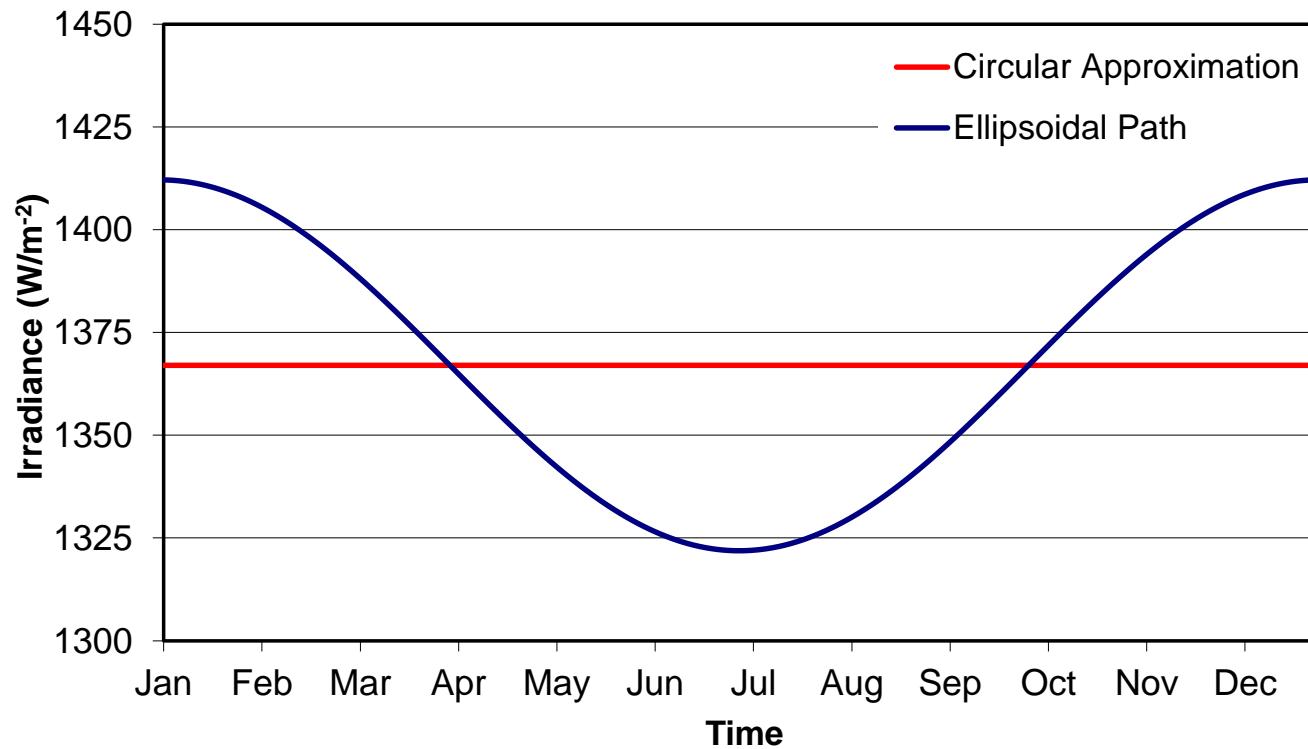
# SOLAR RESOURCE SUN PATH

Dr. Osama Ayadi

# Sun-Earth Geometry



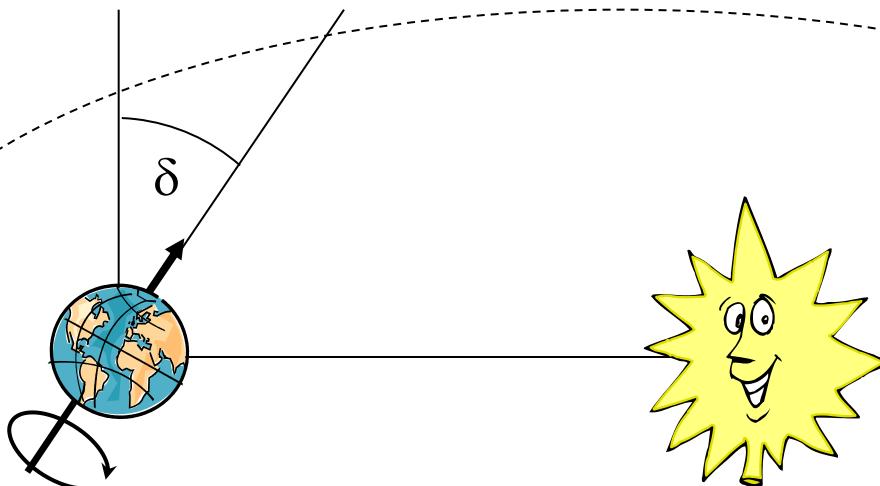
# Irradiance Outside Atmosphere



# Variation of extraterrestrial radiation

- When the sun is closest to the earth, on January 3, the solar heat on the outer edge of the earth's atmosphere is about  $1400 \text{ W/m}^2$  farthest away,
- on July 4, it is about  $1330 \text{ W/m}^2$ .
- The average value of the solar constant is  $1367 \text{ W/m}^2$

# Sun-Earth Geometry 2

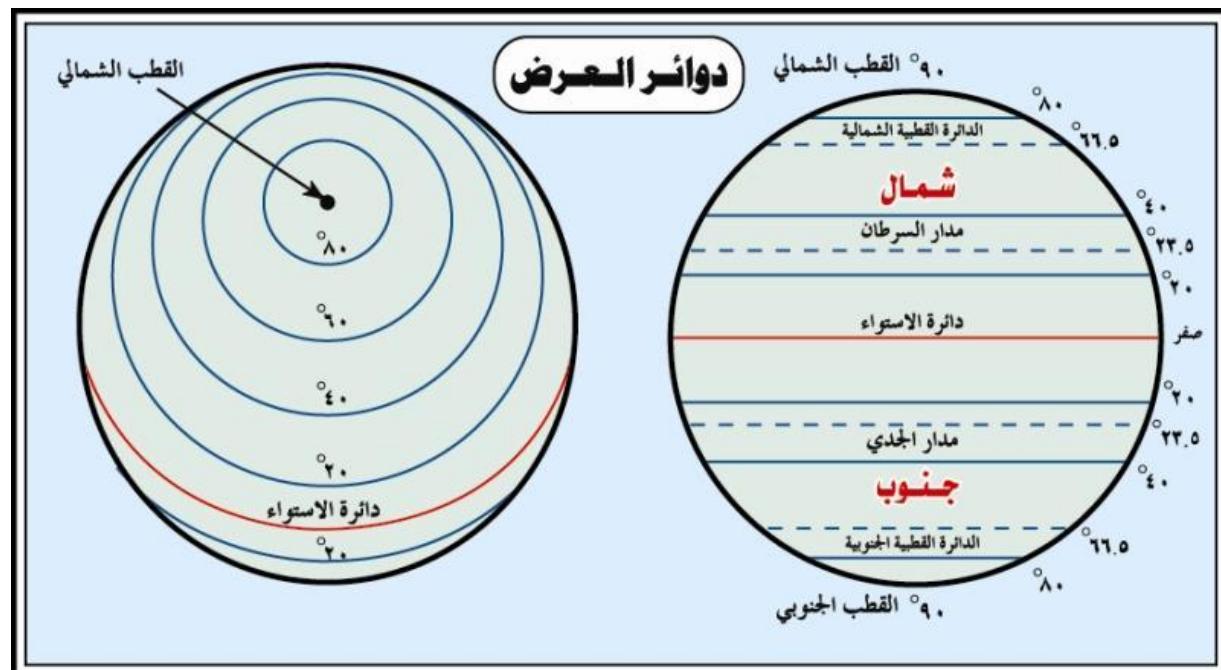


- Earth rotates around its axis
- Earth's rotational axis is angled at  $\delta=23.45^\circ$  to the orbital plane around the Sun
- Ellipsoidal movement around Sun

# Latitude

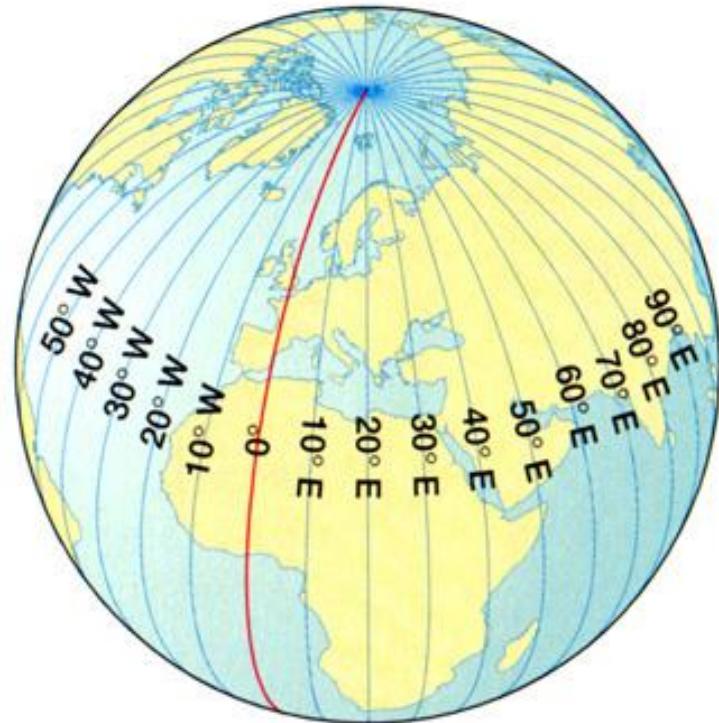
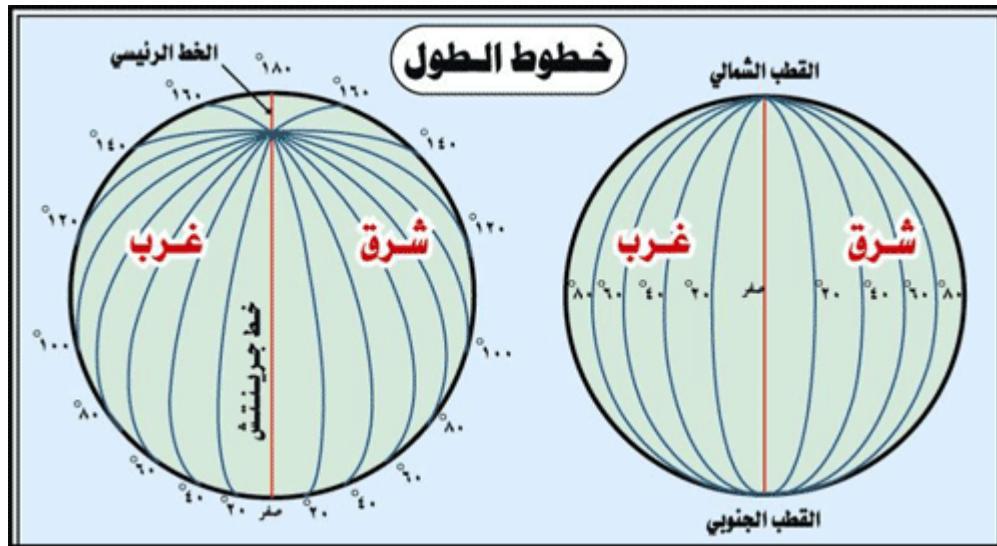
The angular location north or south of the equator, north positive.

$$-90 < < 90^\circ$$



# longitude

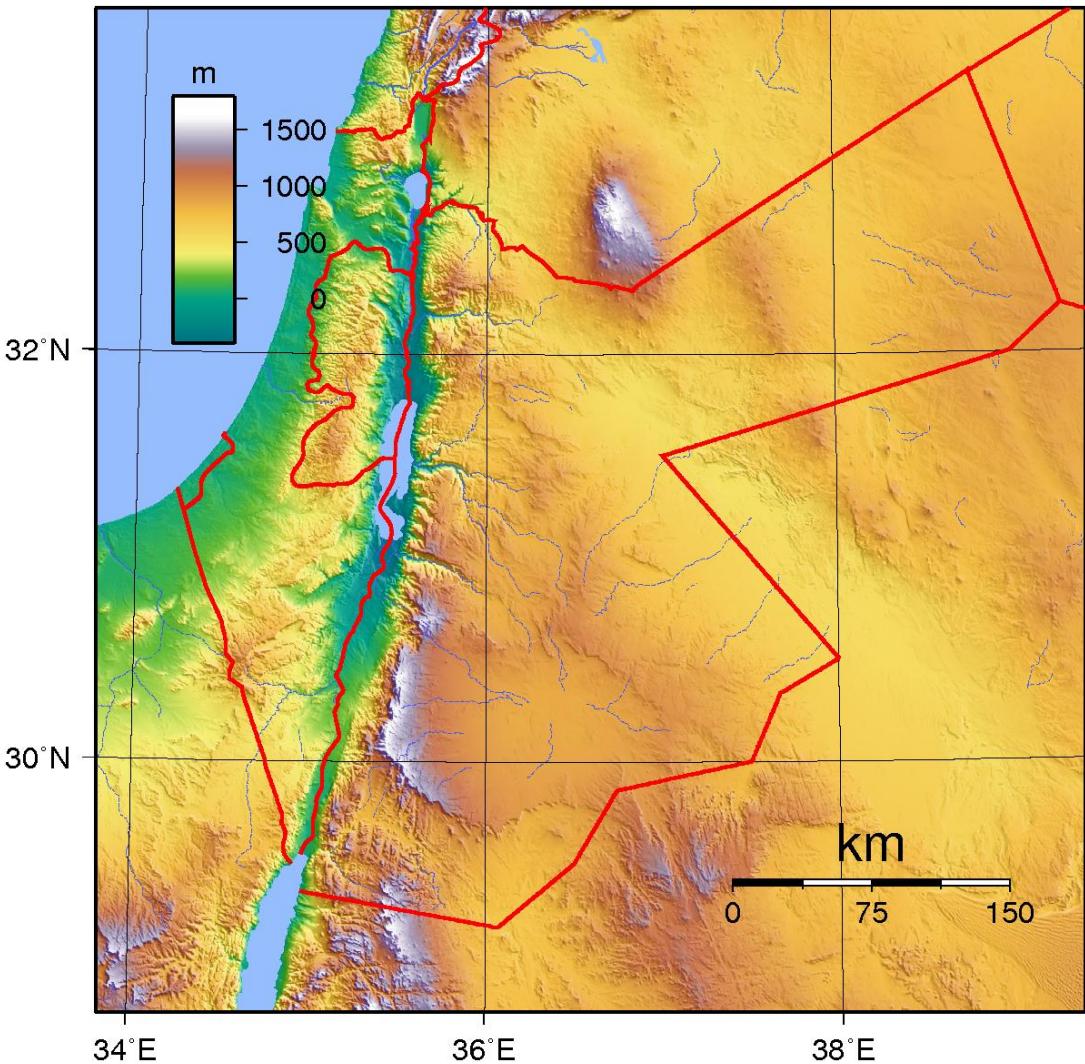
- is a geographic coordinate that specifies the east-west position of a point on the Earth's surface ( $\lambda$ )



## □ Amman

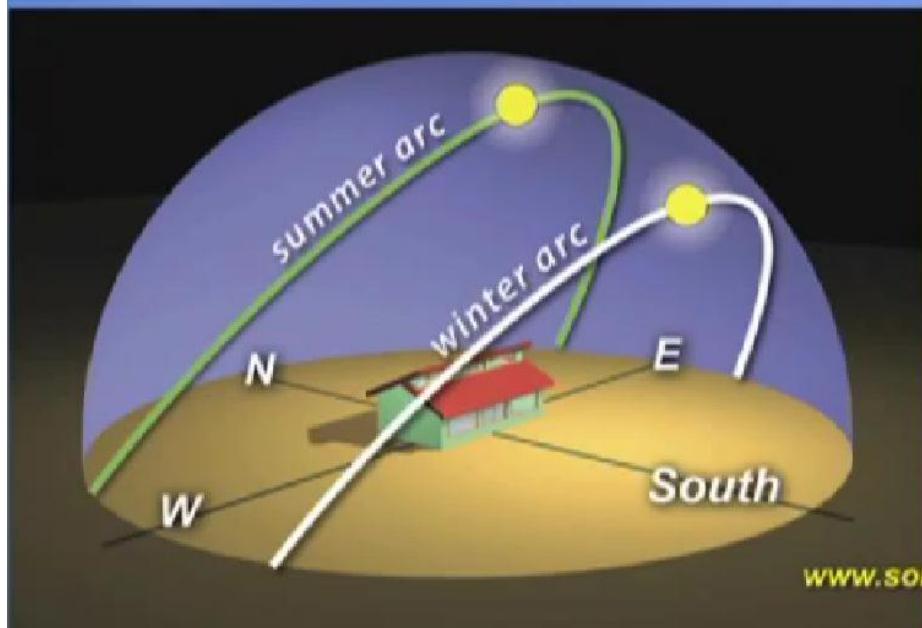
Latitude :  $31^{\circ}57'N$

Longitude:  $35^{\circ}52'E$



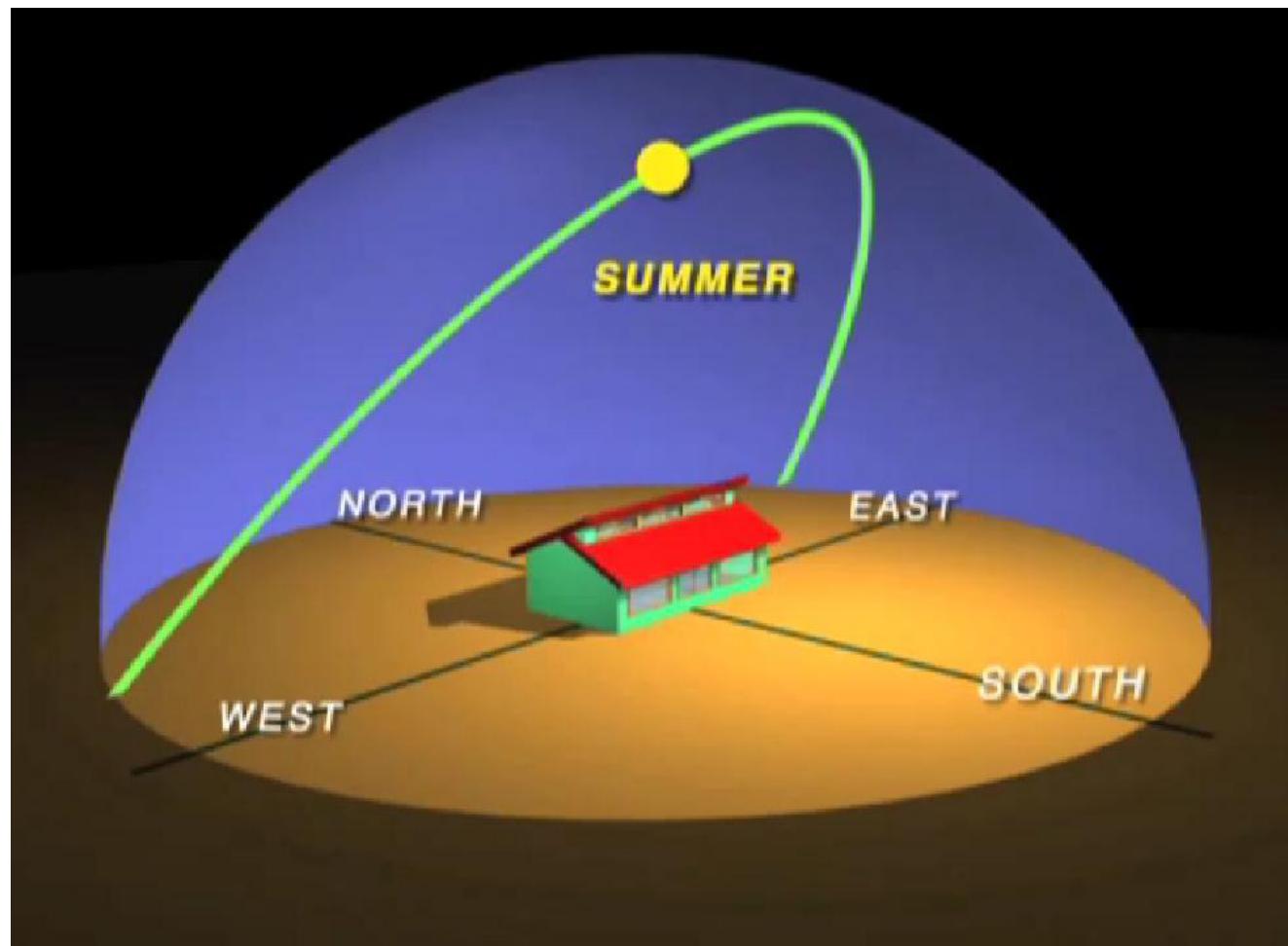
## ***Solar Orientation:***

**Using Solar Energy in Any Season**



**Clay Atchison  
Media Director  
Rahus Institute**

[www.solarschoolhouse.org](http://www.solarschoolhouse.org)





# *The Reasons for the Seasons*

*Why is it hotter in  
the summer?*



*Because the summer Sun  
is higher in the sky:*

- 1. Summer days are longer.*
- 2. Summer sunlight is more intense.*

*90 degree angles give more  
light & heat per unit of area.*



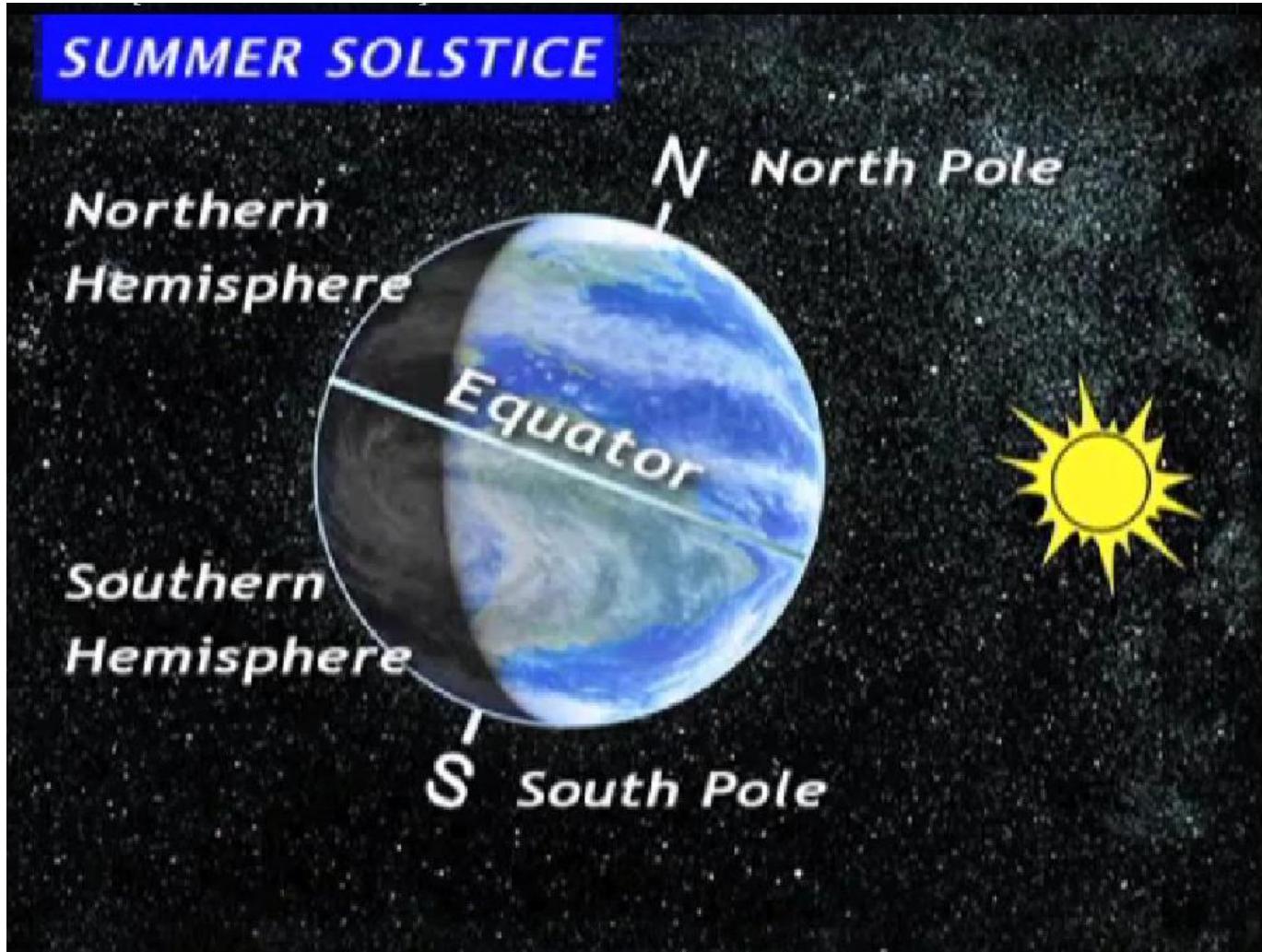
*Oblique angles give less  
light & heat per unit of area.*

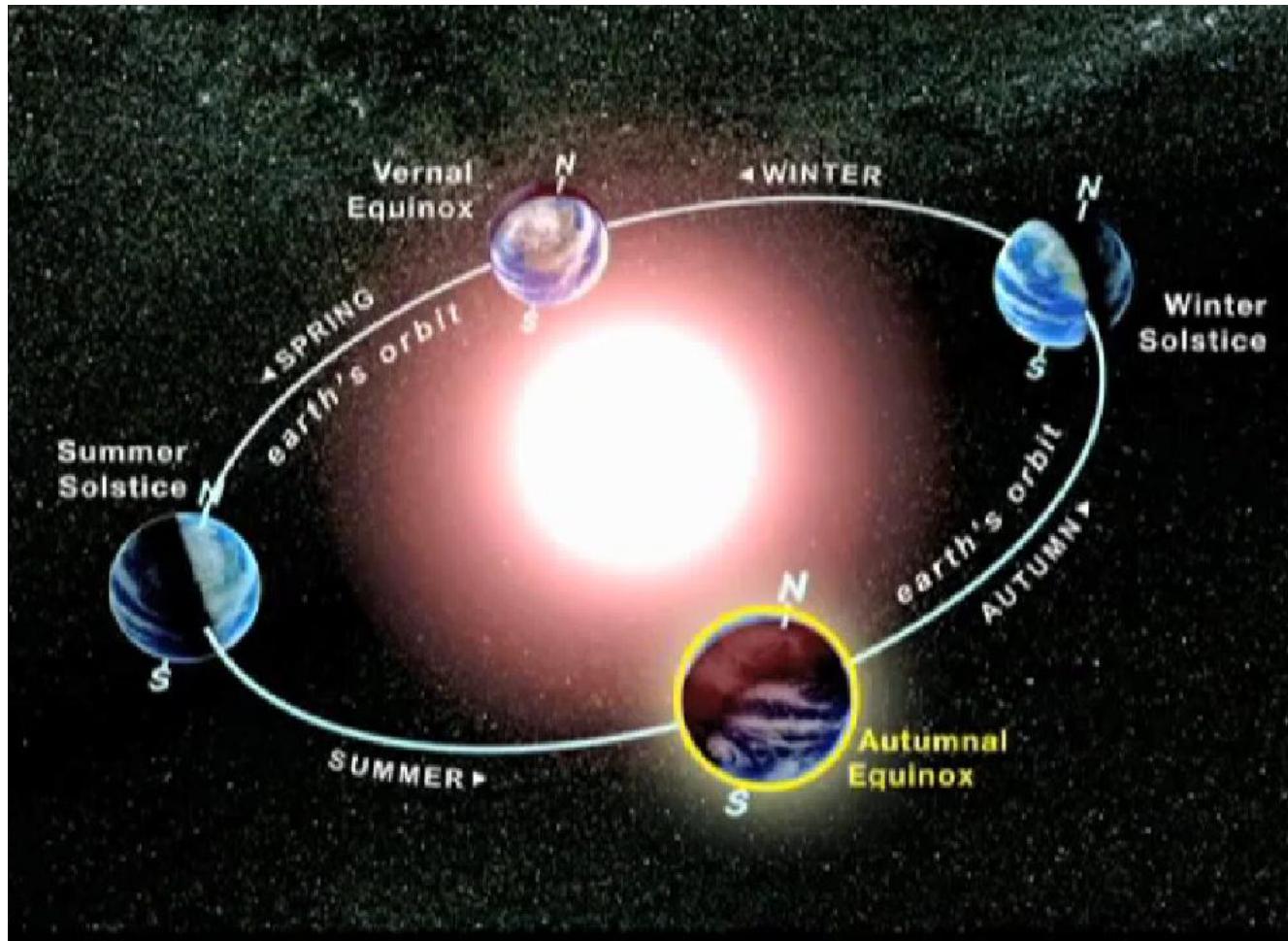


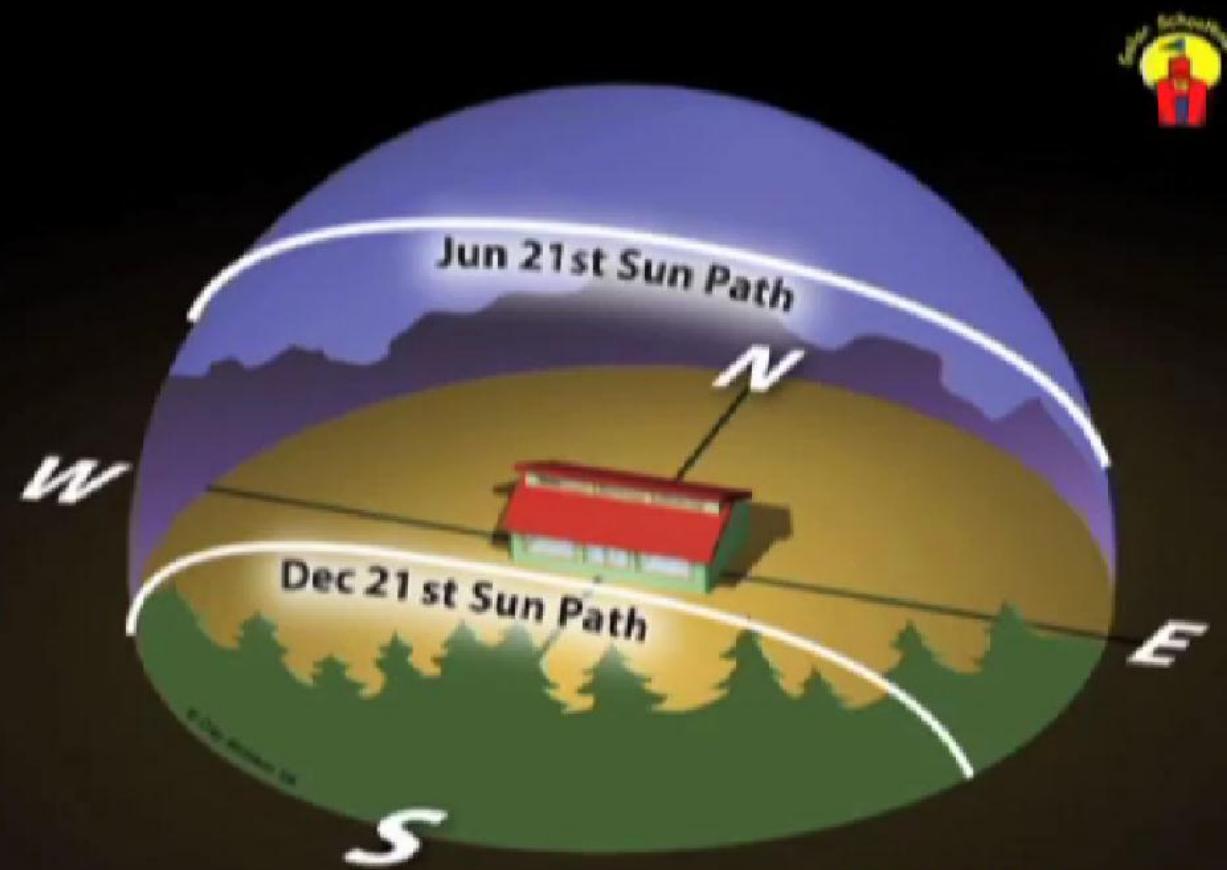


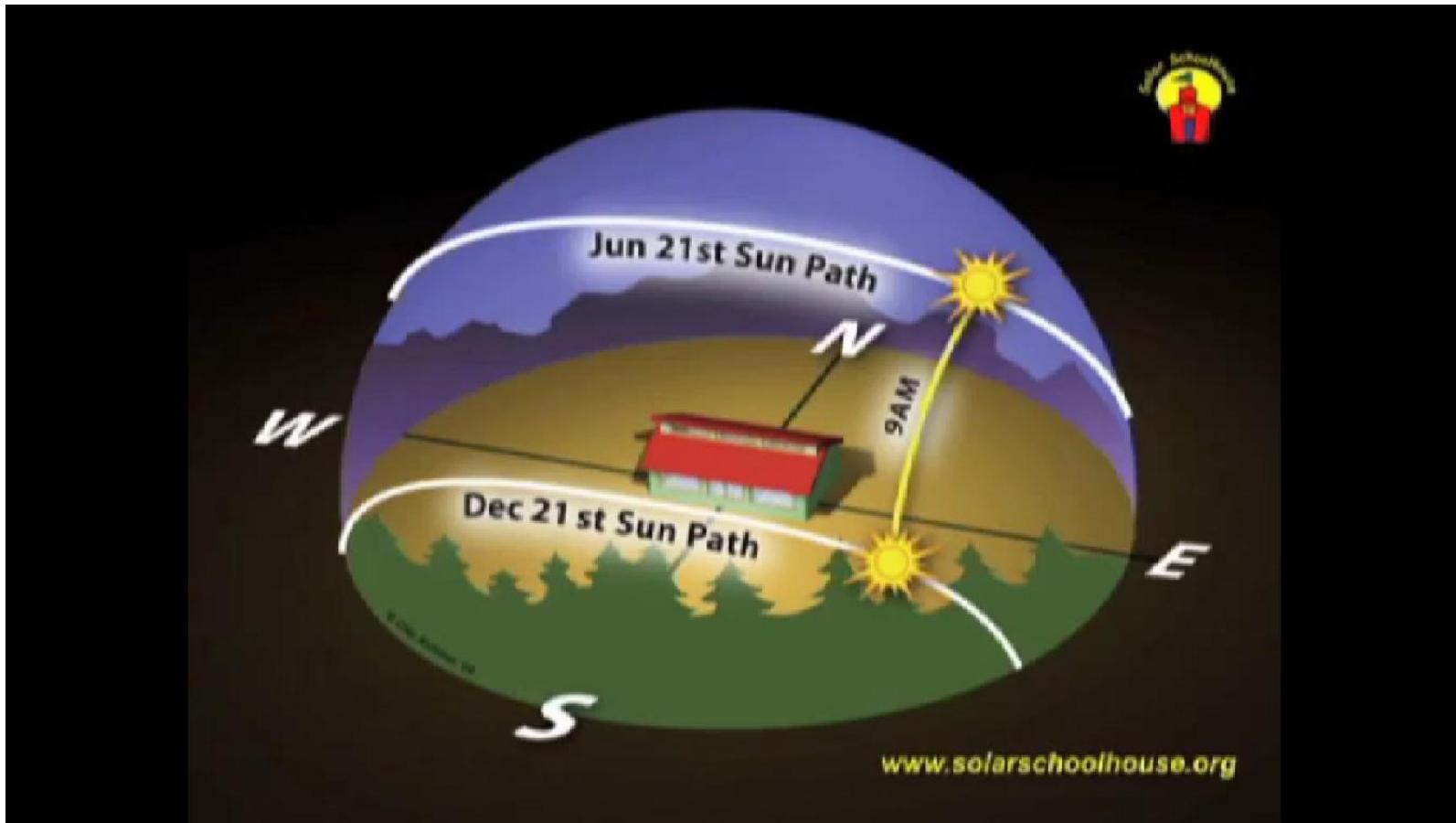
*Why is the Sun higher  
in the summer sky?*

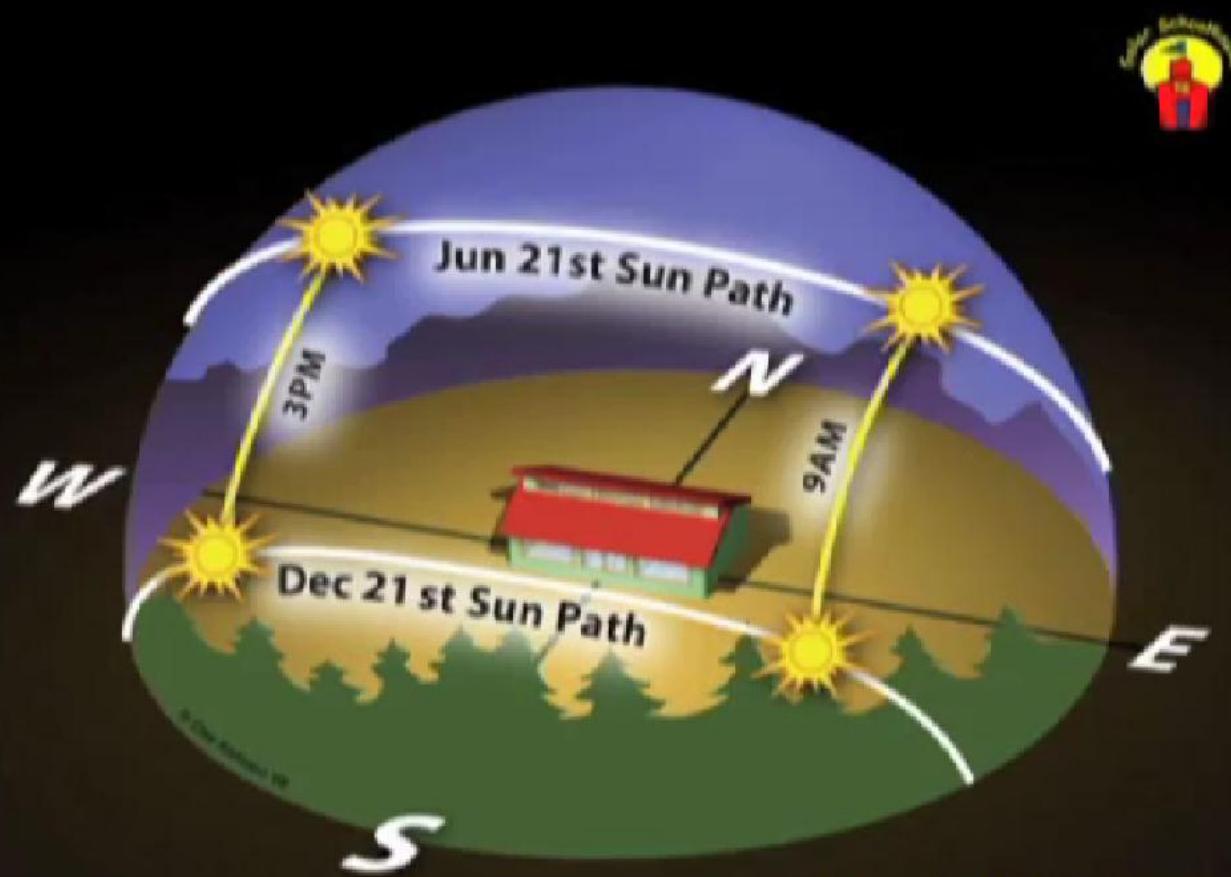
## SUMMER SOLSTICE







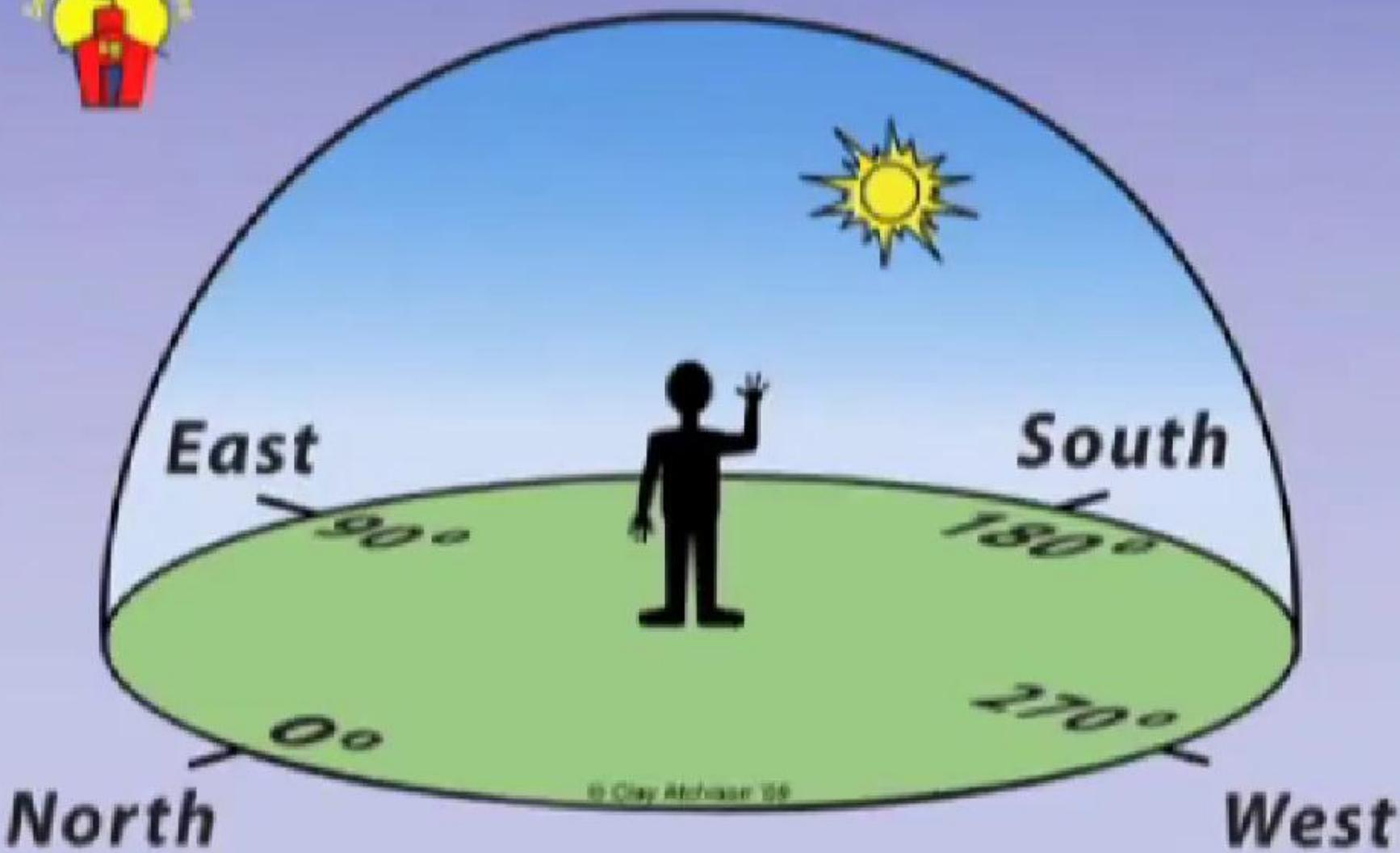




# Solar Window



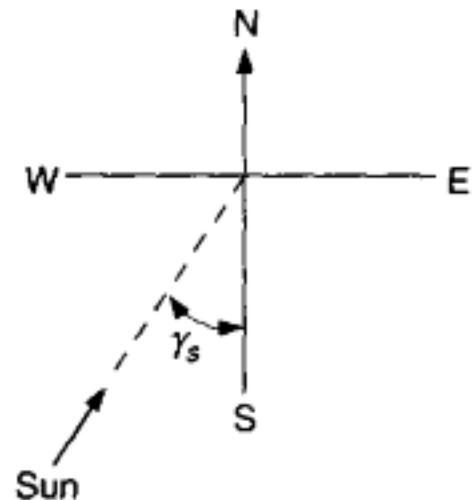


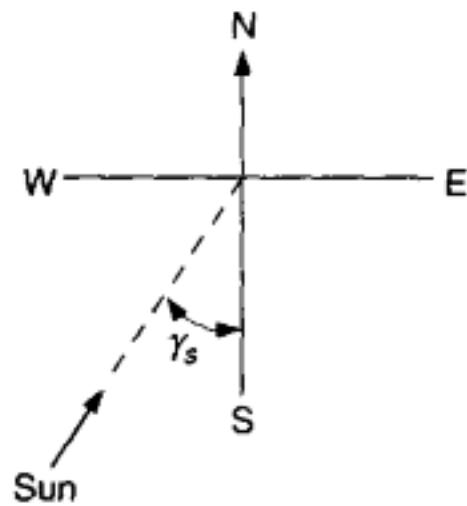
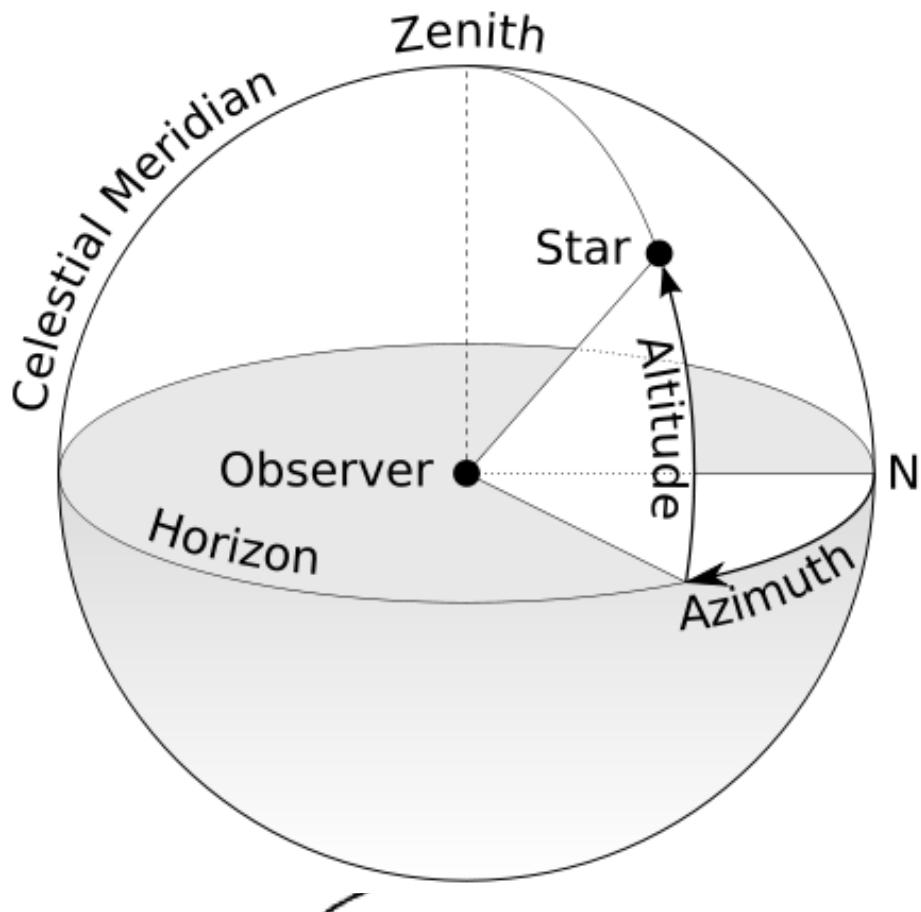


© Clay Richesse 1996

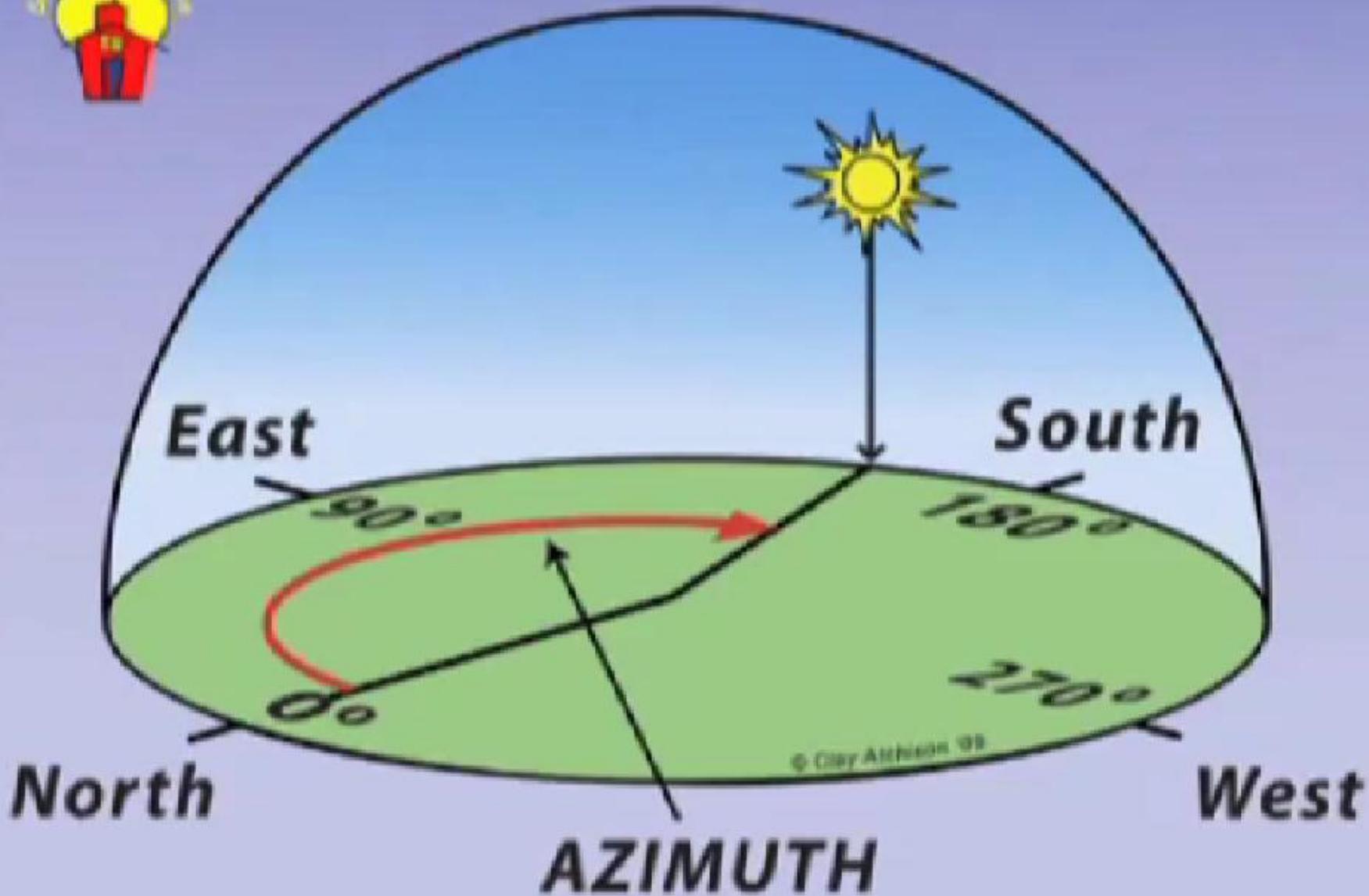
# Solar azimuth angle

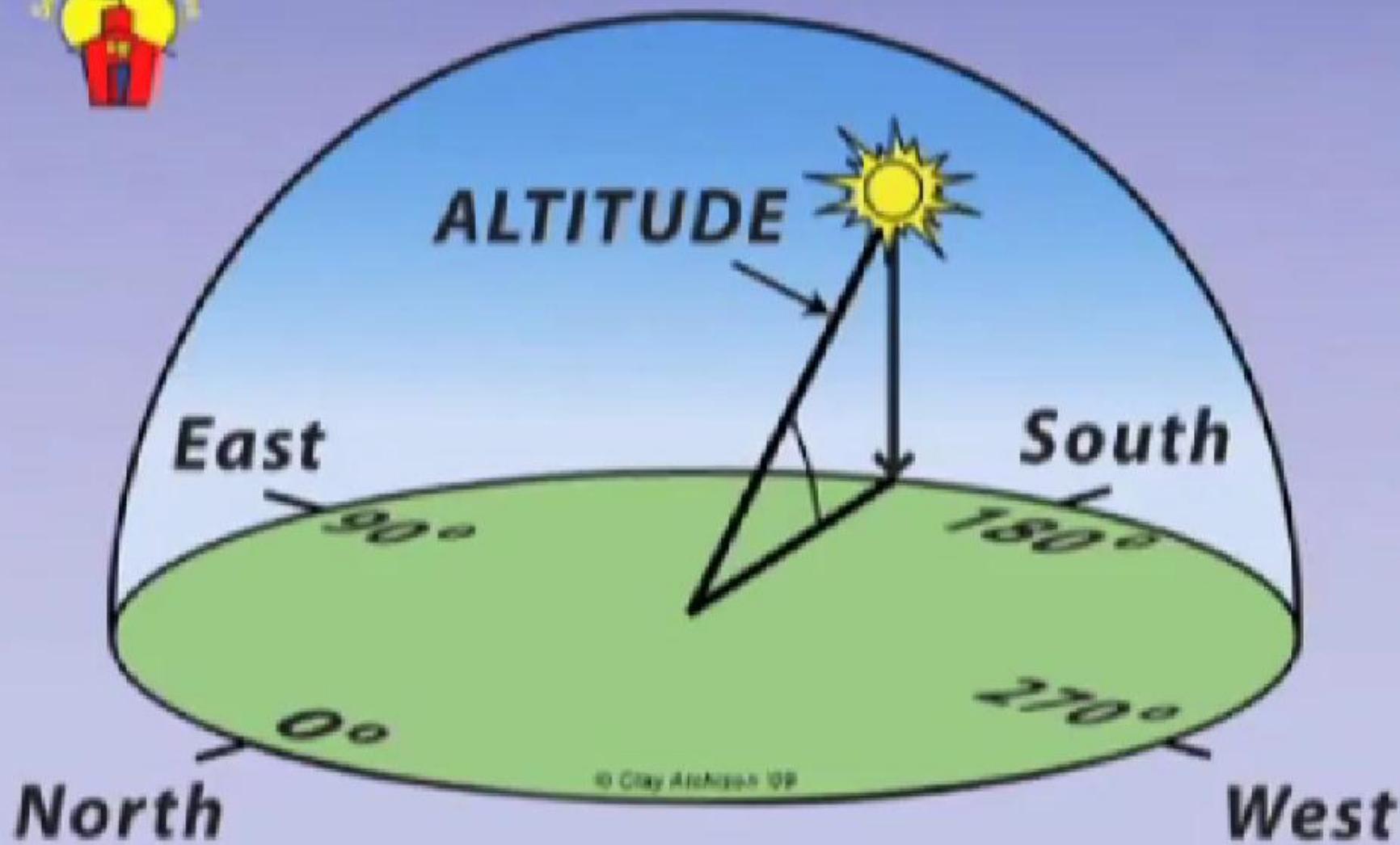
- An **azimuth** (i/ˈæzɪməθ/; from Arabic السمت as-samt, meaning "a way, a part, or quarter"[1]).
- The angular displacement from south of the projection of beam radiation on the horizontal plane.
- East of south are negative and west of south are positive.





**Figure 1.6.1** (a) Zenith angle, slope, surface azimuth angle, and solar azimuth angle for a tilted surface. (b) Plan view showing solar azimuth angle.

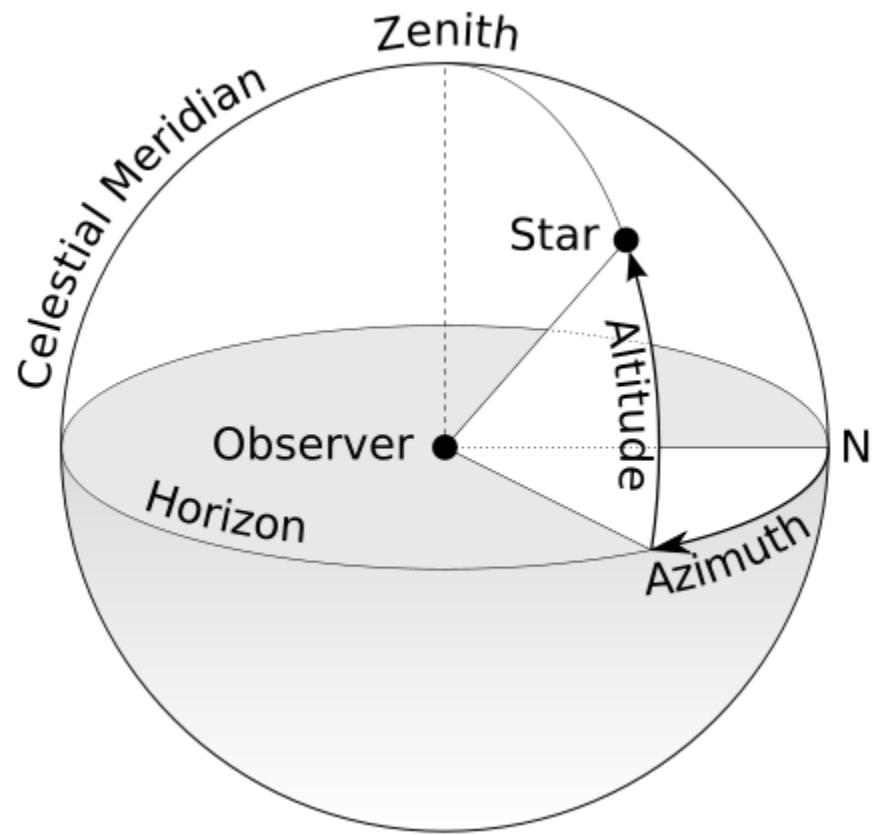


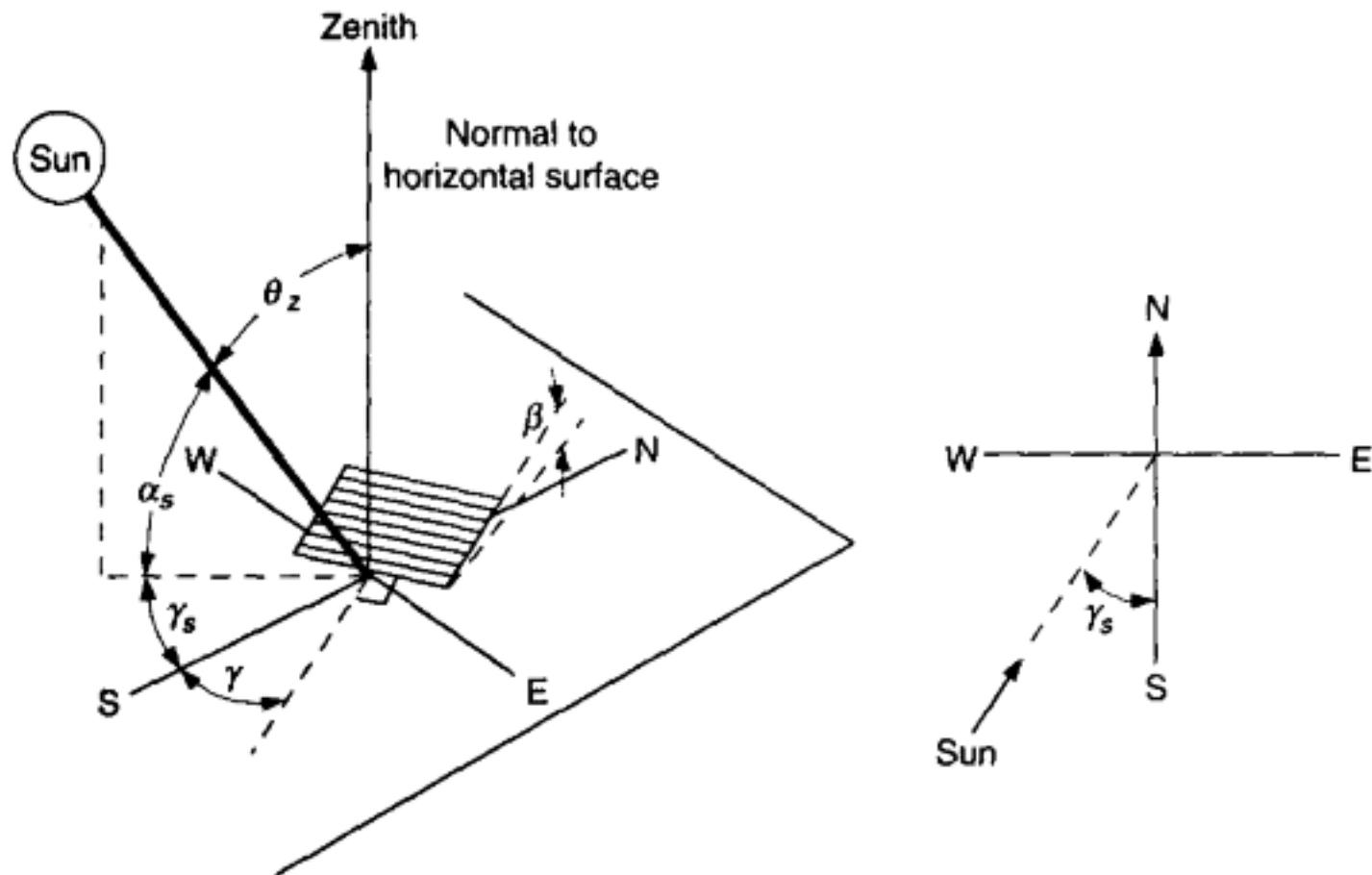


© City Schools of SF

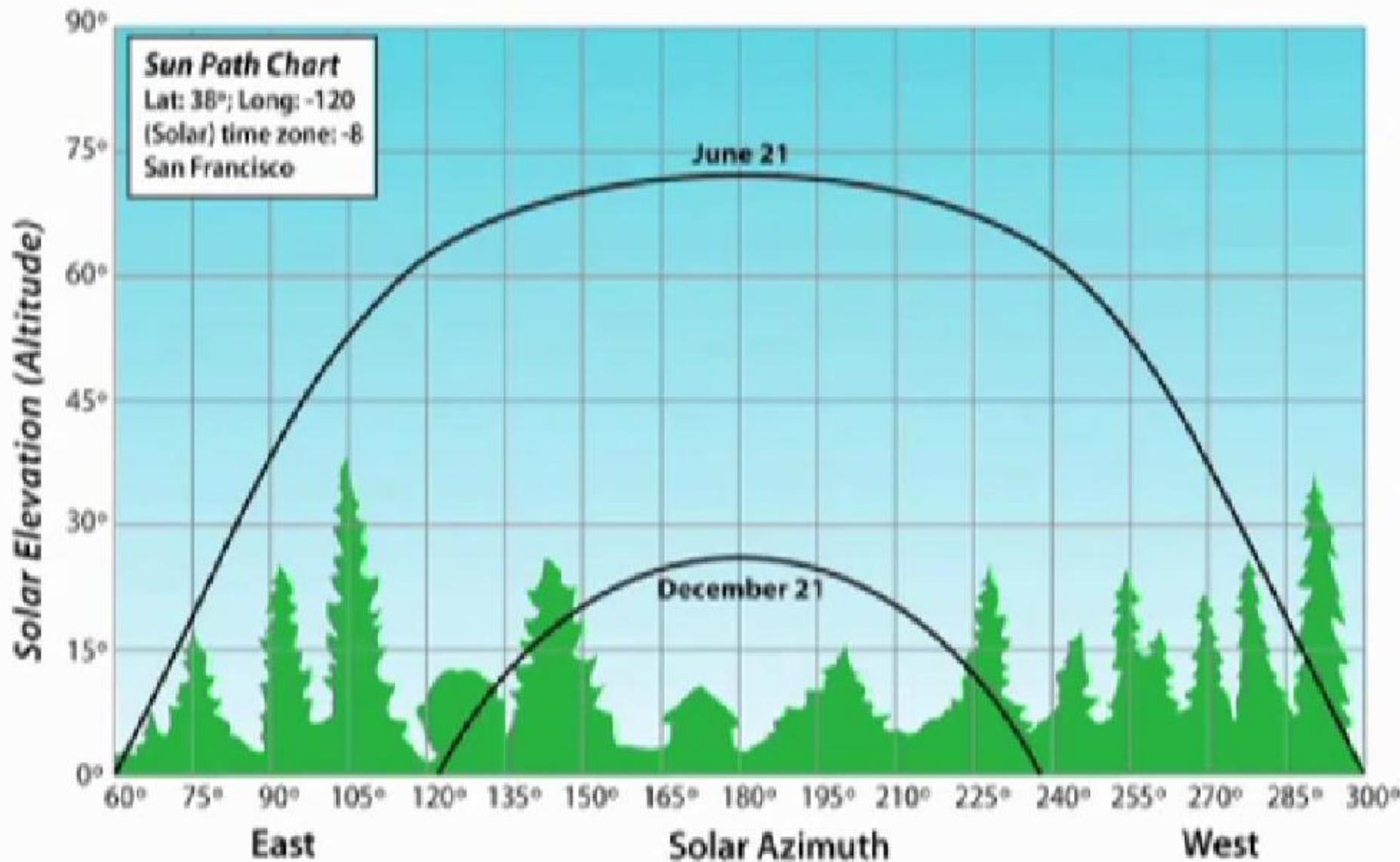
# Zenith Angle

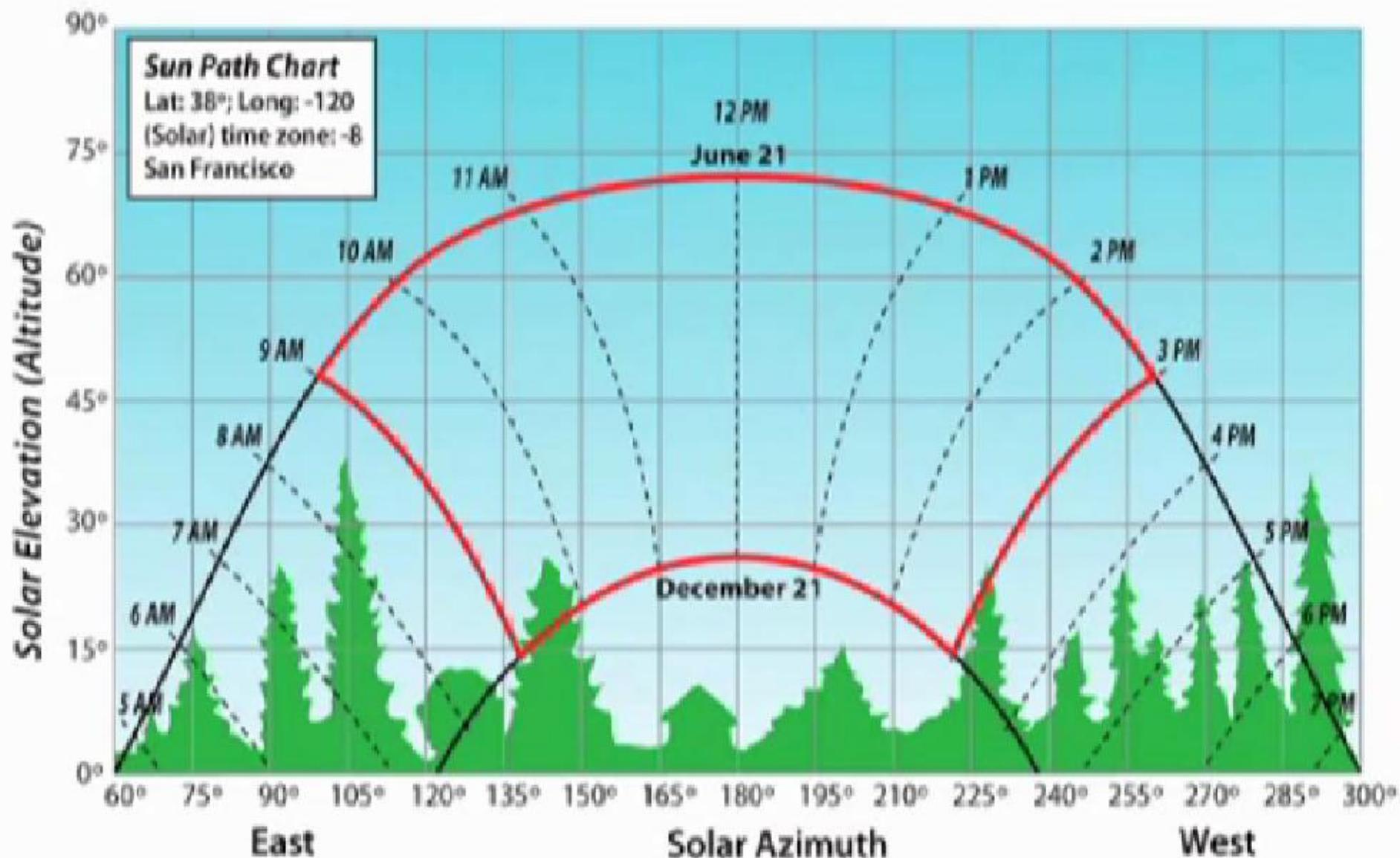
- The word "zenith" derives from the inaccurate reading of the Arabic expression ( سمت الرأس ) samt ar-ra's.
- The angle between the vertical and the line to the sun, that is , the angle of incidence of beam radiation on a horizontal surface.

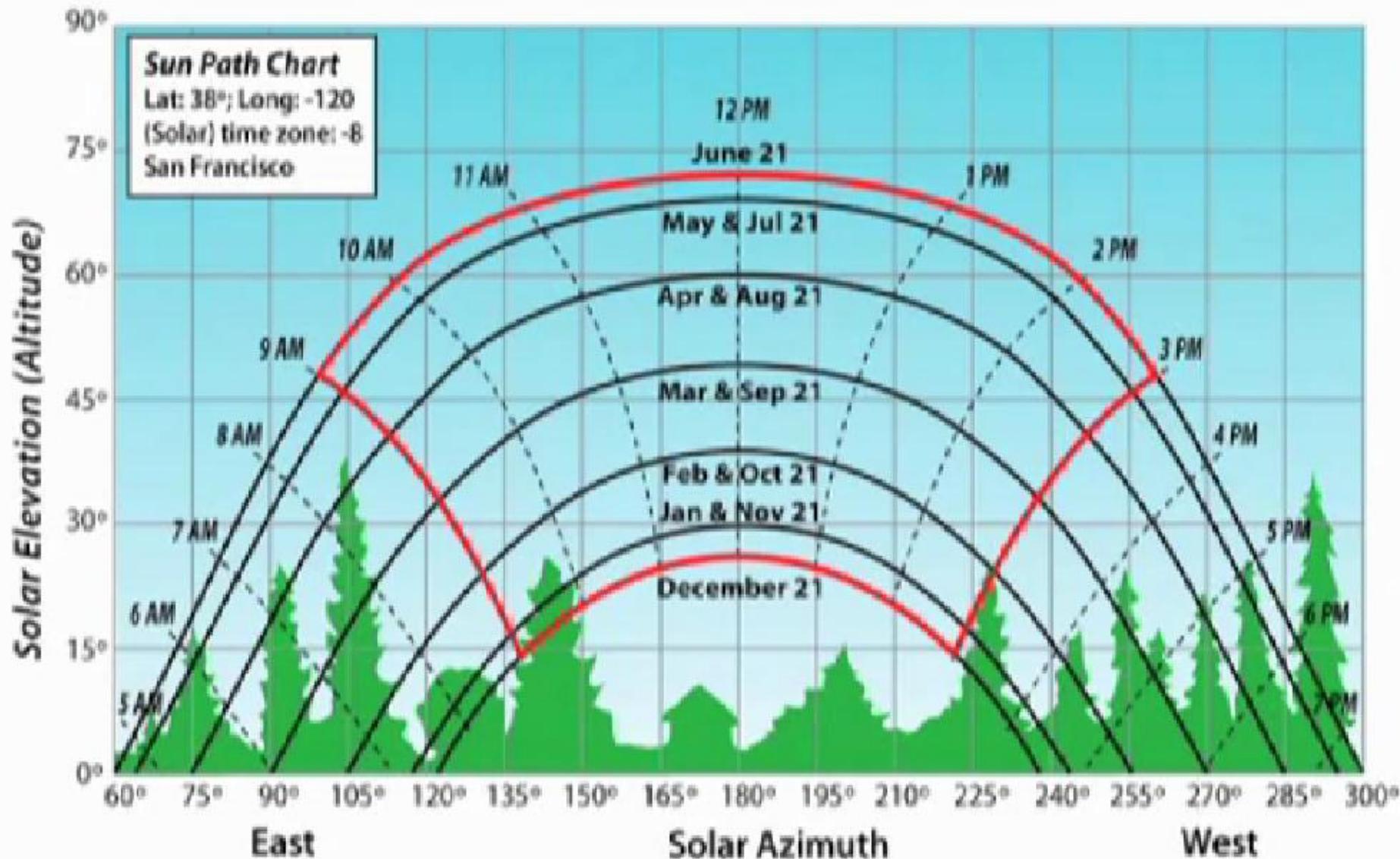


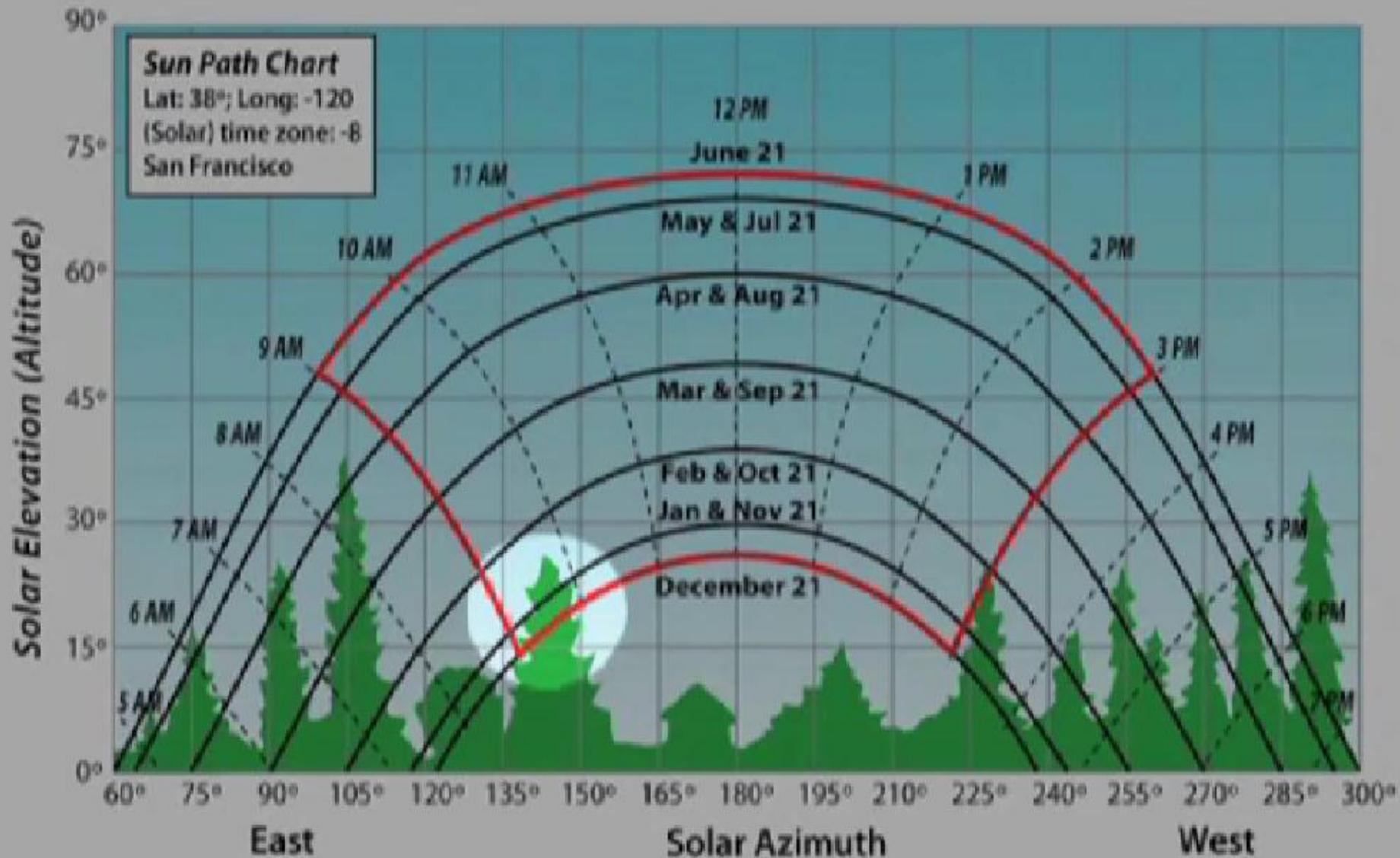


**Figure 1.6.1** (a) Zenith angle, slope, surface azimuth angle, and solar azimuth angle for a tilted surface. (b) Plan view showing solar azimuth angle.











*[http://solardat.uoregon.edu/  
SunChartProgram.html](http://solardat.uoregon.edu/SunChartProgram.html)*

90°

80°

70°

60°

50°

40°

30°

20°

10°

(c) Univ. of Oregon SRML  
Sponsor: DPA  
Lat: 31.95, Long: 35.93  
(Solar) time zone: 2

12 PM

11 AM

10 AM

9 AM

8 AM

7 AM

6 AM

5 AM

1 PM

2 PM

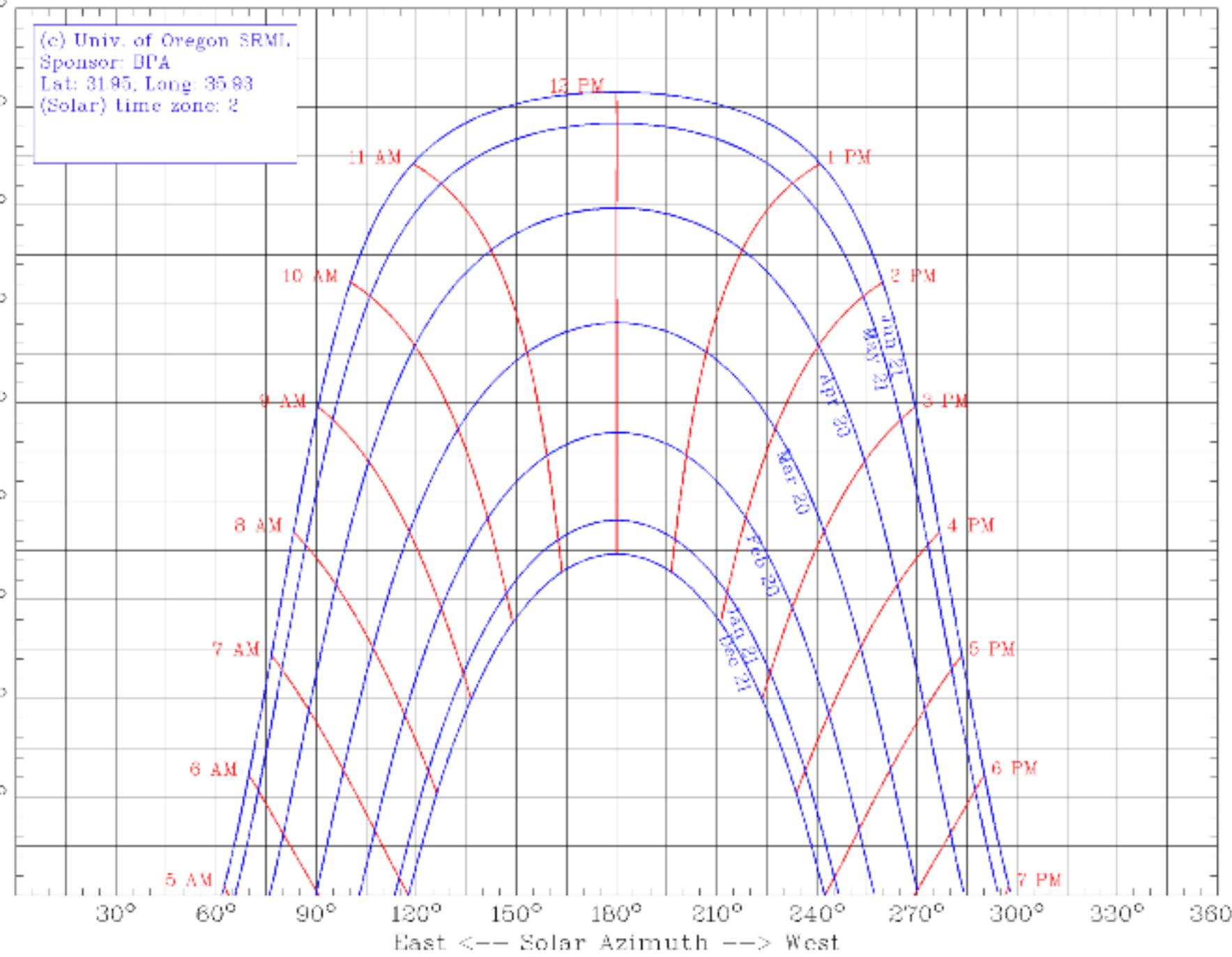
3 PM

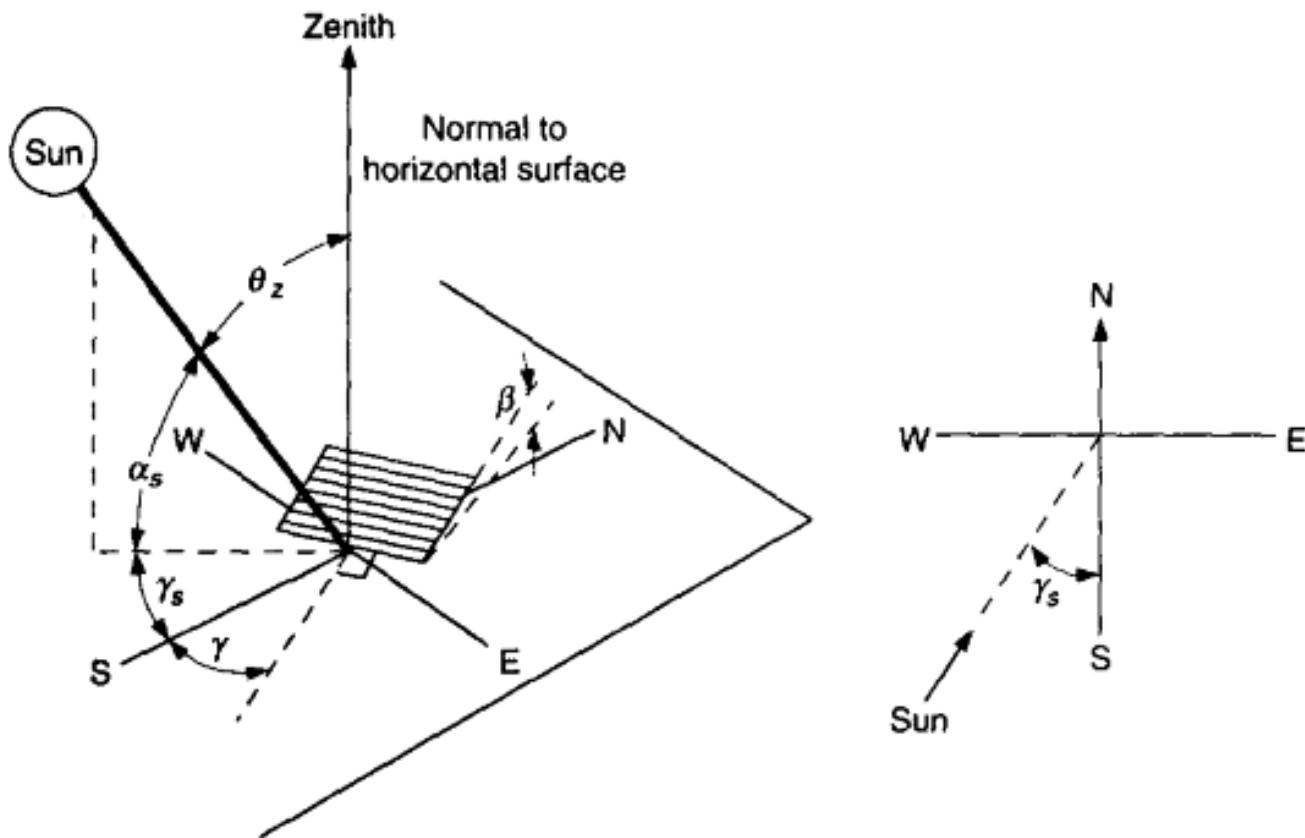
4 PM

5 PM

6 PM

7 PM





**Figure 1.6.1** (a) Zenith angle, slope, surface azimuth angle, and solar azimuth angle for a tilted surface. (b) Plan view showing solar azimuth angle.