AST3.1 Annual solar motion

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European Society for Astronomy in Culture

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Société Européenne pour l'Astronomie dans la Culture

Solar Motion

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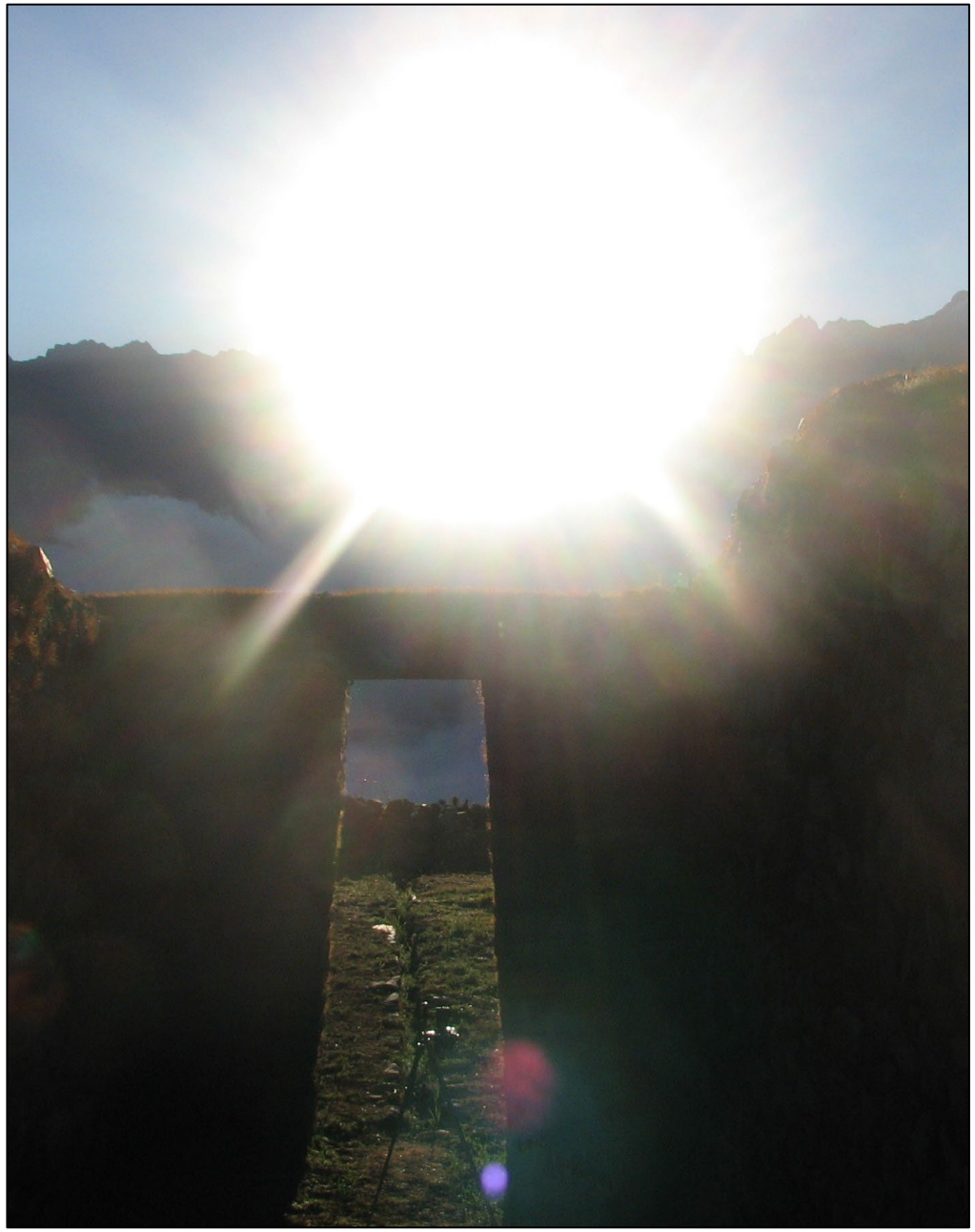
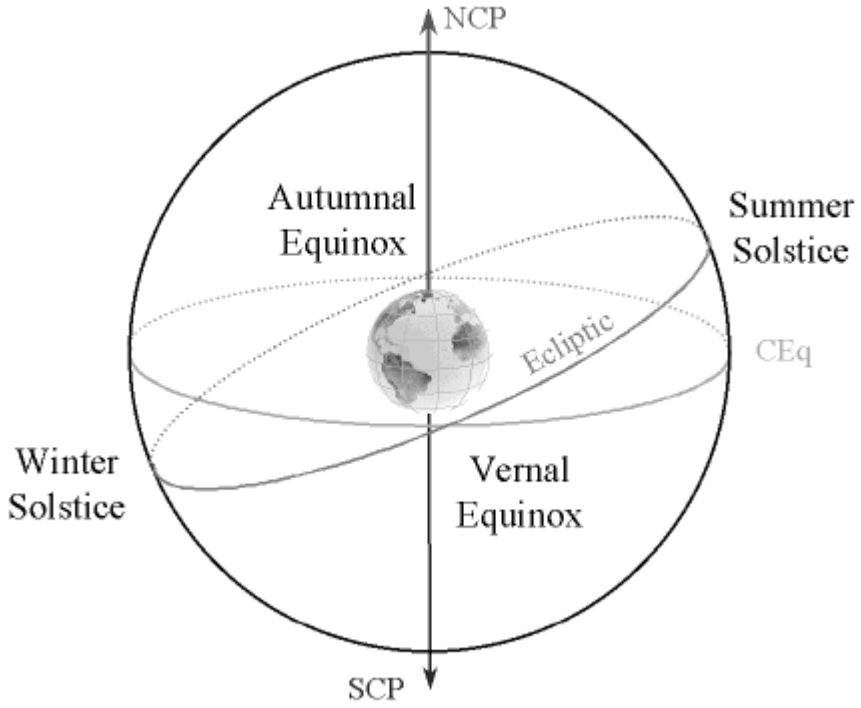


Annual Motion of the Sun

The Sun appears to move across the sky slightly to the east by close to 1 degree per day. This is a result of the Earth's revolution around the Sun and because there are 365 days per year but only 360 degrees in a circle.

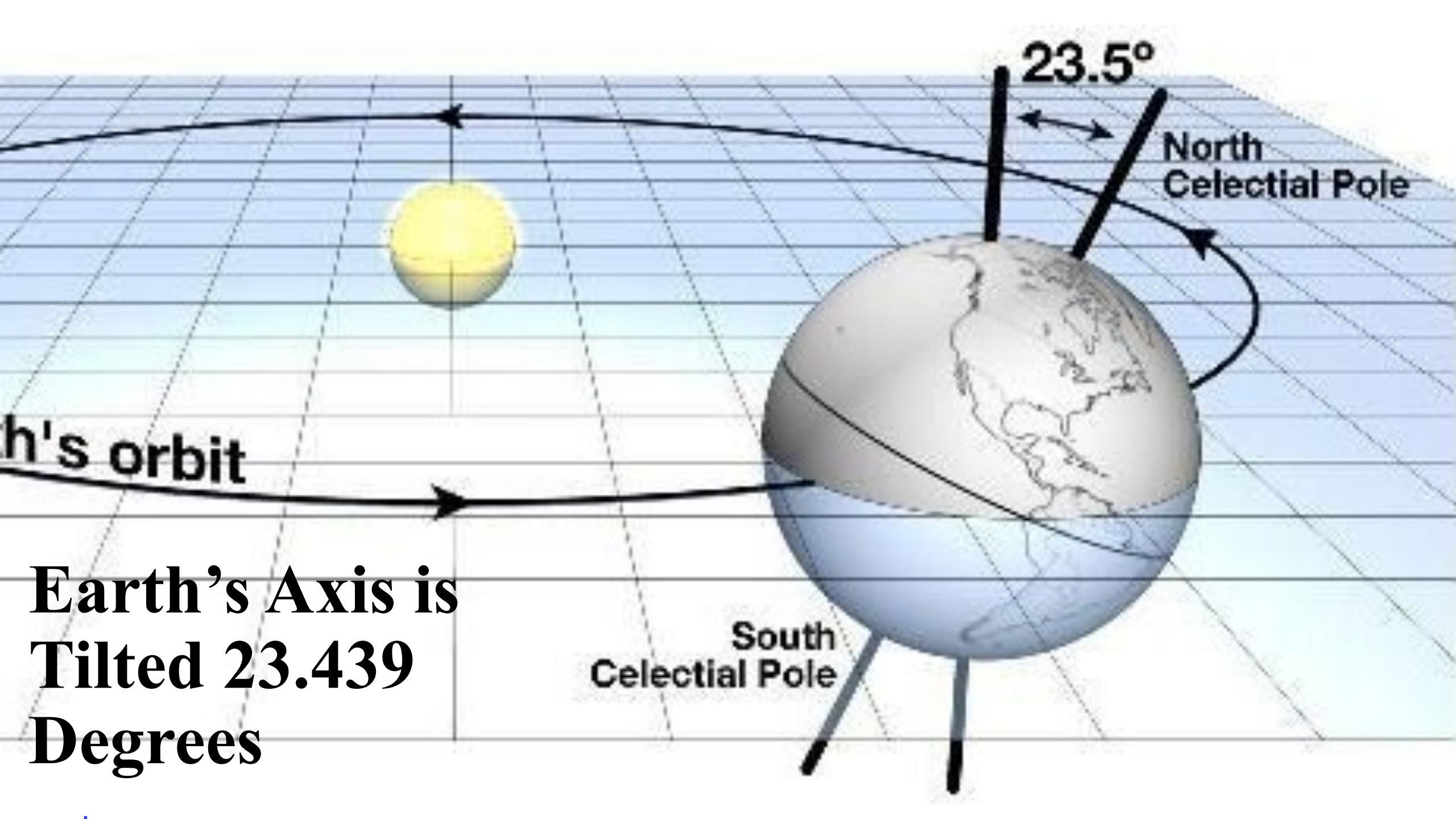


The Ecliptic

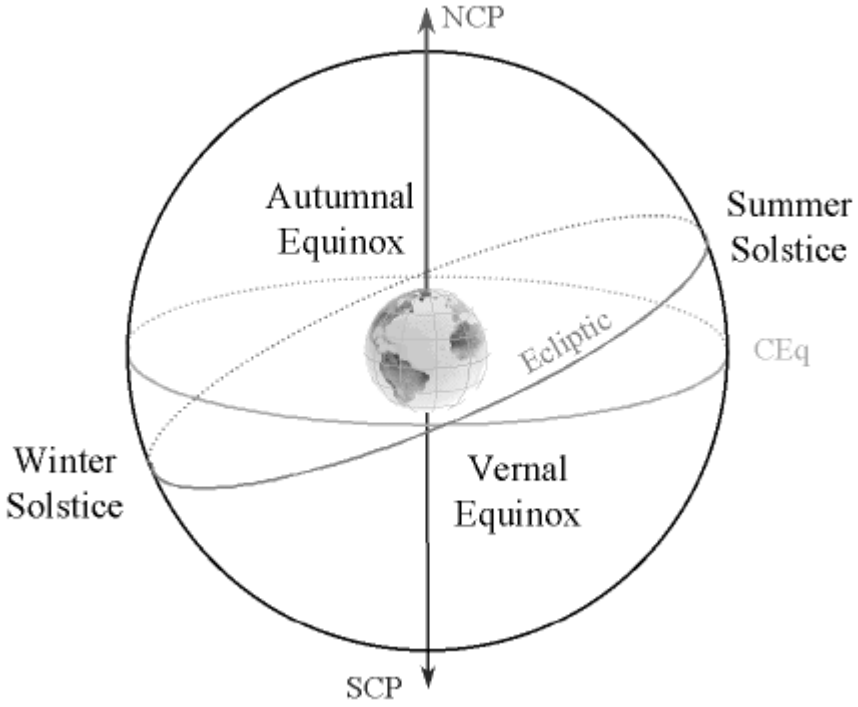
The Ecliptic is the apparent path of the Sun as it crosses the sky

It is tilted 23.439 degrees from the Celestial Equator
This is called the Obliquity of the Ecliptic

The Obliquity changes slowly over time. It is currently decreasing by 0.013 degrees per 100 years. It is cyclical and takes approximately 41,000 years to complete one cycle.



Earth's Axis is Tilted 23.439 Degrees



Solstices

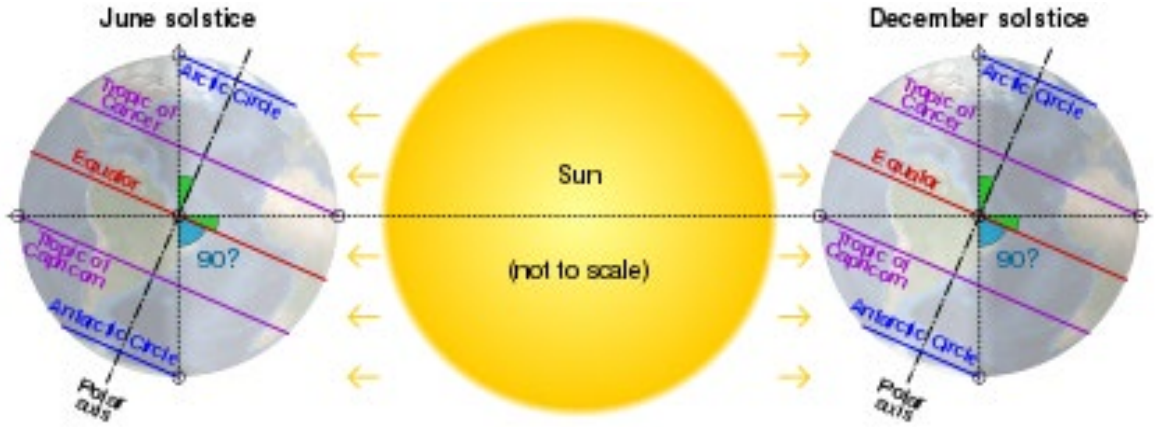
Solstices occur when the apparent Sun is at its maximum northern or southern declination.

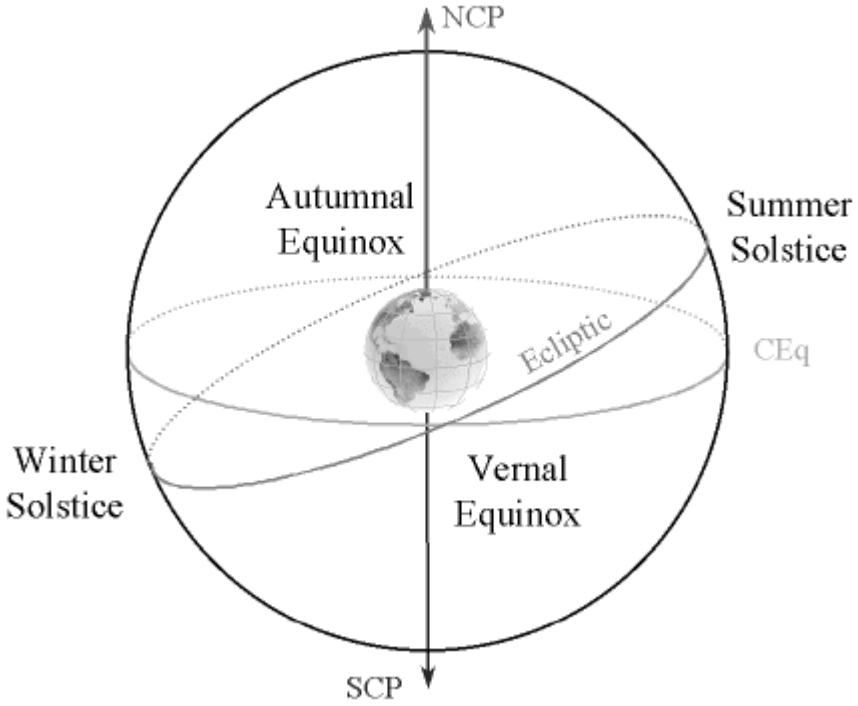
The word Solstice is derived from Latin *sol sistere* which translates as “Sun" and "stand still"

June Solstice occurs at the maximum northern declination of the apparent Sun, N23.439 degrees

December Solstice occurs at the maximum southern declination of the apparent Sun, S23.439 degrees

The Sun Above the Tropics





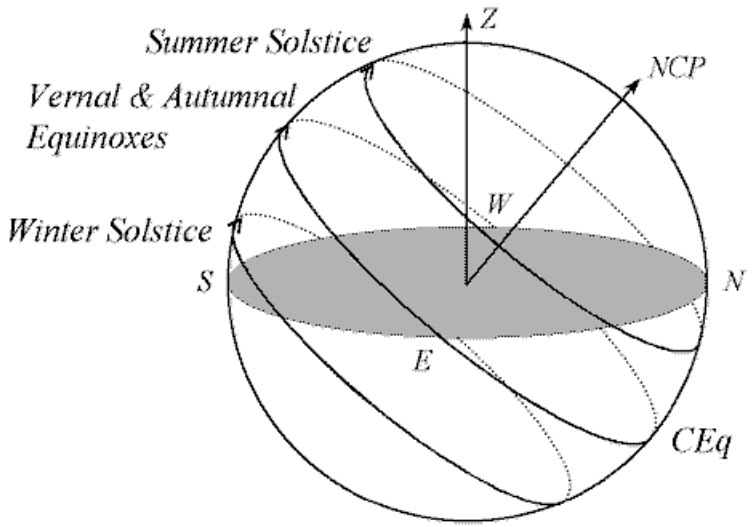
Equinoxes

Equinoxes occur when the apparent Sun crosses the Celestial Equator.

The word Equinox is derived from Latin *equinoctis* which means "equal night"

March Equinox occurs as the apparent Sun crosses the Celestial Equator from south to north

September Equinox occurs as the apparent Sun crosses the Celestial Equator from north to south



The length of a day depends on where the apparent Sun is located on the Ecliptic

On the June Solstice -

The Northern Hemisphere's summer with day longer than night; the apparent Sun crosses the sky in a high arc above the horizon

The Southern Hemisphere's winter with day shorter than night; the apparent Sun crosses the sky in a low arc above the horizon

On the March and September Equinoxes -

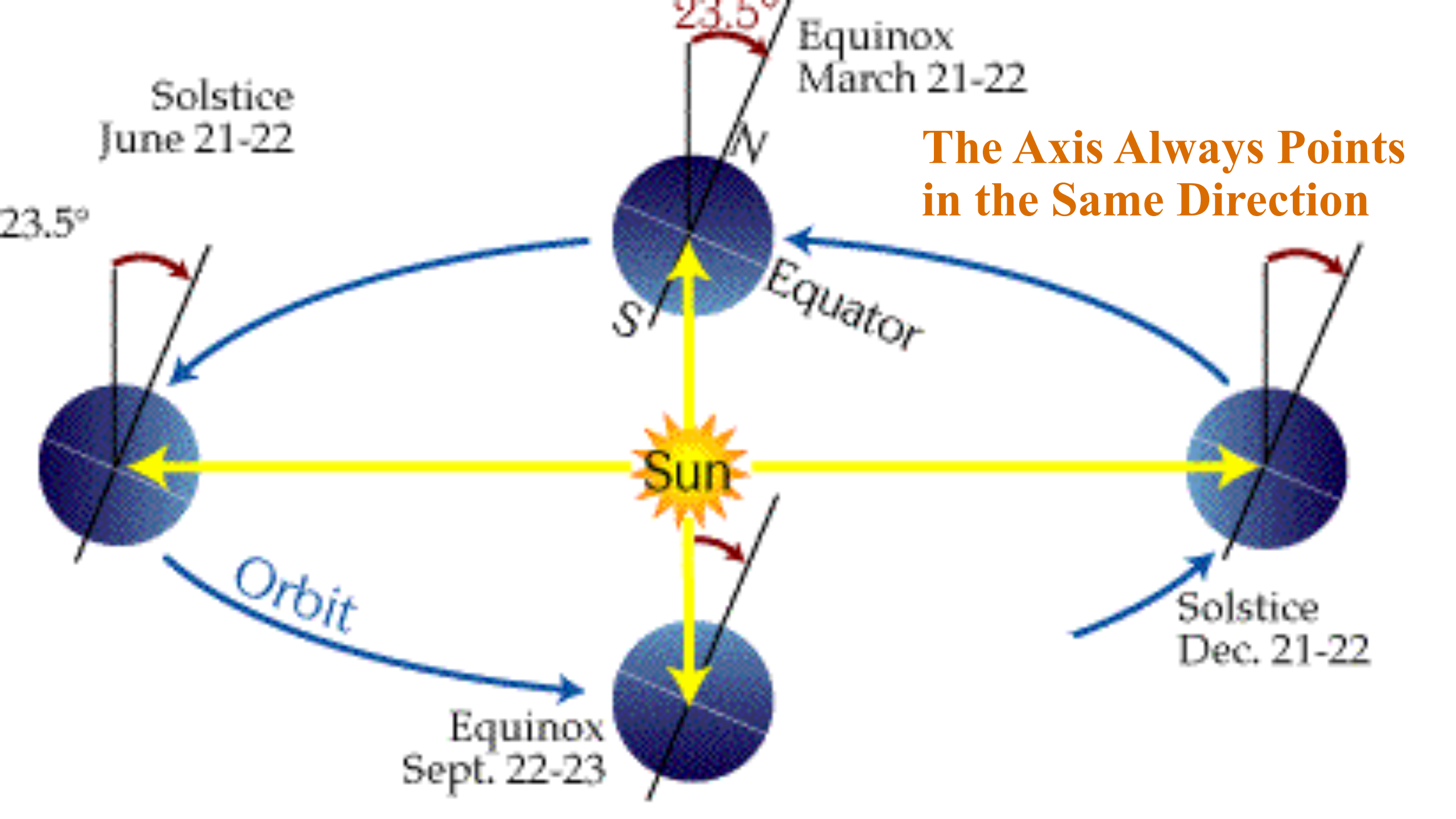
The apparent Sun rises due east and sets due west

Day and night have equal lengths of approximately 12 hours

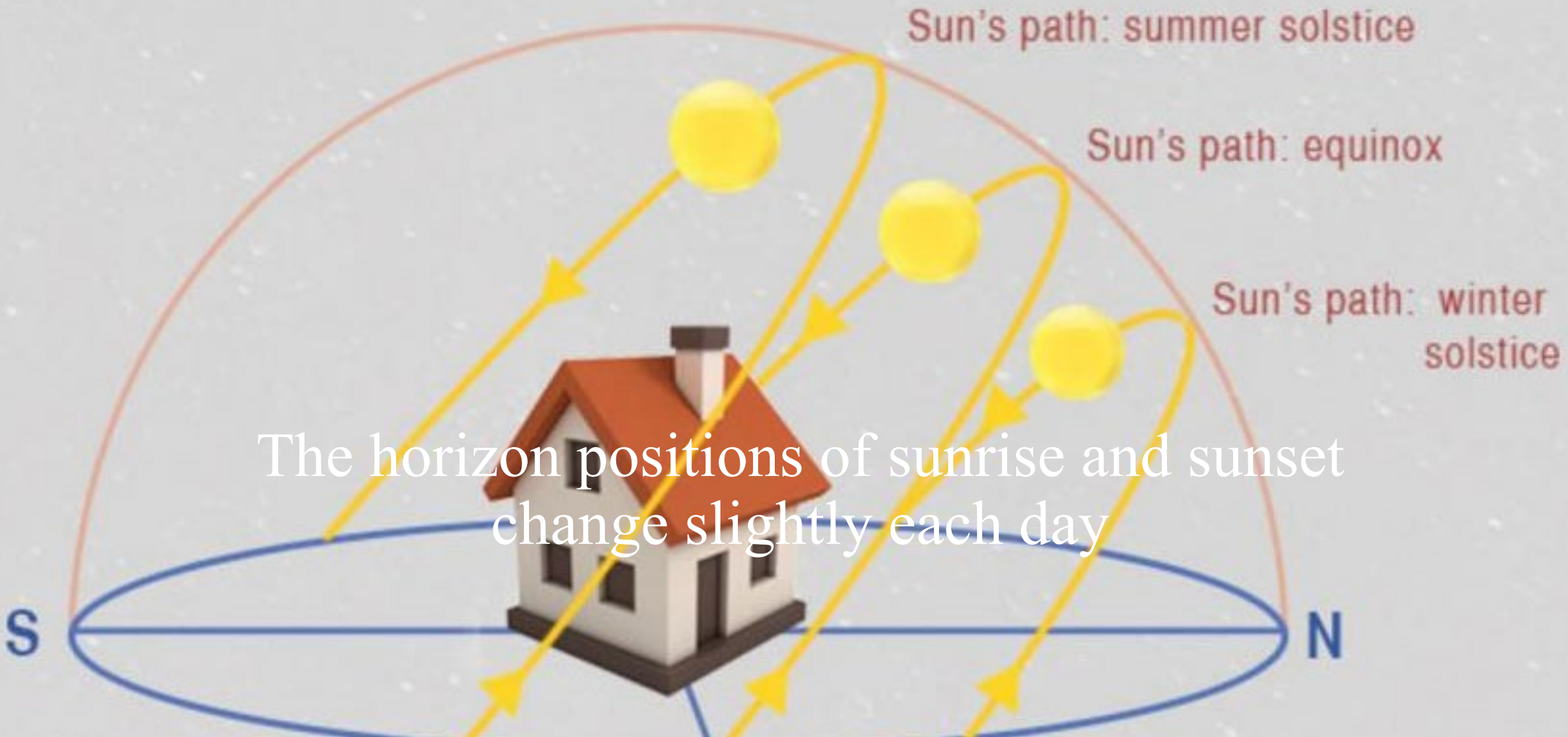
On the December Solstice -

The Northern Hemisphere's winter with day shorter than night; the apparent Sun crosses the sky in a low arc above the horizon

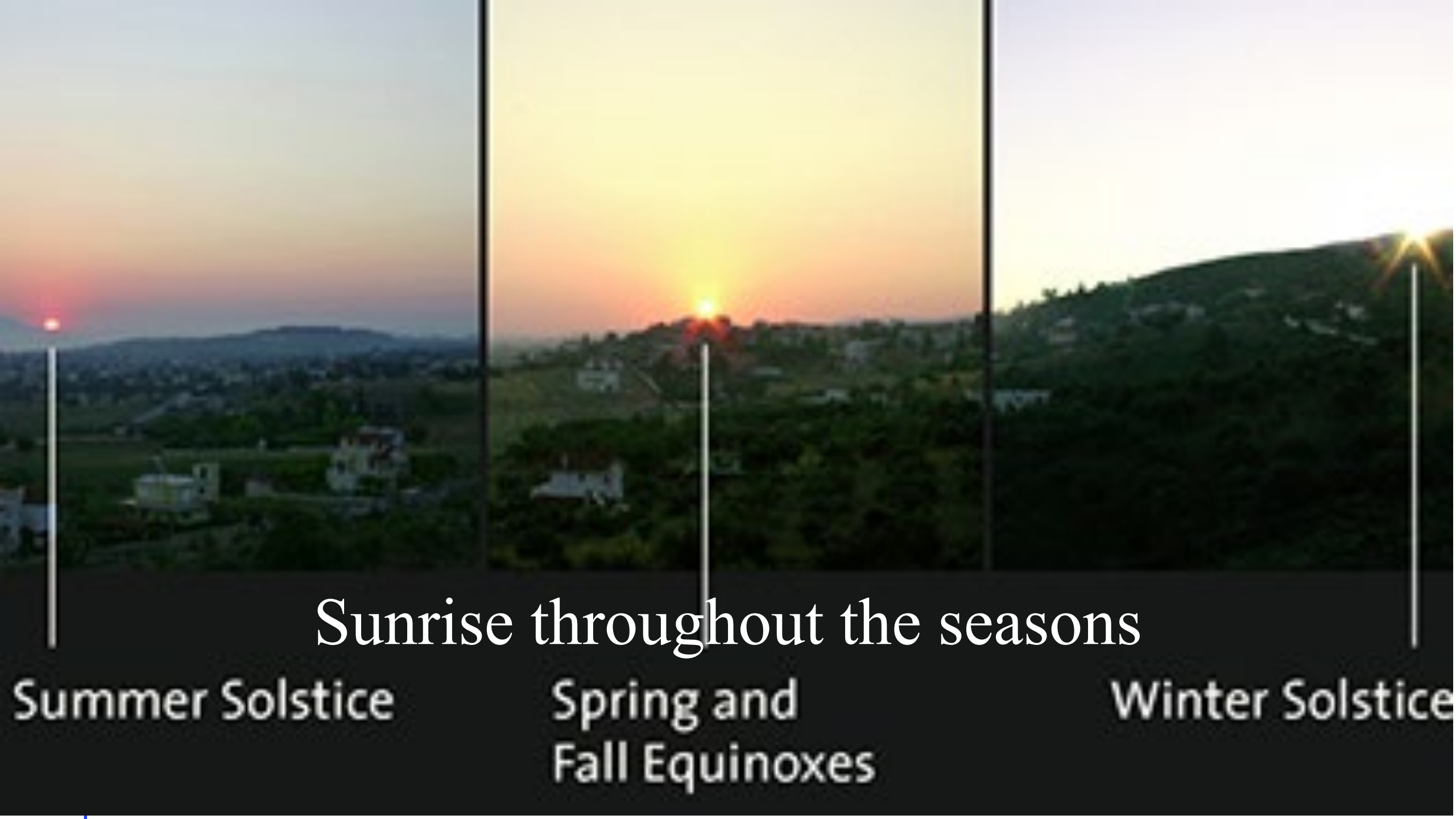
The Southern Hemisphere's summer with day longer than night; the apparent Sun crosses the sky in a high arc above the horizon


23.5°
Equinox
March 21-22
Solstice
June 21-22
The Axis Always Points
in the Same Direction
23.5°
N
S
Equator
Sun
Orbit
Equinox
Sept. 22-23
Solstice
Dec. 21-22

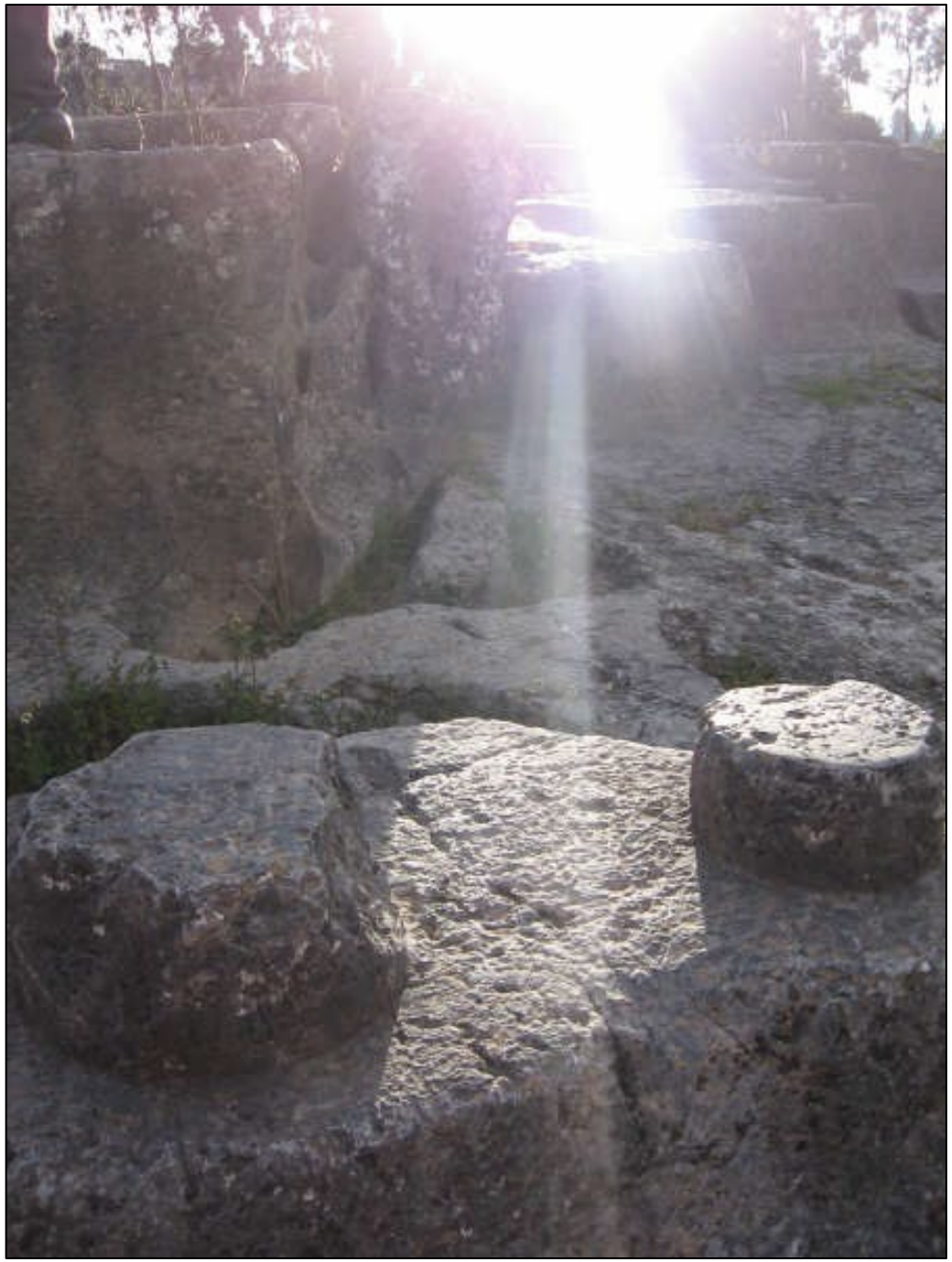
During **summer**, the sun rises in the south-east and sets in the south-west, travelling higher and further across the sky.



The horizon positions of sunrise and sunset change slightly each day


Sunrise throughout the seasons
Summer Solstice
Spring and
Fall Equinoxes
Winter Solstice

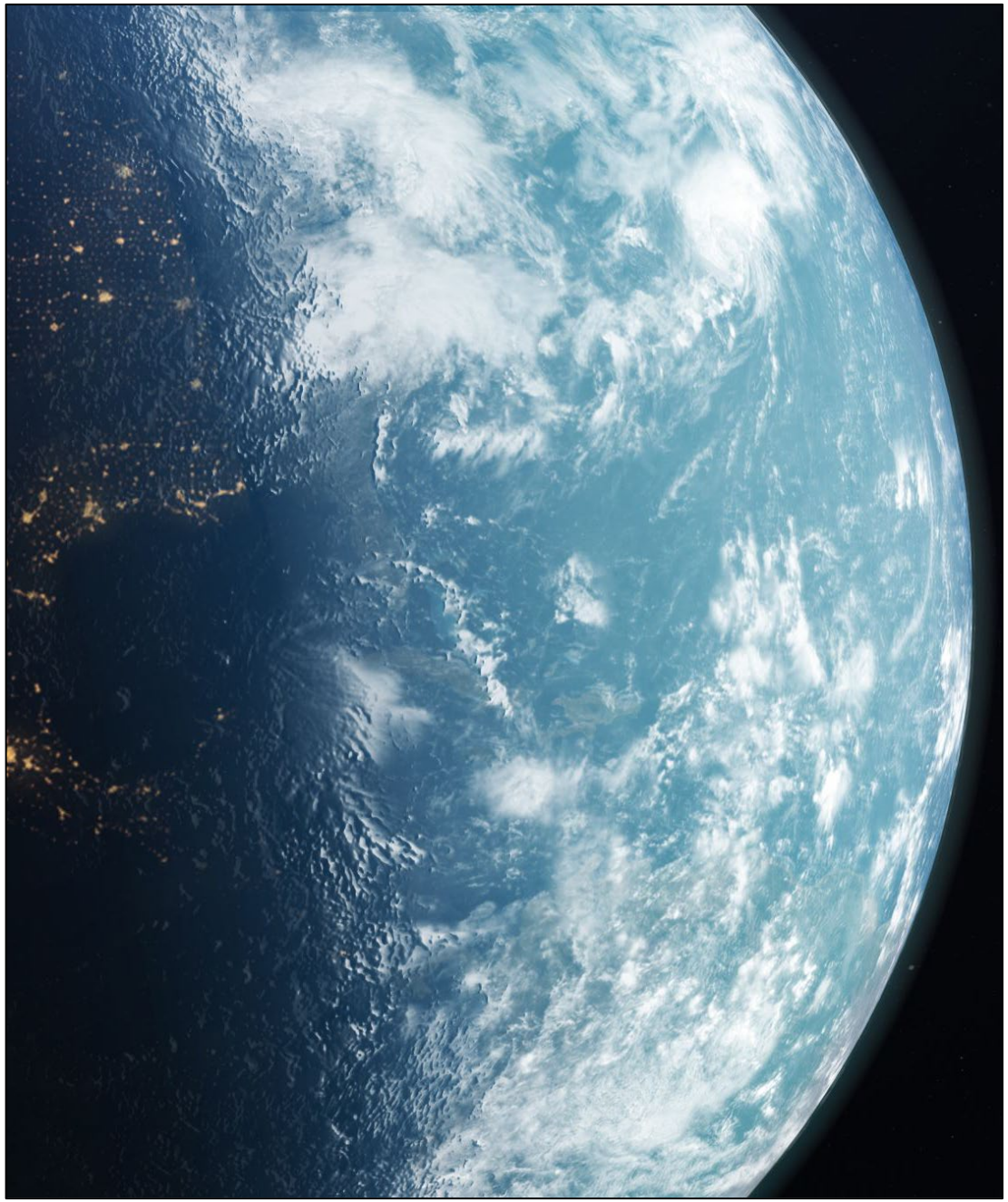
Diurnal Motion of the Sun



The position of the Sun in the sky is a function of both time and from where on the Earth it is observed.

The Sun appears to travel along the ecliptic each day.

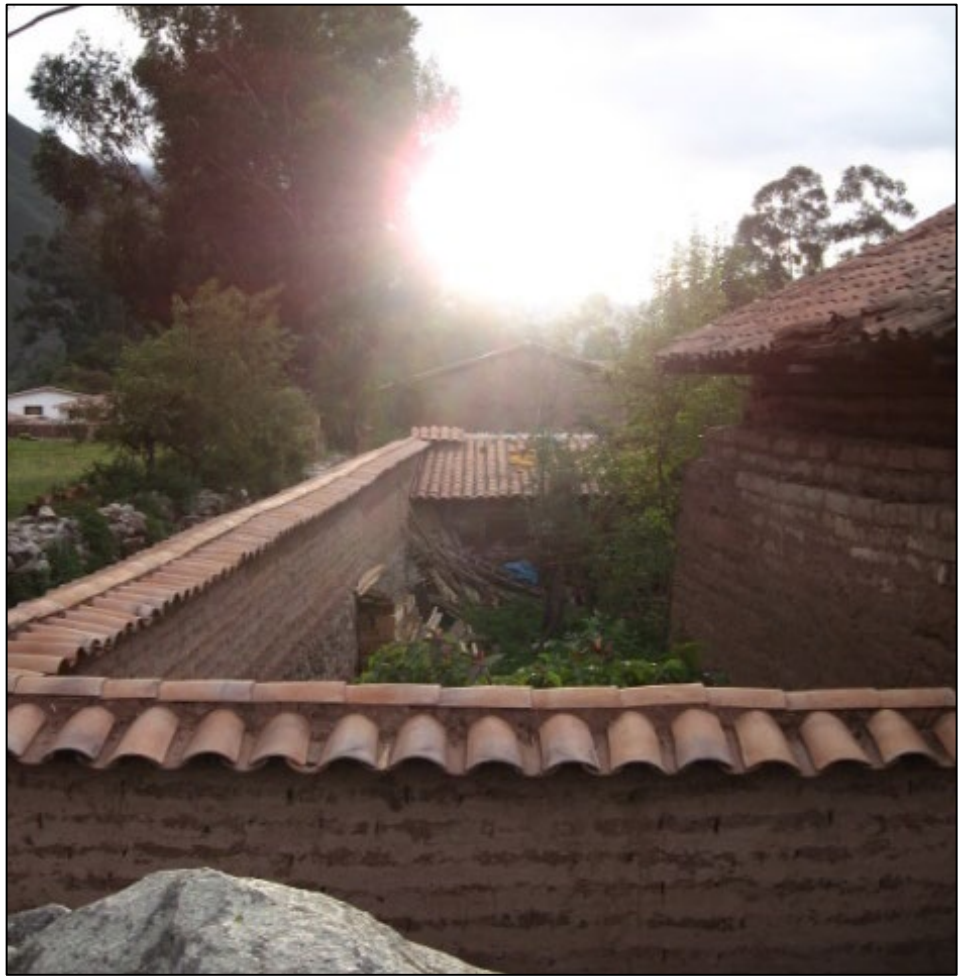
Earth’s rotation about its axis is what causes diurnal motion, so that the Sun appears to move across the sky at an angle above the horizon that depends on the observer's latitude.



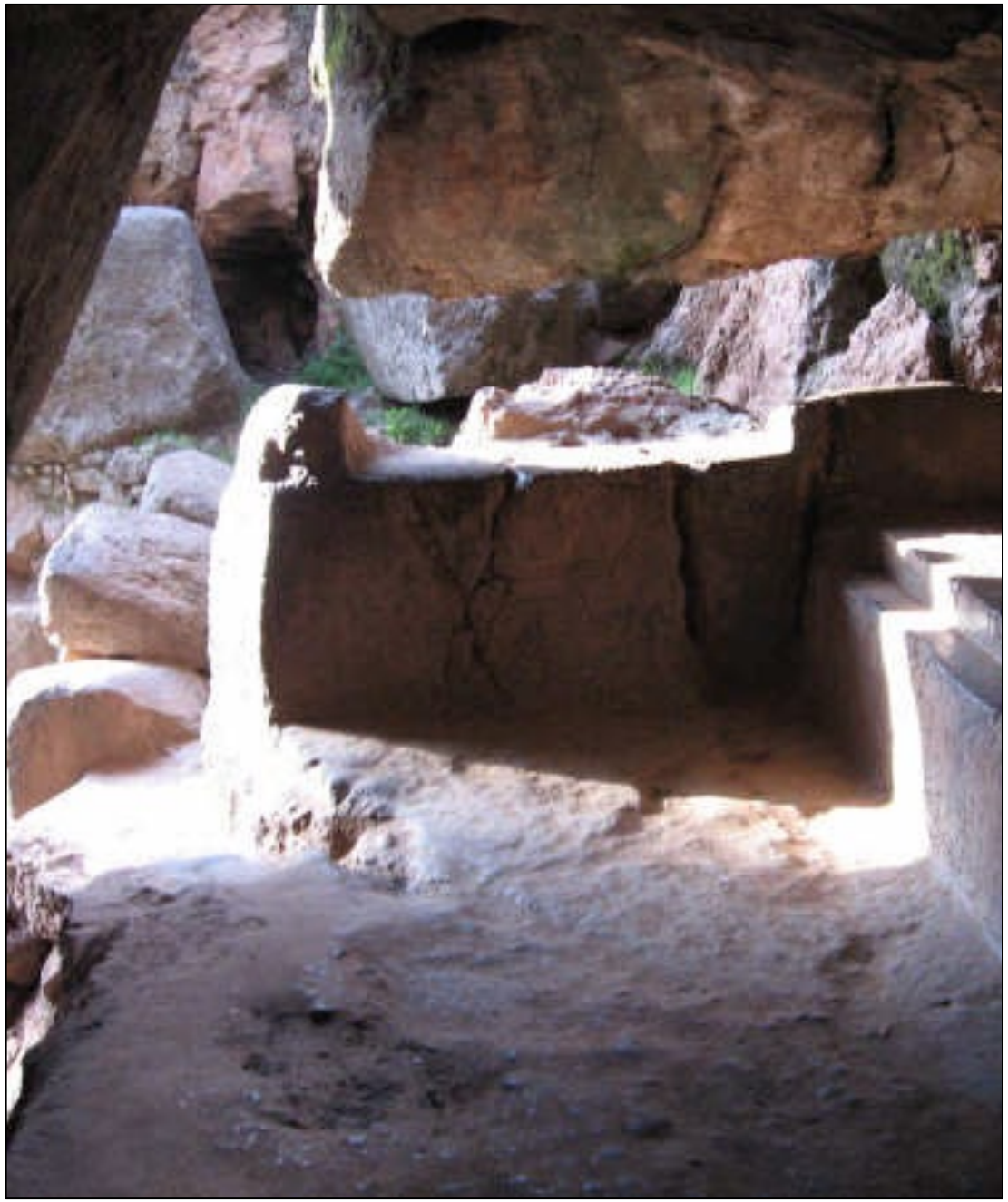
The time that it takes for one complete daily rotation of the Earth is 23 hours, 56 minutes, and 4.09 seconds, which is one sidereal day.

Sidereal time gains about four minutes every 24 hours when compared with local civil time.

In the Northern Hemisphere the Sun moves from south to north and crosses the celestial equator on the March equinox. Its declination reaches its maximum of N23.439 degrees on the June solstice, then decreases until reaching S23.439 degrees on the December solstice. This variation produces the seasons due to when and where the angle of incidence of solar rays most directly strike the Earth.



The Earth’s orbit is elliptical. It moves more rapidly around the Sun near perihelion, in early January, than near aphelion, in early July. This makes processes like the change in solar declination happen faster in January than in July.



Once again, the declination of the Sun is the angle between the rays of the Sun directly overhead and the plane of the Earth's equator. The Earth’s axial tilt, the *Obliquity of the Ecliptic*, is the angle between the Earth's axis and a line perpendicular to the Earth's orbit. Because the Earth's axial tilt changes so slowly over thousands of years its current value of 23.439 degrees is for practical purposes essentially constant.

As previously mentioned, at the solstices, the angle between the rays of the Sun and the plane of the Earth's equator reaches its maximum value of 23.439 degrees.

Then at each equinox, the center of the Sun appears to pass through the celestial equator, and the declination is 0.0 degrees before continuing toward the maximum value at the next solstice.

Objects in the sky appear to rise in the east and set in the west; this apparent daily motion is due to the Earth's rotation about its axis

The Earth completes one rotation each day

Rotation is such that in the Northern Hemisphere the apparent Sun when viewed looking south moves east to west across the sky from left to right

In the Southern Hemisphere the apparent Sun is viewed to the north so while traveling from east to west it now moves from right to left

Credits

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- Presentation template based on Isabella by SlidesCarnival