

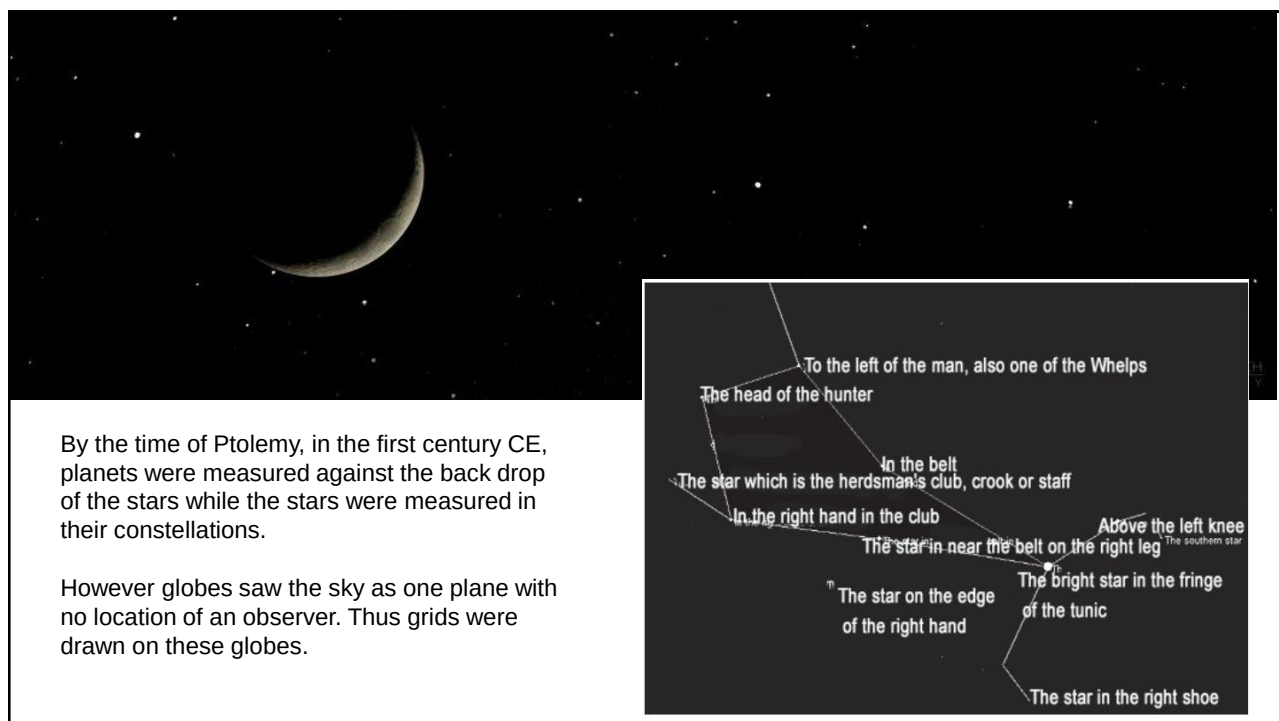
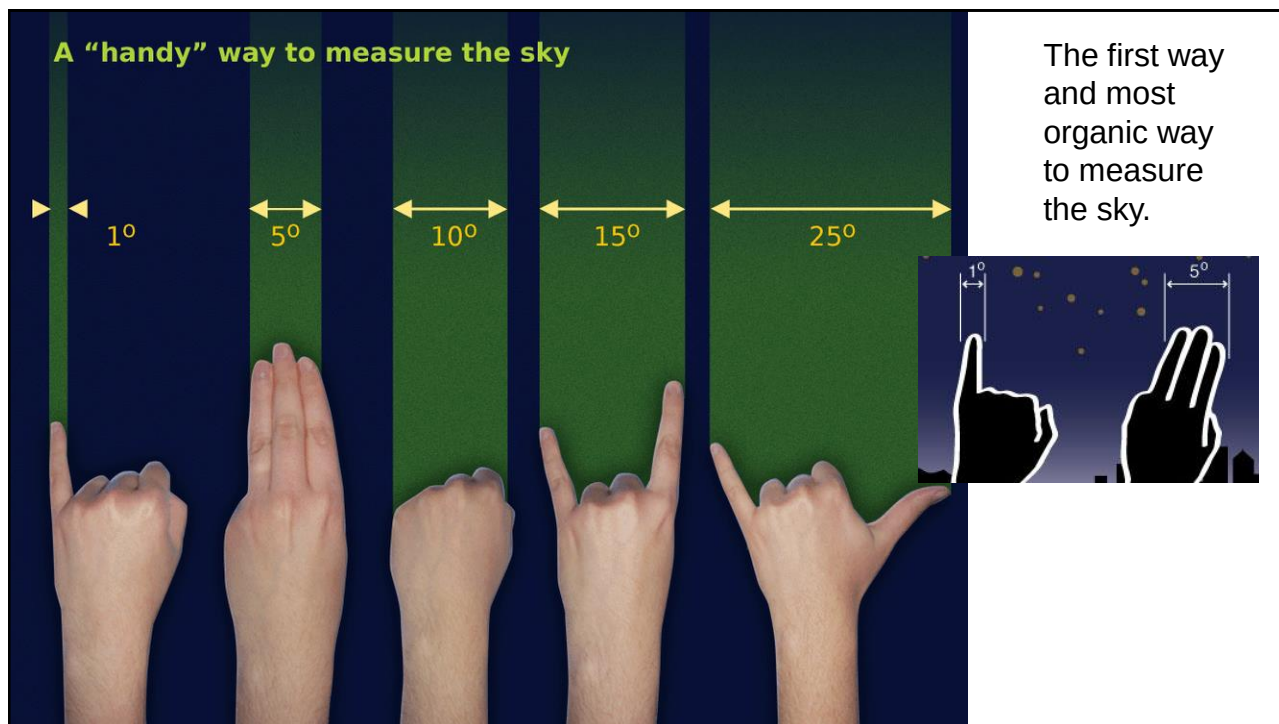
Watching the Sky

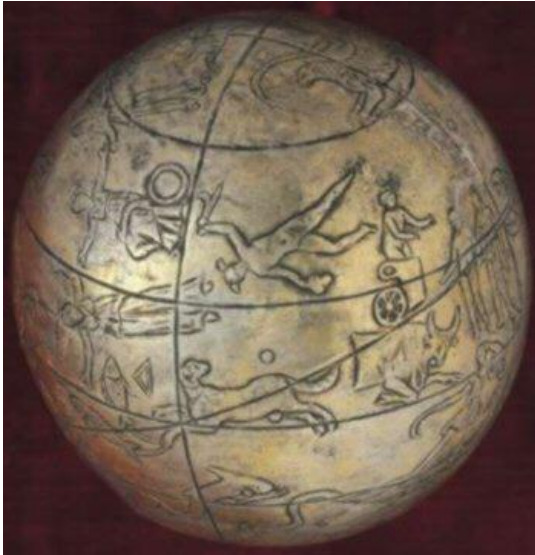
Dr Bernadette Brady
University of Wales Trinity Saint David
Feb 2017



The sky is a moving canvas set against a fixed local landscape.
How do you describe the movement of the sky?
How do you record the location of an object in the heavens?
How do you ascertain the relationship a place or structure has to the sky?





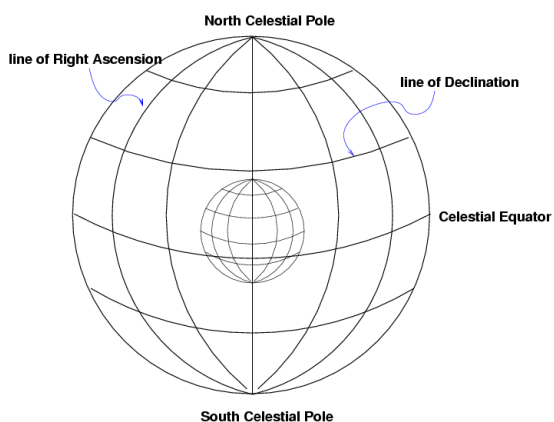


The Kugel globe shows the polar circles, the tropic of Capricorn and Cancer, the equator, the ecliptic and the prime vertical and prime median.

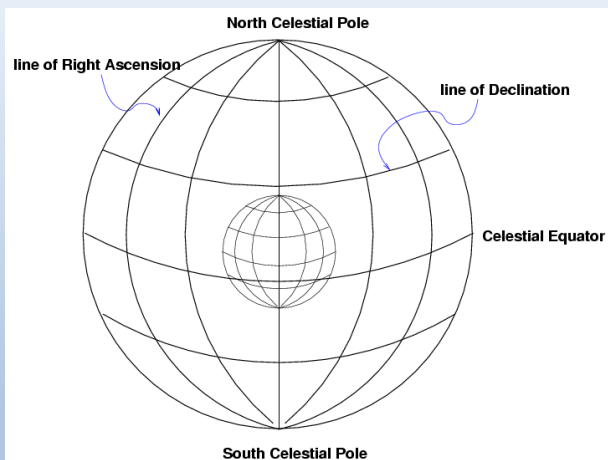
The Kugel Globe
a miniature globe which is
dated circa 300-100 BCE



Modern celestial globe,
showing the constellations,
the equator, the ecliptic,
polar circles and a grid
system.



Basic numbers you need to understand



The Fixed Address System

Just as cities have a longitude and latitude sky objects have a Right Ascension and Declination

Declination is *like* latitude and RA is *like* longitude (time based)

The Fixed Address of the star Sirius the star:

RA: 06:45:38

Dec: $-16^{\circ}44'$

Sirius will pass directly overhead once a day if you are located at a latitude $16^{\circ}44'$ South, thus just south of Darwin, Australia.

RA is a time based measurement and can be used to find the time difference between two stars culminating.

Just like the longitude of cities can be used to find their local time differences.

For example the RA of:

Arcturus, in Bootes is: 14h 16' 08"

Spica, in Virgo is 13h 25' 45"

Time difference between their two culminations is: 0h 50' 13"

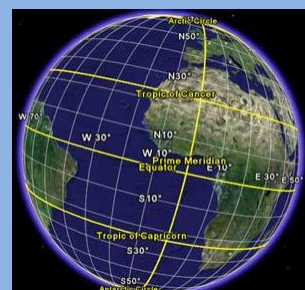
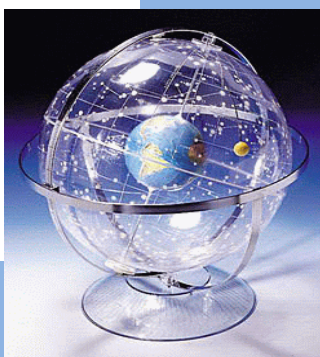
New York has a longitude of 74° 00' 23" West.

Dublin has a longitude of 00° 10' West

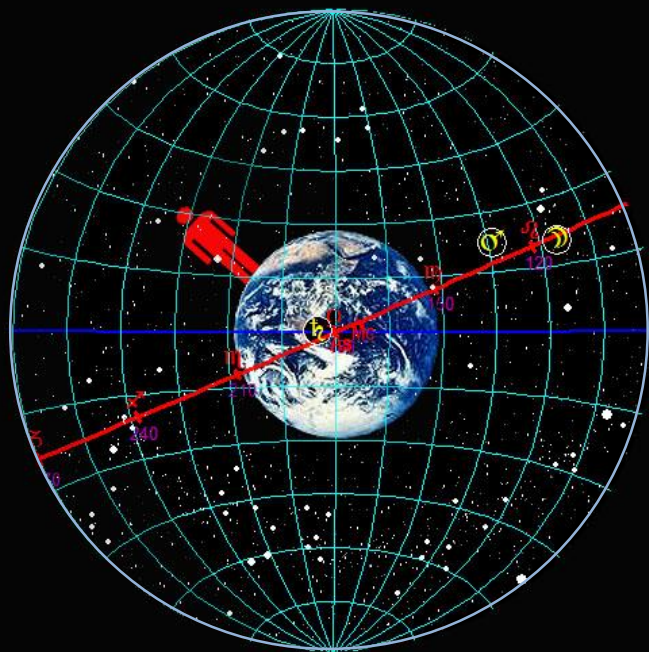
Longitude difference is 73° 50' 23"

This is converted to time by every 1 degree of longitude being equal to 4 minutes of time.

Time difference is 4 hours 55 minutes.

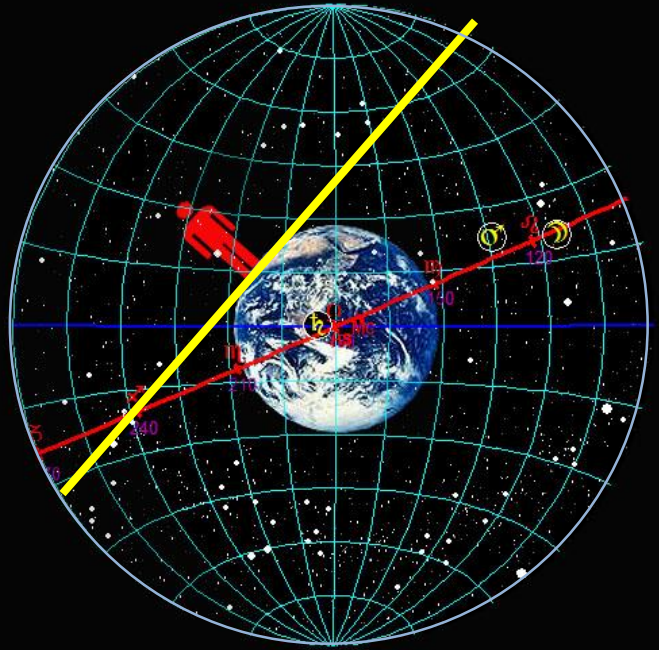


We see the sky from our own perspective so we need a system of measurement that reflects our personal spatial and temporal view.

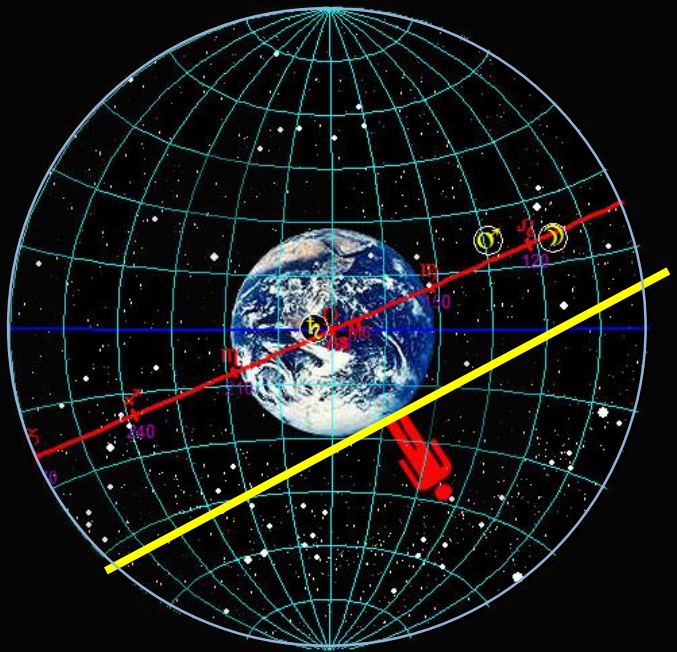


Part of our view is
the horizon which is
ALWAYS
90° from our upright
position.

We see the sky
moving as it rotates
around the pole.



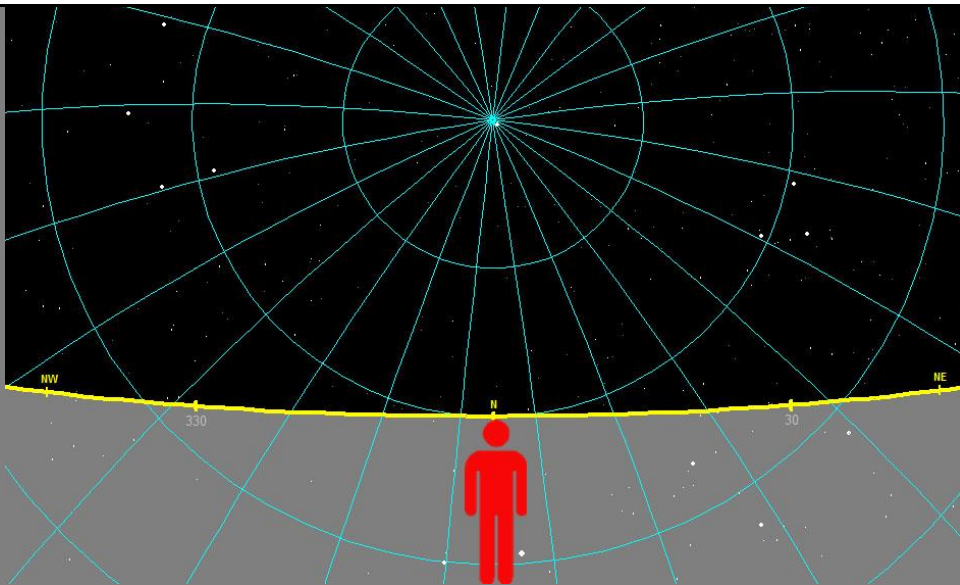
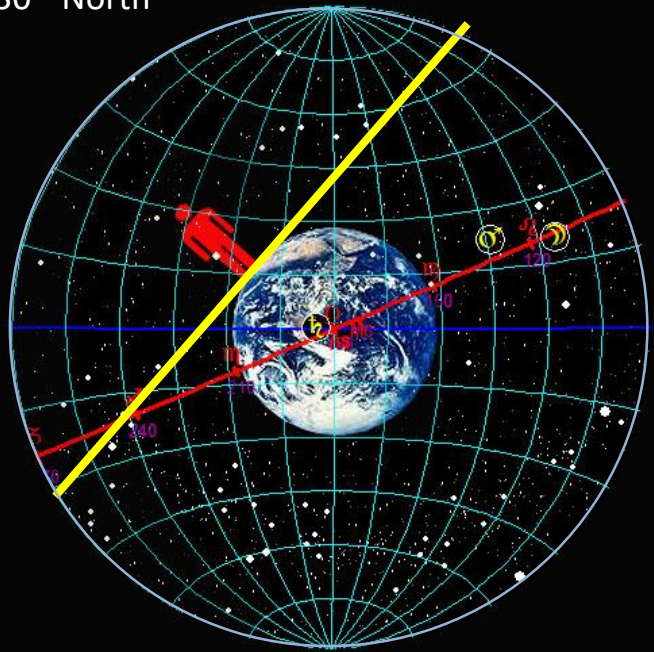
No matter where we
are standing!



At about 30 ° North

The pole for this person is elevated 30 ° above their horizon.

The latitude of the observer defines the elevation of the pole.



Looking at the Pole when you are at 30 North

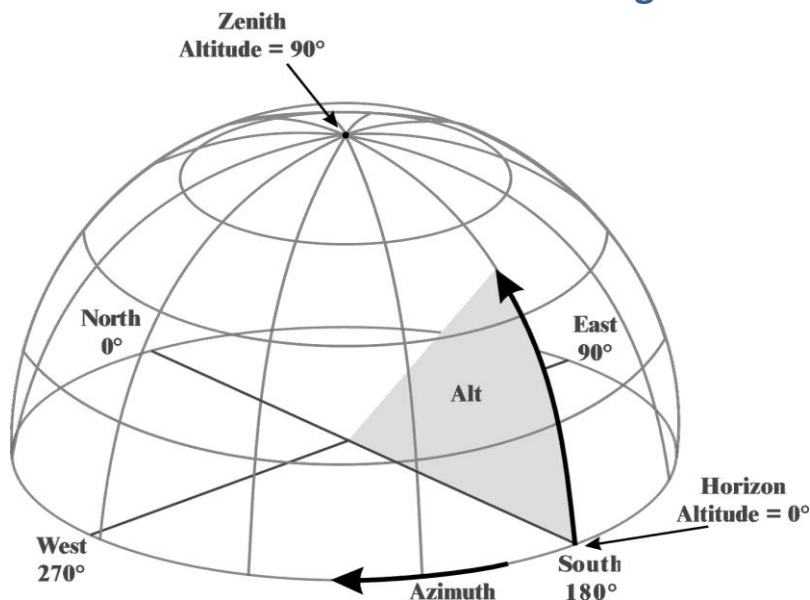


The moon can be located on the grid based on the equator and the pole and thus it will have a particular declination and RA. Any heavenly body on a set declination line will rise and set in the same place on the horizon. The moon, in this image is at dec -10.53° , RA $14^{\text{h}} 36' 10''$.



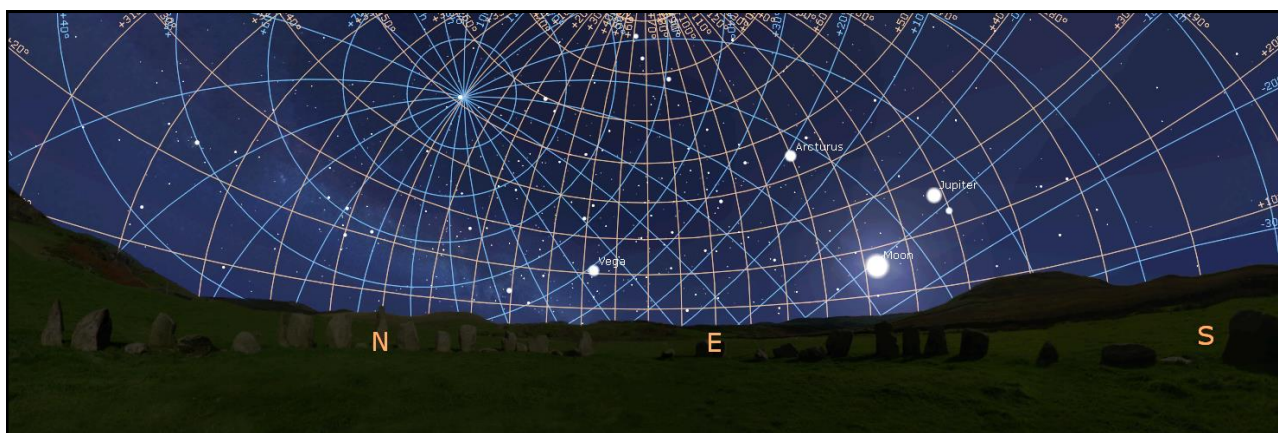
But the measurement of Declination and Right Ascension does not help us describe the moon's relationship to the horizon. For this we need to build a grid based on the horizon and elevation above (or below) the horizon. This is known as azimuth and altitude.

The “Moving” Addresses



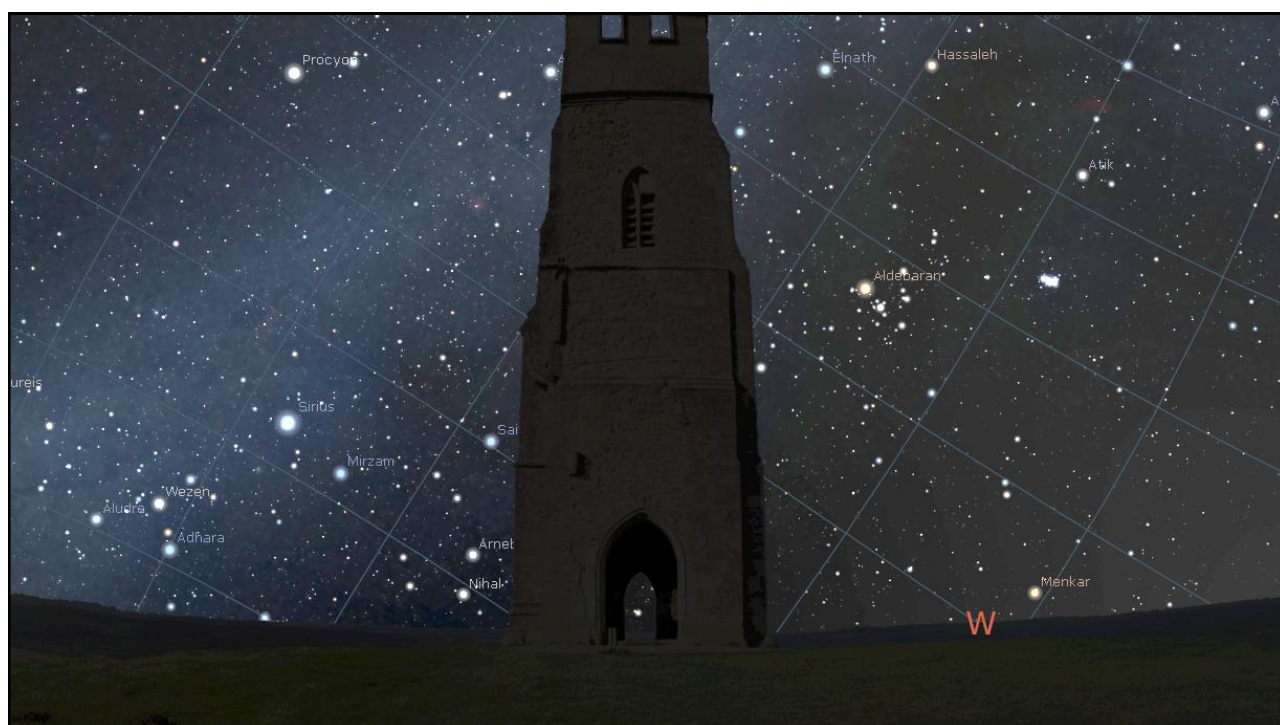
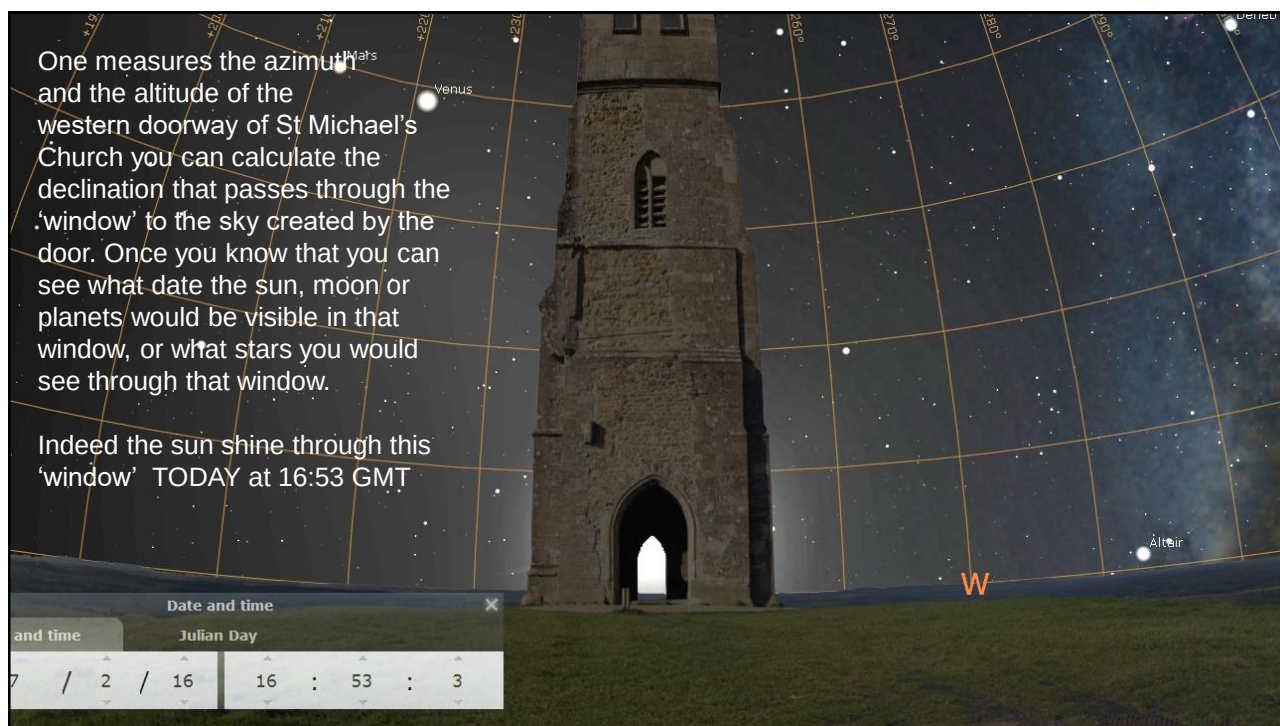
Azimuth and
Altitude

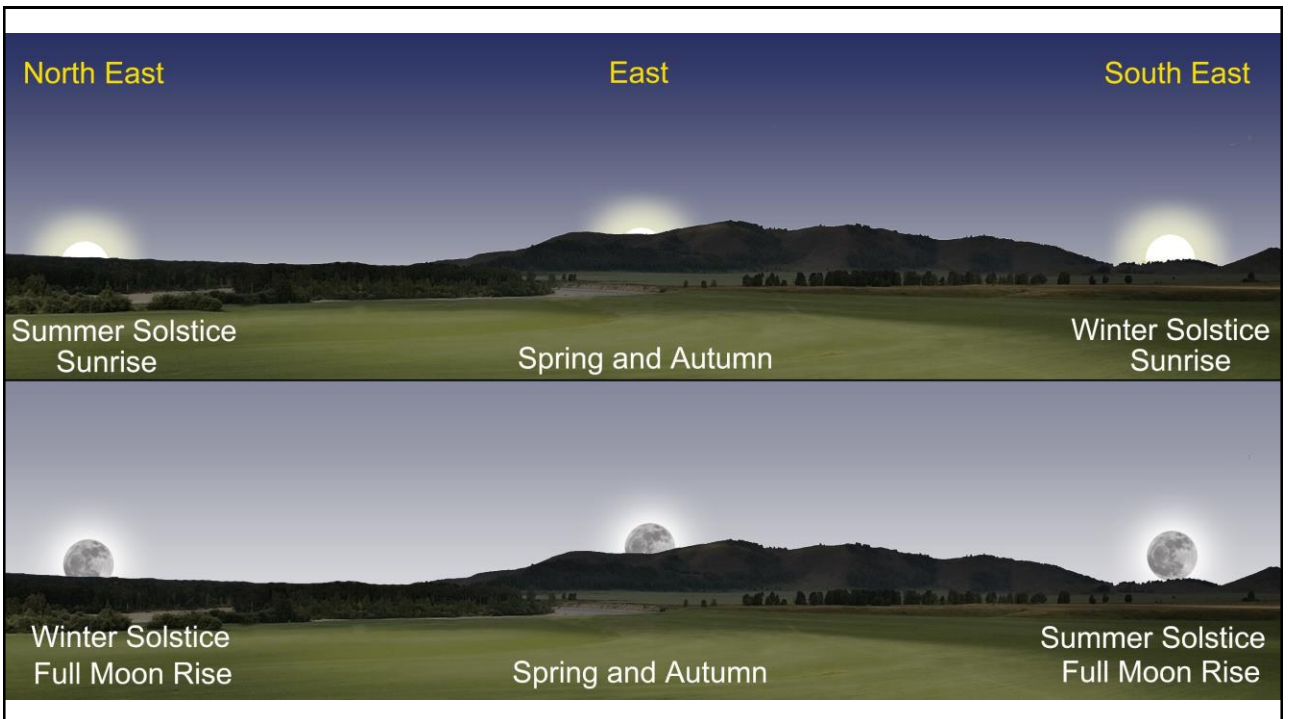
Fixed on the
horizon but
the heavenly
bodies move
against this
'net'



The moon will move through the sky fixed (ignoring its orbital movement) to the blue grid, (dec and RA) but will change its position again the brown grid (azimuth and altitude).

By moving from the horizon grid to the equatorial grid (blue) you can work out when or if a heavenly body will rise or set over a marker in the landscape.

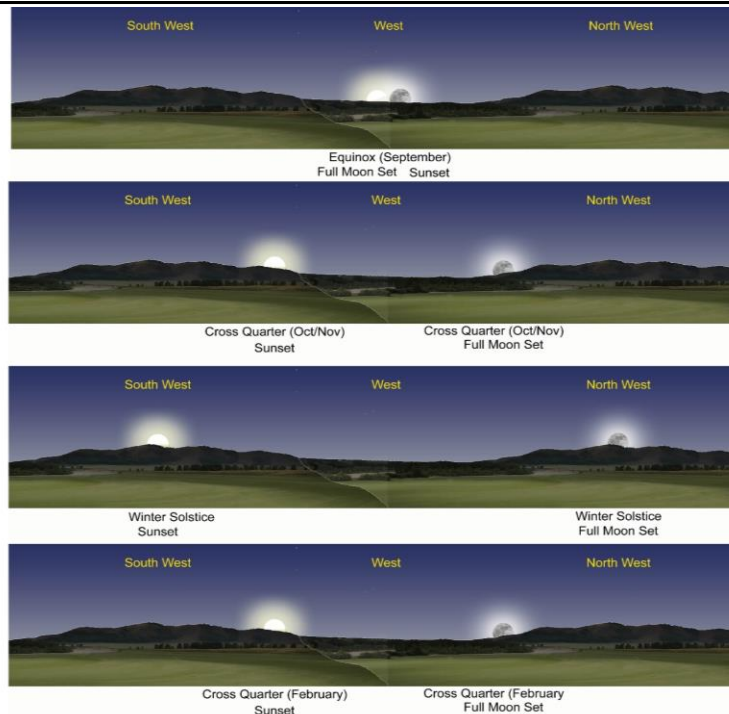
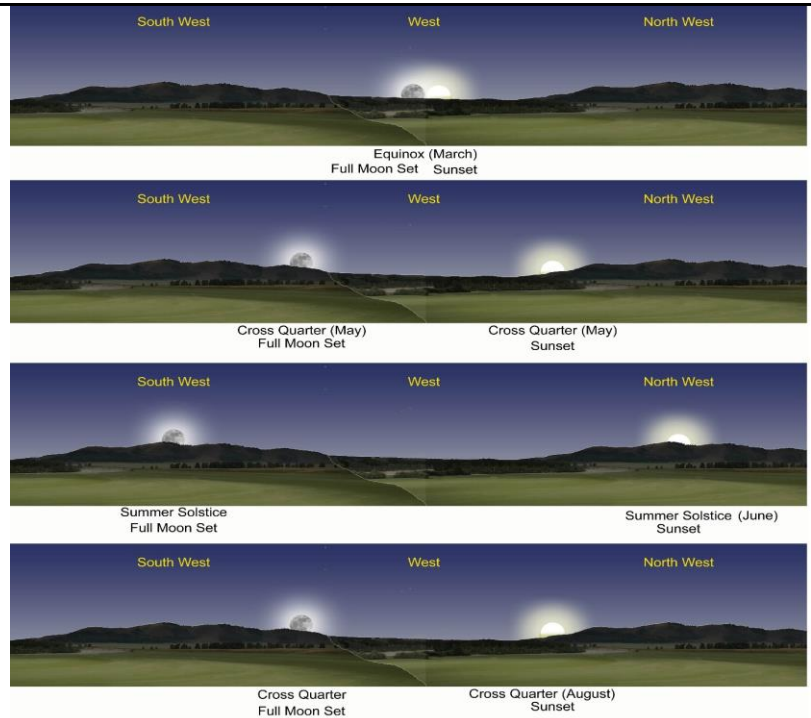




Landscape harmony
between the sun and
the moon.

Location of sunsets
and full moon sets on
a horizon.

March through to
August.

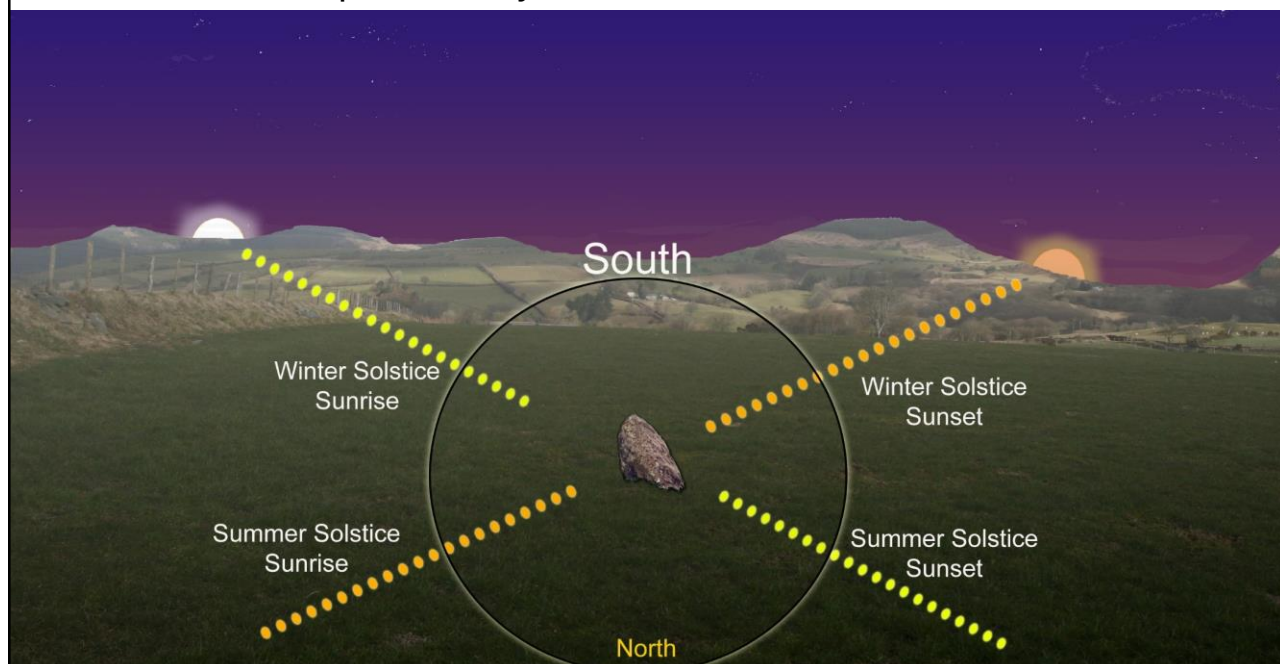


Landscape harmony
between the sun and
the moon.

Location of sunsets
and full moon sets on
a horizon.

September through to
February.

Landscape harmony between the sun and its extremes



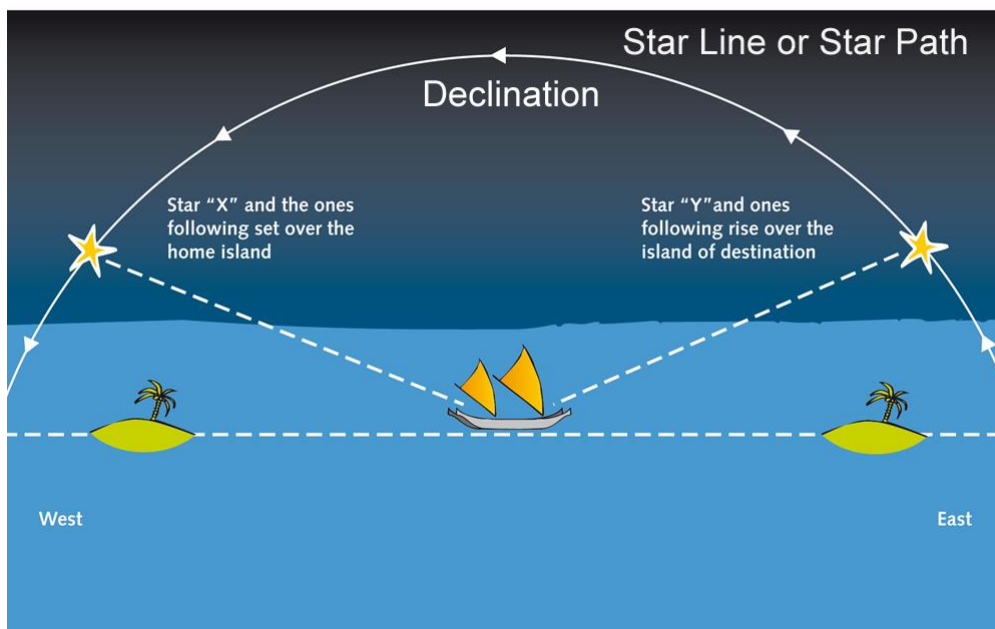
The harmony of the stars to the earth



Because the stars are on a set location on the celestial sphere (ignoring precession) they have a set declination. A given declination will always rise and set at the same location on the horizon. Thus a line of stars at the same declination can define a key calendar location on the horizon as well as a compass bearing.

STARPATH NAVIGATION

By sea or by land



The harmony of the stars to the earth



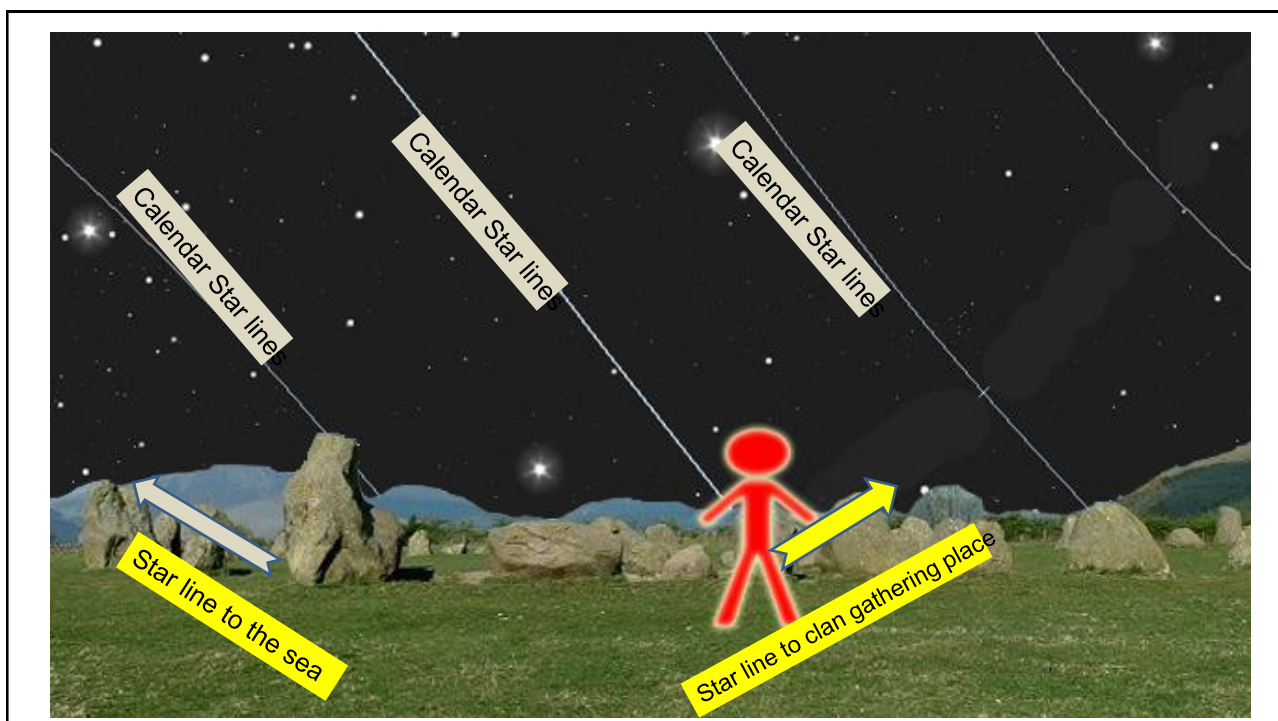
Where will the summer solstice sun rise on this horizon?

The harmony of the stars to the earth



The sun at the summer solstice has a declination of $+23.5^\circ$

Thus look for where the declination line of $+23.5^\circ$ cuts the eastern horizon – that is where the sun will rise that day.





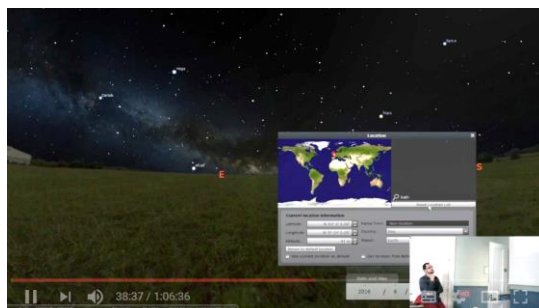
To get a feel for the way the sky moves download the free planetarium software.

Stellarium -

<http://www.stellarium.org/>

<https://www.youtube.com/watch?v=EDgtgvVPMLA&t=6s>

YouTube demonstration of Stellarium by Fabio and Dan Brown



References

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