The Celestial Sphere

A Model For the Motions Seen In The Night Sky

Types of Motions

- Diurnal
  - Daily motion of objects in the sky.
  - Caused by Earth's rotation on its axis.
- Seasonal
  - Yearly motion of objects in the sky.
  - Caused by Earth's revolution around the Sun.
- Precession
  - Slow wobble of Earth's rotational axis over a period of 26,000 years.

Diurnal Motion

- 24-hour period motion due to the rotation of the Earth.
- Causes most objects to rise in the East and set in the West here in the middle latitudes.
- Seen on a larger scale, all of the stars in the sky appear to ‘orbit’ the North Star, Polaris.
- Stars that never drop below the horizon are called *circumpolar* stars.

Seasonal Motion

- 1 year period motion resulting from the Earth's revolution around the Sun.
- Accounts for the drift of objects in the sky westward ~1 degree per day.
- Explains why different constellations are visible at different times of the year.

Precession

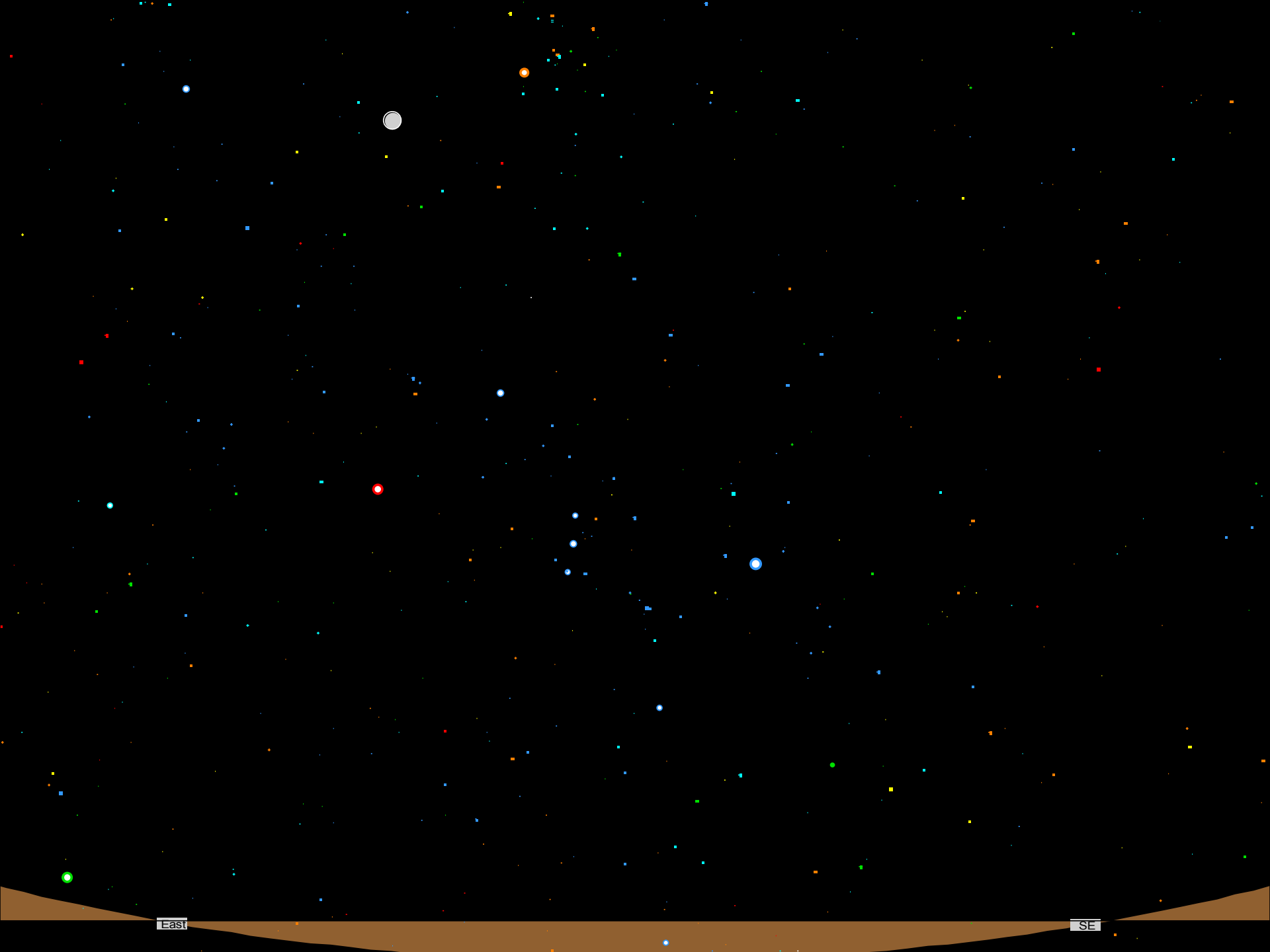
- Precession is the slow wobble of the Earth's rotational axis with a period of 26,000 years.
- Right now, Polaris is our 'Pole Star'. During the age of the Egyptian Empire, Thuban was the 'Pole Star'.
- Important even for small corrections today to make GPS as precise as possible.

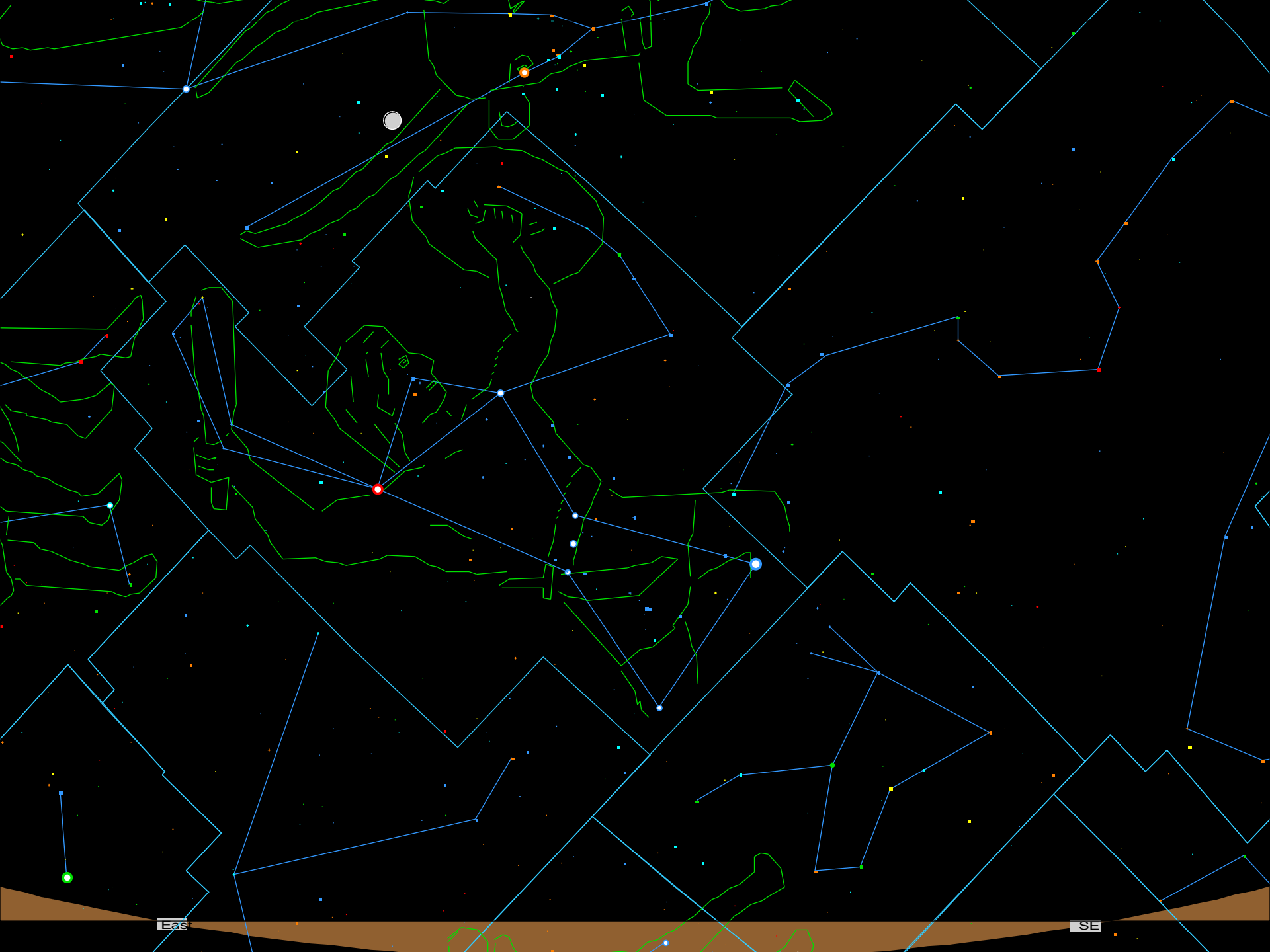
Locating Things In The Sky

- Constellations
  - Method of locating places in the sky in relation to recognizable groupings of stars.
  - Our constellations are from the Greeks.
- Altitude and Azimuth
  - Measures angle above the horizon & angle from north.
  - Only good for your local horizon.
- Right Ascension and Declination
  - Based upon the Terrestrial longitude and latitude system.
  - Good for all locations anywhere on the globe.

Constellations

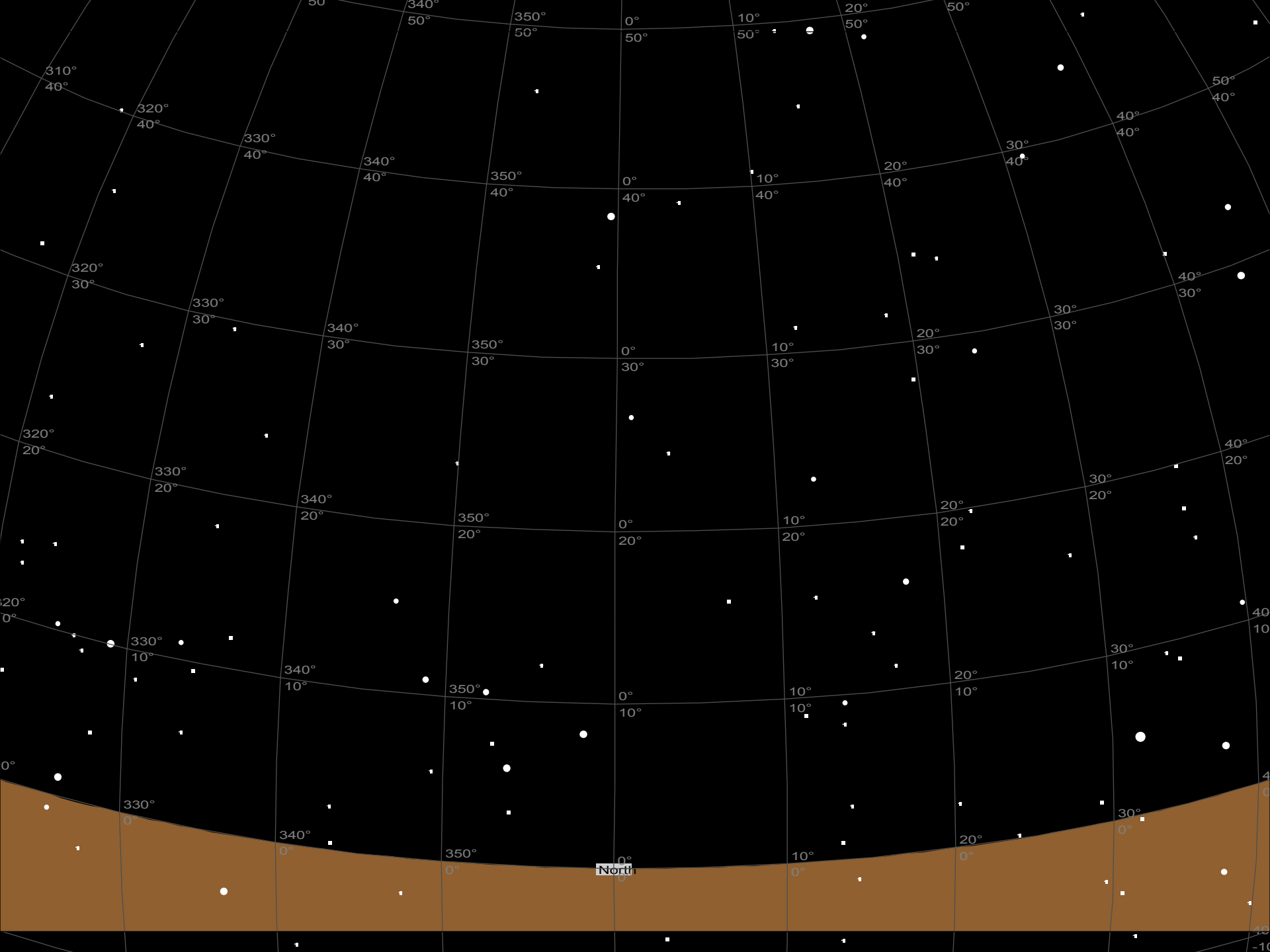
- Our constellations are based upon those invented by the Greeks.
- Now the 88 constellations are defined as regions in the sky with well-defined boundaries.
- Constellations are good only for describing broad regions in the sky. Similar to the way states describe broad regions of the country.


East
SE


Las
SE

Altitude and Azimuth

- Altitude
  - An object's angle above the horizon.
  - The altitude of Polaris is the observer's latitude.
- Azimuth
  - An object's angle from due North.
  - Angle is measured clockwise from North.
- An object's altitude and azimuth vary with time and the observer's location.

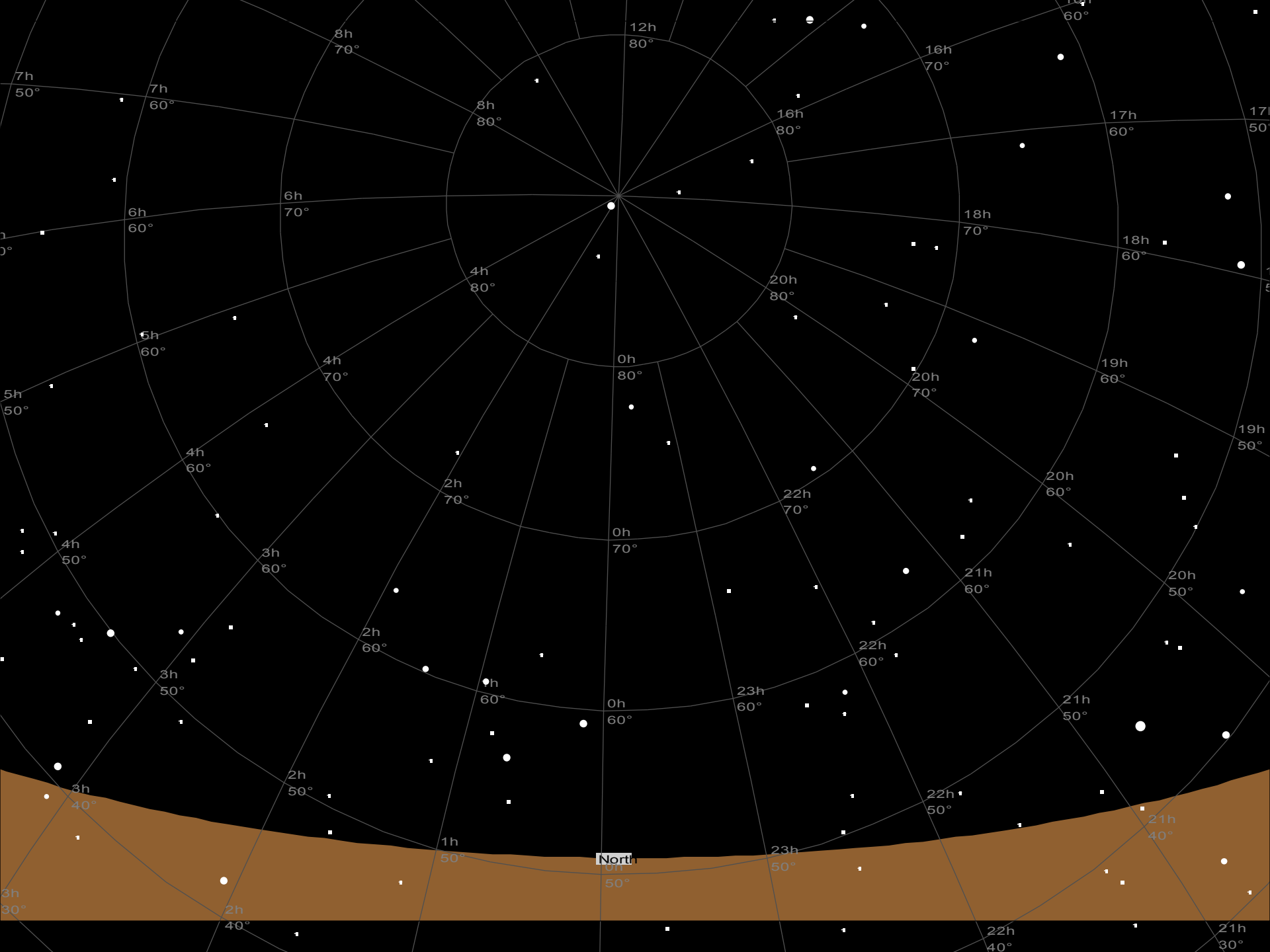

North

Latitude and Longitude

- Latitude measures the angle north or south of the equator.
  - The equator is the point on the Earth equidistant between the north and south poles.
  - The equator has a latitude of 0 degrees.
- Longitude measures the angle east or west of the prime meridian.
  - The prime meridian is defined to be a line running from pole to pole passing through Greenwich, England.
  - The prime meridian has a longitude of 0 degrees.

Right Ascension and Declination

- Declination measures a star's angular position north or south of the celestial equator.
  - The celestial equator is the point in the sky equidistant between the north and south celestial pole.
  - The declination of the celestial equator is 0 degrees.
- Right ascension measures a star's angular position east of the Vernal Equinox.
  - The Vernal Equinox is the point in the sky at which the Sun crosses the celestial equator on its way northward.
  - The Vernal Equinox has a right ascension of 0 hours.
  - Right ascension is measured in hours with 24 hours around the full circle of the sky, 1 hour = 15 degrees.


12h
80°
8h
70°
16h
70°
7h
50°
7h
60°
8h
80°
16h
80°
17h
60°
6h
70°
6h
60°
18h
70°
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60°
4h
80°
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2h
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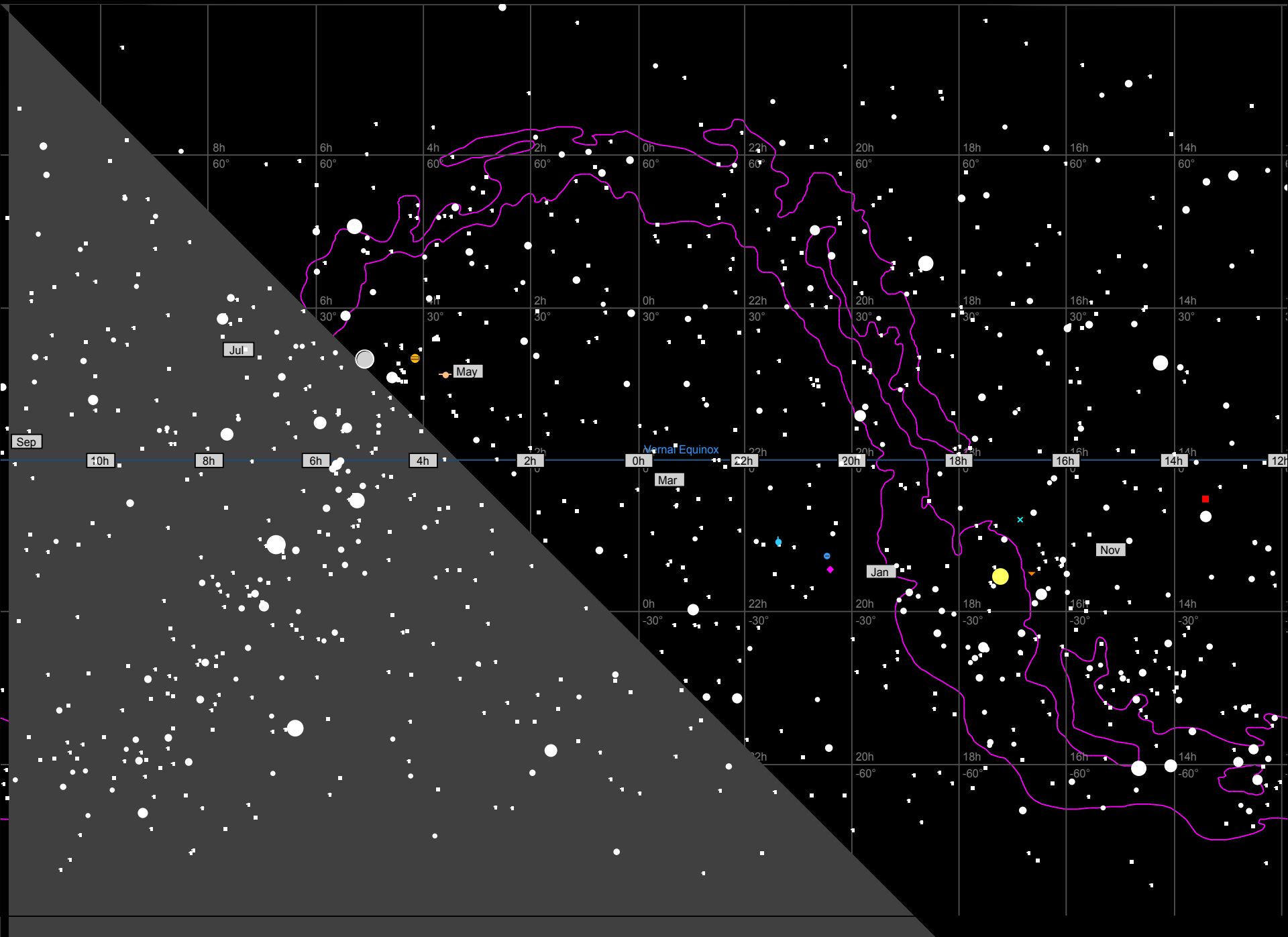
21h
40°
1h
50°
North
23h
50°
0h
50°
3h
30°
2h
40°
22h
40°
21h
30°

The Ecliptic, Equinoxes and Solstices

- Ecliptic
  - The the path of the Sun across the sky.
  - Tilted to the celestial equator by 23.5 degrees due to the tilt of Earth’s rotational axis.
- Equinoxes
  - Points where the Sun crosses the celestial equator.
  - During equinoxes, the number of daylight and nighttime hours are equal.
- Solstices
  - Point where the Sun is the farthest from the celestial equator.
  - During the Solstices, number of daylight and nighttime hours are the most different.


8h
6h
4h
2h
0h
22h
20h
18h
16h
14h
60°
30°
-30°
-60°
Jul
May
Sep
Mar
Jan
Nov
Vernal Equinox
10h
12h