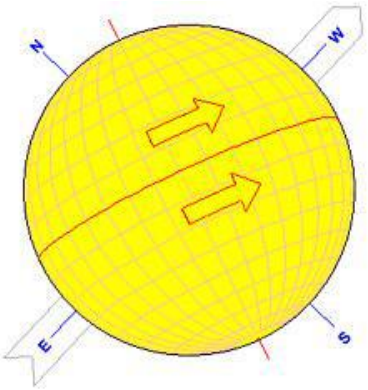
TiltingSun



Contents

What does it do?

TiltingSun shows the orientation of the Sun's disk exactly as it appears through any type of solar telescope**, however mounted, at any time and date anywhere on Earth.

It shows the:

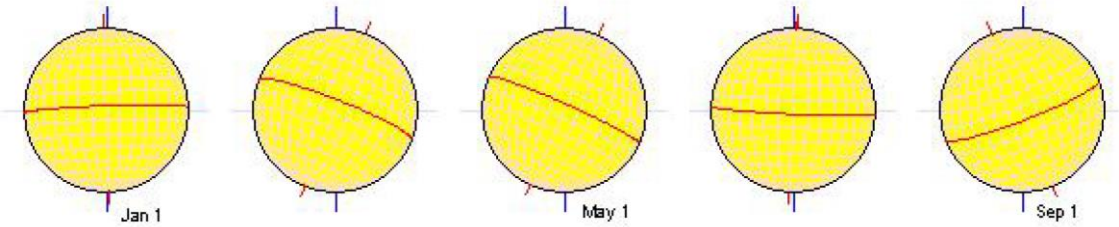
- Position of the Sun's poles and equator
- Direction of rotation
- Path a sunspot will take from day to day across the disk
- Angular positions of prominences
- Direction that the Sun drifts through the telescope field of view

**Never look at the sun through a telescope unless it is professionally designed to safely filter the light and the filters are securely fixed. If in doubt – don't, it could be the last thing you see.

Why is it needed

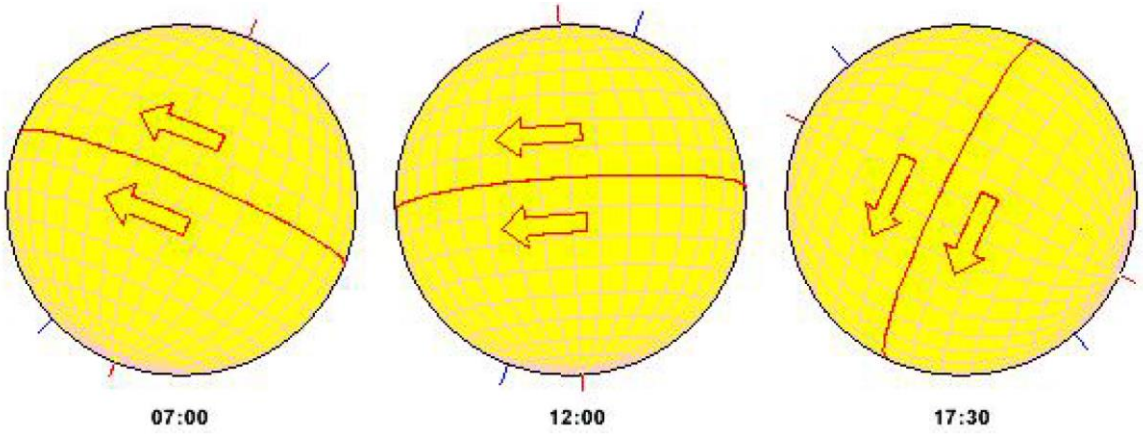
The rotation axes of the earth and Sun are tilted relative to each other and neither are perpendicular to the ecliptic, the plane of Earth's orbit around the Sun.

1) As a result, the orientation of the Sun's poles and equator appear to change throughout the year.



Some telescopes, like the **PST** Halpha scope, turn the view upside-down. Others, like the **SolarMax 40 90** 'scopes have North at the top but the field is flipped from right to left. Other 'scopes do both.

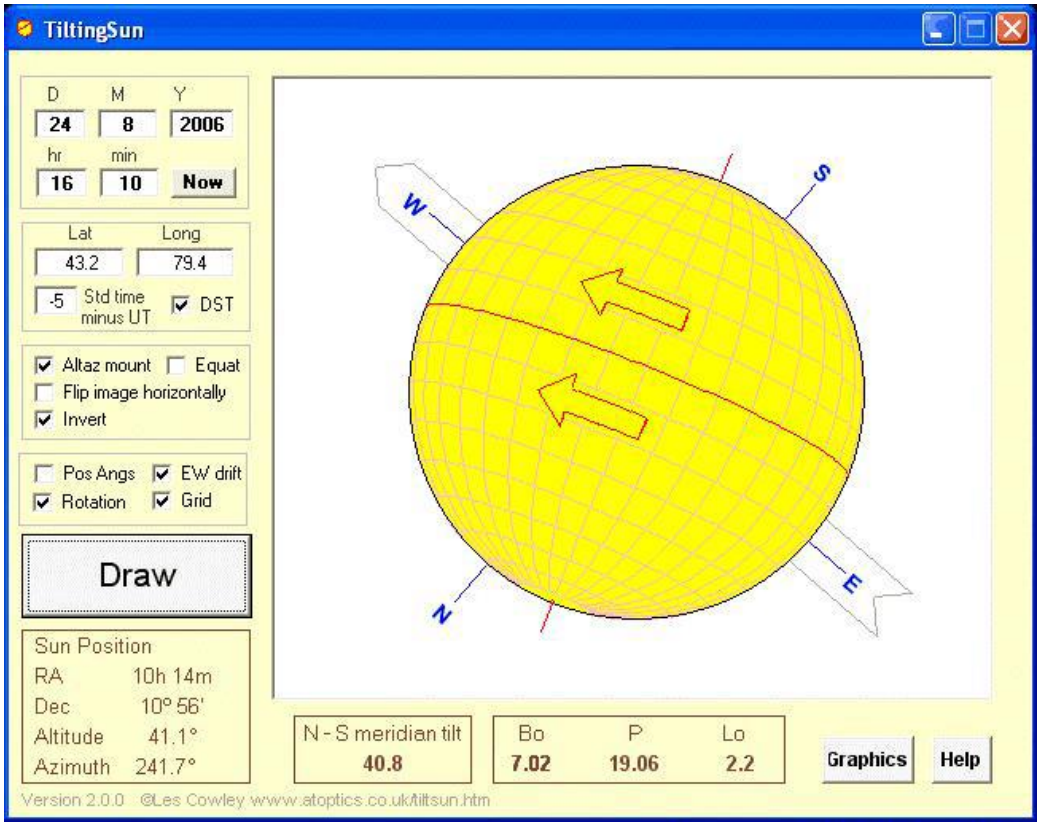
2) Things get even more complicated if you use a camera tripod or altazimuth mounting. The whole field of view including the Sun tilts in different directions depending on whether you view in the morning (Eastwards) or afternoon (Westwards).



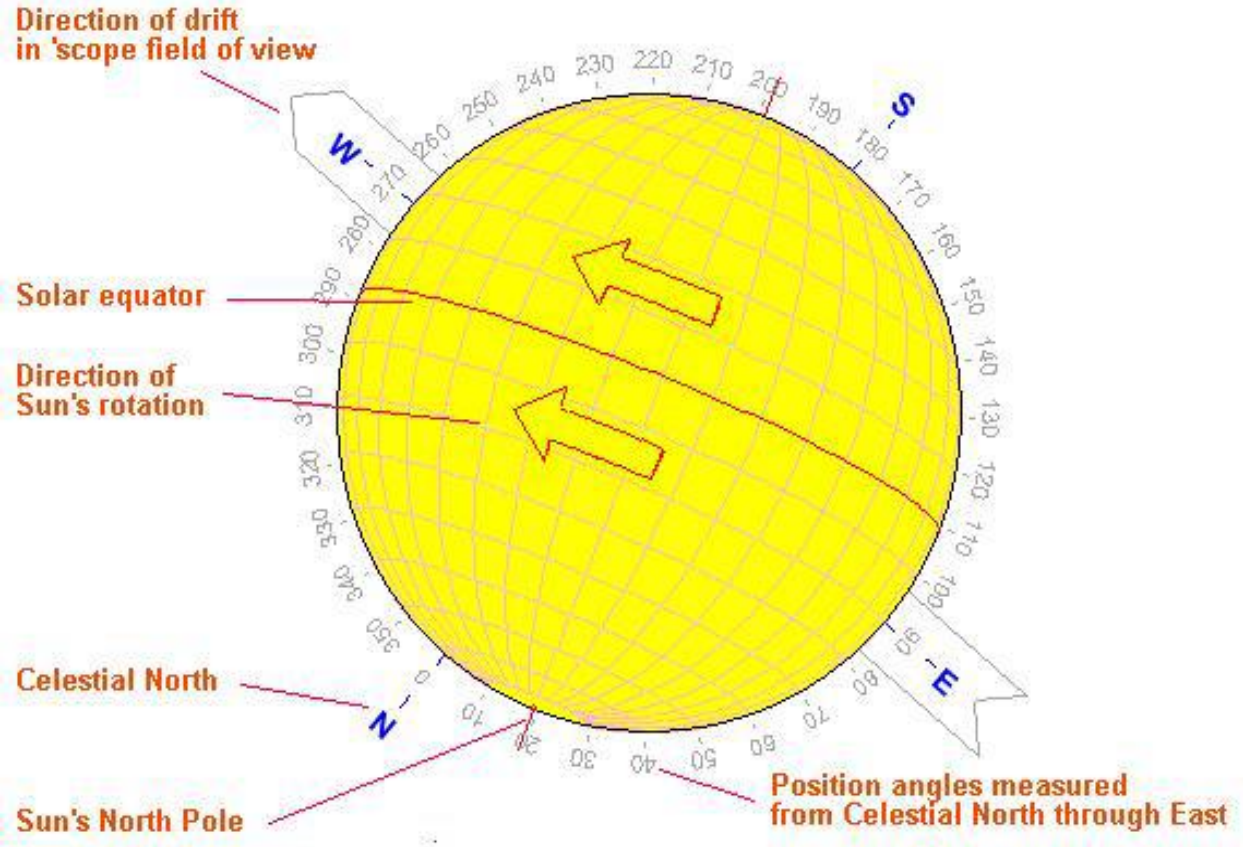
The diagram shows the Sun at three times on March 15,2006 at Toronto as seen through a SolarMax 60.

First Look

When you first open TiltingSun it shows the Sun as seen at your computer's time and date. The view is exactly as you would see the sun through an altazimuth mounted PST telescope located in Toronto, Canada.



- All the controls and settings are visible.
- Once set up they are remembered.
- From then on only the date and time need be altered.
- The next page explains the graphical display.



- The example shows the display with all graphics options switched on.
- It is for the inverted view as seen through a PST on an altazimuth mount at the location, date and time on the previous page.
- The Sun is being viewed in the afternoon and so the Celestial North is tilted relative to a vertical line through the field of view. The Earth's rotation makes the sun drift along the East to West line from lower right to upper left.
- Over several days, the rotation of the Sun will carry features along lines of latitude in the direction of the two red arrows.
- The circular position angle scale is useful for measuring the positions of prominences. Its zero is at Celestial North **not** the Sun's North Pole.

The controls let you show or hide many of the graphical features.

Follow the next section, 'Setting Up', to customize TiltingSun for your location, telescope and graphics preferences.

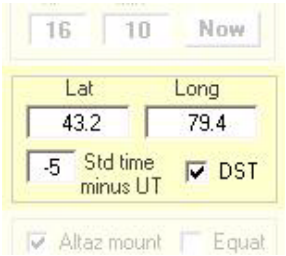
Setting Up

Entering your location, telescope and mount characteristics and display preferences has to be done only once. The settings can be changed at any time they are stored whenever you click the “Draw” button.

Time/Date

These are the only settings that might need to be changed when you use TiltingSun after the initial setting up. The program always presents a display for your current time and date when it starts.

Enter values manually. Click (Now) whenever you want your current (PC) time and date.



Position

Latitude

Enter in degrees. Positive for the Northern Hemisphere

Longitude

In degrees. Positive for west of Greenwich, i.e. all of North America has positive longitudes.

Standard time – UT

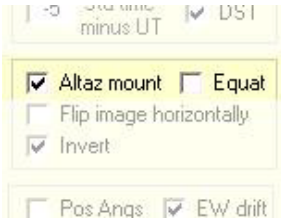
Your Standard (not Daylight Saving) Time difference from Greenwich Mean (Universal) Time. San Francisco is –8 hours, Sydney is +10.

DST

Tick the box if your clocks are on Daylight Saving Time. TiltingSun then internally converts your time to standard time.

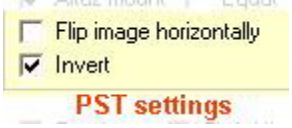
Telescope & Mounting

Mount – Choose an altazimuth (Altaz) or equatorial (Equat) mounting. Check ‘Altaz’ for a ‘scope on a camera tripod.

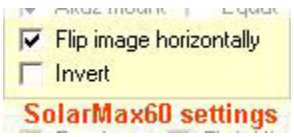


Scope – When looking through a new solar scope (see warning above) it is not at all obvious which way the Sun is oriented. The Sun, unlike the Moon, has no fixed markings.

A **Coronado PST** inverts the image – tick only the ‘Invert’ box.



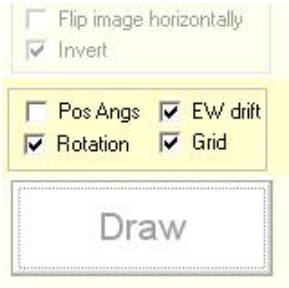
A **SolarMax 40/60/70/90** has an erect image but flipped right to left – tick only ‘Flip image horizontally’.



For **other 'scopes** watch how the image shifts when you raise or lower it. If the sun moves upwards when you lower the scope then it has an erect image. Otherwise tick 'Invert'.

If the scope has a **diagonal or prism** then it likely needs 'Flip image horizontally' ticked. (The PST uses an internal pentaprism and does not flip the image.) Turn off the drive to see whether the direction of drift corresponds with the arrow on the TiltingSun display.

View preferences



Tick the relevant box to display the feature then click 'Draw'.

Grid – The Sun's latitude and longitude system. The spacing is 10°.

Rotation – Tick for arrows showing the direction features on the Sun move due to its rotation.

Pos Angs – Position Angles are measured around the Sun's limb. They start at Celestial North not the Sun's North Pole. East is 90, South 180 and West 270°. Double star observers will be familiar with them. Position angles are useful for describing the positions of solar prominences.

EW drift – East to West drift. Displays a large grey arrow pointing which way the sun drifts due to the Earth's daily rotation. A useful check that you have the 'Flip image horizontally' and 'Invert' boxes appropriately ticked for your 'scope.

Display

Always click 'Draw' to produce a display for your selected settings, the display does not change automatically. Clicking 'Draw' also stores your settings.

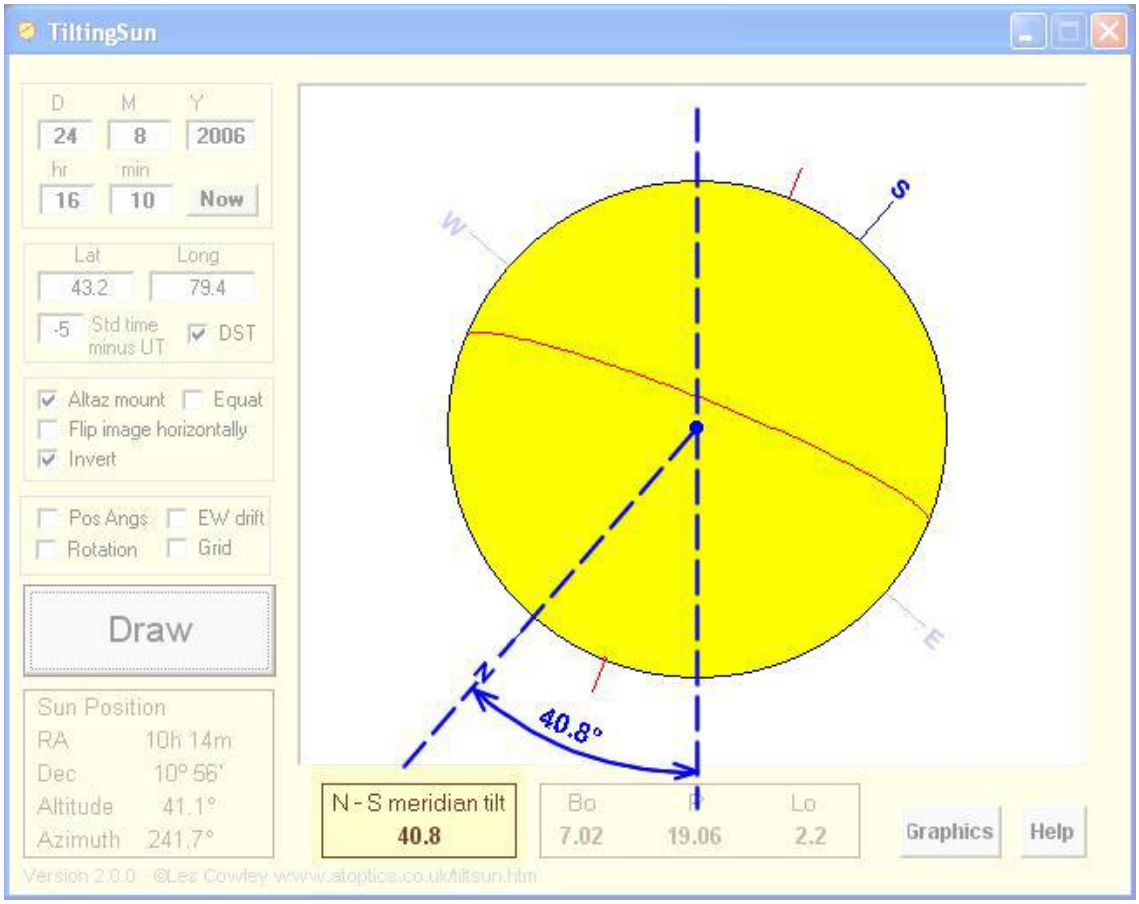
Graphics are explained under **First Look** above.

Sun Position – The Sun's position on the celestial sphere (RA and Declination) and its actual altitude and azimuth in the sky. Azimuth is measured from geographical north around the horizon. East is 90°, South 180° and west 270°.

N – S meridian tilt – This is the angle that the Celestial North South Line is tilted in the field of view.

The value is negative if the Celestial North South line is tilted in an anticlockwise direction (for an unflipped field!). Use the number to mark with a protractor the celestial N – S direction onto whole disk sketches.

The N – S meridian tilt is not visible if an equatorial mount is selected. Its tilt – relative to a plane perpendicular to the declination axis is zero.

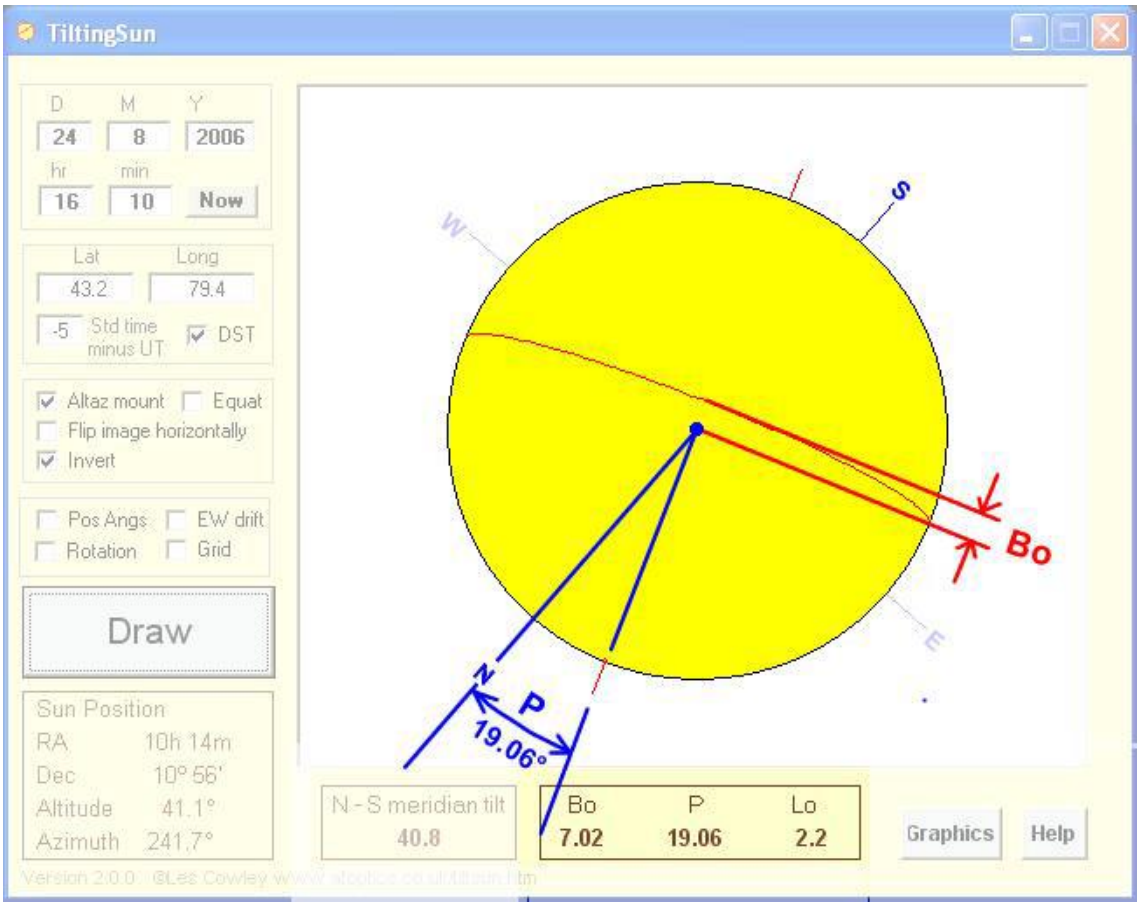


Bo and **P** describe the orientation of the Sun's equator and poles relative to the celestial sphere.

P is the angular tilt of the projection of the Sun's rotation axis to the Celestial North South line. P is positive when the Sun's North Pole is to the East of Celestial North. Use this value with a protractor to mark the position of the Sun's poles onto daily whole disk sketches. Draw the Celestial NS line first.

Bo describes the tilt of the Sun's NS rotation axis out of the plane of the display (or sky). Bo is the latitude of the centre of the visible disk. Bo is positive when the Sun's North Pole is tilted towards Earth.

Lo is the longitude of the central meridian of the solar disk in the Carrington rotation system.



TiltingSunG makes graphics…

You may want to produce custom graphics of the Sun's orientation to transfer to PhotoShop for overlays onto images or as stand alone figures. "TiltingSunG" makes these. Access it by clicking the "Graphics" button or directly by double clicking on 'tiltingsun_g.exe" in the program folder.

Les Cowley

http://www.atoptics.co.uk