Sidereal, tropical, and anomalistic years

The relations among these are considered more fully in Axial precession (astronomy).

Each of these three years can be loosely called an 'astronomical year'.

The **sidereal year** is the time taken for the Earth to complete one revolution of its orbit, as measured against a fixed frame of reference (such as the fixed stars, Latin *sidera*, singular *sidus*). Its average duration is 365.256363004 mean solar days (365 d 6 h 9 min 9.76 s) (at the epoch J2000.0 = January 1, 2000, 12:00:00 TT).[3]

The **tropical year** is the period of time for the ecliptic longitude of the Sun to increase by 360 degrees. Since the Sun's ecliptic longitude is measured with respect to the equinox, the tropical year comprises a complete cycle of the seasons; because of the economic importance of the seasons, the tropical year is the basis of most calendars. The tropical year is often defined as the time between southern solstices, or between northward equinoxes. Because of the Earth's axial precession, this year is about 20 minutes shorter than the sidereal year. The mean tropical year is approximately 365 days, 5 hours, 48 minutes, 45 seconds[4] (= 365.24219 days).

The **anomalistic year** is the time taken for the Earth to complete one revolution with respect to its apsides. The orbit of the Earth is elliptical; the extreme points, called apsides, are the perihelion, where the Earth is closest to the Sun (January 3 in 2011), and the aphelion, where the Earth is farthest from the Sun (July 4 in 2011). The anomalistic year is usually defined as the time between perihelion passages. Its average duration is 365.259636 days (365 d 6 h 13 min 52.6 s) (at the epoch J2011.0).[5]

If Earth moved in an ideal Kepler orbit, *i.e.* a perfect ellipse with the Sun fixed at one focus, each kind of year would always have the same duration, and the sidereal and anomalistic years would be equal. Because of perturbations by the gravity of other planets, Earth's motion varies slightly, causing the sidereal and tropical years to vary in length by about 25 minutes (see table below). Both are affected in the same way, so that the sidereal year is consistently 20 minutes longer than the tropical year, provided that they are measured in the same way.

Winter solstice (Atomic time)	Deviation of the following year's duration from the mean value 365.24219 SI days
2007-12-22 06:04:04.2	+10.51 minutes
2008-12-21 12:03:19.7	-11.86 minutes
2009-12-21 17:40:13.2	+15.91 minutes
2010-12-21 23:44:53.2	-11.94 minutes
2011-12-22 05:21:41.8	+3.58 minutes
2012-12-21 11:14:01.9	+2.85 minutes
2013-12-21 17:05:38.3	+0.86 minutes
2014-12-21 22:55:15.2	+0.48 minutes

An example of a year that will have a duration exceeding the average value of 365.24219 SI days with as much as 24.23 minutes is the one that will begin at winter solstice December 21, 2042 17:47:45.5 (Atomic time).

Earth's precession was historically called **precession of the equinoxes** because the equinoxes moved westward along the ecliptic relative to the fixed stars, opposite to the motion of the Sun along the ecliptic. This term is still used in non-technical discussions, that is, when detailed mathematics are absent. Historically,[2] Hipparchus is credited with discovering precession of the equinoxes. The exact dates of his life are not known, but astronomical observations attributed to him by Ptolemy date from 147 BC to 127 BC.