

# Package ‘galisats’

September 11, 2025

**Title** Configuration of Jupiter's Four Largest Satellites

**Version** 2.0.2

**Description** Calculate and plot the configuration of Jupiter's four largest satellites (known as Galilean satellites) for a given date and time (UTC - Coordinated Universal Time).

The galsat() function returns numerical values of the satellites' positions.

x – the apparent rectangular coordinate of the satellite with respect to the center of Jupiter's disk in the equatorial plane in the units of Jupiter's equatorial radius; X is positive toward the west,

y – the apparent rectangular coordinate of the satellite with respect to the center of Jupiter's disk from the equatorial plane in the units of Jupiter's equatorial radius; Y is positive toward the north.

For more details see Meeus (1988, ISBN 0-943396-22-0) ``Astronomical Formulae for Calculators".

The function delta\_t() returns the value of delta-T in units of seconds.

**License** MIT + file LICENSE

**Encoding** UTF-8

**RoxygenNote** 7.3.3

**Imports** graphics, png

**URL** [https://lechjaszowski.github.io/galilean\\_satellites/](https://lechjaszowski.github.io/galilean_satellites/)

**NeedsCompilation** no

**Author** Lech Jaszowski [aut, cre, cph] (ORCID:  
<<https://orcid.org/0009-0001-4748-9603>>)

**Maintainer** Lech Jaszowski <[lech.jaszowski@interia.pl](mailto:lech.jaszowski@interia.pl)>

**Repository** CRAN

**Date/Publication** 2025-09-11 08:50:02 UTC

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delta_t	<i>Return the value of delta-T in units of seconds</i>
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### Description

Converting the Coordinated Universal Time (UTC) to the Ephemeris Time (ET) is complex. It is due to the unpredictable nature of the Earth's rotation, which is the basis for UTC, whereas ET was based on the more uniform orbital motion of the Earth around the Sun. The key to converting between these time scales lies in a value known as delta-T, which is the difference between a uniform time scale and one based on Earth's rotation. The conversion is handled as:  $ET = UTC + \text{deltaT}$ . However, delta-T is not a constant value and cannot be calculated using a simple formula. The delta-T values are derived from the historical records and from direct observations. A series of polynomial expressions have been created to simplify the evaluation of delta-T. The calculated values are valid for the years from -1999 to +3000.

### Usage

```
delta_t(year, month)
```

### Arguments

year	Type in the year (integer between -1999 and 3000).
month	Type in the month (integer between 1 and 12).

### Details

More details: Morrison, L. and Stephenson, F. R., "Historical Values of the Earth's Clock Error delta-T and the Calculation of Eclipses", J. Hist. Astron., Vol. 35 Part 3, August 2004, No. 120, pp 327-336 (2004) Stephenson F.R., Historical Eclipses and Earth's Rotation, Cambridge Univ. Press, 1997

### Value

numeric: vector of numeric values

### Examples

```
delta_t(1999, 10)  
delta_t(c(-200, 1610, 2030), c(1, 10, 12))
```

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`galsat`*Calculate & draw the positions of the Galilean satellites*

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**Description**

`galsat()` is used to determine the positions of the four greatest satellites of Jupiter (called Galilean satellites). Positions are shown on the plot for given UTC time (Coordinated Universal Time between year 0 and 3000) with respect to the planet, as seen from the Earth.

The `galsat()` function returns numerical values of the satellites' positions:

`x` - the apparent rectangular coordinate of the satellite with respect to the center of Jupiter's disk in the equatorial plane in the units of Jupiter's equatorial radius; `X` is positive toward the west

`y` - the apparent rectangular coordinate of the satellite with respect to the center of Jupiter's disk from the equatorial plane in the units of Jupiter's equatorial radius; `Y` is positive toward the north

**Usage**

```
galsat(year, month, day, hour, minute)
```

**Arguments**

<code>year</code>	Type in the year (integer number from 0 to 3000).
<code>month</code>	Type in the month (integer number from 1 to 12).
<code>day</code>	Type in the day (integer number from 1 to 31).
<code>hour</code>	Type in the hour (integer number from 0 to 23).
<code>minute</code>	Type in the minute (integer number from 0 to 59).

**Details**

The function is based on algorithms in the book: *Astronomical Formulae for Calculators* (4th edition), Jean Meeus, Willmann-Bell Inc., 1988

**Value**

`data.frame`: 4 observations of 3 variables: `$ moon`: chr "Io" "Europa" "Ganymede" "Callisto" `$ x`: num `$ y`: num Four rows - each row has the position (x,y) of one moon. Additionally, the positions of the moons are shown graphically.

**Examples**

```
galsat(2025, 10, 13, 23, 30)
```

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