Data from the ULYSSES FINAL ARCHIVE

Open ulysses_daily_heliocentric_data_1990-2009.txt
~/PUI-fun/Ulysses/Trajectory/trajectory_data

```
lat: Sun Mean Equator and Equinox of 1950
RA and DEC: Earth Mean Orbit and Equinox of 1950
long: long of Ulysses wrt Earth in Sun Mean Equator and Equinox of 1950

YYYY MM DD YYYY DOY JD        HH MM SS  ESP    SPE    SEP     R      R              dR      V       lat    RA      DEC    long
[UTC]                                   [deg]  [deg]  [deg]   [AU]   [km]           [km/s]  [km/s]  [deg]  [deg]   [deg]  [deg]

1990 10 07 1990 280 2448171.5 00 00 00    0.08  97.86  82.06  0.999  149497071.034  -2.512  41.092  6.35   12.98   0.01    0.08
1990 10 08 1990 281 2448172.5 00 00 00    0.45  98.57  80.97  0.998  149301115.851  -2.035  40.987  6.32   14.34   0.06    0.46
1990 10 09 1990 282 2448173.5 00 00 00    0.83  97.43  81.74  0.997  149145073.980  -1.577  40.996  6.28   15.70   0.10    0.83
1990 10 10 1990 283 2448174.5 00 00 00    1.20  96.17  82.63  0.996  149028578.950  -1.119  41.008  6.24   17.06   0.15    1.21
1990 10 11 1990 284 2448175.5 00 00 00    1.58  94.86  83.56  0.996  148951687.780  -0.661  41.017  6.20   18.42   0.20    1.59
1990 10 12 1990 285 2448176.5 00 00 00    1.96  93.54  84.50  0.995  148914448.678  -0.201  41.020  6.15   19.78   0.24    1.96
1990 10 13 1990 286 2448177.5 00 00 00    2.33  92.21  85.46  0.995  148916887.222   0.258  41.019  6.10   21.14   0.29    2.34
1990 10 14 1990 287 2448178.5 00 00 00    2.71  90.88  86.42  0.996  148958991.852   0.717  41.012  6.05   22.51   0.34    2.72
```

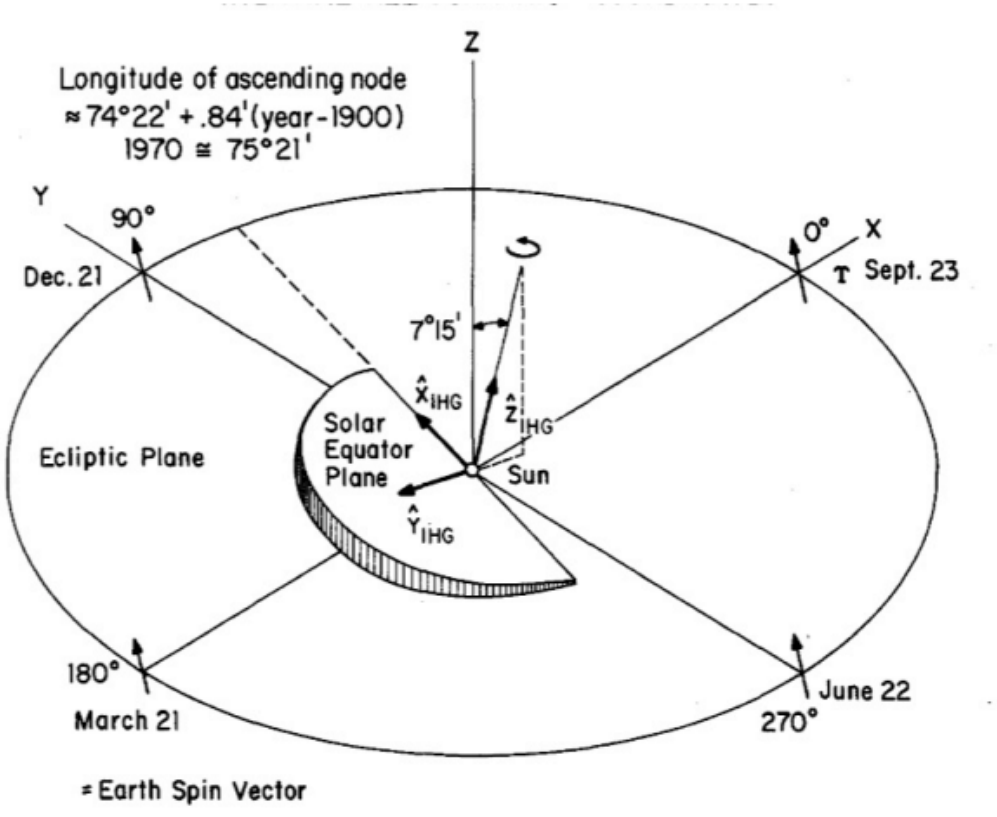
Open helio.dat
~/PUI-fun/Ulysses/Trajectory/trajectory_data

Year	DOY	HR	MN	SC	Earth Sun S/C [deg]	Sun S/C Earth [deg]	Sun Earth S/C [deg]	Helioc. Range [AU]	Heliograph. Latitude [deg]	Helioc. Rt. Asc. [deg]	Helioc. Ecliptic Lat. [deg]	Solar Longitude wrt Earth [deg]
1990	296	00	00	00	5.93	78.96	95.11	1.0100	5.42	-999.	0.75	-999.
1990	297	00	00	00	6.25	77.64	96.11	1.0127	5.34	-999.	0.79	-999.
1990	298	00	00	00	6.58	76.31	97.11	1.0154	5.25	-999.	0.83	-999.
1990	299	00	00	00	6.89	74.99	98.12	1.0187	5.16	-999.	0.87	-999.
1990	300	00	00	00	7.19	73.67	99.14	1.0227	5.07	-999.	0.91	-999.
1990	301	00	00	00	7.48	72.35	100.20	1.0261	4.98	-999.	0.95	-999.
1990	302	00	00	00	7.76	71.03	101.20	1.0301	4.89	-999.	0.99	-999.
1990	303	00	00	00	8.04	69.72	102.20	1.0348	4.79	-999.	1.03	-999.
1990	304	00	00	00	8.30	68.41	103.30	1.0394	4.69	-999.	1.07	-999.
1990	305	00	00	00	8.54	67.10	104.40	1.0441	4.60	-999.	1.10	-999.
1990	306	00	00	00	8.78	65.79	105.40	1.0488	4.50	-999.	1.14	-999.
1990	307	00	00	00	9.01	64.49	106.50	1.0542	4.40	-999.	1.17	-999.
1990	308	00	00	00	9.22	63.19	107.59	1.0593	4.29	155.19	1.20	9.240
1990	309	00	00	00	9.42	61.90	108.69	1.0648	4.19	156.38	1.24	9.440
1990	310	00	00	00	9.60	60.60	109.79	1.0706	4.09	157.57	1.27	9.620

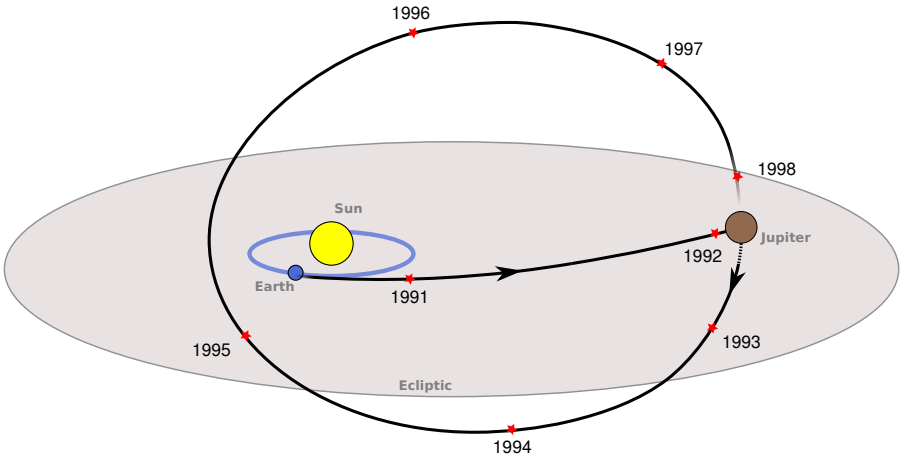
Coordinate Systems

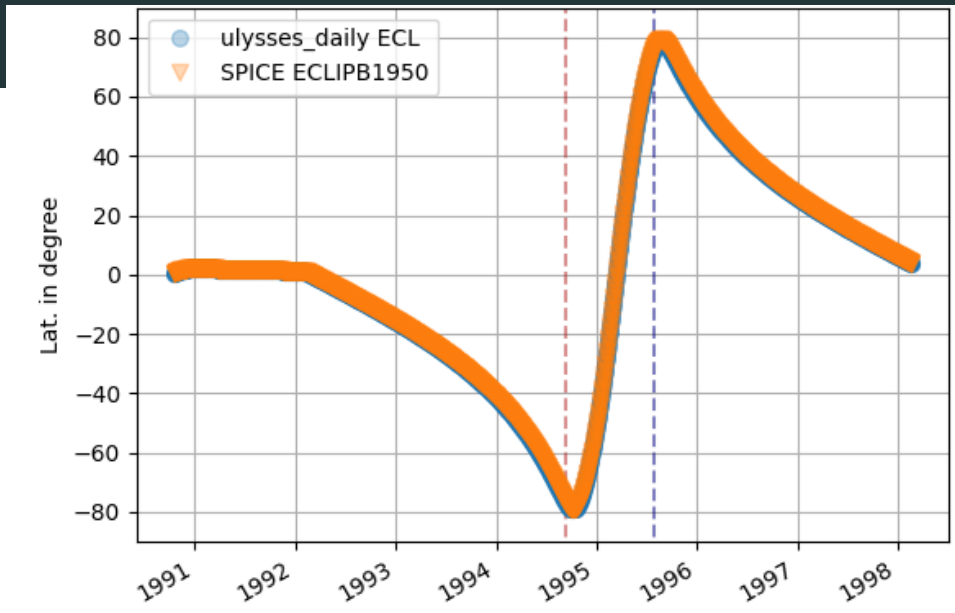
There seem to be two options for coordinate systems:

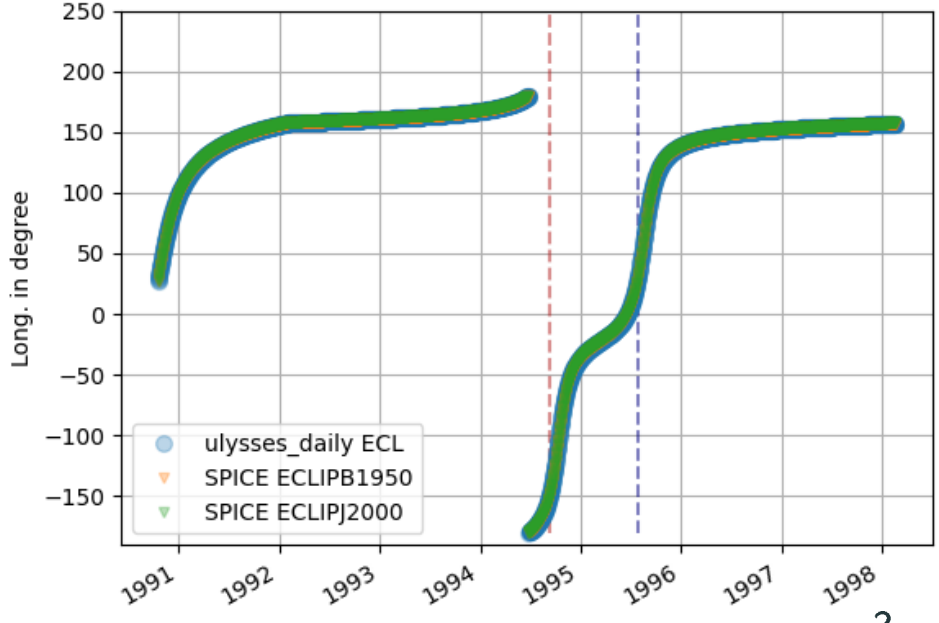
- ***Heliocentric Inertial*** (HCI) system
- ***Heliocentric Aries Ecliptic*** (HAE) system



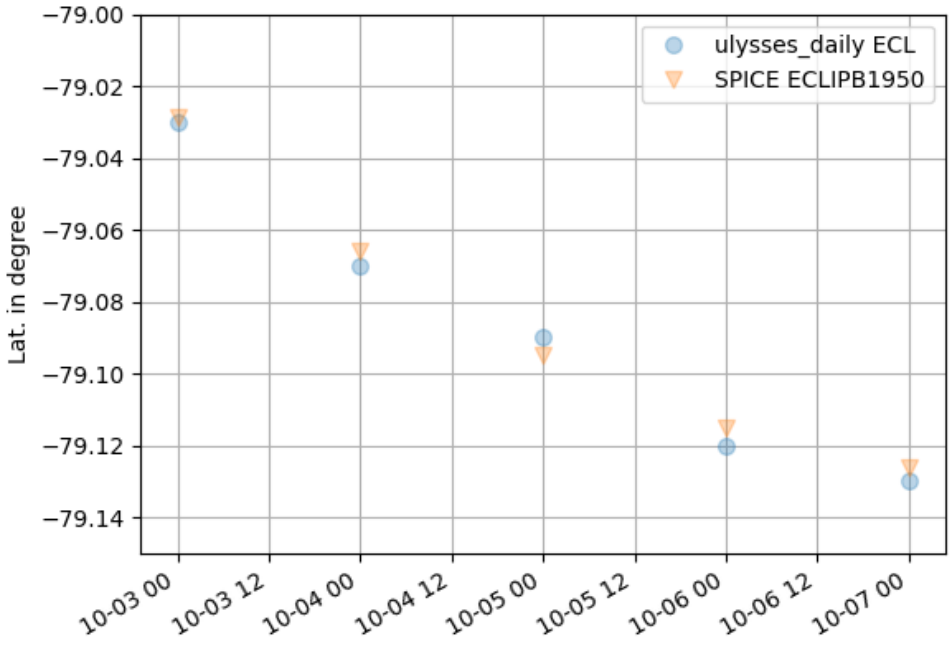
Ulysses' 1st Orbit

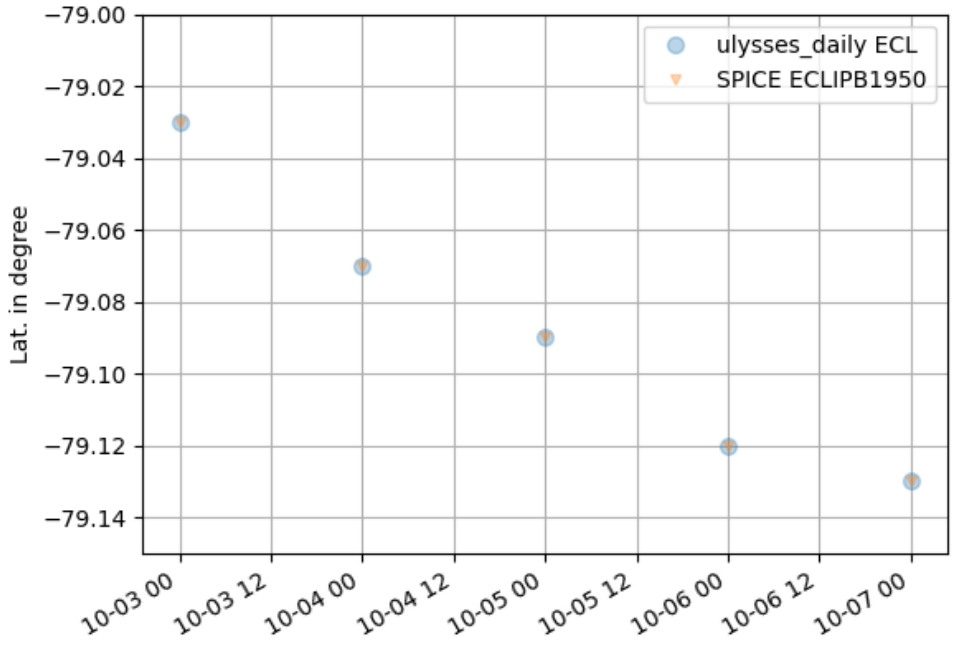




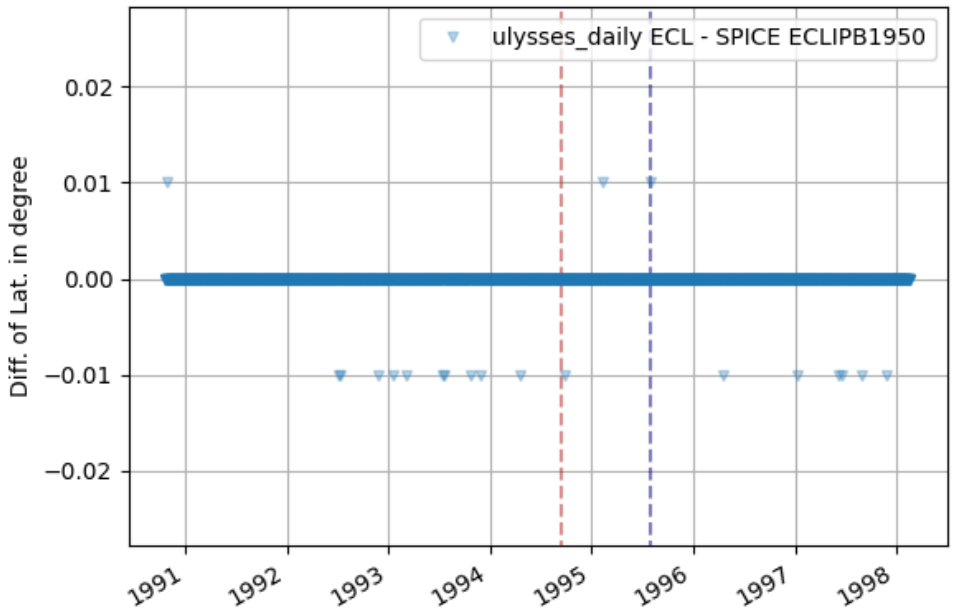


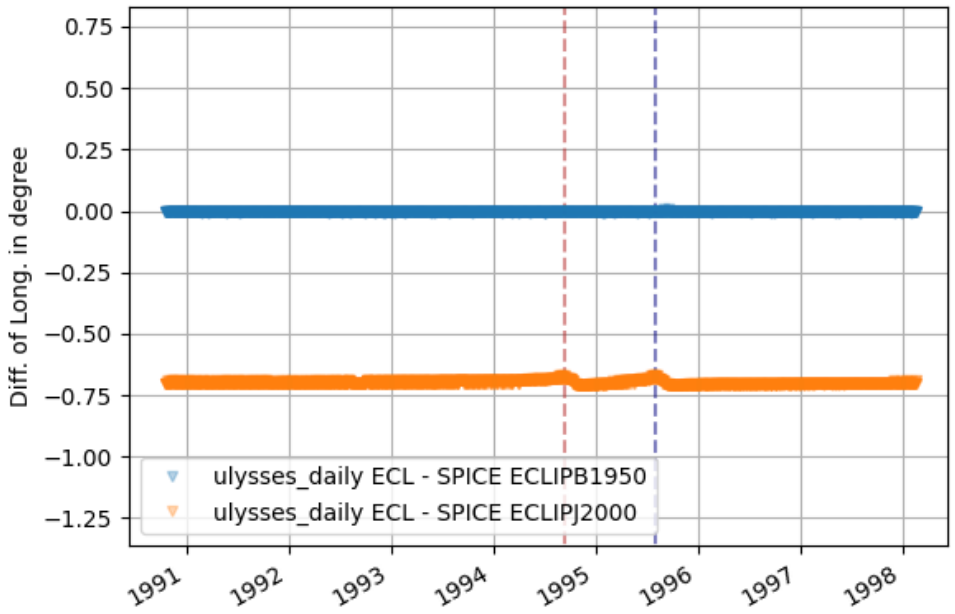
Ecliptic System – Latitude





Ecliptic System – Differences

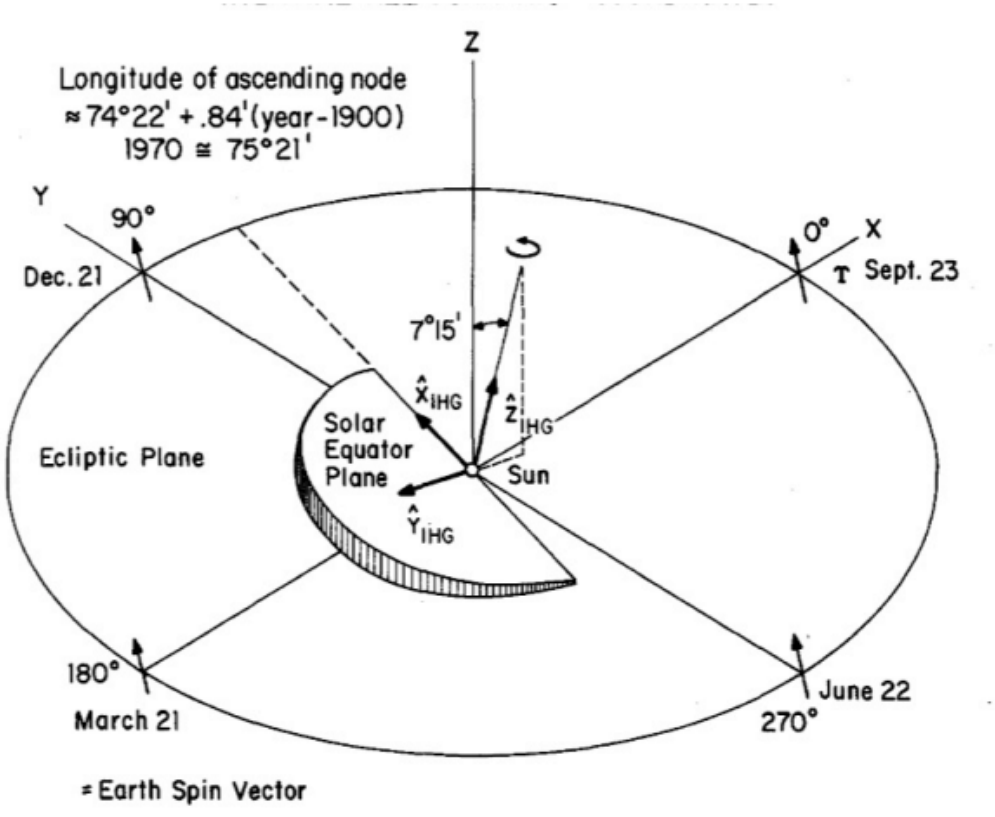




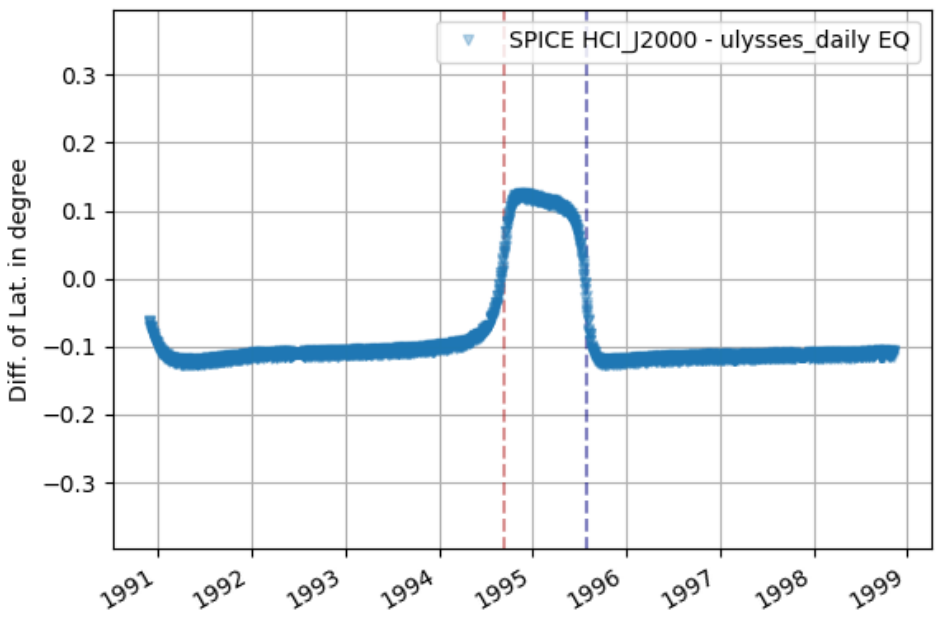
Equatorial System

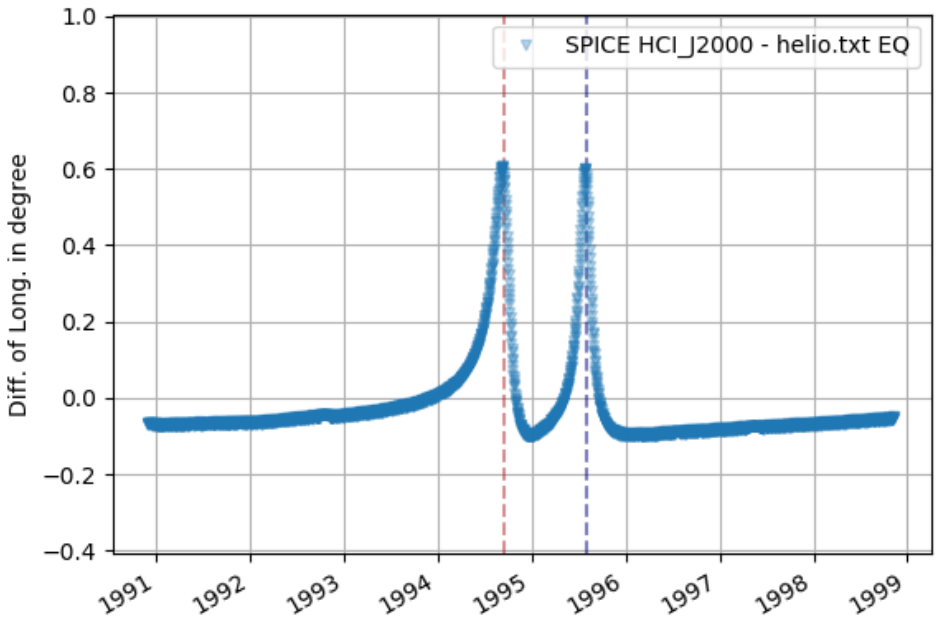
There seem to be two options for coordinate systems:

- ***Heliocentric Inertial*** (HCI) system
- ***Heliocentric Aries Ecliptic*** (HAE) system

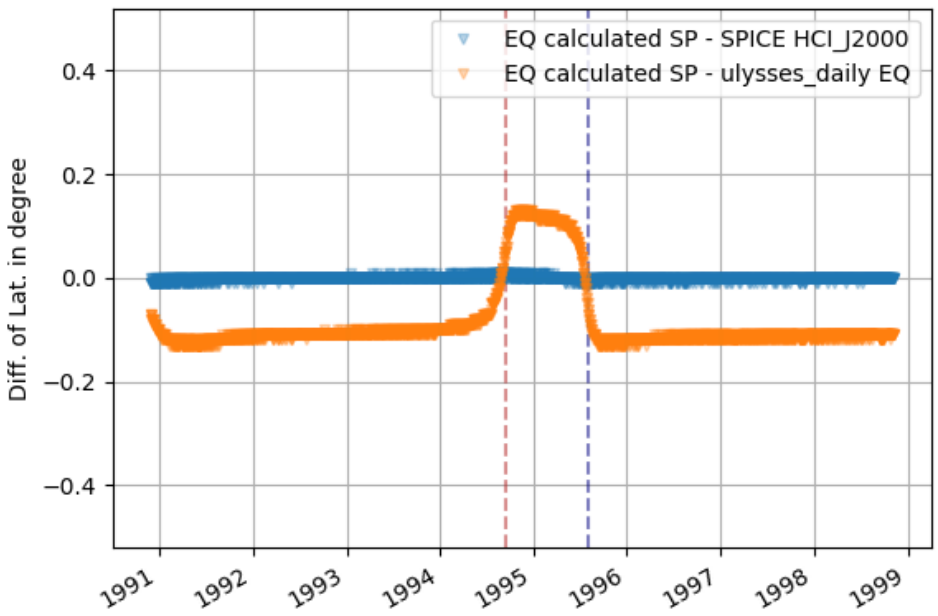


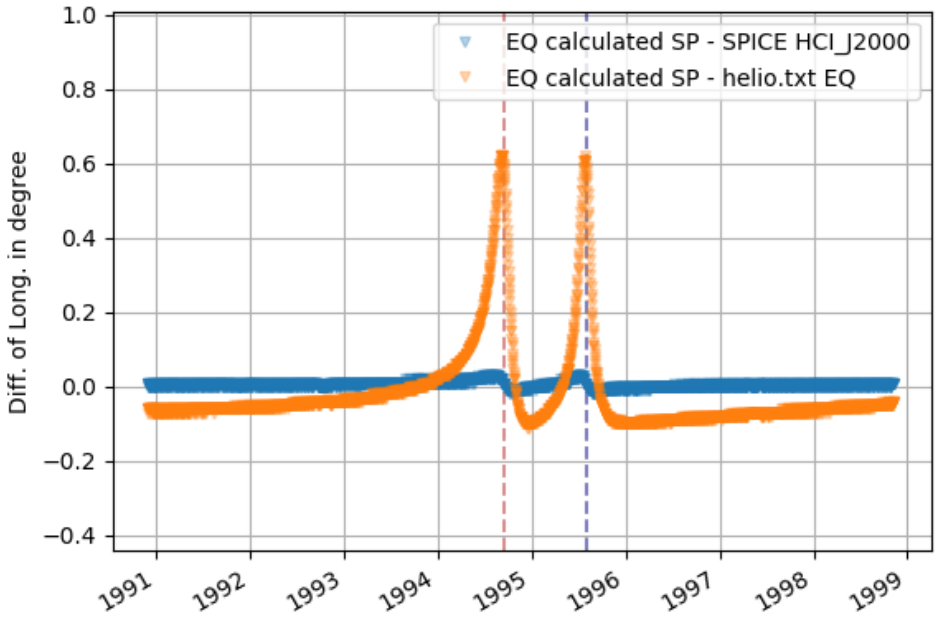
Equatorial System



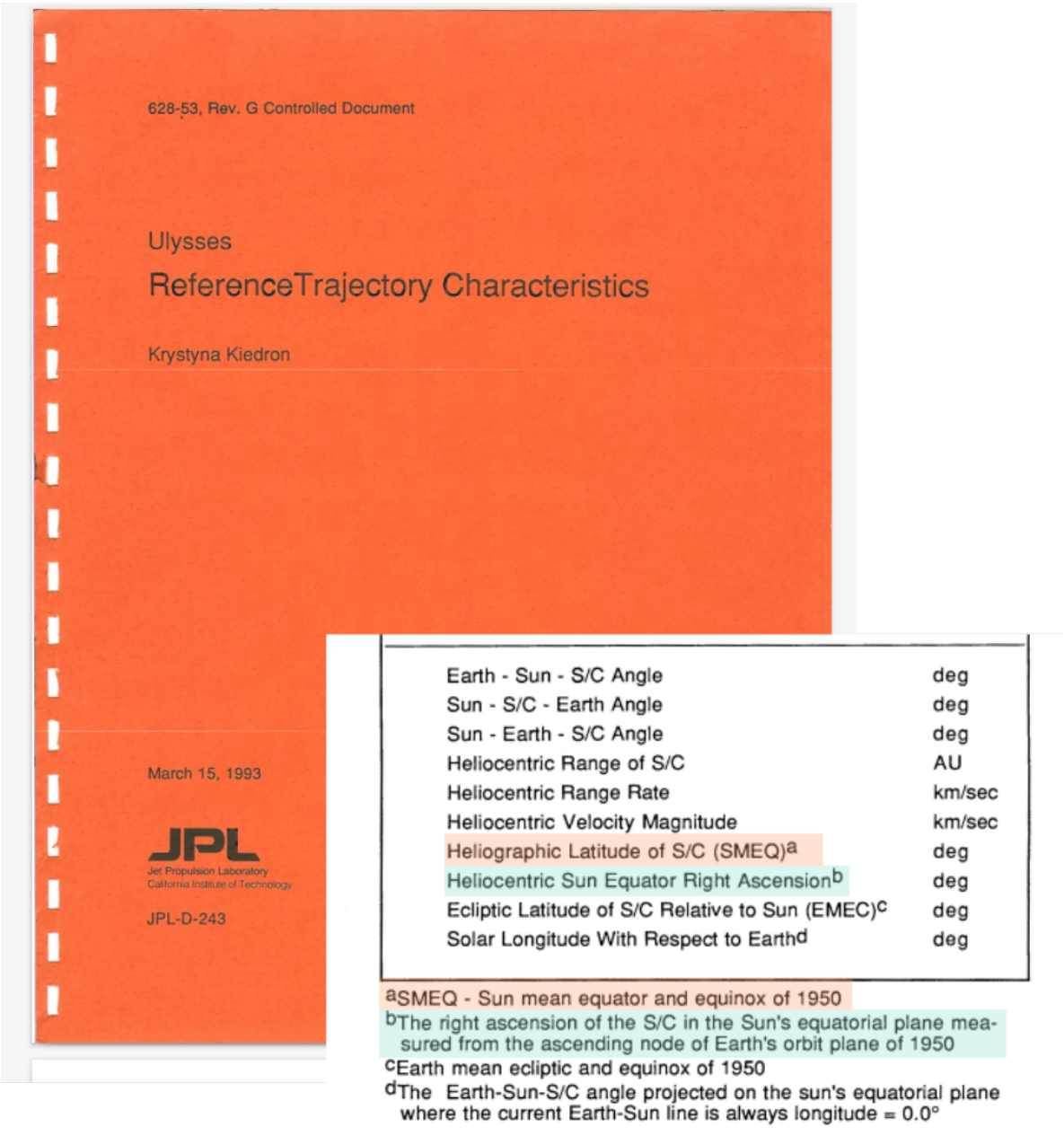


Equatorial System – calculated





Equatorial System



628-53, Rev. G Controlled Document

Ulysses

ReferenceTrajectory Characteristics

Krystyna Kiedron

March 15, 1993

JPL

Jet Propulsion Laboratory
California Institute of Technology

JPL-D-243

Earth - Sun - S/C Angle	deg
Sun - S/C - Earth Angle	deg
Sun - Earth - S/C Angle	deg
Heliocentric Range of S/C	AU
Heliocentric Range Rate	km/sec
Heliocentric Velocity Magnitude	km/sec
Heliographic Latitude of S/C (SMEQ)[a]	deg
Heliocentric Sun Equator Right Ascension[b]	deg
Ecliptic Latitude of S/C Relative to Sun (EMEC)[c]	deg
Solar Longitude With Respect to Earth[d]	deg

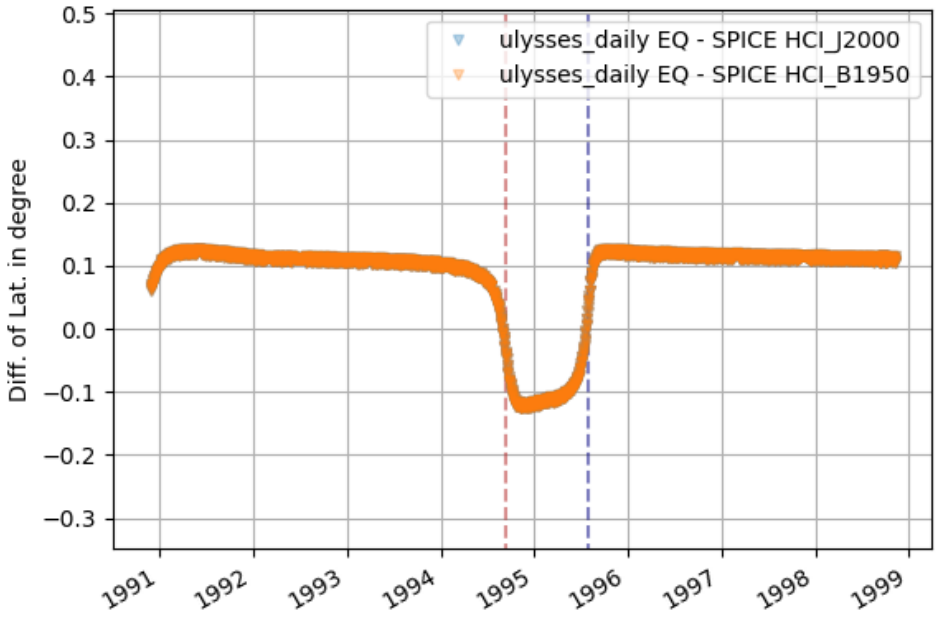
[a]SMEQ - Sun mean equator and equinox of 1950

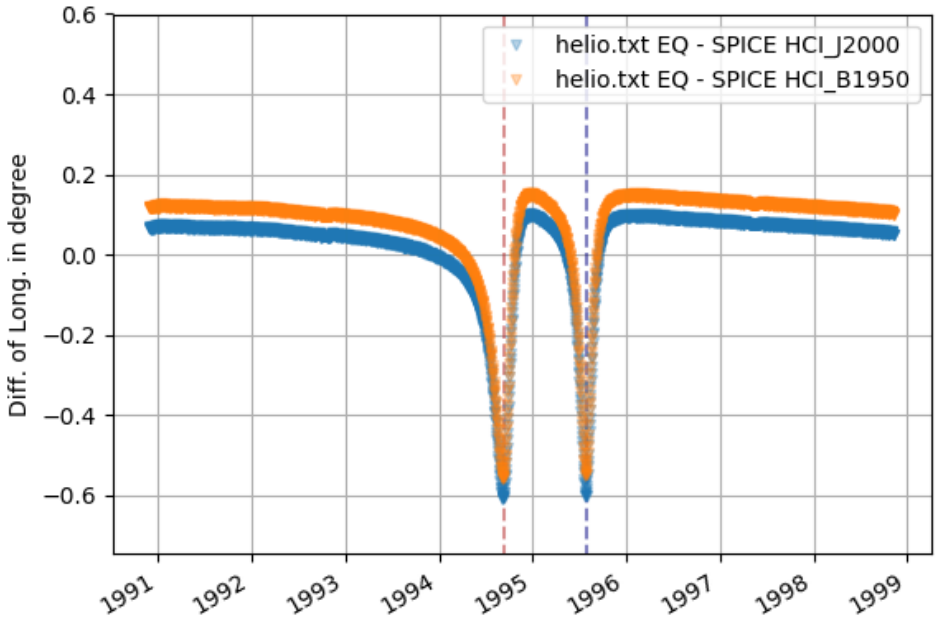
[b]The right ascension of the S/C in the Sun's equatorial plane measured from the ascending node of Earth's orbit plane of 1950

[c]Earth mean ecliptic and equinox of 1950

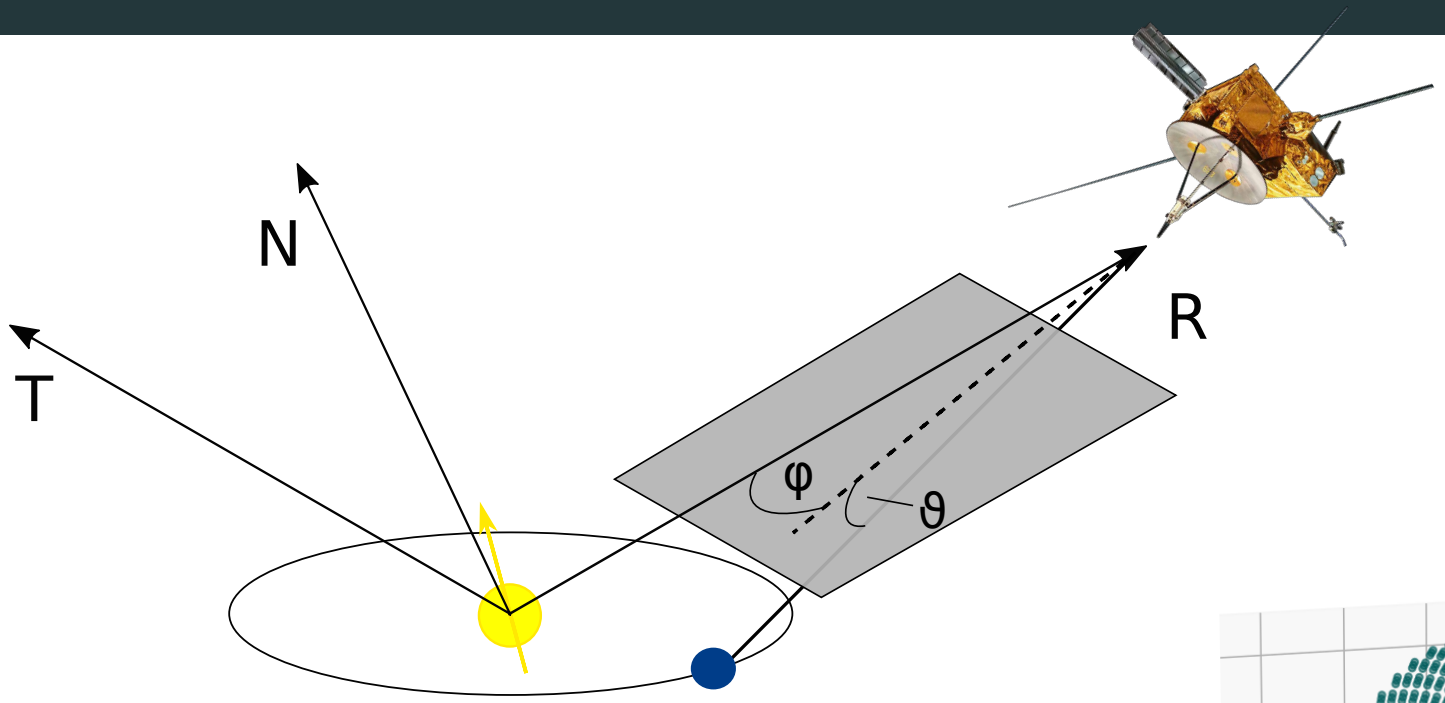
[d]The Earth-Sun-S/C angle projected on the sun's equatorial plane where the current Earth-Sun line is always longitude = 0.0°

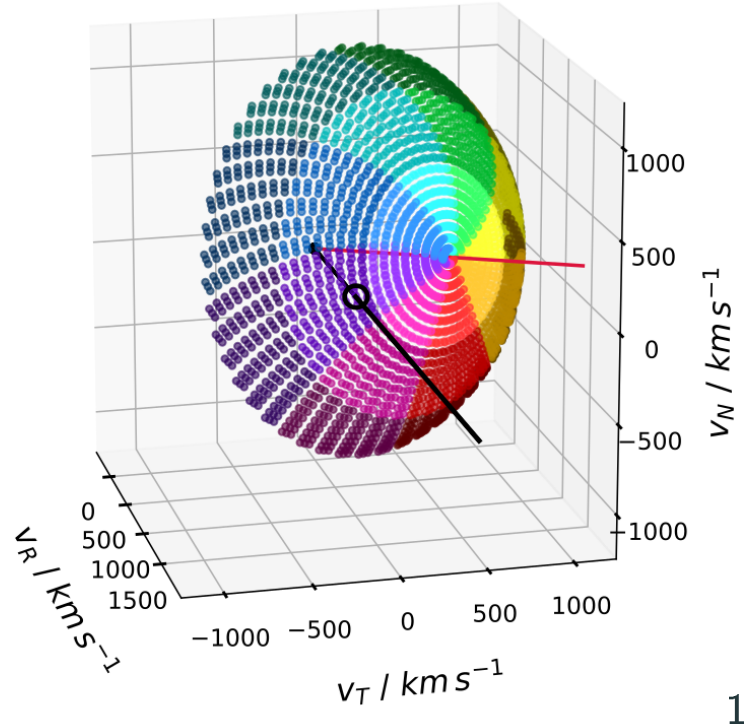
Equatorial System – B1950 vs. J2000





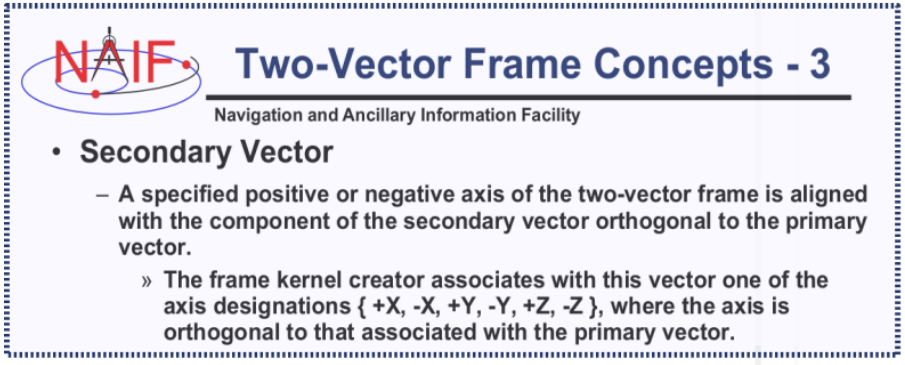
Aspect Angle





asptheta B1950
asptheta J2000
Aspect Latitude / deg.
25
0
−25
B1950 - J2000
0.5
0.0
−0.5
aspphi B1950
aspphi J2000
Aspect Latitude / deg.
25
0
−25
B1950 - J2000
1
0
−1
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010

SPICE Reference Frame Kernel




```
Heliocentric Inertial (HCI) Frame

    Definition of the Heliocentric Inertial frame:

        All vectors are geometric: no aberration corrections are
        used.

        The solar rotation axis is the primary vector: the Z axis points
        in the solar north direction (IAU_SUN frozen at J2000 epoch).

        The ascending node on the ecliptic of J2000 of the IAU_SUN
        equator forms the X axis.  *** N.B this is accomplished by
        using the +Z axis of the ecliptic of J2000 as the secondary
        vector and HCI +Y as the secondary axis

        The Y axis is Z cross X, completing the right-handed
        reference frame.

\begindata

        FRAME_HCI                    =  1810420
        FRAME_1810420_NAME           = 'HCI'
        FRAME_1810420_CLASS          =  5
        FRAME_1810420_CLASS_ID       =  1810420
        FRAME_1810420_CENTER         =  10
        FRAME_1810420_RELATIVE       = 'J2000'
        FRAME_1810420_DEF_STYLE      = 'PARAMETERIZED'
        FRAME_1810420_FAMILY         = 'TWO-VECTOR'
        FRAME_1810420_FREEZE_EPOCH   = @2000-JAN-01/12:00:00
        FRAME_1810420_PRI_AXIS       = 'Z'
        FRAME_1810420_PRI_VECTOR_DEF = 'CONSTANT'
        FRAME_1810420_PRI_FRAME      = 'IAU_SUN'
        FRAME_1810420_PRI_SPEC       = 'RECTANGULAR'
        FRAME_1810420_PRI_VECTOR     = ( 0, 0, 1 )
        FRAME_1810420_SEC_AXIS       = 'Y'
        FRAME_1810420_SEC_VECTOR_DEF = 'CONSTANT'
        FRAME_1810420_SEC_FRAME      = 'ECLIPJ2000'
        FRAME_1810420_SEC_SPEC       = 'RECTANGULAR'
        FRAME_1810420_SEC_VECTOR     = ( 0, 0, 1 )
```