

# 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
1990	10	15	1990	288	2448179.5	00	00	00	3.08	89.54	87.38	0.996	148914448.678	1.178	41.008	6.00	23.87	0.39	3.08
1990	10	16	1990	289	2448180.5	00	00	00	3.46	88.21	88.34	0.996	148870000.000	1.640	40.999	5.95	25.23	0.44	3.46
1990	10	17	1990	290	2448181.5	00	00	00	3.84	86.88	89.46	0.996	148825000.000	2.101	40.989	5.90	26.59	0.49	3.84
1990	10	18	1990	291	2448182.5	00	00	00	4.22	85.55	90.58	0.996	148780000.000	2.562	40.979	5.85	27.95	0.54	4.22
1990	10	19	1990	292	2448183.5	00	00	00	4.60	84.22	91.70	0.996	148735000.000	3.023	40.969	5.80	29.31	0.59	4.60
1990	10	20	1990	293	2448184.5	00	00	00	4.98	82.89	92.82	0.996	148690000.000	3.484	40.959	5.75	30.67	0.64	4.98
1990	10	21	1990	294	2448185.5	00	00	00	5.36	81.56	93.94	0.996	148645000.000	3.945	40.949	5.70	32.03	0.69	5.36
1990	10	22	1990	295	2448186.5	00	00	00	5.74	80.23	95.06	0.996	148600000.000	4.406	40.939	5.65	33.39	0.74	5.74
1990	10	23	1990	296	2448187.5	00	00	00	6.12	78.90	96.18	0.996	148555000.000	4.867	40.929	5.60	34.75	0.79	6.12
1990	10	24	1990	297	2448188.5	00	00	00	6.50	77.57	97.30	0.996	148510000.000	5.328	40.919	5.55	36.11	0.84	6.50
1990	10	25	1990	298	2448189.5	00	00	00	6.88	76.24	98.42	0.996	148465000.000	5.789	40.909	5.50	37.47	0.89	6.88
1990	10	26	1990	299	2448190.5	00	00	00	7.26	74.91	99.54	0.996	148420000.000	6.250	40.899	5.45	38.83	0.94	7.26
1990	10	27	1990	300	2448191.5	00	00	00	7.64	73.58	100.66	0.996	148375000.000	6.711	40.889	5.40	40.19	0.99	7.64
1990	10	28	1990	301	2448192.5	00	00	00	8.02	72.25	101.78	0.996	148330000.000	7.172	40.879	5.35	41.55	1.04	8.02
1990	10	29	1990	302	2448193.5	00	00	00	8.40	70.92	102.90	0.996	148285000.000	7.633	40.869	5.30	42.91	1.09	8.40
1990	10	30	1990	303	2448194.5	00	00	00	8.78	69.59	104.02	0.996	148240000.000	8.094	40.859	5.25	44.27	1.14	8.78
1990	10	31	1990	304	2448195.5	00	00	00	9.16	68.26	105.14	0.996	148195000.000	8.555	40.849	5.20	45.63	1.19	9.16
1990	11	01	1990	305	2448196.5	00	00	00	9.54	66.93	106.26	0.996	148150000.000	9.016	40.839	5.15	46.99	1.24	9.54
1990	11	02	1990	306	2448197.5	00	00	00	9.92	65.60	107.38	0.996	148105000.000	9.477	40.829	5.10	48.35	1.29	9.92
1990	11	03	1990	307	2448198.5	00	00	00	10.30	64.27	108.50	0.996	148060000.000	9.938	40.819	5.05	49.71	1.34	10.30
1990	11	04	1990	308	2448199.5	00	00	00	10.68	62.94	109.62	0.996	148015000.000	10.399	40.809	5.00	51.07	1.39	10.68
1990	11	05	1990	309	2448200.5	00	00	00	11.06	61.61	110.74	0.996	147970000.000	10.860	40.799	4.95	52.43	1.44	11.06
1990	11	06	1990	310	2448201.5	00	00	00	11.44	60.28	111.86	0.996	147925000.000	11.321	40.789	4.90	53.79	1.49	11.44

helioc.dat

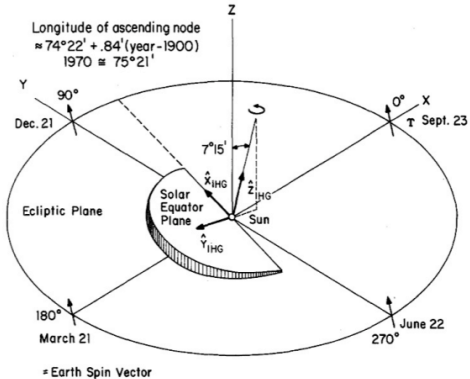
~/PUI-Fun/Ulysses/Trajectory/trajectory\_data

Year	DOY	HR	MN	SC	Earth Sun S/C	Sun S/C Earth	Sun Earth S/C	Helioc. Range	Heliograph. Latitude	Helioc. Rt. Asc.	Helioc. Ecliptic Lat.	Solar Longitude wrt Earth
					[deg]	[deg]	[deg]	[AU]	[deg]	[deg]	[deg]	[deg]
1990	10	23										
1990	10	24	1990	296	00 00 00	5.93	78.96	95.11	1.0100	5.42	-999.	0.75
1990	10	25	1990	297	00 00 00	6.25	77.64	96.11	1.0127	5.34	-999.	0.79
1990	10	26	1990	298	00 00 00	6.58	76.31	97.11	1.0154	5.25	-999.	0.83
1990	10	27	1990	299	00 00 00	6.89	74.99	98.12	1.0187	5.16	-999.	0.87
1990	10	28	1990	300	00 00 00	7.19	73.67	99.14	1.0227	5.07	-999.	0.91
1990	10	29	1990	301	00 00 00	7.48	72.35	100.20	1.0261	4.98	-999.	0.95
1990	10	30	1990	302	00 00 00	7.76	71.03	101.20	1.0301	4.89	-999.	0.99
1990	10	31	1990	303	00 00 00	8.04	69.72	102.20	1.0348	4.79	-999.	1.03
1990	11	01	1990	304	00 00 00	8.30	68.41	103.30	1.0394	4.69	-999.	1.07
1990	11	02	1990	305	00 00 00	8.54	67.10	104.40	1.0441	4.60	-999.	1.10
1990	11	03	1990	306	00 00 00	8.78	65.79	105.40	1.0488	4.50	-999.	1.14
1990	11	04	1990	307	00 00 00	9.01	64.49	106.50	1.0542	4.40	-999.	1.17
1990	11	05	1990	308	00 00 00	9.22	63.19	107.59	1.0593	4.29	155.19	1.20
1990	11	06	1990	309	00 00 00	9.42	61.90	108.69	1.0648	4.19	156.38	1.24
1990	11	07	1990	310	00 00 00	9.60	60.60	109.79	1.0706	4.09	157.57	1.27

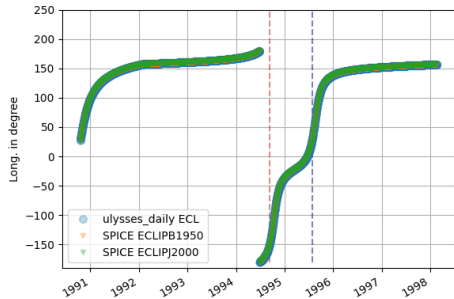
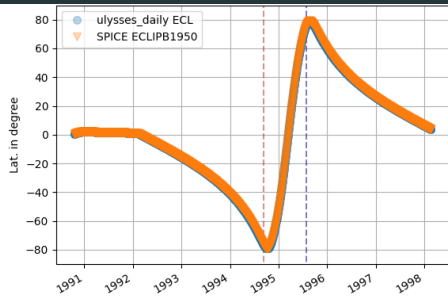
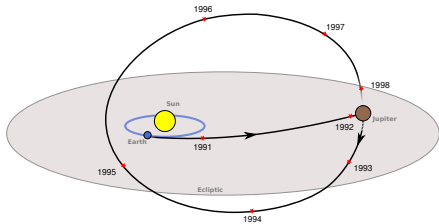
# Coordinate Systems

There seem to be two options for coordinate systems:

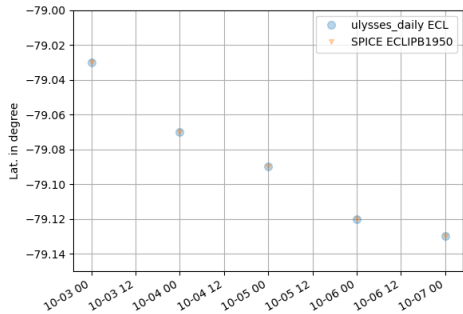
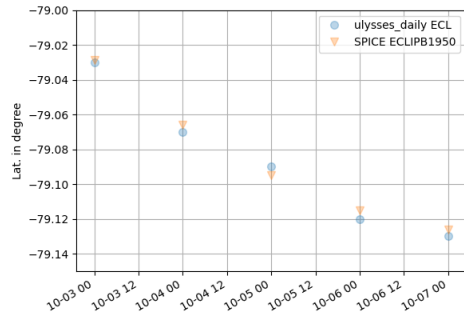
- ***Heliocentric Inertial*** (HCI) system
- ***Heliocentric Aries Ecliptic*** (HAE) system



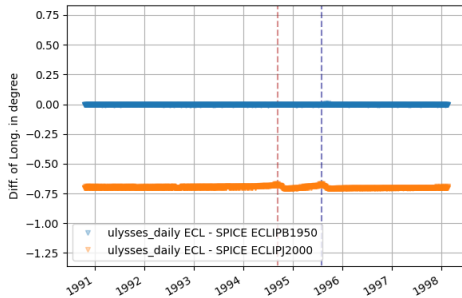
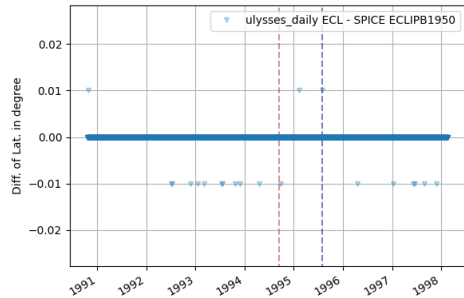
# Ulysses' 1st Orbit



# Ecliptic System – Latitude



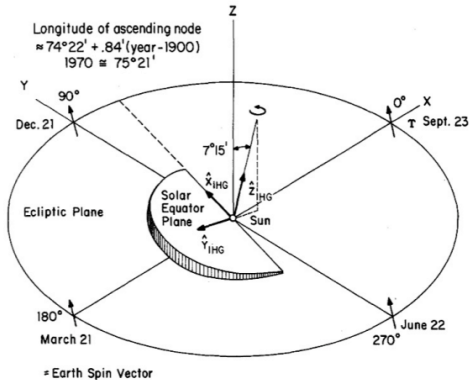
# Ecliptic System – Differences



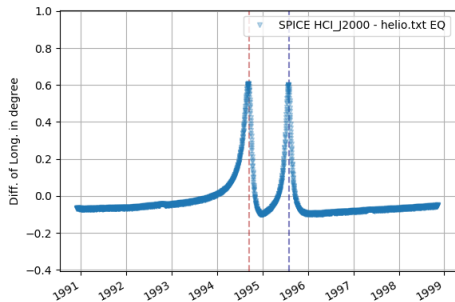
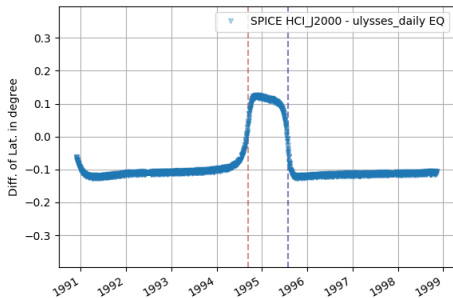
# Equatorial System

There seem to be two options for coordinate systems:

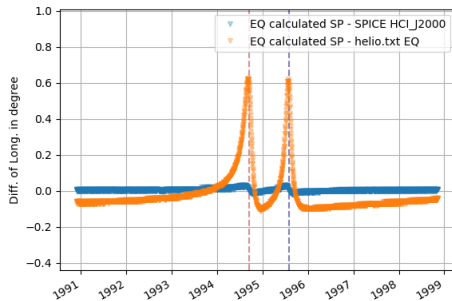
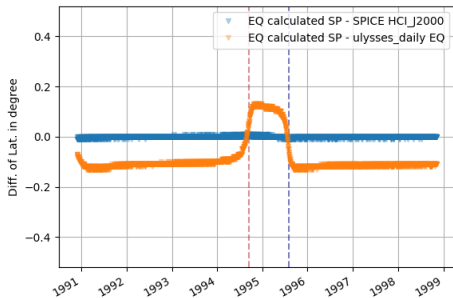
- **Heliocentric Inertial (HCI)** system
- **Heliocentric Aries Ecciptic (HAE)** system



# Equatorial System



# Equatorial System – calculated





# Equatorial System

628-53, Rev. G Controlled Document

Ulysses

## Reference Trajectory Characteristics

Krystyna Kiedron

March 15, 1993



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) <sup>a</sup>	deg
Heliocentric Sun Equator Right Ascension <sup>b</sup>	deg
Ecliptic Latitude of S/C Relative to Sun (EMEC) <sup>c</sup>	deg
Solar Longitude With Respect to Earth <sup>d</sup>	deg

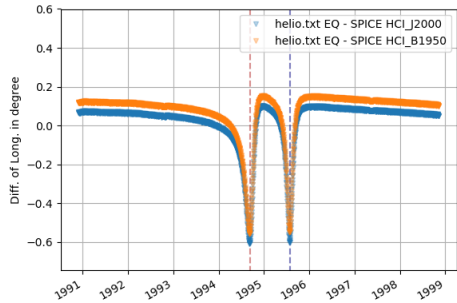
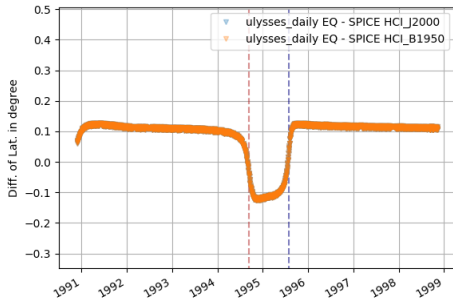
<sup>a</sup>SMEQ - Sun mean equator and equinox of 1950

<sup>b</sup>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

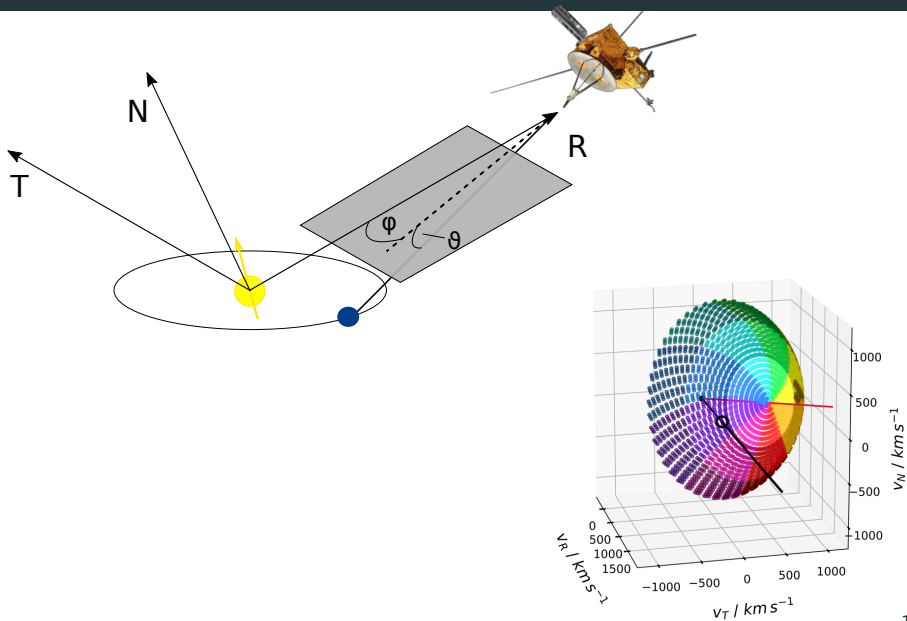
<sup>c</sup>Earth mean ecliptic and equinox of 1950

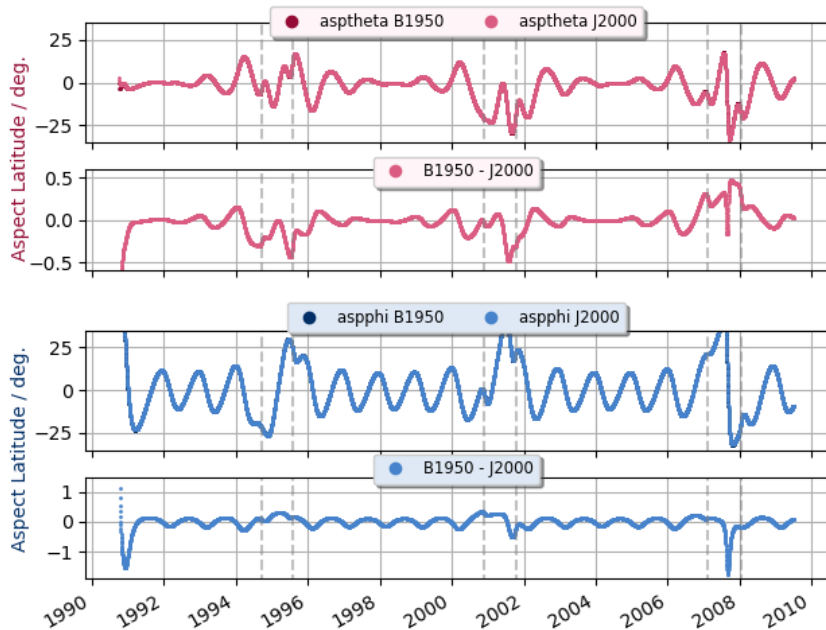
<sup>d</sup>The Earth-Sun-S/C angle projected on the sun's equatorial plane where the current Earth-Sun line is always longitude = 0.0°

# Equatorial System – B1950 vs. J2000



# Aspect Angle





# SPICE Reference Frame Kernel



## Two-Vector Frame Concepts - 3

Navigation and Ancillary Information Facility

### • Secondary Vector

- A specified positive or negative axis of the two-vector frame is aligned with the component of the secondary vector orthogonal to the primary vector.
  - » The frame kernel creator associates with this vector one of the axis designations { +X, -X, +Y, -Y, +Z, -Z }, where the axis is orthogonal to that associated with the primary vector.

### 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 )
```