

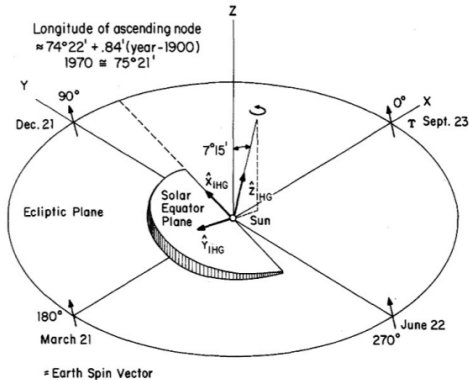
Data from the ULYSSES FINAL ARCHIVE

ulysses_daily_heliocentric_data_1990-2009.txt														Save					
~/Pul-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	3.09	89.55	87.38	0.996	148901747.422	1.186	41.005	5.99	23.88	0.39	3.10
1990	10	16	1990	289	2448180.5	00	00	00	3.47	88.22	88.34	0.996	148844503.000	1.655	40.998	5.93	25.25	0.44	3.48
1990	10	17	1990	290	2448181.5	00	00	00	3.85	86.89	89.30	0.996	148787258.578	2.124	40.991	5.87	26.62	0.49	3.86
1990	10	18	1990	291	2448182.5	00	00	00	4.23	85.56	90.26	0.996	148730014.156	2.593	40.984	5.81	27.99	0.54	4.23
1990	10	19	1990	292	2448183.5	00	00	00	4.61	84.23	91.22	0.996	148672769.734	3.062	40.977	5.75	29.36	0.59	4.61
1990	10	20	1990	293	2448184.5	00	00	00	4.99	82.90	92.18	0.996	148615525.312	3.531	40.970	5.69	30.73	0.64	4.99
1990	10	21	1990	294	2448185.5	00	00	00	5.37	81.57	93.14	0.996	148558280.890	4.000	40.963	5.63	32.10	0.69	5.37
1990	10	22	1990	295	2448186.5	00	00	00	5.75	80.24	94.10	0.996	148501036.468	4.469	40.956	5.57	33.47	0.74	5.75
1990	10	23	1990	296	2448187.5	00	00	00	6.13	78.91	95.06	0.996	148443792.046	4.938	40.949	5.51	34.84	0.79	6.13
1990	10	24	1990	297	2448188.5	00	00	00	6.51	77.58	96.11	0.996	148386547.624	5.407	40.942	5.45	36.21	0.84	6.51
1990	10	25	1990	298	2448189.5	00	00	00	6.89	76.31	97.11	0.996	148329303.202	5.876	40.935	5.39	37.58	0.89	6.89
1990	10	26	1990	299	2448190.5	00	00	00	7.27	74.99	98.12	0.996	148272058.780	6.345	40.928	5.33	38.95	0.94	7.27
1990	10	27	1990	300	2448191.5	00	00	00	7.65	73.67	99.14	0.996	148214814.358	6.814	40.921	5.27	40.32	0.99	7.65
1990	10	28	1990	301	2448192.5	00	00	00	8.03	72.35	100.20	0.996	148157569.936	7.283	40.914	5.21	41.69	1.04	8.03
1990	10	29	1990	302	2448193.5	00	00	00	8.41	71.03	101.20	0.996	148100325.514	7.752	40.907	5.15	43.06	1.09	8.41
1990	10	30	1990	303	2448194.5	00	00	00	8.79	69.72	102.20	0.996	148043081.092	8.221	40.900	5.09	44.43	1.14	8.79
1990	10	31	1990	304	2448195.5	00	00	00	9.17	68.41	103.30	0.996	147985836.670	8.690	40.893	5.03	45.80	1.19	9.17
1990	11	01	1990	305	2448196.5	00	00	00	9.55	67.10	104.40	0.996	147928592.248	9.159	40.886	4.97	47.17	1.24	9.55
1990	11	02	1990	306	2448197.5	00	00	00	9.93	65.79	105.40	0.996	147871347.826	9.628	40.879	4.91	48.54	1.29	9.93
1990	11	03	1990	307	2448198.5	00	00	00	10.31	64.49	106.50	0.996	147814103.404	10.097	40.872	4.85	49.91	1.34	10.31
1990	11	04	1990	308	2448199.5	00	00	00	10.69	63.19	107.59	0.996	147756858.982	10.566	40.865	4.79	51.28	1.39	10.69
1990	11	05	1990	309	2448200.5	00	00	00	11.07	61.90	108.69	0.996	147699614.560	11.035	40.858	4.73	52.65	1.44	11.07
1990	11	06	1990	310	2448201.5	00	00	00	11.45	60.60	109.79	0.996	147642369.138	11.504	40.851	4.67	54.02	1.49	11.45
1990	11	07	1990	311	2448202.5	00	00	00	11.83	59.30	110.89	0.996	147585124.716	11.973	40.844	4.61	55.39	1.54	11.83
1990	11	08	1990	312	2448203.5	00	00	00	12.21	58.00	111.99	0.996	147527879.294	12.442	40.837	4.55	56.76	1.59	12.21
1990	11	09	1990	313	2448204.5	00	00	00	12.59	56.70	113.09	0.996	147470634.872	12.911	40.830	4.49	58.13	1.64	12.59
1990	11	10	1990	314	2448205.5	00	00	00	12.97	55.40	114.19	0.996	147413389.450	13.380	40.823	4.43	59.50	1.69	12.97
1990	11	11	1990	315	2448206.5	00	00	00	13.35	54.10	115.29	0.996	147356145.028	13.849	40.816	4.37	60.87	1.74	13.35
1990	11	12	1990	316	2448207.5	00	00	00	13.73	52.80	116.39	0.996	147298900.606	14.318	40.809	4.31	62.24	1.79	13.73
1990	11	13	1990	317	2448208.5	00	00	00	14.11	51.50	117.49	0.996	147241656.184	14.787	40.802	4.25	63.61	1.84	14.11
1990	11	14	1990	318	2448209.5	00	00	00	14.49	50.20	118.59	0.996	147184411.762	15.256	40.795	4.19	64.98	1.89	14.49
1990	11	15	1990	319	2448210.5	00	00	00	14.87	48.90	119.69	0.996	147127167.340	15.725	40.788	4.13	66.35	1.94	14.87
1990	11	16	1990	320	2448211.5	00	00	00	15.25	47.60	120.79	0.996	147069922.918	16.194	40.781	4.07	67.72	1.99	15.25
1990	11	17	1990	321	2448212.5	00	00	00	15.63	46.30	121.89	0.996	147012678.496	16.663	40.774	4.01	69.09	2.04	15.63
1990	11	18	1990	322	2448213.5	00	00	00	16.01	45.00	122.99	0.996	146955434.074	17.132	40.767	3.95	70.46	2.09	16.01
1990	11	19	1990	323	2448214.5	00	00	00	16.39	43.70	124.09	0.996	146898189.652	17.601	40.760	3.89	71.83	2.14	16.39
1990	11	20	1990	324	2448215.5	00	00	00	16.77	42.40	125.19	0.996	146840945.230	18.070	40.753	3.83	73.20	2.19	16.77
1990	11	21	1990	325	2448216.5	00	00	00	17.15	41.10	126.29	0.996	146783700.808	18.539	40.746	3.77	74.57	2.24	17.15
1990	11	22	1990	326	2448217.5	00	00	00	17.53	39.80	127.39	0.996	146726456.386	19.008	40.739	3.71	75.94	2.29	17.53
1990	11	23	1990	327	2448218.5	00	00	00	17.91	38.50	128.49	0.996	146669211.964	19.477	40.732	3.65	77.31	2.34	17.91
1990	11	24	1990	328	2448219.5	00	00	00	18.29	37.20	129.59	0.996	146611967.542	19.946	40.725	3.59	78.68	2.39	18.29
1990	11	25	1990	329	2448220.5	00	00	00	18.67	35.90	130.69	0.996	146554723.120	20.415	40.718	3.53	80.05	2.44	18.67
1990	11	26	1990	330	2448221.5	00	00	00	19.05	34.60	131.79	0.996	146497478.698	20.884	40.711	3.47	81.42	2.49	19.05
1990	11	27	1990	331	2448222.5	00	00	00	19.43	33.30	132.89	0.996	146440234.276	21.353	40.704	3.41	82.79	2.54	19.43
1990	11	28	1990	332	2448223.5	00	00	00	19.81	32.00	133.99	0.996	146382989.854	21.822	40.697	3.35	84.16	2.59	19.81
1990	11	29	1990	333	2448224.5	00	00	00	20.19	30.70	135.09	0.996	146325745.432	22.291	40.690	3.29	85.53	2.64	20.19
1990	11	30	1990	334	2448225.5	00	00	00	20.57	29.40	136.19	0.996	146268501.010	22.760	40.683	3.23	86.90	2.69	20.57
1990	11	31	1990	335	2448226.5	00	00	00	20.95	28.10	137.29	0.996	146211256.588	23.229	40.676	3.17	88.27	2.74	20.95
1990	12	01	1990	336	2448227.5	00	00	00	21.33	26.80	138.39	0.996	146154012.166	23.698	40.669	3.11	89.64	2.79	21.33
1990	12	02	1990	337	2448228.5	00	00	00	21.71	25.50	139.49	0.996	146096767.744	24.167	40.662	3.05	91.01	2.84	21.71
1990	1																		

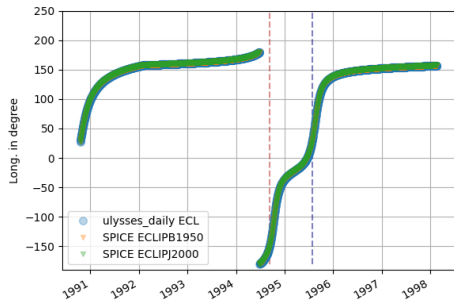
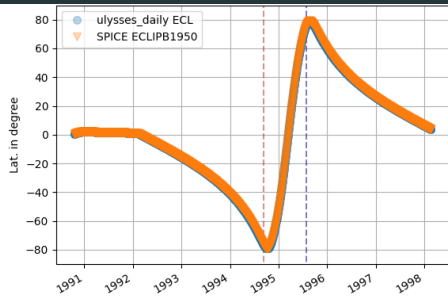
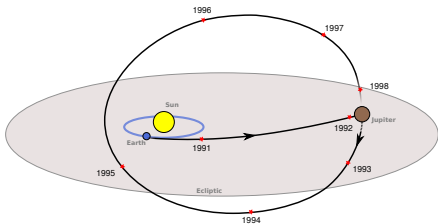
Coordinate Systems

There seem to be two options for coordinate systems:

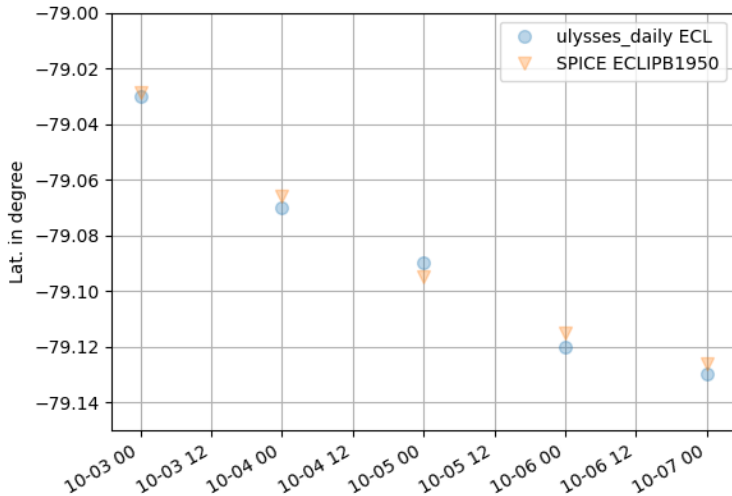
- **Heliocentric Inertial (HCI)** system
- **Heliocentric Aries Ecciptic (HAE)** system



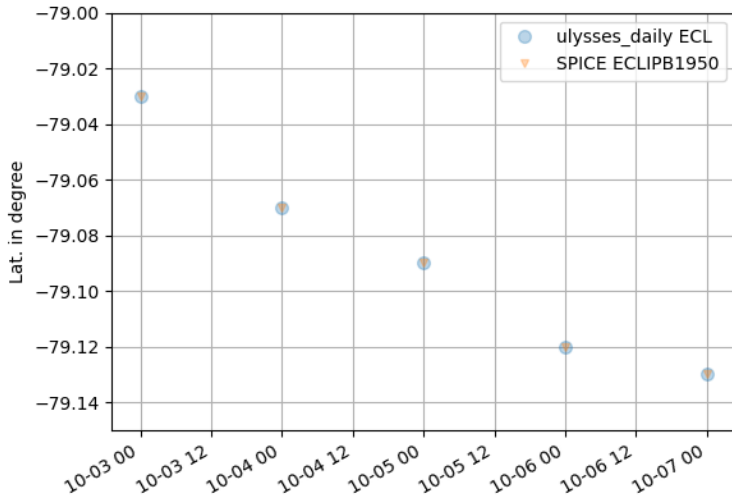
Ulysses' 1st Orbit



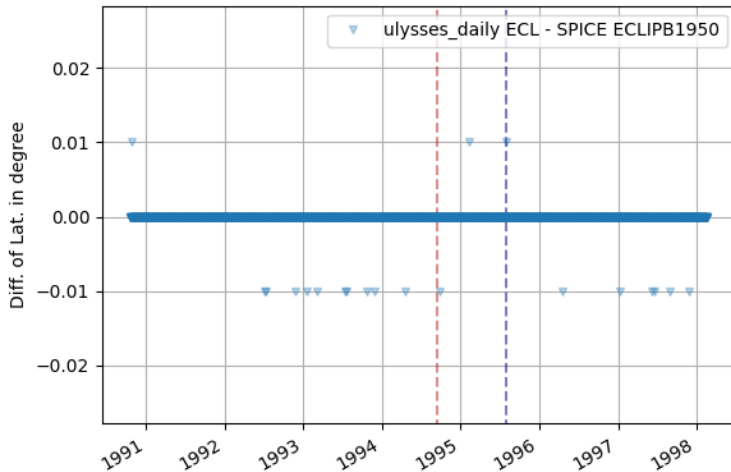
Ecliptic System – Latitude



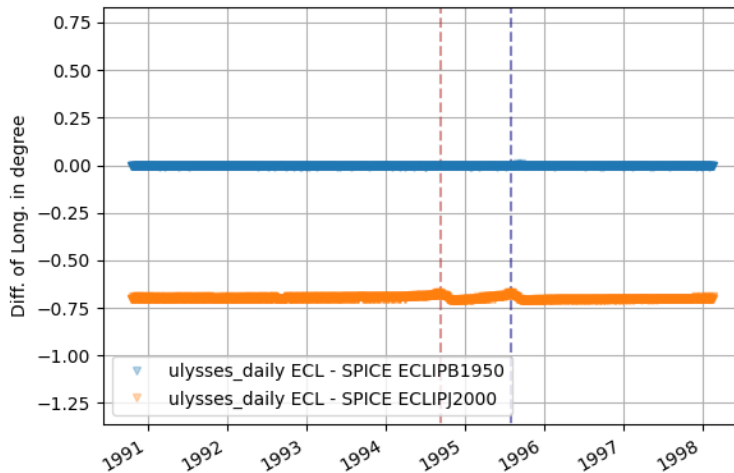
Ecliptic System – Latitude



Ecliptic System – Latitude



Ecliptic System – Longitude



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) ^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

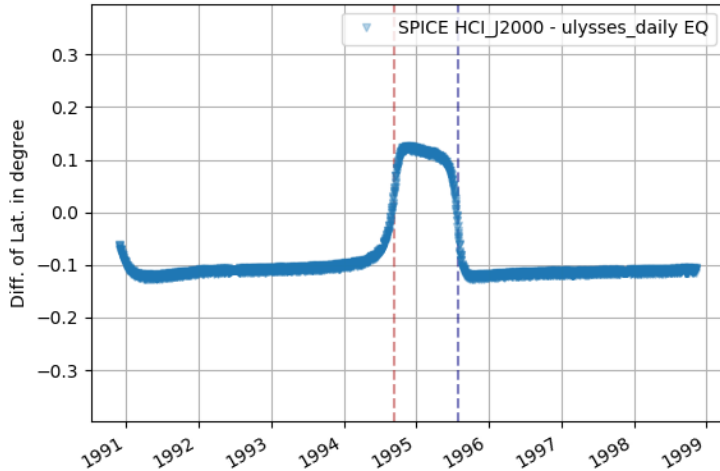
^aSMEQ - Sun mean equator and equinox of 1950

^bThe right ascension of the S/C in the Sun's equatorial plane measured from the ascending node of Earth's orbit plane of 1950

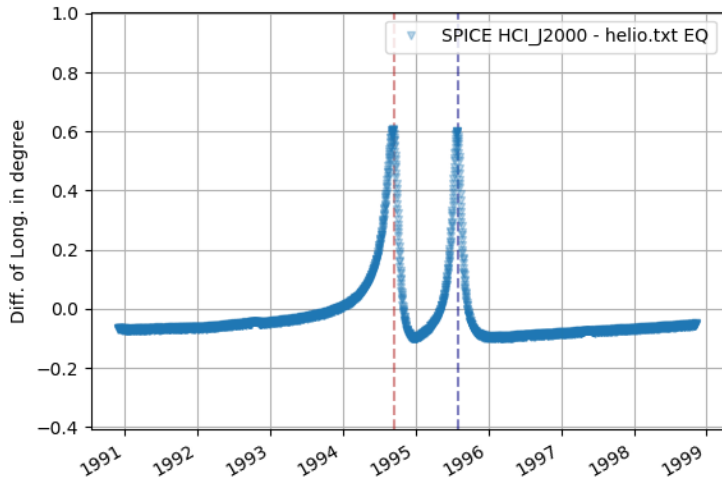
^cEarth mean ecliptic and equinox of 1950

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

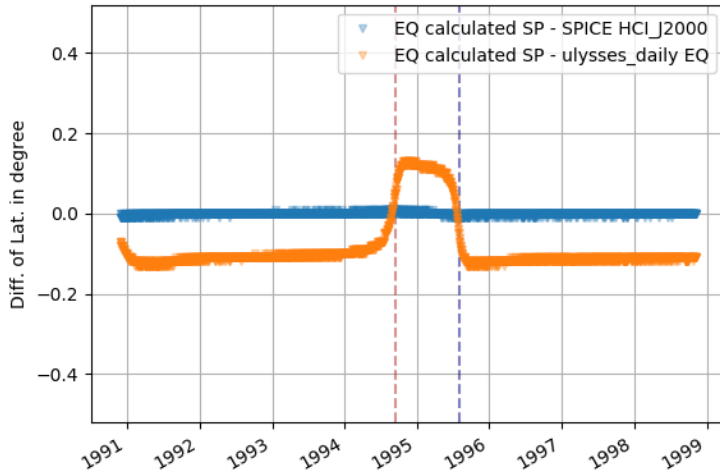
Equatorial System – Latitude



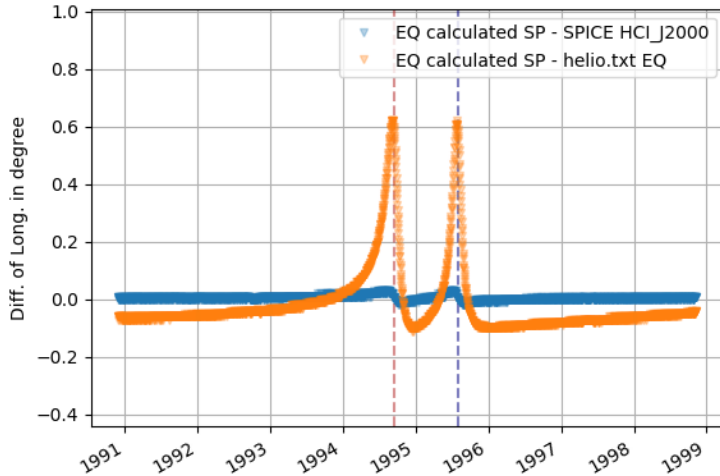
Equatorial System – Longitude



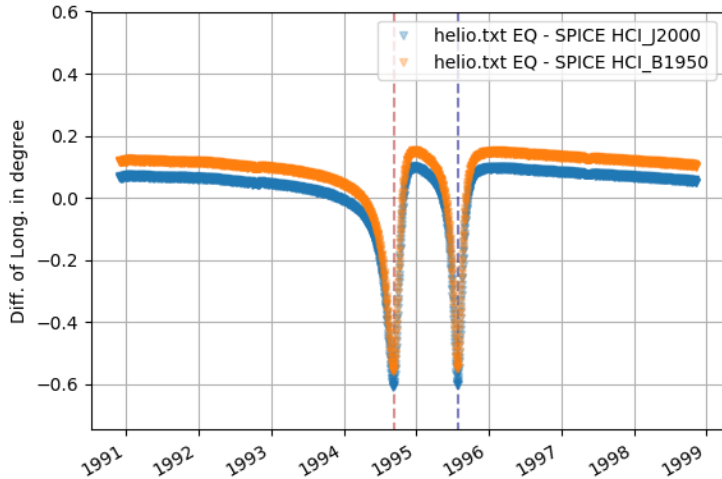
Equatorial System – Latitude calculated



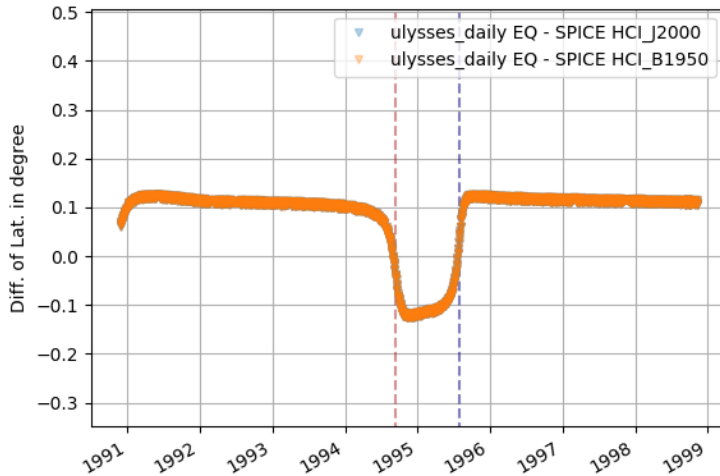
Equatorial System – Longitude calculated



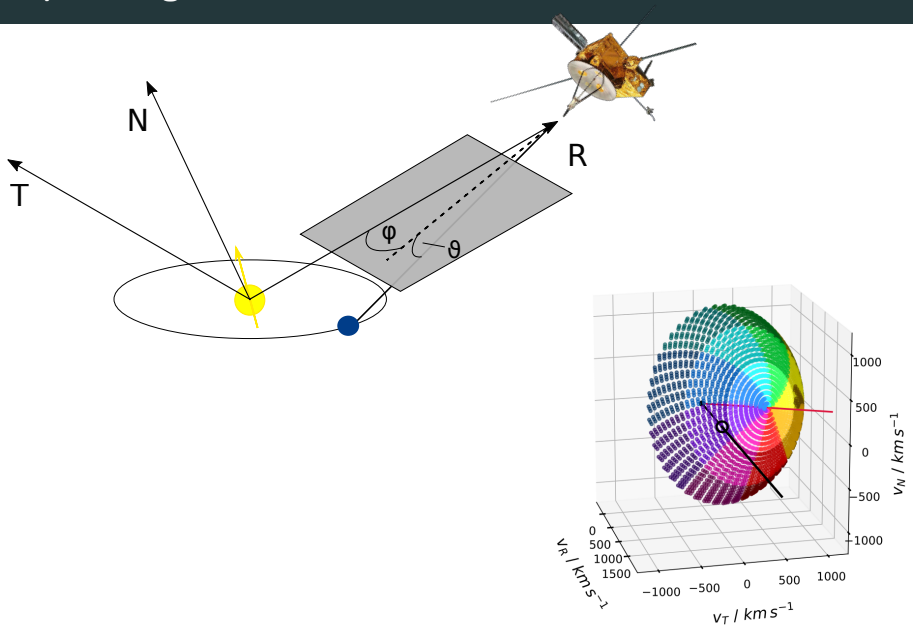
Equatorial System – Longitude – B1950 vs. J2000

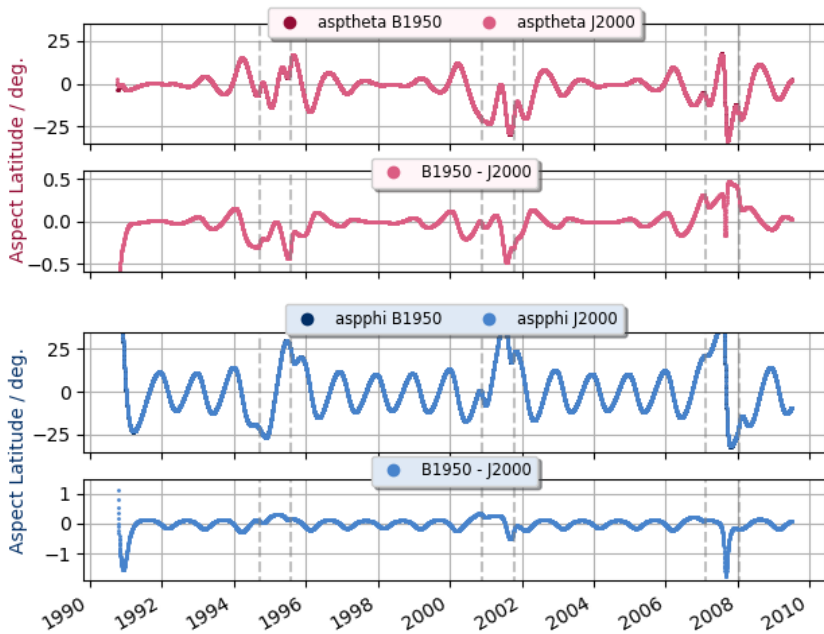


Equatorial System – Latitude – B1950 vs. J2000



Aspect Angle







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

```

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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'
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