



General: Nonsidereal Starlist Generator

Author	Date	Comment
jlyke	2008 May 20	Original

Purpose: Easily convert JPL Horizons-generated non-sidereal coordinate list into Keck format

Method: Download list from the web, use csh script nonsidereal to convert

Procedure:

1. If you need the name of an observable non-sidereal target, use this web form: <http://ssd.jpl.nasa.gov/sbwobs.cgi>, and set your time, location, and constraints
2. Go to the JPL Horizons web form: <http://ssd.jpl.nasa.gov/horizons.cgi> and select the following:
 - a. Ephemeris Type: OBSERVER
 - b. Target Body: Your target
 - c. Observer Location: 568 (Mauna Kea)
 - d. Time Span (times are UT, *e.g.*):
 - i. Start Time: 2008-05-21 05:00
 - ii. Stop Time: 2008-05-21 15:00
 - iii. Step size: 10-30 minutes depending on non-sidereal rates
 - e. Table Settings: 1, 3, 4, 8, 9
 - f. Display Output: download/save
3. Click on “Generate Ephemeris” and download the file to your directory (default name is horizons_results.txt)
4. Run `~kics/instr/bin/nonsidereal horizons_results.txt [object_name]`
 - a. Note: object_name is optional. If no name is given, target will be called “movintarg”.
 - b. Note: If object_name is longer than 9 characters, it will be truncated; if object_name is shorter than 9 characters, “_” will be appended to the name.
 - c. Note: This script does not verify that the target has positive elevation
5. Verify output looks reasonable (see appendix)
6. Run `~kics/instr/bin/nonsidereal horizons_results.txt [object_name] >> newfile.list`
7. Copy newfile.list to /kroot/starlists/your_directory/



Appendix: (Sample input and output)

Sample horizons_results.txt

```
*****
JPL/HORIZONS                5 Astraea                2008-May-17 22:40:52
Rec #:      5 (+COV)   Soln.date: 2008-Apr-23_14:14:53   # obs: 1721 (1845-2008)
```

FK5/J2000.0 helio. ecliptic osc. elements (AU, DAYS, DEG, period=Julian yrs):

```
EPOCH= 2449241.5 ! 1993-Sep-11.00 (CT)           Residual RMS= .32652
EC= .1913495556883082   QR= 2.082302091450191   TP= 2449863.052818913
OM= 141.788005893536    W= 356.354827816858        IN= 5.357532388549395
A= 2.575033633008893    MA= 211.7455439878357   ADIST= 3.067765174567595
PER= 4.13221            N= .238522699             ANGMOM= .027093987
DAN= 2.08298            DDN= 3.0663              L= 138.1587152
B= -.3401235           TP= 1995-May-25.5528189
```

Physical parameters (KM, SEC, rotational period in hours):

```
GM= n.a.                RAD= 59.535              ROTPER= 16.8
H= 6.8888               G= .150                 B-V= .826
ALBEDO= .2268          STYP= S
```

ASTEROID comments:

```
1: soln ref.= JPL#52, OCC=0
2: source=ORB
```

```
*****
Ephemeris / WWW_USER Sat May 17 22:40:52 2008 Pasadena, USA / Horizons
*****
```

```
Target body name: 5 Astraea {source: JPL#52}
Center body name: Earth (399) {source: DE405}
Center-site name: Mauna Kea
```

```
Start time : A.D. 2008-May-18 05:00:00.0000 UT
Stop time : A.D. 2008-May-18 15:00:00.0000 UT
Step-size : 20 minutes
```

```
*****
Target pole/equ : No model available
Target radii : 59.5 km
Center geodetic: 204.527800,19.8261152,4.2078485 {E-lon(deg),Lat(deg),Alt(km)}
Center cylindric: 204.527800,6006.35451,2151.0229 {E-lon(deg),Dxy(km),Dz(km)}
Center pole/equ : High-precision EOP model {East-longitude +}
Center radii : 6378.1 x 6378.1 x 6356.8 km {Equator, meridian, pole}
Target primary : Sun {source: DE405}
Interfering body: MOON (Req= 1737.400) km {source: DE405}
Deflecting body : Sun, EARTH {source: DE405}
Deflecting GMs : 1.3271E+11, 3.9860E+05 km^3/s^2
Small perturbers: Ceres, Pallas, Vesta {source: SB405-CPV-2}
Small body GMs : 6.32E+01, 1.43E+01, 1.78E+01 km^3/s^2
Atmos refraction: NO (AIRLESS)
RA format : HMS
Time format : CAL
RTS-only print : NO
EOP file : eop.080516.p080807
EOP coverage : DATA-BASED 1962-JAN-20 TO 2008-MAY-16. PREDICTS-> 2008-AUG-06
Units conversion: 1 AU= 149597870.691 km, c= 299792.458 km/s, 1 day= 86400.0 s
Table cut-offs 1: Elevation (-90.0deg=NO),Airmass (>38.000=NO), Daylight (NO)
Table cut-offs 2: Solar Elongation ( 0.0,180.0=NO)
*****
```

Initial FK5/J2000.0 heliocentric ecliptic osculating elements (AU, DAYS, DEG):

```
EPOCH= 2449241.5 ! 1993-Sep-11.00 (CT)           Residual RMS= .32652
EC= .1913495556883082   QR= 2.082302091450191   TP= 2449863.052818913
OM= 141.788005893536    W= 356.354827816858        IN= 5.357532388549395
```



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Asteroid physical parameters (KM, SEC, rotational period in hours):

GM= n.a.	RAD= 59.535	ROTPER= 16.8
H= 6.8888	G= .150	B-V= .826
	ALBEDO= .2268	STYP= S

Date__(UT)__HR:MN R.A.__(ICRF/J2000.0)_DEC dRA*cosD d(DEC)/dt Azi_(a-appr)_Elev a-
mass APmag S-brt

\$\$SOE

2008-May-18 05:00 Cm 12 49 59.95 +02 53 14.0 -3.22 -3.96 110.5581 50.2503
1.299 10.59 5.46
2008-May-18 05:20 Nm 12 49 59.87 +02 53 12.7 -3.27 -3.98 114.6165 54.6063
1.226 10.59 5.46
2008-May-18 05:40 Nm 12 49 59.80 +02 53 11.3 -3.32 -3.99 119.5932 58.8069
1.168 10.59 5.47
2008-May-18 06:00 Am 12 49 59.73 +02 53 10.0 -3.36 -4.00 125.8604 62.7784
1.124 10.59 5.47
2008-May-18 06:20 m 12 49 59.65 +02 53 08.7 -3.39 -4.01 133.9383 66.4030
1.091 10.59 5.47
2008-May-18 06:40 m 12 49 59.58 +02 53 07.3 -3.40 -4.03 144.4692 69.4946
1.067 10.59 5.47
2008-May-18 07:00 m 12 49 59.50 +02 53 06.0 -3.41 -4.04 157.9613 71.7785
1.052 10.59 5.47
2008-May-18 07:20 m 12 49 59.42 +02 53 04.6 -3.41 -4.05 174.0969 72.9266
1.046 10.59 5.47
2008-May-18 07:40 t 12 49 59.35 +02 53 03.3 -3.39 -4.07 191.0912 72.7107
1.047 10.59 5.47
2008-May-18 08:00 m 12 49 59.27 +02 53 01.9 -3.36 -4.08 206.5287 71.1778
1.056 10.59 5.47
2008-May-18 08:20 m 12 49 59.20 +02 53 00.6 -3.33 -4.09 219.0815 68.6095
1.073 10.59 5.47
2008-May-18 08:40 m 12 49 59.12 +02 52 59.2 -3.28 -4.10 228.7835 65.3278
1.100 10.59 5.47
2008-May-18 09:00 m 12 49 59.05 +02 52 57.8 -3.22 -4.12 236.2361 61.5797
1.136 10.59 5.47
2008-May-18 09:20 m 12 49 58.98 +02 52 56.4 -3.15 -4.13 242.0555 57.5271
1.184 10.59 5.47
2008-May-18 09:40 m 12 49 58.91 +02 52 55.1 -3.07 -4.14 246.7143 53.2720
1.246 10.59 5.47
2008-May-18 10:00 m 12 49 58.84 +02 52 53.7 -2.99 -4.15 250.5448 48.8784
1.326 10.59 5.47
2008-May-18 10:20 m 12 49 58.78 +02 52 52.3 -2.89 -4.17 253.7764 44.3878
1.427 10.59 5.47
2008-May-18 10:40 m 12 49 58.72 +02 52 50.9 -2.79 -4.18 256.5690 39.8277
1.558 10.59 5.47
2008-May-18 11:00 m 12 49 58.66 +02 52 49.5 -2.68 -4.19 259.0358 35.2172
1.730 10.59 5.47
2008-May-18 11:20 m 12 49 58.60 +02 52 48.1 -2.56 -4.20 261.2592 30.5700
1.959 10.60 5.47
2008-May-18 11:40 m 12 49 58.54 +02 52 46.7 -2.44 -4.21 263.3007 25.8960
2.278 10.60 5.47
2008-May-18 12:00 m 12 49 58.49 +02 52 45.3 -2.31 -4.22 265.2077 21.2029
2.743 10.60 5.47
2008-May-18 12:20 m 12 49 58.44 +02 52 43.9 -2.18 -4.23 267.0181 16.4971
3.473 10.60 5.47
2008-May-18 12:40 m 12 49 58.39 +02 52 42.5 -2.04 -4.23 268.7630 11.7836
4.761 10.60 5.47
2008-May-18 13:00 m 12 49 58.35 +02 52 41.1 -1.90 -4.24 270.4693 7.0671
7.547 10.60 5.47
2008-May-18 13:20 m 12 49 58.31 +02 52 39.7 -1.77 -4.25 272.1615 2.3517
16.592 10.60 5.47
2008-May-18 13:40 s 12 49 58.27 +02 52 38.3 -1.63 -4.26 273.8627 -2.3584
n.a. 10.60 5.47
2008-May-18 14:00 m 12 49 58.24 +02 52 36.8 -1.49 -4.26 275.5958 -7.0590
n.a. 10.60 5.47



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```

2008-May-18 14:20 m 12 49 58.20 +02 52 35.4 -1.35 -4.27 277.3853 -11.7454
n.a. 10.60 5.47
2008-May-18 14:40 A 12 49 58.17 +02 52 34.0 -1.22 -4.27 279.2577 -16.4124
n.a. 10.60 5.47
2008-May-18 15:00 N 12 49 58.15 +02 52 32.6 -1.09 -4.28 281.2436 -21.0538
n.a. 10.60 5.47

```

\$\$EOE

Column meaning:

TIME

Prior to 1962, times are UT1. Dates thereafter are UTC. Any 'b' symbol in the 1st-column denotes a B.C. date. First-column blank (" ") denotes an A.D. date. Calendar dates prior to 1582-Oct-15 are in the Julian calendar system. Later calendar dates are in the Gregorian system.

The uniform Coordinate Time scale is used internally. Conversion between CT and the selected non-uniform UT output scale has not been determined for UTC times after the next July or January 1st. The last known leap-second is used over any future interval.

NOTE: "n.a." in output means quantity "not available" at the print-time.

SOLAR PRESENCE (OBSERVING SITE)

Time tag is followed by a blank, then a solar-presence symbol:

```

'*' Daylight (refracted solar upper-limb on or above apparent horizon)
'C' Civil twilight/dawn
'N' Nautical twilight/dawn
'A' Astronomical twilight/dawn
' ' Night OR geocentric ephemeris

```

LUNAR PRESENCE WITH TARGET RISE/TRANSIT/SET MARKER (OBSERVING SITE)

The solar-presence symbol is immediately followed by another marker symbol:

```

'm' Refracted upper-limb of Moon on or above apparent horizon
' ' Refracted upper-limb of Moon below apparent horizon OR geocentric
'r' Rise (target body on or above cut-off RTS elevation)
't' Transit (target body at or past local maximum RTS elevation)
's' Set (target body on or below cut-off RTS elevation)

```

RTS MARKERS (TVH)

Rise and set are with respect to the reference ellipsoid true visual horizon defined by the elevation cut-off angle. Horizon dip and yellow-light refraction (Earth only) are considered. Accuracy is < or = to twice the requested search step-size.

R.A._(ICRF/J2000.0)_DEC =

J2000.0 astrometric right ascension and declination of target center. Corrected for light-time. Units: HMS (HH MM SS.ff) and DMS (DD MM SS.f)

dRA*cosD d(DEC)/dt =

The rate of change of target center apparent RA and DEC (airless). d(RA)/dt is multiplied by the cosine of the declination.

Units: ARCSECONDS PER HOUR

Azi_(a-appr)_Elev =

Airless apparent azimuth and elevation of target center. Corrected for light-time, the gravitational deflection of light, stellar aberration, precession and nutation. Azimuth measured North(0) -> East(90) -> South(180) -> West(270) -> North (360). Elevation is with respect to plane perpendicular to local zenith direction. TOPOCENTRIC ONLY. Units: DEGREES

a-mass =

Relative optical airmass at target center point. Topocentric EARTH sites, ABOVE HORIZON ONLY. Unitless.



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APmag S-brt =

Asteroid's approximate apparent visual magnitude & surface brightness:
APmag = H + 5*log10(delta) + 5*log10(r) - 2.5*log10((1-G)*phi1 + G*phi2)
In principle, accurate to ~ +/- 0.1 magnitude. For solar phase angles > 90 deg,
the error could exceed 1 magnitude. No values are output for phase angles
greater than 120 degrees, since the errors could be large and unknown.
Units: NONE & VISUAL MAGNITUDES PER SQUARE ARCSECOND

Computations by ...

Solar System Dynamics Group, Horizons On-Line Ephemeris System
4800 Oak Grove Drive, Jet Propulsion Laboratory
Pasadena, CA 91109 USA
Information: <http://ssd.jpl.nasa.gov/>
Connect : telnet://ssd.jpl.nasa.gov:6775 (via browser)
telnet ssd.jpl.nasa.gov 6775 (via command-line)
Author : Jon.Giorgini@jpl.nasa.gov

Sample output

puakea{jlyke}590: nonsidereal horizons_results.txt object_name

```
record divider 00 00 00.00 +00 00 00.0 2000.0 #####
object_na 05-00 12 49 59.95 +02 53 14.0 2000.0 dra=-0.214667 ddec=-3.96 vmag=10.59
object_na 05-20 12 49 59.87 +02 53 12.7 2000.0 dra=-0.218 ddec=-3.98 vmag=10.59
object_na 05-40 12 49 59.80 +02 53 11.3 2000.0 dra=-0.221333 ddec=-3.99 vmag=10.59
object_na 06-00 12 49 59.73 +02 53 10.0 2000.0 dra=-0.224 ddec=-4.00 vmag=10.59
object_na 06-20 12 49 59.65 +02 53 08.7 2000.0 dra=-0.226 ddec=-4.01 vmag=10.59
object_na 06-40 12 49 59.58 +02 53 07.3 2000.0 dra=-0.226667 ddec=-4.03 vmag=10.59
object_na 07-00 12 49 59.50 +02 53 06.0 2000.0 dra=-0.227333 ddec=-4.04 vmag=10.59
object_na 07-20 12 49 59.42 +02 53 04.6 2000.0 dra=-0.227333 ddec=-4.05 vmag=10.59
object_na 07-40 12 49 59.35 +02 53 03.3 2000.0 dra=-0.226 ddec=-4.07 vmag=10.59
object_na 08-00 12 49 59.27 +02 53 01.9 2000.0 dra=-0.224 ddec=-4.08 vmag=10.59
object_na 08-20 12 49 59.20 +02 53 00.6 2000.0 dra=-0.222 ddec=-4.09 vmag=10.59
object_na 08-40 12 49 59.12 +02 52 59.2 2000.0 dra=-0.218667 ddec=-4.10 vmag=10.59
object_na 09-00 12 49 59.05 +02 52 57.8 2000.0 dra=-0.214667 ddec=-4.12 vmag=10.59
object_na 09-20 12 49 58.98 +02 52 56.4 2000.0 dra=-0.21 ddec=-4.13 vmag=10.59
object_na 09-40 12 49 58.91 +02 52 55.1 2000.0 dra=-0.204667 ddec=-4.14 vmag=10.59
object_na 10-00 12 49 58.84 +02 52 53.7 2000.0 dra=-0.199333 ddec=-4.15 vmag=10.59
object_na 10-20 12 49 58.78 +02 52 52.3 2000.0 dra=-0.192667 ddec=-4.17 vmag=10.59
object_na 10-40 12 49 58.72 +02 52 50.9 2000.0 dra=-0.186 ddec=-4.18 vmag=10.59
object_na 11-00 12 49 58.66 +02 52 49.5 2000.0 dra=-0.178667 ddec=-4.19 vmag=10.59
object_na 11-20 12 49 58.60 +02 52 48.1 2000.0 dra=-0.170667 ddec=-4.20 vmag=10.60
object_na 11-40 12 49 58.54 +02 52 46.7 2000.0 dra=-0.162667 ddec=-4.21 vmag=10.60
object_na 12-00 12 49 58.49 +02 52 45.3 2000.0 dra=-0.154 ddec=-4.22 vmag=10.60
object_na 12-20 12 49 58.44 +02 52 43.9 2000.0 dra=-0.145333 ddec=-4.23 vmag=10.60
object_na 12-40 12 49 58.39 +02 52 42.5 2000.0 dra=-0.136 ddec=-4.23 vmag=10.60
object_na 13-00 12 49 58.35 +02 52 41.1 2000.0 dra=-0.126667 ddec=-4.24 vmag=10.60
object_na 13-20 12 49 58.31 +02 52 39.7 2000.0 dra=-0.118 ddec=-4.25 vmag=10.60
object_na 13-40 12 49 58.27 +02 52 38.3 2000.0 dra=-0.108667 ddec=-4.26 vmag=10.60
object_na 14-00 12 49 58.24 +02 52 36.8 2000.0 dra=-0.0993333 ddec=-4.26 vmag=10.60
object_na 14-20 12 49 58.20 +02 52 35.4 2000.0 dra=-0.09 ddec=-4.27 vmag=10.60
object_na 14-40 12 49 58.17 +02 52 34.0 2000.0 dra=-0.0813333 ddec=-4.27 vmag=10.60
object_na 15-00 12 49 58.15 +02 52 32.6 2000.0 dra=-0.0726667 ddec=-4.28 vmag=10.60
```

puakea{jlyke}591: