HTDP LOG

Last modified: October 17, 2018

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HTDP version 3.2.7

October, 17, 2018 – HTDP now recognizes the ITRF2014/IGS14 frame.
Limiting NAD83 to the USA and its territories has been removed.
HTDP now recognizes the following frame codes to accommodate program ADJUST:

29 -- ITRF 2008. Defined by IERS at epoch 2005.0. Not used as a frame for orbits.
30 -- WGS 84 (G1674). Aligned with ITRF2008 at epoch 2005.0.
31 -- WGS 84 (G1762). Update of WGS 84 (G1674), aligned with ITRF2008 at 2005.0.
32 -- ITRF 2014. Defined by IERS at epoch 2010.0. Not used as a frame for orbits.
33 -- IGS14 epoch 2010.0 used by NGS since 1/29/2017, aligned with ITRF2014 at 2010.0
34 -- NAD 83 (2011) epoch 2010.0. Applies to NAD 83 2011/2007/CORS96/FBN/HARN realizations referenced to the North America tectonic plate at any epoch. Defined by NGS in 1996 and code since 1/29/2017.
35 -- NAD 83 (PA11) epoch 2010.00. Applies to NAD 83 (PA11/PACP00) realizations referenced to the Pacific tectonic plate at any epoch. Defined by NGS in 2003 and code used since 1/29/2017.
36 -- NAD 83 (MA11) epoch 2010.00. Applies to NAD 83 (MA11/MARP00) realizations referenced to the Mariana tectonic plate at any epoch. Defined by NGS in 2003 and code used since 1/29/2017.

HTDP version 3.2.5

August 30, 2015 – Corrected minor rounding error inconsistencies.

October 7, 2014 – HTDP now recognizes the WGS 84(G1762) reference frame

October 7, 2014 – HTDP now uses the IERS-adopted transformation between ITRF96 and ITRF97 when relating ITRS realizations developed after ITRF96 with ITRS realizations developed prior to ITRF97. Previously, HTDP had used the IGS-adopted transformation between ITRF96 and ITRF97 for this purpose. HTDP still uses the IGS-adopted transformation between ITRF96 and ITRF97 (if necessary) when dealing with transformations from or to NAD 83 realizations.

November 18, 2013 – When transforming positional coordinates between reference frames and/or between dates, HTDP users may now enter a batch file of locations in one of the following three formats:

- A BlueBook file that contains *80* records for latitudes, longitudes and location names and *86* records for ellipsoid heights
- An ASCII file in which each record is of the form lat-lon-eht-name
- An ASCII file in which each record is of the form X-Y-Z-name where X-Y-Z denote Earth-centered, Earth-fixed Cartesian coordinates.

HTDP will provide an output file in which the transformed coordinates will be in the same format as the input coordinates. HTDP will no longer provide the verbose output file that lists both the input coordinates and the transformed coordinates in both geodetic coordinates (lat-lon-eht) and Cartesian coordinates (X-Y-Z).

November 18, 2013 – HTDP no longer requires its users to enclose location names in parentheses when submitting a batch file (in free format) for a collection of locations to be transformed.

November 18, 2013 – Now when a user enters information in a wrong format, HTDP will provide the user with an appropriate error message and then this software will abort gracefully.

November 18, 2013 – HTDP now recognizes the IGb08 reference frame.

HTDP version 3.2.4

Modified some of the Perl scripts supporting the Web version of HTDP to eliminate certain error messages being erroneously written to an internal NGS file. These modifications do not affect HTDP users.

HTDP version 3.2.3

June 11, 2012 – Introduced ITRF2008 Euler poles published by Altamimi et al. (2012) in the *Journal of Geophysical Research*. HTDP uses these Euler poles to estimate ITRF2008 horizontal velocities on parts of several tectonic plates where no gridded velocity models are available.

July 16, 2012 – Updated the velocity model for western CONUS by using horizontal velocities for CORS and IGS sites which were computed by NGS in September 2011 and horizontal velocities for PBO sites which were computed by UNAVCO in August 2011, plus many other horizontal velocities which had been used in developing previous HTDP velocity models for western CONUS.

July 16, 2012 – Added transformations involving WGS_84(G1674).

HTDP version 3.2.2

May 7, 2012 – Introduced a rigid plate model for the Philippine Sea plate. Also, introduced improved plate boundaries (based on Bird (2003)) for each of the seven tectonic plates addressed by HTDP.

HTDP version 3.2.1

November 29, 2011 – Introduced a new horizontal velocity model for Alaska. This model was developed by Jeff Freymueller.

November 29, 2011 – Introduced model for the postseismic deformation associated with the M7.9 Denali earthquake which occurred on November 3, 2002. This model was developed by Jeff Freymueller.

March 1, 2012 - Introduced a new model for horizontal crustal velocities in eastern CONUS, that is, for longitudes ranging from 66°W to 110°W and for latitudes ranging from 24°N to 50°N.

November 29, 2011 – Equated WGS84(G730) to ITRF91. It had previously been incorrectly equated to ITRF92.

December 12, 2011 - HTDP no longer allows transformations to or from WGS72, because WGS72 uses a different ellipsoid than the other reference frames allowed by HTDP.

HTDP version 3.1.2

May 2011 – Reinstated the ISG08 reference frame as an option.

May 2011 – Introduced three new reference frames: NAD_83(2011), NAD_83(PA11), NAD_83(MA11), and transformations from these reference frames to other reference frames.

May 2011 – Corrected an error in the boundary for the Alaskan velocity grid.

June 2011 – Updated "rigid plate" velocity models for the following four tectonic plates: Caribbean, Pacific, Juan de Fuca, and Cocos; based on information from Altamimi et al. (2007) and DeMets et al. (2010**).**

HTDP version 3.1.1 – Released late March 2011

March 2011 – Removed the IGS08 reference frame as an option.

HTDP version 3.1 – Released March 9, 2011

July 19, 2010 - Introduced two new reference frames, ITRF2008 and IGS08, and transformations from these reference frames to other reference frames.

July 19, 2010 – Users may now submit batch files, having a certain format, to HTDP to process multiple points. For example, to transform several positions from one reference frame to another and from one date to another, a user may submit a file containing several records where each record has the format:
LAT, LON, EHT, "TEXT"
Here
LAT = latitude in degrees (positive north)
LON = longitude in degrees (positive west)
EHT = ellipsoid height in meters
TEXT = Descriptive text (up to 24 characters)
EXAMPLE:
40.731671553,112.212671753,34.241,"SALT AIR"

October 15, 2010 - Introduced a model for estimating horizontal velocities in Alaska for the region from 55˚N to 66˚N and from 131˚W to 163˚W. This model supersedes HTDP's existing Alaskan horizontal velocity model that was developed in 2001.
Introduced a model for estimating displacements associated with the M7.2 El Mayor – Cucapah earthquake which occurred in Baja, Mexico on April 4, 2010.
Improved the existing HTDP model for estimating horizontal velocities in western CONUS.
Enhanced the HTDP software so that its users may enter times in the decimal-year format. HTDP still accepts times in the month-day-year format as well.

November 8, 2010 – Introduced a new region that spans the segment of the San Andreas fault located in central California where surface slip is significantly large.

HTDP version 3.0 – Released June 2008

February 8, 2008 - Incorporated a new model for horizontal crustal velocities within western CONUS. This model was developed by Dr. Robert McCaffrey and it spans the rectangle with latitudes between 31ºN and 49ºN and with longitudes between 100ºW and 125ºW. Dr. McCaffrey represents this region as being comprised of a collection of elastic, rotating blocks that are separated by geologic faults. He used 4,890 GPS-derived horizontal velocities, 170 fault slip rates, and 258 fault slip vectors to estimate the model parameters.

February 8, 2008 - HTDP now computes all velocities relative to ITRF2005. These velocities are then transformed to NAD_83(CORS96) for performing all further computations in this latter reference frame. After the computations, the results are then transformed to the user-specified reference frame for output.

February 8, 2008 - HTDP now uses the ITRF2005 rotation pole for North America as published by Altamimi [2007] to predict ITRF2005 horizontal velocities for those points in North America that are located external to the region modeled by Dr. McCaffrey and external to the Alaska region that Snay had previously modeled. HTDP had previously been using the NNR-NUVEL1A rotation pole for North America to predict ITRF2005 velocities for these regions.

February 8, 2008 - HTDP now recognizes the new NAD_83 realization known as NAD_83(NSRS2007). HTDP equates this realization to NAD_83(CORS96).

April 22, 2008 - HTDP now contains a dislocation model for the magnitude 7.9 Denali earthquake that occurred on November 3, 2002. The model was developed by Elliott et al. [2007].

Version 2.9

July 3, 2006 - Encoded dislocation model for the M6.0 Parkfield, CA earthquake of October 2004 as derived by Johanson et al. [2006].

November 21, 2006 - Corrected error involving the misuse of the radius of curvature in the parallel for the radius of curvature in the meridian (and vice versa) when converting angular units to linear units for earthquake displacements. This error occurred only when checking whether a point was within an “earthquakes radius of influence”. Hence, I doubt that it caused any substantial problem.

December 13, 2006 - Encoded dislocation model for M6.5 San Simeon earthquake of December 2003 as derived by Johanson in her Ph. D. dissertation at the University of California at Berkeley.

December 13, 2006 - Introduced two new reference frames, ITRF2005 and IGS05, and the transformations from these reference frames to other reference frames.

Version 2.8

August 19, 2005 - HTDP now recognizes the IGb00 reference frame.

Version 2.7

February 28, 2002 - Replaced dislocation model for 1999 Hector Mine earthquake with that published by Peltzer, Crampe, and Rosen (2001).

December 26, 2002 - Included capability to convert positions and velocities to/from the Pacific-plate-fixed NAD 83 (PACP00) reference frame. Also, included capability to convert positions and velocities to/from the Mariana-plate-fixed NAD 83 (MARP00) reference frame. Also, included capability to convert positions and velocities to/from WGS 84 (G1150)reference frame.

December 27, 2002 - When reading a blue book file, HTDP now uses the ellipsoid height given on the *86* record. If this record does not contain an ellipsoid height, then HTDP computes the ellipsoid height as the sum of the orthometric height and geoid height specified on this record. If the geoid height is not specified on the *86* record, then

HTDP uses the orthometric height on this record as the ellipsoidal height. If the blue book file does not contain an *86* record for a particular station, then HTDP sets the ellipsoid height equal to the value found in columns 70-75 of the *80* record, whereby a blank field is considered to represent an ellipsoid height of zero meters.

December 27, 2002 - The numbers used to identify the different reference frames have been changed in subroutine MENU1.

December 30, 2002 - The output file now displays the input velocities used when updating positions and/or transforming positions between reference frames.

November 26, 2004 - HTDP now allows records in the GFILE to have a length of 120 characters (as opposed to 80) as requested by Dale Pursell for the adjustment of the National Spatial Reference System.

Version 2.6

December 14, 2001
Added parameters to transfer to and/or from ITRF00.
Added code to input points in the southern hemisphere.
Added code to print the header "HTDP (version 2.6) OUTPUT"
on the standard output file.

Version 2.5

December 27, 2000
The velocity field model was completely revised using point velocities estimated from several sources:
* Version 2 of the SCEC velocity field for 363 sites in southern California,
* velocity field for 239 sites in the western U.S. derived by Matt van Domselaar of CSRC/SIO in November, 2000,
* velocity field for 86 CA HARN sites derived by Matt van Domselaar of CSRC/SIO in November, 2000,
* version 2 of the Western U.S. Cordillera velocity field for 373 sites,
* velocity field for 378 international sites derived by NGS as part of its ITRF97 solution for the CORS and its ITRF2000 solution for the IGS tracking network,
* velocity field for 73 sites in Oregon published by Robert McCaffrey et al. [2000],
* velocity field for 6 sites in Washington published by Khazaradze et al. [1999].

May 23, 2001
The new velocity field is defined by grids for 2 regions:
Region 1 = western U.S (31.75N-50N, 111W-125W)
Region 2 = Alaska (55N-66N, 131W-163W)
Elsewhere the velocity is defined by the NNR-NUVEL-1A model. Added capability to convert positions and velocities to/from the IGS97 reference frame (= ITRF97).

Version 2.4

April 28, 2000

HTDP was updated to incorporate a new transformation from ITRF96 (= ITRF94) to ITRF97. The previous version of HTDP assumed that ITRF97 = ITRF96, as declared by the IERS when ITRF97 was released on 1 AUG 1999. Several IGS researchers subsequently determined that the ITRF97 positions and velocities for about 50 GPS stations in their satellite tracking network differed systematically from their corresponding ITRF96 positions and velocities (positions at the 15 mm level and velocities at the 2 mm/yr level). Consequently, IGS adopted a 14-parameter Helmert transformation between ITRF96 and ITRF97 (IGS Electronic Mail: Message Number 2432, 20 AUG 1999). The IGS transformation parameters are expressed relative to an epoch date of 1 AUG 1999. HTDP incorporates this IGS transformation with parameters expressed relative to 1 JAN 1997.

HTDP now includes a term for the rate of change in scale in the array that specifies the parameters of a Helmert transformation. Also, the equations for converting positions and velocities between reference frames have been modified to consider a non-null rate of change in scale.

June 16, 2000
HTDP now enables users to specify values for site velocities (as opposed to using HTDP-predicted values) when predicting displacements or updating positions or transforming positions for individual sites entered interactively. Users can still opt to use HTDP-predicted velocities for any of these tasks.

HTDP now enable users to transform velocities between reference frames.

June 19, 2000
Encoded dislocation model for M7.1 Hector Mine, CA earthquake as derived by Jay.W.Parker@jpl.nasa.gov and as found at
http://milhouse.jpl.nasa.gov/hector/hectormine3.model .
This model will be published by Hurst et al. in Geophysical Research Letters.

Version 2.3

November 29, 1999
HTDP now performs transformations involving ITRF97.
Because observing dates for classical observations in the standard blue-book BFILE (4-digit SSN) express years with only 2 digits, the source code was rewritten to identify the proper century from the information on the *12* record. See the routines called UPBB4 and TRFDAT.
To get observing dates for classical observations in a non-standard blue-book (5 digit SSN), the program now reads the Year, Month, and Day from columns 101-108 of the observational records.

Version 2.2

June 26, 1997
HTDP will now transform positional coordinates to a new reference frame and/or to a new epoch date when these coordinates are contained in the *80* records of a blue-book

file. HTDP interprets the elevations in the *80* records as ellipsoid heights.

December 5, 1997
HTDP will now predict velocities in coastal Oregon and Washington by applying a model by Fluck et al. (1997).

December 24, 1997
HTDP will now predict velocities for points on selected tectonic plates (North American, Caribbean, Pacific, Juan de Fuca, and Cocos) using NNR-NUVEL-1A parameters adopted by the IERS (McCarthy, 1996).

August 18, 1998
HTDP will now perform transformations involving ITRF96. Also, the software now uses the new transformation from ITRF96 to NAD_83 that was recently adopted by NGS and the Geodetic Survey of Canada.

September 17, 1998
In updating GPS observations to a common date, HTDP now reads the reference frame identifier from the B-record of the GFILE (columns 52, 53), and uses this information to compute time-dependent changes to the corresponding observed vectors. Previous versions of HTDP erroneously used the reference frame that the user specified for the positions in the BFILE.

September 17, 1998
HTDP now enables users to transform all GPS vectors in a GFILE to a common, user-specified reference frame when these vectors are updated to a common date. Columns 52 and 53 of the B-records are modified accordingly. Alternatively, GPS vectors may be left in the reference frame noted in the corrsponding B-record upon input.

September 17, 1998
HTDP now puts a "warning" message at the top of the output BFILE and GFILE when their observations have been updated to a common date. Also, when the GPS vectors in a GFILE have been updated to a common date, HTDP enters the letters, ZT, in columns 79 and 80 of this file's A-record, and HTDP enters the new date for these vectors in the "start-of-project" and "end-of-project" fields of this A-record. Note that the dates appearing on the observational records are not modified; only the observed values are modified on the observational records.

December 1, 1998
The data that resides in the three ASCII files--GRIDx.y, BNDRYx.y, and QUAKEx.y--have now been transcribed into BLOCK DATA routines. Thus, the HTDP executable code does not need to read these three ASCII files.

Version 2.1

March 1, 1997
HTDP now accepts positions in all official realizations of ITRF (Boucher and Altamimi,

1996) as well as in NAD_83. Also HTDP now enables its users to transform positional coordinates among these reference frames in a manner that rigorously addresses differences among the definitions of their respective velocity fields.

Version 2.0

January 1, 1996
Velocity information is now stored in grid format as opposed to storing coefficients of a piecewise linear function of latitude and longitude. The piecewise linear functions were used to predict the horizontal velocity for each node of a 15-minute-by-15-minute grid that spans California. These velocities are stored in the GRID2.0 file. The software uses bilinear interpolation to predict velocities at other locations.

January 1, 1996
The DYNAP-G software was used with a more extensive data set to obtain new estimates for horizontal velocities in the rectangular region bounded by latitudes 32.5N and 36.0N and longitudes 117.5W and 121.5W (Snay et al., JGR, 1996, v101, pp3173-3185).

January 1, 1996
HTDP now accepts positions in the ITRF93 reference frame as well as the NAD83 reference frame. Also HTDP will now predict velocities and/or displacements in either reference frame.

January 1, 1996
HTDP now accepts positions in cartesian coordinates (X,Y,Z) as well as in geodetic coordinates (latitude and longitude).

January 17, 1996
The dislocation model for the 1940 Red Mountain earthquake was deleted from the software as the values for its parameters were of questionable quality.

January 18, 1996
Changed the format of the earthquake input file so that latitudes and longitudes are given in decimal degrees as opposed to degrees-minutes-seconds.

January 19, 1996
New dislocation parameters for the 1992 Joshua Tree earthquake were introduced. The new model was derived by Bennett et al (1995) with a 1 km x 1 km grid defining the fault plane. The software uses a 5 km x 5 km grid where the slip on each grid element equals the average of the slip values for 25 1 km x 1 km elements.

Version 1.10

November 1, 1995
The capability was added to update geodetic positions and/or geodetic observations contained in a non-standard blue-book file featuring 5-digit station identifiers.

Version 1.9

August 2, 1994

New dislocation parameters replaced the old parameters for the 1941 Red Mountain earthquake. The new parameters were derived by Snay (unpublished).

January 1, 1995
New dislocation parameters for the 1994 Northridge earthquake were introduced. The new model was derived by Ken Hudnut and 10 others (1995) BSSA.

January 1, 1995
New dislocation parameters for the 1992 Landers/Big Bear earthquake sequence were introduced. The new model was derived by K.W. Hudnut and 16 others (1994) BSSA 84:625-645.

Version 1.8 - March 16, 1994

Dislocation parameters were added for the March 28, 1964 Prince William Sound, Alaska earthquake as derived by S. Holdahl and J. Sauber (*Pure and Applied Geophysics*,142:55-82).

Version 1.7 - December 16, 1993

Changed format of QUAKE file to contain centroid and radius for each earthquake. The software will now compute the dislacement at a given location if that location is within the specified radius of the centroid. Also changed the internal data structure for storing the earthquake parameters. In particular, the dislocation parameters are now stored on a direct access file.

Corrected a small error in the QUAKE file. A dislocation rectangle for the Landers earthquake had been unintentionally omitted.

Added capability to produce a file of point-velocity (PV) records when predicting velocities. These records are written in the required format for input into the DYNAPG software.

Dislocation parameters were added for the July 21, 1986 Chalfant Valley earthquake as derived by J. Savage and W.K. Gross (BSSA, 1995, v85, pp629-631).

New dislocation parameters for the 1934 and 1966 Parkfield earthquakes were introduced. The new model was derived by Paul Segall and Yijun Du (JGR, v98, pp4527-4538).

Dislocation parameters were added for the March 15, 1979 Homestead Valley earthquake as derived by R. Stein and M. Lisowski (JGR, 1983, v88, pp6477-6490).

Dislocation parameters were added for the July 8, 1986 North Palm Springs earthquake and the April 22, 1992 Joshua Tree earthquake as derived by J. Savage, M. Lisowski, and M. Murray (JGR, 1994, v98, pp19951-19958).

Dislocation parameters were added for the January 17, 1994 Northridge earthquake as derived by M. Murray (personal communication, January 25, 1994).

Version 1.6 - September 17, 1993

Dislocation parameters were added for the Nov. 24, 1987 Superstition Hill earthquake sequence as derived by S. Larsen et al. (JGR, 1992, v97, pp4885-4902).

Dislocation parameters were added for the May 2, 1983 Coalinga earthquake as derived by R. Stein and G. Ekstrom (JGR, 1992, v97, pp4865-4883).

Dislocation parameters were added for the Aug. 4, 1985 Kettleman Hills earthquake as derived by G. Ekstrom et al. (JGR, 1992, v97, pp4843-4864).

Dislocation parameters were added for the Oct. 1, 1987 Whittier Narrows earthquake as derived by J. Lin and R. Stein (JGR, 1989, v94, pp9614-9632).

Changed format of QUAKE file to use month-day-year instead of julian day-year for earthquake date. The HTDP software was modified accordingly to read the new format.

Changed format of output file to be more compact. In particular, the name-of-site field was reduced from 30 characters to 24 characters.

Version 1.5 - July 22, 1993

Corrected a logical error in the routine that updates GPS observations. Previous versions of the software would erroneously drop the negative sign when a component of a GPS vector is a negative number whose magnitude lies between 10 meters and 100 meters.

Version 1.4 - July 15, 1993

Dislocation parameters were added for the June 28, 1992 Landers- Big Bear earthquakes as derived by Hudnut et al. (preprint submitted to Bulletin of the Seismological Society of America).

Version 1.3 - May 11, 1993

The software was modified to use the Okada equations for dislocation theory as opposed to the Dunbar equations. The dislocation parameters in the file QUAKE were modified accordingly.

Dislocation parameters were added for the April 25, 1992 Petrolia earthquake as derived by Oppenheimer et al. (preprint submitted to Science).

Version 1.2 - April 8, 1993

The software was modified to accept GPS observations for updating when these observations are entered as F records in the G-file. The new software still accepts C records as well.

Version 1.1 - March 23, 1993

The software was modified (a) to make it more user friendly, (b) to accept the 1989 blue-book formats as opposed to the 1982 blue-book formats, and (c) to accept GPS observations for updating their observed values to a user-specified date.

Version 1.0 – Released June 1992