

TM137 BIPM TAI Time Link Comparison on ftp

Version 1: Oct. 2004 by ZJ

Version 6 Last edit: 27 May 2005 by AF/GP

Version 7 Last edit: 26 May 2008: Comparison including GPS PPP by GP

Version 8 Last edit: 10 June 2009: Comparison including GLONASS by ZJ,

Version 9 Last edit: 21 Jan. 2011 by ZJ: Link combinations: GPS+GLN, TW+PPP/P3:
ftp://tai.bipm.org/TimeLink/LkC/ReadMe_LinkComparison_ftp_v9.doc

Version 10 Last edit 17 March 2016 by GP.

Version 11 Last edit 19 January 2018 by GP;

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This is the Read Me file of the ftp site on the TAI time link results calculated by the BIPM Time Section. The comparison results since January 2005 are published each month after the BIPM Circular T in <ftp://ftp2.bipm.org/pub/tai/publication/timelinks/lkc>

Version 6 is characterized by the comparisons of the time transfer methods: GPS common view and all in view.

Version 7 is characterized by the comparisons between TW and **GPS PPP** for TAI and non-TAI time links. Important modifications vs. version 6 are in red colour. Version 7 is mis en pratique since TAI 0804. The monthly GPS PPP computation solutions are on <ftp://ftp2.bipm.org/pub/tai/publication/timelinks/taippp>

Version 8 is based on the version 7 and characterized by including **GLONASS** and long term (yearly) data comparisons. SU-PTB GLN has been used in UTC since Nov. 2009.

Version 9 includes the link combinations of GPS+GLN and TW+GPSPPP. Cf. TM185: ftp://ftp2.bipm.org/pub/tai/publication/timelinks/lkc/tm185_new-in-tsoft_lnkcombination.doc, and the Figures 7, 8, 9 and 10 in the end of this doc. Combined links have been used in UTC for SU, UME, CH, NIST, OP and SP since Jan. 2011

Version 10 includes optical fiber links, as of January 2016 the two links AOS-PL and BEV-TP. It also includes experimental computation of GPS PPP with integer ambiguities (IPPP) which, as of January 2016, concerns the link AOS-PL. Although the principle of IPPP is equivalent to the classical GPS PPP, its results are presently computed and treated by the BIPM software as if they were two way links. Therefore they are classified below, and they appear in the ftp site, as TW links.

Version 11 incorporates the possibility to publish TW SDR links and link comparisons, as well as Galileo (GAL) and BeiDou (BDS) dual frequency links and link comparisons. It also clarifies the presentation in section 2 and provides new accompanying figures.

Warning: The monthly LkC directories are intended to provide all links available on a given month but only "official" links that are used for UTC computation can be considered as calibrated. These links and the calibration information are listed in Circular T section 5. Therefore users are warned that the comparison between two links does not necessarily reflect the relative accuracy of the links. On the other hand, the comparison is expected to reflect the

relative stability of the links. Similarly long solutions that can be assembled by stacking monthly files are not certified to be continuous.

Starting with version 7, neither mean value nor slope will be removed in the plots as was the case in the version 6. Cf. TM151 for details:

ftp://ftp2.bipm.org/pub/tai/publication/timelinks/lkc/tm151_twcalib.doc

1. Introduction and directory structure

The monthly comparisons are in \LkC\YYMM where YYMM corresponds to the year and month of the calculated Circular T, for example, 0501 is for 2005 January. They contain plots and data files for link values and link comparisons for all measurement dates. See section 2.

The general directory tree looks like:

<ftp://ftp2.bipm.org/pub/tai/publication/timelinks/lkc>

ReadMe

```

|
|-----0501          : results for 2005 January
|      |
|      | Dlk0501.sum
|      |-----Lab2Lab1: results for link Lab2-Lab1 of 0501
|      |      |
|      |      |-----Dlk: Link comparisons for Lab2-Lab1
|      |      |-----Lnk: Link results for Lab2-Lab1
|      |      |
|      |      |-----... ..
|      |
|-----0502          : results for 2005 February
|      |
|      |-----... ..
|
```

A link, Lab2Lab1 is always defined as: $Link = UTC(Lab2) - UTC(Lab1)$. Here Lab1 is usually the so called pivot laboratory.

A comparison of links is always defined as $dLink = Link1 - Link2$

By default, the unit for all the tables and plots is 1 ns.

The link results are computed without any time or receiver jumps introduced.

2. The Monthly Comparison

2.0 Summary of statistics of link comparisons

File DlkYYMM.sum in subdirectories \LkC\YYMM\ provides the summary of the statistics of all link comparisons in the subdirectory \YYMM. For each link comparison data file one line summarises the statistics (see example in section 2.2). Comments may be added for each link to indicate special features that may affect the statistics e.g. data gaps, known or suspected time steps, known or suspected outliers, etc...

2.1 The file naming conventions

In each sub-directory of \LkC\YYMM\Lab2Lab1\, there are two sub-directories: The Link subdirectory contains the Link files and the dLink subdirectory contains the dLink (link comparisons) files:

2.1.1 Link files

The Link files are ASCII data files (for GNSS) with the name **Lab2Lab1.ABCDc.dat** and plots in Gif format with the name **Lab2Lab1.ABCDc.gif**, where

C is the **Link type**

D is the **Link computation type**

c is an additional identifier of the link computation type

If the **Link type C** indicates a single technique, then

A is the **Observation type** of Lab2

B is the **Observation type** of Lab1

If the **Link type C** indicates a combination of techniques, then

A is the **Link type** of the first technique

B is the **Link type** of the second technique

- **Observation types** and single-technique **Link types** are

S = GPS Single Channel C/A code

M = GPS Multi-Channel C/A code

R = GLONASS C/A code

P = GPS dual frequency P3 code

C = BDS dual frequency, as defined in CGGTTS version 2E (B1I and B2I codes)

E = GAL dual frequency, as defined in CGGTTS version 2E (E1 and E5a codes)

3 = GPS PPP

T = Two way time transfer techniques, e.g. through satellites on Ku band or through optical fibers. For practical reasons, this also includes links obtained with IPPP computations.

Although the codes are the same for the two fields, they have different meanings, e.g. a "Link type" S can result from two data files with "Observation type" M and S, or S and S. Only the "Link type" is retained to name the dLink (link comparison) files.

- **Link types** of combinations of techniques are

B = GNSS and TW combination

- The **Link computation types** are

- For single-technique **Link types**:

C = Common View for GNSS links

A = All in View for GNSS links (also applies to PPP)

B = GNSS and TW combination

T = Two way time transfer. For Ku band, the computation follows ITU-Rec1153; other types are identified by the additional identifier **c** (see below).


- For **Link types** of combinations of techniques:
 - 1** = Average of two techniques
 - 3** = Combined Vondrak smoothing of two techniques

Note that GNSS links are always computed with data corrected for IGS precise ephemerides and solid Earth tides. **S** and **M** types are also corrected for ionospheric delay from IGS maps

- The additional identifier of the link computation type is
 - _** = no additional identifier needed, e.g. for GNSS or TW time transfer Ku band
 - o** = two way by optical fiber
 - i** = link obtained with IPPP computations
 - s** = TW time transfer Ku band with Software Defined Radio (SDR) receiver

See in Figure 1 an example of directory with link files.

Index de <ftp://ftp2.bipm.org/pub/tai/timelinks/lkc/1711/opptb/lnk/>

 Vers un rép. de plus haut niveau

Nom














 opptb.333a_.dat	333a_ = GPSPPP link from two PPP results files
 opptb.333a_.gif	
 opptb.mmma_.dat	mma_ = GPS MC link from two multi-channel C1 GPS files, All-in-view
 opptb.mmma_.gif	
 opptb.pppa_.dat	pppa_ = GPS P3 link from two dual-frequency GPS files, All-in-view
 opptb.pppa_.gif	
 opptb.rrrc_.dat	rrrc_ = GLN MC link from two multi-channel C1 GLONASS files, Common-view
 opptb.rrrc_.gif	
 opptb.t3b3_.dat	t3b3_ = TWGPPP link, from combined smoothing of TW and GPSPPP links
 opptb.t3b3_.gif	
 opptb.tttt_.gif	tttt_ = TWSTFT link, from standard Ku-band TW on geo satellites
 opptb.tttts.dat	ttts = TWSTFT link, from Ku-band TW on geo satellites with SDR
 opptb.tttts.gif	

Fig. 1: Directory of link files for the link OP-PTB for November 2017, available at <ftp://ftp2.bipm.org/pub/tai/timelinks/lkc/1711/opptb/lnk/>, with explanatory notes on the filenames.

2.1.2 Link comparison files

The dLink (link comparison) files are data in ASCII format and plots in Gif format. The file name is **Lab2Lab1.ABCD5** for a data file and **Lab2Lab1.ABCD5.gif** for a plot file, where

A is the Link type of the first link

B is the Link type of the second link

C is the Link computation type of the first link if the additional identifier is ‘_’, or the additional identifier if it is not ‘_’.

D is the Link computation type of the second link if the additional identifier is ‘_’, or the additional identifier if it is not ‘_’.

WARNING: Until November 2017, some errors in the nomenclature occurred, where the ‘C’ or ‘D’ codes were not correctly attributed.

See in Figure 2 an example of directory with link comparison files

Index de <ftp://ftp2.bipm.org/pub/tai/timelinks/lkc/1711/opptb/dlk/>

 Vers un rép. de plus haut niveau



















Nom	
 opptb.b33a5	b33a5 = Comparison of TWGPPP combination to GPSPPP link
 opptb.b33a5.gif	
 opptb.p3aa5	p3aa5 = Comparison of GPS P3 to GPSPPP link
 opptb.p3aa5.gif	
 opptb.rmca5	rmca5 = Comparison of GLN MC link (common view) to GPS MC link (All-in-view)
 opptb.rmca5.gif	
 opptb.rtct5	rtct5 = Comparison of GLN MC link (common view) to TWSTFT link
 opptb.rtct5.gif	
 opptb.t3sa5	t3sa5 = Comparison of TWSTFT SDR link to GPSPPP link
 opptb.t3sa5.gif	
 opptb.t3ta5	t3ta5 = Comparison of TWSTFT link to GPSPPP link
 opptb.t3ta5.gif	
 opptb.tbt35	tbt35 = Comparison of TWSTFT link to TWGPPP combination
 opptb.tbt35.gif	
 opptb.tpta5	tpta5 = Comparison of TWSTFT link to GPS P3 link
 opptb.tpta5.gif	
 opptb.ttts5	ttts5 = Comparison of TWSTFT link to TWSTFT SDR link
 opptb.ttts5.gif	

Fig. 2: Directory of link comparison files for the link OP-PTB for November 2017, available at <ftp://ftp2.bipm.org/pub/tai/timelinks/lkc/1711/opptb/dlk/>, with explanatory notes on the filenames.

2.2 The data files

2.2.1 Link data files

A GNSS link data file **Lab2Lab1.ABCD_.Dat** has three parts: the header, the link data body and the plot data body. We ignore here the first and the 3rd parts. The link data body has four columns: MJD, link value, Vondrak smoothing value and their difference, as displayed in the table below. The TW link data files are not included. The complete TW link data values can be found in the link comparison file, see below section 2.2.2.

MJD	Link	Smth	Resid
54552.00000	91.820	92.140	0.320
54552.00347	91.942	92.167	0.225
54552.00694	91.980	92.195	0.215
54552.01042	92.075	92.224	0.149
54552.01389	92.083	92.254	0.171
54552.01736	92.157	92.285	0.128
54552.02083	92.313	92.316	0.003
54552.02431	92.378	92.348	-0.030

2.2.2 Link comparison data files

An example of link comparison data is shown below, the comparison between the TW link (Link1) and GPS single channel CV link (Link2): NISTPTB.TSTC5.

! 0502	Mjd	Link1	Link2	dLink	Jump1	Jump2	dLink_
1	53397.0347	-5.879	7.420	-13.299	0.000	0.000	-13.299
2	53397.3680	-6.051	7.264	-13.315	0.000	0.000	-13.315
...							
130	53430.6180	-0.170	12.480	-12.650	0.000	0.000	-12.650
131	53430.7014	-0.703	12.371	-13.074	0.000	0.000	-13.074
! Combined dLink Statis. NISTPTB.TSTC5 :							
N,Min,Max,Mean,RMS,SD=		131	-15.539	-10.240	-12.850	12.896	1.085

Data lines are numbered consecutively and contain

Mjd = Date of measurement
Link1, Link2 = Link values
dLink = Link1 - Link2
Jump1, Jump2 : optional time correction applied to Link1 or Link2
dLink_ = (Link1+Jump1) - (Link2+Jump2)

Information in the last line:

N = total number of measurements
Min = minimum value of dLink
Max = maximum value of dLink
Mean = mean value of dLink
RMS = Root Mean Square of the dLink values
SD = Standard Deviation of the dLink values

The values following this line are only used to produce the corresponding stability plots and are not described here.

In general, the first link is chosen as the less dense and the denser second link is interpolated to the epochs of the first link.

2.3 The Plots of links and link comparisons

2.3.1 The plot of a link

See examples Figures 3 and 4.

The plot contains 4 figures:

- the top figure represents the link measured values (ns) with red numbers indicating the link values computed on the standard TAI dates.¹
- the middle figure represents the residuals = measured - smoothed: For GNSS 'smoothed' is the result of Vondrak smoothing. For TW, it is the linear interpolation of the two adjacent point.
- the bottom left figure : the Modified Allan Deviation of the link measured values.
- the bottom right figure : the Time Deviation of the link measured values.

Description of the legends in the plots

- Bottom line of the top figure indicates, the type of the link, the year and month, the two laboratories and their TAI codes, the total number of points and the time and date of the processing.
- Bottom line in the middle figure indicates the maximum value and the standard deviation of the residuals, and (for GNSS links) the power of the Vondrak smoothing.
- Top line of the bottom figures indicates Tau0, the averaging time for the first point of the deviations, and Scale, the unit for the indicated values.
- Bottom line of the bottom figures, d/8, d/4 and d/2 stand for day/8, day/4 and day/2; dd and ddd stand for 2 and 3 days; wk means a week

2.3.2 The plot of a link comparison (dLink)

See an example Figure 5.

The plot contains 4 figures:

- the top figure represents the measured values (ns) of the two links to be compared Link1(black crosses) and Link2(blue circles)². If the maximum absolute value of the difference dLink exceeds 100 ns, the mean value of dLink (shown in the middle figure) will be subtracted from the Link1 before plotting and the keyword "MeanRmved" will appear.
- The middle figure is the differences dLink = Link1 - Link2. Note that the red numbers represent real points chosen "at random" to indicate the order of magnitude of the values and their variations. They are not intended to represent special points.
- the bottom left figure : the Modified Allan Deviation of the dLink values.
- the bottom right figure : the Time Deviation of the dLink values.

Description of the legends in the plots

- Bottom line of the top figure indicates the year and month, the name of the dLink data file, the total number of points. MeanRmved appears if the mean value has been removed.
- Bottom line in the middle figure indicates the maximum, minimum and average value of dLink and its standard deviation.
- Legends in the bottom figures are similar to the Link plot.

¹ For a IPPP link, the mention « IPPP reset » indicates that there is no intrinsic connection between the sections before and after the reset. In this case the two sections have been connected using external information, usually another available link.

² See note 1, preceding page.

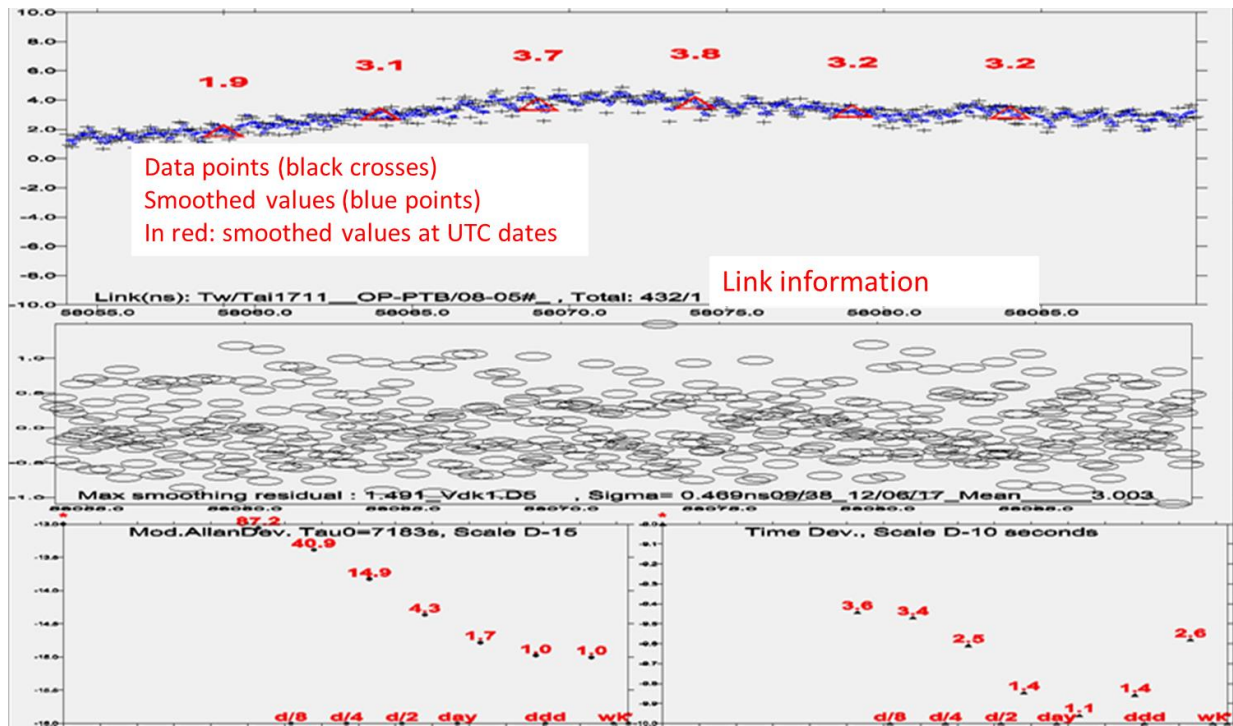


Fig. 3: Plot of the link TWSTFT OP-PTB for November 2017, available at <ftp://ftp2.bipm.org/pub/tai/timelinks/lkc/1711/opptb/lnk/>. See text for details.

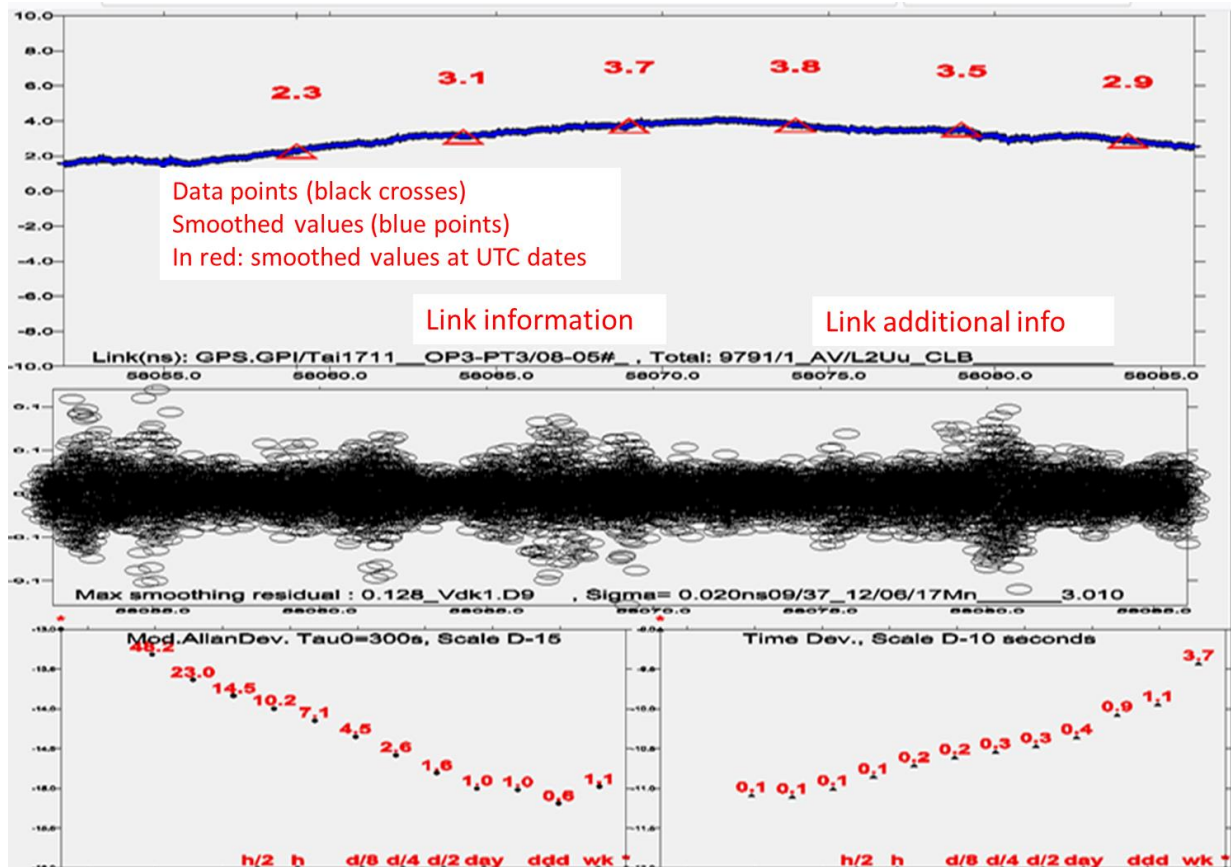


Fig. 4: Plot of the link GPSPPP OP-PTB for November 2017, available at <ftp://ftp2.bipm.org/pub/tai/timelinks/lkc/1711/opptb/lnc/>. See text for details. Note that the data points and the smoothed values are indiscernible in the top plot. The 'link additional info' indicates whether additional corrections were added to the link results to access UTC(k), please contact Time department for details.

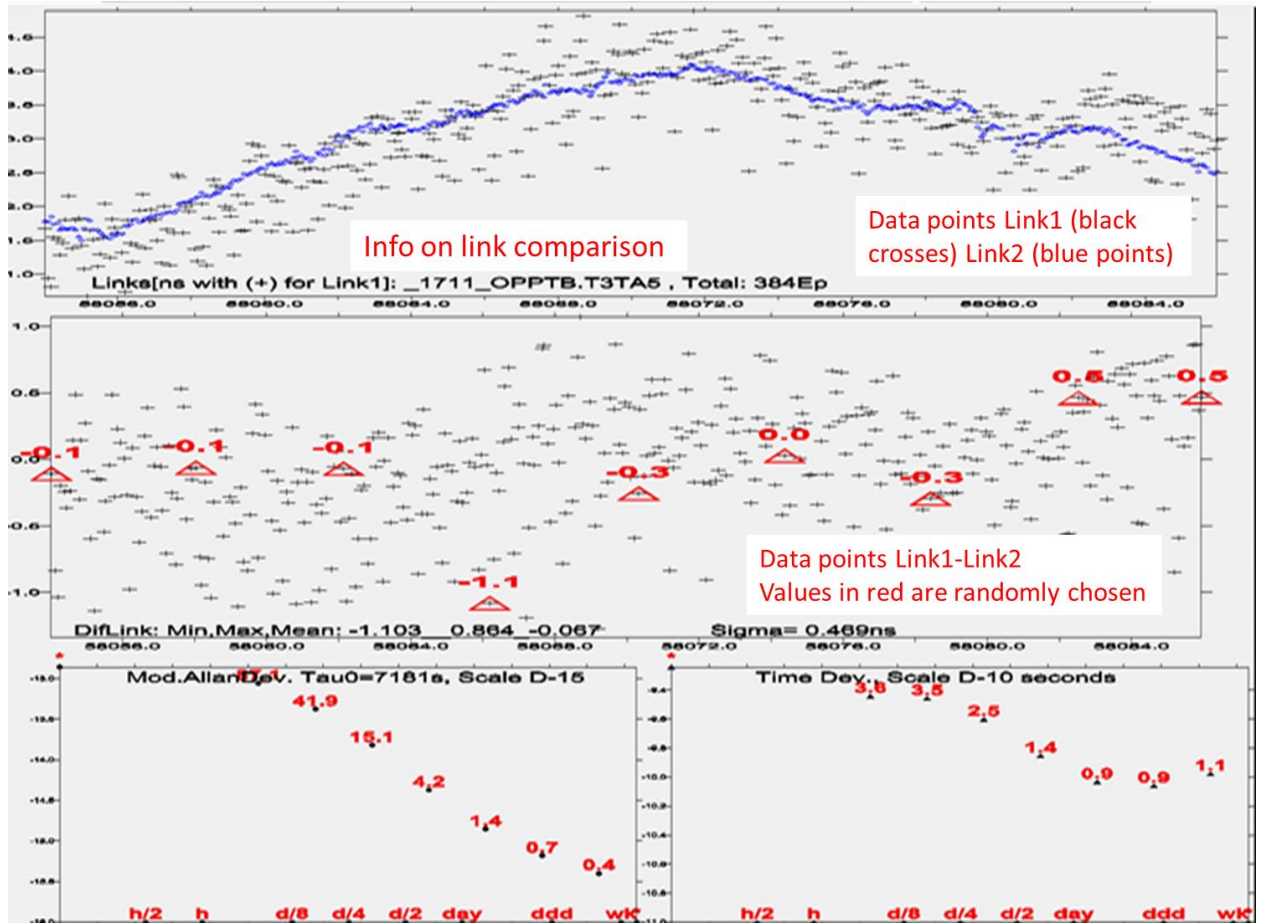


Fig. 5: Plot of the link comparison TWSTFT - GPSPPP of OP-PTB for November 2017, available at <ftp://ftp2.bipm.org/pub/tai/timelinks/lkc/1711/opptb/dlk/>. See text for details.