A Comparative Study on Different GNSS Time Offsets Monitoring Methods

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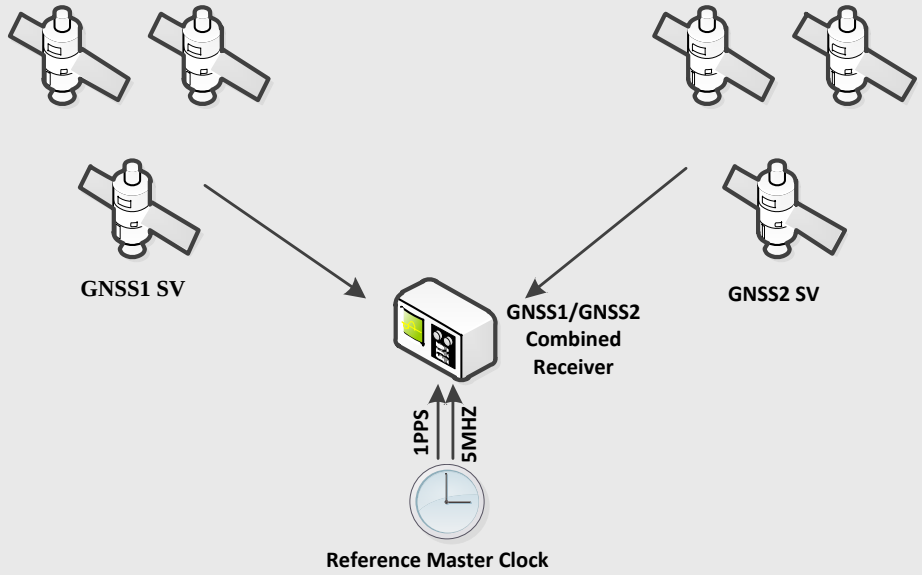
GNSS time offsets monitoring methods

I. GNSS time offset monitoring – single station



UTC(k)- GNSST(i)

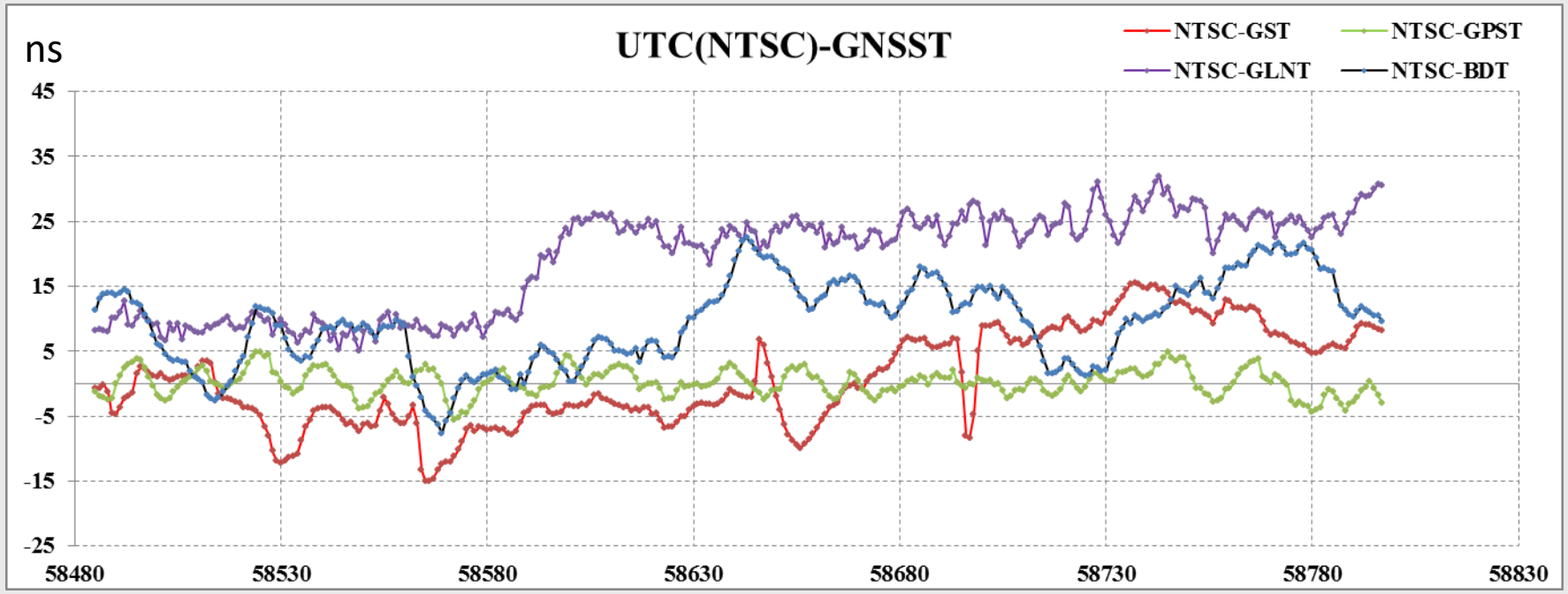
UTC(k)- GNSST(j)

GNSST(i) - GNSST(j)

01 GNSS time offset monitoring methods

I. GNSS time offset monitoring – single station

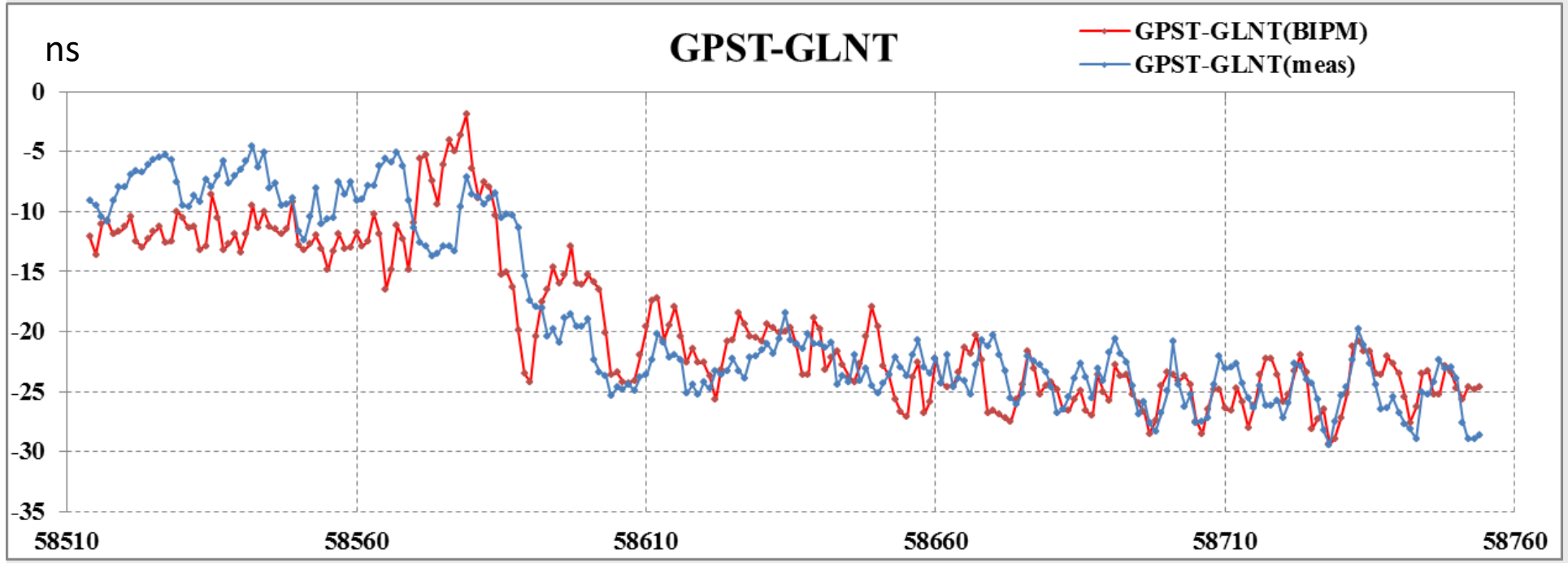
Time Offsets between UTC(NTSC) and GNSST (2019-1-1 ~ 2019-11-10, 482days)



01 GNSS time offset monitoring methods

I. GNSS time offset monitoring – single station

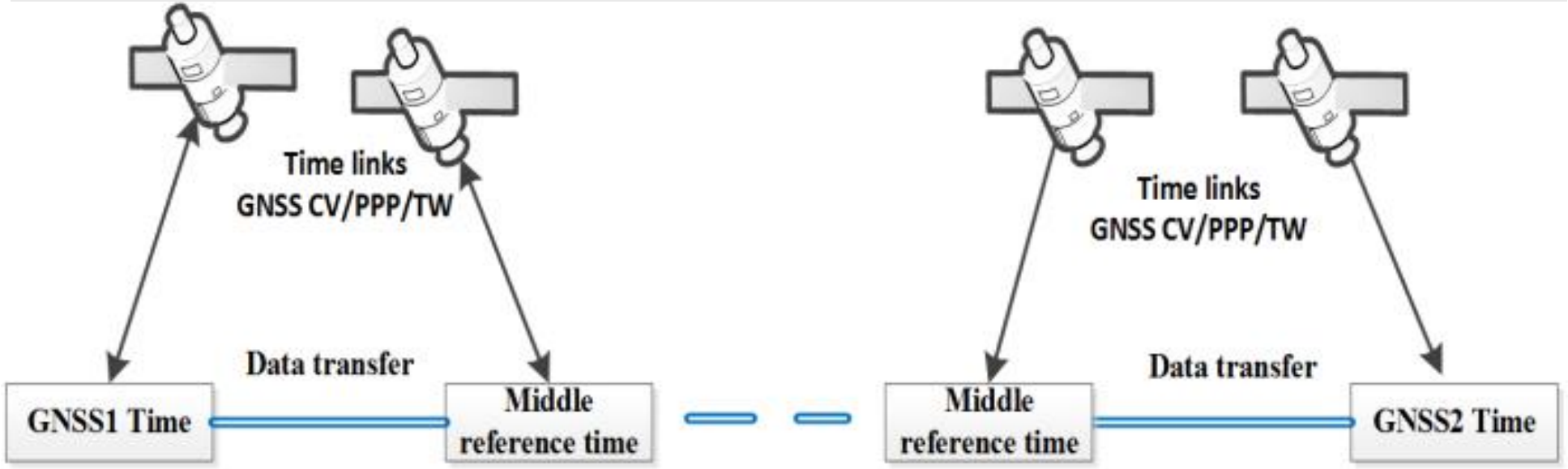
➢ **The time offset of GPST – GLNT by NTSC & BIPM (For Validation)**



Period of time: 2019-1-31 ~ 2019-09-28

01 GNSS time offset monitoring methods

II GNSS time offset monitoring---- time link



UTC(i)- GNSST(i)

UTC(j)- GNSST(j)

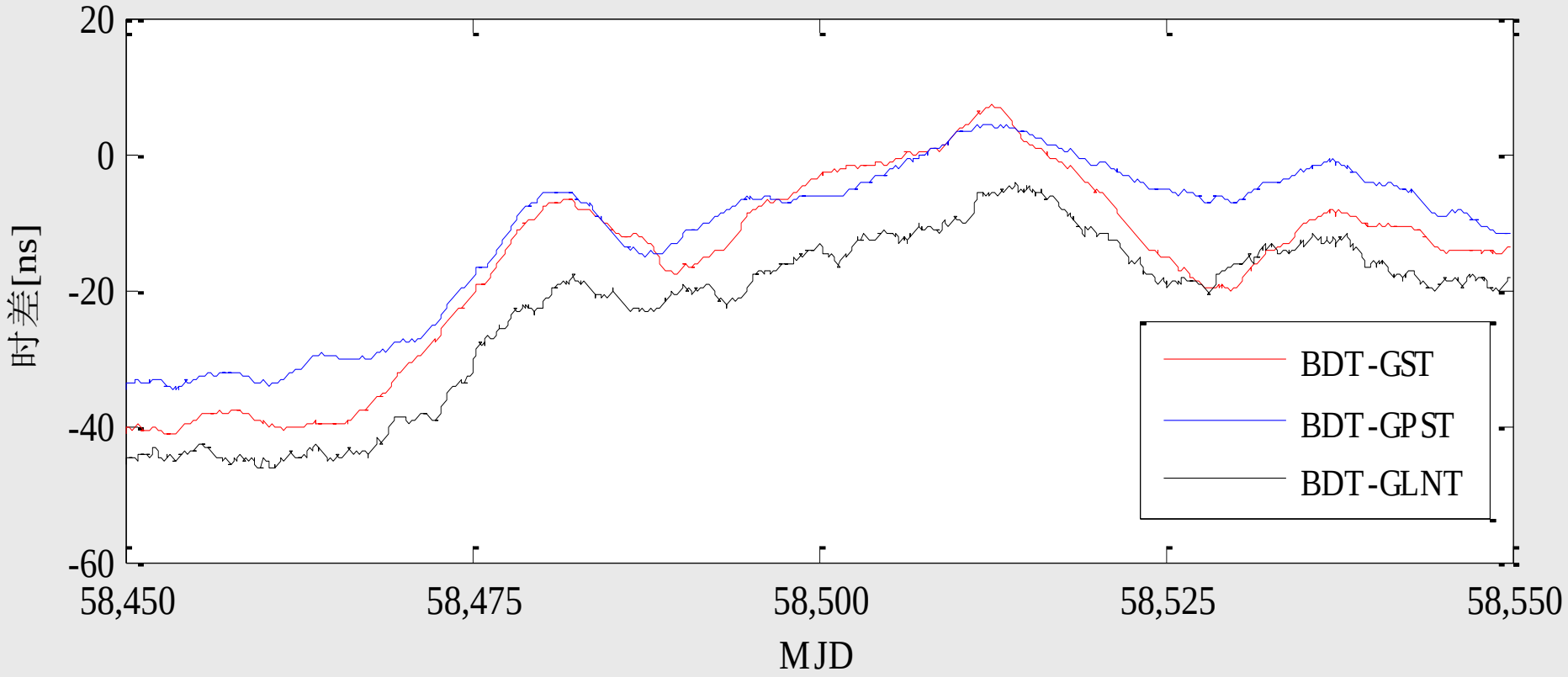
UTC(i)- UTC(j)

(UTC/UTCr)

GNSST(i) - GNSST(j)

GNSS time offset monitoring methods

II. GNSS time bias monitoring- time links



01 GNSS time offset monitoring methods

Items	Single station	Time links(UTC/UTCr)
Equipment	Multi mode GNSS Receiver In Time Lab.& GNSS MCS	Time comparison between each GNSS MCS through Time links
Data processing	Real time calculation	Data interchange, Post processing
Time period	Real time	Due to time comparison links， calculation period of UTC/UTCr
Accuracy	~10ns	~5ns

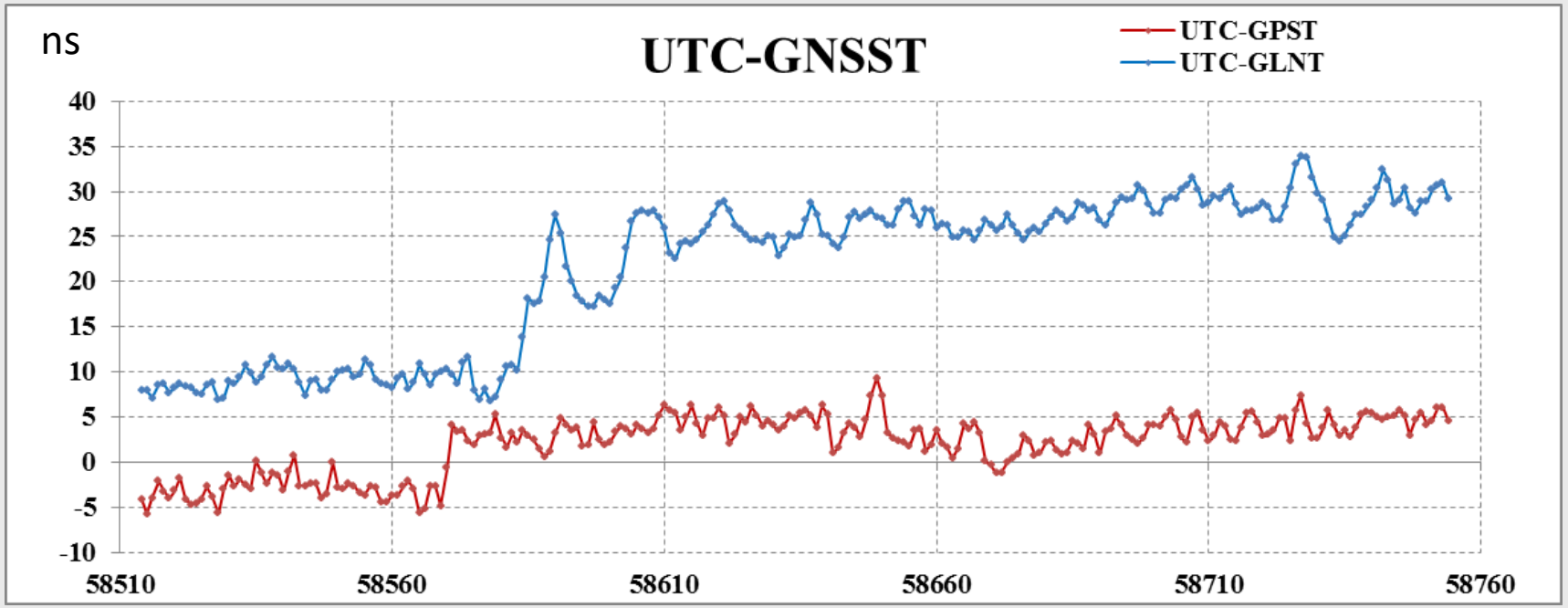
02

Selection of time interoperation methods

02 Selection of time interoperation methods

I. Time offsets parameters based on UTC-GNSST

- **Advantage**: **Unified reference, Easy to implement.**
- **Disadvantage**: **Low precision , long prediction period.**

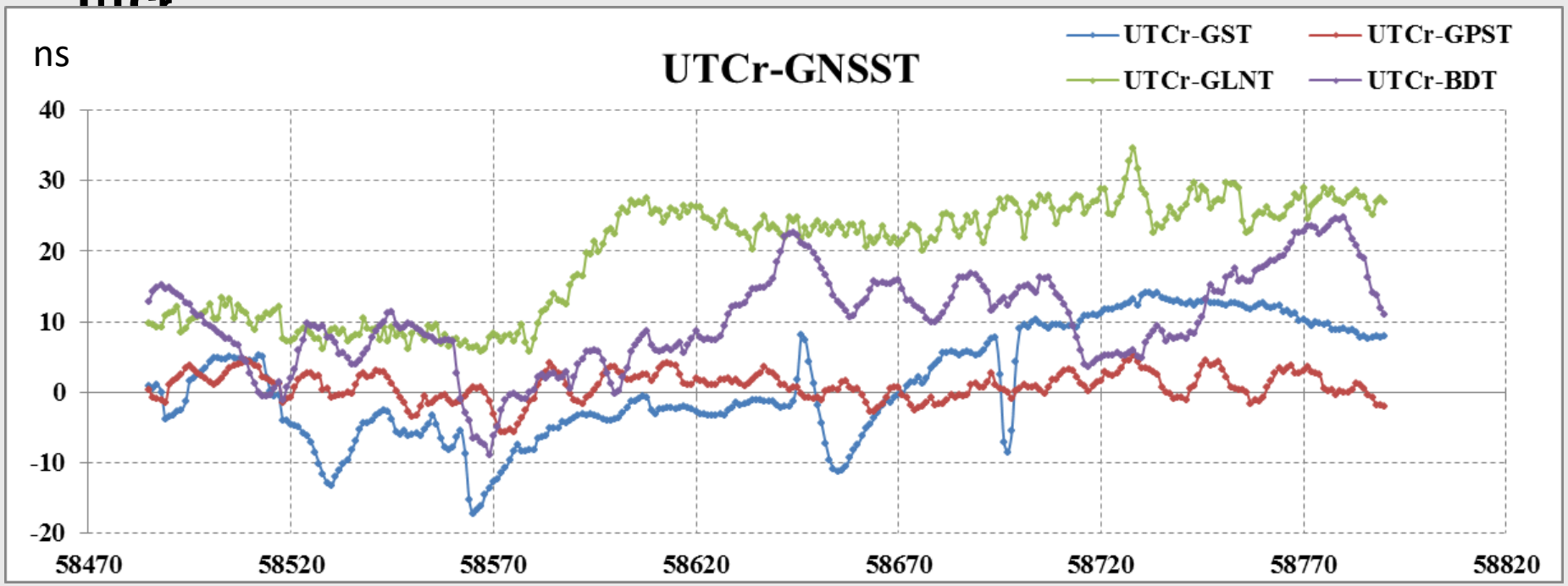


UTC/UTCr time links

Selection of time interoperation methods

II. Time offset parameters based on UTCr-GNSST

- **Advantage**: **Unified reference, Easy to implement.**
- **Disadvantage** : **low precision, long update period , depend on the UTC-UTCr**

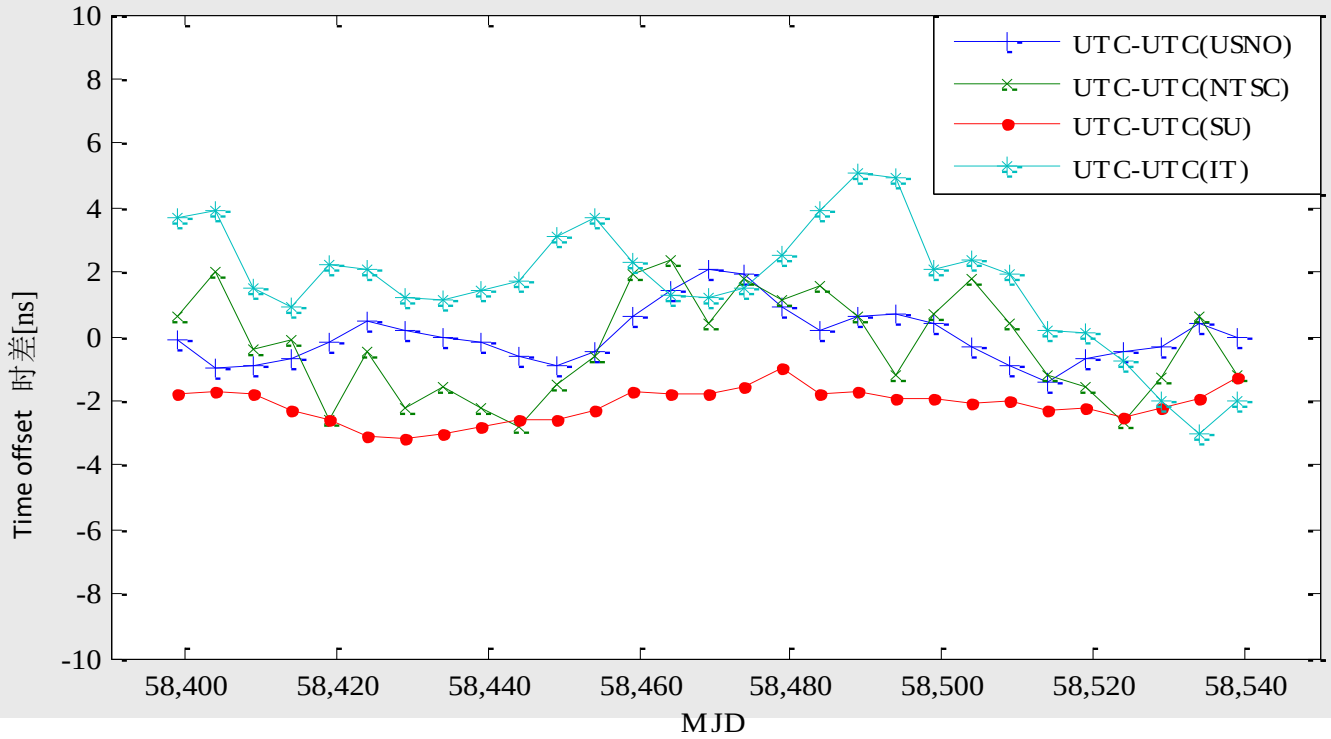


UTC/UTCr time links

Selection of time interoperation methods

II. Time offset parameters based on UTC(k)-GNSST

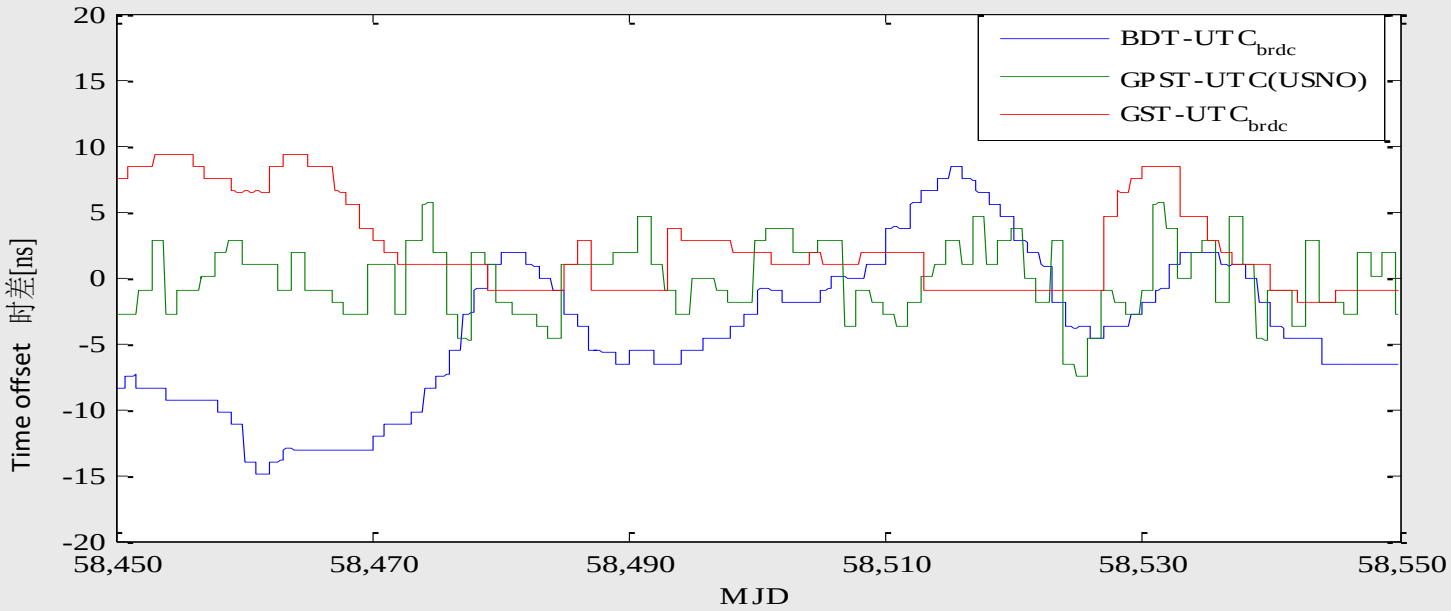
- **Advantage: broadcasted by all GNSS, monitor the results(absolute)**
- **Disadvantage: relying on UTC-UTC(K)**



Selection of time interoperation methods

II. Time offset parameters based on UTC(k)-GNSST

- **Advantage： broadcasted by all GNSS**
- **Disadvantage： depend on UTC-UTC(K).**

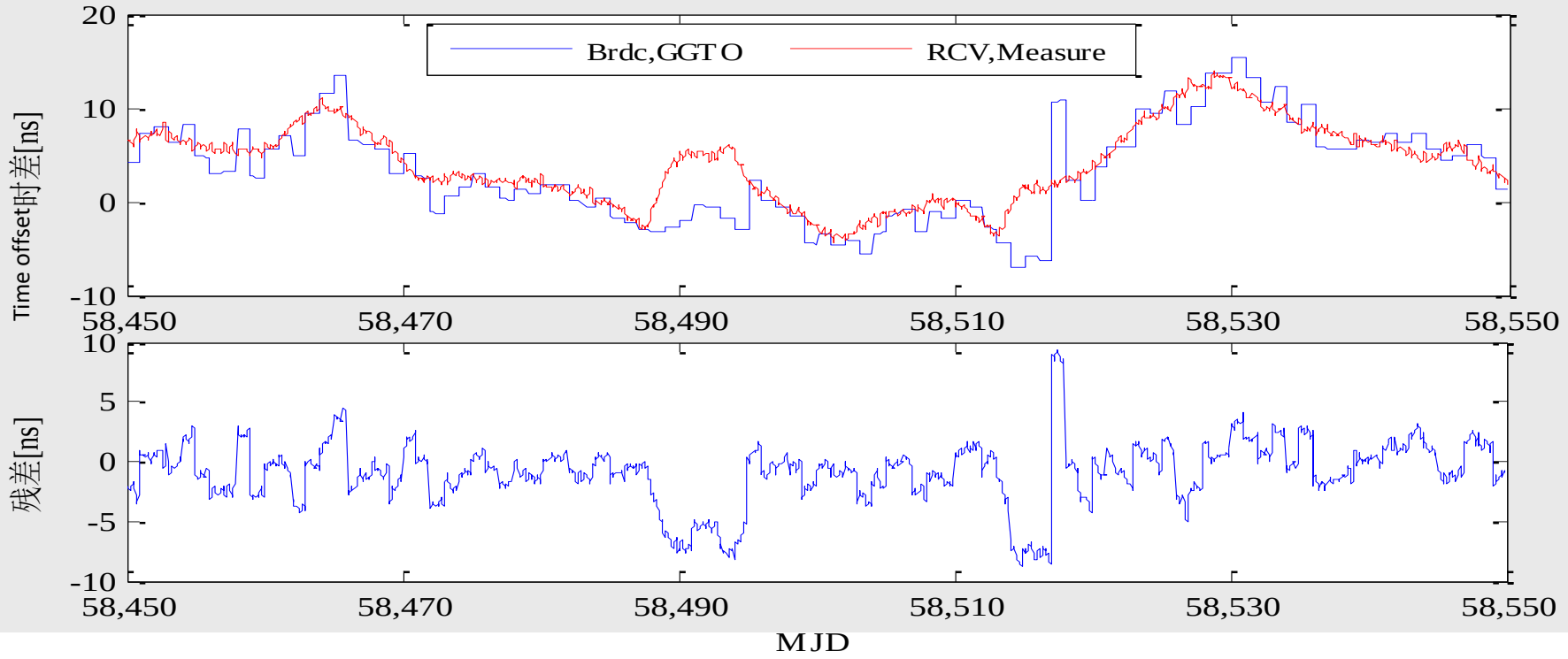


GNSST – UTC(k) Broadcasted by the GNSS provider in the navigation message

Selection of time interoperation methods

II. Time offset parameters based on GNSS to GNSS（GGTO）

- **Advantage： real time, Easy to reality, Easy to use.**
- **Disadvantage： need the enough navigation message space.**



03

Discussion

03 Discussion

I. Time interoperability using existing satellite broadcast parameters (UTC(k))

➢ GNSST-UTC(k)

1） The prediction accuracy of GNSST (i) - UTC (k) data is as good as possible, and the updating time of model parameters is as short as possible.

2） The deviation between the reference time UTC (k) of each system tends to be consistent as much as possible, which requires high enough performance for UTC (k) traceability to UTC。

II. Time interoperability with UTC/UTCr

- **GNSST-UTCr/UTC**

1） The UTCr –UTC(K) parameters should be updated frequently

2）The traceability of UTC(k) to UTCr should be reached.

03 Discussion

III. Time interoperability with GNSST-to- GNSST

- GNSST–to-GNSST time offsets based on the single station method can realize the real time monitoring.
- The optimal solution solves the problem of GNSS time interoperability from the system side, and reduce the cost of users.
- The GNSS independence and reliability could be guaranteed.

03 Discussion

III. Next steps

- Continue to study the GNSS time offset monitoring and prediction technology.
- investigate the parameters and its precision request in the satellite navigation system.
- Analyze the calibration technology (time link and GNSS receiver) to improve the accuracy of GNSS time offsets monitoring .