Clock Products Working Group

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CLOCK PRODUCT

Clock Products Working Group

- WG initiated in 2003 following a joint pilot project between the IGS and BIPM on accurate time and frequency comparisons using GPS phase and code measurements.

- This group now advises the Analysis Center Coordinator and other developers on the status, importance and possible improvements for the core clock products.

- Group consults the IGS and Governing Board, specifically on issues pertaining to clocks and timing infrastructure in GNSS and the IGS network.

- Charter update in 2019 set a target goal for multi-GNSS clock products.

- Membership updated to emphasize participation from various facets of the community concerned with clocks and timing.

Current Membership

Ex Officio Members:

- Current chair of the WG ;

- Immediate past chair of the WG;

- IGS Analysis Center Coordinator(s);

- BIPM representative to the IGS GB

Representatives:

- One from the IGS CB;

- One from each analysis center producing clock products;

- One from any UTC(k) timing center which also serves as an IGS network site; up to six such representatives to be invited and appointed by the chair.

- At-Large: Up to six at-large members, each as recommended by any member of the CPWG and with consultation of the existing WG, may be appointed by the chair.

Repro III and Multi-GNSS Clock Products

- Clock combination (CKCOM developed by PPP-AR and Wuhan) completed with RMS precision generally at 10 ps or less for GPS and GAL satellite clocks.

Satellite Clock Combination RMS
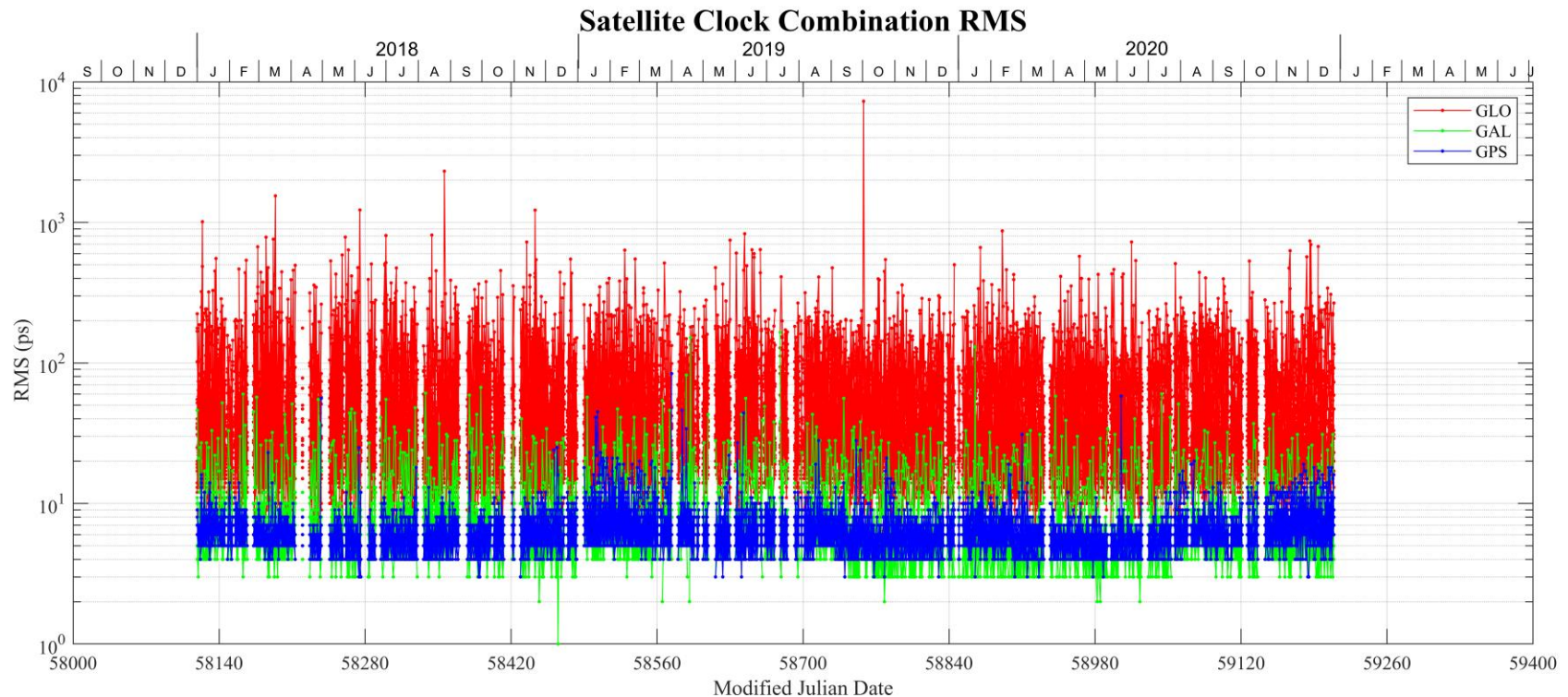
IGS Reference Time

- Generated by new IGS Clock Ensemble (ICE22).

- Day boundary clock jumps can be sizable in these combinations

Day boundaries removed

Clock Solution versus IGRT
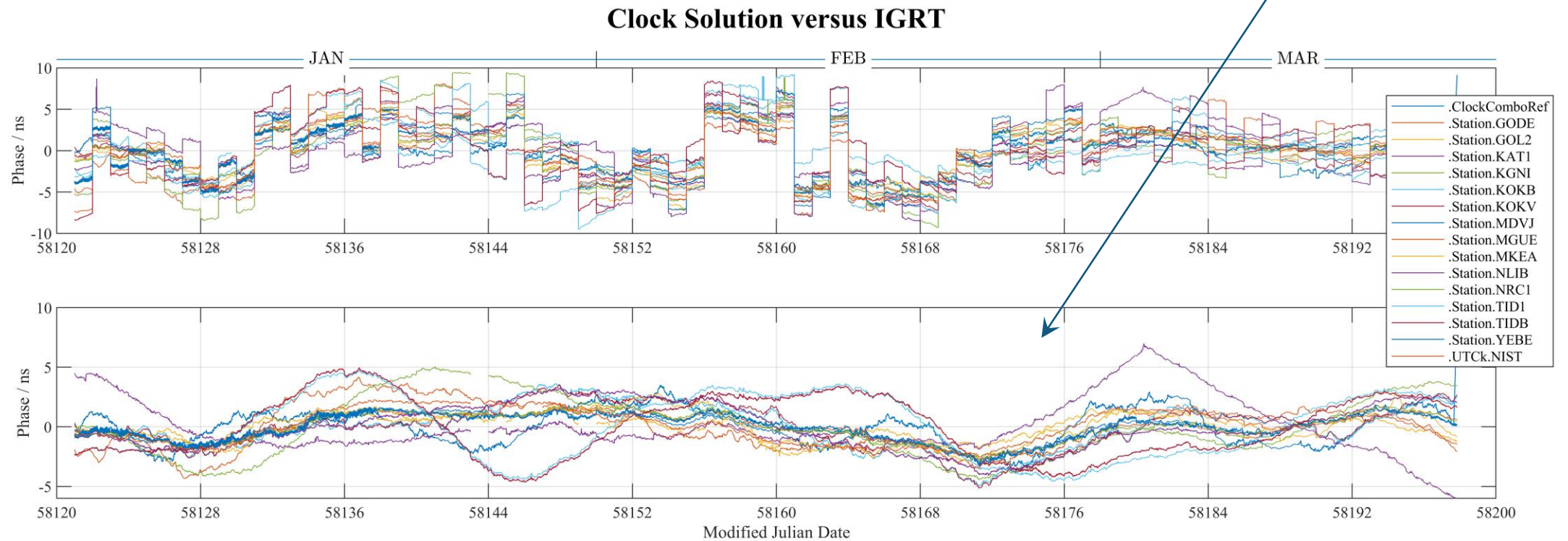
Clock Exchange File Update

- Updates to Clock Exchange Format is allowing records containing more information which could be added to the existing CLK file, or contained separately.

- Day boundary jumps (as seen on last page) could be helpful to users interested in a continuous clock series.

- Calibration data could be helpful for certain ground stations.

- Clock Ensemble generates clock frequency estimates, which already have an allocated (but unused!) field.

The Saga of Leap Seconds

The IGS adopted a position that favors no additional discontinuities (leap seconds) in UTC − GNSST owing to:

- Differing implementations of leap seconds in each GNSS.
- Continual update of leap second records and file format documentation.
- Difference between IGS time tags and UTC change over time-- not desirable.
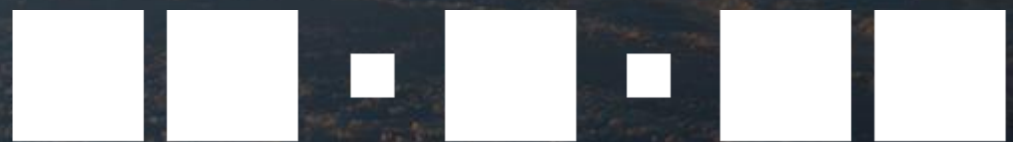- Hardware malfunctions that can occur as a result of leap second insertions.

Conference General des Poids et Mesures (CGPM) adopted Resolution 4 in November 2022 deciding that:

The maximum value of UT1 − UTC

shall increase in or before 2035.

- To be done in consultation with the ITU and other affected organizations to agree upon a new maximum value and an implementation plan.

Ref: Resolutions of the General Conference of Weights and Measures (27th Meeting), 15 − 18 November 2022.

IGS INTERNATIONAL GNSS SERVICE

Future **Work**

- Near Term Goals

  - Finalize timescale computations with ground station clocks.

  - Work with PPP-AR to determine any possible mitigation to clock day boundary jumps.

- Long Term Goals

  - WG noted possibility of multiple clock files depending on signal frequency combination; discussion needed with Bias & Calibration WG as well as PPP-AR WG.

- Working goals aim to establish multi-GNSS clock solutions and enhance the types of products that can help the community better utilize the rapid and final clock solutions.

Thank You!

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