A Clock Performance Analysis of GNSS Receivers with CORS

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Introduction

Typically, the clock offset of the receiver is treated as an unknown parameter to be determined alongside the three-dimensional coordinates of the station. Despite the existence of minimum requirements for receiver clocks, variations in clock quality persist across different receiver models.

Introduction-2

In this study, clock corrections derived from the post-processed Precise Point Positioning (PPP) procedure were employed to assess the performance of clocks installed on three distinct receivers.

The Data and Analysis

- NYCU: Trimble NetR9
- NTOU: Septentrio Mosaic X5, version 4.12.1
- PARK (Geoscience Australia): Septentrio PolaRx5TR + an external H-Maser, manufactured by Vremya CH, providing a frequency at 10 Hz

The Data and Analysis-2

Ten-day observations from each station in 2023 were collected for processing. Processed with. The ITRF reference frame was chosen, and the data were processed in static mode, with the sampling interval automatically set to 30 seconds by CSRS-PPP.

The data used

CORS	DOY	Sampling interval
PARK	271-280	30 sec
NTOU	336-338; 340-346	1 sec
NYCU	294-296; 298-304	1 sec

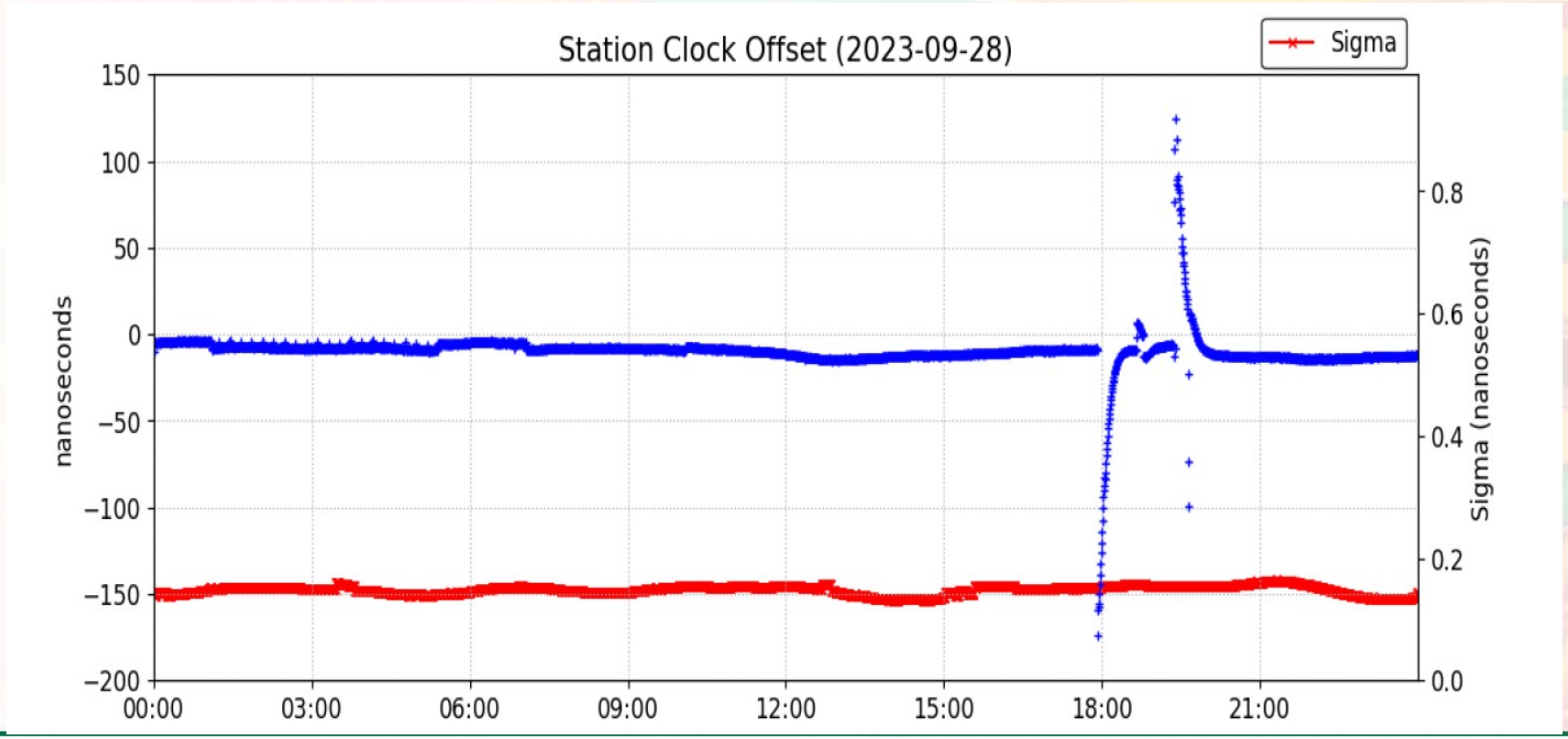
The Sigma (95%) from a daily solution (in m)

CORS	DOY	n	e	h
PARK	271	0.002	0.002	0.008
NTOU	336	0.002	0.002	0.010
NYCU	294	0.002	0.002	0.008

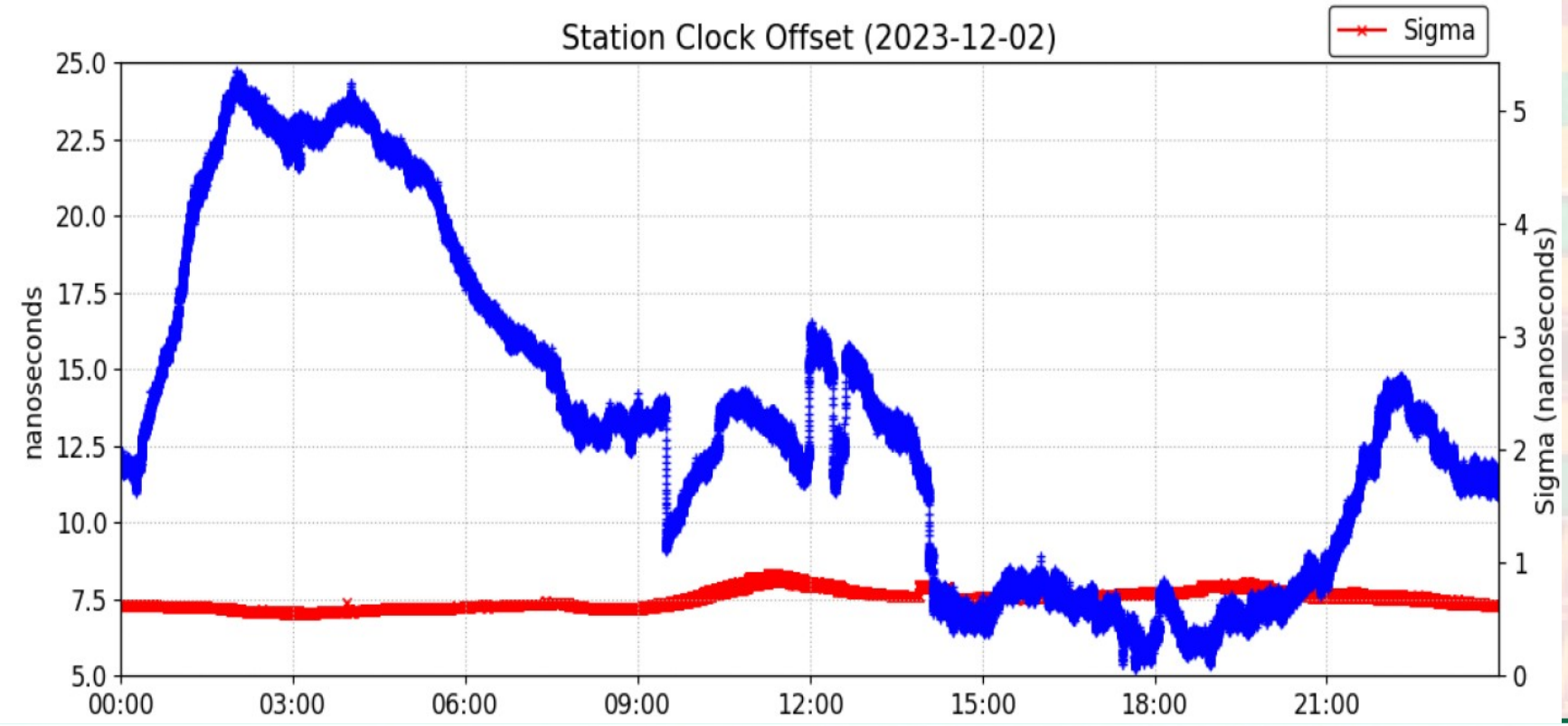
Clock offsets

The CSRS-PPP PDF report includes a representation of the clock offset time series.

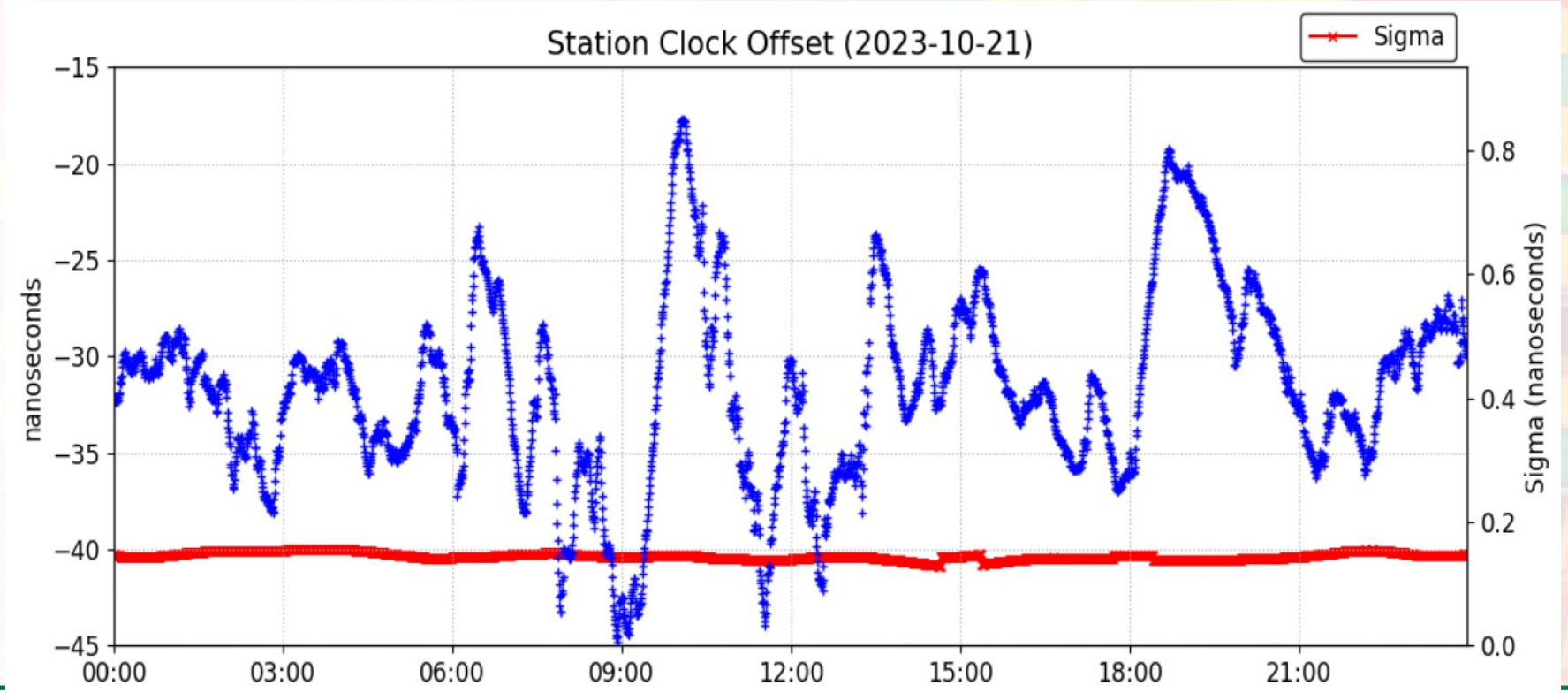
Station Clock Offset, PARK, DOY:271



Station Clock Offsets, NTOU, DOY:336



Station Clock Offset, NYCU, DOY:294



Clock offsets

Upon scrutinizing the clock offset values, it is evident that the PARK station exhibits the smallest magnitude among the three, followed by NTOU, and then NYCU.

Allan deviation

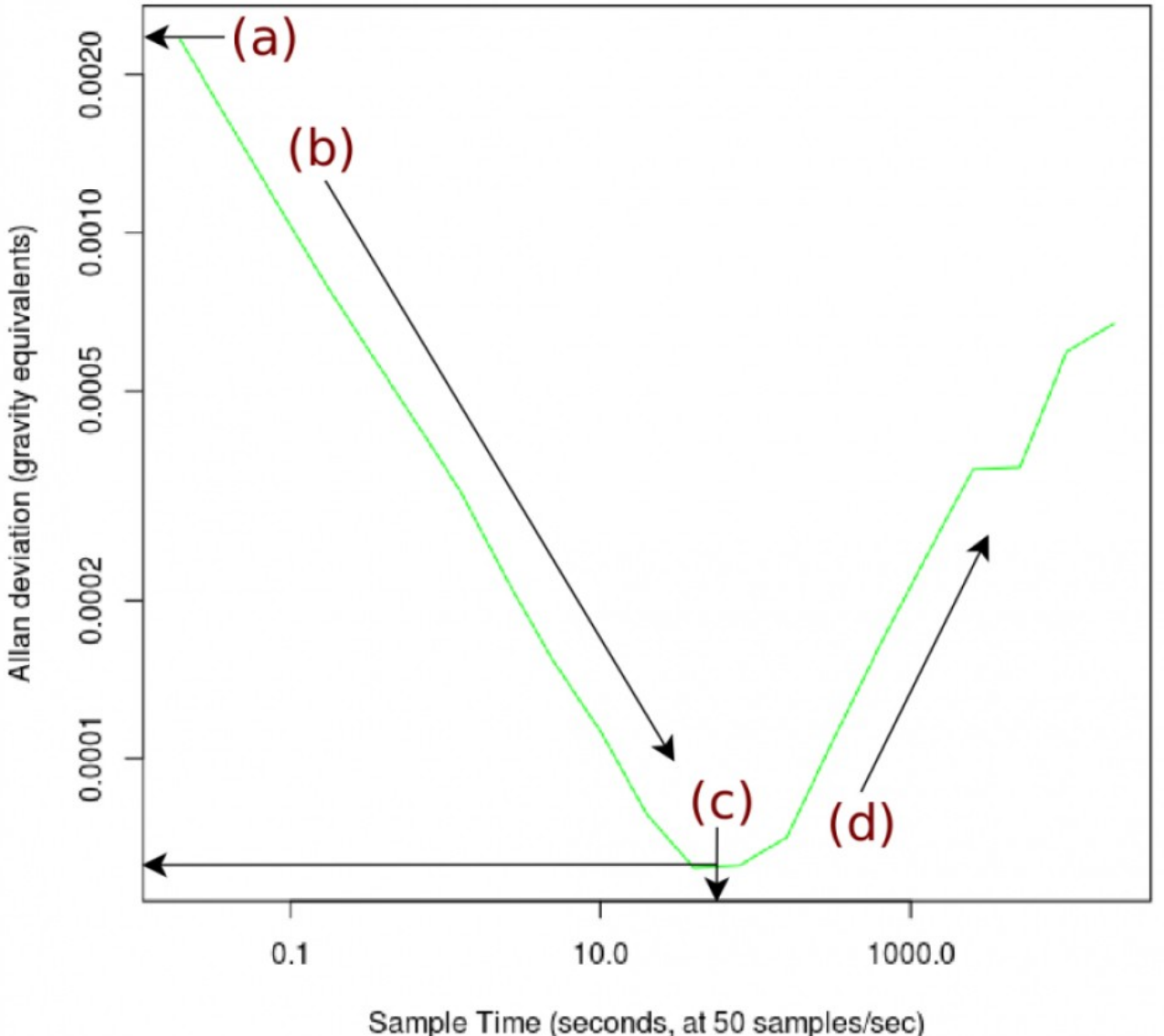
Within the output files generated by CSRS-PPP, there exists a .clk file formatted in RINEX_CLOCK. This file contains information on the receiver clock offset and the clock offset sigma (95%) for each processed epoch. In this study, the clock offset data extracted from the .clk file is subjected to evaluation using Allan variance, facilitated by the application of Stable32 (http://www.stable32.com/).

Point A-This y-axis value is the standard deviation of noise for any one single measurement point.

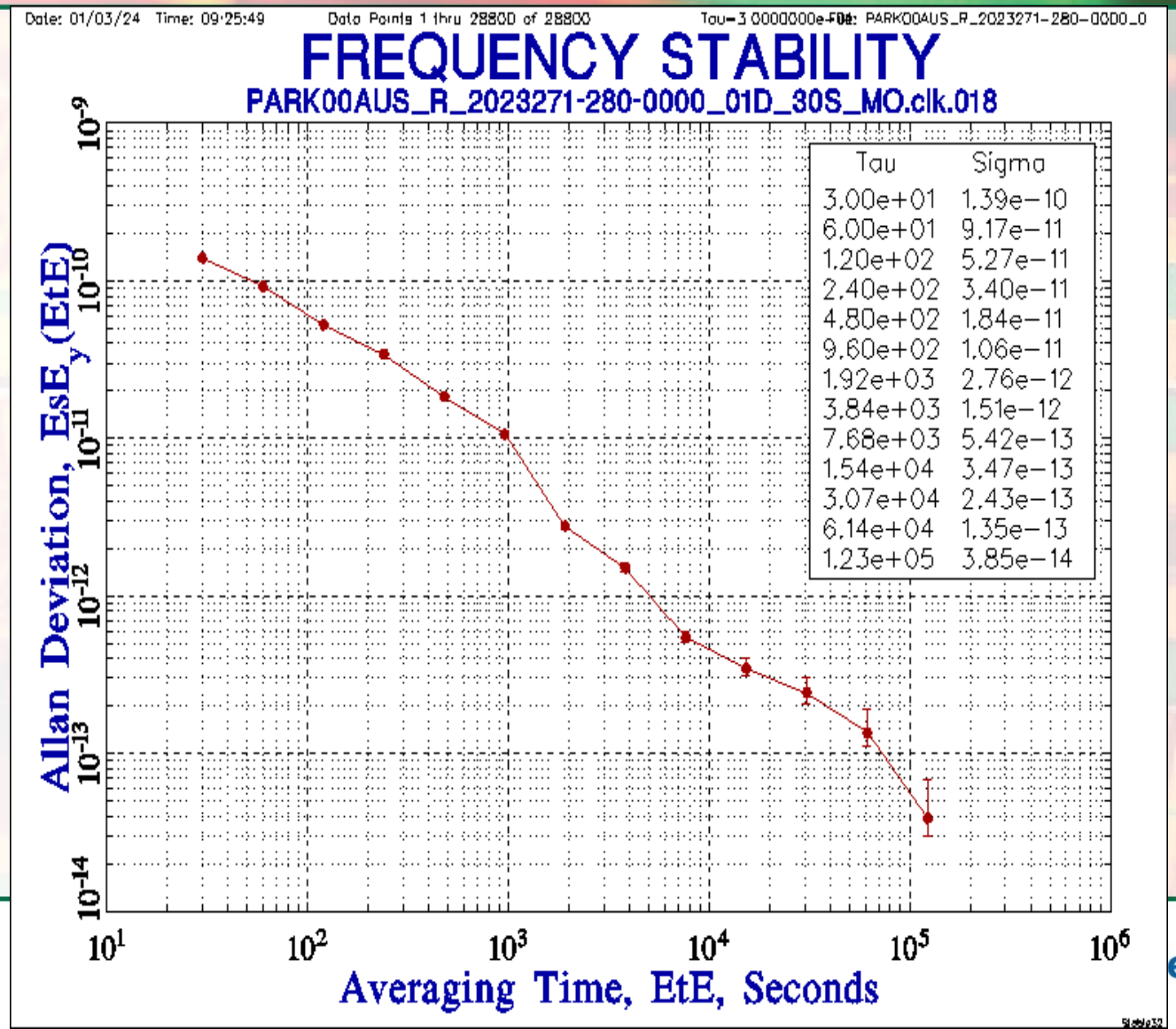
Point B-Averaging over the time spans along the decreasing slope corrects noise which oscillates quickly.

Point C-Eventually, you average enough that the fast-oscillating noise is mostly corrected for. This minimum has both an X and Y value of interest.

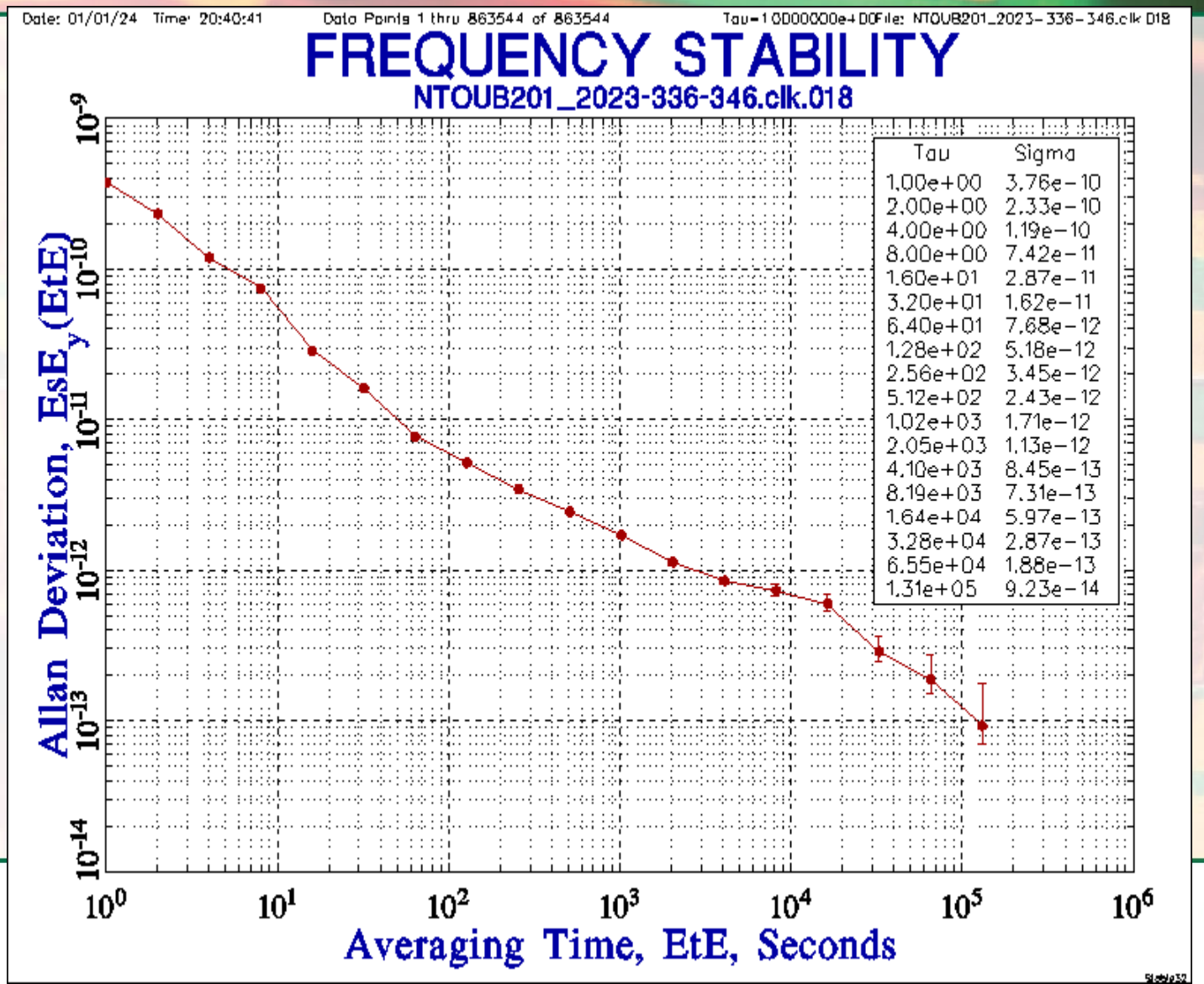
Point D-Noise which oscillates over longer time frames begins to influence bigger groups of averaged data.



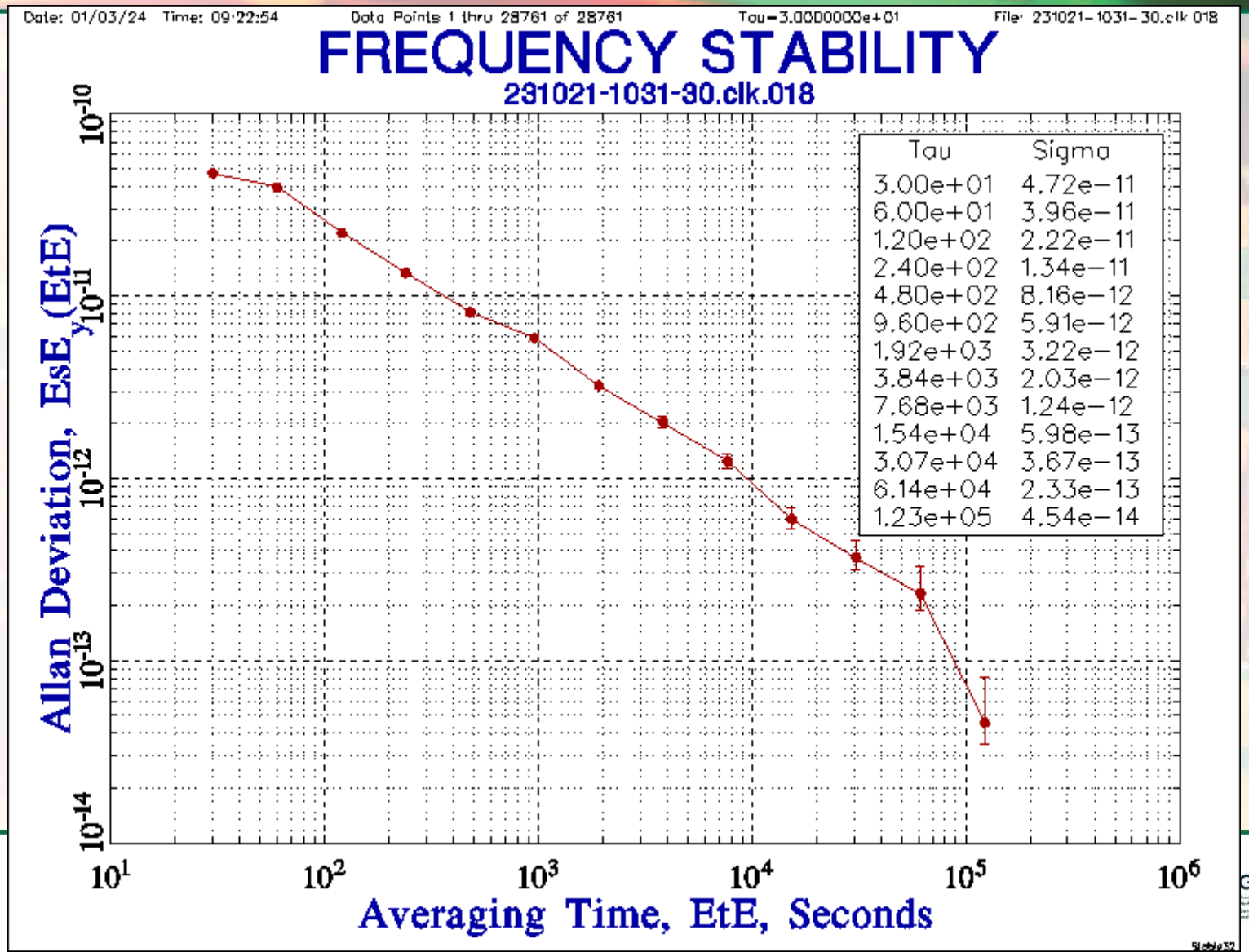
PARK, 10 days, Allan deviation



NTOU, 10 days, Allan deviation



NYCU, 10 days, Allan deviation



Concluding Remarks

In the conducted experiments, all three stations exhibited no reverse point in their Allan deviation plots with 10 days clock offsets derived from CRSR-PPP. From the perspective of Allan deviation, the behaviors of the three distinct receiver models and settings appeared similar. Further evaluation is necessary to determine if an external H-Maser clock could enhance performance.