## A Brock Performance Analysis of GNSS Receivers with CORS

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#### Outline

- Introduction
- The Data and Analysis
  - Clock offsets
  - Allan deviations
- Concluding remarks









### 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.







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#### 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.









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### **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







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### 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.









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#### 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	









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

CORS	DOY	n	е	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







# FIG 19-24 May Vour World, Our World: Accra, Ghana Vour World, Our World: Resilient Environment and Sustainable Resource Management for All

### **Clock offsets**

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









# FIG 19-24 May Vour World, Our World: Accra, Ghana Vour World, Our World: Resilient Environment of All

#### Station Clock Offset, PARK, DOY:271



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# FIG 19-24 May Vour World, Our World: Accra, Ghana Vour World, Our World: Resilient Environment of All

### Station Clock Offsets, NTOU, DOY:336







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### Station Clock Offset, NYCU, DOY:294



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### **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 (<u>http://www.stable32.com/</u>).





#### FIG Norking Week 2024 19-24 May Accra, Ghana Your World, Our World: Accra, Ghana Your World, Our World: Resilient Environment or All

**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.



Sample Time (seconds, at 50 samples/sec)



## PARK, 10 days, Allan deviation





### NTOU, 10 days, Allan deviation



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#### Your World, Our World: FIG Working Week 2024 **Resilient Environment** and Sustainable **Resource Management** 19-24 May Accra, Ghana for All Date: 01/03/24 Time: 09/22:54 File: 231021-1031-30.clk 018 FREQUENCY STABILITY NYCU, 10 days, 231021-1031-30.clk.018 <u>10</u>-\*\*\*\*\*\* Sigma Tau **Allan deviation** 4.72e-11 3.00e+01 $6.00e \pm 01$ 3.96e - 112.22e-11 $1.20e \pm 02$ (EfE) 2.40e+02 1.34e-11 4.80e+02 8.16e-12 5.91e-12 9.60e+02 ESE $1.92e \pm 0.3$ 3.22e-12 3.84e+03 2.03e-12 7.68e+03 1.24e-12 5.98e-13 1.54e+04 Deviation, 3.67e-13 3.07e+04 2.33e-13 $6.14e \pm 04$ 4.54e-14 1.23e+05 Allan 10<sup>-13</sup> 10<sup>-14</sup> 10<sup>1</sup> $10^{2}$ $10^{3}$ $10^{4}$ 105 10<sup>6</sup> Averaging Time, EtE, Seconds

# FIG 19-24 May Vour World, Our World: Accra, Ghana Vour World, Our World: Resilient Environment and Sustainable Resource Management for All

### **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.



