Fetch AZA: Data Processing

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Logged Data - Sensors

- Exported data from the software is a CSV file type.

- File contains a header with the record formats

- Each sensor logged will create a new record on a separate line with its own identifier. E.g. TMP for Temperature

- Each record will contain an individual timestamp, serial number and the data fields.

- 8318 file specification provides details regarding the data formatting along with timestamp format, units and decimal place information.

```
PAG,Record Time,Retrieval Time,Node Ref,UID,Page Number
BAT,Record Time,Retrieval Time,Node Ref,UID,UsedPercentage %,Volts V
INC,Record Time,Retrieval Time,Node Ref,UID,Index,Pitch (deg),Roll (deg),Serial Number
TIM,Record Time,Retrieval Time,Node Ref,UID
TMP,Record Time,Retrieval Time,Node Ref,UID,Index,Temperature Deg C,Serial Number
DQZ,Record Time,Retrieval Time,Node Ref,UID,Index,Pressure (kPa),Temperature (Deg C),Serial Number
KLR,Record Time,Retrieval Time,Node Ref,UID,Index,Pressure (kPa),Temperature (Deg C),Serial Number
# Data
PAG,2021/08/27 10:30:00,2021/12/14 14:54:19,,0064E4,630
KLR,2021/08/27 10:30:00,2021/12/14 14:54:19,,0064E4,5,127.17340,21.720,59891
TIM,2021/08/27 11:30:00,2021/12/14 14:54:19,,0064E4
BAT,2021/08/27 11:30:00,2021/12/14 14:54:19,,0064E4,2,14.2
TMP,2021/08/27 11:30:00,2021/12/14 14:54:19,,0064E4,4,-246.8610,0
INC,2021/08/27 11:30:00,2021/12/14 14:54:19,,0064E4,1,-3.9438,4.4688,0
DQZ,2021/08/27 11:30:00,2021/12/14 14:54:19,,0064E4,3,138.89453,22.05,136594
KLR,2021/08/27 11:30:00,2021/12/14 14:54:19,,0064E4,5,127.34812,21.729,59891
TIM,2021/08/27 12:30:00,2021/12/14 14:54:19,,0064E4
TMP,2021/08/27 12:30:00,2021/12/14 14:54:19,,0064E4,4,-246.8610,0
DQZ,2021/08/27 12:30:00,2021/12/14 14:54:19,,0064E4,3,138.88792,22.05,136594
KLR,2021/08/27 12:30:00,2021/12/14 14:54:19,,0064E4,5,127.73521,21.767,59891
TIM,2021/08/27 13:30:00,2021/12/14 14:54:19,,0064E4
TMP,2021/08/27 13:30:00,2021/12/14 14:54:19,,0064E4,4,-246.8610,0
DQZ,2021/08/27 13:30:00,2021/12/14 14:54:19,,0064E4,3,138.91096,22.05,136594
KLR,2021/08/27 13:30:00,2021/12/14 14:54:19,,0064E4,5,127.34602,21.707,59891
TIM,2021/08/27 14:30:00,2021/12/14 14:54:19,,0064E4
TMP,2021/08/27 14:30:00,2021/12/14 14:54:19,,0064E4,4,-246.8610,0
DQZ,2021/08/27 14:30:00,2021/12/14 14:54:19,,0064E4,3,138.89693,22.05,136594
KLR,2021/08/27 14:30:00,2021/12/14 14:54:19,,0064E4,5,127.59645,21.722,59891
```

AZA Data Format

• Each AZA event will contain 5 logged records, 2x AZS records and 3x AZA records.

• AZS – status record, occurs at the start and end of the AZA event, averaged pressure readings,

    - used to indicate if there are any issues caused by the AZA cycle.

• AZA readings are averaged pressure readings and occur during each stage of the AZA cycle.

• 3 AZA records per event, first with the Quartz pressure sensor at high (ambient), the second after the quartz sensor is at the barometer pressure and the third when the quartz sensor is back at ambient pressure.

```
AZS,2021/05/11 01:30:20,2021/12/03 21:12:15,166,00530C,1,0.0,4000,8039,9059.30273,5.298,136405,9060.35156,5.322,5232045,98.12901,-9999.000,10116141
AZA,2021/05/11 01:30:20,2021/12/03 21:12:15,166,00530C,1,31.4,4023,8039,9059.13477,5.307,136405,9060.42676,5.338,5232045,98.13000,-9999.000,10116141,0.00004,-0.006
AZA,2021/05/11 01:30:20,2021/12/03 21:12:15,166,00530C,1,310.4,4053,8036,94.48977,5.350,136405,9060.62891,5.527,5232045,94.82000,-9999.000,10116141,0.00000,0.002
AZA,2021/05/11 01:30:20,2021/12/03 21:12:15,166,00530C,1,1105.4,4083,8039,9058.65820,5.480,136405,9060.73340,5.812,5232045,98.40800,-9999.000,10116141,0.00005,0.000
AZS,2021/05/11 01:30:20,2021/12/03 21:12:15,166,00530C,1,1117.6,4001,9439,9058.66992,5.481,136405,9060.73926,5.815,5232045,98.41100,-9999.000,10116141
```

Prototype AZA field record
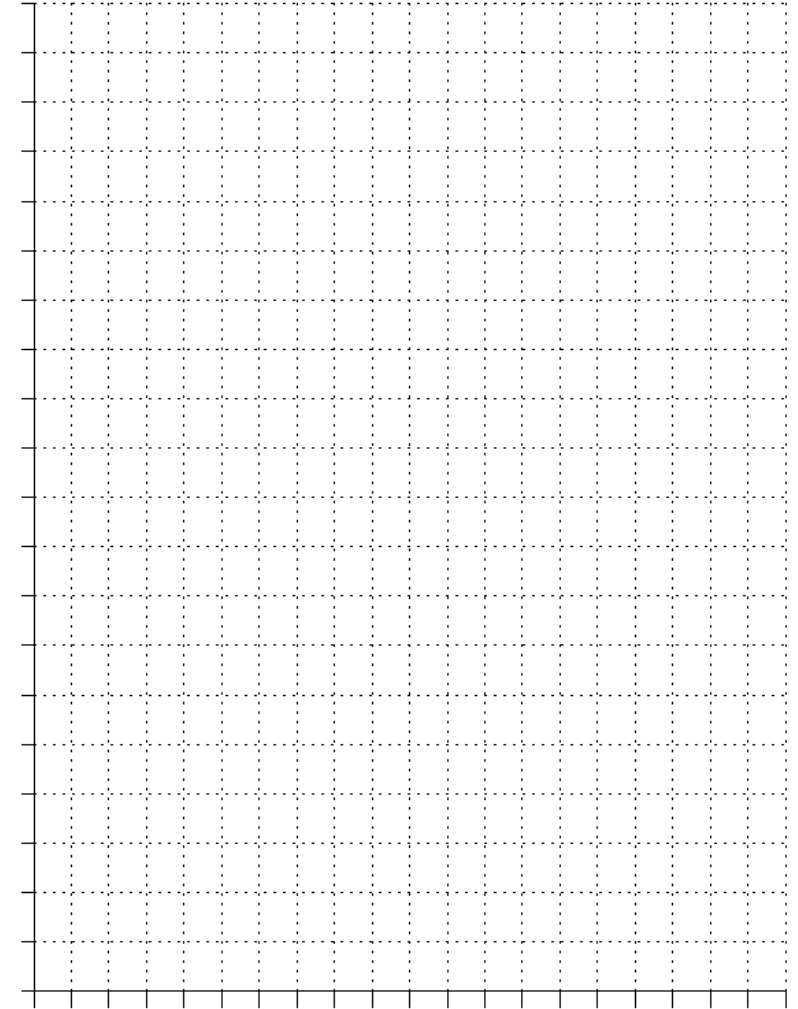
Deployed July 2017

Water depth c. 1000 m

Dual layer battery 504 Ah

AZA cycles completed = 230

Battery usage = 33% over 6 years

Data not permitted to be shared

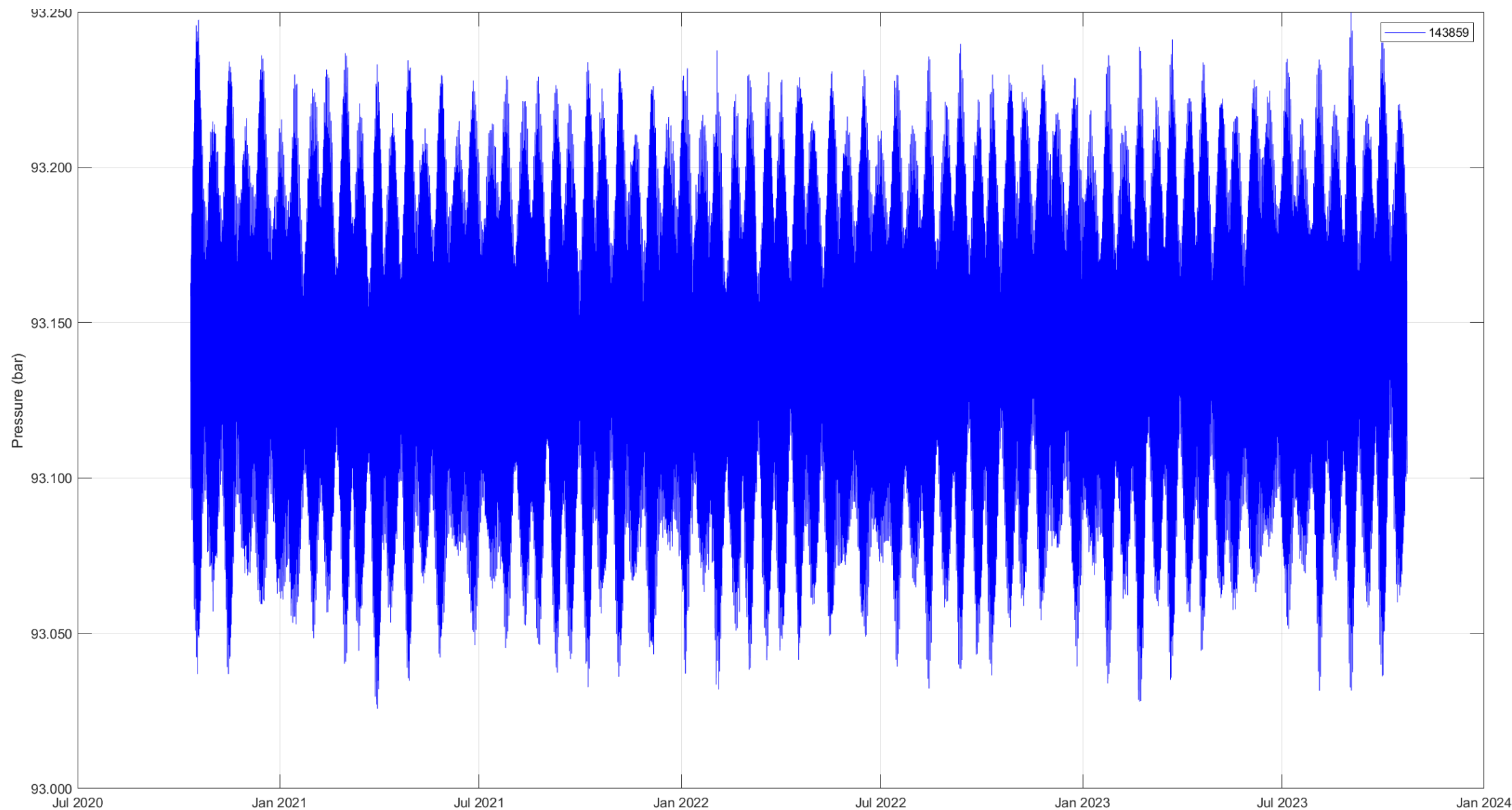## Deployed October 2020

Water depth c. 900 m

Dual layer battery 504 Ah
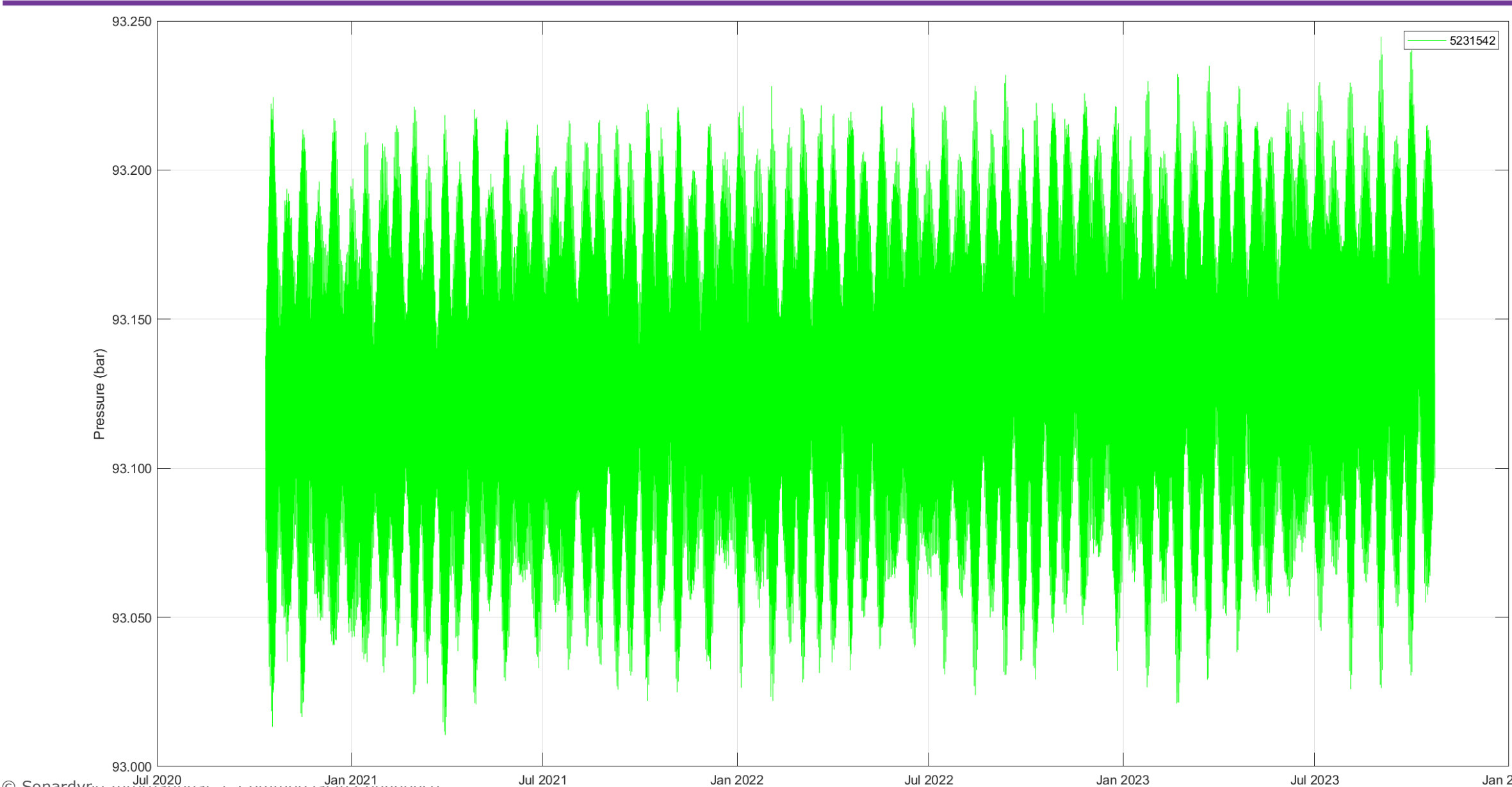
AZA cycles completed = 95
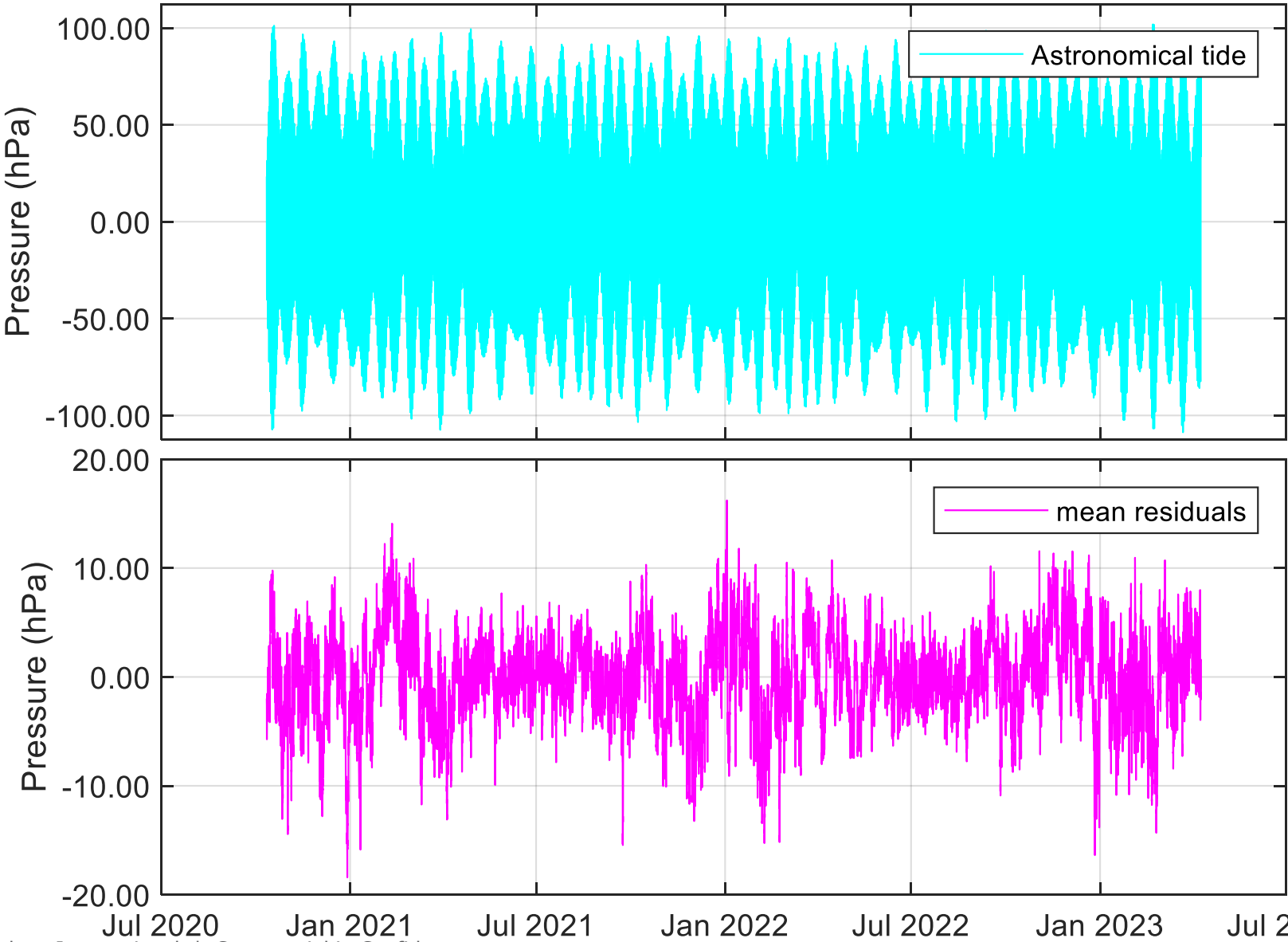
Battery usage = 12% over 3 years

By kind permission of AS Norske Shell, data from 5 AZA
units is shared here.

Absolute pressure - Digiquartz

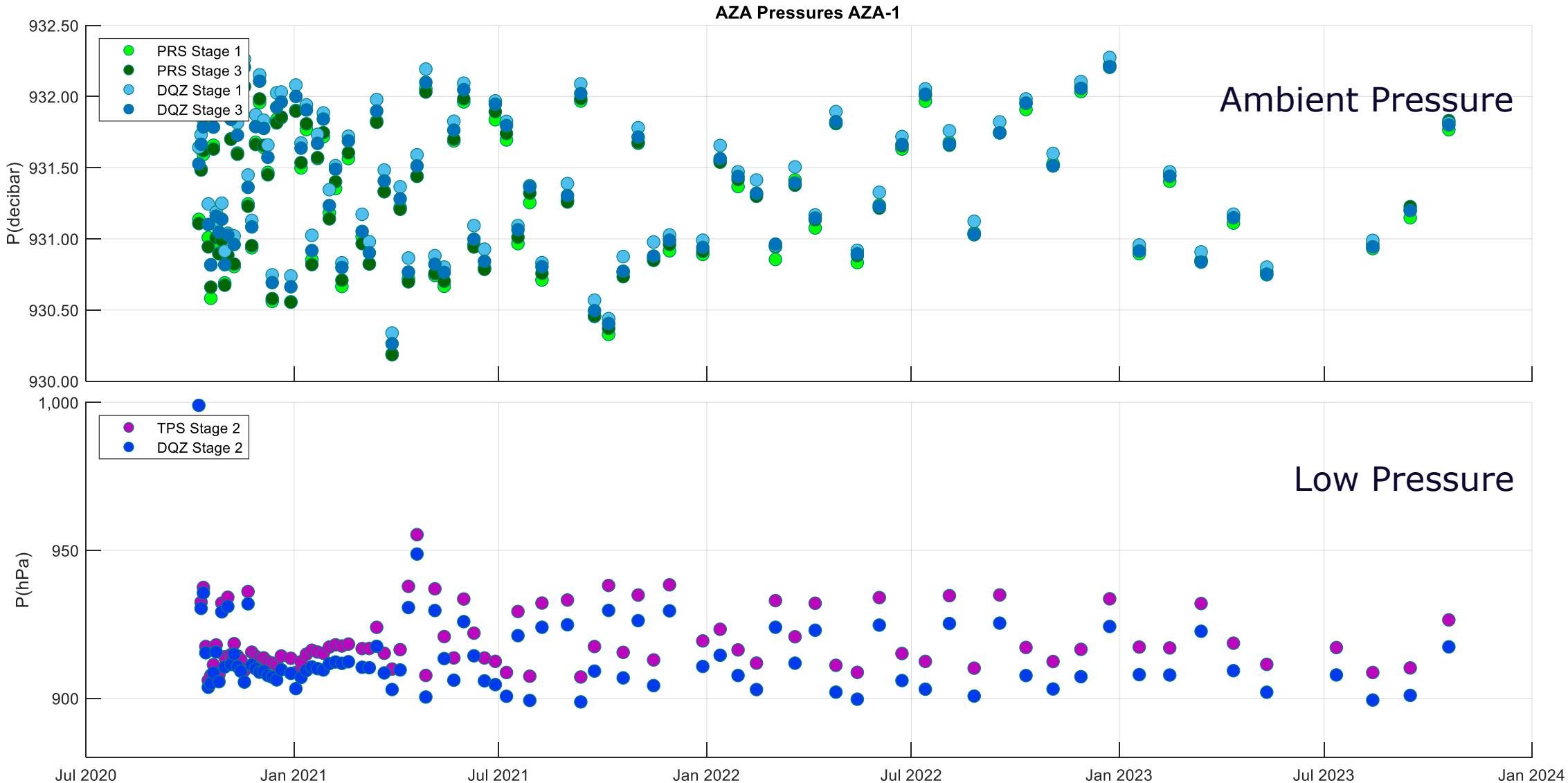# Absolute pressure – Presens

Tidal analysis and removal
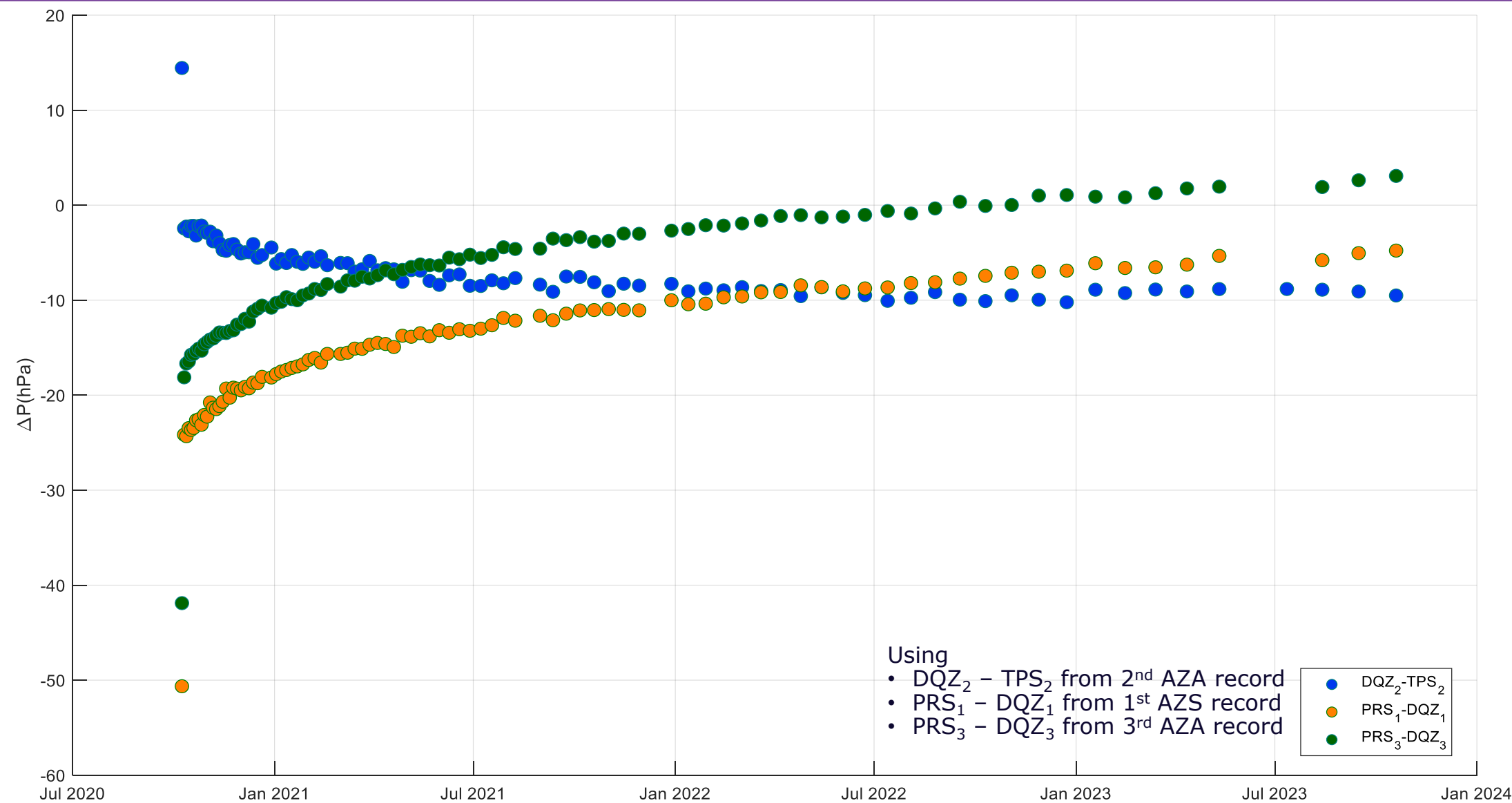
Using all detrended DQZ data from the 5 AZAs

(Alternative is to have a reference Fetch outside the dynamic area)

The average of the residuals after removing astronomic/harmonic tides give the environmental tides, metocean effects.
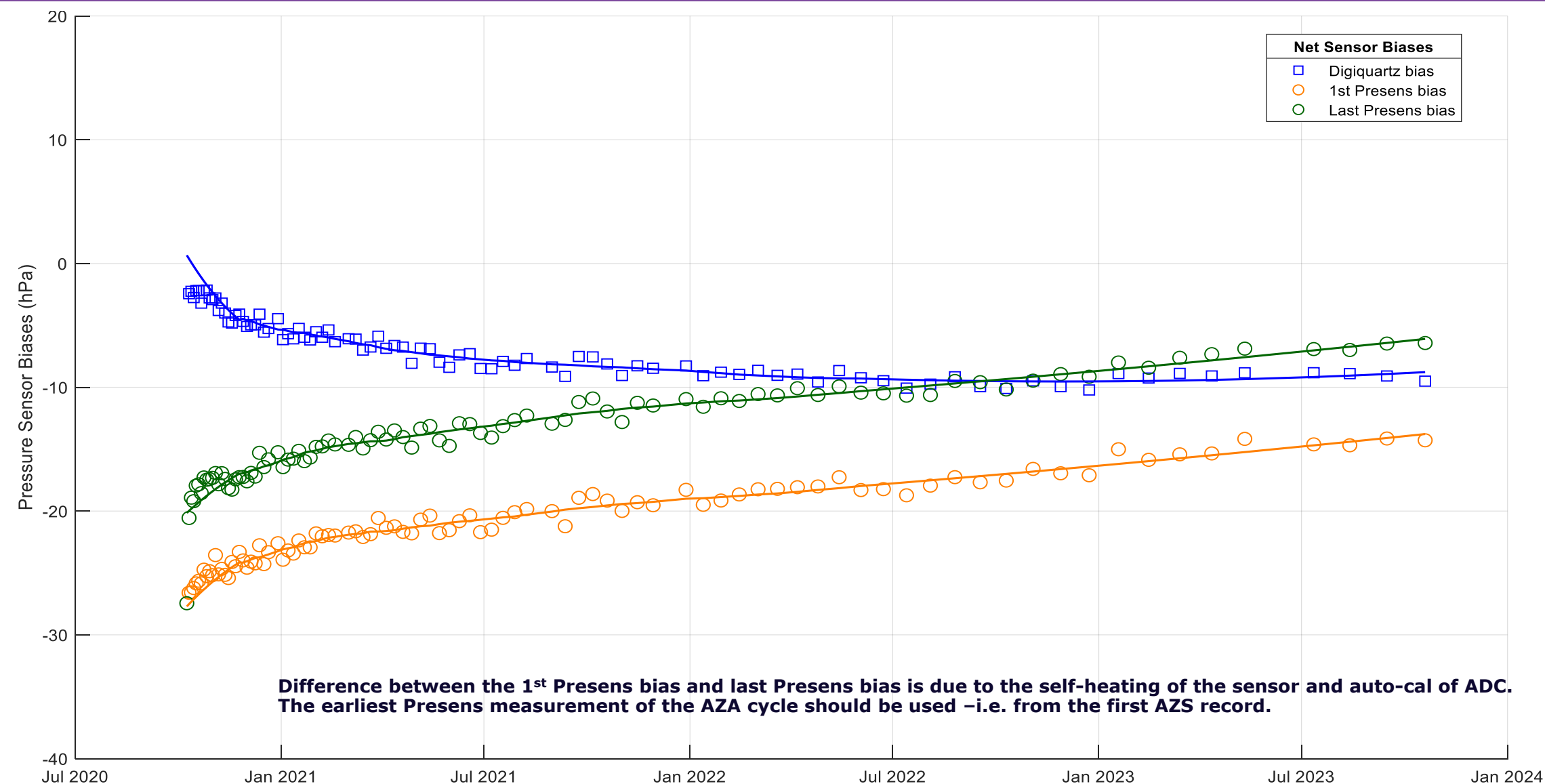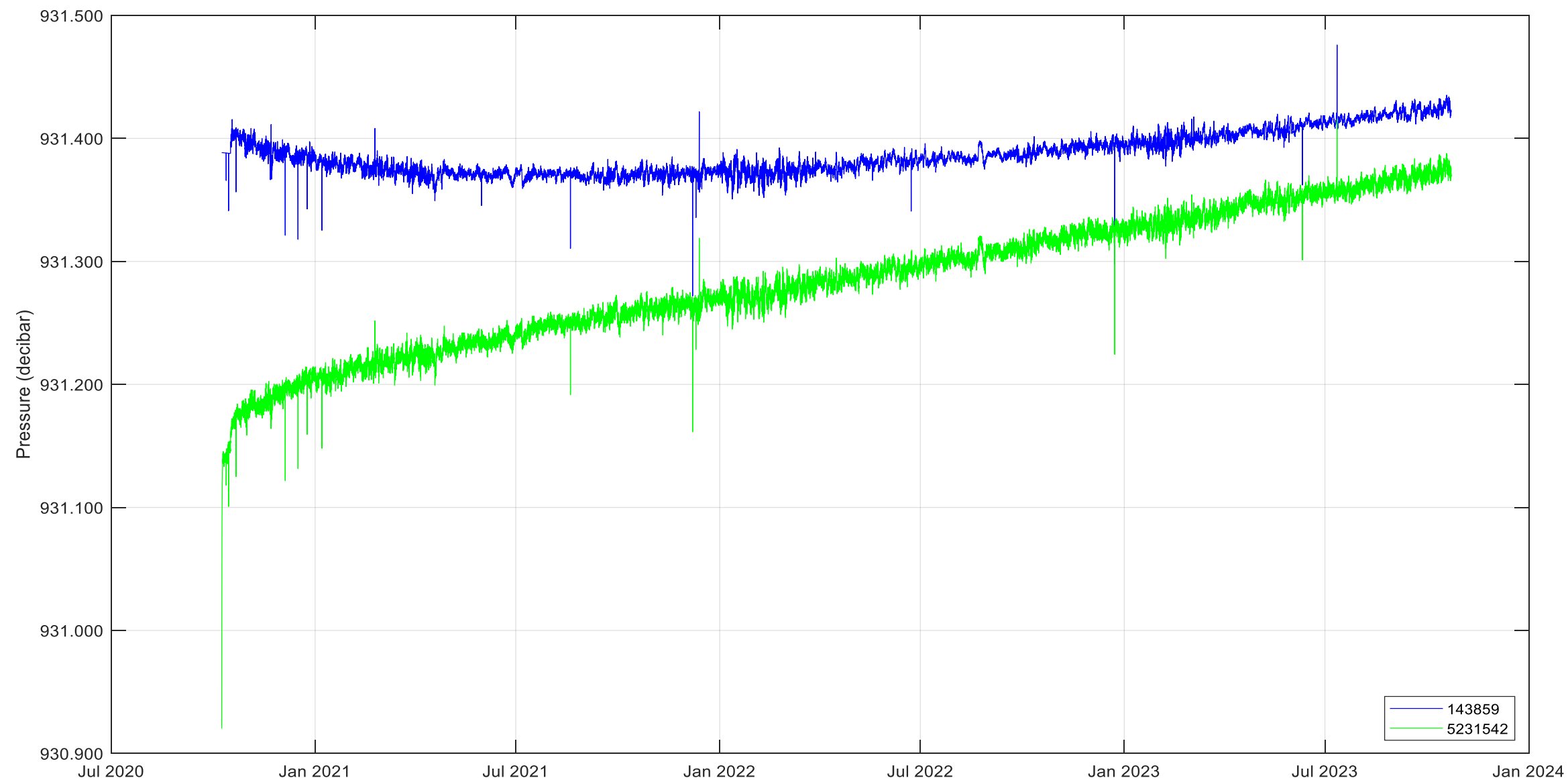
1 hPa ~ 1 cm

Raw AZA measurements

AZA Pressures AZA-1

Ambient Pressure

Legend:
- PRS Stage 1
- PRS Stage 3
- DQZ Stage 1
- DQZ Stage 3

Low Pressure

Legend:
- TPS Stage 2
- DQZ Stage 2

Differenced AZA Measurements

Using
- $DQZ_2 - TPS_2$ from 2nd AZA record
- $PRS_1 - DQZ_1$ from 1st AZS record
- $PRS_3 - DQZ_3$ from 3rd AZA record

Legend:
- DQZ_2-TPS_2
- PRS_1-DQZ_1
- PRS_3-DQZ_3

Unfiltered Residuals – tides removed

Filtered Residuals (1 day moving average) – with and without biases removed

diff 0.01 +/- 0.55 hPa

Legend:
- DQZ - bias
- DQZ
- Presens
- Presens - bias

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Summary
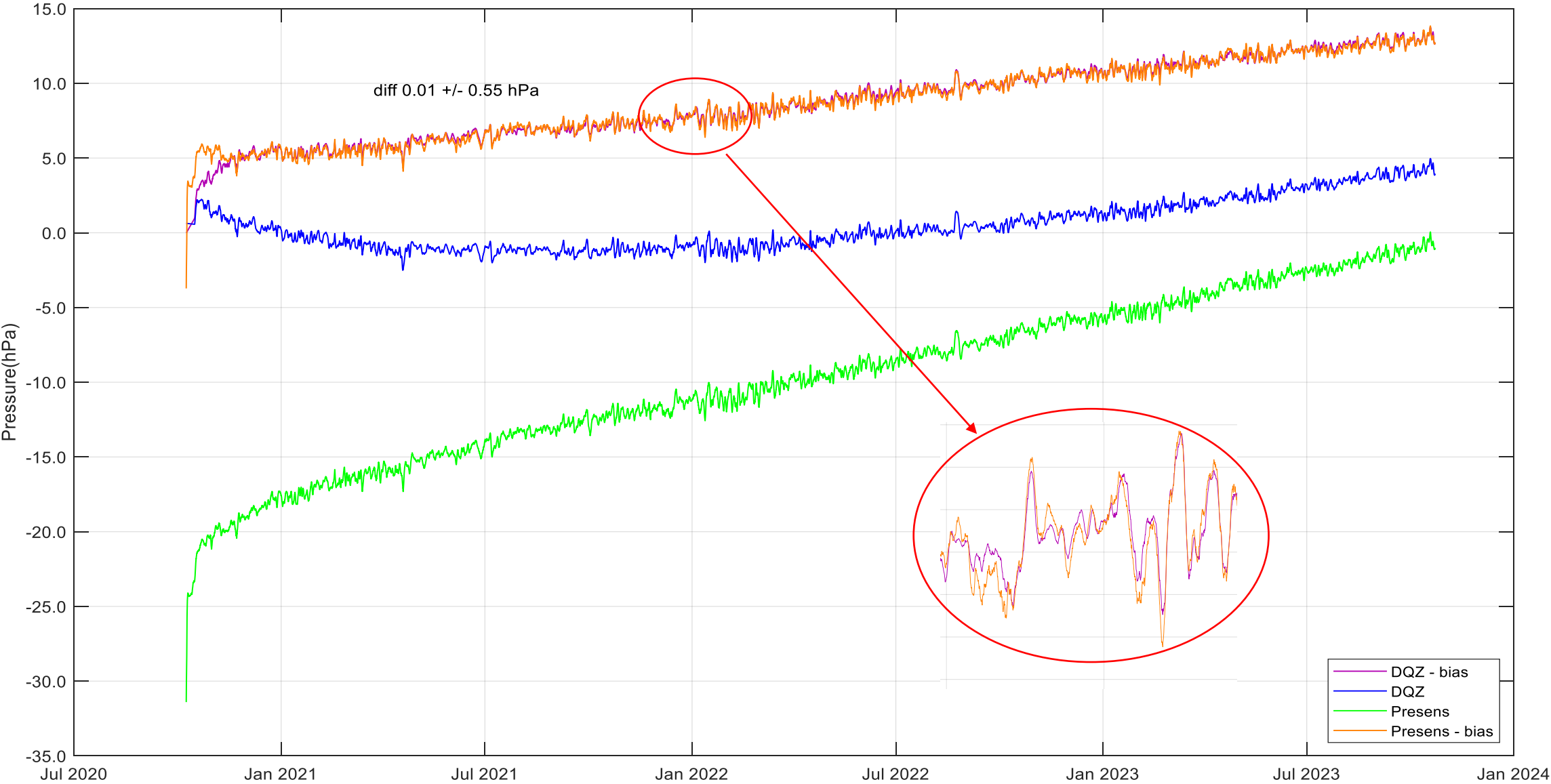
1. QC and remove any bad data

2. Calculate the astronomical tides, and possibly environmental tides

3. Subtract the tides

4. Calculate the sensor biases and interpolated sensor biases.

5. Subtract the biases

6. Apply a suitable filter to the residuals

Removing the tides before calculating the biases is best as the tide can be observed to move during the AZA cycle

Thank you for your time today

Any questions?

Contact Nick Street:

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