Extreme Energy Events Project @ ICD 2026
January 2026 Forbush decrease

Using data collected by the EEE MRPC telescopes to study the Forbush decrease observed between 19 and 20 January 2026.

Data

For this analysis, we will use data from the EEE Data Quality Monitor (DQM), available at https://iatw.cnaf.infn.it/eee/monitor/. Data may be downloaded either in CSV format (for analysis with Excel or equivalent software) or in ROOT format.

IMPORTANT NOTES

1. **The instructions below refer to analyses performed with Excel (English-language version)**
2. **These instructions are intended as a starting point for developing the analysis.**
3. **DQM files cover a 10-day period. For example, AREZ-01_2026-01-15_2026-01-24_summary_Trending.csv contains trending data from the Arezzo telescope from 15 to 24 January 2026.**

The following table lists several telescopes and provides direct links to the corresponding DQM trending files. You may analyse one or more telescopes.

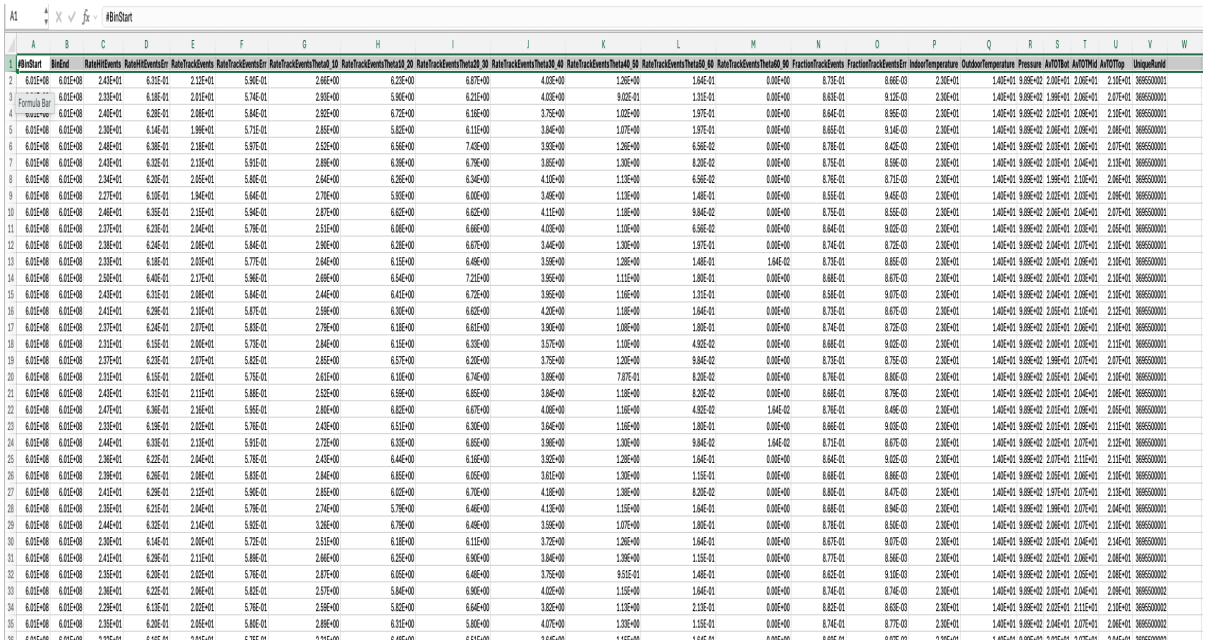
TELESCOPE	DQM file link
AREZ-01	https://iatw.cnaf.infn.it/eee/monitor/dqmreport/AREZ-01/2026-01-24/AREZ-01_2026-01-15_2026-01-24_summary_Trending.csv
BOLO-01	https://iatw.cnaf.infn.it/eee/monitor/dqmreport/BOLO-01/2026-01-24/BOLO-01_2026-01-15_2026-01-24_summary_Trending.csv
BOLO-05	https://iatw.cnaf.infn.it/eee/monitor/dqmreport/BOLO-05/2026-01-24/BOLO-05_2026-01-15_2026-01-24_summary_Trending.csv
CARI-01	https://iatw.cnaf.infn.it/eee/monitor/dqmreport/CARI-01/2026-01-24/CARI-01_2026-01-15_2026-01-24_summary_Trending.csv
FERM-01	https://iatw.cnaf.infn.it/eee/monitor/dqmreport/FERM-01/2026-01-24/FERM-01_2026-01-15_2026-01-24_summary_Trending.csv
LECC-01	https://iatw.cnaf.infn.it/eee/monitor/dqmreport/LECC-01/2026-01-24/LECC-01_2026-01-15_2026-01-24_summary_Trending.csv
PISA-01	https://iatw.cnaf.infn.it/eee/monitor/dqmreport/PISA-01/2026-01-24/PISA-01_2026-01-15_2026-01-24_summary_Trending.csv
POLA-01	https://iatw.cnaf.infn.it/eee/monitor/dqmreport/POLA-01/2026-01-24/POLA-01_2026-01-15_2026-01-24_summary_Trending.csv
POLA-02	https://iatw.cnaf.infn.it/eee/monitor/dqmreport/POLA-02/2026-01-24/POLA-02_2026-01-15_2026-01-24_summary_Trending.csv
POLA-03	https://iatw.cnaf.infn.it/eee/monitor/dqmreport/POLA-03/2026-01-24/POLA-03_2026-01-15_2026-01-24_summary_Trending.csv
POLA-04	https://iatw.cnaf.infn.it/eee/monitor/dqmreport/POLA-04/2026-01-24/POLA-04_2026-01-15_2026-01-24_summary_Trending.csv
REND-01	https://iatw.cnaf.infn.it/eee/monitor/dqmreport/REND-01/2026-01-24/REND-01_2026-01-15_2026-01-24_summary_Trending.csv
SALE-03	https://iatw.cnaf.infn.it/eee/monitor/dqmreport/SALE-03/2026-01-24/SALE-03_2026-01-15_2026-01-24_summary_Trending.csv
VICE-01	https://iatw.cnaf.infn.it/eee/monitor/dqmreport/VICE-01/2026-01-24/VICE-01_2026-01-15_2026-01-24_summary_Trending.csv

The first telescope in the table, AREZ-01, is used as the worked example in these instructions.

After downloading the CSV file:

1- - Make a backup copy and add *orig* to the filename, so that the original data are preserved.
2- - Open the copy without *orig* in its filename.

To open the file in Excel, double-click the file. If this does not work, right-click the filename and select "Open with" → "Excel".
The file should appear as shown in the following figure:



#BinStart	BinEnd	RateHitEvents	RateHitEventsErr	RateTrackEvents	RateTrackEventsErr	RateTrackEventsTheta0_10	RateTrackEventsTheta10_20	RateTrackEventsTheta20_30	RateTrackEventsTheta30_40	RateTrackEventsTheta40_50	RateTrackEventsTheta50_60	RateTrackEventsTheta60_90	FractionTrackEvents	FractionTrackEventsErr	IndoorTemperature	OutdoorTemperature	Pressure	AvTOTBot	AvTOTMid	AvTOTTop	UniqueRunId
6.01E+08	6.01E+08	2.43E+01	6.31E-01	2.12E+01	5.90E-01	2.66E+00	6.22E+00	6.07E+00	4.03E+00	1.26E+00	1.64E-01	0.00E+00	8.73E-01	8.66E-03	2.30E+01	1.40E+01	9.89E+02	2.00E+01	2.06E+01	2.16E+01	3695500001
6.01E+08	6.01E+08	2.35E+01	6.18E-01	2.01E+01	5.74E-01	2.93E+00	5.96E+00	6.21E+00	4.03E+00	9.02E-01	1.31E-01	0.00E+00	8.63E-01	9.12E-03	2.30E+01	1.40E+01	9.89E+02	1.99E+01	2.06E+01	2.07E+01	3695500001
6.01E+08	6.01E+08	2.40E+01	6.26E-01	2.06E+01	5.84E-01	2.92E+00	6.72E+00	6.16E+00	3.75E+00	1.02E+00	1.97E-01	0.00E+00	8.64E-01	8.95E-03	2.30E+01	1.40E+01	9.89E+02	2.02E+01	2.09E+01	2.16E+01	3695500001
6.01E+08	6.01E+08	2.26E+01	6.14E-01	1.99E+01	5.71E-01	2.85E+00	5.82E+00	6.11E+00	3.84E+00	1.07E+00	1.97E-01	0.00E+00	8.65E-01	9.14E-03	2.30E+01	1.40E+01	9.89E+02	2.06E+01	2.09E+01	2.08E+01	3695500001
6.01E+08	6.01E+08	2.48E+01	6.38E-01	2.18E+01	5.97E-01	2.52E+00	6.56E+00	7.40E+00	3.93E+00	1.26E+00	6.56E-02	0.00E+00	8.78E-01	8.42E-03	2.30E+01	1.40E+01	9.89E+02	2.03E+01	2.06E+01	2.07E+01	3695500001
6.01E+08	6.01E+08	2.43E+01	6.32E-01	2.13E+01	5.91E-01	2.89E+00	6.39E+00	6.79E+00	3.85E+00	1.30E+00	8.20E-02	0.00E+00	8.75E-01	8.59E-03	2.30E+01	1.40E+01	9.89E+02	2.03E+01	2.04E+01	2.13E+01	3695500001
6.01E+08	6.01E+08	2.34E+01	6.20E-01	2.05E+01	5.80E-01	2.64E+00	6.26E+00	6.34E+00	4.10E+00	1.13E+00	6.56E-02	0.00E+00	8.76E-01	8.71E-03	2.30E+01	1.40E+01	9.89E+02	1.99E+01	2.10E+01	2.06E+01	3695500001
6.01E+08	6.01E+08	2.27E+01	6.10E-01	1.94E+01	5.64E-01	2.70E+00	5.93E+00	6.00E+00	3.49E+00	1.13E+00	1.48E-01	0.00E+00	8.55E-01	9.45E-03	2.30E+01	1.40E+01	9.89E+02	2.02E+01	2.03E+01	2.06E+01	3695500001
6.01E+08	6.01E+08	2.46E+01	6.35E-01	2.15E+01	5.94E-01	2.87E+00	6.62E+00	6.62E+00	4.11E+00	1.18E+00	9.84E-02	0.00E+00	8.75E-01	8.55E-03	2.30E+01	1.40E+01	9.89E+02	2.06E+01	2.04E+01	2.07E+01	3695500001
6.01E+08	6.01E+08	2.37E+01	6.23E-01	2.04E+01	5.79E-01	2.51E+00	6.08E+00	6.66E+00	4.03E+00	1.10E+00	6.56E-02	0.00E+00	8.64E-01	9.02E-03	2.30E+01	1.40E+01	9.89E+02	2.00E+01	2.03E+01	2.05E+01	3695500001
6.01E+08	6.01E+08	2.38E+01	6.24E-01	2.08E+01	5.84E-01	2.90E+00	6.28E+00	6.67E+00	3.44E+00	1.30E+00	1.97E-01	0.00E+00	8.74E-01	8.72E-03	2.30E+01	1.40E+01	9.89E+02	2.04E+01	2.07E+01	2.10E+01	3695500001
6.01E+08	6.01E+08	2.33E+01	6.18E-01	2.03E+01	5.77E-01	2.64E+00	6.15E+00	6.49E+00	3.59E+00	1.28E+00	1.48E-01	1.64E-02	8.73E-01	8.85E-03	2.30E+01	1.40E+01	9.89E+02	2.00E+01	2.09E+01	2.10E+01	3695500001
6.01E+08	6.01E+08	2.50E+01	6.40E-01	2.17E+01	5.96E-01	2.89E+00	6.54E+00	7.21E+00	3.95E+00	1.11E+00	1.80E-01	0.00E+00	8.68E-01	8.67E-03	2.30E+01	1.40E+01	9.89E+02	2.00E+01	2.03E+01	2.10E+01	3695500001
6.01E+08	6.01E+08	2.41E+01	6.31E-01	2.08E+01	5.84E-01	2.44E+00	6.41E+00	6.72E+00	3.95E+00	1.16E+00	1.31E-01	0.00E+00	8.58E-01	9.07E-03	2.30E+01	1.40E+01	9.89E+02	2.04E+01	2.09E+01	2.10E+01	3695500001
6.01E+08	6.01E+08	2.41E+01	6.29E-01	2.10E+01	5.87E-01	2.59E+00	6.30E+00	6.62E+00	4.20E+00	1.18E+00	1.64E-01	0.00E+00	8.73E-01	8.67E-03	2.30E+01	1.40E+01	9.89E+02	2.05E+01	2.10E+01	2.12E+01	3695500001
6.01E+08	6.01E+08	2.37E+01	6.24E-01	2.07E+01	5.83E-01	2.79E+00	6.18E+00	6.61E+00	3.90E+00	1.06E+00	1.80E-01	0.00E+00	8.74E-01	8.72E-03	2.30E+01	1.40E+01	9.89E+02	2.03E+01	2.06E+01	2.16E+01	3695500001
6.01E+08	6.01E+08	2.31E+01	6.15E-01	2.00E+01	5.73E-01	2.84E+00	6.15E+00	6.30E+00	3.57E+00	1.10E+00	4.92E-02	0.00E+00	8.68E-01	9.02E-03	2.30E+01	1.40E+01	9.89E+02	2.00E+01	2.03E+01	2.11E+01	3695500001
6.01E+08	6.01E+08	2.37E+01	6.23E-01	2.07E+01	5.82E-01	2.85E+00	6.57E+00	6.20E+00	3.75E+00	1.20E+00	9.84E-02	0.00E+00	8.73E-01	8.75E-03	2.30E+01	1.40E+01	9.89E+02	1.99E+01	2.07E+01	2.07E+01	3695500001
6.01E+08	6.01E+08	2.31E+01	6.15E-01	2.02E+01	5.75E-01	2.61E+00	6.10E+00	6.74E+00	3.89E+00	7.87E-01	8.20E-02	0.00E+00	8.76E-01	8.80E-03	2.30E+01	1.40E+01	9.89E+02	2.05E+01	2.04E+01	2.10E+01	3695500001
6.01E+08	6.01E+08	2.43E+01	6.31E-01	2.11E+01	5.88E-01	2.52E+00	6.58E+00	6.65E+00	3.84E+00	1.18E+00	8.20E-02	0.00E+00	8.68E-01	8.79E-03	2.30E+01	1.40E+01	9.89E+02	2.03E+01	2.04E+01	2.06E+01	3695500001
6.01E+08	6.01E+08	2.47E+01	6.36E-01	2.16E+01	5.95E-01	2.80E+00	6.82E+00	6.67E+00	4.08E+00	1.16E+00	4.92E-02	1.64E-02	8.76E-01	8.49E-03	2.30E+01	1.40E+01	9.89E+02	2.01E+01	2.09E+01	2.05E+01	3695500001
6.01E+08	6.01E+08	2.35E+01	6.19E-01	2.02E+01	5.76E-01	2.43E+00	6.51E+00	6.30E+00	3.64E+00	1.16E+00	1.80E-01	0.00E+00	8.66E-01	9.03E-03	2.30E+01	1.40E+01	9.89E+02	2.01E+01	2.09E+01	2.15E+01	3695500001
6.01E+08	6.01E+08	2.44E+01	6.33E-01	2.13E+01	5.91E-01	2.72E+00	6.33E+00	6.85E+00	3.98E+00	1.30E+00	9.84E-02	1.64E-02	8.71E-01	8.67E-03	2.30E+01	1.40E+01	9.89E+02	2.02E+01	2.07E+01	2.12E+01	3695500001
6.01E+08	6.01E+08	2.36E+01	6.22E-01	2.04E+01	5.78E-01	2.43E+00	6.44E+00	6.16E+00	3.92E+00	1.28E+00	1.64E-01	0.00E+00	8.64E-01	9.02E-03	2.30E+01	1.40E+01	9.89E+02	2.07E+01	2.11E+01	2.15E+01	3695500001
6.01E+08	6.01E+08	2.39E+01	6.26E-01	2.06E+01	5.83E-01	2.84E+00	6.85E+00	6.05E+00	3.61E+00	1.30E+00	1.15E-01	0.00E+00	8.68E-01	8.86E-03	2.30E+01	1.40E+01	9.89E+02	2.05E+01	2.06E+01	2.10E+01	3695500001
6.01E+08	6.01E+08	2.41E+01	6.29E-01	2.12E+01	5.90E-01	2.85E+00	6.02E+00	6.70E+00	4.18E+00	1.28E+00	8.20E-02	0.00E+00	8.80E-01	8.47E-03	2.30E+01	1.40E+01	9.89E+02	1.97E+01	2.07E+01	2.10E+01	3695500001
6.01E+08	6.01E+08	2.35E+01	6.21E-01	2.04E+01	5.79E-01	2.74E+00	5.79E+00	6.46E+00	4.13E+00	1.15E+00	1.64E-01	0.00E+00	8.68E-01	8.94E-03	2.30E+01	1.40E+01	9.89E+02	1.99E+01	2.07E+01	2.04E+01	3695500001
6.01E+08	6.01E+08	2.44E+01	6.32E-01	2.14E+01	5.92E-01	3.26E+00	6.79E+00	6.49E+00	3.59E+00	1.07E+00	1.80E-01	0.00E+00	8.78E-01	8.50E-03	2.30E+01	1.40E+01	9.89E+02	2.06E+01	2.07E+01	2.10E+01	3695500001
6.01E+08	6.01E+08	2.30E+01	6.14E-01	2.06E+01	5.72E-01	2.51E+00	6.18E+00	6.11E+00	3.72E+00	1.26E+00	1.64E-01	0.00E+00	8.67E-01	9.07E-03	2.30E+01	1.40E+01	9.89E+02	2.03E+01	2.04E+01	2.14E+01	3695500001
6.01E+08	6.01E+08	2.41E+01	6.29E-01	2.11E+01	5.88E-01	2.66E+00	6.25E+00	6.90E+00	3.84E+00	1.28E+00	1.15E-01	0.00E+00	8.77E-01	8.56E-03	2.30E+01	1.40E+01	9.89E+02	2.02E+01	2.06E+01	2.08E+01	3695500001
6.01E+08	6.01E+08	2.35E+01	6.20E-01	2.02E+01	5.76E-01	2.87E+00	6.05E+00	6.48E+00	3.75E+00	9.51E-01	1.48E-01	0.00E+00	8.62E-01	9.10E-03	2.30E+01	1.40E+01	9.89E+02	2.00E+01	2.05E+01	2.08E+01	3695500002
6.01E+08	6.01E+08	2.36E+01	6.22E-01	2.06E+01	5.82E-01	2.57E+00	5.84E+00	6.90E+00	4.02E+00	1.15E+00	1.64E-01	0.00E+00	8.74E-01	8.74E-03	2.30E+01	1.40E+01	9.89E+02	2.03E+01	2.04E+01	2.09E+01	3695500002
6.01E+08	6.01E+08	2.29E+01	6.13E-01	2.02E+01	5.76E-01	2.59E+00	5.82E+00	6.64E+00	3.82E+00	1.13E+00	2.13E-01	0.00E+00	8.82E-01	8.63E-03	2.30E+01	1.40E+01	9.89E+02	2.02E+01	2.11E+01	2.10E+01	3695500002
6.01E+08	6.01E+08	2.35E+01	6.20E-01	2.05E+01	5.80E-01	2.89E+00	6.31E+00	5.80E+00	4.07E+00	1.33E+00	1.15E-01	0.00E+00	8.74E-01	8.77E-03	2.30E+01	1.40E+01	9.89E+02	2.04E+01	2.07E+01	2.06E+01	3695500002

If the data are not automatically split into columns, select Data -> Text to Columns, choose Delimited, and select Comma as the delimiter. Excel will display a preview. If Excel uses a comma as the decimal separator, use Advanced in Step 3 and set the decimal separator to a period (.) before completing the import.

Information contained in the file:

- **#BinStart:** Start of the time interval considered.
- **BinEnd:** End of the time interval considered.
- **RateHitEvents:** Rate of events containing hits recorded by the EEE telescope.
- **RateHitEventsErr:** Uncertainty associated with RateHitEvents.
- **RateTrackEvents:** Rate of events in which at least one track was reconstructed.
- **RateTrackEventsErr:** Uncertainty associated with RateTrackEvents.
- **RateTrackEventsTheta0_10:** Reconstructed-track event rate for zenith angles between 0 and 10 degrees.
- **RateTrackEventsTheta10_20:** Reconstructed-track event rate for zenith angles between 10 and 20 degrees.
- **RateTrackEventsTheta20_30**: Reconstructed-track event rate for zenith angles between 20 and 30 degrees.
- **RateTrackEventsTheta30_40**: Reconstructed-track event rate for zenith angles between 30 and 40 degrees.
- **RateTrackEventsTheta40_50**: Reconstructed-track event rate for zenith angles between 40 and 50 degrees.
- **RateTrackEventsTheta50_60**: Reconstructed-track event rate for zenith angles between 50 and 60 degrees.
- **RateTrackEventsTheta60_90:** Reconstructed-track event rate for zenith angles between 60 and 90 degrees.
- **FractionTrackEvents:** Fraction of events with a reconstructed track relative to all events containing hits.
- **FractionTrackEventsErr:** Uncertainty associated with FractionTrackEvents.
- **IndoorTemperature:** Temperature measured inside the room housing the telescope, in degrees Celsius.
- **OutdoorTemperature:** Outdoor temperature, in degrees Celsius.
- Pressure: Atmospheric pressure associated with the time interval, normally expressed in hPa.

- **AVTOTBot:** Mean Time Over Threshold for the bottom chamber.
- **AVTOTMid:** Mean Time Over Threshold for the middle chamber.
- **AVTOTTop:** Mean Time Over Threshold for the top chamber.
- **UniqueRunId:** Unique identifier of the acquisition run from which the data were obtained.

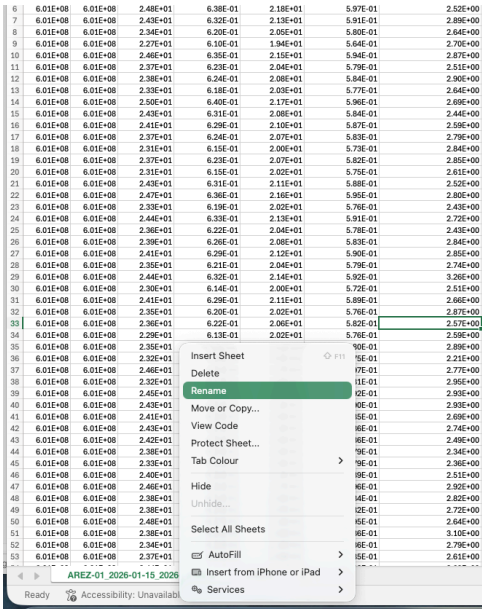
N.B. The data are sampled once per minute.

Analysis guide

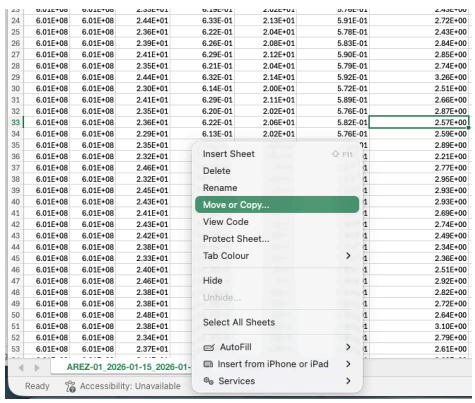
The first stage of the exercise concerns the analysis of telescope data during the period in which the Forbush decrease occurred.

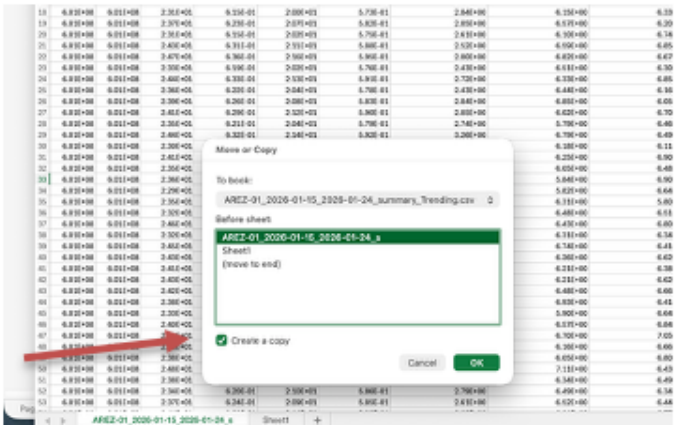
RECOMMENDED STRATEGY:

1. Rename the original worksheet as "orig": right-click the worksheet tab (Sheet1), select Rename, and use orig or "fixed" as the new name.



2. Create a copy of the worksheet and rename it "AREZ-01 Forbush": right-click the worksheet tab, select Move or Copy, tick Create a copy, and rename the copied worksheet.





37	6.01E+08	6.01E+08	2.46E+01	6.35E-01	2.17E+01	5.97E-01	2.77E+00
38	6.01E+08	6.01E+08	2.32E+01	6.17E-01	2.06E+01	5.81E-01	2.95E+00
39	6.01E+08	6.01E+08	2.45E+01	6.33E-01	2.14E+01	5.92E-01	2.93E+00
40	6.01E+08	6.01E+08	2.43E+01	6.32E-01	2.12E+01	5.90E-01	2.93E+00
41	6.01E+08	6.01E+08	2.41E+01	6.28E-01	2.09E+01	5.85E-01	2.69E+00
42	6.01E+08	6.01E+08	2.43E+01	6.31E-01	2.10E+01	5.86E-01	2.74E+00
43	6.01E+08	6.01E+08	2.42E+01	6.29E-01	2.09E+01	5.86E-01	2.49E+00
44	6.01E+08	6.01E+08	2.38E+01	6.24E-01	2.05E+01	5.79E-01	2.34E+00
45	6.01E+08	6.01E+08	2.33E+01	6.18E-01	2.05E+01	5.79E-01	2.36E+00
46	6.01E+08	6.01E+08	2.40E+01	6.28E-01	2.12E+01	5.89E-01	2.51E+00
47	6.01E+08	6.01E+08	2.46E+01	6.35E-01	2.17E+01	5.96E-01	2.92E+00
48	6.01E+08	6.01E+08	2.38E+01	6.24E-01	2.08E+01	5.84E-01	2.82E+00
49	6.01E+08	6.01E+08	2.38E+01	6.24E-01	2.07E+01	5.82E-01	2.72E+00
50	6.01E+08	6.01E+08	2.48E+01	6.37E-01	2.16E+01	5.95E-01	2.64E+00
51	6.01E+08	6.01E+08	2.38E+01	6.24E-01	2.09E+01	5.86E-01	3.10E+00
52	6.01E+08	6.01E+08	2.34E+01	6.20E-01	2.10E+01	5.86E-01	2.79E+00
53	6.01E+08	6.01E+08	2.37E+01	6.24E-01	2.09E+01	5.85E-01	2.61E+00
54	6.01E+08	6.01E+08	2.44E+01	6.33E-01	2.14E+01	5.92E-01	2.69E+00
55	6.01E+08	6.01E+08	2.43E+01	6.32E-01	2.14E+01	5.92E-01	2.87E+00
56	6.01E+08	6.01E+08	2.40E+01	6.27E-01	2.09E+01	5.86E-01	2.87E+00

AREZ-01_Forbush | AREZ-01_2026-01-15_2026-01-24_s | Sheet1 | +

Ready | Accessibility: Unavailable

Work in the copied worksheet. For the first part of the analysis, keep only the variables needed: **#BinStart, RateHitEvents, and Pressure. The other columns may be deleted.**

	A	B	C	D
1	**#BinStart**	**RateHitEvents**	**Pressure**	
2	6.01E+08	2.43E+01	9.89E+02	
3	6.01E+08	2.33E+01	9.89E+02	
4	6.01E+08	2.40E+01	9.89E+02	
5	6.01E+08	2.30E+01	9.89E+02	
6	6.01E+08	2.48E+01	9.89E+02	

Convert #BinStart into a date and time

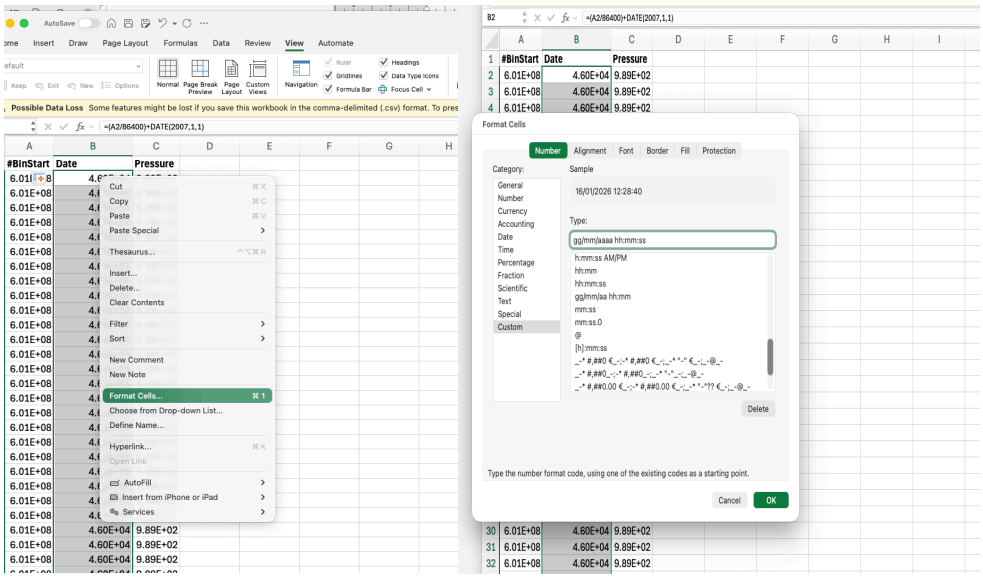
#BinStart is the number of seconds elapsed since 1 January 2007, the conventional time origin used for EEE runs. Insert a new column between #BinStart and RateHitEvents and name it "**Date**".

	A	B	C	D
1	#BinStart	Date	RateHitEvents	Pressure
2	6.01E+08		2.43E+01	9.89E+02
3	6.01E+08		2.33E+01	9.89E+02
4	6.01E+08		2.40E+01	9.89E+02
5	6.01E+08		2.30E+01	9.89E+02
6	6.01E+08		2.48E+01	9.89E+02

In cell B2 enter the following formula **=(A2/86400)+DATE(2007,1,1)** and press Enter:
DATE is the correct function name for the English-language version of Excel. In the Italian version, use DATA(2007;1;1).

	A	B
1	#BinStart	Date
2	6.01E+08	4.60E+04
3	6.01E+08	
4	6.01E+08	
5	6.01E+08	
6	6.01E+08	

Extend the formula to the entire column and use Format Cells to display the date and time correctly.



If the required format is not listed, enter it manually in the "Type" field.

The resulting worksheet should look similar to the following figure.

	A	B
1	#BinStart	Date
2	6.01E+08	16/01/2026 12:28:40
3	6.01E+08	16/01/2026 12:29:41
4	6.01E+08	16/01/2026 12:30:42
5	6.01E+08	16/01/2026 12:31:43
6	6.01E+08	16/01/2026 12:32:44

3. Correction for the barometric effect

The measured rate must be corrected for atmospheric-pressure variations.
The barometric correction is applied using the rate corrected for detector efficiencies (column C). Recall that the formula for the correction is:

Rate_Corr = Rate_nonCorr * EXP(a * (Pmis - P_ref))

With:
α = **2.30E-03 (mbar^{-1})**
P_ref = **1000 (mbar)**

Create a "Rate_Corr" column. Enter the barometric coefficient **α** and reference pressure **P_ref** in two separate cells, as shown in the figure.

A	B	C	D	E	F	G	H	I	J	K	L
#BinStart (s)	Date (gg/mm/aaaa hh:mm:ss)	RateHitEvents (Hz)	Pressure (mbar)	Rate_corr (Hz)					P_ref (mbar)	1000	
6.01E+08	16/01/2026 12:28:40	2.43E+01	9.89E+02						α (1/mbar)	2.30E-03	
6.01E+08	16/01/2026 12:29:41	2.33E+01	9.89E+02								
6.01E+08	16/01/2026 12:30:42	2.40E+01	9.89E+02								
6.01E+08	16/01/2026 12:31:43	2.30E+01	9.89E+02								
6.01E+08	16/01/2026 12:32:44	2.48E+01	9.89E+02								
6.01E+08	16/01/2026 12:33:45	2.43E+01	9.89E+02								

Column E (renamed Rate_Corr) is now used to calculate the barometric correction of the rate in column C. In cell E2, the correction formula is entered, considering that the Reference Pressure and α are constant:

E2=C2*EXP(K2*(D2-K1))

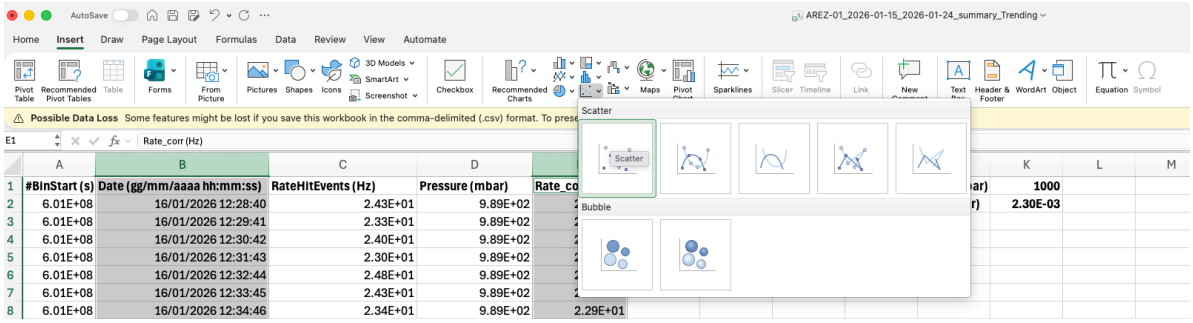
	A	B	C	D	E	F	G	H	I	J	K	L
1	#BinStart (s)	Date (gg/mm/aaaa hh:mm:ss)	RateHitEvents (Hz)	Pressure (mbar)	Rate_corr (Hz)					P_ref (mbar)	1000	
2	6.01E+08	16/01/2026 12:28:40	2.43E+01	9.89E+02	=C2*EXP(K2*(D2-K1))					α (1/mbar)	2.30E-03	
3	6.01E+08	16/01/2026 12:29:41	2.33E+01	9.89E+02								
4	6.01E+08	16/01/2026 12:30:42	2.40E+01	9.89E+02								
5	6.01E+08	16/01/2026 12:31:43	2.30E+01	9.89E+02								
6	6.01E+08	16/01/2026 12:32:44	2.48E+01	9.89E+02								

Press Enter and copy the formula down the entire column to obtain the pressure-corrected event rate.

	A	B	C	D	E	F	G	H	I	J	K	L
1	#BinStart (s)	Date (gg/mm/aaaa hh:mm:ss)	RateHitEvents (Hz)	Pressure (mbar)	Rate_corr (Hz)					P_ref (mbar)	1000	
2	6.01E+08	16/01/2026 12:28:40	2.43E+01	9.89E+02	2.37E+01					α (1/mbar)	2.30E-03	
3	6.01E+08	16/01/2026 12:29:41	2.33E+01	9.89E+02	2.27E+01							
4	6.01E+08	16/01/2026 12:30:42	2.40E+01	9.89E+02	2.34E+01							
5	6.01E+08	16/01/2026 12:31:43	2.30E+01	9.89E+02	2.24E+01							

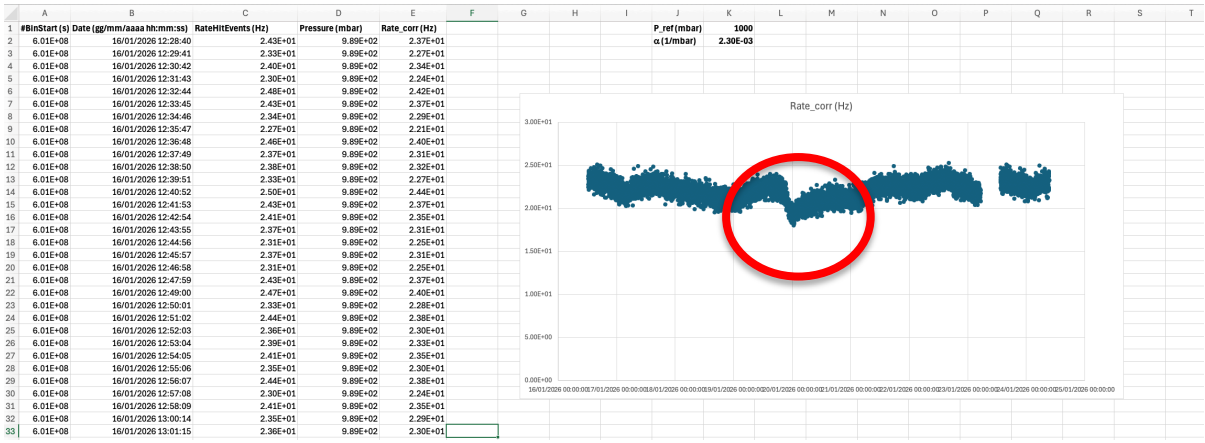
4. Plot corrected rate versus time

Select the Date column first and then the Rate_Corr column. From the Excel Insert tab, choose an XY scatter plot.



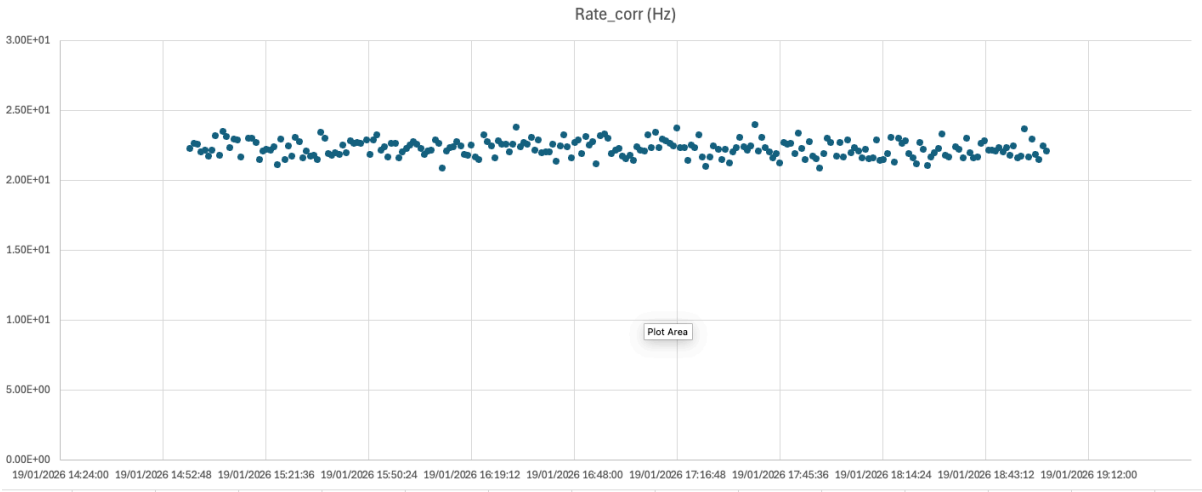
	A	B	C	D	E	K	L	M
1	#BinStart (s)	Date (gg/mm/aaaa hh:mm:ss)	RateHitEvents (Hz)	Pressure (mbar)	Rate_co	1000		
2	6.01E+08	16/01/2026 12:28:40	2.43E+01	9.89E+02		2.30E-03		
3	6.01E+08	16/01/2026 12:29:41	2.33E+01	9.89E+02				
4	6.01E+08	16/01/2026 12:30:42	2.40E+01	9.89E+02				
5	6.01E+08	16/01/2026 12:31:43	2.30E+01	9.89E+02				
6	6.01E+08	16/01/2026 12:32:44	2.48E+01	9.89E+02				
7	6.01E+08	16/01/2026 12:33:45	2.43E+01	9.89E+02				
8	6.01E+08	16/01/2026 12:34:46	2.34E+01	9.89E+02	2.29E+01			

The resulting plot should show the time evolution of the corrected rate and make the Forbush decrease identifiable (as shown in the figure).



5.Evaluation of the Forbush decrease

A useful way to quantify the Forbush decrease is to normalize the rate to 1 by dividing each measured value by the average rate before the decrease. From the graph, select a reference interval before the decrease. **For example,** calculate the average rate between 15:00 and 19:00 on 19 January.

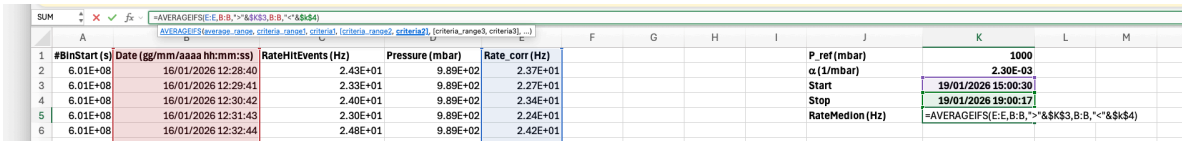


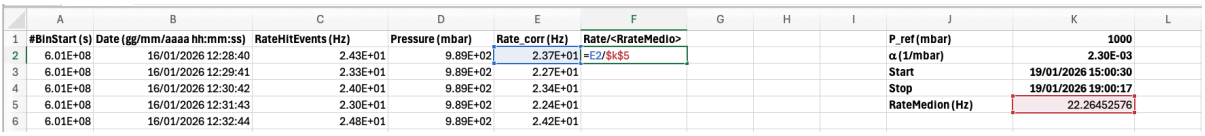
In this case, we suggest using the Excel function **AVERAGEIFS** (in the English-language version; in Italian it is MEDIA.PIÙ.SE), which returns the arithmetic mean of all cells that meet multiple criteria. The syntax is:
AVERAGEIFS(average_range; criteria_range1; criteria1; [criteria_range2; criteria2]; ...)

The arguments are as follows:

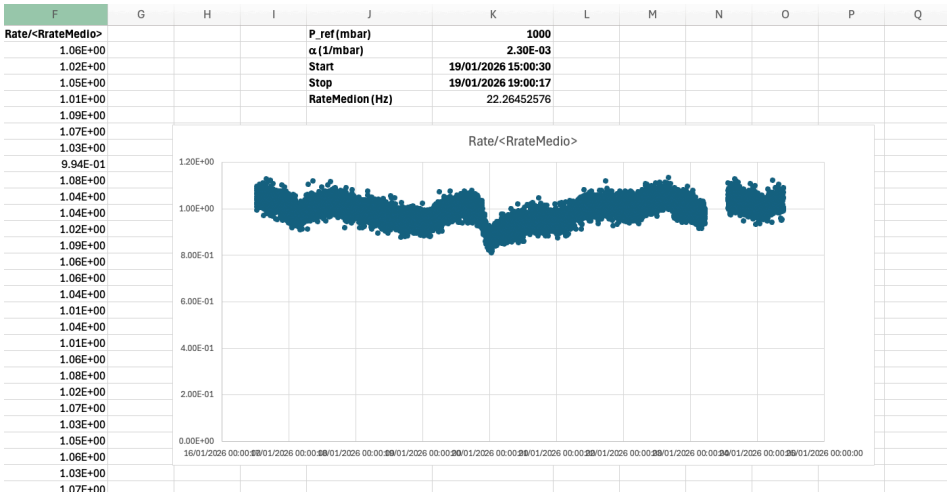
- Average_range. One or more cells to average, including numbers or names, arrays, or references that contain numbers.
- Criteria_range1, criteria_range2, … Criteria_range1 is required, while subsequent criteria ranges are optional. They specify from 1 to 127 ranges in which to evaluate the associated criteria.
- Criteria1, criteria2, ... Criteria1 is required, while subsequent criteria are optional. They specify from 1 to 127 criteria in the form of numbers, expressions, cell references, or text that determine which cells will be averaged. Criteria can be expressed, for example, as 32, “32”, “>32”, “apples”, or B4.

The goal is to calculate the mean rate (cell K5) when the time value (#BinStart) is greater than the lower limit of the time interval (cell K4) and smaller than the upper limit of the time interval (cell K4).





At this point, the rate normalized to the mean rate before the Forbush event can be calculated simply by dividing each rate value by the mean rate. A plot of the normalized rate versus time can also be created.



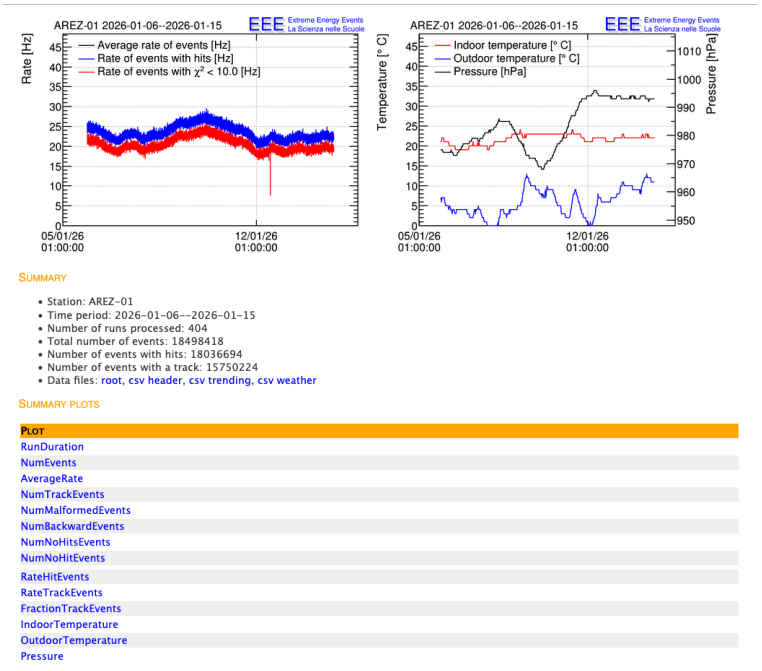
Ideas for further analysis

1) Evaluate the percentage variation in the rate.

Tip: Use the minimum normalized rate during the Forbush decrease and compare it with the reference value.

2) Determine the barometric coefficient using another data file from the same telescope and use the measured coefficient to correct the Forbush-period data.

Choose a DQM period during which the telescope operated regularly. For example, AREZ-01, an appropriate starting point is https://iatw.cnaf.infn.it/eee/monitor/dqmreport/AREZ-01/2026-01-15/.



Download the file https://iatw.cnaf.infn.it/eee/monitor/dqmreport/AREZ-01/2026-01-15/AREZ-01_2026-01-06_2026-01-15_summary_Trending.csv and proceed as follows:

a) Starting from the original worksheet, create a working copy named AREZ-NoForbush.
b) In the working worksheet, keep only #BinStart, RateHitEvents, and Pressure.
c) Insert a column and convert #BinStart to a date and time.

Calculate the maximum and minimum pressure values in the selected period.

	A	B	C	D	E	F	G	H	I	J
1	#BinStart	Date	RateHitEven	Pressure				PMIN	968	
2	6.00E+08	05/01/2026 23:00:02	2.59E+01	9.75E+02				PMAX	996	
3	6.00E+08	05/01/2026 23:01:03	2.47E+01	9.75E+02						
4	6.00E+08	05/01/2026 23:02:04	2.40E+01	9.75E+02						

Create another worksheet containing a Pressure column populated from the minimum to the maximum pressure in 1 mbar steps.
For each pressure value, calculate the mean event rate. One possible method is the Excel AVERAGEIF function introduced in paragraph 5. The function returns the arithmetic mean of all cells in a range that meet a specified criterion.

The syntax is AVERAGEIF(range; criteria; [average_range])

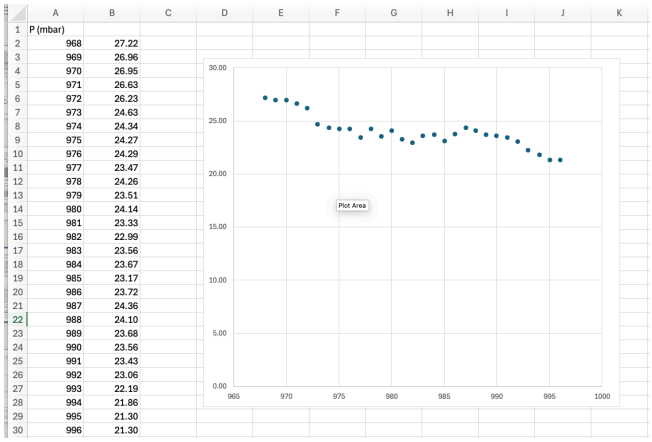
The arguments of the AVERAGEIF function syntax are as follows:

- **Range**: one or more cells to average, including numbers or names, arrays, or references that contain numbers. In our case, these are the measured pressure values, so column E of the initial worksheet.
- **Criteria**: in the form of a number, expression, cell reference, or text that determines which cells will be averaged. Criteria can be expressed, for example, as 32, "32", ">32", "apples", or B4. In our case, the criterion for calculating the mean is that the pressure (Range) be equal to the pressure value of the cell under consideration.
- **Average_range**: the actual set of cells to average. If omitted, the range is used. In our case, we want to average the rate column (for example, column C of the initial worksheet).

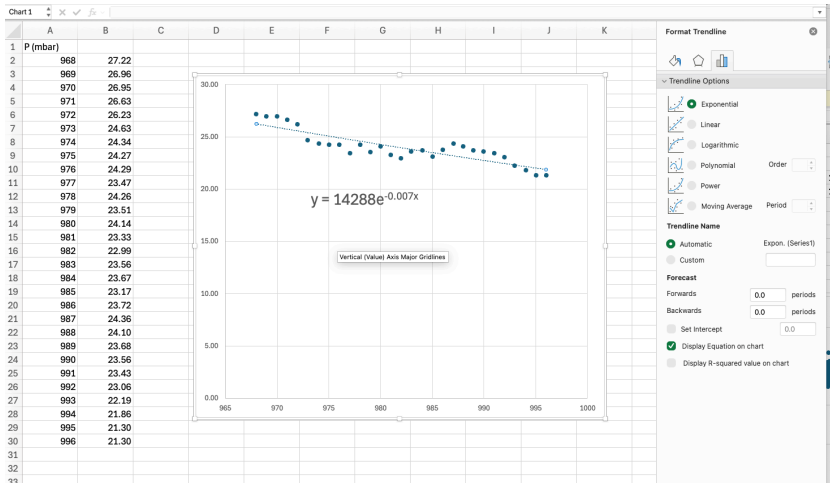
For each Pressure value in the current sheet (column A), we enter the following formula in column B:
=AVERAGEIF(column D of the initial sheet, pressure value of the Pressure cell, column C of the initial sheet)
For the correct syntax, see the figure:

	A	B	C	D	E	F	G
1	P (mbar)						
2	968	=AVERAGEIF('AREZ-01_NoForbush'!D:D,A2,'AREZ-01_NoForbush'!C:C)					
3	969						
4	970						

After calculating all mean rates, create a Rate versus Pressure graph and fit the data with an exponential function.



Add an exponential trendline and display its equation. Use the fitted exponential coefficient as the experimental barometric coefficient.



Use the coefficient obtained from the fit to repeat the barometric correction of the Forbush-period data.

3- - Repeat the analysis after grouping the data into one-hour intervals instead of one-minute intervals.

4- - Compare the results obtained with different telescopes.